

Practical Computing

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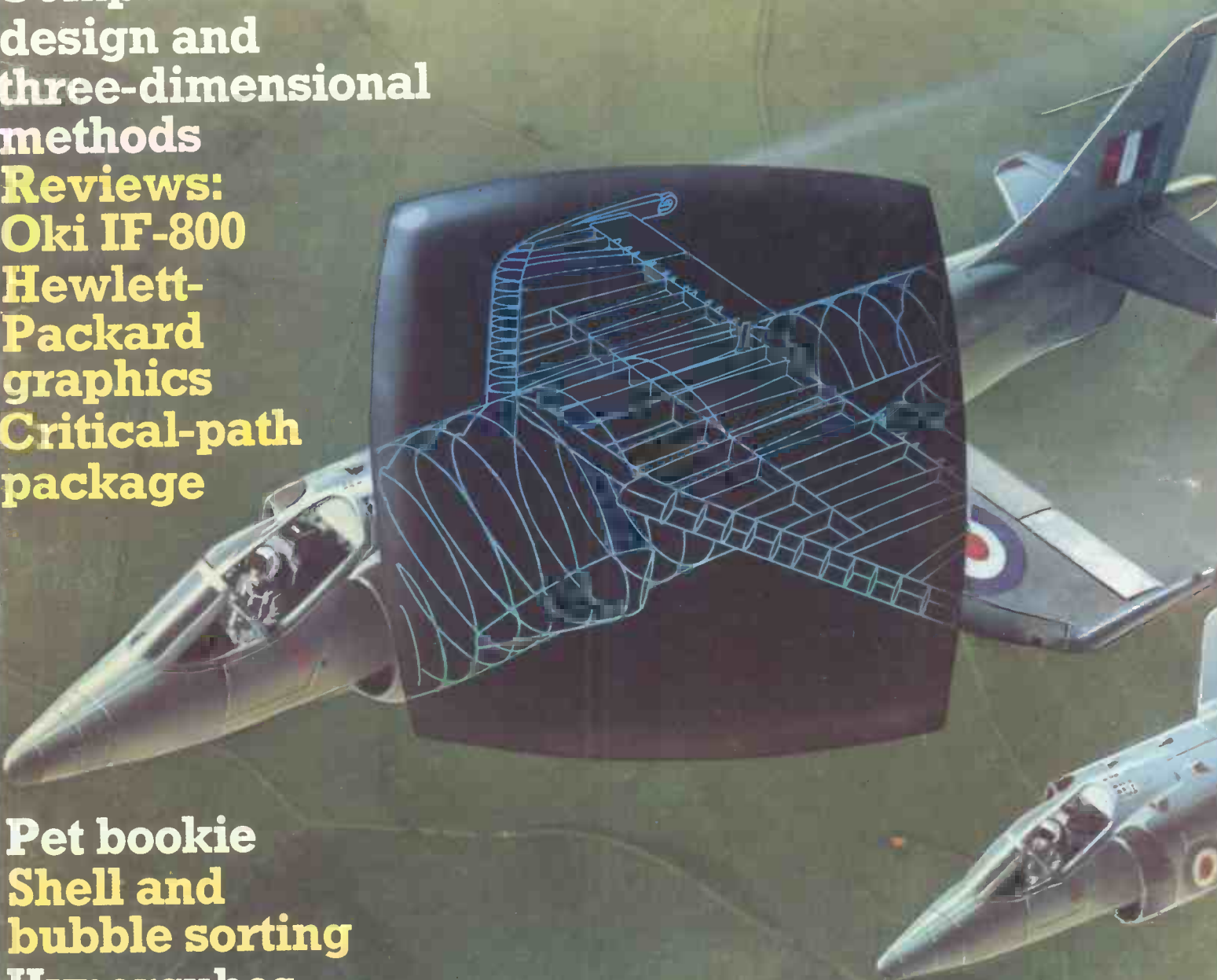
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Reviews: Oki IF-800

Hewlett-Packard graphics

Critical-path package

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Computer-aided design — page 70

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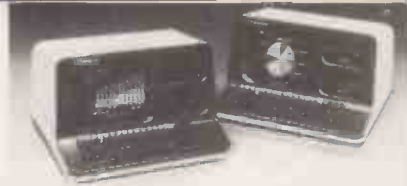
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Other software, eg. order entry, invoicing and stock control, tailored to individual user requirements.

Microshade provides a total sales and support service for the System 10.

Contact: Bryon Horton
Microshade (Business Computers) Ltd
Westhill House, 4 Market Hill
CALNE, Wiltshire
Telephone: (0249) 814879

CAMBRIDGE

The Avery Computer Company showroom caters specifically for the needs of local small businesses. A wide range of systems cover applications from financial modelling, forecasting, payroll etc. to large multi-user systems which can carry out all the functions of the electronic office.

We supply standard and customised software, special computer-aided learning courses and, above all, maintain close client liaison before and after installation.

Contact: Michael Avery or David Spry
The Avery Computer Company
13 The Mall, Bar Hill
CAMBRIDGE CB3 8DZ
Telephone: (0954) 80991

CHELTENHAM

'We won't blind you with science' is the basis of this locally owned company's services to businesses, institutions and individuals.

Partners have wide-ranging business and computer experience and have built up an impressive range of books, manuals, personal computers, business computers, standard software and consumables.

Contact: David Lewis,
Robin Phelps or Don Price
The Computer Shack
14 Pittville Street
CHELTENHAM, Gloucestershire
Telephone: (0242) 584343

EXETER

Teffont Business Systems have specialised in 'word communication' equipment throughout south-west England for the past three years.

The computer division markets Micro and Mini computers. We put strong emphasis on well-proven business software, word-processing, telecommunication, and professional service/training by experienced engineering and training staff.

We also supply 'Europe's No.1' range of facsimile machines and are Prestel dealers.

Contact: Stephen Taylor
Teffont Business Systems Ltd
48-49 High Street, EXETER EX4 3DJ
Telephone: (0392) 30438/9

EPSOM, Surrey

The primary business of Bryan Wright Ltd is the production of programmes to meet specialised and individual needs, exclusively for the Millbank System 10 Micro-computer range.

Consultancy and advice to potential Micro-computer users.

Specifications, analysis and programming. A personal after-sales service for users' operational problems, for changing requirements in programming, and system upgrading.

Address labels and mailing-list service, with statistical analysis by areas or other criteria including delivery within a reasonable distance from Epsom.

Contact: Bryan Wright or Denis Wright
Bryan Wright Ltd
1st Floor, 57 South Street
EPSOM, Surrey KT18 7PX
Telephone: (78) 22653

MANCHESTER

Calderbrook Technical Services (CTS) moved successfully into the Micro computer business in the mid 1970s and now offer a wide range of products from personal to business systems, plus a vast software library.

CTS apply a very high level of technical and engineering skills to system design, installation, training and after sales service & maintenance.

Contact: Peter Fawthrop
Calderbrook Technical Services
31-33 Church Street
LITTLEBOROUGH, Lancs OL15 8DA
Telephone: 0706 74342/79332

SWANSEA

Croeso Computer Services is a well established Micro computer systems house specialising in turnkey systems for financial companies, bakeries, licenced trade stock-taking and petrol stations.

We design specialist software systems for individual requirements in business, industry and the professions. A wide range of computer equipment is available.

Contact: Simon Shellard or
Michael Breach
Croeso Computer Services
516 Mumbles Road, MUMBLES
Swansea, West Glamorgan
Telephone: (0792) 61555/6

LONDON (C)

Forte Data Systems offer a complete business computer service from feasibility study to implementation. We provide a wide range of evaluated business packages based on cost-effective solutions to user requirements, using customised software if necessary.

First-time users find our free consultation service an ideal starting point, existing users may be more interested in our main-frame and distributed data processing software development service.

Contact: Mr V. Sippy
Forte Data Systems
27 Rathbone Street, LONDON W1
Telephone: (01) 637-0164

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B D Computer Systems brings 'mainframe' levels of skills and professionalism to the Micro market. Our experience in selling and installing large computers now provides full operational systems solutions in the Micro market.

Our customers range from a small professional user to a large Government department.

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Susan Weitzkorn or Peter Hines
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Telephone: (01) 435-4442

LONDON (S)

Micro Automation Computing Ltd was formed in 1979 with over fifty man years of computer experience to provide and support systems and software based on Micro and Mini technology.

Special emphasis is placed on real time systems for commercial, industrial and engineering applications. Services available include the supply of complete computer systems, tailored turnkey systems and packages, data base applications, specialised drivers for word-processing and colour graphics, and systems software for Micros.

Contact: David Shorter
Micro Automation Computing Ltd
207 Putney Bridge Road
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Telephone: (01) 874 2535

This is not a comprehensive list of Millbank dealers so if your area is not covered by any of the dealers listed here call us direct.

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TWICKENHAM TW1 3HN
Telephone: 01-891 4691

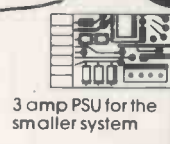


Gemini MultiBoard

THE

STOP & PICK UP ANY MULTIBOARDS ON YOUR WAY

GM 807

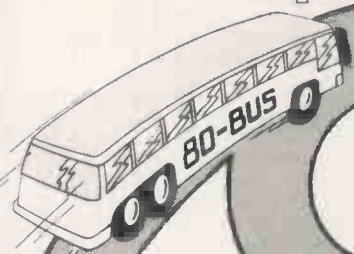


GM 810



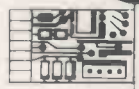
ESOTERIC ROUTE

CHEAPSKATE ROUTE



nascom OWNERS START HERE

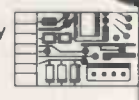
GM 811 CPU



Utilising the powerful 4MHz Z80A Microprocessor the GM811 CPU card can be used as either a stand alone controller or as the heart of a complex microcomputer system. Four 'Byte-wide' sockets allow great flexibility in the type and size of memory devices chosen. Input and output facilities include both programmable serial and parallel interfaces - RS232, 1200 baud CUTS cassette interface, Z80A PIO, and an eight bit input port. In an expanded system the unique on-board RP/M monitor allows the creation of cassette or Eprom based programs or files which are upwards compatible with a disk based CP/M system.

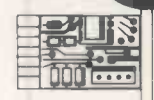
Similar to the popular GM811 CPU card, the new GM 813 CPU/RAM card has 64K of dynamic RAM replacing the 'byte-wide' sockets. An extended addressing mode facilitates future memory expansion up to 2 megabytes! The RP/M 2 monitor retains full RP/M - CP/M compatibility.

GM 813 CPU/RAM



With a 59 key full QWERTY layout, this ASCII encoded keyboard includes cursor control keys, caps. lock, two key rollover and auto-repeat.

GM 821 KEYBOARD



80 BUS STATION

ROUTE

The Gemini MultiBoard concept is the logical route to virtually any microcomputer system you care to name. Whether you require a business system, an educational system, a process control system or any other system, there is a combination of MultiBoards to fulfil that function.

This concept ensures maximum flexibility and minimal obsolescence. Maintenance and expansion is greatly enhanced by the modular board design. MultiBoard is based on the 80-BUS structure, which is finding increasing acceptance among other British manufacturers; thus broadening the product base.

FARES

Hardware (Built & tested)

GM802	64K RAM card	£140
GM803	EPROM/ROM card	£65
GM807	3A PSU	£40
GM808K	EPROM programmer	£29.50
GM809	FDC card	£125
GM810K	5A PSU/8 slot motherboard	£69.50
GM811	Z80 CPU card	£125
GM812	Z80 IVC card	£140

Software

GM512	CP/M 2.2 for MultiBoard	£90
GM517	Gem-Zap edit/asm tape	£45
GM518	Gem-Zap edit/asm disk	£45
GM519	Gem Pen editor/text formatter tape	£45
GM520	Gem Pen editor/text formatter EPROM	£45
GM521	Gem Pen editor/text formatter disk	£45

GM813	Z80 CPU/64K RAM card	£225
EV814	IEEE 488 card	£140
GM815-1	Single drive disk unit with PSU (350K)	£325
GM815-2	Double drive disk unit with PSU (700K)	£550
GM816	Multi I/O board	£125
AM819	Speech board	£85
AM820	Light Pen	£35
GM821	ASCII keyboard	£57.50

GM524	Gem Dis disassembler/debugger tape	£30
GM525	Gem Dis disassembler/debugger disk	£30
GM526	Comal-80 tape	£100
GM527	Comal-80 disk	£100
GM528	APL disk	£200

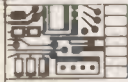
LOGICAL ROUTE

GM 812
-IVC

The GM812 Intelligent Video Controller card features an on board Z80A processor to provide independence of the host processor and the ability to redefine the functions and parameters of the display.

Normally used in an 80 x 25 mode the card contains a programmable character generator allowing three additional modes of operation - inverse characters, 160 x 75 block graphics, or user defined characters.

A keyboard socket allows buffered character input, and a light pen socket is provided for specialist applications. Being I/O mapped the card does not occupy any system memory space.



GM 809
FDC

GM 809 FDC

The GM809 floppy disk controller card can support up to four disk drives in either single or double density modes. The card uses the Western Digital 1797 controller and has variable write precompensation and phase locked loop data recovery circuitry.

GM 815
DRIVE UNIT

GM 815 Drive unit

The GM815 floppy disk housing contains one or two 5 1/4" double density, double sided Perfec FD 250 drives. This gives a storage capacity of 350K per drive. Power for the drives is provided by an integral supply unit.

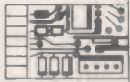


AUTO-EXCHANGE
All your RP/M software automatically transferred to CP/M



The GM802 RAM board provides a full 64K of dynamic memory. The 80 BUS RAMDIS signal is fully supported so that any EPROM in the system is given priority over the RAM, preventing any possibility of bus contention. Page Mode is also supported by the card which, with the appropriate software, allows up to four memory boards to be used in a system.

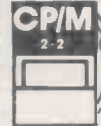
GM 802
RAM



FILL-UP WITH SOFTWARE



RP/M software is available on tape and includes Editor/Assembler; Text Editor/Formatter; Disassembler/Debugger; Pascal and Comal-80. These packages can also be run under CP/M.



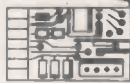
A CP/M 2.2 package is available with the GM 809 card and Perfec drives. On-screen editing auto single/double density selection and parallel or serial printers are supported. Running under CP/M is a wide range of utilities, application software and languages.



ONE WAY

The GM803 Eprom Board will accept up to 16 2708 or 2716 Eprom devices. This allows the addition of up to 32K of firmware to the system. The board supports the Page Mode system and consequently need not occupy any memory space when not in use.

GM 803
EPROM BOARD



GM 816
I/O BOARD

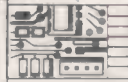
The Gemini I/O board provides a unique solution for interfacing to "the real world". The board contains 3 PIO's,

A number of manufacturers are busy working on additional 80-BUS boards which will progressively increase the potential of your MultiBoard system.

MEN AT WORK

80 BUS compatible prototyping boards are available from both Vero and Winchester Technology. These allow the user to easily add a card of their own design to the system.

PROTO-TYPING BOARDS



a CTC and a real time clock with battery back up. "Daughter" boards may also be added and these include A-D, D-A, opto-coupling and serial interface boards.

GM 808
EPROM PROGRAMMER



The GM808 Eprom programmer connects to the PIO on the CPU card and allows the user to program 2708 or 2716 type Eproms.

AM 819
SPEECH BOARD



The Arfon Microelectronics speech board utilises the National Semiconductor Digitaltalker chip set. This gives a vocabulary of over 140 words and sub sounds. Output is from an on-board speaker.

AM 820
LIGHT PEN



This low cost light pen can be used with the GM812 IVC for many applications, including answer selection, editing, menu selection and movement of displayed data blocks.

EV 814
IEEE 488



The EVC IEEE 488 Controller card has been designed to fully implement all IEEE 488 interface functions. This card gives the user a very versatile method of controlling any equipment fitted with a standard IEEE 488 or GPIB interface at minimal cost.

GEMINI MULTIBOARDS - BUY THEM AT YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed on right (Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.



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Oakfield Corner, Sycamore Road,
Amersham, Bucks.
Tel: (02403) 22307. Tlx: 837788.

COMPUTER INTERFACING & EQUIPMENT LTD.,
The MICRO-SPARES Shop,
19 Roseburn Terrace,
Edinburgh EH12 5NG
Tel: (031) 337 5611

E. V. COMPUTING
700 Burnage Lane, Burnage,
Manchester M19 1NA.
Tel: (061) 431 4866.

ELECTROVALUE LTD.
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Egham, Surrey TW20 0HB.
Tel: (0784) 33603. Tlx: 264475.

SKYTRONICS,
2 North Road, The Park,
Nottingham.
Tel: (0602) 45053/45215

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel: (0272) 421196.

BITS & PC'S
4 Westgate, Wetherby,
W. Yorks.
Tel: (0937) 63774.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel: (01) 402 6822.
Tlx: 262284 (quote ref: 1400).

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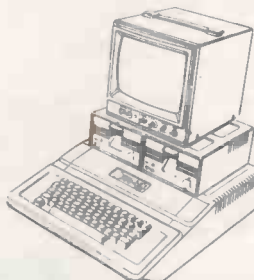
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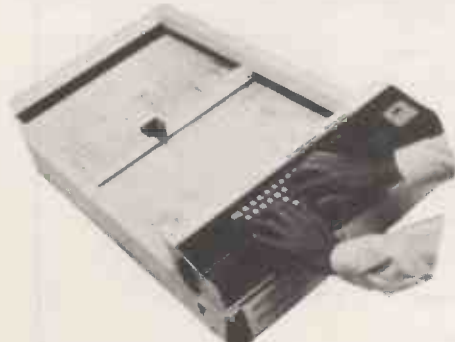


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Appletel System	525.00	78.75	603.75
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VisiPilot	95.00	14.25	109.25
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VisiTerm	80.00	12.00	92.00
VisiDex	105.00	15.75	120.75
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All advertised products are guaranteed one year from date of purchase against defects in materials and workmanship.

During the guarantee period, Metrotech will repair or replace, at no extra charge, components that prove defective - providing that the product is returned, shipping or postage prepaid, stating when bought and enclosing proof of purchase.

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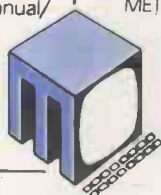
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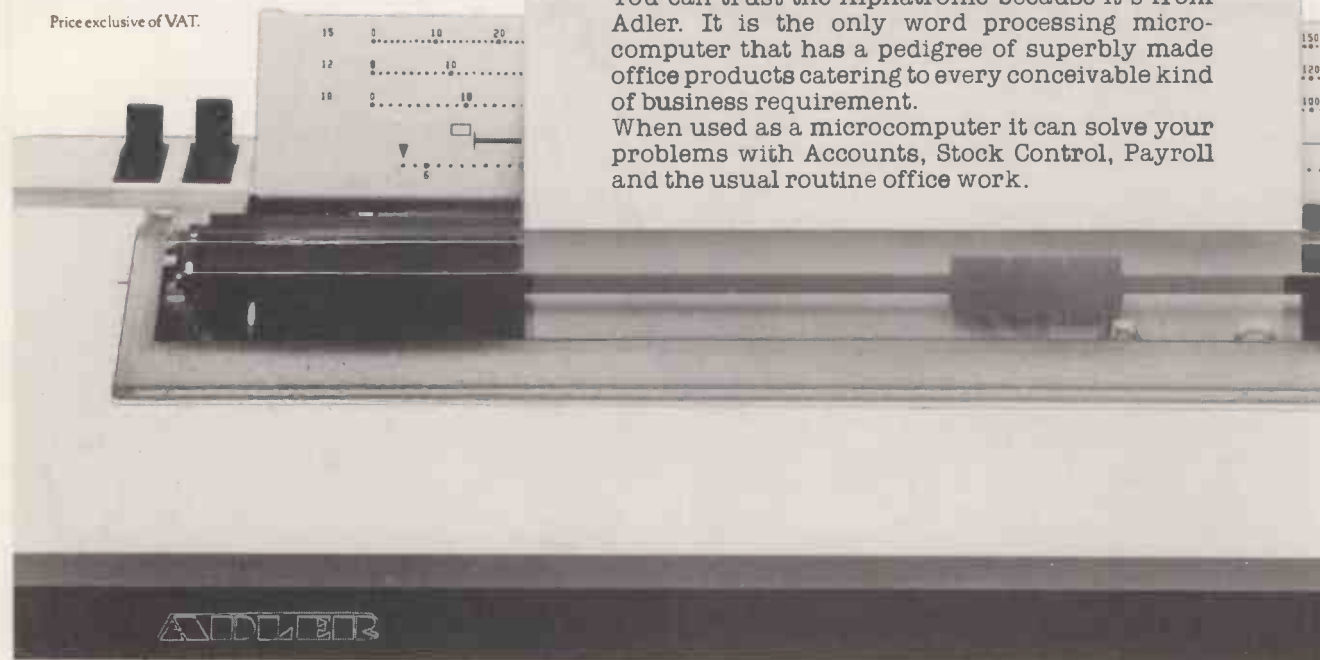
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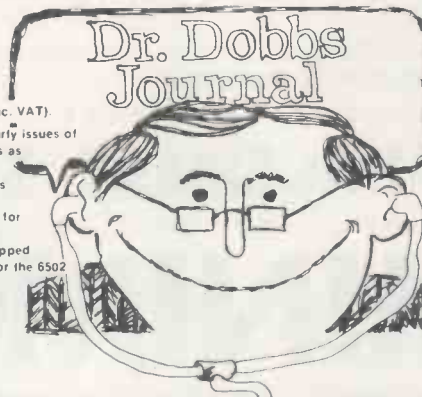
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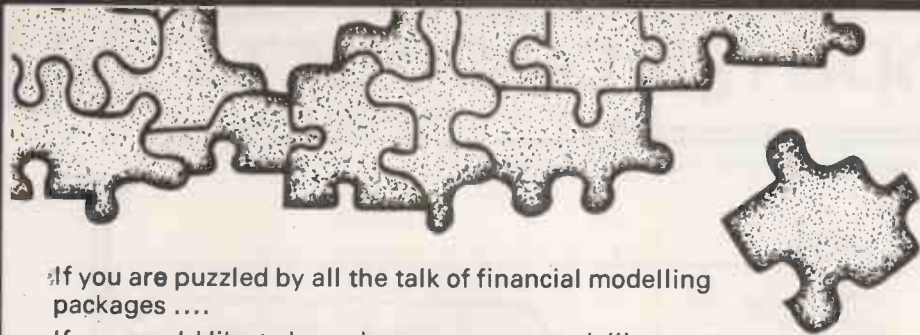
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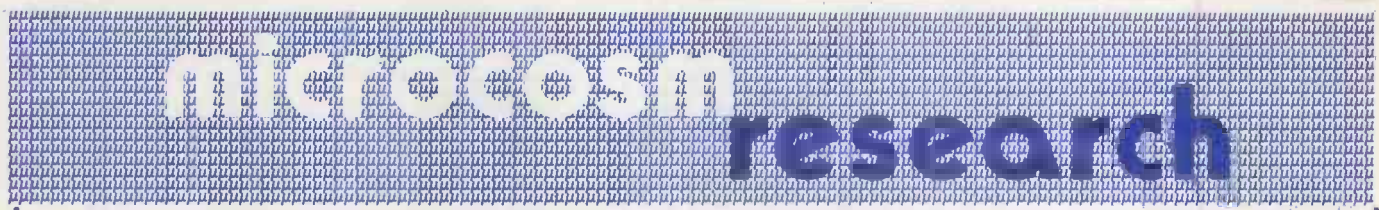
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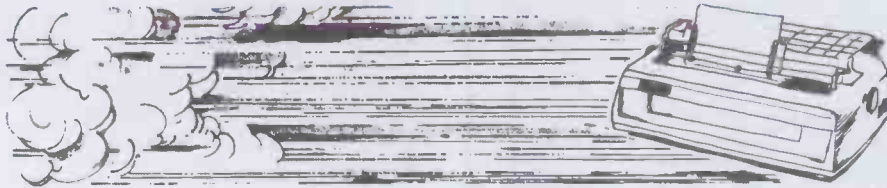
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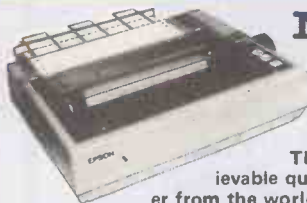
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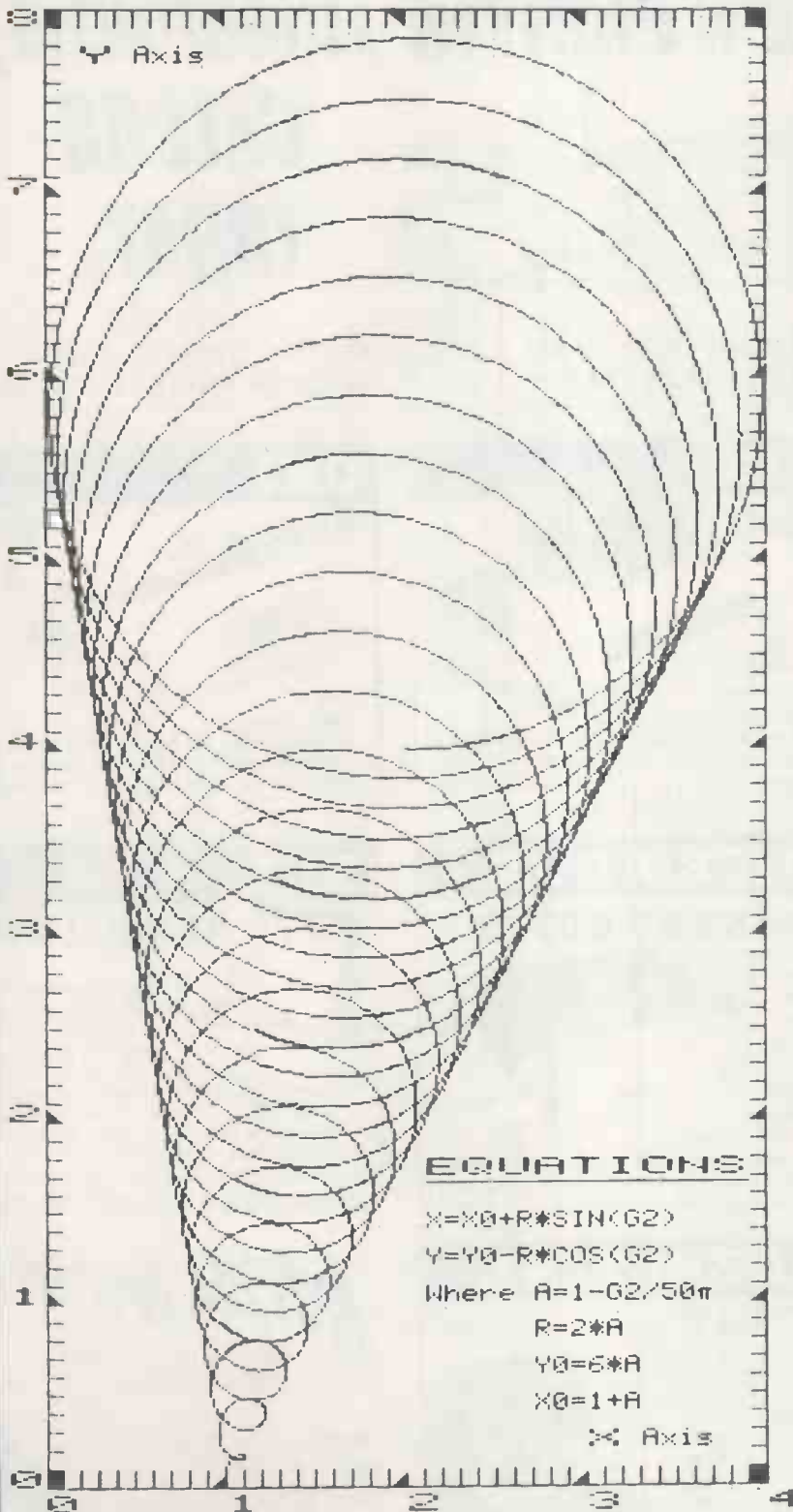
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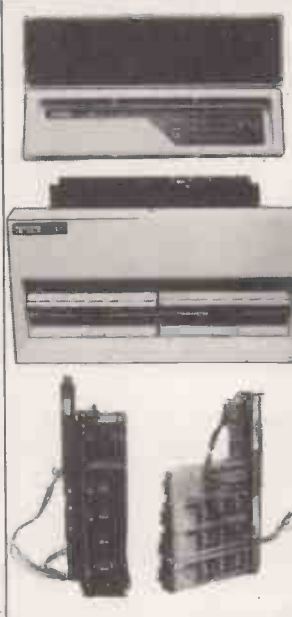
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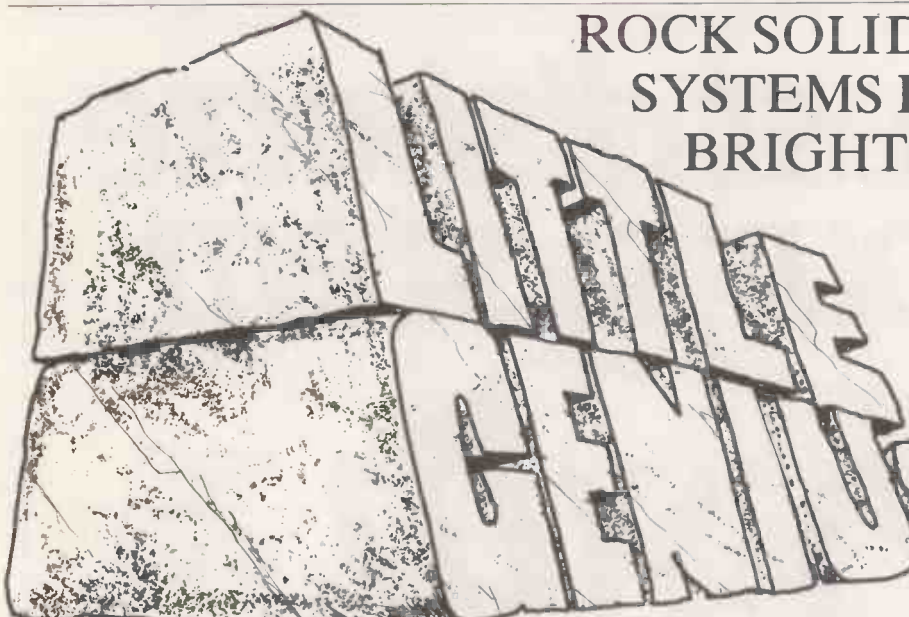
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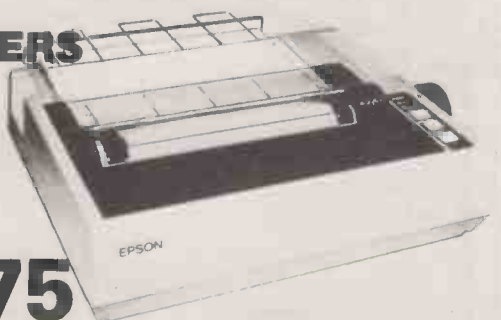
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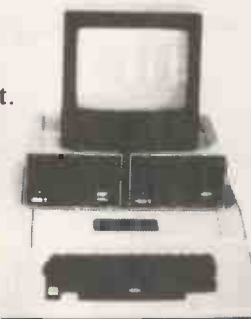
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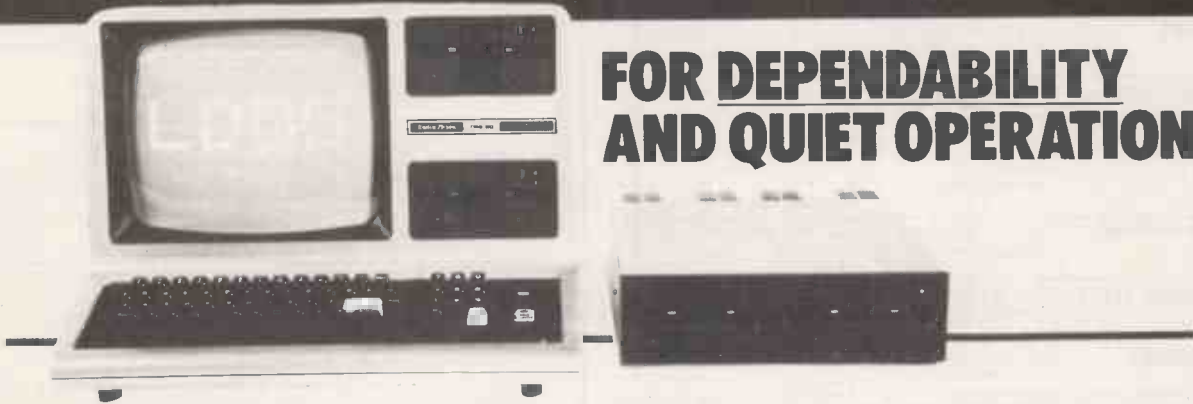
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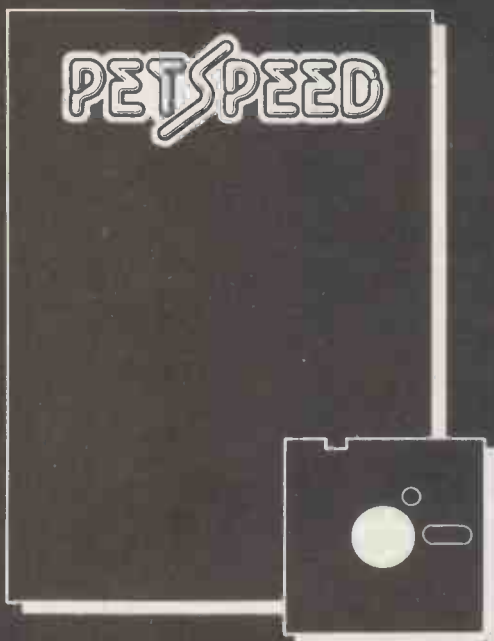
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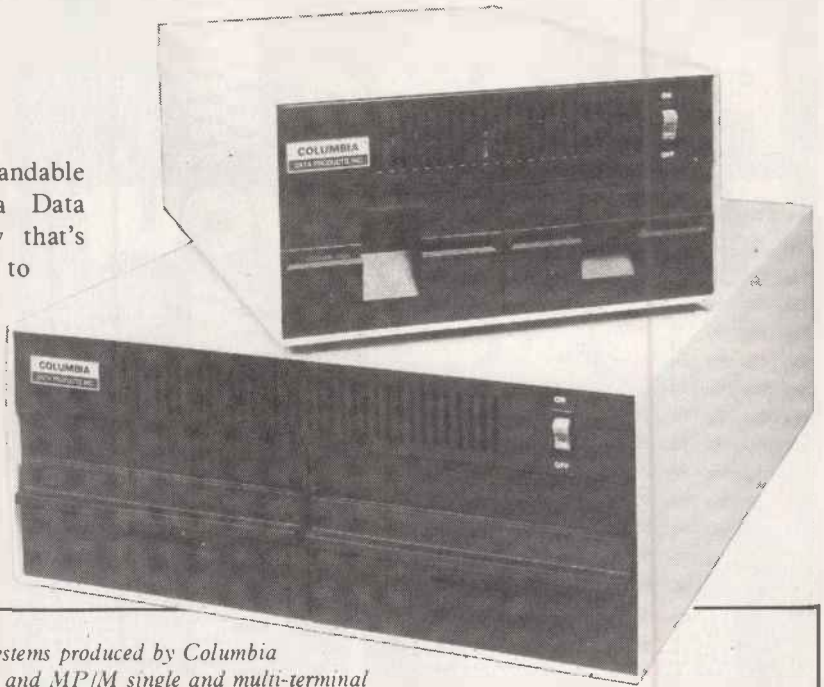
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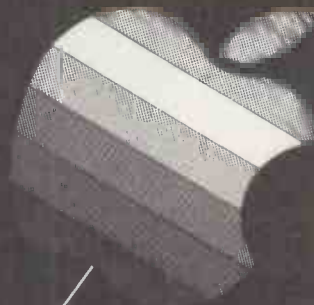
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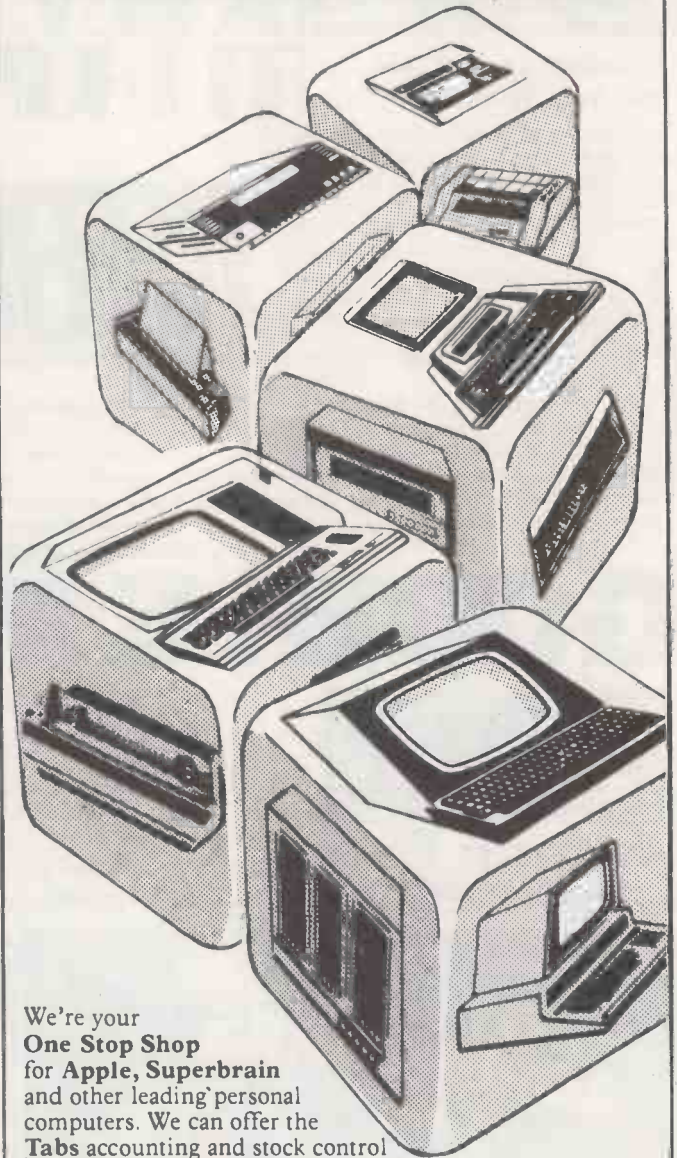
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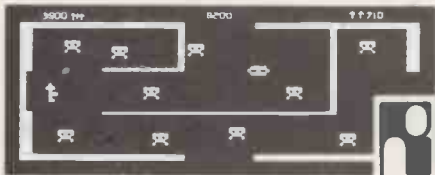
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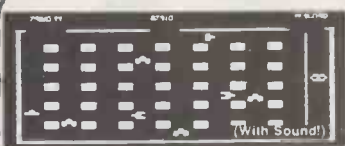
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Canned thoughts

SOFTWARE AUTHORS' stock in trade is, or should be, canned thought. Yet, too often, what they wish on their unfortunate victims is a can of worms.

What are the symptoms of brain damage induced by software? We all know the archetypal programmer — the withdrawn antisocial being, silent or wildly enthusiastic by turns, sullen, argumentative, pedantic and incapable of rational conversation or interest in anyone else's ideas. The worms have burrowed deep into the heads of these unfortunates.

William Blake wrote on this subject, and was of the opinion:

Oh head, thou art sick
The invisible worm
That flies in the night
In the howling storm
Has found out thy bed
Of crimson joy
And his dark secret bag
Does thy life destroy

The discriminating observer has to admit that Blake understands the symptoms. But where do these worms come from? The fundamental problem is, as so often in human affairs, no-one's fault. The things that computers can do are so much more complicated than the things people can do that the user needs a complete outfit of new concepts to handle them. These concepts are much harder to grasp than say, the concept "tree" because there is nothing to see. A recent editorial recalled the horrors of first trying to come to grips with computing. For weeks "files", "bytes", "floating-point arithmetic", "vectors", "indexes" "string pointers" and a whole host of ill-digested intellectual phantasms swirl about in your poor head. Only after a good deal of experience does some substrate of reality emerge, on to which to tack these words.

The worms hatch out of the conflict between the ideas already comfortably installed in one's head and the new ones that have to be forcibly constructed out of such unpromising, invisible materials. The conflict makes the worms. If you are not all that keen on worms, the question to ask is, "Could we reduce the conflict?" This is a hard one to answer because it depends on so many things.

Think, for instance, of the steps you have to go through as a newcomer to develop an idea of a disc file. You might start with a paper file in a filing cabinet. You have to make it invisible and continuous. You have to get away from pages of paper and move over to . . . well, there are pages, but they are not quite the same. You have to spread this invisible, continuous file over a piece of black plastic that you are not allowed to touch and then get to grips with the idea that parts of it are in RAM and parts are not, and that if it is not closed at the end of everything there is nothing there next time you look.

The whole process is an agonising business of making something out of nothing. It is not unlike trying to plaster a ceiling. You get a good solid lump of concept on your trowel, slap it up, and wait for it to fall on your head. If it stays up you have to get some more up beside it quick before it dries out and then, nine times out of ten, they will both fall off.

The difficulty of the whole business is compounded by language. Practically all the words used in computing have perfectly good meanings already: sector, record, memory, processor, bus. In relearning them you have to throw away hundredweights of perfectly good associations.

It improves matters a little if the concepts are well explained, but in the end, explanations of computing are about as much practical use as explanations of bicycling. You have to get on the thing and wobble into the ditch. So how could we

improve the mental ergonomics, spread pesticide on the worms, and help the naive user?

The problem is largely historical. Computing started with operations on bits. The complexities of bytes, files, languages, output were grafted on to the central concept of the processor. They arose in ways that made sense to the engineers who built the machines and the systems programmers who made them go. We, obedient users, 40 years down the road, docilely assume that we have to learn all these tough ideas too, even though they correspond only vaguely to the ideas we want to manipulate.

Let's start with the idea of screen and file in the context of word processing. You might expect the letter corresponding to the key you hit to appear on the screen as it would on paper. You then expect the document you have created to be "in the computer's memory banks". This is not at all unreasonable. Yet how many word-processing packages start out with exotic questions about the number of disc sectors to allocate? How many more, which avoid that difficulty, expect the user to manage the business of writing RAM to disc and paging in new buffers full of text for editing? Most of us have met the word processor that leaves the files empty if you do not go through some absurd rigmarole of closing them? Even those that spare us these troubles are quite capable of allowing a text to be edited that cannot, in the end, fit on to the disc.

Even though the user must, by virtue of the power word processing gives you, understand and manipulate more ideas than you need simply to type on paper, there are no word processors that restrict their concepts to those the user actually needs. Of course, if every software package requires the user to make decisions about disc files, it is hard to realise that the user need not necessarily know or care about them.

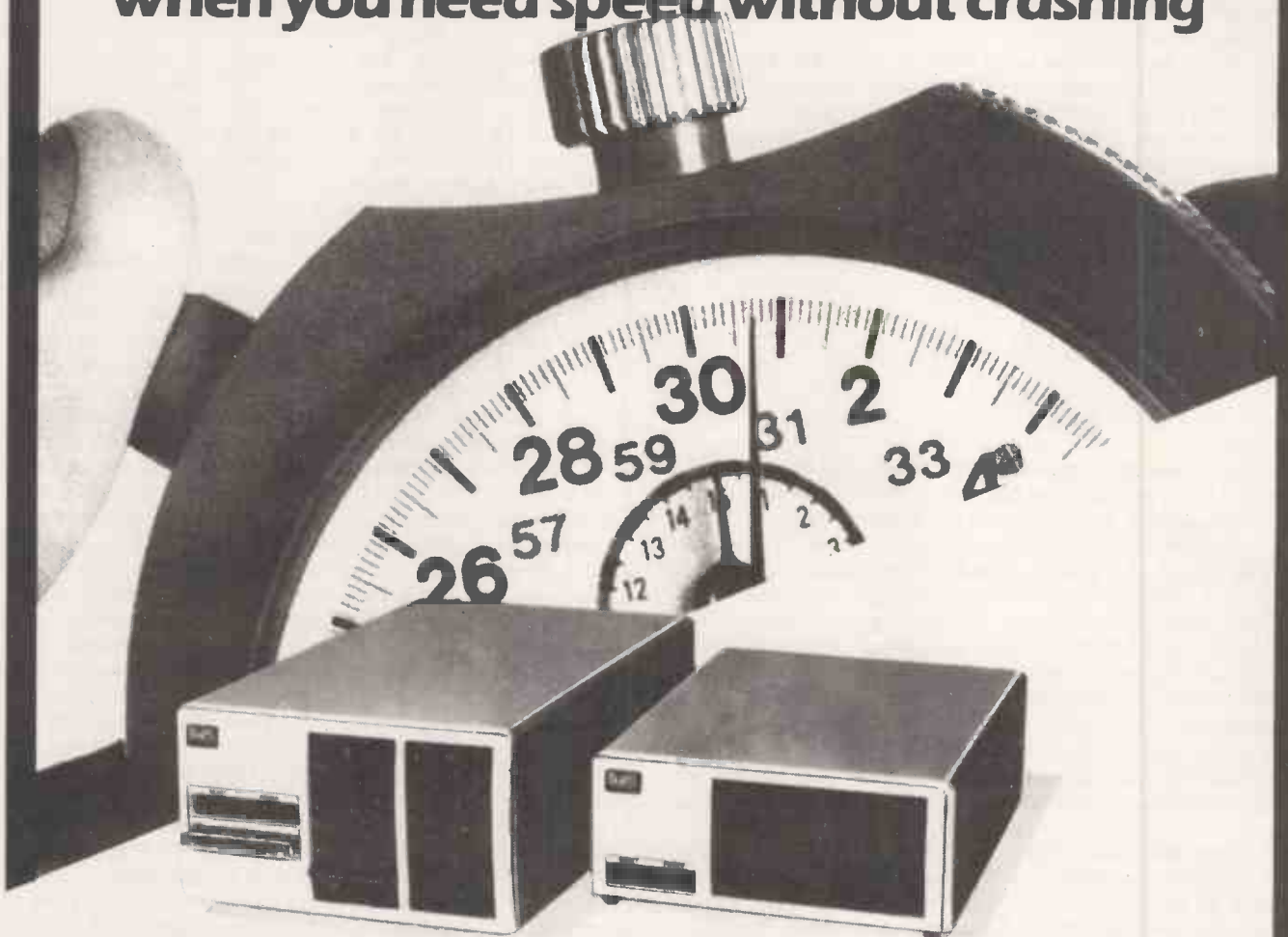
A great American aircraft builder used to advise his designers to "simplify and add more lightness". This is no bad advice for the software author too; the difficulty is that simplification is very much harder work than complication. Yet this is work that urgently needs doing at this stage of the game.

One easy way of simplifying things is to go through the manual of whatever software is to get the treatment, and look for the word "must". "If there is not enough disc space you must erase . . ."; "To open a file you *must* . . .". Whenever something "must" be done the computer ought to do it. The user ought only to be asked when choices are to be made and the choices should be presented in understandable terms. "Do you want to keep your back-up version of this text, or erase it?" Ideally, anything in memory should also be on disc and the user should be unaware that RAM exists. When hard discs become commonplace it may be unnecessary for the user to know explicitly about either RAM or files: it might be better to present some in-between concept — just as the idea of a CP/M file conceals the ideas of sector directories and random access.

Ultimately, this all comes down to marketing. You do not sell computers or software: you sell power, speed, convenience, prestige — in the customer's terms. If the customer cannot understand what it is you're trying to sell, then you will never sell it. You have to offer concepts that are already properly understood. You certainly cannot assume that the intellectual scrap-heap we have come to accept is already there.

The time is ripe for some powerful, simplifying ideas that start with the user rather than the machine. Let us ask what concepts are actually needed to manipulate the kind of information that people want to put on micros. Then we ask how they can be made to work using the available hardware and software. If only one-tenth of the passion that goes into the language debate could be focused on this much more important problem, we would make startling progress. □

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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.

Improved graphics

LIKE R J GREENHILL, Feedback, January 1982, I found the Portable Graphics series by Wynford and Jane James most useful and certainly the best published games for some time. However, Greenhill's random-movement selector does not eliminate all the difficulties of Wallball.

I find that the computer tends to find itself in dead ends of its own making relatively quickly, so my improvements may be of interest.

I have incorporated a speed-up arrangement in line 350. This line is simply a time delay from which 5 is subtracted at each pass. It is reasonably simple to replace the 5 with a variable which is changed by the setting of the skill level entered in line 1060. So, at skill level 1, a larger number is subtracted than at lower skill levels. This causes the movement of the trails to accelerate, and before long you will find you need plenty of skill to avoid a crash.

In addition, I have incorporated a scoring system. This is a simple counter which increments at each move made by the computer. When one game ends, line 360, the score is added to a running total if the player wins, and subtracted from the running total if the computer wins.

The final score is printed after the final run, in line 440. The increments can be fixed or made variable in the skill-level line — higher increments for more skill.

The effect of these two improvements is that the player tries a high skill level for a higher score and lets the computer run for as long as possible before trapping it so as to build up the score. By this time, however, the acceleration has built up so that it is much more difficult to control the player's trail.

In addition to these changes to Wallball, perhaps I might point out two errors in other programs of the same series which readers may not have found. In Head on Crash, November 1981, I found that after clearing the board the first time the score continues, but subsequent clearings will not reset the board and the score. This is quickly remedied as follows.

Eliminate `NH=0` in line 85 and re-insert it as line 81 `NH=0`.

In Alien Maze, December 1981, line 650 has a misprint and should start with:

```
650 IF CB=0 THEN POKE, etc
not 650 ECB=0 THEN POKE, etc
```

**B L Hensman,
Keighley,
West Yorkshire.**

Maze corrections

I SUCCESSFULLY used the maze-making program on "Portable Graphics" *Practical Computing* December 1981 — on my UK 101. There appears to be an error in line 650, which should read:

```
650 IF CB=0 THEN POKE P1, W3: POKE P2,
W3: POKE P3, W3
```

A repetitive division-by-zero error tended to occur in line 105, which I prevented by inserting a new line:

```
104 IF LD=0 THEN LD=2
```

Other UK 101 users may be interested in this amendment to line 950, for which experiments were recommended in the article:

```
950 TL=53332: BL=54164: TR=53357:
BR=54189: LL=64: DW=2: CD=3
```

**Simon Talbot,
Garston,
Hertfordshire.**

Authors reply

R J GREENHILL's letter in January 1982 Feedback was a constructive criticism of our portable graphic series which started in the October 1981 issue. It was clear from several letters we received that we should have clarified the keyboard-control command used by the Superboard. We feel that Greenhill's own explanation should resolve these problems for readers.

Regarding Rem statements within programs, it is sometimes difficult to include these when only 4K RAM is available. We concede that on shorter programs we should not omit Rems — a bad habit.

We had already begun to incorporate the keyboard-control commands into subroutines in later programs and — as Greenhill said — this should aid portability.

We are currently working on a collection of portable programs which we hope to have published in 1982. If any reader feels that features in the previous programs made transfer to their own micro a problem, we would be pleased to hear from them. Any other suggestions for improving portability would also be welcomed.

**Wynford and Jane James,
Royal Tunbridge Wells,
Kent.**

Family tree

THE ARTICLE "Climbing the Family Tree" in the November 1981 issue is a reminder that family records represent an

almost ideal database which is more easily handled by computer than manually. Yet few serious genealogists will be satisfied with no more than 30 direct ancestors. So often it is the collaterals which provide the clues to extend the main line further back.

There must be many people tackling these wider problems for themselves and thereby reinventing the appropriate wheels for organising the data about relatives or indexing the names in public records.

The time is ripe for them to meet and share their experiences. The Society of Genealogists plans to organise in June this year a seminar to provide an opportunity for that exchange. The director of the Society, A J Camp, would like to hear from anyone wishing to attend or contribute to such a meeting. Write to him at the Society, 37 Harrington Gardens, London SW7 4JX, mentioning any special interest or progress you have made. The detailed program will depend on the response and will be sent to you in due course.

Similarly, the Society is considering a newsletter on the applications of computers to records of genealogical interest. If you would like to subscribe or contribute to it, please let the director know.

**A Sandison,
Chairman, Computer Committee,
Society of Genealogists,
London SW7.**

DNA twist

WE VERY MUCH enjoyed the article 'DNA the First Machine Code' by John Leach, in the January 82 issue. However, we feel that we must attempt to rectify certain slight misconceptions expressed by Leach, in aspects of the genetic code as it is understood today. Also, we wish to point out certain program errors and modifications.

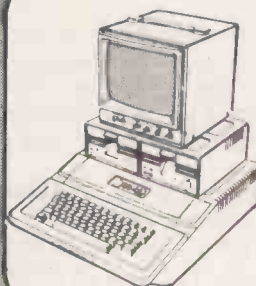
Firstly, and most importantly, what Leach says about messenger RNA is misleading. He implies that mRNA is made by attaching itself to the start codon, and is copied along the DNA from that. This is not so.

A simplified explanation of what generally happens is this: mRNA is made by an enzyme RNA polymerase which binds to a reconision site on the DNA before the coding part of the gene — or program — called the 'promotor'. The enzyme moves down the DNA, making an exact complementary copy of that strand of DNA, except that it makes the copy in

(continued on page 45)

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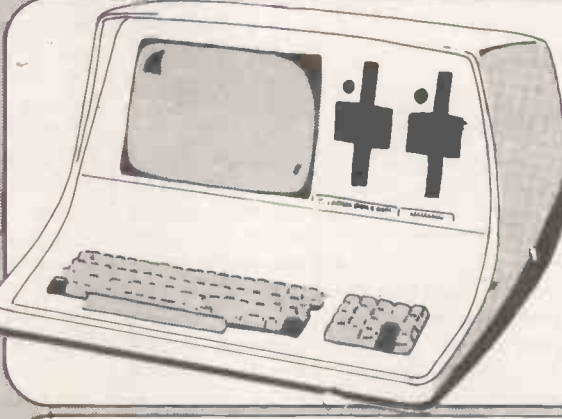


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(continued from page 43)

RNA, which contains the base uridine instead of thymine.

This mRNA contains a good deal of material additional to the coding part of the gene, including the start and stop codons. It also contains an area recognised by the ribosome. The ribosome attaches to this site, but starts to translate the message into protein from the start codon.

The best comparison of this with the way a computer program works that we can think of is that the promotor region acts as the name of a program. The program is called up by its name, from whatever form of storage, disc, tape or chromosome, to a short-lived copy — the program loaded into the computer's RAM or the mRNA. The start codon acts as the first line number, anything else is not read. The program is run from that copy and not the original.

Whilst on the subject of analogy, the computer mimics genetics in other ways. Perhaps the most interesting is the use of library routines. A kind of library is used by certain specialised genes, such as the immunoglobulin genes. These code for the proteins protecting us from infections caused by bacteria, viruses, and other foreign bodies. These genes are bizarre in that each gene is constructed by a combination of several pieces of DNA from various sets. In other words, there is a series of programs, any of which may be selected, and which may use a combination of two library routines, one from each set.

This leads to an enormous variety of related proteins coded for by a relatively small amount of DNA. Every time man thinks he has been clever, life has beaten him to it.

Other niggles with Leach's article are that; transfer RNA is not a hairpin structure. It has a clover leaf appearance, with the anti-codon on the second leaf. This consists of the triplet of bases which complement exactly, and therefore pair with the codon.

Leach is correct when he states that three-dimensional structures play an important role, since shape defines function in proteins. However, he implies that if just any one of the amino acids in haemoglobin is changed, sickle-cell anaemia results. The change causing sickle-cell anaemia is a very specific one. The glutamine in position 6 in the B chain is replaced by a valine.

Other amino acid changes in haemoglobin may have profound effects on its function, but will not necessarily result in sickle-cell anaemia. Altogether, about 150 kinds of mutant haemoglobin have been found in humans. Nearly all are the results of a single amino acid change.

Here are one or two points about the program listing. a) In line 330 the Goto 340 statement is not required. b) In line 2520 the first D\$ should be E\$.

```
Add 2625 IF EP=0 AND DP=0 THEN PRINT
"Enzyme and DNA not selected":
```

```
GOSUB 2860: GOTO 2200
and in line 2320 alter 2630 to 2625. Alter
line 2590 to read:
```

```
2590 GOSUB 1740: FOR 1 = 1 TO 12:
PRINT :NEXT I :GOSUB 2800: GOTO 2200
```

David and Linda Priestley,
Henton,
Oxfordshire.

Micros in schools

THE ARTICLE by Tony West in the January 1982 edition on the use of microcomputing in primary schools gave a reasonable description of a program which he obviously finds helpful and stimulating for the children in his charge. However, the article, although an adequate description of one particular program, never attempted to answer the one question which teachers who have had no experience of computers ask: why use a computer?

To moderate the rush of teachers who read this article to the micro shops, I feel I must give some reasons why the micro should not be used for this particular job, at least not in this form.

If this program were guaranteed to meet the aims and objectives which the teacher had set out to achieve, how could 35 children in one class make use of it? The only answer for this program would be for each child to have access to the machine.

We have two microcomputers in the school where I teach, and we have great difficulty in coaxing the children into using them. It is not that they do not want to; we have not the time to let them. Some advice on how to overcome this problem would be more useful than a fairly technical description of a program.

Tony West says: "Numerical accuracy in adding the digits is ignored and the child can correct any such mistakes". I hope I have not taken this quotation out of context, but what a statement for a teacher to make. Supposing the child did not realise he had made a mistake?

The second quotation I would like to draw attention to is: "Should he make a mistake when entering these digits, the computer waits until the correct digit is pressed". If the child knows the correct digit then the program is wasted on him; if he does not then ignoring his attempts does not help him.

The rest of the article describes the programming tricks which make the program run. They are the trivial parts. What is much more important is how they allow the child to learn. In a program which is a test where wrong answers are not allowed, there seems to be little scope for learning.

Before we make computing attractive to primary schools, we must make it right. The process which Tony West is trying to teach with the program under question is only one part of the complete addition

algorithm which primary schools traditionally teach. The whole process must undergo much greater analysis before we decide if the use of a micro is justified.

There is no doubt in my mind that the microcomputer offers a challenge to primary education. I think it has enormous potential which we are only just beginning to appreciate. However, there is a great deal of hard work to be done to realise that potential, and programming is only a very small part of that work.

Colin Watkins,
Primary Computing Co-ordinator,
Birmingham Educational Computing
Centre,
Birmingham.

Comal again

HAS ANYONE a Data-statement generating program for the TRS-80 level III? I need it for machine code and assembly language programming. Also, I would be very interested in corresponding with anyone trying to implement Comal on a TRS-80. Since receiving a copy of the Pet 6502 version, I have been very impressed with its simplicity and structured approach.

When defending Basic many claim that it is easy to learn; but what they do not mention is that it is easy to learn badly. Comal is easy to learn but it forces the user to analyse problems and to write programs in a more disciplined manner.

By adopting a hotch-potch of the two for its otherwise sophisticated machine, the BBC is doing present and future computer users a great disservice. Why is there no 'While Do' facility for example?

In today's modern businesses the keyword for efficiency is 'structure'. It is sad that the BBC educates the population in computer programming with little emphasis on this vital approach. How long will it take to re-teach all these people to reach the level of the rest of Europe where Comal and structured programming is already so widely taught from schools upwards.

C J Brady,
Shoreham,
West Sussex.

Unix group

I HAVE BEEN asked by the American commercial Unix organisation user group to form a similar group in the United Kingdom. Since the Computer Retailers' Association also has an interest in Unix, we will hold a session for all interested parties in commercial Unix. All parties wishing to attend should write to: Dr Keen, Chairman of Technical Group, Computer Retailers Association, Owles Hall, Buntingford, Hertfordshire. SG9 9PL.

Tim Keen,
Buntingford,
Hertfordshire. ☐

Universal appeal of CBM's new micros

COMMODORE Business Machines is about to upset the microcomputer applegart with the introduction of a "universal microcomputer". The new machine will be capable of running software originally written for rival machines. In addition there will be two new personal computers, and a video game which will double as a microcomputer will also be released.

The universal microcomputer will initially be able to emulate the Apple, Tandy and IBM microcomputers, thus opening up the machine to a

large sector of the microcomputer software market. It will feature as an option on the Commodore 64, using plug-in modules. The beauty of the move is that it means Commodore users will now be able to implement packages developed by rivals, after they incurred the expensive development costs. The target price of this machine will be under \$1,000, grossly undercutting the opposition.

The new computers are all aimed at the lower end of the personal micro market. It appears that Commodore is

making an attempt to produce a range that is both cheaper and more accessible than any other. One of the "fun" personal computers will be little more than an intelligent music synthesiser, though it will not be on sale in Europe until later in the year.

The move by Commodore into emulators is unprecedented in the world of microcomputers but is a well-established part of the mainframe computer business. There are a host of companies offering IBM plug-compatible products, allowing them to ride on the back of the larger company's success and market penetration.

There are a couple of side-effects of this trend. Firstly the price of hardware tends to drop significantly — because of the intense competition, manufacturers try to recoup profits by software and systems sales. Secondly there is a tendency for the manufacturers to attempt to protect themselves by inventing ever more complex protocols. All this goes very much against the traditions of the microcomputer industry, so it will be interesting to see what the response to Commodore's move will be. □

Building up knowledge

ARCHITECTS involved in computing will be able to build on their knowledge at the RIBA computer conference and exhibition. The exhibition will cover those aspects of computing that are relevant to the architect and other building-industry professionals.

The conference will take place on each of the three days, but each day's session will be self-contained, allowing delegates to attend only the parts that are relevant to them.

Day one of the conference will deal with how to choose and use a computer for your office. The speakers will deal with the packages available and cover topics in general terms, allowing a more detailed treatment on days two and three. The second day will concentrate on the practical application of the technology, with papers being presented that are based on users' experience of various computer applications. The third and final day will take the topic of computer-aided design and drafting a stage further. The conference will cost around £45 per day. It runs from April 20 to 22 at the Bloomsbury Crest Hotel, Coram Street, London WC1. The organisers can be contacted on 01-637 8991. □

CBM founder Jack Tramiel — plans in the pipeline.



Cheaper RAM for ZX-81


BYG BYTE is an alternative 16K RAM pack for the ZX-81 microcomputer. Costing only two-thirds the price of the Sinclair memory add-on, the Byg Byte is fully compatible with the ZX-81. Each pack is fully assembled and tested before leaving the factory, and it is cased to avoid handling problems.

At only £34.95 including VAT, postage and packing, together with the maker's full guarantee, the Byg Byte must represent considerable value. Delivery time is currently within 28 days. Byg Byte is available from Computer Aided Printing Services, 56 Trafalgar Avenue, Broxbourne, Hertfordshire EN10 7DL. □

Noise pollution is the price we have to pay for microcomputers and word processors. The rasp of the dot-matrix printer is as common as the tap of the typewriter these days, but often it is much louder. To remove these unpleasant noises Ventguard has developed a range of printer covers. They are available for the Commodore 4022 and 3022 tractor printers, as well as a number of the popular word-processor printers — Qume, Nec and Diablo among others. All functions of the printer remain accessible with the cover in place. Contact Ventguard, Unit 12, High View Avenue, Keyworth, Nottinghamshire. Telephone (06077) 5856. □






The new ZX-81 desk console unit from Traffic Technology should prove to be a neat answer to the "Where-did-I-put-that" question. Moulded in a heavy-gauge, black, grained ABS plastic the console arrives fully assembled and ready to plug in. There are recesses to accept the ZX-81 micro-computer, the 16K RAM pack, the printer, power unit, a cassette recorder and assorted cassettes and pencils. Underneath is a detachable base cover with non-slip feet. At the rear of the console is a switch panel with a three-position slide switch for Save/Run-List/Load which earths the unused inputs to the cassette recorder and the computer. There is also a switch for the 9V power supply. The console measures 19.25in. by 13.5in. by 3in. and weighs just over three pounds. It costs £33.33 from Traffic Technology, P.O. Box 2, Warminster, Wiltshire BA12 7QX. 

Champion's winning ways

AMONG commercially-available chess computers, the world champion is the Chess Champion Mark V. The machine has been proving its worth and pitting its "brains" against those of the human champions Karpov and Korchnoi. When key positions in the recent world championship match were fed into the Mark V, the computer came up with a few surprises.

Chess commentator Raymond Keene — who was Korchnoi's second in the two Russians' previous clash — commented: "The Mark V's results were remarkable. On several occasions the machine was able to improve on the play in the match and once it succeeded in seeing more than the commentators. Naturally if the Mark V had to face Karpov now it would be slaughtered, but it is still a remarkable machine".

The Mark V also recently uncovered two alternative solutions to a set problem said to have only one answer.

Contact SciSys of Suite 8, 266 Fulham Road, London, SW10 9EL. 

ITT 3030 puts the accent on expansion

THE ITT 3030 is a microcomputer with the emphasis on expansion. Although the ITT 2020 used the 6502 processor — the machine was similar to the Apple II — the new micro is Z-80 based. Based on a modular construction, the 3030 can be upgraded into a much more powerful system simply by changing the plug-in printed-circuit boards in the central processor cabinet.

Manufactured in West Germany, where it was developed, the 3030 is of totally European conception and has been designed for the small and medium-sized business. The basic machine includes the CP/M operating system — which means it will have a wide base of available user software. In addition, the U.K. division of ITT Consumer Products has reached an agreement with a software house, MPSL, to develop a range of software using the machine's own operating system BOS.



The price and specification of the 3030 indicate that it is a machine destined for the more serious application. The manufacturer claims that it will be able to begin work within hours of delivery. For the basic end-user price of £2,500 the purchaser receives the central processor, 64K of RAM, twin mini-floppy drives, a separate keyboard that has been specially extended for word processing, the CP/M operating system, the BOS operating system, the Autowriter word-processing package, and the Autoindex database package.

The 3030 can be upgraded to a 16-bit machine simply by removing the CPU board and replacing it with another con-

SimpliCalc answers 'what if?' questions


SIMPLICALC is a 134-line Basic program which performs a host of "what if?" projections and other routines. The powerful program will run on an 8K or larger Pet. It was developed by Mark Turner of the Cronite Group, whose major problem was compressing of the program into a small enough memory that, once loaded, there would still be sufficient RAM left for the complicated and numerous calculations.

The program is not a Basic version of machine-code VisiCalc but a new program which recognises that in small computers, program and data fight for memory space. With SimpliCalc you can get a lot more data in than you could using more traditional calculating routines, without the need for a costly disc drive.

The designer believes that


among the many people who will find the program useful will be accountants with their own Pets who, it is envisaged, will find SimpliCalc an efficient way of working out such problems as when to advise clients to seek separate tax elections for husband and wife.

The program was originally written for the Pet, but is now being prepared for the Vic-70 and the Apple microcomputers. Versions for the Sinclair and the BBC Micro are under way.

SimpliCalc is available either on cassette at £29.90 or on disc at £39.80 including VAT and postage and an instruction manual. For further information contact Mark Turner, The Cronite Group Limited, Montgomery Street, Birmingham B11 1DT. Telephone 021-773 8281. 

taining the Intel 8086. In a similar way the memory can be expanded from 64K to 256K. Other upgrades include doubling the density of the mini-floppy disc, and the addition of hard discs which can offer a total of 10Mbyte on-line.

A multiple RS-232 interface card allows the ITT 3030 to become a multi-access, multi-programming computer, both these functions are supported by the BOS operating system. Up to four users can access files or undertake processing at the same time.

The BOS operating system uses the MicroCobol language, and a UCSD Pascal-supporting operating system is also available. Among the packages already prepared for the machine are the usual ledgers, a payroll program, stock control, and a program generator. For more details about the ITT microcomputer contact ITT Consumer Products (U.K.), Chester Hall Lane, Basildon, Essex. 

The new Transdata **Cx 502-S SUPERSPEED Microcomputer** offers CP/M performance up to 5 times faster than conventional floppy disc systems. The unique high speed master processor and intelligent disc controller combine to give unrivaled processing power; superior to many Winchester disc based systems.

High Speed Master Processor

The Z80B 6MHz Master Processor gives a 50% increase in throughput over more conventional Z80A systems.

Intelligent Floppy Disc Controller

The Cx 502-S exploits the full power of the FLEXIBUS multi-processor architecture common to all members of the Cx 500 family of Microcomputers. The Z80 based floppy disc controller features a 10Kb full track cache buffer, advanced DMA and automatic error recovery. The twin 8" double-sided double-density disc drives provide 2Mb of storage with software selectable single density for IBM compatibility.

CP/M × 5 = Cx502

Load 20Kb in 1 Second

The Cx 502-S programme load performance outstrips many Winchester Disc competitors and response times for disc I/O bound applications are dramatically reduced.

MP/M on Floppies?

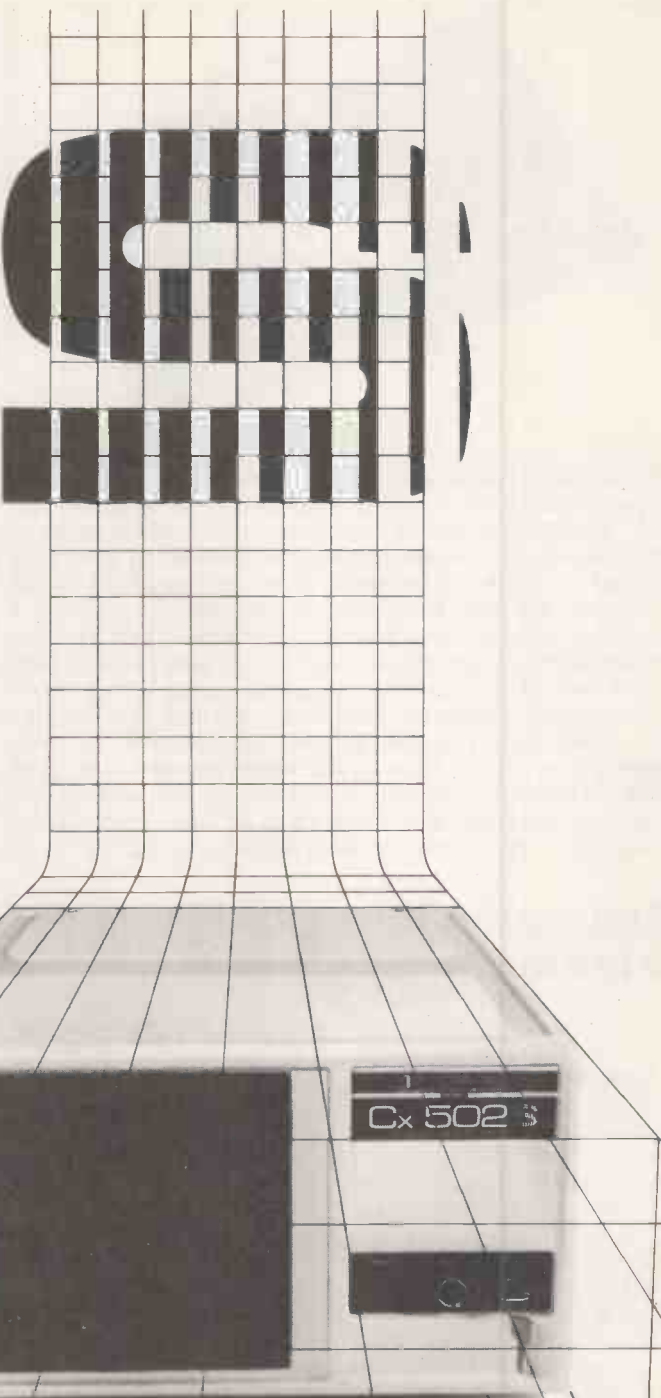
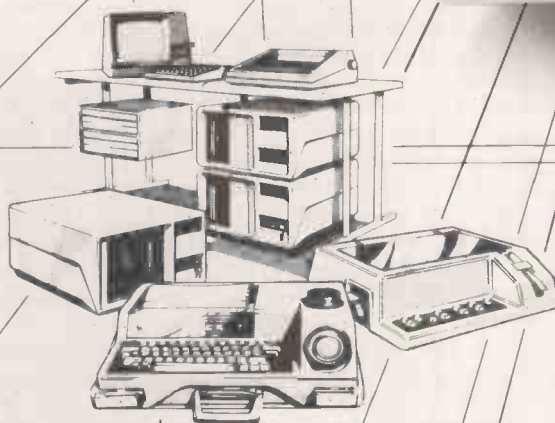
By applying the sophisticated and proven technology of the advanced Cx 500 hard disc systems, the new Cx 502-S offers viable multi-user capabilities. For those applications where large on-line storage is not required and cost per user is an important consideration the answer is the Cx 502-S.

A True Member of the Growing Cx 500 Family

Transdata's Cx 500 Family of Business and Scientific Microcomputers features upgrade potential from single-user floppy disc based systems to multi-user hard disc systems with cartridge tape back-up. Experienced End Users, Computer professionals and Distributors will value the quality, reliability and after sales support offered with these advanced U.K. manufactured Microcomputers.

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DATA TERMINALS AND MICROCOMPUTER SYSTEMS

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London, SE1 2RA Telephone: 01 403 5115 Telex: 8952068

The speed to rival Winchester systems

THE NEW Z-80B processor chip which runs at a fast 6MHz gives the Superspeed micro-computer its name. The CP/M performance of this machine is up to five times that of other floppy-disc-based systems and can provide more power than many of the Winchester hard-disc systems. The 6MHz operation of the processor provides a 50 percent increase in throughput over conventional Z-80A systems, loading a 20K program in one second.

The CP/M operating system gives the user a wide base of applications software to choose from, but if this is not

enough the user can add MP/M together with Winchester hard discs to provide a multi-user system. The floppy-disc controller features a 10K buffer, advanced direct memory access and automatic error recovery. The twin 8in. double-sided, double-density disc drives provide 2Mbyte of storage with software-selectable single-density for IBM compatibility.

The one-off price of the system is £3,500, that is for the minimum configuration which also features 160K of RAM and four I/O ports. The machine is part of Transdata's

Cx500 family of CP/M-based microcomputer systems.

Languages available include Basic, Fortran, Cobol, PL/1 and APL. Also available is a fully-comprehensive, on-site maintenance contract employing Transdata's own field-service engineers. Transdata is at 87-89 Tooley Street, London, SE1 2RA. Telephone 01-403 5115. □

Fast Episode fits the desk-top bill

THE EPISODE is a microcomputer with "micro" dimensions — it occupies about as much desk space as a sheet of foolscap paper. Even so it is a powerful stand-alone system based on the Z-80A processor running at 4MHz. The Episode is capable of running CP/M packages markedly faster than other systems.

The Episode will work with virtually any VDU and printer and can be used as a station in a network linked to other equipment. It is an extremely

Typewriter solution

OLIVETTI daisywheel typewriters make excellent micro-computer printers — the only problem is interfacing them. The £250 Discom interface is approved by Olivetti and will allow a typewriter to interface all the common buses — RS-232, IEEE and Centronics.

Details can be obtained from Discom, Old Manor Farm, Ashton-under-Hill, Worcestershire. Telephone Evesham (0386) 8819, extension 62. □

Stitch in time for clothing industry

CLOTHMAN is an integrated system developed for use by the clothing industry. It has been developed by Taunton Electronics, a microcomputer systems house that specialises in providing computer systems for the clothing and allied trades.

There are five areas in which the Clothman system can improve or simplify tedious bookwork. These are: providing piece-work calculations which can be extended to year-end reports; production of work-in-progress reports with up to 10 process points; order processing, enquiry and status reporting; work-ticket printing on special copy-through tickets; and style rate book reporting and printing.

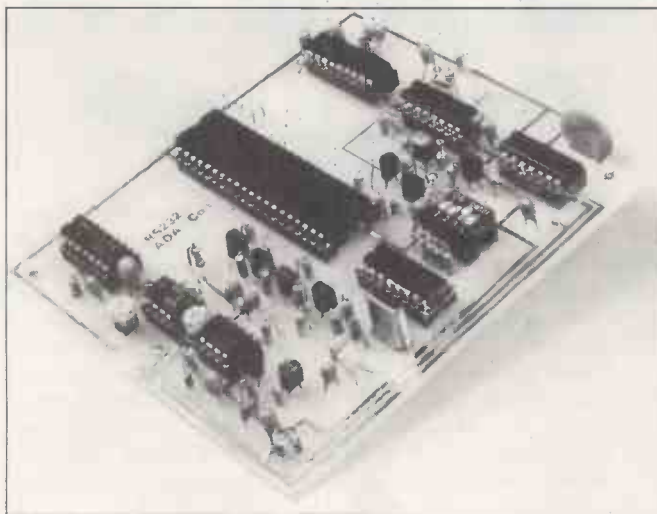
The system has been produced with the co-operation of a clothing manufacturer and is already fully operational in a number of factories, varying in size from 55 to 250 employees. Clothman runs on an Apple II computer or can put on the Nestar system with up to 64 Apples connected to a large disc back-up.

Clothman has been developed and conceived so that the system can be used by non-specialists, though the price of the package includes a

week of operator training at the company's training centre in Taunton, Somerset.

Clothman costs £2,250 and is available direct from Taunton Electronics. Telephone Bishops Lydeard (0823) 433142. □

Equipped with the standard RS-232 serial output, this analogue/digital/analogue board enables almost all microcomputers to interface with the analogue signals of the real world. Featuring eight-bit resolution of any signal in the range 0-2.5V, the board can handle both DC and AC currents. Output can also be in the 0-2.5 range, with a load driving capability of 25mA. The baud rate can be any one of 15 standard rates between 50 and 19,200. The kit version costs £39.50 and the built version £49 from Ambit International, 200 North Service Road, Brentwood, Essex. □



mobile computer: weighing only 15 pounds it can be carried easily to the place where you want to use it. The other dimensions of the Episode are the 7.5 inches height, 9.5 inches width and the 14.5 inches depth.

The mass integral storage is provided by twin mini-floppy disc drives of either single, double or quad density. A maximum of 1-6Mbyte of on-line storage is thus available. Other features of the system are two RS-232C serial interfaces, a Centronics compatible parallel interface, a battery-operated calendar clock, and 64K of RAM.

Episode is available from Equinox Computers, who will market the machine with a number of applications packages. Software includes word processing; invoicing stock control; sales, purchase and nominal ledgers; and a sales-management package.

The Episode microcomputer costs £1,995 plus VAT. For further details contact Equinox Computers, 16 Anning Street, New Inn Yard, London EC2 3HB. Telephone 01-739 2387/9. □

Next One hits routine tasks

THE NEXT ONE is a program generator that costs only £100 plus VAT. Written for the Apple II microcomputer the program will also run on the ITT 2020 and there is a CP/M version too.

The Next One writes to a disc file the program statements which make up the created program. It is really a tool to take all the drudgery out of programming by writing the tedious input/output sub-routines between the keyboard and the disc, and the disc and the memory. It is not intended to replace programmers.

Target programs generated by the Next One are written in a structured form, which is ready for use within a few minutes of creation. There are many diagnostic features built in to the program and its structured nature makes it easy to read and understand. The Next One is available from Logical Computing, 26 Wide Lane, Swaythling, Southampton. Telephone Southampton (0703) 583857. □

Composing oneself with Music Maker

THE PLUG-IN Music Maker module for the Texas Instruments TI-99/4A computer allows music to be composed, edited and played. It assists the creation of musical compositions by serious musicians and beginners alike.

Notes can be entered, one measure at a time, into the microcomputer's memory. Music can then be replayed at the touch of a key.

Serious musicians will be attracted by the system's method of composing, placing notes on the traditional treble and bass staves. Novices can compose using sound graphs. Either method allows the user access to three voices.

There is a flexible choice of key- and time-signatures, and a total of 30 different speeds at which the music can be played. Any note can be accepted, provided that it is in the three-octave range from the second A below middle C to the second A above middle C.

There is a facility for repeating passages of music, and if a

printer is added to the system, the music can be printed. Computer owners who consider themselves to be in the musical avant-garde will find the system capable of many interesting sound effects. The Music Maker module costs £34.95 and is available from Texas dealers. For details ring Texas Instruments on 0234-67466. □

How to make Tandy run as terminal

TERMINAL is a product which allows the Tandy TRS-80 range of microcomputers to act as remote terminals to larger mini- or mainframe computers. The emulator runs under the standard Tandy DOS operating system, but a CP/M version is planned.

Under Terminal, the baud rate used will be software-selectable between 110 and 9,600baud. Also software-selectable are the word length,

Economy of Cintcode

BCPL CINTCODE is a new implementation of an established systems programming language, BCPL. It permits larger and more complicated systems to be built and maintained on microcomputers.

It adds a number of extra features and only uses one-third of the space used by fully compiled systems such as Pascal. Telephone RCP, Blewbury (0235) 850218. □

the number of stop-bits and the parity. There are input and output translation tables for total control over all transmitted and received data, and screen-print facilities. Echoing, flashing cursor, lower case, and error checking are all provided for, and so are programmable break sequences.

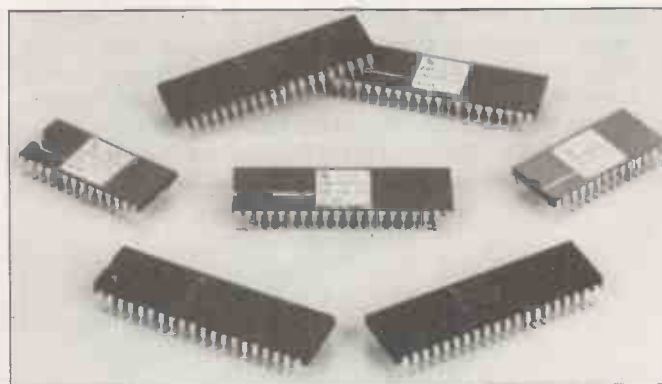
Translation tables are provided for IBM, Univac, ICL 2900 and ICL 1900. Terminal costs £45 for TRS-80 models I and III, and £55 for model II. The CP/M version will be available soon. Contact MTW Computer Services, 4 Wyvern, Tamworth, Staffordshire, B77 2RL. Telephone Tamworth (0827) 61320. □

Zilog chip makes huge power savings

THE Z-80L is the latest version of the well-proven Z-80 microprocessor. The new chip is still an eight-bit device, but it consumes only 10 percent of the power of the standard Z-80.

The Z-80L is available for operation at three speeds: 1MHz, 1.5MHz or 2.5MHz in the L1, L2, L3 versions. The low power consumption of the Z-80L family — 75mW — means that they are ideally suited for use in hand-held or portable battery-powered products. On the other hand, the low power consumption allows battery back-up to be implemented easily in systems where the data being processed is of a critical nature or where the application relies on continuous processing.

In other respects the chip is fully compatible with the stan-



dard Z-80, allowing it to be replaced directly in circuit boards without any redesigning. Additionally the device is fully supported by Z-80 development systems and in-circuit emulators, allowing products to be developed, tested and debugged quickly.

The Z-80L can be used in conjunction with all the

eight-bit peripheral devices currently offered by Zilog. Low-power versions of the peripheral chips will be available in the future. The Z-80L is produced in both ceramic or plastic packages. For further details contact Zilog, Babbage House, King Street, Maidenhead, Berkshire. Telephone Maidenhead (0628) 36131. □

Source of TRS-80 facts

TANDY TRS-80 microcomputer users will find the TRS-80 software sourcebook an invaluable aid. The first volume of the sourcebook lists the details and sources of over 500 applications programs, written in the U.K. for the TRS-80 models I, II, III, the Tandy Colour Computer and the Pocket Computer.

Entries are indexed by a series of seven categories: Business, Inventory Control, Education, Games, Home-Personal, Statistics-Maths, and specific industrial-professional programs. The book also contains an entry form for those who wish to submit their own software packages. The book costs £3.95 and is available at Tandy stores.

First time on Earth.

SHARP MZ-80B

Sharp bring you the MZ80B. A machine that offers you functions previously only associated with more powerful, more expensive computers; that gives you versatility to handle a huge range of software and hardware applications in scientific, business and personal use.

The MZ80B opens up a new world of graphic display potential, more flexible data storage and retrieval, and ease of operation.

Here is the computer from the future. Available today.

Stunning Graphic Display.

Seeing is believing. The large-screen, high-focus, green-face display incorporated in the MZ80B gives you high-resolution graphics of 320 x 200 dots.

An additional graphic RAM can be added which allows another 320 x 200 dot resolution pattern to be displayed.

This dual high-resolution graphic ability is especially useful for simulating and displaying a dynamic picture. It can display 40 characters x 25 lines or 80 characters x 25 lines via software switching.

In addition there are facilities for full, on-screen editing, reverse video, partial scrolling and a full range of graphic symbols.

Character and Graphic Printer.

This fast, quiet printer will reproduce your graphic displays and, of course, print-out upper and lower case letters and symbols. A tractor/friction feed version is also available.

Data Storage/retrieval.

The MZ80B has a remarkable memory. 64K of RAM. And that constitutes all the memory area, giving flexible storage of any computer language and its software. The cassette deck is electromagnetically-controlled, with a data transfer speed of 1800 bits/sec combined with a unique

programme search facility to make data storage and retrieval super-fast.



A typewriter-style keyboard incorporates characters and symbols plus a numeric key-pad and ten user-definable keys for fast and simple operation.

BASIC is, of course, provided with Z-80 Assembler Packages, PASCAL and a BASIC compiler.

Floppy Disk Drive.

A twin Floppy Disk Drive unit can be added which will give you 560 bytes of storage on double-sided, double-density disks.



Comprehensive Documentation.

Each MZ80B comes complete with a full set of documentation including an owners' manual giving full circuit diagrams, a monitor reference manual and programming manuals.

Interfaces

RS-232C and IEEE Interfaces are available from January 1982 allowing the MZ80B to communicate with scientific instruments and other peripherals.

CP/M*2.2

CP/M* is also available making a wide range of packages immediately available including wordprocessing, financial modelling, data base management to mention but a few. CP/M* also increases the disk capacity to 680K.

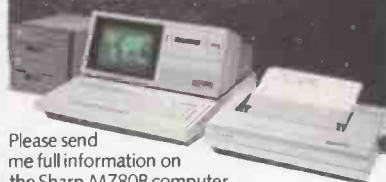
(CP/M* is a Trade Mark of Digital Research Ltd.)

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PC 4/82

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3. Fully expandable to 32K of user RAM.

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5. Accessible machine language as standard.

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17. Machine bus port for memory expansion and ROM software.

18. Standard interfaces for hardware peripherals.

19. VIC 20 is truly expandable into a highly sophisticated computer system with a comprehensive list of accessories (see panel below).

20. Full range of software for home, education, business and entertainment on disk, cassette and cartridge.

21. Books, manuals and learning aids from Teach Yourself Basic to the VIC programmers' reference guide (a must for advanced programmers).

22. Full support for VIC owners – their own magazine 'VIC Computing' as well as a national network of VIC user groups.

23. National dealer network providing full service and support to VIC owners.

24. Expertise and experience – Commodore are world leaders in microcomputer and silicon chip technology.

25. Commodore is the leading supplier of micro-computers in the UK to business, schools, industry and the home.

26. VIC 20 is the best-selling colour home computer in the UK.

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Accessories include:

- Cassette tape unit.
- Single drive 5¼" floppy disk unit (170 K bytes capacity).
- 80-column dot matrix printer.
- 3K, 8K and 16K RAM expansion cartridges.
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commodore
VIC 20
The best home computer in the world.

The 1982 Computer Fair, being held at London's Earls Court exhibition centre on April 23-25, provides a showcase for the whole gamut of small business systems and home computers. We look ahead to the highlights of the Fair.

Computer Fair preview

THE COMPUTER Fair will be the biggest show of its kind ever held in the U.K. The Fair will be concentrating on the microcomputers that are becoming a part of our everyday lives, and to avoid confusion, it will be divided into two areas, one for the business microcomputer user and a fun section for the more frivolous home user.

In the business section, the main exhibitors will be displaying a variety of microcomputers aimed at the serious computer user. A number of leading companies will be displaying their pro-



The IBM micro can be seen at the Fair.

ducts to the public for the first time. One of the more interesting products to be shown at the fair will be the IBM personal computer which is on sale in Britain through Microcomputerland.

The IBM personal computer represents an important trend in microcomputing. In the past, the industry has been dominated by smaller companies with rapid growth. Now the larger, more established equipment manufacturers are moving in, bringing with them new standards in hardware and software, as well as reliability and support.

Industrial charm

These advances have been made at the expense of some of the charm of the industry, but are well worth the price. If you would like an opportunity to see the IBM personal computer at first hand, then call in at the Microcomputerland stand, number 407.

Tangerine expects to be launching the new Tigress microcomputer at the Computer Fair. The Tigress is a major new British microcomputer that will compete on far from equal terms with the better-known imported machines. The micro is aimed at the businessman and the top-of-the-range hobbyist. One of the most

attractive features of the Tigress is the built-in Prestel unit and its telephone answering facility. This enables the computer to connect directly with Prestel and download pages. All current or projected Prestel standards are catered for.

Tigress processors

In addition each Tigress will be able to act in a telephone-answering mode, accepting messages from other terminals or computers over the telephone network. It will be possible to connect the machines using the integral Econet communications network.

The Tigress employs three processors — the main CPU is the Z-80 which runs CP/M. A 6809 will be in control of all the input, output and communications functions of the machine, while a separate dedicated chip will control the real-time high-resolution graphics. The target price of the basic Tigress system will be around the £600 to £700 mark; discs will be extra.

In addition to this exciting new machine, Tangerine is showing a range of software. Marketed under the Tansoft label, this software is designed to run on the new Tangerine disc units and will include a disc-operating system. There is also some utilities software covering such functions as reformatting. The focal point of interest will no doubt be the Tangerine Forth package.

The ZX Village

Home and hobby computer users will find much to their taste at the show, with the finals of the U.K. Micromouse competition and the ZX Village. Ever mindful that this just might be the time and the place for the launch of the ZX-82, the Fair's organisers have allocated a whole section of the show for the Village which will be, to all intents and purposes just like a space-age market.

The ZX Village will be an ideal place for users to bring themselves up to date with the latest developments on the Sinclair scene. Sinclair Research is exhibiting at the Computer Fair and in the past Sinclair has produced a few surprises. In this area of the show user groups and clubs will be able to use stands free of charge.

If the ZX Village combines the excitement of the eastern bazaar with the technology of the space age then the Micromouse competition combines the same technology with the flavour of a Roman circus. As tiny robotic mice endeavour to find their way through labyrinths of

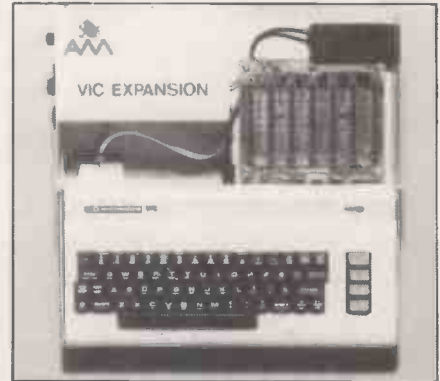
Minotaurian proportions, baying crowds of supporters will cheer on the heros and offer a "thumbs down" to the vanquished in the time-honoured tradition of the amphitheatre.

If it all sounds a little too light-hearted for you, the techniques and technology used in building and running these Micromice are some of the most sophisticated around. The competition is not really about mice at all, but about building ever-better robots, to specification. The strength of such a competition is represented in the interest shown in it by top engineering concerns. To find out more about the *Practical Computing* Micromouse finals, you can read the rules of the competition on page 143 of this issue of *Practical Computing*.

Package deal

The Computer Fair is to be held at the giant Earls Court exhibition centre in the heart of the nation's capital. It is the first time a major computer show of this size has been held at that venue. If you are intending to stay over night in London for the Fair, you might be interested to know that Pharoah Hughes Associates Ltd is offering a special package deal.

In the best tradition of business package deals the offer can include both



Home computers are amply catered for.

reasonably-priced accommodation in twin-bedded hotel rooms and reduced-rate rail travel. There is a choice of either two-star or three-star hotel accommodation, and both include continental breakfast and admission to the show. Two-star accommodation costs £13.80 per person and three-star £15.30. For more details telephone Pharoah Hughes Associates on 01-995 8995.

The Computer Fair is being organised by IPC Exhibitions Ltd, in conjunction with *Practical Computing* and *Your Computer*. For more details telephone 01-643 8040.



Plotting to put HP-83 graphics on to paper

Exploded pie segments and clustered bar charts are child's play for the Hewlett-Packard graphics plotting package. David Watt reviews this tablet and plotter which turn statistical data into shaded and coloured hard copy for permanent display.

HEWLETT-PACKARD is renowned for producing equipment of very high quality, which is particularly respected by members of the scientific and engineering community. The equipment for this review was provided by Microdigital — now a subsidiary of Laskys, the hi-fi chain — and consisted of an HP-83 computer, a 9111A graphics tablet, a 7225A plotter, dual mini-floppy disc drives, VisiCalc Plus, and graphics demonstration software. The system also included a 16K add-on memory module, HP-IB interface and cables, mass-storage ROM, and plotter/printer ROM.

The equipment was connected using the HP-IB interface bus, invented by Hewlett-Packard and since adopted as the IEEE-488-1978 standard. The HP-IB interface allows several devices to be connected on a common bus. Each device has a unique address which may be set by adjusting switches at the back. Up to 15 devices may be connected on one bus. The IEEE-488 interface is also used by the Commodore Pet.

All the equipment worked well, with the exception of an apparent fault on the plotter. The pen did not always lift clear of the paper when being moved between plots, and therefore drew faint traces on the paper.

Attractively styled

The equipment looks extremely well made, and is styled attractively in matching light-grey plastic cabinets, with dark-grey front panels. The HP-83 computer is the same as the HP-85, but without the integral tape cassette drive and printer. It is very pleasant to use: the keyboard design, in particular, is excellent with a number of useful special functions keys. The 5in. display screen is easy to read, despite its small size, though it is only possible to display 16 lines of 32 characters. The HP-83 has a larger display memory, a total of 64 lines, which can be displayed by scrolling up or down.

The graphics tablet has a large, white ceramic platen, a stylus attached by a thin cable, and four lights marked Digitise, Menu, Error and Line. The platen is marked out with a large rectangular plotting area, measuring 11.9 by 9.36 in. and 16 square "softkeys" grouped in fours above the plotting area. In the bottom, right-hand corner of the plotting area is a small dot called the self-test dot, used for testing the platen and stylus circuits.

When the tablet is switched on, all the lights flash on and off and a sequence of notes is sounded on the tablet's tone generator. The tone generator may be programmed to give an auditory acknowledgement when an operation is performed — when a softkey is selected, for example — or if an error occurs.

At the rear of the tablet there is a row of switches used for setting the device address on the HP-IB interface. The tablet may also be connected to a non-intelligent device for data logging, in which case the switches may be set to "talk-only". One of the switches is used to initiate the graphics tablet self-test, which makes all the lights flash and start-up tones play. If the stylus is touched on the self-test dot, the start-up sequence will be played again.

Tracing lines

The stylus contains a ball-point pen cartridge which may be either inked or inkless and has a spring-loaded micro-switch which operates when the pen is pressed on the platen. It can be used in two ways. For single-point digitising the X, Y co-ordinates of the pen are transmitted when the pen is pressed on the platen and the switch closes. The alternative mode, continuous digitising, is useful for tracing lines. In switch-normal mode, a line is started by pressing the pen once and points are taken continuously until the pen is pressed again. In switch-follow mode, points are taken only while the pen is kept pressed down, on the tablet.

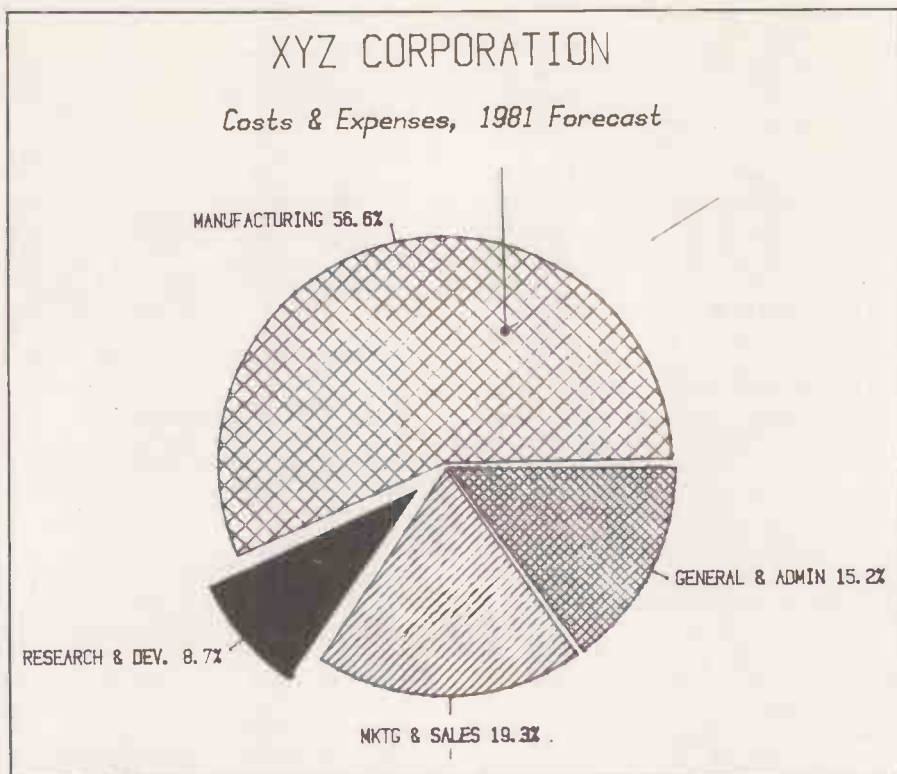
The Digitise light indicates when the graphics tablet is ready to receive a location. The Menu light comes on when one of the softkeys is to be selected. As the name suggests the softkeys can be used to select options from a menu; they are used by many of the programs in the graphics demonstration software.

The plotter has several push-buttons along the front, which are used for setting it up. The Chart Load switch causes the pen to move up to the top-right corner, and releases the electrostatic hold-down on the plotter so that a sheet of paper or mylar may be placed on the platen. The electrostatic hold-down feature makes sure the paper lies flat and does not move about.

Pen movements

The pen may be moved about the platen and raised or lowered using ←, →, ↑, ↓, and Pen Up or Pen Down. There is also a button marked Fast to move the pen more quickly. The lower-left and upper-right limits of the plotting area can be set, if you do not want to use the default values, by moving the pen to the required positions and pressing Enter, followed by the buttons marked Lower Left or Upper Right. The button at the rear of the plotter marked Confidence Test generates a test plot.

The pen can be moved in increments of



The tablet and plotter can deftly transform statistics into graphical form.

0.032mm. which the plotter will take charts up to 210 by 297mm. A4-sized paper. The pen velocity can be varied between 10 and 250mm./s. and labels can be printed at up to three characters per second. Five character sets are available. Two use the £ sign instead of "#", and one has the symbols Ø, Æ, ø, æ.

The printer/plotter and input/output ROMs provide a number of extensions to Basic for use both with the graphics tablet and the plotter. Amongst these are Limit, Scale, Digitise and Cursor, Printer Is and Plotter Is from the Printer/Plotter ROM; and Output and Enter instructions provided by the input/output ROM. The I/O ROM was not supplied for review, but all the software provided worked perfectly

Figure 1. Plotter/printer ROM statements.

AXES	LINETYPE
BLINIC	LOCATE
BPLOT	LOGR
BREAD	MOVE
CLIP	MSCALE
CRT IS	NOBLINIC
CSIZE	PDIR
CURSOR	PEN
DIGITISE	PENUP
DRAW	PLOT
EPROM	PLOTTERIS
ERASE	PRINTERIS
FRAME	RATIO
GCLEAR	RPLOT
GRAPHICS	SCALE
GRID	SETGU
IDRAW	SET I/O
IMOVE	SETUU
IPLOT	SHOW
LABEL	TRANSLATE
LABLE USING	UNCLIP
LAXES	WHERE
LDIR	XAXIS
LGRID	YAXIS
LIMIT	

without it and so does not depend on it.

HP-85 Basic has a powerful set of graphics commands. Graph switches the screen to the graphics-display area, GClear clears the screen below a specified line, and Frame draws a line round the edge of the screen.

Scale command

The Scale command sets the horizontal and vertical, X and Y, units. The default values for scale are zero 0 to 100 in both directions. The ranges for X and Y can be set independently, and can range over any values; they do not have to start at zero.

The screen has a resolution of 256 dots horizontally by 192 dots vertically, so when using the default scale, the y units are shorter than the x units. However, setting the scale so that the number of Y units is three-quarters the number of X units gives equal-sized units, which make it easier to draw regular shapes like circles or polygons.

Points are plotted according to the current scale, and mapped automatically on to the graphics display, so it is easy to expand or contract a display.

The X-Axis, Y-Axis statements may be used to draw axes specifying where to position ticks; Plot is used to set a point on the display; Move moves the pen without drawing a line; Draw is used to draw a line. IMove and IDraw are the same as Move and Draw except that they move the pen a number of units relative to the last pen position.

Labels may be written anywhere on the display using the Label command, and

(continued on next page)

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can be written vertically or horizontally by specifying the label direction with LDir. Another powerful feature of HP-85 Basic is the ability to create your own characters using BPlot.

These features are considerably enhanced by the use of the plotter/printer ROM. A list of all the commands it provides the plotter/printer ROM is shown in figure 1.

The Plotter Is and Printer Is commands are used to direct output to specified devices: 1 is the address of the HP-83 CRT; 705 is the default address of the graphics tablet, and 706 the default address of the plotter on the HP-IB interface. A plot can first be displayed on the CRT and if it is satisfactory it can then be output on the plotter.

The Limit, Scale, Show, Locate and MScale commands allow considerable flexibility in defining the plotting limits. The Limit statement allows a program to set the physical plotting area for the HP-7225A plotter, as an alternative to setting them using the buttons on the front panel. The Show statement allows the ranges for X and Y units to be defined, and scales the plotting area automatically so that X and Y units are the same size. MScale sets the user units to millimeters, so that precisely-scaled objects can be drawn or measured. You can specify windows in the plotting area using the Locate statement: for example, you can define a part of the plotting area to contain your main plot while another portion is reserved for labels.

Dots and dashes

Lines can be plotted using varying combinations of dots and dashes with the Linetype statement. Eight combinations are available, and the length of the repetitive pattern can be specified.

The plotter/printer ROM provides several new commands for drawing axes and labels. The Axes statement allows both the X-axis and Y-axis to be specified, together with major and minor tick marks. Thus it combines all the features of the XAxis and YAxis statements in one. The Grid command allows a grid to be drawn instead of the axes alone. In addition to the standard Label statement the plotter/printer ROM has a Label Using statement which operates in a similar fashion to Print Using; a format mask is defined which governs the position and print format of the data specified in the rest of the statement.

For labelling it is possible to specify the character size, the ratio of character height to width, and the slant of characters, all using the CSize statement. When using the plotter, labels can be drawn in any direction — not just horizontally and vertically — with the LDir statement.

For digitising, Digitise, Cursor and Where are statements that interrogate the plotter or graphics tablet to find the

The review system

HP-83 computer	£1,486.35
16K memory module	£194.88
ROM drawer	£29.73
Mass-storage ROM	£98.19
Plotter/printer ROM	£98.19
Input/output ROM	£199.77
HP-IB interface	£260.94
7225A plotter with personality module for HP-IB interface	£2,115.00
9111A graphics tablet	£1,355.00
Dual mini-floppy disc drive	£1,693.00
TOTAL	£7,351.05

HP-85 computer	£2,146.95
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HP-85, 16K memory module, ROM drawer, plotter/printer ROM, I/O ROM, HP-IB, plotter and graphics tablet	£6,400.66
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Software

Graphics presentation	£135.44
VisiCalc Plus	£135.44

X,Y co-ordinates of the pen or cursor. The plotter/printer ROM provides some additional facilities for use with the CRT graphics. BPlot has been improved so that your characters can be as large as you like, filling the whole screen if you wish, and BRead allows a character created on the screen to be stored for re-display by BPlot.

Both the plotter and the graphics tablet have internal microprocessors, and will execute commands given in Hewlett-Packard's graphic language, HPGL. This enables you to use features not available through the plotter/printer ROM, such as changing the speed of the pen or using a different character set on the plotter, and obtaining information on the status of the graphics tablet. To use many of these functions it is necessary to have the input/output ROM.

Practical value

The Graphics Presentation software and VisiCalc Plus was provided to test the system. The Graphics Presentation package consists of six programs: a drawing program; an area- and distance-measuring program; a continuous line-drawing program; a graphic data-entry program; a music-demonstration program which plays "Daisy Bell" using the sound generators of both the HP-83 and the 9111A; and an asteroid game. They were great fun to use, and effectively demonstrated the facilities of the graphics tablet. The first four programs have a practical value as well.

The programs all display help instructions, the HP-83's CRT to tell you how to use the softkeys, but they tended to scroll off the screen too quickly. You have to be ready with your finger on the Pause key to be able to read the information.

VisiCalc Plus is the ubiquitous VisiCalc program with the addition of some very useful programs which take data stored

by VisiCalc and generate line graphs, bar charts, pie charts or fit regression curves. It showed up well in the example described in the VisiCalc manual which produced the various charts on the plotter. The bar and pie charts could be shaded in various ways, stacked or clustered bar charts could be drawn, and exploded pie segments could be drawn to emphasise a particular sector.

The review system was supplied with special paper for plotting, four different coloured pens and mylar for producing overhead-projection slides. One obvious application for the plotter is in preparing material for presentations, lectures or reports.

The detailed documentation supplied with the system was of very high quality: diagrams and examples were provided in abundance. The sheer quantity of documentation was daunting at first, but you should soon learn to find your way around it.

You may be amused by the following item from the introduction to the Plotter/Printer ROM Manual: "By the time you get the plotter/printer ROM and the manual, you will have accumulated a stack of literature at least 1.8 m. tall. And you are wondering where to dig in". It clearly caters for every level of user from the absolute beginner to the experienced programmer.

Conclusions

- All the Hewlett-Packard equipment is made to a very high standard. It looks good and feels good to use. The documentation is also extremely good.
- The plotter has many very useful features and it was possible to produce excellent graphs with it. It is even possible to digitise information by positioning the pen — a special digitising sight is available — and pressing the Enter button.
- The strength of the graphics tablet is the ease with which it can be used to enter data from charts or graphs. It can also be used as a design tool for creating drawings.
- Hewlett-Packard has an extensive service network and a good reputation for reliability.
- The VisiCalc Plus programs provide powerful extensions to VisiCalc, and the graphics demonstration software would be useful for digitising drawings and graphs, and possibly as design tools. The source code was supplied for the VisiCalc Plus programs — not VisiCalc itself — and the graphics demonstration programs, so they could be easily enhanced. The packages are reasonably priced.
- The hardware is rather expensive by normal standards, and seems to be aimed primarily at scientific, engineering and business users demanding high-quality equipment and service.
- The system is particularly suited for use in business graphics, statistics, medicine, numerical control, surveys and design. □



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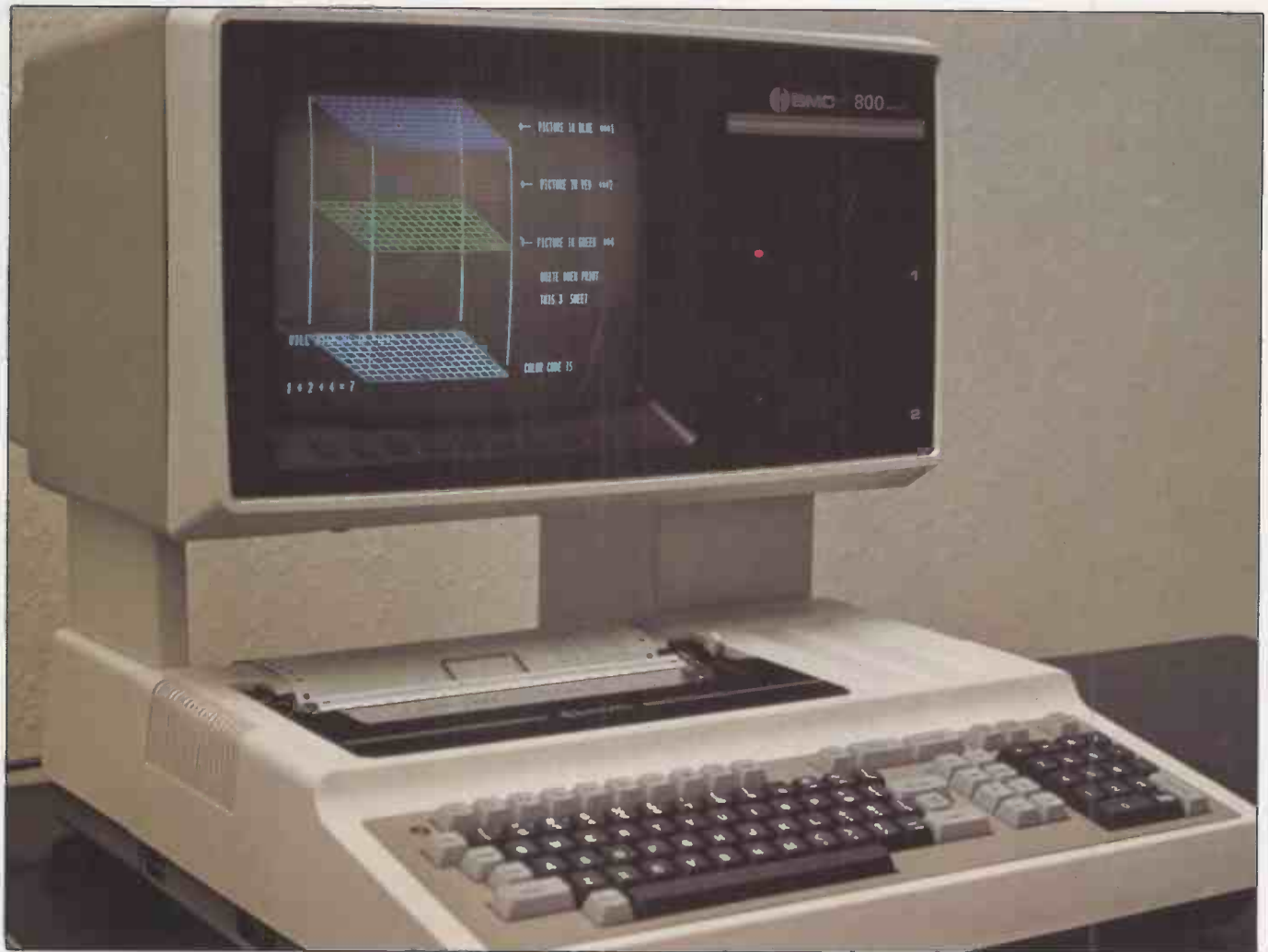
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Equipped with an unusually high level of sophisticated hardware, this integrated microcomputer system is clearly designed to appeal to a wide range of business and technical users. John Dawson finds out whether its practical performance matches up to the advanced specification.

THE OKI IF-800 Model 20 personal computer is an eight-bit machine intended as a small business computer, for scientific purposes, and for diverse applications such as instrument control and running business colour-graphics software. It uses a Z-80A CPU running at 4MHz, backed up by 64K of dynamic RAM for program store and 16K for the monochrome display, or 48K if you have the colour monitor. There is a 2K bootstrap ROM.

The IF-800 has a built-in printer which uses a five-by-seven-dot matrix, and consequently produces no lower-case descenders. The printer provides for both tractor and friction paper feed. The other input/output facilities for the computer are listed in table 1.

Two 5in. double-sided, double-density

mini-floppy disc drives are built into the computer. Each drive has a capacity of 280K, giving a total on-line storage capability of 560K. With four floppy-disc drives in place, the machine can access 1.12Mbyte. A brochure accompanying the computer, dated November 1981, offers a 5.25in. hard-disc drive with a capacity of five or ten megabytes.

The computer is delivered as two units: the first incorporates the keyboard, printer and CPU/memory. The second unit contains the VDU and the two floppy-disc drives mounted on a plinth to raise them above the keyboard. Power and data connections are brought neatly down the inside of one leg of the plinth to plug into the back of the computer/keyboard unit.

Eight-colour image

The computer is supplied with a mains lead wired directly to the machine and a continental three-pin plug at the far end of the lead. Despite this, the IF-800 contains a 240-volt power supply and the first job you will have to undertake after unpacking the computer is to cut off the plug to substitute a standard U.K. plug.

An eight-colour image is available on the IF-800 with a high-resolution display — 640 horizontal by 200 vertical pixels.

OKI

Alternatively the machine can be supplied with a green monochrome display with the same resolution.

The story, however, does not end there. The colour mask in the colour cathode-ray tube is perceptible to an operator using the computer, and the effect of this is to lower the apparent resolution. When this is combined with the absence of lower-case descenders in the VDU type font, the result is to make the machine unsuitable for use over extended periods by, for example, a word-processor operator.

Any computer should have an easily-legible character set that will not cause fatigue when used for a number of hours at a stretch — nothing less is acceptable, certainly not in the prestige, up-market product range to which the IF-800 aspires. The poor quality of the 80-character IF-800 alpha-numeric display is a serious shortcoming.

In addition to the normal typewriter-keys on the IF-800 keyboard, there are 10 user-programmable "soft keys" and 32 special-function keys, including a numeric keypad. Three keys are dedi-

cated to printer functions: to print the current contents of the VDU on the printer; eject a "form" length of paper from the printer; and echo whatever is typed in at the keyboard to the printer.

The soft keys are repeated along the bottom edge of the VDU screen, and some of the CRT control options allow a label field to be displayed across the bottom of the VDU indicating the function of the 10 programmable soft keys. The keys along the bottom edge of the VDU are particularly useful when a menu of commands is provided for a user to choose from. The first three characters of the command are displayed when the CRT display is in 40-character mode, and the first seven characters of a maximum of 15 are displayed when the VDU is in the 80-character mode.

A reset switch and a key to break into the operation of a Basic program are located on the left-hand edge of the computer. A diverse and comprehensive set of sockets scattered round the computer will allow you to plug in additional peripheral devices such as a light-pen, an acoustic coupler or British Telecom Modem, laboratory instruments, a printer with a Centronics interface, or the two additional floppy-disc drives.

Hard information

Two manuals are supplied with the computer. The Operation Manual contains 200 pages packed with hard information about the system and example Basic programs. The second manual is the Basic Reference Manual which

Two built-in mini-floppy double-sided, double-density disc drives — 280K per disc. An extra two disc units can be connected.

Loudspeaker: Can switch a tone on and off with a frequency range from 65Hz to 1,976Hz.

Calendar clock: A hardware clock is fitted, powered by a NiCad battery. It displays the year, month, day, hour, minute, second and day of the week on request.

ROM cartridge: Holds 20K, the interface is said to be addressable to 1Mbyte.

RS-232C interface: From 110 to 9,600 baud under software control.

External I/O interface: Three slots for optional cards to give a Centronics-type parallel interface, an IEEE-488 interface, and a two-channel, 12-bit D-to-A board or an eight-channel, 12-bit A-to-D board.

Audio cassette I/O: Uses non-standard BMC protocol; cassette recorder motor control by Basic instruction.

Printer: Five-by-seven-dot matrix; tractor/friction feed; paper up to 9.5in. wide; no lower-case descenders.

Dimensions: width 20in. (51cm.); depth 26.7in. (68cm.); height 19.9in. (50cm.). Weight: 77lb. (35kg.) with monochrome display; colour display weighs an extra 11lb. (5kg.).

Table 1. Dimensions and input/output channel specifications.

devotes about 30 pages to a general explanation of the Oki Basic interpreter, and a further 100 or so to a more detailed description of the use of each command and intrinsic function.

The IF-800 is likely to be marketed into offices, scientific and hospital laboratories, and possibly executive conference rooms. Many of the machine's users will be intelligent and capable people who are quite ignorant about computers. The documentation supplied with the machine is crucially important, particularly where small detail is concerned, because this group of users is unlikely to have the accumulated wisdom that will allow them to disregard red lights and to cope with unexpected error messages when following programs in the Operation Manual.

For example, there is a caution that you should not attempt to remove a disc from the disc drive when the drive-select

light is on. Yet the red light remains on the whole time on drive 1, presumably to indicate that the drive is selected rather than that the head is in contact with the disc, reading or writing material. Even if it were possible to select the second drive manually this is an incredibly clumsy way of removing a disc. There is no cross-reference in the manual to tell you how to overcome the problem.

Additional boards

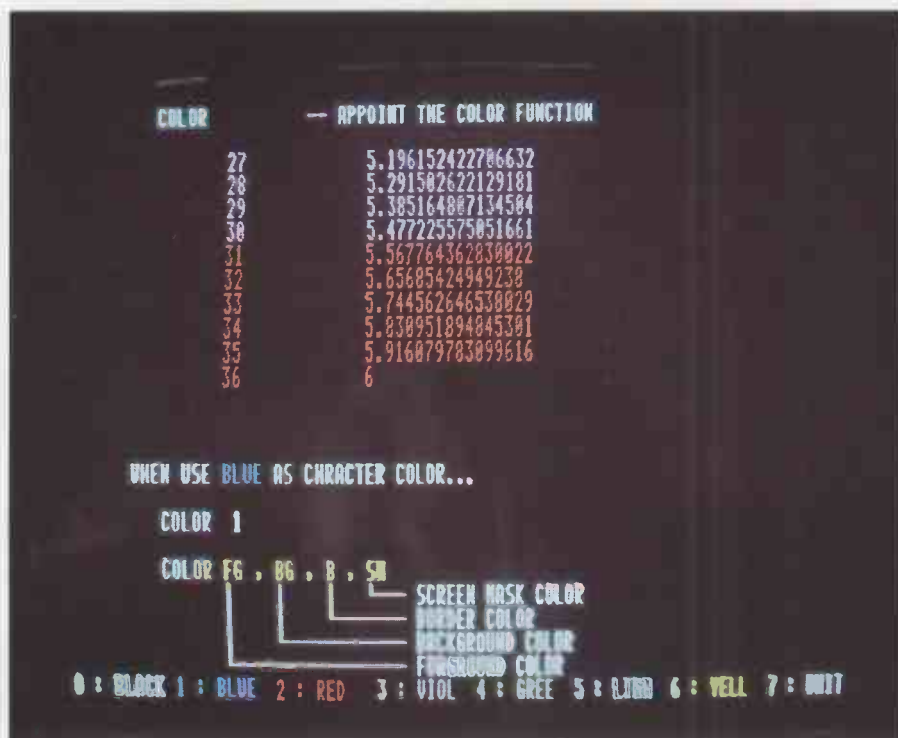
The Operation Manual does improve when it reaches the technical description of the various additional boards that can be attached to the basic system. There is plenty of information, well set out, on the pin connections, voltage levels and timing patterns that are expected by the D-A and A-D boards, the IEEE-488 interface and so on. A technician in a polytechnic or university laboratory should be able to interface the IF-800 to other equipment without difficulty after consulting these sections of the manual.

There are, however, numerous other small discrepancies in the Operation Manual and generally too little attention has been given to a user approaching the computer for the first time. The poor introduction to the documentation has been overcome to some extent by an impressive training program supplied on disc. The program demonstrates some of the Graphics Macro Language commands, described later, and many of the other Basic commands concerned with drawing on to the screen. The screen photographs were taken while this program was running and you should be able to see the command in the lower portion of the screen, with explanatory comments and the effect of the command in the upper half. Training by the company supplying the machine is still necessary for other aspects of the computer's operation.

The IF-800 is supplied with an extended Basic interpreter based on Basic-80 developed by Microsoft. The version of the language supplied allows various screen formats with either abrupt or

(continued on next page)

IF-800



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smooth scrolling, and a Basic command which will access a Graphic Macro Language. Circle, for example, will draw a circle or arc on the screen, given coordinates for the centre, the radius of the circle and the colour of the line.

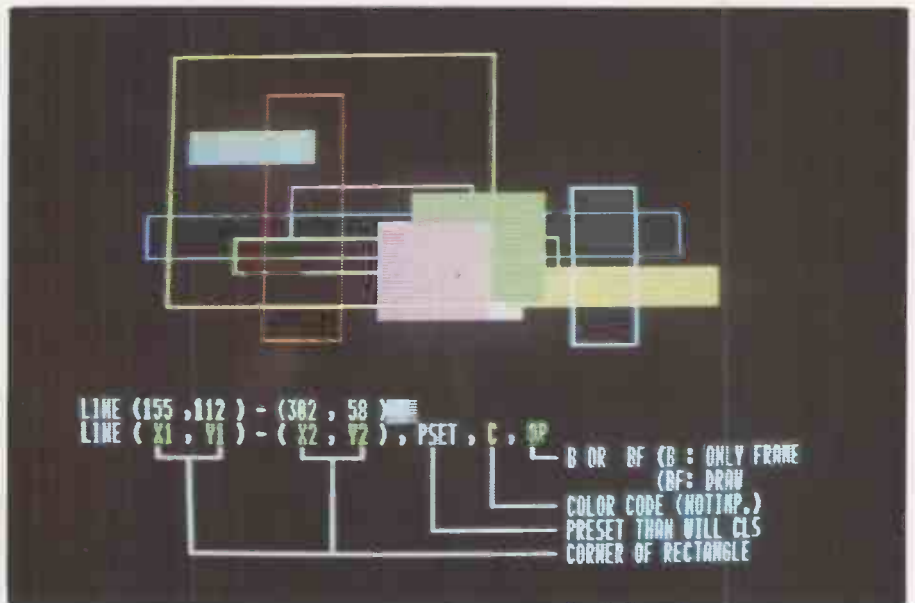
A further parameter allows you to set the elongation of the vertical axis of the circle, and the ratio of the vertical to the horizontal axes can be set between zero and one. Zero will make the computer draw a straight line while, a ratio of one will draw an ellipse. In the same way, the angle of arc that is to be drawn can be set, where zero represents 90 degrees, 0.25 represents 180 degrees, and 0.5 starts or stops an arc at 270 degrees.

Another basic command, DEF CHR\$, allows you to redefine the graphics characters held in the machine. The eight-by-eight screen matrix can be controlled by a character string consisting of eight bytes expressed in hexadecimal notation, concatenated into a string.

The Basic interpreter contains many commands peculiar to the machine. Although the machine runs CP/M and has a vast quantity of software available through Lifeboat Associates, it is unlikely that WordStar, Fortran-80, Pascal, muSimp/muMath or the Peachtree financial packages will make adequate use of the special hardware and software features available on the IF-800.

For example, the Pen commands in Oki Basic will return the horizontal and vertical position of the light-pen on the screen to a resolution of one pixel. It should be possible to use the light-pen for editing purposes in a word-processor program, selecting first a command at the top of the screen such as Delete, and then selecting the character or word to be deleted anywhere on the screen.

In the same way, it should be possible to scroll the screen in any direction merely by placing the light-pen on the appropriate boundary. Obviously WordStar does not have this facility in the form



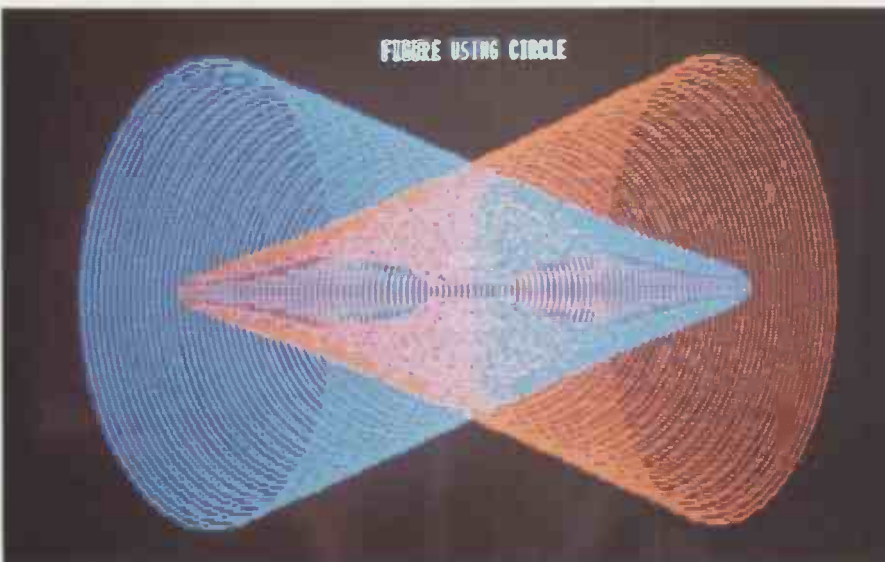
in which it is implemented on a Superbrain or Cromemco. In the absence of software designed specifically for the IF-800 it is constrained into the mould of a straightforward business computer with a colour display.

The Oki Basic interpreter has two commands for storing and retrieving machine-code programs from disc, and has both Call and USR commands which transfer program execution to a user machine-code subroutine. There are no details in the manual to tell you how to return to the Basic program at the end of the machine-code subroutines.

VARPTR returns the address of the first byte of data identified with a variable name. VARPTR can be used to obtain the address of the variable array so that it can be passed to an assembly-language subroutine. For example the instruction VARPTR (A (ZERO)) identifies the lowest element of the array.

Conclusions

● The IF-800 costs £4,300, including VDU, printer and double disc drive.



● The comprehensive input/output facilities on the IF-800 will be attractive to scientists wishing to gather and display complex information in graphic form. Business executives may find the colour display a useful presentation device for their colleagues.

● The tidy appearance of the computer must be set against the fixed relationship between the keyboard and the VDU which is poor ergonomic design.

● Operation of the machine is quite separate from programming it, and the confusion over details such as the orientation of the label on a floppy disc and the drive-select light on the floppy disc units is an unnecessary burden on a small business looking for a robust system for the first time.

● The 80-character display is not backed up by a sufficiently high-resolution display on the colour VDU to make it acceptable for prolonged use as a word processor or for other applications which demand reading or correcting text.

● Dot-matrix print is acceptable for memoranda and papers that will be used within an office, but the lack of lower-case descenders on the IF-800 printer makes documents tiring and annoying to read.

● Despite its length, the documentation supplied is inadequate to allow anyone unfamiliar with microcomputers to operate the machine successfully.

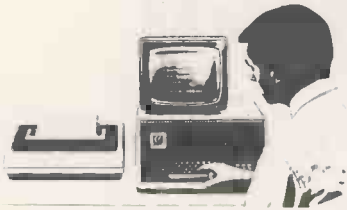
● A wide choice of C/PM software should be available, but this is unlikely to take advantage of the sophisticated hardware features of the IF-800. Software that is specific to the machine will take longer to emerge, but when available will provide a powerful and versatile system.

● The IF-800 appears to be strongly made and should be reliable in operation.

● If the price/performance ratio is attractive to you, and if you have the facilities to write appropriate software without needing too much support from the system manuals, the IF-800 is worth considering. A

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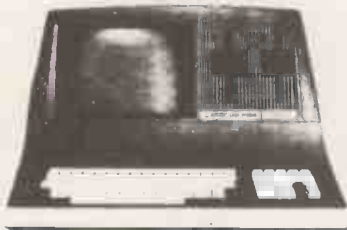


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In these days of recession and tight monetary controls, many companies look to micros to improve efficiency and profitability. Peter Wood tests **Hornet**, a package designed to appeal to any firm aiming at effective project planning.

ONE APPLICATION of particular interest to manufacturing and building industries, and also to any company involved in project planning, is Precedence Network Analysis. Traditionally available on mainframes, Claremont Controls has brought this application to the Pet.

Hornet is a precedence-network analysis program written for the Commodore 8032 computer, 8050 disc unit and any suitably-interfaced printer, preferably with 132-column print width. Using Hornet, complex sequences of activities can be analysed to determine how much delay, if any, may be tolerated in each activity. This information can help with the assignment of priorities on a project, and lead to better use of resources. An up-to-date record of work completed may be kept, so that future events and activities are simultaneously rescheduled.

The program is available in four levels

Program level	1	2	3	4
Number of activities	256	512	1024	1024
Bar chart	no	yes	yes	yes
Printer width	80	80/132	80/132	80/132
Actual starts/finishes	no	yes	yes	yes
Target starts/finishes	no	no	yes	yes
Real run date	no	no	yes	yes
Shutdowns	no	no	yes	yes
Time-base options	no	no	yes	yes
User-defined sorts	no	no	yes	yes
Resources	no	no	no	yes

Table 1

of sophistication — Hornet 1, 2, 3 and 4 — which differ only in the number of facilities offered — see table 1. It is possible to use Hornet without being familiar with basic precedence-network theory, but understanding the principles involved will probably allow more efficient use of the program and lead to more satisfactory results.

All projects are made up of sequences of distinct activities or tasks, each of which is dependent on other activities. There will, therefore, be a particular sequence in which the various activities must be completed. In figure 1 there are four activities A, B, C and D. Activity C cannot possibly start until A and B have both been completed. It is also dependent on D, which is shorter than the total length of A and B, and can be carried out at the same time as A and B.

The boxes are divided into six compartments. The top-centre indicates the activity reference and the bottom-centre shows the duration of the activity. The

Hornet takes the critical path to completion

top-left and top-right compartments show the earliest possible start and finish dates, while the bottom-left and bottom-right compartments show the latest allowable start and finish dates. Any activity which has the same early and late start and finish dates cannot be delayed without extending the network completion time. Such activities are termed critical. In figure 1, A, B and C are all critical, but D has a "float" of 2 days.

As well as analysing simple networks, Hornet contains several special facilities to allow large and complicated networks to be analysed. Apart from the normal "end of precedent/start of successor" link — known as link type — used in figure 1, four other link types may be used:

Link type 1 is a "lead link", where the start of a successor is tied to the start of the precedent, usually with a delay period built-in. It

logic. If it is impossible to achieve a target, it will be ignored and reported to the output. Target dates can be used to move individual events within their period of float to optimise available resources, which is particularly powerful when used in conjunction with the resources module in Hornet 4.

Nearly all projects are subject to shutdown periods, such as holidays or temporary suspensions in work. The program allows up to 32 such shutdowns to take care of lost days in calculating start and finish dates and precedence delays. Since not all activities are subject to shutdowns, each activity can be specified as insensitive, as required.

The analysis of a network is initially concerned with the prediction of when each activity must be carried out in order to achieve the required completion date. As the project progresses true start and finish dates become known and may be substituted for the estimated or predicted dates. When these actual dates are entered, all other considerations for the particular activity are overruled, and succeeding activities are calculated from the known date references.

The program provides a "real run date" facility. Whenever the calculation mode is selected, a current or analysis date may be entered and any activities not yet started are automatically delayed until the current date. Activities with both an actual start and finish date are labelled "historic", while activities with only an actual start date are labelled "working". At any stage in the project a report may be produced on past performance, future schedules, and the status of activities which are under way.

The 40-day week

Activities of zero duration are accepted by Hornet and handled in the same way as normal activities. They may be used as milestones within the network and are useful in defining individual sub-projects within a large network. They may also be used to extend the number of precedents on any one activity beyond the five allowed on the screen display.

The program will run under any of three time scales, called Units, Weeks and Calendar. The Unit scale starts from 1 and runs through to project completion. The scale may be taken as hours, weeks or even years. The Weeks scale offers a weeks/days division, where the number of

may be used where a shared resource is necessary to start each activity, and avoids the need to split the precedent into two activities.

Link types 2 and 3 are "premature start" links, allowing a successor to start before the precedent is complete, so that an activity could start before transfer of a shared resource. These two links are essentially similar, but the delay is measured on the precedent for type 2, and on the successor for type 3.

Link type 4, the "lag" link, specifies that the finish of a precedent must precede the finish of the successor by a specified period.

Often the lead and lag links will be used together to represent a series of activities which follow each other but are in part concurrent.

Frequently the periods during which activities can take place are prescribed by external constraints. The package allows the specification of such conditional start and/or finish dates, known as "target" dates, for individual activities. A target constraint will not override the analysis

days in a week may be defined by the user, up to a maximum of 40 days. The Calendar time scale works on real dates, with a maximum of seven working days in a week; true calendar dates are given on all reports. A clever piece of programming allows the user to switch between any of the time scales at any time without having to re-enter data or re-calculate. It is therefore possible to plan a network on a Weeks timescale, then convert it to real dates when the start date is known.

Three types of report may be generated: Time Analysis, Bar Chart and List of the Activity data. Each type may be printed with the activities arranged in a number of ways, e.g., activities with no float first, or arranged in order of start date, or normal numeric sequence. It is also possible to print a range of activity numbers — 100 to 299, for instance — or to include only those active over a defined period. Any combination of these sort facilities may be used simultaneously.

Main menu options

Each activity is referenced by a 25-character description as well as an activity number. Within this description, a "search string" may be defined, for selective report printing. This character string may be of any length and positioned anywhere within the description field. Whenever a report is specified it is possible to select activities on a full or partial match with this search string, which could be very useful if a number of individual jobs or orders make up the complete network.

If a simple coding is used, it is possible to select all activities concerned with a particular job, or a summary of all jobs, or individual activities associated with a particular task across all jobs. This may be of specific interest to factory production or office management where several distinct jobs are active at the same time, each at a different stage of development.

Hornet uses the same type of screen display for all data entry. Fields are defined within triangular brackets into which the user may key the data. This type of screen handling, probably originated on the Pet by Anagram Systems, enables simple, fast data entry with a minimum of mistakes.

As usual with Pet-based business software, the program disc is inserted in drive

SSSSSSSSSS	Scheduled activity, non-critical.
CCCCCCCCCC	Critical activity.
AAAAAAAAAA	Activity with specified actual start and actual finish.
WWWWWWWWWW	Working activity, which has an actual start date but no actual finish date. Activities are shown as working up to real run date.
XXXXXXXXXX	Overrunning activity: a critical activity which has actual start but no actual finish, and should have been completed and is therefore delaying project completion.
-----	Float for the activity.
/ / / / / / / /	Shutdown periods.
< >	Target start and finish markers, showing exclusive dates.
DDDDDDDDDD	Dummy activities which may be overwritten by a target finish marker.
*	Real run date, printed on preceding time unit week or period-division marker.

Table 2

zero and the data disc in drive one, and the program is loaded and run with one keystroke. While the program performs its initialisation routines it displays a rather pretty windmill, followed by the standard copyright information. The main menu is then displayed, with nine options:

- Add Activities
- Update Activities
- Delete Activities
- View Activities
- Resource Module Menu — on Hornet 4 only
- Calculate Network
- Print Network Report
- System Status
- Format Network Report

The top line of the screen shows, in reverse video, the job name of the network currently under analysis and the name of the task currently being performed. The bottom line, also in reverse, gives the current status — either what the program is doing or what it expects you to do, together with two reference numbers

showing the number of activities entered into the network and the last activity number that was modified.

The cursor is positioned to the left of the first menu option, and may be moved down the screen by pressing any key. When it is next to the required option, this option is selected by pressing shift-return. This method of selection is consistent throughout the package, and insures against any unintentional selections that would otherwise waste time. Hornet 4 allows the user to interrupt any of the calculation or printing functions by means of the shift key, after which the process may be continued or aborted.

Each full screen of data is entered by the operator field by field, and checked for validity by the system when shift-return is pressed. If any data is incorrect the offending entry is highlighted, and the user is invited to correct it before continuing. If a search string has been defined, then those character positions within the description field are underlined for ease of identification.

Pressing Escape followed by a letter will perform certain special functions — for instance, A for add mode, U for update — which makes for very fast data entry. Both entry of new and updating of existing activities is very straightforward, thanks to the well thought-out screen design and data-entry routines. Deletions are also possible, but are protected against accidental erasure by the requirement to press Escape followed by D before any deletions can take place.

In several places throughout the package, a "progress bar" is displayed. It looks rather like a horizontal thermometer which indicates how far the machine has progressed through a certain procedure, and reassures the user that the computer has not "died" during a long calculation routine.

Error reports

The Calculate Network or Report Printing options will recalculate the network if the activity data has been updated. The reports follow the format set up by the user with the Format Network Report option. If the network has already been analysed, the user is invited to alter the real run date if required.

The calculations are made up of four distinct parts, each performed automatically. The first stage, Data Checking, works through the activities locating the relevant precedent. Any activities not found generate a detailed error message on the printer and a note on the screen. The second stage finds the order in which the activities are to be calculated and checks for logic errors in the precedence. If a logic loop is detected, a list of all activities that cannot be printed is produced on the printer and a note appears on the screen. The sequence of actual dates is also checked at this stage: if an

(continued on next page)

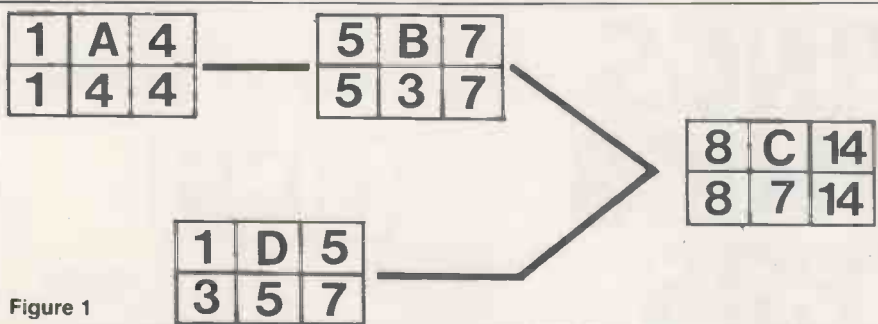


Figure 1

(continued from previous page)

activity has been given an actual date the preceding activities must also have actual dates. Errors are reported on printer and screen.

The analysis proper then begins. It is made up of both a forward and a backward pass, to give both the early and late start and finish dates. Once the forward pass has been completed, the project-completion time is displayed on the screen. When the analysis is complete the results are stored on disc. If report printing has been selected, the reports are then produced.

Formatting of reports is simple, and the user may set up these parameters:

Printout Title to be printed in the heading of the report, up to 35 characters long.

Output required. The three types of report possible are time analysis, bar chart, and activity data-listings. They are specified for printing by Y for yes or N for no.

Printout Sequence. This sets the priority of the sort criteria available — Numeric, State date, Critical and Float — such that the first selection is the main sort criterion. Any activities with equal priority are sorted on the second criterion, and so on.

Printout Range allows the user to define a range of activity numbers to be printed from the entire network.

String Search. If a string search has been set up in the System Status, then activities may be selected for printing on the basis of a full or partial match within the defined area of the activity description.

Auto Paging is a simple yes/no selection for page headings. If auto paging is selected, the reports take care of perforations and reprint the headings on each page, assuming a 66-line page.

The **System Status** option from the main menu permits the user to specify any one of the following system-level parameters:

Password. If a password is provided at this stage by the user then the suite cannot be run unless the correct password is entered.

Printer Width sets the maximum print width to either 80 or 132 columns.

Shutdown Periods allows up to 32 shutdown periods to be defined.

Timescale sets the timescale to be used to Units, Weeks or Calendar.

Week Length. If either Weeks or Calendar have been selected, this parameter sets the number of working days per week.

Commencement Date. If Calendar timescale has been selected this will be entered as the first working day of the project.

Activity Search String. This defines the position and length of the search string within the activity description field. When the search string option is used, the program allows "wild card" or "pattern matching" to be used in the same way as the Pet DOS: "?" can be used to represent any individual character, and "*" may be used to represent the remainder of any string.

The bar chart uses the symbols shown in table 2, with one character representing one period unit. The activity data printout lists all details on network activities. The data printed is :

- Activity number
- Activity description
- Duration
- Non-shutdown status
- Actual dates
- Remaining duration
- Target start
- Scheduled delay
- Preceding activities with link type and delay

Conclusions

● The program does its job very efficiently and is very easy to use.

● The data-entry routines and screen layouts are excellent.

● Most business users will probably buy the **Hornet 3** or **Hornet 4** program, as they give the range of facilities required for the majority of applications.


● **Hornet 1** and **2** will most likely suit educational users, especially technical colleges, polytechnics and universities.

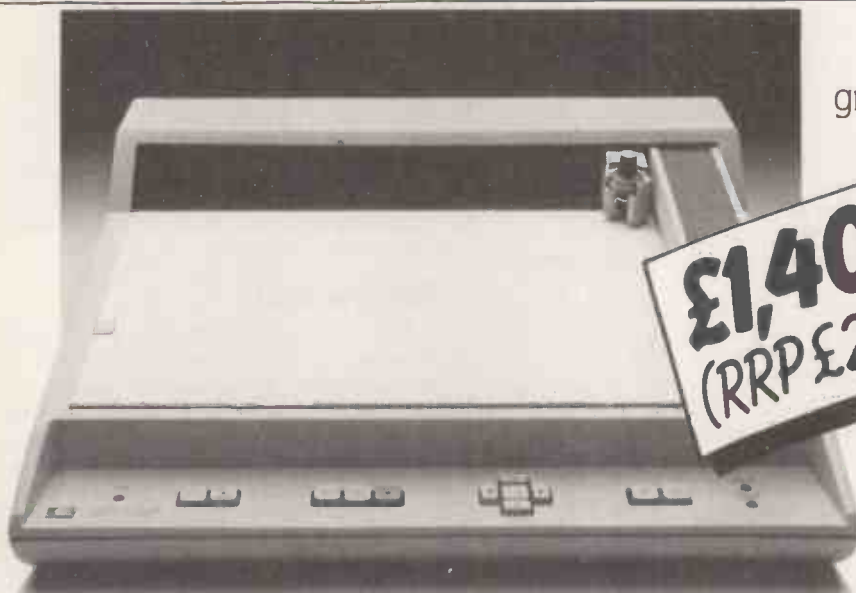
● A resources module is available but was not reviewed.

● The program was a pleasure to use.

● The manual is well-written and accurate.

● **Hornet** provides yet another marketplace for the business microcomputer as a cost-effective alternative to larger machines.

● **Hornet 3** is priced at £990, **Hornet 4** at £1,500, and is available from **Commodore Key Dealers**. Details from **Roy Stephenson** at **Claremont Controls**. Telephone 0669 21081. 



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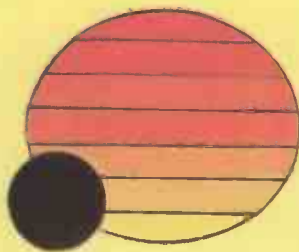
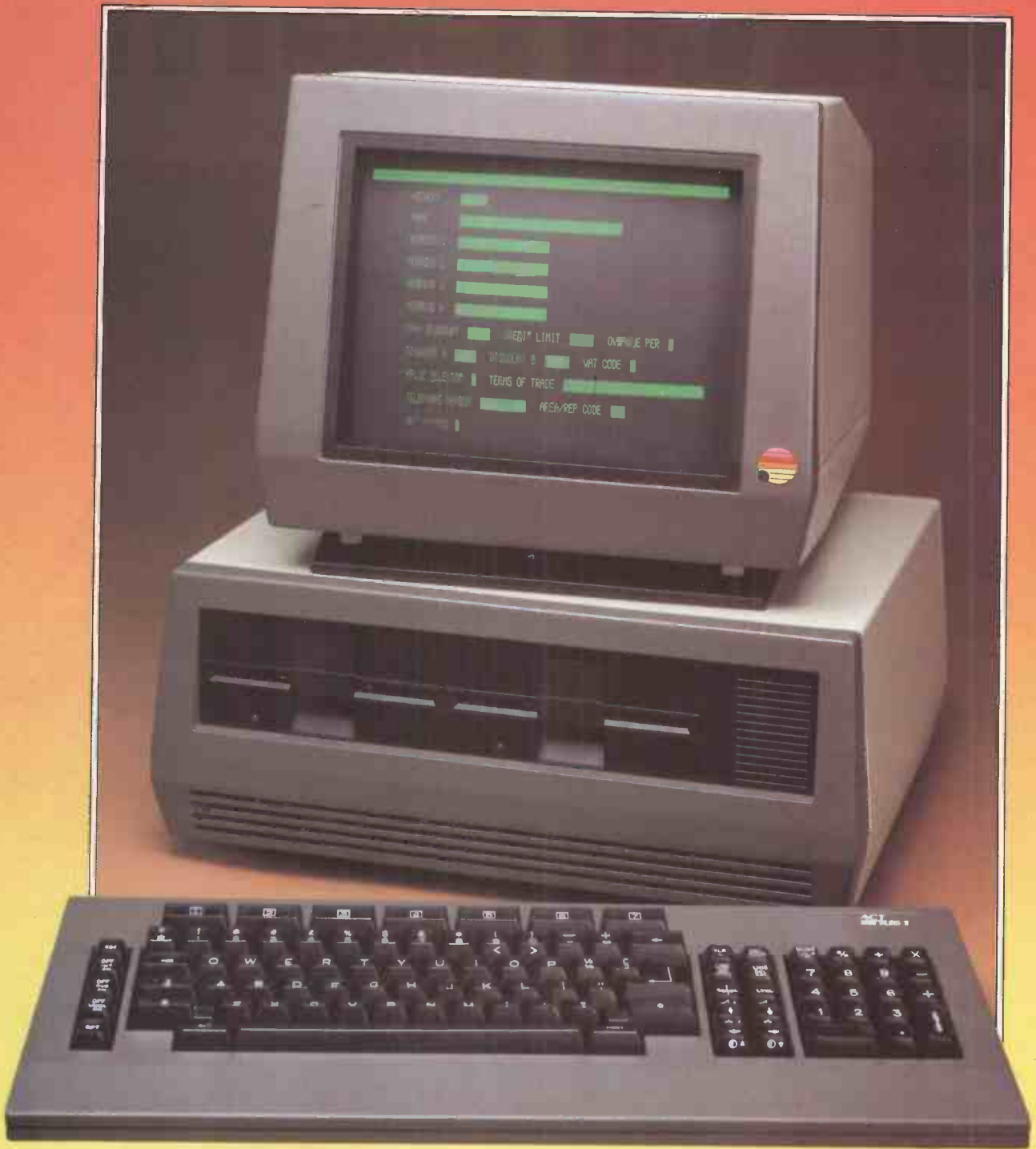
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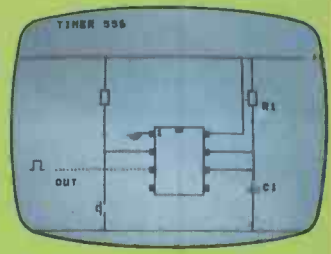
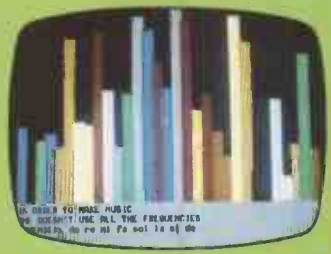
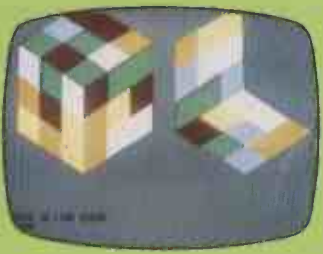
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Computer-aided design techniques are already well established as tools for
Computer methods are now poised to move out of the drawing office to take

This CAD has plans for factories of the future

THERE IS MORE to computer-aided design than meets the eye. This dynamic, fastest-growing sector of the computer industry heralds a total change for the industrial world. Senior management in every company that manufactures something had better take notice of CAD: to ignore it will be akin to having ignored the Industrial Revolution of the last century.

CAD is not simply an aid in the relatively simple task of producing an engineering or architectural drawing. It is an electronic medium in its own right which is fast, intelligent and interactive. Blueprints — diagrams on paper — are a medium which belongs to an earlier age.

Uncomfortable transition

For the moment, we are stuck in the uncomfortable period of transition. Manufacturers are still geared to basing their product on familiar and reassuring "working diagrams". They lie around the office or factory, constant and visible proof that work is in progress.

Even when the new oil refinery is on stream or when that neat little extension to the clubhouse is completed, then the builder makes yet another set of drawings — what the Americans call "as-builts" — to act as a guide for repairs and maintenance. Drawings have been around in one form or another for 20,000 years, but now, suddenly, they are not at all essential.

CAD systems must be able to handle all the relevant design information.



The most far-sighted people in the computer-graphics industry are aware that the present craze for hard-copy devices — printers and plotters — is but a passing phase along the road to total automation. The destination is the completely integrated factory in which the process of design and manufacturing is a single task. Karl Marx and his concept of the division of labour — an accurate analysis in its time — will be finally discredited as computers and robots team up to create all the necessary products of the future.

This vision is not mere science fiction. In the United States they already have a

by John Lewell

name and an acronym for it: computer-integrated manufacturing or CIM. It is the next step beyond CAD/CAM — computer-aided design and manufacturing. Just as we are getting used to the idea of CAD/CAM, at least to the extent of understanding what the initials stand for, along comes CIM. You can be sure that it

is coming because it is market forces which provide the motivation for the change.

The keys to economic survival are efficiency, competitiveness and productivity. The world's population is expected to double and treble before it finally stabilises, and the emphasis will be placed on the most efficient uses of energy and materials. Our present use of resources is so wasteful because industry is not organised on a rational basis. Under the influence of those same market forces it has evolved like a Gothic cathedral, each generation tacking on its own contribution.

Now the time has arrived when industry has to increase its efficiency and productivity. It can do it only by the complete integration of computers into the industrial process. Piecemeal computerisation will not work in the long run. If you streamline one part of the operation, then you tend to create a bottleneck somewhere else. To get rid of the bottleneck you have to use a computer.

Everyone who has used a computer for even a simple task realises the importance of understanding the process which is being computerised. When a system has been analysed rationally, you may find that you do not need a computer at all. Yet no individual can keep in mind every one of the millions of operations that go on in a factory and so the best, simplest, the most rational manufacturing solution can never be achieved. What is needed is integration, and this will be the keyword to the future.

Agent provocateur

Why is CAD proving to be the *agent provocateur* in this leap towards the future? After all, industry has been using computers for years. So far, word processing, payroll accounting and even numerical control have not provoked a total rethink of how to run an entire manufacturing process.

The reason is simply that design is an "upstream" operation, whereas those parts of a business which are often the first to be computer-assisted are mainly "downstream" operations. Word processing is downstream of management

design engineers, yet they are still far from having reached their full potential. charge of the average factory's entire design and manufacturing process.

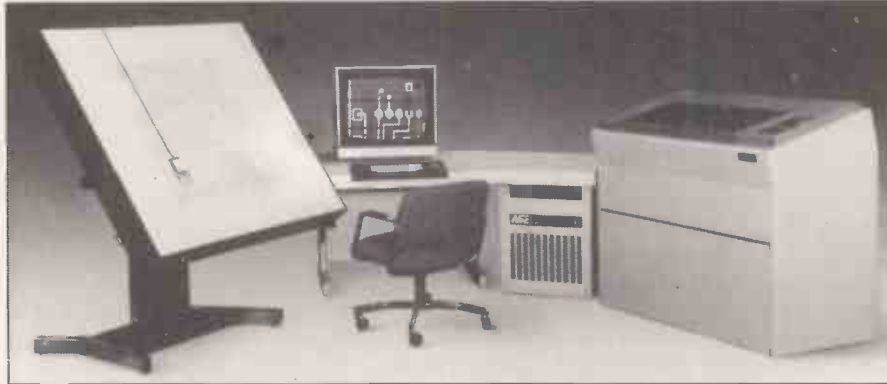
instructions. Invoicing is done after you have made and delivered the product. Payroll is the most downstream operation of all: everyone is paid in arrears. But this downstream computerisation does not have a knock-on effect. It does not necessarily force us to make other changes. CAD, by contrast, does.

Frank Lloyd Wright was one of America's greatest architects, yet some of his greatest buildings were designed on the back of an envelope. He and his

sophisticated, so the number of visual representations increases. For instance, with a model of the human body a display might one day be able to show the skeleton, or perhaps the nervous system, or the blood circulation, or the familiar skin-covered figure itself. More easily displayed with current technologies are engineering designs which involve structural, electrical, piping or instrumentation models. All these models are related to each other. You cannot change

pen you can magnify, rotate or move the image — or any part of it — and make additions and improvements. Using the keyboard you can type in facts and figures, descriptions and dimensions. You can ask the system to automatically retrieve the previous drawings, and there is always an instant library of symbols at your command, ready to be pasted into any position on the screen.

Even when it is being used as a high-class drafting aid or as an expensive "ideas pad" the average CAD system is an effective and impressive tool. Shortly after it is installed, senior company men will murmur approvingly about high productivity ratios — that is to say: how much more work is being done as a result of using the new toy. It is not unusual to find that the work is completed in a fraction of the time. A piping diagram may have a 2:1 ratio, a mechanical diagram 4:1, an instrument diagram 5:1, and others may be even higher.



A typical stand-alone system is based on a minicomputer with VDU and plotter.

assistants would fill in the details later on, in the conventional way. The design took shape in Frank Lloyd Wright's head. It was a synthesis of experience, of knowledge of materials, of the environment and of architectural forms. More than that, it also contained the vital element of originality. A Frank Lloyd Wright building had all the elements of good design.

Being an exceptional sort of man, Wright did not spend much time developing his concepts diagrammatically. The model was in his head. The secret of design is in conceiving the model, and not at all in making a representation of the model on, for instance, a piece of paper.

The essence of CAD is in the creation of the model. If computers are going to be really useful in assisting us with designs then they have to assume the role of Frank Lloyd Wright's head.

The computer has to contain the model. Where else could you put it? On paper? That would be far too complex. In our own heads? We are not all Frank Lloyd Wright, and the design capability of even his brain would not be sufficient for a high-technology product, such as a car or a space shuttle. The machine has to be programmed with all the relevant information about the properties of materials, about the environment in which a product will be used, with appropriate marketing information — not to mention a whole library of existing designs.

Graphics are one of the windows into the model. They are a communications link which provides a visual representation of it. As graphics displays become more

one without changing the others. The great advantage of CAD is that the computer can be programmed to make many of the changes automatically, and to warn you if something is not possible. The truth of my opening statement should now be apparent. There is, literally, more to CAD than meets the eye.

Graphics displays

Nevertheless, for the time being, CAD is mainly concerned with producing diagrams. Early graphics displays could show only the outlines of objects, conveniently echoing the tradition of engineering drawings. This does not necessarily mean that vector displays, or even drawings themselves, will be with us forever. In the last two years, raster displays have made great strides, bringing with them all the benefits of full colour and fully-shaded surfaces. They point us in a new direction: the computer model itself need not be related to "wire-frame" drawings at all.

Much of what passes for computer-aided design would be better described as computer-aided drafting. By the time the operator sits down at the terminal most of the work has already been done. A decision has been made to build a particular product, the shape and function of which is largely known. The CAD system is used to tidy up the details, put in all the symbols, put lettering in the right places, and then to print out sets of isometric and orthographic drawings.

Operators can, of course, refine and modify the designs. With a stroke of the

The bottleneck

What used to take a week to design on paper may take only a couple of hours with a little help from your friendly computer. Suddenly, the rest of the manufacturing process seems to be abysmally lethargic. The whole factory has become one long bottleneck. At this point, CAD has to be extended to CAD/CAM. A design is created with computer assistance, then the computer automatically instructs the machine-tools to start turning out the new product.

Those companies that have already made a heavy investment in CAD/CAM are beginning to reap the rewards: indeed, many of them could not survive without it. In the United States particularly, there is such a shortage of fully-trained design staff that it would be impossible to handle a large defence contract without CAD. Automated manufacturing carries the process one stage further as components are produced with only a fraction of the highly-paid workforce which was previously needed. The time between design and production shrinks dramatically, while last-minute changes can be made without escalating cost.

Best answer

CAD/CAM is seen in the United States as being the best answer to the Japanese lead in manufacturing techniques. At present still in its early stages, CAD/CAM usually means that the computer design station has been linked up to some numerical-control machinery. The machine-tools are placed under the control of punched tape which comes directly from the designers. Though this is a leap

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forward, it is still a long way from the goal of CIM, where all the operations of the factory are plugged into a common database.

CAD/CAM not only provides increased productivity, there is often an outstanding increase in product quality as well. Machine-tool paths are generated more quickly and more accurately. The numerical-control programmer no longer has the task of making hundreds of error-prone calculations in specifying tool path motions, and is provided with a visual feedback guide at each stage.

Product testing

Other benefits include the ability to test a product before it has been manufactured. CAD deals with a model rather than an image, and models can simulate processes. This is particularly useful when physical tests might be dangerous or impractical. Much has been learned from flight-simulation techniques — which are now so advanced that in some countries an airline pilot can theoretically qualify for a licence without setting foot in a real plane. Trucks and cars can be tested in simulated bad weather conditions while many design variants are tried out in order to find the best solution.

Introducing CAD into a company usually implies a long-term commitment to CAD/CAM. A good example is the Hughes Tool company which manufactures equipment for the drilling industry. CAD has already helped to give Hughes Tool a competitive edge by halving the time needed to design a new product. A single designer, using a CAD system, can now produce a design for a new rock-drilling bit in under two weeks. It is an industry in which speed is essential, because drilling bits are often custom-made to cope with a specific problem which a drilling team has just encountered on site. Work is held up until the new bit arrives. Using an Applicon special-purpose graphics computer, Hughes Tool's designers in Houston, Texas maintained their lead in the market. Once the CAD system was working successfully the company was able to extend the program to include design analysis and structural analysis — the next steps along the road to CIM.

First steps

A company's first step in CAD might be to use a service bureau to produce some of the routine drawings. Royal Graphics of San Francisco and Houston is one such bureau, and has grown dramatically since introducing computer graphics in 1970. Most of its clients are architects. Using a Calma system, with standard software and specially-written subroutines, Royal Graphics produces more than 1,000 drawings a month.

Over the years a vast library of symbols

has been created which can be slotted into the design. Architects can be provided with data such as the gross area or the gross volume of a building. Instant tile-count or brick-count can also save the client time and effort. With an 80 percent annual growth rate — and no CAD sales force — Royal Graphics proves that the bureau service is in demand.

After using a bureau and becoming familiar with the new techniques, a company may want to buy a CAD system to use in-house. The simplest approach is to buy a turnkey system from a manufacturer such as Computervision, Calma, Auto-trol, Applicon or Summagraphics. These companies, and others like them, will specify and deliver a complete, packaged system to meet your needs. Full training for the operators is supplied along with the equipment and software; no previous experience of computers is necessary.

A typical CAD system is modular, allowing you to add to it as your needs change. A stand-alone system would include a minicomputer and mass storage with its system software. The work station consists of a digitiser, a graphics tablet, a function keyboard, an alphanumeric keyboard, and a VDU. An appropriate hard-copy device such as a flatbed plotter will be linked to the system. Larger systems may have extra output devices such as a film recorder or an electrostatic plotter. Several additional work stations can often be supported by one central-processing facility. Individual users can create their own design databases on a single system while each person works on a different project.

Interesting art-form

The design of CAD work stations is an interesting art-form in itself. Operators have to spend many hours at a time at the work stations and it is very important that it should be as comfortable as possible. Once they have tried it, most designers prefer using a computer to working with passive instruments. The constant interaction usually increases concentration.

There has been a steady stream of innovations in work-station design. For example, Calma Corporation was the first manufacturer to introduce a voice-control unit. The operator wears a headset with a lightweight microphone attachment, which provides up to 50 functions under voice control. These can include commands such as Zoom, Pan, Multiple View, or Composite Image — all achieved without a keyboard, pen or menu. Calma claims a 99.8 percent accuracy rate for the input commands, and the technique reduces eye movements and achieves a faster operational speed.

Another graphics company, Genisco, has produced a three-dimensional display called Spacegraph. On this system you

can actually see the model suspended in space, so that it looks like a real object rather than an image; for this three-dimensional effect you do not even have to wear special spectacles.

Once it has been decided to use CAD, one of the first questions to ask is whether you need a customised system or a general-purpose system. The fastest-growing segment of the CAD industry is in providing general-purpose systems, though purpose-built systems may still be the best buy for some users, particularly for firms with printed-circuit designers on the staff.

Building your own CAD system to cope with exacting specialised work — such as printed-circuit board design — can give you an increased throughput of work. Britain has many small system houses which could design a purpose-built CAD system.

Industry boom

Outside consultants can frequently be helpful. In the computer-graphics world there are two sorts of consultant: generalists and specialists. A good generalist who knows the industry can save a client a considerable sum of money. New products come on to the market almost daily — this is a booming industry. Your consultant should establish a broad picture of what you are trying to achieve, and point you towards specialists or to appropriate manufacturers. Since CAD demonstrations tend to be somewhat lengthy, and manufacturers are scattered round the country, "shopping around" can be time-consuming and expensive.

A complete, self-contained turnkey system for professional designers costs between £20,000 and £500,000 and there are some signs that the minimum price will come down this year. In 1981, Ramtek, the market leader in raster displays, launched a desk-top terminal in the U.S. at just under \$6,000.

The micro future

It will be a few years before micro-computers have the speed and memory capacity to cope with the millions of calculations needed in a useful graphics display. Personal computers can produce interesting and colourful presentation graphics, but they are not yet serious contenders in the professional design market. They are, however, ideal training tools, since many of the techniques used in the larger systems can be performed by a micro — but without the speed and resolution which are necessary in most design tasks.

Computer-aided design is not a panacea for all the problems of ailing manufacturing industries. What the planned introduction of CAD can do is to help many engineering and architectural firms to increase their productivity and reduce their costs. All companies in these areas should at least take a look at CAD and evaluate its usefulness. □

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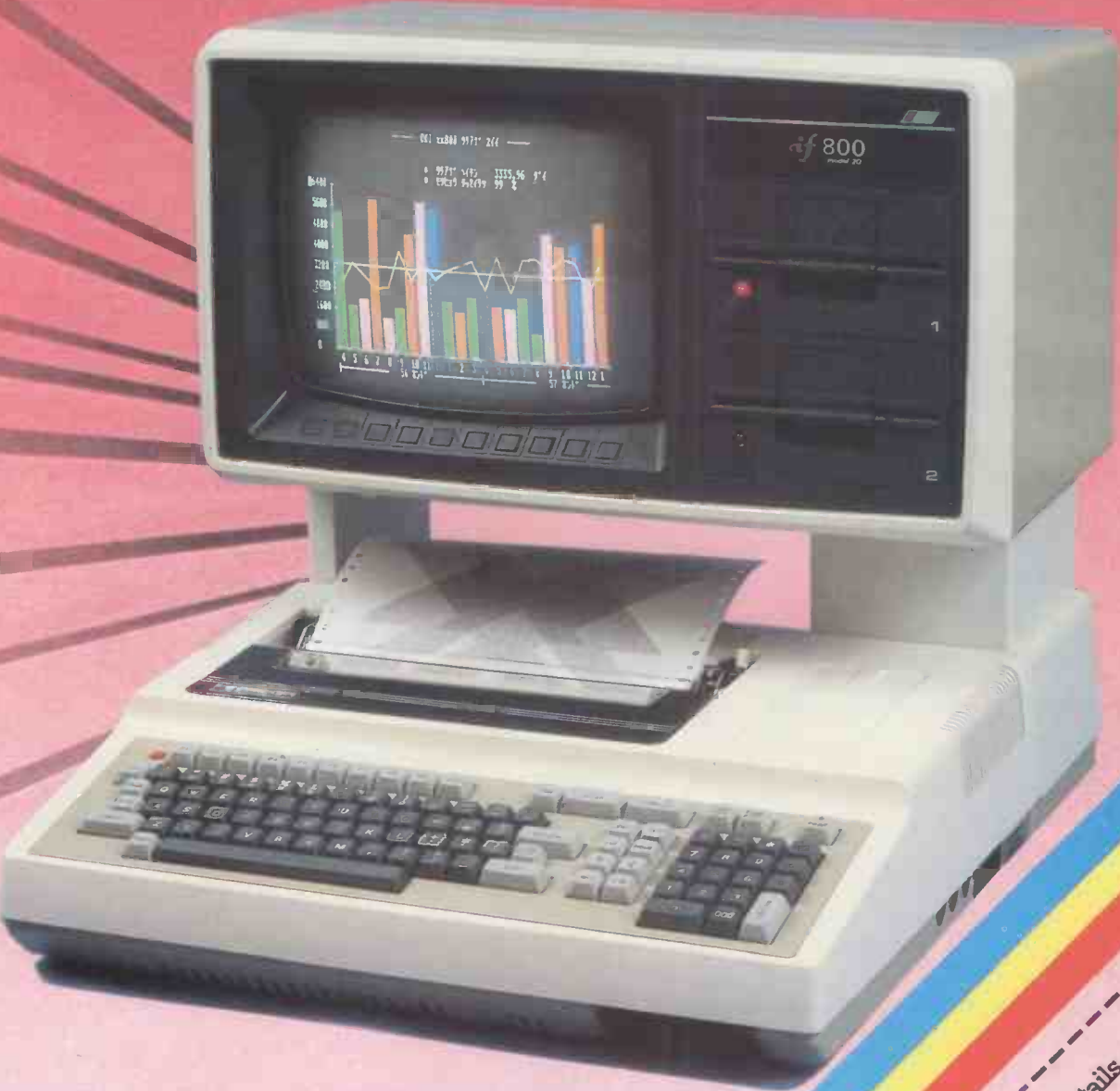
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Data manipulation for 3D displays

THE PROCESSES of defining, storing, manipulating, interrogating and finally outputting pictorial information are the essence of computer graphics. The graphics operation is essentially passive, and the observer has no direct control over the picture being presented. Interactive graphics also use the computer to prepare and present pictorial information, while allowing the user to influence the picture as it is being prepared.

From the user's point of view, computer graphics can be divided into the following areas:

- Representing pictures to be presented.
- Preparing pictures for representation.
- Presenting previously prepared pictures.
- Interacting with the picture.

The word "picture" is used in its broadest sense to mean any collection of lines, points, text, etc., to be displayed on a graphics device. It may be anything from a line to a fully-scaled representation of an aircraft, ship, or building.

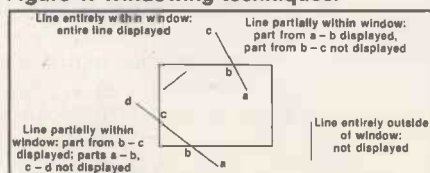
Textual material

Pictures represented in computer graphics can be considered as a collection of lines, points, and textual material. A line can be represented by the co-ordinates of its end points X_1, Y_1, Z_1 and X_2, Y_2, Z_2 , a point by a single co-ordinate triplet X_1, Y_1, Z_1 , and textual material by collections of lines or points.

A series of points, each of which is a position vector relative to a local co-ordinate system, may be stored in a computer as a matrix of numbers. The position of these points can be controlled by manipulating the matrix which defines the points. Appropriate computer hardware or software can be used to generate lines, curves or pictures as output.

Pictures ultimately consist of points whose co-ordinates are stored in a file — an array — prior to being used to present the picture. This file is called a database. Very complex pictures require correspondingly complex databases and a complex program to access them. These databases may involve ring structures, tree structures, etc., and may contain points, substructures, and other non-graphic data.

Figure 1. Windowing techniques.



Interactive displays are available through arithmetic operations on the graphics database. R S Khaira provides the transformations on which to base your graphics algorithms.

Points are the basic building blocks of a graphic database. There are three basic methods or instructions for treating a point as a graphic geometric entity:

- Move the beam, pen, cursor, plotting head to the point.
- Draw a line to that point.
- Draw a dot at that point.

The best way to specify the position of a point is to use homogeneous co-ordinates in which an N-dimensional space is represented by N+1 dimensions. If the position of a point in three dimensions is given by the triplet X, Y, Z, it is represented by four co-ordinates hX, hY, hZ, h , where h is an arbitrary number.

A database used to prepare the picture for representation is hardly ever the same as the display file used to present the picture. The database represents the total picture, while the display file represents only some position, view, or part of the picture. The display file is created by transforming the database.

The picture contained in the database may be resized, rotated, translated, partially removed, or viewed from a particular point to obtain necessary perspective before being displayed. Many of these operations can be accomplished by using simple linear transformations involving matrix multiplications. Among these are rotation, translation, scaling, perspective and stereoscopic views. Homogeneous co-ordinates are very convenient for accomplishing these transformations.

A four-by-four matrix can be used to perform any of these individual transformations on points represented as a matrix in homogeneous co-ordinates. When a sequence of transformations is desired, each individual transformation can be sequentially applied to the points to achieve the desired result. If, however, the number of points is large, this is inefficient and time-consuming.

An alternative method is to multiply together the individual matrices representing each required transformation and then to finally multiply the matrix of points by the resulting four-by-four transformation matrix. This matrix operation

is called concatenation and saves a significant amount of time when performing compound matrix operations on sets of data points.

In some graphics applications the complete database is displayed, but frequently only portions of the database are needed. This process of displaying only a part of the complete picture database is called "windowing". It is not easy to achieve, particularly if the picture database has been transformed.

In general there are two types of windowing — clipping and scissoring. Clipping involves determining which lines or portions of lines in the picture lie outside the window — see figure 1. Those lines or portions of lines are then discarded and not displayed. In the scissoring technique, which is not used here, the display device has a larger physical drawing space than is required.

In two dimensions, a window is specified by values for the left, right, top and bottom edges of a rectangle. Clipping is easiest if the edges of the rectangle are parallel to the co-ordinate axes. When this is not the case, the rotation of the window can be compensated for by rotating the database in the opposite direction.

The final step

As a final step in the picture presentation process it is necessary to convert from the co-ordinates used in the picture database, called user co-ordinates, to those used by the display device, called display co-ordinates. In particular, it is necessary to convert co-ordinate data which passes the windowing process into display co-ordinates such that the picture appears in some specified area on the display, called a viewport.

The viewport can be specified by giving its left, right, top and bottom edges if two-dimensional, and if three-dimensional by specifying a near and far boundary too. In the most general case, conversion to display co-ordinates within a specified three-dimensional viewport requires a linear mapping from a six-sided frustum of vision to a six-sided viewport.

To interact with the picture you need some type of interactive device to communicate with the program while it is running. In effect this interrupts the program so that new or different information can be used to accomplish the task. The simplest is, of course, the alpha-numeric keyboard. More sophisticated devices

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include light pens, joysticks, and so on. The ability to represent or display a three-dimensional object is fundamental to the understanding of the shape of that object. Furthermore, the ability to rotate, translate, and project views of that object is also, in many cases, fundamental to the understanding of its shape.

This is easily demonstrated by picking up a relatively complex, unfamiliar object. You naturally rotate it, hold it at arm's length, stand back from it, etc., in order to obtain an understanding of its shape.

To do this with a computer we must introduce an analysis of the shape in three dimensions, and we immediately introduce homogeneous co-ordinates. Hence a point in three-dimensional space $[x \ y \ z]$ is represented by a four-dimensional position vector $[x \ y \ z \ 1]$ or $[X \ Y \ Z \ H]$. Again the transformation from homogeneous co-ordinates to ordinary co-ordinates is given by

$$[X \ Y \ Z \ H] = [x \ y \ z \ 1] \times T$$

$$\text{and } [x' \ y' \ z' \ 1] = \begin{bmatrix} X & Y & Z \\ H & H & H \end{bmatrix}$$

where T is some transformation matrix and x' , y' , and z' are the transformed co-ordinates.

The generalised four-by-four transformation matrix for three-dimensional homogeneous co-ordinates is

$$T = \begin{bmatrix} a & b & c & p \\ d & e & f & q \\ h & i & j & r \\ l & m & n & s \end{bmatrix}$$

It can be partitioned into four separate sections:

$$\begin{bmatrix} 3 \times 3 & 3 \times 1 \\ 1 \times 3 & 1 \times 1 \end{bmatrix}$$

The three-by-three matrix produces a linear transformation in the form of scaling, shearing, and rotation. A linear transformation is one which transforms an initial linear combination of vectors into the same linear combination of transformed vectors. The one-by-three row matrix produces translation and the three-by-one column matrix produces perspective transformation. The final

Figure 3. Three-dimensional rotation.

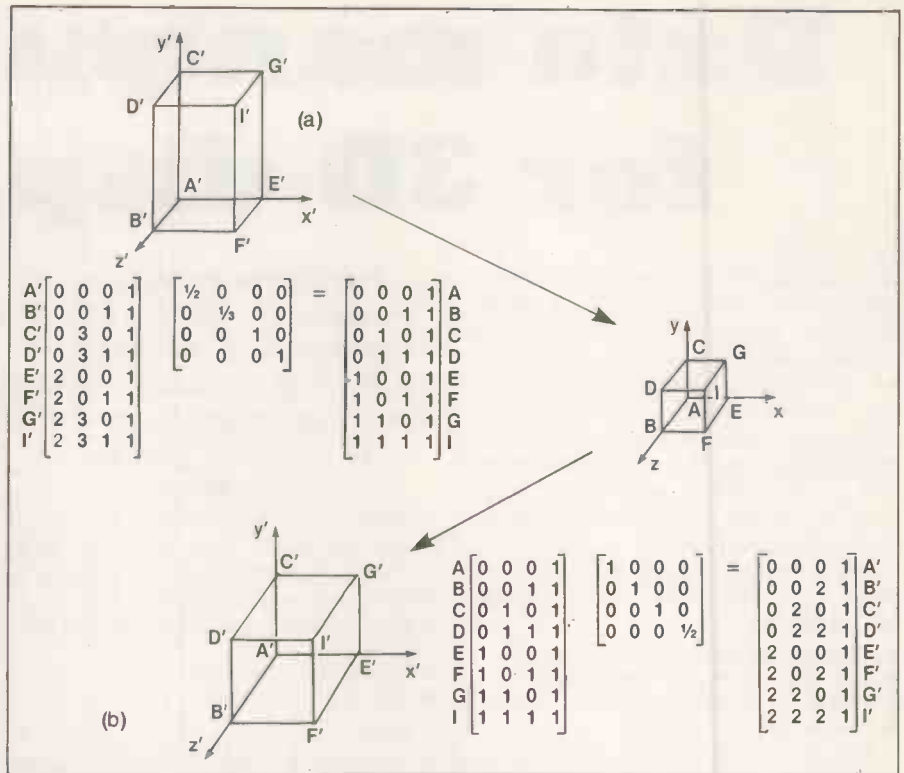
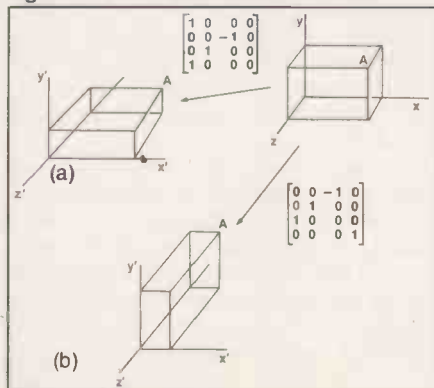


Figure 2. Rescaling a parallelepiped.

single-element matrix produces overall scaling.

The total transformation obtained by operating on a position vector with the four-by-four matrix and normalising the transformed vector is called a bilinear transformation. It gives a combination of

- shearing
- local scaling
- overall scaling
- rotation
- reflection
- translation
- perspective

The diagonal terms of the general four-by-four transformation matrix produce local and overall scaling. The product

$$[x \ y \ z \ 1] \times \begin{bmatrix} a & 0 & 0 & 0 \\ 0 & e & 0 & 0 \\ 0 & 0 & j & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = [ax \ ey \ jz \ 1] = [x' \ y' \ z' \ 1]$$

which shows the local scaling effect. Figure 2a shows a parallelepiped rescaled as a unit cube. Overall scaling is obtained by using the fourth diagonal element, i.e.,

$$[x \ y \ z \ 1] \times \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & s \end{bmatrix} = \begin{bmatrix} x & y & z & s \\ x' & y' & z' & 1 \\ x & y & z & 1 \\ x & y & z & 1 \end{bmatrix}$$

This effect is shown in figure 2b.

If the determinant of the three-by-three component matrix is +1, then it produces a pure rotation about the origin. Before considering the general case of three-dimensional rotation about an arbitrary axis, consider several special cases.

In a right-handed co-ordinate system, a point may be rotated clockwise by degrees around the x axis by

$$x' = x$$

$$y' = y \cos \theta + z \sin \theta$$

$$z' = z \cos \theta - y \sin \theta$$

i.e., the x-dimensions do not change. Thus the transformation matrix will have zeros in the first row and first column, except for unity on the main diagonal. The transformation matrix for rotation around the x-axis is

$$T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos \theta & \sin \theta & 0 \\ 0 & -\sin \theta & \cos \theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Rotation is assumed to be positive in a right-hand sense as you look from the origin outward along the axis of rotation. Figure 3a shows a -90° rotation about the x-axis.

Rotation about the y-axis is carried out by

$$x' = x \cos \theta - z \sin \theta$$

$$y' = y$$

$$z' = z \cos \theta + x \sin \theta$$

In this case zeros appear in the second row and second column of the transformation matrix, except for unity on the main diagonal. The complete matrix is

$$T = \begin{bmatrix} \cos \theta & 0 & -\sin \theta & 0 \\ 0 & 1 & 0 & 0 \\ \sin \theta & 0 & \cos \theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Figure 3b shows a rotation about the y-axis.

Rotation about the z-axis is carried out by

$$x' = x \cos \theta + y \sin \theta$$

$$y' = y \cos \theta - x \sin \theta$$

$$z' = z$$

The complete transformation matrix is

$$T = \begin{bmatrix} \cos \theta & \sin \theta & 0 & 0 \\ -\sin \theta & \cos \theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

' Some orientations of a three-dimensional object require reflections. In three dimensions the simplest reflections occur through a plane. For a rigid body the determinant of the reflection transformation will be -1 .

In a reflection through the xy -plane, only the z -co-ordinate values of the position vectors of the object will be changed: in fact they will be reversed in sign. Thus the transformation matrix for a reflection through the xy -plane is

$$T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

The reflection of a unit cube through the xy -plane is shown in figure 4.

For a reflection through the yz -plane

$$T = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

and for a reflection through the xz -plane

$$T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Three-dimensional translation is obtained by writing

$$[X Y Z H] = [x y z 1] \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ l & m & n & 1 \end{bmatrix}$$

When expanded this yields

$$[X Y Z H] = [(n + l)(y + m)(z + n)1]$$

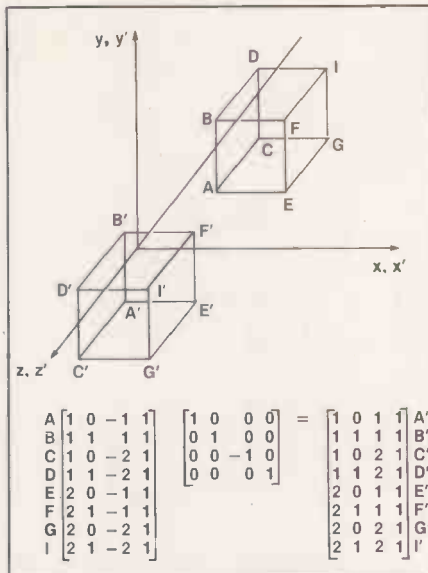


Figure 4. Three-dimensional reflection.

It follows that

$$\begin{aligned} x' &= \frac{X}{H} = x + l \\ y' &= \frac{Y}{H} = y + m \\ z' &= \frac{Z}{H} = z + n \end{aligned}$$

The procedure for rotations about an arbitrary axis is to translate the object and the desired axis of rotation so that the rotation is made about an axis passing through the origin of the co-ordinate system. The method involves a three-dimensional translation, a rotation about the origin, and a translation back to the

initial position. If the axis about which rotation is desired passes through the point

$$A = [l \ m \ n \ 1]$$

then the form of the transformation matrix is

$$[X Y Z H] = [x y z 1] \times \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -l & -m & -n & 1 \end{bmatrix} \times \begin{bmatrix} R \\ R \\ R \\ R \end{bmatrix} \times \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ l & m & n & 1 \end{bmatrix}$$

where the elements in the four \times four rotation matrix R are, in general, given by matrix A . The generalised three-dimensional rotation is a very important capability. A derivation for determining the elements of the rotation matrix R is given by Rogers and Adams in chapter 3 of their book.

Non-zero elements in the first three rows of the last column of the four-by-four transformation matrix yield a perspective transformation. A perspective projection is obtained by concatenation of a perspective transformation followed by a projection on to a two-dimensional viewing plane. A perspective projection is given by the transformation

$$[X Y Z H] = [x y z 1] \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & r & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = [x y 0 (rz+1)]$$

(continued on next page)

```

2000 REM SCALE OPTION
2001 REM =====
2010 ? CHR$(12) + " SCALE OPTION."?
2020 GOSUB 9000:REM SETS F3,4,L3,4
2025 INPUT "X-STRETCHING FACTOR";A
2030 INPUT "Y-STRETCHING FACTOR";E
2040 INPUT "Z-STRETCHING FACTOR";J1
2050 INPUT "OVERALL SCALING FACTOR";S
2055 GOSUB 3500:REM ZEROIZE T(4X4)
2060 FOR I=F4 TO L4
2070 U(I,1)=X(I):U(I,2)=Y(I)
2080 U(I,3)=Z(I):U(I,4)=1
2085 NEXT I
2090 T(1,1)=A:T(2,2)=E:T(3,3)=J1
2100 T(4,4)=1/S
2110 GOSUB 9500:REM MATRIX U*T
2120 FOR I=F4 TO L4
2130 X(I)=V(I,1):Y(I)=V(I,4)
2140 V(I)=V(I,2):V(I,4)
2150 Z(I)=V(I,3):V(I,4):NEXT I
2160 GOTO 500
3000 REM ROTATE ABOUT AXIS OPTION
3001 REM =====
3010 ? CHR$(12) + " ROTATE OPTION."?
3020 GOSUB 9000:REM SETS F3,4,L3,4
3025 INPUT "ROTATION ANGLE";T1
3027 T2=T1/57.2957795
3030 ?"WHICH AXIS OF ROTATION (X,Y,Z) "
3040 INPUT B$
3045 GOSUB 3500:REM ZEROIZE T(4X4)
3050 IF B$="X" THEN 3200
3060 IF B$="Y" THEN 3300
3070 IF B$="Z" THEN 3400
3080 ?"NO SUCH AXIS .....TRY AGAIN"
3090 GOTO 3040
3100 FOR I=F4 TO L4
3105 U(I,1)=X(I):U(I,2)=Y(I)
3110 U(I,3)=Z(I):U(I,4)=1
3120 NEXT I
3130 GOSUB 9500:REM MATRIX V=U*T
3135 FOR I=F4 TO L4
3140 X(I)=V(I,1):Y(I)=V(I,2):Z(I)=V(I,3)
3145 NEXT I
3150 GOTO 500
3200 REM X-AXIS ROTATION
3210 T(1,1)=1:T(4,4)=1
3220 T(3,3)=COS(T2):T(2,2)=T(3,3)
3230 T(2,3)=SIN(T2)
3240 T(3,2)=-T(2,3)
3250 GOTO 3100
3300 REM Y-AXIS ROTATION
3310 T(1,1)=COS(T2):T(3,3)=T(1,1)
3320 T(3,1)=SIN(T2)
3330 T(1,3)=-T(3,1)
3340 T(2,2)=1:T(4,4)=1
3350 GOTO 3100
3400 REM Z AXIS ROTATION
3410 T(2,2)=COS(T2):T(1,1)=T(2,2)
3420 T(1,2)=SIN(T2)
3430 T(2,1)=-T(1,2)
3440 T(3,3)=1
3450 T(4,4)=1
3460 GOTO 3100
3500 REM ZEROIZE THE T(4X4) MATRIX
3510 FOR I=1 TO 4
3520 FOR J=1 TO 4
3530 T(I,J)=0
3540 NEXT J:NEXT I
3550 RETURN
9000 REM A SUBROUTINE WHICH READS IN
9001 REM S$ AND FINDS IT IN N$(SHAPES)
9002 REM IT SETS F3-L3(RANGE OF LINES)
9003 REM AND L3-L4(THE RANGE OF POINTS)
9010 INPUT"NAME OF SHAPE OR @ FOR ALL";S$
9020 IF S$="" THEN 9410
9030 FOR I=1 TO N7-1
9040 IF S$=N$(I) THEN 9100
9050 NEXT I
9060 ?"NO SUCH SHAPE" GOTO 9010
9100 F3=F(I) L3=L(I)
9110 REM SEARCH L1,L2 FOR RANGE F4-L4
9115 F4=32000:L4=-1
9120 FOR I=F3 TO L3
9130 IF L1(I,1)<F4 THEN F4=L1(I,1)
9140 IF L1(I,2)<F4 THEN F4=L1(I,2)
9150 IF L1(I,1)>L4 THEN L4=L1(I,1)
9160 IF L1(I,2)>L4 THEN L4=L1(I,2)
9170 NEXT I
9180 IF F4=32000 OR L4=-1 THEN ?"POINTS ERROR" GOTO 9010
9190 RETURN
9200 F3=1:F4=1:L3=N8-1:L4=N9-1
9450 RETURN
9500 REM MATRIX MULTIPLICATION
9505 REM ALL POINTS FROM F4 TO L4
9506 REM ARE MULTIPLIED BY THE MATRIX
9507 REM CALLED T(4X4), INTO V(F4:TL4)
9508 A=0
9510 FOR I=F4 TO L4
9520 FOR K=1 TO 4
9530 FOR J=1 TO 4
9540 A=A+U(I,J)*T(J,K)
9550 NEXT J
9560 V(I,K)=A
9570 A=0
9580 NEXT K:NEXT I
9590 RETURN
9999 END
    
```


(continued from previous page)

The ordinary transformed co-ordinates are then

$$\begin{aligned} x' &= \frac{X}{H} = \frac{x}{rz+1} \\ y' &= \frac{Y}{H} = \frac{y}{rz+1} \\ z' &= \frac{Z}{H} = \frac{0}{rz+1} \end{aligned}$$

The geometrical effect of this transformation can be indicated with the aid of Figure 5.

The non-transformed point P is transformed to P' by the above operation with $r = 1/k$. In figure 5 the centre of projection is located at $[0\ 0\ -K]$ and the plane of projection is $z = 0$. Since this operation produces no translation, the origin is unchanged and the xy - and $x'y'$ -co-ordinates share the same origin. By using the similar triangles shown in figure 5 it follows that

$$\frac{x'}{k} = \frac{x}{(z+k)} \text{ or } x' = x / \left(\frac{z}{k} + 1 \right)$$

Considering the yz -plane in a similar manner gives

$$y' = y / \left(\frac{z}{k} + 1 \right)$$

These are the transformed co-ordinates produced by the matrix operation with $r = 1/k$. This operation produces a perspective projection on the $z = 0$ plane from a centre of projection located at $z = -k$.

Perspective can help distinguish the ambiguous interpretations of a wire-frame drawing. In some cases it helps to exaggerate the perspective, equivalent to distorting the objects, though the distortion may have undesirable side-effects.

Once an object has been transformed to a desired position, many techniques can be used to display it. Shading, colouring, etc., are frequently device-dependent, while other methods such as hidden-line removal and clipping can be accomplished in either software or hardware.

Stereo pairs can be used to create an illusion of depth in place of hidden-line removal. In a stereographic projection, a

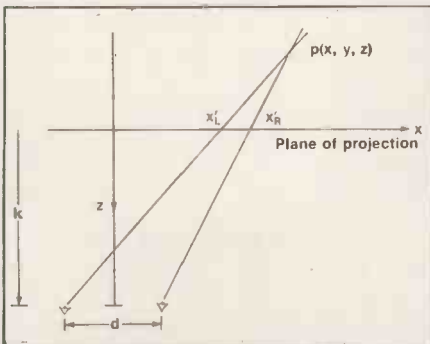


Figure 6. Stereographic perspective. Rotation matrix R.

$$R = \begin{bmatrix} n_1^2 + (1-n_1^2)\cos\theta & n_1n_2(1-\cos\theta) + n_3\sin\theta & n_1n_3(1-\cos\theta) - n_2\sin\theta & 0 \\ n_1n_2(1-\cos\theta) - n_3\sin\theta & n_2^2 + (1-n_2^2)\cos\theta & n_2n_3(1-\cos\theta) + n_1\sin\theta & 0 \\ n_1n_3(1-\cos\theta) + n_2\sin\theta & n_2n_3(1-\cos\theta) - n_1\sin\theta & n_3^2 + (1-n_3^2)\cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

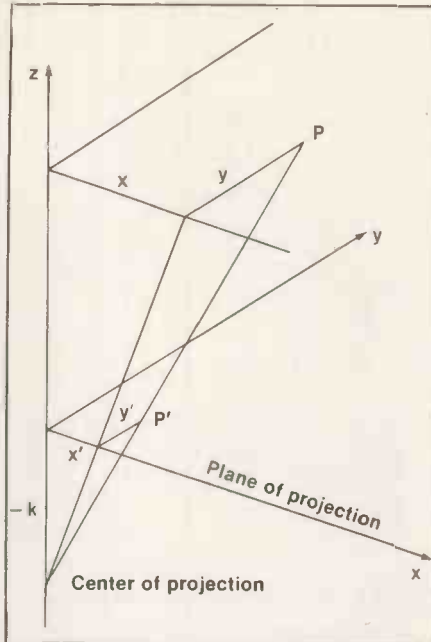


Figure 5. Perspective transformation.

separate perspective view must be created for each eye. A stereo viewer is then used to view the apparent single three-dimensional object. For a human with average eyesight, the strongest stereo effect occurs at a distance of about 50cm. in front of the eyes. Thus for an eye separation of 5cm, the stereo angle is

$$\epsilon = \tan^{-1}(5/50) = 5.71^\circ$$

For a stereo viewer, let d be the scaled separation distance between the eyes — see figure 6. If the viewer has a focal length of k units, then the value of d is fixed by the requirement

$$\tan^{-1}(d/k) = 5.71^\circ$$

so d must equal $k/10$ to maintain the correct stereo angle ϵ .

To obtain this scaled eye-separation distance from a single view of the object, a $+d/2 = +k/20$ horizontal translation is performed before creating the right-eye view. To create a stereo pair, the matrix containing the new position vectors is transformed by use of the two matrices:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1/k \\ k/20 & 0 & 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1/k \\ -k/20 & 0 & 0 & 0 \end{bmatrix}$$

which create two separate perspective views, one for the left eye and one for the right eye.

At this intermediate step the left-eye view is to the right of the origin, and the right-eye view is to the left, as shown in figure 7. The last operation is to separate the two perspective views by the proper distance along the x -axis in order to place each view directly in front of the proper eye.

In figure 7, $(\bar{x})_R$ is the average value between the largest and smallest value of x'_R ; $(\bar{x})_L$ is the average value between the largest and smallest value of x'_L . If $D = (\bar{x})_L - (\bar{x})_R$, then the value of D must be calculated by searching the normalised x' -values of each perspective view. A final horizontal translation in the x -direction of

$$L = D + (E - D)/2$$

for the right-eye view, and $-L$ for the left-eye view places the stereo pair in the proper position.

The value of E is the actual eye-separation distance for the human observer, measured in the scale of the output device. For example, if the final points for the left-eye view fall between

$$-4 \leq x'_L \leq -2,$$

and the final points for the right-eye view fall between

$$2 \leq x'_R \leq 4,$$

then you might choose to plot these two views on a standard sheet of paper, using a 10-unit scale between $-5 \leq x' \leq 5$. Then E , the actual 5cm. distance between human eyes, measured on this scale would be about 2.5.

The two programs are written for the Research Machines 380-Z, and exemplify how the matrix transformations can be manipulated using Basic. The transformation algorithms assume that the

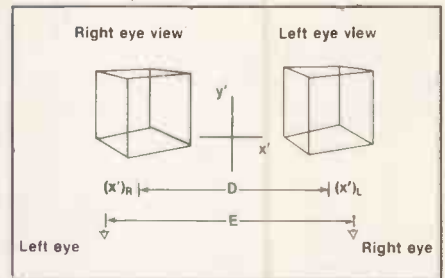


Figure 7. Intermediate stereo position.

database is presented in ordinary co-ordinates. They then develop the necessary homogeneous co-ordinate representation, perform the transformation, and return to ordinary co-ordinates.

To implement the transformations you should fully understand the mathematical theory presented, as well as the graphical capabilities e.g., the co-ordinate system, of your computer system. High-resolution graphics are necessary for satisfactory results. Satisfactory displays were achieved on a Tektronix-4010 VDU with a resolution of 1,024 by 780.

References

- Interactive Computer Graphics* by B S Walker, J R Gurd and E A Drawneek, published by Edward Arnold, 1976.
- Principles of Interactive Computer Graphics* by W M Newman and R Sproull, second edition published by McGraw-Hill Kogakusha, 1978.
- Mathematical Elements for Computer Graphics* by D F Rogers and J A Adams, published by McGraw-Hill, 1976.

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"off" to allow flexibility, e.g., to correct keying-in errors.

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sented after each race showing how much you have won or lost. Each race is a unique combination of horses and odds, and you require both judgement and luck to be successful.

(continued on next page)

```

50 REM*** GRANDSTAND PARK RACE GAME ***
60 REM*** BY PHILIP. H. DAY ***
70 REM*** SEPTEMBER 1981 ***
80 K$=" " : C$=" "
90 N$="BACK YOUR HORSE"
100 J$=" " : D$=" "
110 CR=10000:F$=" 2:1 ON":G$=" EVENS":I$=" " : P$=" "
120 TS=0:A=0:B=0:C=0:T=T+1:PRINT"J$"TAB(6)"GRANDSTAND PARK - RACE NO" T
130 PRINT" *START" TAB(34)"FINISH":TP=0:X=RND(-TI)
140 N=INT(RND(1)*6+3):FORJ=1TON:P(J)=RND(1):TP=TP+P(J):NEXT:Z=1
150 FORJ=1TON:O(J)=INT(TP/P(J))-1:IF O(J)>30 THEN O(J)=30
160 IF O(J)=0 THEN O(J)=.5
170 GOSUB660:PRINT" "O$:H(J)=32888+80*J:POKEH(J),J
180 B(J)=0:L(J)=0:F(J)=0:G(J)=0:NEXT:PRINTC$N$
190 GOSUB640:IFA$="X"ANDCR>=TSTHEN360
200 PRINTC$N$ " "J$: IFA$>CHR$(N+64)ORA$<"A" THEN190
210 M=ASC(A$)-64
220 PRINTI$:FORJ=1TOM:PRINT" ":NEXT:POKEH(M),M+128:IFN<6THEN290
230 PRINTD$ "?"J$:GOSUB640:IFA$="W" THEN290
240 IFA$="E" THENPRINTD$"EACH WAY":B(M)=69:GOTO300
250 IFA$="P" THENPRINTD$"PLACE " : B(M)=80:GOTO300

```

(listing continued on next page)

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A perfectly fair set of odds against a win is one in which

$$\sum_{i=1}^N (\text{prob}) = 1,$$

that is, the sum of all the probabilities is unity, where the probability for any horse is given by

$$\text{Prob} = 1/(\text{Odds} + 1)$$

The first problem when writing this program therefore was to devise a simple way of generating random odds for the horses, but such that the

$$\sum (\text{prob}) = 1$$

condition was satisfied to give a reasonably fair game. This was neatly solved by generating random numbers in the range 0 to 1, then dividing each by their sum to obtain the relative probability for each horse. The odds are then calculated using the equation:

$$\text{Odds} = \text{INT}(1/\text{prob}) - 1$$

The truncation effect of the INT function gives a slight advantage to the Pet on some bets to win. In a real race, the bookie lowers his odds such that

$$\sum (\text{prob}) > 1$$

to give him sufficient advantage to enable him to make a living. The equations could be amended along the same lines to make the game tougher if required. Maximum odds are limited to 30:1 for outsiders, while low odds are catered for by strings "2:1 ON" and "EVENS", as appropriate.

The next problem is form. If all races ran to form the favourite would win every time and the rank outsider would always come in last. In the real world this obviously does not happen, and must be allowed for in the program.

Form weighting

A random "form" weighting parameter in line 370 determines the extent to which the horses will run to form in any particular race. The punter is, of course, unaware in advance of how well his choices will run, adding the excitement to the game. This tantalising effect is achieved by the conditional part of line 410:

IF X < (.5 + Z/10 + .5 * FM * P(J)/TP)
THEN ...

which determines the progress of each horse on a partly random, partly form basis. The first .5 is a fixed element, which Z/10 encourages a close and therefore more exciting finish, FM is the form weight for that race, while the remainder is the form for each horse. These factors were found by trial and error to give a satisfactory compromise between predictable and random results, but they could easily be altered to give different racing conditions.

The next aspect of the program con-

cerns the finishing order. Arrays G(J) and F(Z) capture each horse as it reaches the post and stores its identity. Lines 470 to 520 compute the win, each-way and place winnings and return the stake money for successful bets, a place bet pays at one-quarter odds. The last part of the program prints out the account.

Substantial use of For-Next loops, strings for Printing and Gosub limits the amount of memory needed to 3K, permitting a quick load from cassette or allowing the game to be one of several on a menu.

Checking the stakes

The stake Input function is reasonably well-protected against invalid entries. Note that lines 120 and 530 are the only ones with the reverse-heart clear-screen symbol, which can easily be confused with the cursor-up symbol found elsewhere in the program. Although written for the 32K Pet, the program could be adapted for other machines by changing the Peek and Poke values, etc.

The game runs as follows:

- Type Run and Return to begin. You start with £10,000 credit. The screen then displays the horses and their odds.
- Type the letter of the horse of your choice.

The horse identity then changes into reverse field to indicate that you have chosen it. If there are five or fewer horses in the race then, WIN will be displayed automatically.

- If there are six or more horses, press W to bet to win, E for each-way, or P for place as required.
- Type in the amount of your stake, then press Return. You must stay within your current credit. Larger or illegal entries will not be accepted.
- To cancel a bet, type the appropriate horse letter and press Return.

Extra bets or changes can be made by repeating the last four steps as necessary.

- Press key 'X' to start the race. You can keep an eye on the horses that you backed because they are in reverse field. When the race is over, the screen displays the first three horses, their odds and your winnings, if any, the profit or loss on the race and the updated credit figure.

Races can be run indefinitely, but you drop out of the game if your credit falls below £1.

Although the game is designed for one player, a group of people could hold a competition, each person taking his turn on the machine, until he is either bankrupt or wins a £1,000,000.

(listing continued from previous page)

```

260 IFA$=CHR$(13)THEN280
270 GOTO230
280 P(M)=0:L(M)=0:POKEH(M),M:PRINTD$J$:GOTO330
290 PRINTD$"WIN"J$:B(M)=87
300 INPUT"*****";L$
310 L(M)=VAL(L$)
320 IFL(M)<=0ORINT(L(M))<L(M)THEN280
330 TS=0:FORJ=1TON:TS=TS+L(J):IFB(J)=69THENTS=TS+L(J)
340 NEXT:PRINT"TAB(22)"":IFTS>CRTHEN710
350 GOTO190
360 PRINTI$:FORJ=1TO18:PRINT"###"J$K$:POKE32887+40*J,103:NEXT
370 PRINTC$"UNDER STARTER'S ORDERS":FM=RND(1)*2:IFFM<.2THENFM=0
380 FORJ=1TO1500:NEXT:PRINT"###"J$K$&THEY'RE OFF"K$
390 FORJ=1TON:D=PEEKH(J):X=RND(1):IFH(1)=32927THENPRINT"###"J$K$
400 IFH(J)>=32927+80*JTHEN440
410 IFX<(.5+Z/10+.5*FM*P(J)/TP)THENPOKEH(J),32:H(J)=H(J)+1:POKEH(J),D
420 NEXT:IFZ<NTHEN390
430 GOTO460
440 IFG(J)=0THENF(Z)=J:G(J)=1:Z=Z+1
450 GOTO420
460 PRINT"TAB(29)"&RACE OVER":FORJ=1TO1500:NEXT
470 U=F(1):V=F(2):W=F(3):IFK6THEN520
480 IFB(U)=80THENA=L(U)*(O(U)/4+1)
490 IFB(U)=69THENA=L(U)*(O(U)*5/4+2)
500 IFB(V)=69ORB(V)=80THENB=L(V)*(O(V)/4+1)
510 IFB(W)=69ORB(W)=80THENB=L(W)*(O(W)/4+1)
520 IFB(U)=87THENA=L(U)*(O(U)+1)
530 CR=CR-TS+A+B+C:PRINT"*****RESULTS FOR RACE NO";T
540 PRINT"### HORSE ODDS STAKE BET WINNINGS"
550 E=A:J=U:H$="FIRST":GOSUB660
560 E=B:J=V:H$="SECOND":GOSUB660
570 E=C:J=W:H$="THIRD":GOSUB660
580 GOSUB700:PRINTTAB(30)A+B+C:PRINTTAB(8)"LESS TOTAL STAKES":TS
590 GOSUB700:PRINTTAB(8)"PROFIT/LOSS THIS RACE":A+B+C-TS
600 GOSUB700:PRINTP$"YOUR CREDIT NOW STANDS AT":CR
610 IFCR>=1E6THEN720
620 IFCR<1THEN730
630 PRINTP$"PRESS ANY KEY FOR THE NEXT RACE":POKE158,0:GOSUB640:GOTO120
640 GETA$:IFA$=" "THEN640
650 RETURN
660 O$=STR$(O(J))+":1":IFO(J)=.5THENO$=F$
670 IFO(J)=1THENO$=G$
680 IFZ=1THENRETURN
690 PRINTH$CHR$(J+64)"O$TAB(18)L(J)TAB(26)CHR$(B(J))TAB(30):RETURN
700 PRINTTAB(30)"":RETURN
710 PRINTC$"EXCEEDS CREDIT"CR"CHANGE BETS":GOTO190
720 FORJ=1TO22:PRINT"CONGRATULATIONS - MILLIONNAIRE !":NEXT:END
730 FORJ=1TO2000:NEXT:FORJ=1TO8
740 PRINTP$"YOU ARE BANKRUPT - END OF GAME":NEXT:END
    
```

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Osborne 12" Monitor	165.00	24.75	189.75

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19/21 Corporation Street, Birmingham, B2 4LP. Tel: 021-632 6303. Manager: Peter Siallard. 300 yards from Bullring Centre.

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16/20 Penn Street, Bristol, BS1 3AN. Tel: 0272 20471. Manager: Steve Heynes. Between Holiday Inn and C&A

Chester

The Forum, Northgate Street, Chester, CH1 2BZ. Tel: 0244 317667. Manager: Jeremy Ashcroft. Next to the Town Hall.

Edinburgh

4 St. James Centre, Edinburgh, EH1 3SR. Tel: 031-556 6717. Manager: Colin Draper. East end of Princes Street, St. James Centre.

Preston

1/4 Guildhall Arcade, Preston, PR1 1HR. Tel: 0772 59264. Manager: Jim Comisky. Directly under Guild Hall.

Manchester

12/14 St. Mary's Gate, Market Street, Manchester, M1 1PX. Tel: 061 837 6087. Manager: Lesly Jacobs. Corner of Deansgate.

Glasgow

22/24 West Nile Street, Glasgow, G7 2PF. Tel: 041-226 3349. Manager: David Livingstone. Between Buchanan Street and Central Station.

Sheffield

58 Leopold Street, Sheffield, S1 2GZ. Tel: 0742 750971. Manager: Justin Rowles. Top of the Moor, opposite Town Hall.

Liverpool

33 Dale Street, Liverpool, L2 2HF. Tel: 051-236 2828. Manager: Mark Butler. Between the Town Hall and Magistrates Courts.

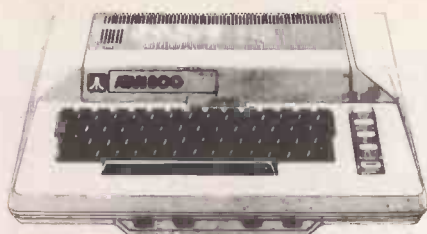
London

42 Tottenham Court Road, London, W1 9RD. Tel: 01-636 0845. Manager: Vass Demosthenis.

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850 RS 232 Interface	145.00
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Pair Joysticks	12.00
I/O Cable	12.95
Printer Cable	28.50
Interface Cable	25.00
RS 232 Cable	25.00
Monitor Cable	25.00
Thermal Paper	4.00
Master Disk	21.95
5 Blank Disks	16.00
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Conversational French	39.95
Conversational German	39.95
Conversational Spanish	39.95
Conversational Italian	39.95
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Touchtype	15.95
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Graphit	13.95
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Hangman	9.95
Kingdom	9.95
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States Europe	9.95
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Asteroids ROM	35.95
Base/Ball ROM	29.95
Blackjack	9.95
Chess ROM	29.95
Missile Command ROM	35.95
Space Invaders ROM	29.95
Space Invaders	12.95
• Star Raiders ROM	
Super Breakout ROM	35.95
Assembler Editor ROM	39.95
Pilot ROM	79.95
Microsoft Basic	59.95

PRINTERS

Epson - Spring Special

MX80 T Newtype 2	390.43	58.57	449.00
MX80 FT/1	346.95	52.05	399.00
MX80 FT Newtype 2	390.43	58.57	449.00
MX100	564.34	84.66	649.00

Epson Interfaces

Epson/Sharp Cassette	65.00	9.75	74.75
Epson/Sharp Disk	120.00	18.00	138.00
Epson/Apple	85.00	12.75	97.75
Epson/TRS 80 Bus	59.00	8.85	67.85
Epson/TRS 80 Expansion	25.00	3.75	28.75
Epson Ribbons	7.00	1.05	8.05
Epson MX100 Ribbons	8.50	1.28	9.78

• Microline 80	270.00	40.50	310.50
• New Microline 82A	395.00	59.25	454.25
Microline 80 Tractor	45.00	6.75	51.75
Diplomat Card (Apple-Microline)	85.00	12.75	97.75
Microline Ribbons	2.25	0.34	2.59

Seikoshia

• Seikoshia GP80A	195.00	29.25	224.25
• Seikoshia GP80D (for MZ-80)	252.13	37.82	289.95
• Seikoshia GP100	215.00	32.25	247.25

Seikoshia Interfaces

Seiko/Apple	59.00	8.85	67.85
Seiko/Pet	59.00	8.85	67.85
Seiko/Video Genie (EG3016)	33.00	4.95	37.95
Seiko/RS232	79.00	11.85	90.85
Seiko/TTL Serial	43.00	6.45	49.45
Seiko/IEEE 488	59.00	8.85	67.85
Seiko/Sharp (Disk)	59.00	8.85	67.85
Seiko/Ribbons	4.00	0.60	4.60
Seiko Paper 8 1/2" X 11" 2000 Sheets	12.00	1.80	13.80
Paper Delivery	3.00	0.45	3.45

VIDEO MONITORS

	NETT	V.A.T.	TOTAL
BMC 12" Green - Spring Special	120.86	18.14	139.00
New 12" Green Screen	125.00	18.75	143.75
VM129 12" B/W	183.00	27.45	210.45
VM906 9" HI-RES B/W	150.00	22.50	172.50
VM910 9" B/W			
	125.00	18.75	143.75
9" B/W Monitor	85.00	12.75	97.75
Cables	5.00	0.75	5.75

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CE 150 4 pen printer/plotter 149.95



SHARP MZ 80B



MZ 80K	NETT	V.A.T.	TOTAL
MZ 80K Computer 48K	347.00	52.00	399.00
MZ 80FD Dual Disks	560.00	84.00	644.00
MZ 80P3 Dot Matrix Printer	365.00	54.75	419.75
MZ 80F I/O Disk Interface	52.00	7.80	59.80
MZ 80 FMD Master Disk and Manual	20.00	3.00	23.00
MZ 80 F15 Disk Cable	8.00	1.20	9.20
MZ 80 FO5 Extra Disk Cable	7.00	1.05	8.05
MZ 80 I/O Expansion Box	96.00	14.40	110.40
MZ 80 BM Basic Manual	6.60		6.60
MZ 80 TIOB Basic Tape	9.50	1.43	10.93
MZ 80 T20C Machine Language	18.00	2.70	20.70
MZ 80 TU Assembler	36.00	5.40	41.40
MZ 80 I/O-1 Universal Interface Card	40.00	6.00	46.00
MZ 8T70 AE FDOS for MZ 80K	67.00	10.05	77.05
MZ 8T70BE Basic Compiler for MZ80K	40.00	6.00	46.00
MZ 8T40E Pascal for MZ80K	40.00	6.00	46.00
MZ-80 DPK - Double precision Basic	38.00	5.70	43.70

New MZ80K Cassette Software

	NETT	V.A.T.	TOTAL
WDPRO - Professional Word Processor	39.13	5.87	45.00
Appolo - Word Processor	24.95	3.75	28.70
Cassette Database	29.47	4.43	33.90
ZEN Editor/Assembler	19.47	2.93	22.40
ZEN MOD	10.43	1.57	12.00
CESIL III	14.95	2.25	17.20
Music Composer/Editor	10.43	1.57	12.00
Camelat	5.47	0.83	6.30
Cosmecad 12K	8.00	1.20	9.20
Home Budget	5.47	0.83	6.30
Space Invaders	5.47	0.83	6.30
Startrek	5.47	0.83	6.30
UFO	5.47	0.83	6.30

PC1211

	NETT	V.A.T.	TOTAL
PC1211 Pocket Computer	69.52	10.43	79.95
CE121 Cassette Interface	11.00	1.65	12.65
CE122 Printer/Cassette Interface	60.86	9.13	69.99
CSR700 Paper Rolls (40)	5.00	0.75	5.75
EA 800R Ink Ribbons	1.80	0.27	2.07

MZ 80B	NETT	V.A.T.	TOTAL
MZ 80B Computer 64K	1095.00	164.25	1259.25
MZ 80 FD Dual Disks	560.00	84.00	644.00
MZ 80 P5 Dot Matrix Printer	387.00	58.05	445.05
MZ 80 P6 Dot Matrix Printer	440.00	66.00	506.00
MZ-8BP51 - P6 Interface	30.00	4.50	34.50
MZ-8BP5C - P6 Cable	24.00	3.60	27.60
MZ 80 FI Disk Interface	94.00	14.10	108.10
MZ 80 MDB Master Disk and Manual	30.00	4.50	34.50
MZ 80 F15 Disk Cable	8.00	1.20	9.20
MZ 80 FO5 Extra Disk Cable	7.00	1.05	8.05
MZ 80 BJC Disk Cable Jainter	15.00	2.25	17.25
MZ 80 EU Expansion Box	47.00	7.05	54.05
MZ 80 GMK Graphics Option	112.00	16.80	128.80
MZ 80 I/O-2 Universal Interface Card	40.00	6.00	46.00
MZ 80 T10C K-B Converter	7.00	1.05	8.05
MZ 8 BD02 FDOS for MZ 80B	67.00	10.05	77.05
MZ 8 BT03 Basic Compiler for MZ 80B	40.00	6.00	46.00
MZ 8 BT02 Pascal for MZ 80B	40.00	6.00	46.00
MZ-80 DPB - Double Precision Basic	38.00	5.70	43.70

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As a Stereoclub member we'll send you regular news and literature from Laskys. Laskys' Stereoclub is probably the best thing that's happened to Microcomputers since the invention of the chip!



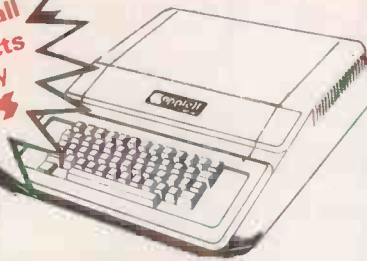
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APPLE II + 48K £799.00 inc. V.A.T.

APPLE

	NETT	V.A.T.	TOTAL
• Disk Drive Plus Controller*(3.3)	375.00	56.25	431.25
• Disk Drive	295.00	44.25	339.25
DOS 3.3 Upgrade	39.00	5.85	44.85
Autostart Rom Pack	33.00	4.95	37.95
Graphics Tablet	485.00	72.75	557.75
Apple Tel System	575.00	86.25	661.25
Pascal Language System	245.00	36.75	281.75
Applesoft Firmware Card	95.00	14.25	109.25
Integer Card	95.00	14.25	109.25
Language Card	97.50	14.63	112.13
Apple Pilot	79.00	11.85	90.85
Apple Fortran	105.00	15.75	120.75
Apple Prototype/Hobby Card	12.00	1.80	13.80
Vera Prototype/Hobby Card	10.00	1.50	11.50
Parallel Printer Interface Card	87.50	13.13	100.63
Communications Card	103.00	15.45	118.45
High Speed Serial Interface Card	94.75	14.21	108.96
Centronics Card	103.00	15.45	118.45
Controller Card	100.00	15.00	115.00
• Eurocolour Card	69.00	10.35	79.35
IEEE 488 Interface	230.00	34.50	264.50
Thermal Paper for Silentye	2.75	0.41	3.16
Vinyl Carrying Case	16.00	2.40	18.40
Apple Ties	6.00	0.90	6.90

LASKYS SPRING SPECIALS!

	NETT	V.A.T.	TOTAL
Omnivision	185.00	27.75	212.75
16K RAM Card (48K-64K)	69.48	10.42	79.90
Z80 Soft Card	173.04	25.96	199.00
Silentye Printer	195.65	29.35	225.00

APPLE III

	NETT	V.A.T.	TOTAL
Apple III	2520.87	378.13	2899.00
Disc III	381.74	57.26	439.00
Pro-file	2251.30	337.70	2589.00
Silentye III	216.52	32.48	249.00
Universal Parallel Interface	134.78	20.22	155.00
Pascal III	146.96	20.04	169.00
Visicalc III	146.96	20.04	169.00
• Mail List Manager	86.09	12.91	99.00
Vinyl Carry Case	47.83	7.17	55.00

MICROCOMPUTERS

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APPLESOFTWARE

	NETT	V.A.T.	TOTAL
• Micro Modeller	425.00	63.75	488.75
• Visicalc (3-3)	105.00	15.75	120.75
Visidex	110.00	16.50	126.50
Visiplot	98.00	14.70	112.70
Visi Trend/Plot	140.00	21.00	161.00
Visi Term	82.00	12.30	94.30
Desktop Plan II	110.00	16.50	126.50
CCA Datamanagement	56.00	8.40	64.40
• D.B. Master V.2.4.	105.00	15.75	120.75

Word Processing

Apple Writer	39.00	5.85	44.85
Magic Window Text Editor	49.00	7.35	56.35
Easywriter (80 Col.)	155.00	23.25	178.25
Mailmerge (80 Col.)	68.50	10.28	78.78
Easywriter (40 Col.)	51.30	7.70	59.00
The Address Book	27.00	4.05	31.05

Games/Aids

Animation Pac	31.00	4.65	35.65
Saturn Navigator	15.00	2.25	17.25
Higher Graphics II	20.50	3.08	23.58
Higher Text	20.50	3.08	23.58
3D Super Graphics	22.25	3.34	25.59
Apple World	33.00	4.95	37.95
Memory Management System	25.25	3.79	29.04
Alien Rain/Typhoon	15.43	2.32	17.75
Sneakers	16.30	2.45	18.75
• Gorgon	16.30	2.45	18.75
Galaxy Wars	14.28	2.14	16.42
Raster Blaster	16.30	2.45	18.75
A.B.M.	15.22	2.28	17.50
Falcons	16.30	2.45	18.75
Pegasus II	17.17	2.58	19.75
Space Raiders	16.30	2.45	18.75
Mychess	23.00	3.45	26.45

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HP-85 Computer	1816.52	272.48	2089.00
16K Memory Module	164.35	24.65	189.00

ROMS

Input/Output ROM	199.77	29.97	229.74
Assembler ROM	199.77	29.97	229.74

Interfaces & Accessories

HP-IB	260.94	39.14	300.08
RS232 Serial Int.	260.94	39.14	300.08
GP-IO	335.21	50.28	385.49
BCD	335.21	50.28	385.49
Parallel Printer Int.	199.77	29.97	229.74

Plotter & Accessories

Plotter	1619.00	242.85	1861.85
Personality Module	496.00	74.40	570.40
Vinyl Carrying Case	151.80	22.77	174.57

Printers & Accessories

Printer Impact	637.81	95.67	733.48
Printer Line	2611.00	391.65	3002.65
Printer Stand	227.00	34.05	261.05

Application packs

Graphics Presentation	135.44	20.31	155.75
Visicalc Plus	135.44	20.31	155.75
Surveying	135.44	20.31	155.75

Flexible Disc Unit

Dual Master (540K bytes) 5 1/4" Disk	1693.00	253.95	1946.95
Dual Add-On (540K bytes) 5 1/4" Disk	1489.84	223.48	1713.32
Single Master (270K bytes) 5 1/4" Disk	1015.80	152.37	1168.17
Single Add-On (270K bytes) 5 1/4" Disk	858.78	128.82	987.60
Dual Master (2400K bytes) 8" Disk	4515.00	677.25	5192.25
Dual Add-On (2400K bytes) 8" Disk	3821.00	573.15	4394.15
Single Master (1200K bytes) 8" Disk	3299.00	494.85	3793.85
Single Add-On (1200K bytes) 8" Disk	2605.00	390.75	2995.75

Graphics Tablet

Graphics Tablet	1355.00	203.25	1558.25
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In these pages Brian Reffin Smith keeps you up to date with computer-based art and design and lays the foundations for graphics routines to use on your own micro.

The direct route

THE BBC's computer-literacy series *The Computer Programme* is already well under way, and you may already have seen programme 6 on graphics and sound, with which I was involved as a technical consultant. It will be shown again on BBC-1 at 11.35 pm on Monday April 26.

Convincing proof

The programme should provide a convincing demonstration for any doubters you may know who still believe that computers are confined to number-crunching and text. After all, simple graphics are a much simpler route from the machine into the human brain — and the possibilities of sound have hardly been explored yet. This month's competition may encourage you to change that lamentable state of affairs.

For now, let us merely celebrate the fact that the high-resolution graphics on


the BBC Microcomputer go up to 640 by 256 points in two colours. You need maximum memory to handle it, and a monitor rather than a TV for a proper display, but at least we do have something which begins to live up to the description "high-resolution".

It is absurd to call a display of around 100 units square "high-resolution", as some manufacturers do, and those nasty little graphics characters are no help either. To anyone seriously interested in computer graphics, a display of less than 256 by 256 is low. You really need 512 by 512, and a monitor to display it on.

For storage, laser videodiscs may seem rather exotic, but they will eliminate videotape recorders quite soon. At present, you can only play them, not record, but for less than £1,000 you can get your own disc made up from film, videotape, colour slides or photos which you supply. Pressings then cost about £3 each.

A popular disc player is not available in the U.S. for less than £500. As for the U.K. market, if I were cynical, I would think the manufacturers were trying to sell us all videotape machines before introducing discs. On each side of a mundane disc, you can store 54,000 colour images — heaven knows how many megabytes of data. A project at the Royal College of Art connects a disc machine up to a computer, able to call up or run any sequences from an art and design visual database of thousands of images.


Canada exhibition

Finally, an invitation. I have organised a show of Canadian artists and musicians who use computers, at the Canada House Gallery, Trafalgar Square, London. Opening on March 24, it continues daily, except Saturday, for about a month. There will be the work of several artists, including graphics, paintings, robots and video, all done by, with or in spite of computers. 

Competition

THIS MONTH'S competition — the one with fame and a fiver as the exhilarating spurs to excellence — is about sound. I know that many computers do not make sounds, and that those that do use a wide variety of commands to control them. But that does not matter because we only want a short description — an algorithm in words — of how to do something.

Think about how to use sound instead of, or as well as, graphics to present information to a user. The sort of information could be trends, quantities, qualities — the kind of thing a business person or manager might need. You can choose any context, from education to ICI, from a small business to a hospital.

In less than 200 words, explain how a computer could use sound to replace or to enhance other information. The address is Art, *Practical Computing*, Room L306, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS. As usual, do not send anything you want back; and no tapes, please. 



BEGINNING GRAPHICS

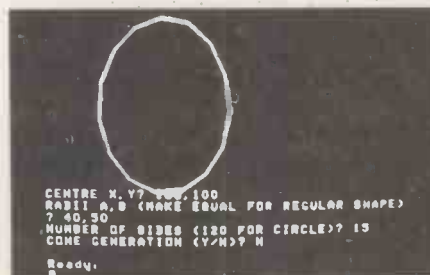
Round in circles

SO FAR we have looked, in quite simple terms, at the way in which images are stored and manipulated in the computer. We have seen that images are related to an internal symbolic representation which is held inside the machine and can be manipulated there, thus changing the image that is the resulting output.

This month, for a change, we look at how a simple routine for drawing circles can be expanded into a more general program. You will see that there is a metaphor here: you can quite often get a routine from a magazine like this, or a

book, or from a friend, and adapt it to do something that seems to go way beyond

(continued on next page)




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100 REM***POLYGON DRAWING WITH CONE FORMATION - B.R.SMITH 1982
110 CALL"RESOLUTION",0,2: REM*** SET UP GRAPHICS
120 PUT12: REM***CLEAR SCREEN
130 INPUT"CENTRE X,Y";HS,VS
140 INPUT"RADI A,B (MAKE EQUAL FOR REGULAR SHAPE)";A,B
150 INPUT"NUMBER OF SIDES (120 FOR CIRCLE)";N
160 INPUT"CONE GENERATION (Y/N)";ZC$: IFZC$="N"THEN180
170 INPUT"POINT OF CONE X,Y";PX,PY
180 ANGLE=2*3.142/N
190 C=COS(ANGLE):S=SIN(ANGLE)
200 XA=1:YA=1
210 FORI=1TON+1
220 X=XA*C-YA*S
230 Y=XA*S+YA*C
240 XA=X:YA=Y
250 IF I>1 THEN P$="LINE" ELSE P$="PLOT"
260 CALL P$,A*XA+HS,B*YA+VS,3
270 IF ZC$="N" THEN 290
280 CALL"LINE",PX,PY,1: CALL"PLOT",A*XA+HS,B*YA+VS,16
290 NEXT I

```

(continued from previous page)

the original intention. It is the way many graphics programs and routines emerge.


The whole story is in the program listing. A simple circle routine at lines 180 to 290 has been expanded first to draw ellipses, then to draw polygons of any number of sides, then to draw cones. The circle routine was, itself, first developed from a polygon-drawing routine.

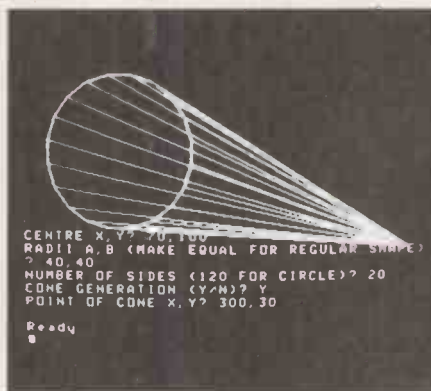
Lines 220 and 230 simply generate each new point from the last one, using a few sines and cosines. Line 260 adds on HS and VS, the horizontal and vertical shift, give the centre of the figure, having multiplied the X and Y points by A and B to give the two radii of the ellipse. Make them equal, and you get a circle — or a regular polygon, if using less than about 120 sides, entered at line 150.

The program was written on the Research Machines 380-Z — which has a screen of about 300 by 200 pixels, with the origin at bottom left. If you operate another computer you need only plot points and lines, with any resolution. Line 260 plots a point when I is 1; otherwise it draws a line to the new point from where you were before. The third parameter to the plot commands — 3, 1 or 16 — merely give the colour; 16 means no line.

Mustering courage

If you answer "Y" to the question at line 160 — you do want cones — then line 280 draws from each point on the "rim" of the circle or polygon to a fixed point, entered at 170, which becomes the tip of the cone. The second half of line 280 moves back to the rim, but without drawing a line, and is thus ready to connect up the next part of the rim.

If you are feeling courageous, try writing a program that will draw two polygons, each with the same number of sides, and will connect each point on the first to the corresponding point on the second. In other words, if you use four-sided, regular polygons — otherwise known as squares — you end up with a box. Beware of jumping in and out of loops. 



Book choice

WHEN PEOPLE ask for advice on books about computers and art, or just computer graphics, I have to tell them that there are very, very few books on either topic which are any good at all. Most of them are expensive too. You are likely to gain at least as much knowledge from the pages of computer periodicals as from many books. However, there are a few which are worth having, and if the cost seems prohibitive, you could ask your library if Mrs Thatcher has left them any money for a book that is, after all, related to her Information Technology Year.

Strictly in the library class, or at least a group purchase, is *Visual Art, Mathematics and Computers*, edited by Frank J Malina and published by Pergamon Press, Oxford in 1979. It is big, wide-ranging, and costs, believe it or not, £31. It consists of reprints, over several years, from the journal about art, science and technology called *Leonardo*. I cannot think of any existing book that is more likely to stimulate the imagination. Though short on techniques as such, it is long on ideas and has plenty of pictures.

Then there is an excellent book edited by David Clark, who works in the audio-visual centre at London University. Called *Computers for Imagemaking*, it is, for the most part, simply presented. Yet if

ANALOGY BOX


Conceptual art, in its heyday in the 1960s, was "art about art", which often consisted of words and diagrams or descriptions. One masterpiece was a framed message, black on white, reading "This is not a Work of Art", another consisted of a radio wave — invisible, of course — beamed through a gallery at a certain time on a certain day, or so they said. What is the computer-graphics equivalent of this sort of art?

you digest it thoroughly, you will know as much as most people about the area it covers. It deals with technical, practical, theoretical and psychological aspects of computer graphics. The paperback edition costs £6.50. It was published in 1981 by Pergamon Press.

Mathematical Elements of Computer Graphics by D F Rogers and J A Adams is a superb book crammed with routines, and with an appendix of Basic listings. However, it does become very advanced, and assumes that your Basic can manipulate matrices; certainly a book to aspire to. It is an import from the United States, published by McGraw-Hill at £12.95.

Expensive items

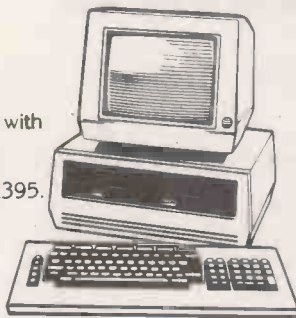
I realise that all these titles are quite expensive items, but there is really no point messing around with anything inferior. You might get together with some friends to share a copy — something which we do not do enough.

Finally, for the purists, there is Newman and Sproull's computer-graphics bible, *Principles of Interactive Computer Graphics*. Personally I find it hard going, though many people swear by it. The second edition, published in 1978 by McGraw-Hill Kogakusha, costs £9.95 in paperback. 

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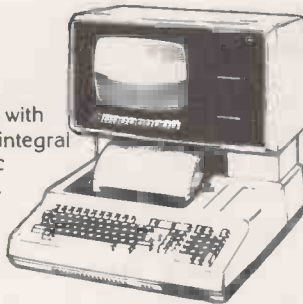
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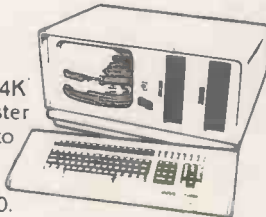
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THE PERFECT MACHINE

"Garbage in, garbage out", muttered Amadeus. Above him the main frame of the rotating Analyser trembled slightly, and he watched as one green ball dropped in a gentle arc, popped like a heavy pea from its churning mechanical pod, to land on and crack the stone flags near his feet. It rolled a short distance and stopped. A second ball did the same.

The great wooden machine did not stop, however, but began in its insistent way to pull one of its bearings from the massive wall. Amadeus looked up sadly as the bearing wobbled and a tiny trickle of dust fell twenty feet to the floor.

Fifty feet above him a stone gallery spanned the great hall, clearing the moving wooden structure by inches. Sullivan was up there, his signalling arms silhouetted against the roof lights, his mouth open but his words lost in the roar from the rotating machine.

Amadeus pulled the stop lever and the great contraption began to slow as Sullivan clanged down his long iron ladder. They stood for a moment in the shadows cast by the tilting beams and watched as the machine came to a standstill. Sullivan broke the silence.

"The same bearing as before, Doctor?"

"Yes, the same".

Sullivan nodded to the few overalled workmen standing by and the offending section was dismantled. Long bolts clanged to the ground, timbers were noisily disassembled, and a hammering began that echoed around the hall.

At the same time Bishop Widred and his entourage entered down the main stone staircase. The entourage sniffed at the dust and the noise. The bishop adjusted his crimson cloak and looked displeased. "Another bearing problem, my Lord", called Amadeus, half turning but more interested in the work than the bishop's presence. The entourage managed to project a communal stare of disapproval across the hall while the bishop spoke.

"We must have results, Amadeus, and we must have them soon. I am under considerable pressure from the rest of the College. They are talking of withdrawing funds. You know it goes against the grain with them to investigate such matters. Your experiments have aroused great controversy". The bishop stared into the dark shadows of the Analyser. The workmen's hammering continued to echo. After a pause he spoke again.

"Perhaps the others are right after all. Perhaps this is heresy".

Amadeus interrupted.

"It is not heresy, my Lord, and it will work. I know it will".

"Yes. Yes. I understand your enthusiasm but —". The entourage behind him looked sufficiently sceptical.

Bishop Widred walked slowly towards the workmen, who hammered less loudly in deference to his presence but did not look up.

"Tell me again, Amadeus", he called without turning, "Tell me what it is that you seek".

Amadeus spread his arms towards the Analyser and explained.

"The main frame. This large outer one.

by David Haynes

It spins on axes that are fixed in the structure of the building. The angles of rotation are adjustable. Within this we have other frames which become progressively smaller like a nest of dolls. These inner frames vary in shape according to calculations made by me, and they are linked by adjustable axles one to another. They turn easily on their bearings. The angle of pivot and the gearing of one frame to another are calculated and fixed before each run. That is a skilled adjustment which Sullivan takes care of".

The bishop nodded and asked him to continue.

"Well, my Lord, within the whole structure run channels, tubes and hatchways which we can preset as well. The machine is turned by a steam engine under the floor, and once the correct speed of rotation is reached, Sullivan inserts the spheres at the top. After a while, if we are lucky, the spheres eventually drop into this cage here", he pointed, "where the numbered troughs indicate the answer".

"Yes, yes. The answer. But what is the question, Amadeus?"

"There are numbers which we use every day, my Lord. Numbers of this world such as 1, 2, 3, 7, 9, and so on. They account for real things. We assume that they go on for ever. There are also negative numbers. We use these often in calculations".

Amadeus bent down and lifted the green ball from the floor. It was the size of a baby's head.

"We colour the spheres to represent

individual numbers. Some green, some red. Many, many colours and combinations of colours. You can see some of these lying around on the floor. They are definite numbers. What we seek are numbers that seem somehow more real than these and yet continue to remain unknown. They must have a precise value and yet they remain imprecise within our numbering system. They slip through the nets fashioned by our minds, and yet within nature they are basic. As though our way of counting things is based on the wrong system to start with. This great machine has been designed to find such numbers".

"Give me an example, Amadeus".
"The most needed number is that relating to the truths regarding circles and spheres".

"Religious truths"?

"I believe that truths will always lead to God, certainly".

"But you will never find God in that way, Amadeus". The bishop looked hard at him.

"I can try, my Lord."

"You believe that you can measure Him with numbers"? the bishop asked. "In any case we know the number that you seek. It has been established as a standard by the Church for many years".

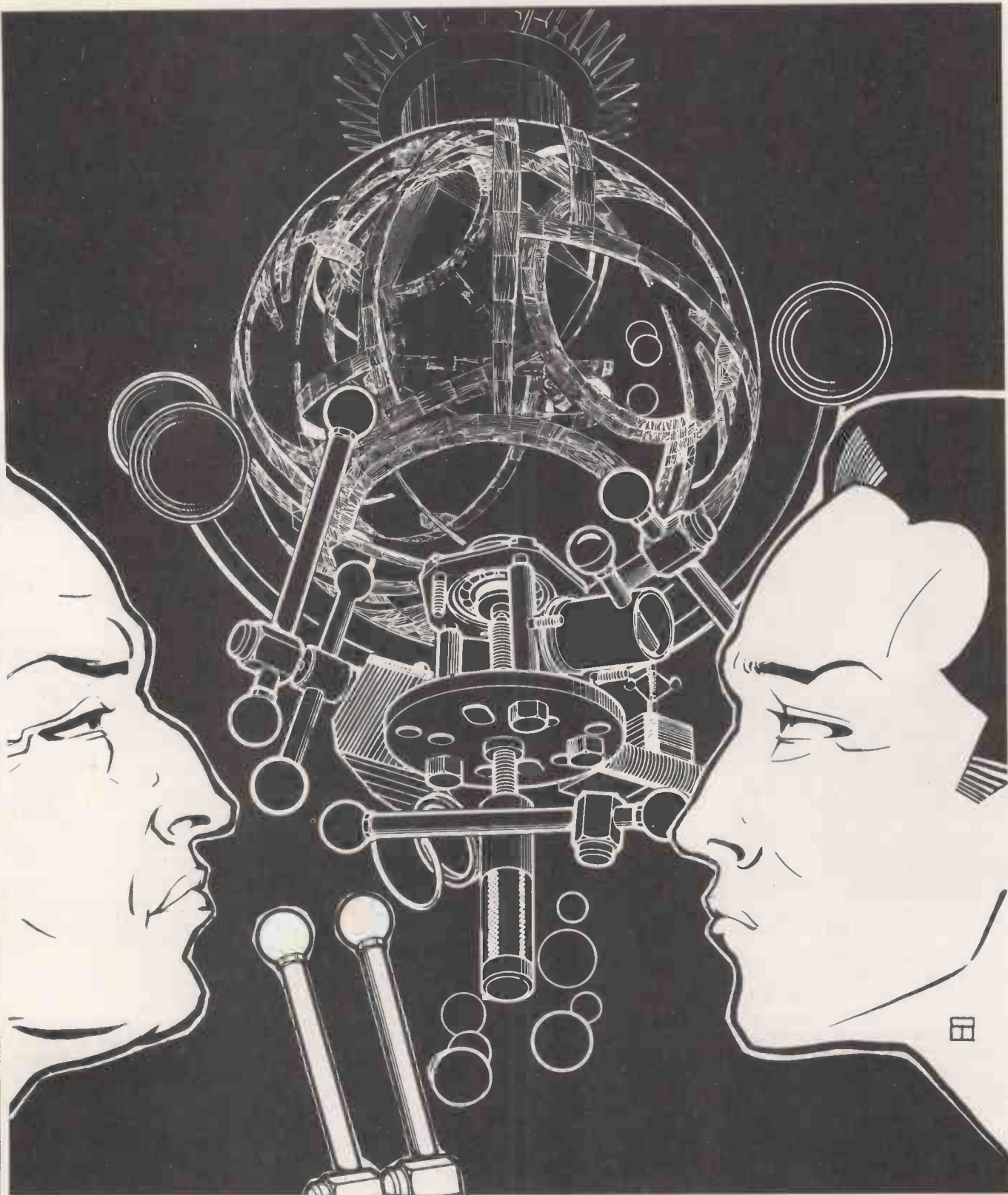
"But the standard is not exact. There is more to learn of this number's nature. Men should know such things. We must make the attempt".

"If you would pin God down to a number, then that is heresy, Amadeus".

"I seek only the truth about the world. Let me continue to try — just one more attempt my Lord".

The workmen had reassembled the frames. The bishop stared for a while at the dark oil stains that they had left on the floor. Without looking up he nodded.

Sullivan climbed to his crow's nest and began to assemble the coloured balls in their delivery hopper, while Amadeus pulled a lever to start the steam engine. The floor rumbled as the drive spindle turned. A second lever was pulled and the main frame began to turn. The noise grew louder. Dark shadows from the massive timbers of the outer structure moved jaggedly around the walls, and the light from the roof scattered and broke into shards as the smaller frames and cages spun and tumbled within it. Sullivan released the cascade of coloured balls which rolled and banged, clattering through the ever-changing wooden maze



as it turned, strained bearings whining.

At last one ball fell into the counting troughs, then another, and another. With great excitement Amadeus crouched to note the results. More balls fell, heavily and noisily, and still others — and then no more.

Amadeus stood slowly and handed the paper to the bishop. The paper trembled in each man's fingers.

The bishop read aloud:

"3 and 1 4 1 5 9 2 6 5 3 5 8 9 7 9 3 2 8".

Both men began to laugh as Amadeus pulled the stop lever.

"You've done it, my boy? Is this it?"


Amadeus nodded, still smiling.

"You will need to run checks of course, but — this is wonderful news".

He beckoned to the entourage.

"We have done it! We have done it! I shall get an Archbishop's chair for this! Amadeus you're a genius".

But Amadeus had his eyes closed and was no longer listening. If we can apply these results, he was thinking, to improve the accuracy of the machine's bearings and rotating parts then we can achieve an even more accurate result. Then we can continue until we have a machine that is almost perfect. His smile broadened as he dared the thought that he could not utter. Why not a machine that *is* perfect? A machine that is never wrong?

Never wrong about anything? 

ONE OF THE most inimical environments imaginable for the microcomputer is on the farm: mud, moisture, unsympathetic use by horny-handed sons of toil to whom a tractor printer is likelier to evoke wheeled machinery than electronic. Nowhere would this seem to be truer than in the cowshed.

To the expected problems of human heavy-handedness are added those of bovine indifference. In a milking parlour, all machinery must be built to withstand regular washing-down with high-pressure hoses, frozen winter and scorching summer alike.

Nevertheless, dairy management is one of the biggest growth areas in on-farm computing, which itself is no mean performer in the systems-sales stakes. Where a year ago there were only six firms supplying agricultural systems and soft-

'Pastures new' for micros

Martin Hayman, never afraid to get his boots dirty, visited ADAS's experimental farm to inspect its micro-based system, which actively monitors the health and performance of a large dairy herd.

Advisory Service's Bridgets Experimental Husbandry Farm, near Winchester, Hampshire, is directed.

Borrowing some techniques from industrial process control, the National Institute of Agricultural Engineers, in collaboration with Ellesmere Electronics, has developed a system known as Automated Farm Management System for the 1980s (AFMS-80) to identify automatically each cow on its arrival in the milking stall, record its milk yield, deliver a pre-programmed quantity of feed into the manger, and to weigh the cow on its exit. These operations are managed by three dedicated microprocessors and a purpose-built micro based on a 54K Motorola 6800 processor with software developed by NIAE's Dr Allen Burgess.

The interfacing hardware between the cow and the micro is interesting. It was an important consideration that any system implemented should not require substantial modification of existing work practices based on the so-called "herringbone" milking parlour, not least because Ellesmere Electronics is a division of the milking-equipment manufacturer Fullwood and Bland which builds them.

The first obvious sign that this is no ordinary dairy operation is when the cows arrive for milking. Slung around their necks on a bright-yellow, plasticised ribbon is a blue box about the size of a large bar of chocolate. This is the cow's electronic identity card.

Each of these transponders, as they are known, can be programmed with one of 65,000 identities — enough for any conceivable herd, or aggregation of herds, since the system is eventually intended for distributed control of several farms via Modem-landline links.

The transponder is energised by a coil on the front of each manger and transmits its identity as a radio signal to the cow-identification processor and the milk-yield processor, alerting the latter to record the yield against the cow's identity number, and the former to deliver the appropriate predetermined quantity of feed for her. But how to persuade the cow to lower her head and eat and thus energise the whole system? Elementary — a small quantity of feed is delivered to the manger as a "carrot".

The milk is weighed on a strain gauge and the figures for each individual cow's yield are recorded against its identity in the main farm-management system,



Agricultural officer Chris Laycock keys in a cow identity. The 40-character display reads out information from the management system.

ware, now there are more than 20 and their number is growing.

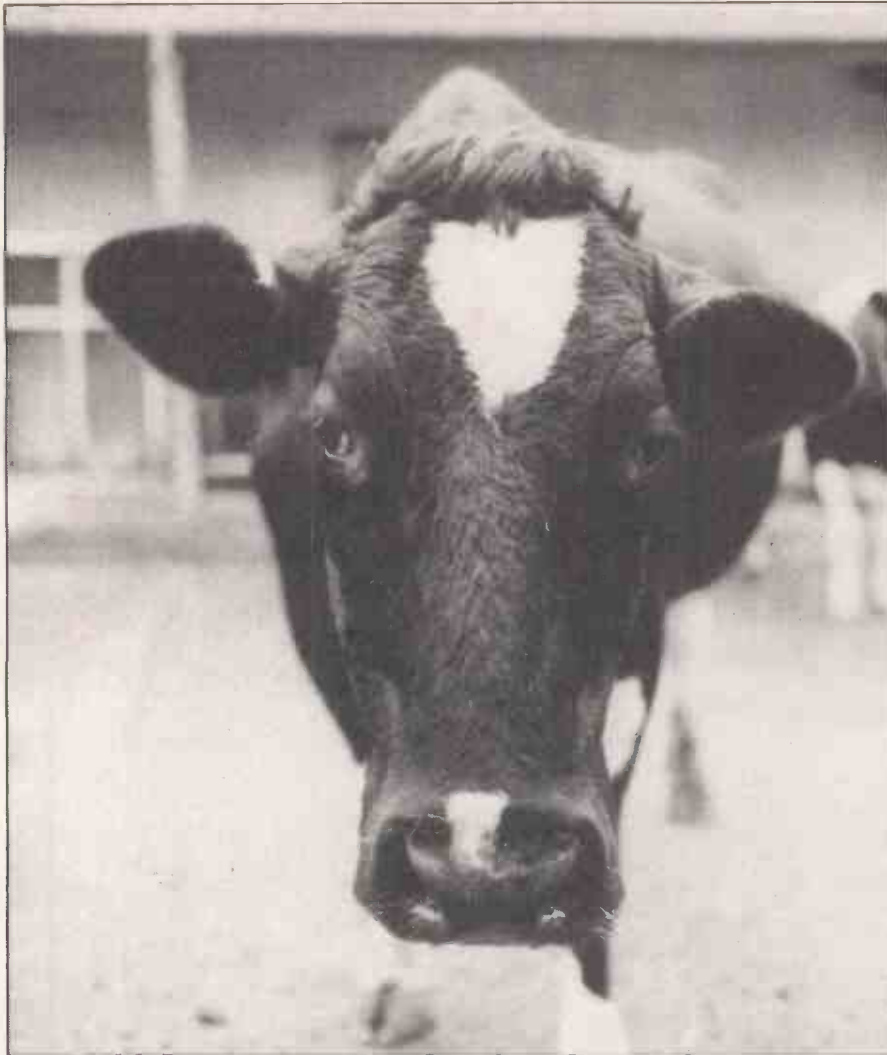
Dairying seems to have been one of the first areas of farming to receive concerted attention from computer people. Reading University's mainframe has had its Daisy herd-management program running for nearly 10 years, but it's not particularly useful to a farmer who essentially wants to eliminate some of the guesswork from his everyday business and has been told that this is the kind of task to which a computer is ideally adapted. A dairy herd of about 300 cows, can be said to be substantial. This is approximately the number of records that a medium-sized micro can manage comfortably, given that the information the farmer wishes to have about each beast is as follows:

- the quantity of milk delivered at each milking, hence
- the appropriate weight of feed it needs;
- its weight on leaving the milking parlour;
- details of pedigree, where it was purchased, veterinary records.

The first three items can be considered as monitoring programs, and will ideally be used on-line; the last is more of a database system and can be expanded according to the way the farmer wishes to manage his herd.

In human terms, the problem of implementing such a system, which from a purely computing point of view seems not so difficult, is input of data. How do you identify an individual cow, measure its milk yield, mete out the right quantity of feed into its manger, and weigh it as it exits from the milking parlour, and at the same time enter all that data into the micro?

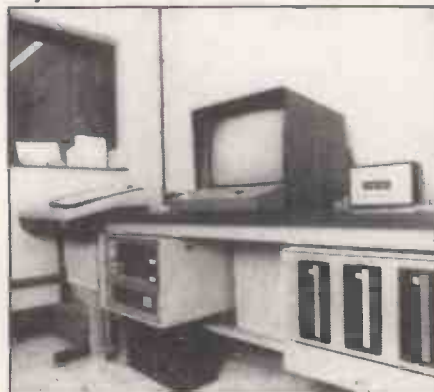
It is impracticable to have cowmen in their white aprons — the only people who become intimate enough with each cow to read the freeze-brand number on its rump — dashing in and out of the messy work area to key details into a keyboard. It's clearly a case for automatic data collection, and this is where the work at the Agricultural Development and



which is a conventional-looking micro away from the dairy parlour. Here the data can be printed out at the time of milking, and averaged to give a weekly mean. This part of the system is now working, with a 99 percent success rate in identity capture, says agricultural officer Chris Laycock.

Concurrently with the milk-weighing operation, the cow-identification processor signals the required balance of feed required by each cow to the gravimetric feeding hoppers and the rest of its dinner cascades down over its nose. In productivity terms, this is the single most important operation of AFMS-80.

Layout of the farm office.



The traditional skill of the dairyman is to judge how much feed to give to a cow during its lactation period in order to obtain the best margin of return. A cow's milk yield grows and declines over a 10-month period, with two months drying-off, when it does not produce milk.

When Tess of the D'Urbervilles was a milkmaid, this was all done by the skill born of observation and experience. Now the farmer has immediately at his disposal the exact figures of each of the twice-daily milkings, and of the weekly mean. Further, any significant shortfall can help detect disease in the individual cow, or to assess the quality of feeds.

Chris Laycock showed me a weekly printout which indicated that average yields, for the week in which I visited, were down by around 15 percent for a substantial proportion of the herd. This was attributable, he says, to a change to a different feed silo with a rather poorer grade of silage. In an experimental farm such as Bridgets this is useful for test purposes; for the average dairyman, it represents an important step in improving his management judgement by putting more precise and useful information at his fingertips, and detecting illness as early as possible.

By contrast the weighing operation, which is undertaken as the cows leave the milking parlour, has attained only a 60 to 70 percent success rate. The processor is programmed, however, to reflect a figure with a variance in weight, after positive identification on the weighbridge, of greater than 30kg. Cows are not by nature unruly beasts but they cannot be trained to step up in an orderly human fashion, one by one, on to the weighbridge. Nevertheless, over the course of a week, the success rate attains 93 percent.

The farm's director, Edwin Mundy, enters the usual caveat with respect to micros used in a traditional field of activity: "It is reasonable to expect that if used intelligently, AFMS-80 should make parlour operation easier, but one could foresee difficulties if it is viewed with suspicion by any operator who is called on to work with it".

This is to say no more than that any computer-based system needs expert human skill. To this end there is a monitor in the dairy parlour itself, giving a 40-character, single-line display of prompts such as "Cow number y Dump Milk (mastitis)" and "Feeder number 4 failed". System fault conditions can then be rectified, either by hand, or by punching in data on the two keypads.

It also permits data to be entered or retrieved by hand. If, for example, the system fails to capture an identity, the dairyman would then enter by hand the freeze-brand number, which is twinned with the transponder's identity.

The most ambitious part of the AFMS-80 is the microcomputer station, which is in an office overlooking the dairy parlour at Bridgets, but might well be elsewhere, connected to a telephone line. Data gathered from both the automatic parlour equipment and the parlour-control equipment is stored on 8in. floppies, and further specific data may also be entered via the keyboard.

Obviously the database work has to be typed in manually — details of where the stock came from, of its pedigree, its medical history. Once at this point, herd data may be manipulated and processed in the conventional way.

One neat touch is the automatic digital clock which switches on the whole system ready to run — along with a memory test — at 4.30am. One of the interactive programs which should shortly be running is the Daily Events and Action List, which will highlight, via the parlour unit, those cows which need veterinary attention, cows due on heat, due to be served and due to calve.

AFMS-80 is still in its development, although many farmers have expressed a strong interest — the farm receives more than 5,000 visitors a year. With the increasing size of dairy herds and the cost of skilled hands, it is not surprising that automation has its attractions for forward-thinking farmers. □

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PRACTICAL COMPUTING April 1982

Jonathan Bowen strikes out beyond our familiar, solid world with a program to generate projections of cubes of four, five and more dimensions.

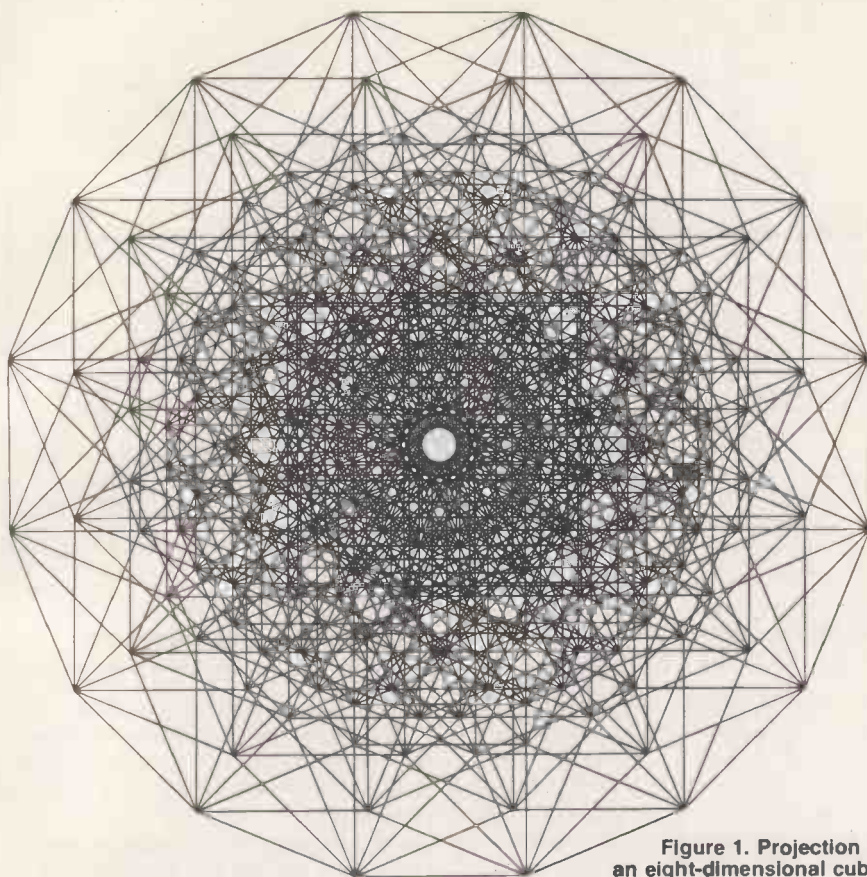


Figure 1. Projection of an eight-dimensional cube.

HYPERCUBE

EVER SINCE the concept of a three-dimensional, physical world has been understood there has been a fascination with the possibility that there might be fourth, and further, dimensions. Henry More (1614-1687) considered that spirits have four dimensions. In *The Time Machine*, H G Wells suggested that the fourth dimension is time, which can be misleading since time is somewhat different from the other three, spatial dimensions we know.

Abbott's *Flatland* is probably nearer the mark, Abbott considers the life of a two-dimensional square which suddenly has the chance to travel in three dimensions. This gives the square the ability to see inside objects in its two-dimensional world, something it previously thought was impossible. Using this analogy from three to four dimensions, we would be able to see inside solid objects if we were able to break out of our own three-dimensional world into the fourth dimension.

Taking the analogy further, when a three-dimensional object crosses a two-dimensional world, its inhabitants simply see an object appear from nowhere, grow in size, changing its shape in a rather odd

manner if the object is irregular, and then decrease in size until it disappears again. In our world this would be the equivalent of an object suddenly appearing somewhere, growing in size, shrinking and then disappearing without trace. If this sounds disturbing it is because we do not fully understand the fourth dimension.

We may define a dimension as being a direction which is at right angles to any other dimension. In our world we simply run out of directions after we have defined three dimensions — length, width and height, for example.

Added dimension

There is no reason why there should be anything special about three dimensions, apart from the fact that we live in a three-dimensional world. Thinking in terms of three dimensions is simply of the most practical use to us. We are quite willing to project three-dimensional objects into two dimensions when we draw or photograph them — again, this is because it is useful to us.

There is no reason why we may not project objects of more than three dimensions. Note that in this case we also have the choice of projecting them into

three dimensions if we wish. Probably the simplest and most interesting objects to consider for projection are "polytopes", which are geometrical figures bounded by portions of lines, planes or hyperplanes, for polytopes of two, three, and four or more dimensions respectively.

In two dimensions the polytope is known as a polygon and in three dimensions it is known as a polyhedron. For simplicity we shall restrict ourselves to regular polytopes in which all the vertices, edges, faces, etc. are the same. In two dimensions they are the equilateral triangle, square, regular pentagon etc. — there are an infinite number of them.

In three dimensions there are only five regular solids, known as the Platonic polyhedra: they are the tetrahedron, cube, octahedron, dodecahedron and icosahedron. A complete description of these and many other polyhedra may be found in *Mathematical Models* by H M Cundy and A P Rollett.

Regular polytopes

In four dimensions there are six regular polytopes, five of which may be considered as the four-dimensional equivalents of the Platonic polyhedra. They are described in H S M Coxeter's *Regular Polytopes*. It turns out that the tetrahedron, cube and octahedron have similar equivalents in any number of dimensions.

A simple algorithm may be used to generate the polytope for the next dimension up in each case, and they may be projected in two dimensions. The cube was chosen here since it produces more interesting projections, with square rather than triangular sides. For those interested in investigating more complicated polytopes, Coxeter's *Regular Complex Polytopes* is recommended.

A cube of N dimensions may be generated from a cube of $N-1$ dimensions in the following manner. Take the $(N-1)$ -dimensional cube and redraw it, displaced by a distance equal to length of one of its sides along a new dimension. Join the corresponding vertices of each of the old cubes to form the new cube.

You can demonstrate the process by starting with a "cube" of zero dimensions. It consists of a single point, as does any zero-dimensional object. Displace the point along any dimension by a given distance — say a distance L from the origin along the X -axis, see figure 2. You now have a line of length L or a one-dimensional cube.

Next, displace the line a distance L along a new dimension — say the Y -axis — and join the corresponding ends as in figure 3. You have now formed a square, which is a two-dimensional cube.

Now expand along the Z -axis, join the

(continued on next page)

(continued from previous page)

corresponding corners, and form the standard three-dimensional cube — see figure 4.

By displacing the cube along a new axis — say the W-axis — and joining the corresponding vertices, you form what is generally known as a hypercube or four-dimensional cube — see figure 5. You may continue this process as many times as you wish to form a multidimensional cube of any given number of dimensions.

The listed program draws N-dimensional cubes. It was written for a Research Machines 380-Z microcomputer with high-resolution graphics, but could be adapted to run on any computer with Basic and a line-plotting facility of some sort. The number of dimensions that can be plotted is limited by the resolution of the plotting device. Above about eight dimensions the cube becomes too complex to be viewed on the 380-Z screen.

Other systems may be able to plot more or fewer dimensions than this. Below three dimensions the figure is no longer a true cube. The program draws the cubes symmetrically, so that above about four dimensions some very pretty and interesting patterns are produced — see figures 1 and 6.

The program works as follows. First the desired number of dimensions is read into the variable N in line 170. Lines 260 to 400 initialise the arrays XM and YM which contain the co-ordinate offsets necessary to plot each possible direction of the cube's sides. Lines 410 to 520 calculate the origin co-ordinates X0,Y0 and the size factor F. Line 530 positions the origin.

The For loop from lines 540 to 830 calculates the start and finish positions of each side of the cube and draws a line

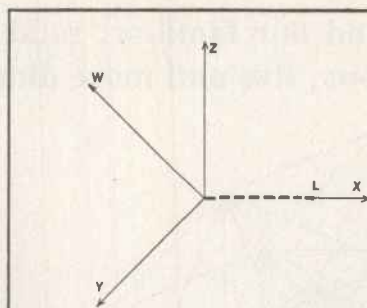


Figure 2. Generating a line.

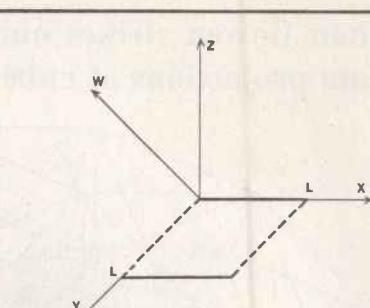


Figure 3. Generating a square.

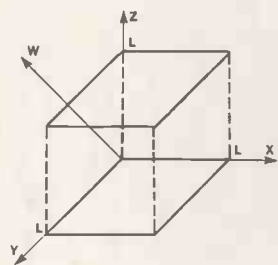


Figure 4. Generating a cube.

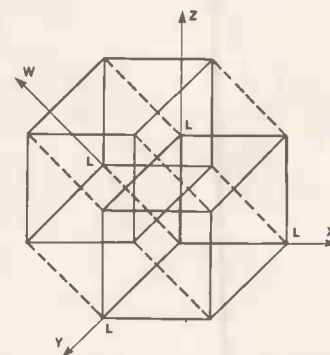


Figure 5. Generating a hypercube.

between them. Arrays JA and JB contain flags — with values of 0 or 1 — which are used to indicate which co-ordinate offsets are to be used for the beginning and end co-ordinates of each side plotted. Lines 610 to 660 calculate the starting position, and line 670 positions the current co-ordinates at that position. Lines 680 to 730 calculate the end position and line 740 draws a line to that position. Finally the program loops back to line 90, displays the number of dimensions of the cube — line 140 — and prompts the user for a new value of N. The program may then be rerun if desired or terminated by

typing a carriage-return on a blank line.

The following lines contain special calls and commands to control graphics on the Research Machines 380-Z, and must be changed for other systems:

Line 90 puts the 380-Z into graphics mode in which only the last four lines are used to display text while the rest of the screen is used for plotting.

Line 180 sets the resolution and clears the screen.

Line 230 resets the screen to normal mode.

Line 530 sets the position of the origin on the screen. For other systems the values of X0, Y0 and F — the co-ordinates of the new origin, and the size factor — will probably need to be adjusted. Change lines 410 to 520 as necessary.

Line 670 moves the current position to the co-ordinates X, Y. It also draws a point at that position, but this is not necessary for the program to work.

Line 740 draws a line from the current position to a new position at co-ordinates X, Y.

In line 260 the value of π is specified as 3.14159. It may be given to more or fewer decimal places, depending on the accuracy of your Basic. Alternatively, it may be calculated using the expression $4.0 * ATN(1.0)$.

The program is written in a standard Basic, and there should be few problems transferring the program to another computer with the necessary hardware and software graphics capabilities.

Flatland by E A Abbott, sixth edition, Blackwell, 1950.

Mathematical Models by H M Cundy and A P Rollett, second edition, Oxford University Press, 1961.

Regular Polytopes by H S M Coxeter, second edition, Macmillan, 1963.

Regular Complex Polytopes by H S M Coxeter, Cambridge University Press, 1974.

N-dimensional cube-drawing program.

```

10 REM N-dimensional cube program
20 REM to run on Research Machines 380Z
30 REM with high resolution graphics.
40 REM Written by Jonathan Bowen.
50 REM Imperial College, London SW7 2AZ.
60 REM Date 22-Oct-81
70 REM COPYRIGHT (C) 1981 J.P.BOWEN
80 DIM X1(10),Y1(10),I1(10),I2(10)
90 GRAPH 1
100 PRINT
110 IF N>0 GOTO 140
120 PRINT "N-dimensional cube program"
130 GOTO 150
140 PRINT TAB(8);N;"dimensional cube"
150 PRINT
160 PRINT
170 INPUT "Enter no of dimensions (2-10)";N
180 CALL "RESOLUTION",0,1
190 IF N>1 THEN 250
200 PRINT
210 PRINT
220 PRINT "End of cube program"
230 GRAPH 0
240 END
250 IF N>10 GOTO 170
260 P=3.14159/N
270 I=-1
280 FOR J=1 TO N STEP 2
290 I=I+1
300 C=I*P
310 X1(J)=COS(C)
320 Y1(J)=SIN(C)
330 NEXT J
340 I=N
350 FOR J=2 TO N STEP 2
360 I=I-1
370 C=I*P
380 X1(J)=COS(C)
390 Y1(J)=SIN(C)
400 NEXT J
410 F=0
420 FOR J=1 TO N
430 F=F+Y1(J)
440 NEXT J
450 X0=0
460 FOR J=1 TO N
470 IF X1(J)<0 THEN X0=X0+X1(J)
480 I1(J)=0
490 NEXT J
500 F=190/F
510 X0=X0-40/F
520 Y0=0
530 CALL "OFFSET",X0*F,Y0*F
540 FOR I=1 TO 2^N-1
550 FOR J=1 TO N
560 I2(J)=I1(J)
570 NEXT J
580 FOR J=1 TO N
590 IF I1(J)=1 GOTO 760
600 I2(J)=1
610 X=0
620 Y=0
630 FOR K=1 TO N
640 X=X+I1(K)*X1(K)
650 Y=Y+I2(K)*Y1(K)
660 NEXT K
670 CALL "PLOT",X*F,Y*F
680 X=0
690 Y=0
700 FOR K=1 TO N
710 X=X+I2(K)*X1(K)
720 Y=Y+I2(K)*Y1(K)
730 NEXT K
740 CALL "LINE",X*F,Y*F,3
750 I2(J)=0
760 NEXT J
770 J=1
780 IF I1(J)=0 GOTO 820
790 I1(J)=0
800 J=J+1
810 GOTO 780
820 I1(J)=1
830 NEXT I
840 GOTO 90
D>

```

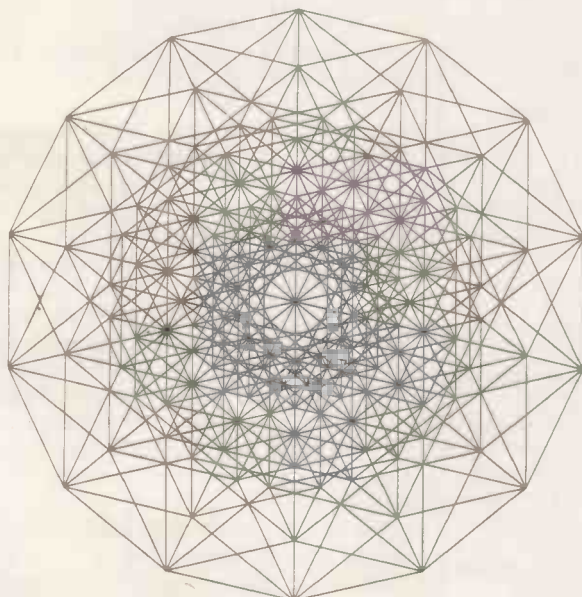
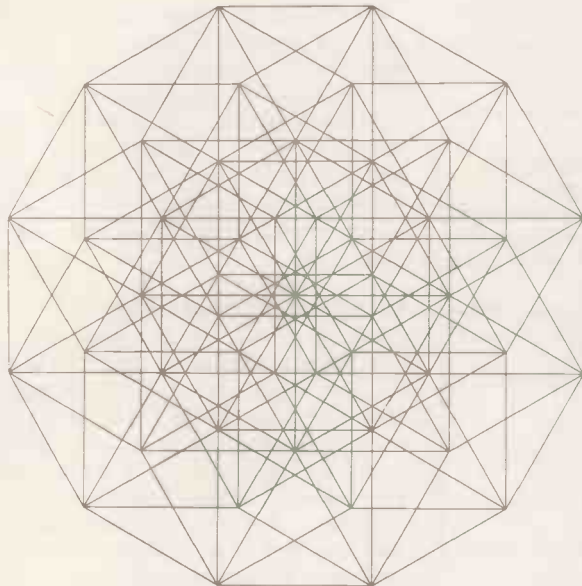
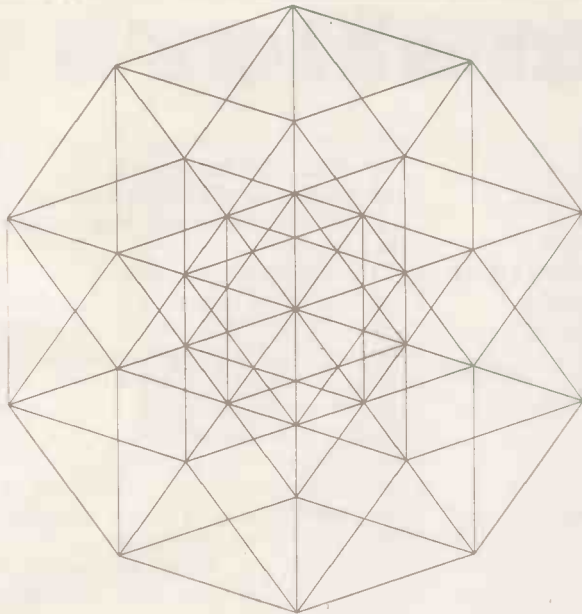


Figure 6. Projections of cubes in five, six and seven dimensions.

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Reading matters

SPECIFIC DIFFICULTIES in acquiring reading skills can be a cause of distress to parents, exasperation to teachers and downright misery to the student. The problem often does not lie with the amount of effort the student is making but with the lack of some specific skill. Children, or for that matter adults, experiencing difficulty with acquiring reading skills will often not know why they are failing to make progress.

Research has shown that reading difficulties are often associated with an inability to recognise shapes and patterns, since reading depends fundamentally on the ability to recognise letter shapes. Although recognition problems can be easy to appreciate in young children and those with severe difficulties, they can be overlooked once a reader has achieved some proficiency. Where these difficulties persist they can lead to "hiccups" in the flow of reading causing loss of contextual cues and leading to further confusion. For example, a student reading "dent" in place of "bent" can be thrown into confusion over the rest of the sentence.

Slowness in recognising letters also affects reading speed. It is generally acknowledged that slow reading speeds are not only inefficient but also disrupt comprehension.

Remedial techniques such as teaching specific rules or approaches — e.g., magic e or word division — can themselves be hindered by poor letter recognition. The magic e rule relies specifically on knowledge of the names and sounds of the vowels. Difficulties with either of these, even if confined to just one letter, mean the student's use of the rule will be ineffective and frustrating.

Difficulties masked

As a reader acquires skill, it becomes more difficult to detect specific problems. Often this is because the speed of reading can mask minor difficulties or because the student uses a reading technique which ensures that any problems are kept as private as possible.

The conventional way of diagnosing problems in letter recognition is to use flash cards. Flash cards are like a pack of large playing-cards. On each one, a single letter is printed in large print. The teacher holds up one card at a time and the pupil is asked to identify it. This method can be used to see if any gross difficulty is being experienced. Its major drawback is that it will not detect the child who requires only slightly longer than average to recognise the letter; the speed and timing of presentation cannot be sufficiently quick or accurate. To overcome these limitations the profes-

Turn your micro into a tachistoscope — a device which displays letters or figures on the screen at a given rate to help children or adults over reading difficulties. Mike and Wendy Cook show you how to make the software transformation.

sional research worker turns to a tachistoscope.

A tachistoscope is a machine much used by research workers in the field of psychology. It is a device for presenting a series of letters or figures on a screen with an accurately-controlled display time and display rate. These devices were designed before the advent of interactive computers and have tended to be expensive and

PROGRAM FUNCTIONS

100-160	Sets up initial variables and turn on real-time clock.
180-200	Reads in the prepared groups; there may be up to 20 groups as defined by Data statements in lines 1280-1340.
210-330	Titles and the inputting of the number of characters required for display.
340-410	Selecting the type of letter group required.
380	Defines full alphabet.
420-600	Enters keyboard-defined letter group.
610-750	Picks letter group from your defined set.
760-780	Converts letter group to lower case if necessary.
790-860	Tests whether letter group has more than one type of letter in it: with only one type of letter this would crash the program at lines 1020-1030.
870-1000	Enters the display time and gap time.
1010-1040	Makes up random letters from chosen group for display. Consecutive letters are tested to ensure that they are not the same.
1050-1140	Draws box on display for the characters as a guide to where the letters will appear.
1140-1240	Runs tachistoscope.
1250-1260	Pauses until a key is pressed and loop for another run.
1280-1340	Data statements for prepared groups. Those shown are the ones that have been found to be useful. They may be altered or added to by putting extra Data statements in front of line 1340. For clarity, use one data statement per group and always end the group with the number zero.

only used by professionals. Careful use of this instrument has helped to diagnose specific reading difficulties, and to devise a course of treatment to help overcome them.

The tachistoscope enables letters to be presented for a very short length of time, much shorter than would be possible manually. The rate of presentation can be accurately controlled, whereas with manual presentation there is always a tendency to pause until the pupil has made an attempt. A tachistoscope can show each letter for such a short time that recognition has to be almost subliminal; the delay between each letter can be long enough for the brain to process the information and for the student to respond.

Our program enables a computer to act as a tachistoscope, and as such it is much more flexible than many conventional tachistoscopes. It is written for a TRS-80 disc-based system or Level-II Basic, though no disc commands are used. A real-time clock is used to control display times; it can be replaced by timing loops as shown with only a small loss in accuracy.

For non-specialists

For best use of the program, the lower-case modification should be installed, but it will run perfectly on upper-case-only machines. The ideas it embodies can easily be adapted to any personal computer — there are no essential special graphics or commands. The program is written to be used by non-specialist and is particularly difficult to crash so it is slightly longer than a "bare bones" program. Though the menu system is often considered to make a program easy to use, the binary tree question-and-answer system was chosen for this program. It was found that it forced the user to think about changing parameters which might have been overlooked, and for testing, this was considered to be a more suitable form of operation for the program.

The program asks for each parameter that is to be used: the display times; the letter set required; the number of letters in the run; and the timing required. The program then draws a box in the centre of the screen, and the letters are flashed within it. The student has to say the letter name, or the letter sound — depending upon the exercise — at sufficient speed as to keep up with the display.

At the end of the predetermined number of characters, any or all of the parameters may be changed. Any parameter can be left unaltered simply by pressing Enter.

The practical operation of the program

consists of diagnosis and training phases. In the diagnosis phase, the program allows letters to be presented at realistic rates so that difficulties can be detected. The rate can be altered to suit the needs of individual students. Two components determine the overall speed of presentation:

- the length of time for which the letters are presented,
- the delay between presentation of successive letters.

both of which can be individually controlled using options provided in the program.

The computer program can be used to detect slowness in letter recognition, or to pin-point specific difficulties such as b/d, j/g confusion, or problems naming vowels, etc. Alternatively it can be used to make a detailed analysis of patterns of difficulties with the aim of discovering specific areas of weakness. For example, n,u,m,w confusion would indicate visual difficulties; confusing a,e,i,o indicates auditory difficulties; confusing b,d,p,q indicates confusion over orientation, and so on. On the basis of such analysis, appropriate remedial techniques can be implemented.

For training, the computer program can be used to increase a student's speed in recognising letters, or to aid discrimination of specific letters. Overall slowness can be improved by practising the full alphabet — option F in the program — at increasing speeds. In such cases, where there are no discrimination problems, we recommend fast presentation times of 0.05 to 0.1s., and gradually-

Glossary

Magic e: The rule which states that an e at the end of the word makes the previous vowel say its name rather than its sound, for example hat/hate or cod/code.

Word division: The word is split into its component parts, each of which is read separately before the whole word is attempted. For example, "preliminary" becomes PRE+LIM+IN+ARY.

decreasing delay times beginning 1.5s. and working towards 0.3s.

Where there are specific difficulties, the prepared-group — option P in the program — is useful. A problem group can be pre-programmed so that the student is given practice in discrimination. Slower presentation times in the range 0.3 to 0.7s. are necessary, but the delay times can be shorter at 0.2 to 0.6s.

Diagnosis of problems obviously requires the parent or teacher to be present, but for training purposes the program can be used by students working alone. Only a brief explanation of the program should be necessary.

It has been found that 30 is the best number of characters for a run if the full alphabet is being used, while 15 seems sufficient for smaller groups.

There are three choices for the type of character group:

F, the full alphabet is useful for diagnosis and general speed training.

P, prepared groups, are used when emphasis is to be placed on a subset of letters. They are stored in Data statements at the end of the program and can be added to or changed by altering these statements. This mode is useful for training on specific difficulties.

D, defined groups, allows the operator to define a set of characters from the keyboard. This is useful in experimenting with groups for subsequent inclusion in the prepared group list. The frequency of occurrence of any particular letter is governed by the number of times it appears in

the group. As the letters are picked out of the group at random — with the constraint that the letter picked must not be the same as the last letter — it is usual to have at least three different letters in the group. The program will prevent you from putting only one letter in a group. Note the back-space arrow still works, and so it is possible to delete an entry.

U/L allows the characters to be presented in either upper or lower case. The lower-case hardware modification has to be installed for this to work, but no software driver is needed. Upper case can be more readable, but lower case occurs more frequently in reading and so is preferable. More difficulties show up
(continued on next page)

```

100 *TACHISTOSCOPE BY M.K.COOK 1982
110 CLEAR 1000
120 DIM RS(101),G$(20)
130 CLS : RANDOM
140 CMD"R"
150 N=10 : DT=.3 : GT= 1.5
160 NM=1
170 READ A$
180 IF A$ <> "0" THEN G$(NM)=G$(NM)+A$ : GOTO 170
190 READ A$
200 IF A$ <> "0" THEN NM=NM+1 : GOTO 180
210 PRINT"RANDOM LETTER TACHISTOSCOPE - PRESS ENTER AFTER EACH ANSWER"
220 PRINT
230 T1=0
240 IF D$="" THEN 280
250 INPUT"SAME AGAIN OR CHANGE SOMETHING ( S/C ) ";A$
260 IF A$="S" THEN 1010
270 IF A$ <> "C" THEN PRINT "PLEASE ANSWER ONE LETTER S OR C " : GOTO 250
280 PRINT"LAST RUN YOU HAD ";N;" CHARACTERS"
290 INPUT"ENTER NEW FIGURE OR PRESS ENTER FOR SAME NUMBER ";T1
300 IF T1 <> 0 THEN N=T1
310 IF N > 100 THEN PRINT"100 IS THE MAXIMUM" : GOTO 290
320 IF N < 1 THEN PRINT "STOP MESSING ABOUT" : GOTO 290
330 IF D$="" THEN 370
340 INPUT"DO YOU WANT THE SAME GROUP OF LETTERS ( Y/N ) ";A$
350 IF A$="Y" THEN 760
360 IF A$ <> "N" THEN PRINT"PLEASE ANSWER ONE LETTER ( Y OR N ) "; GOTO 340
370 INPUT"FULL ALPHABET / PREPARED GROUP / DEFINE GROUP ( F/P/D )";R$
380 IF R$="F" THEN D$="ABCDEFGHIJKLMNOPQRSTUVWXYZ" : GOTO 760
390 IF R$="P" THEN 610
400 IF R$ <> "D" THEN PRINT"PLEASE ANSWER ONE LETTER ( F,P OR D )":GOTO 370
410 IF D$="" THEN GOTO 470
420 IF D$ <> "" THEN PRINT : PRINT"CURRENT LETTERS ARE - ";D$
430 INPUT"DO YOU WISH TO ADD LETTERS OR INPUT A NEW SET ( A/N )";A$
440 IF A$="N" THEN D$="" : GOTO 460
450 IF A$ <> "A" THEN PRINT"PLEASE ANSWER ONE LETTER ( A OR N )":GOTO 430
460 PRINT
470 PRINT"PLEASE ENTER LETTERS - PRESS ENTER TO FINISH"
480 IF D$="" THEN 520
490 FOR A=1 TO LEN(D$)
500 PRINT MID$(D$,A,1); " ";
510 NEXT
520 A$=INKEY$ : IF A$="" THEN 520
530 T=ASC(A$)
540 IF T > 90 THEN 520
550 IF T = 8 AND LEN(D$) > 0 THEN PRINT A$;A$; : D$=LEFT$(D$,LEN(D$)-1) : GOTO 520
560 IF T = 8 THEN 520
570 IF T = 13 AND LEN(D$) > 1 THEN PRINT : D$=D$: GOTO 760
580 IF T <> 13 THEN D$=D$+A$ : D$=D$+A$
590 IF LEN(D$) > 25 THEN PRINT"MAXIMUM NUMBER OF LETTERS REACHED" ELSE GOTO 520
600 GOTO 760
610 PRINT"YOU HAVE PREPARED ";NM;" GROUPS"
620 INPUT"PRESS R TO REMOVE YOUR GROUPS OR THE GROUP REQUIRED ";A$
630 IF LEN(A$) > 2 THEN PRINT"PLEASE TYPE JUST R OR GROUP NUMBER"; GOTO 620
640 IF A$ <> "R" THEN VAL(A$) : GOTO 730
650 FOR A=1 TO NM
660 PRINT"GROUP ";A;" IS - ";
670 FOR A1=1 TO LEN(G$(A))
680 PRINTMID$(G$(A),A1,1); " ";
690 NEXT
700 PRINT
710 NEXT
720 GOTO 620
730 IF NG > NM THEN PRINT"THIS IS OUTSIDE THE RANGE OF YOUR PREPARED GROUPS ":GOTO 610
740 IF NG=0 THEN A$=A$+"XXX" : GOTO 630
750 D$=G$(NG)
760 INPUT"UPPER OR LOWER CASE ( U/L ) ";C$
770 IF C$="U" OR C$="L" THEN 780 ELSE 760
780 IF C$="U" THEN T$=D$ : GOTO 830
790 T$=""
800 FOR A=1 TO LEN(D$)
810 T$=T$+CHR$(ASC(MID$(D$,A,1))+32)
820 NEXT
830 IF LEN(T$) < 2 THEN PRINT"THIS GROUP IS TOO SHORT " :GOTO 370
840 A=2
850 IF LEFT$(T$,1) <> MID$(T$,A,1) THEN 870

```

(listing continued on next page)

(listing continued from previous page)

```

860 IF A < LEN(T*) THEN A=A+1 : GOTO 850 ELSE PRINT"THIS GROUP OF LETTERS IS ALL
THE SAME" : GOTO 370
870 PRINT"CURRENT DISPLAY TIME IS ";DT;" SECONDS"
880 T1=0
890 INPUT"INPUT NEW TIME OR PRESS ENTER TO KEEP CURRENT TIME ";T1
900 IF T1 <> 0 THEN DT=T1
910 TD=INT(DT*40)
920 IF TD > 252 THEN PRINT"DISPLAY TIME TOO LONG " :GOTO 890
930 IF TD < 2 THEN PRINT"DISPLAY TIME TOO SHORT " :GOTO 890
940 PRINT"TIME BETWEEN DISPLAYS IS CURRENTLY ";GT;" SECONDS"
950 T1=0
960 INPUT"INPUT NEW TIME OR PRESS ENTER TO KEEP CURRENT TIME ";T1
970 IF T1 <> 0 THEN GT=T1
980 TG=INT(GT*40)
990 IF TG > 252 THEN PRINT"TIME GAP TOO LONG " : GOTO 960
1000 IF TG < 2 THEN PRINT"TIME GAP TOO SHORT " : GOTO 960
1010 FOR A=1 TO N
1020 RS(A)=ASC(MID*(T*,RND(LEN(T*)),1))
1030 IF RS(A) = RS(A-1) THEN 1020
1040 NEXT
1050 CLS
1060 PRINTCHR*(23);
1070 X1=36;X2=73;Y1=20;Y2=29
1080 FOR A=X1 TO X2
1090 SET(A,Y1):SET(A,Y2)
1100 NEXT
1110 FOR A=Y1 TO Y2
1120 SET(X1,A):SET(X2,A)
1130 NEXT
1140 FOR A=1 TO 800:NEXT
1150 TS=16448 ' TICK STORE
1160 CP=538+15360
1170 FOR A=1 TO N
1180 POKE(CP),RS(A)
1190 POKE(TS),0
1200 IF PEEK(TS) < TD THEN 1200
1210 POKE(CP),32
1220 POKE(TS),0
1230 IF PEEK(TS) < TG THEN 1230
1240 NEXT
1250 PRINT 960,"PRESS ANY KEY FOR ANOTHER RUN";
1260 IF INKEY$="" THEN 1260 ELSE CLS : GOTO 210
1270 'DATA STATEMENTS FOR GROUPS EACH GROUP TO END WITH ZERO
1280 DATA A,E,I,O,U,O
1290 DATA B,D,B,D,A,C,O
1300 DATA Z,X,Z,X,T,K,O
1310 DATA J,G,J,G,S,R,O
1320 DATA U,V,U,Y,V,T,O
1330 DATA Q,V,W,Q,V,O
1340 DATA O

```

(continued from previous page)

when using lower case; for example, b/d confusion is common but B/D confusion is rare. The quality of the display can be improved by carefully adjusting the brightness control of the monitor.

This program has been found to be very helpful in both diagnosis and training. When using a new teaching method there is always some doubt whether the student is responding to the method or the novelty of the situation, but whatever the reason, this program works. It is intended as a tool for remedial teaching, to help teachers or parents to diagnose and teach, though it is not a teaching machine which will diagnose and overcome letter-recognition difficulties by itself.


The program listing is for disc Basic using the real-time clock. For Level II Basic, remove line 140 and replace the following two lines:

```

1200 FOR A1 = 1 TO 10 * TD : NEXT
1230 FOR A1 = 1 TO 10 * TG : NEXT

```

Lines 920 and 990 may then be removed to allow a longer time to be specified.

Any educational establishment which would like a machine-readable copy of this program should write on headed note-paper, enclosing a cassette tape or formatted disc with return postage to M K Cook, Department of PMC, John Dalton Building, Manchester Polytechnic, Oxford Road, Manchester. 

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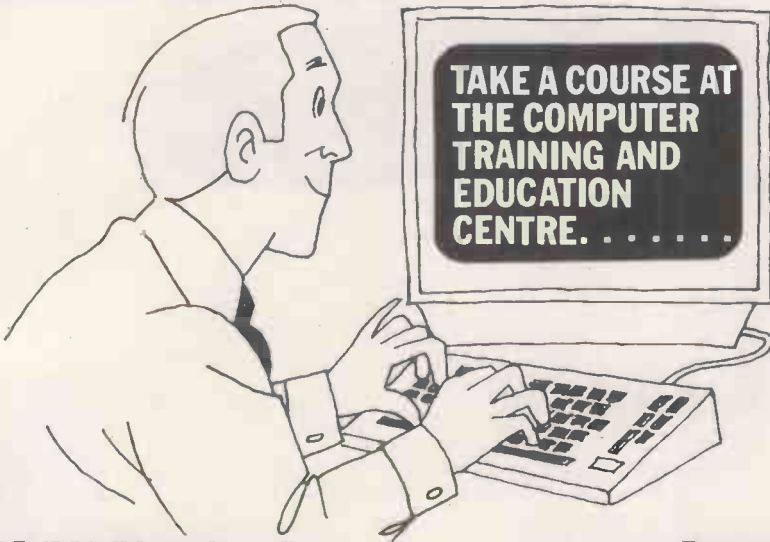
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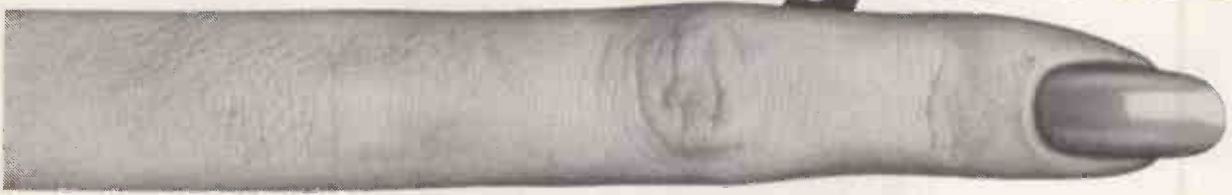
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FAST BUBBLES



A large part of any business package's working life is spent sorting information. Cliff Stanford shows how even the common bubble sort can be streamlined for efficiency.

THE MOST COMMON sort routine is the bubble sort. In this method, adjacent pairs of strings in an array are compared with one another and, if necessary, exchanged. This is tedious since in each pass of the array, a particular string may only move one place upwards. Conversely, one string only will move — or bubble — to the end of the array on each pass.

An example of the bubble sort is given in the program listing, starting at line 9000. In this particular implementation — which was written for Commodore microcomputers — rather than using two For-Next loops, *b* is used to indicate the bottom of the part of the array which has not yet been sorted. This prevents the time-wasting sorting of elements which are already known to be in the correct order.

Batcher's method

However, to create a sort algorithm whose running time is notably faster than the bubble sort, non-adjacent elements of the array must be selected for comparison. This means that strings may move in both directions more quickly than the single step at a time possible with the bubble-sort algorithms. Such an algorithm was devised by K E Batcher in 1964. Not surprisingly it has become known as the Batcher sort.

Batcher's method involves setting various pointers into the array and comparing the elements pointed to. The main pointer in the implementation shown is *p* which starts as the largest exact power of two which is less than the number of elements to sort. For example, with 100 elements to sort, *p* would start at 64. Other pointers are *q*, *r* and *d* which take various values as the sort progresses.

The algorithm specifies precisely which two strings are to be compared and, if necessary, exchanged. It follows therefore, that as many comparisons are necessary to sort an array which is already in order as for one which is random.

Six main stages

The code for the Batcher sort starts at line 10000 in the program listing. You will note that six steps are highlighted:

- **Step 1:** *T* is set to the least integer, such that 2^t is greater than or equal to *n*, where *n* is the number of elements to be sorted. The value of *t* is used to set *p* to the largest exact power of 2, less than *n*.
- **Step 2:** *0* is initialised at the largest exact power of 2, less than *n*. *R* is set to zero and *d* is set to *p*. At this stage, *q*, *d* and *p* are all equal but it will soon be apparent that this situation does not remain.

```

10 REM*****
11 REM**
13 REM**          BATCHER / BUBBLE SORT ROUTINES          **
14 REM**
15 REM**    IMPETUS COMPUTER SYSTEMS                      **
16 REM**    CLASSIC OFFICES, HENDON CENTRAL                **
17 REM**    LONDON NW4 3NN                                DATED:  7 JULY 1981  **
18 REM*****
19 REM
20 INPUTN:DEFFNRU(I)=INT(I)-(I<>INT(I)):DIMAS(N),B$(N)
30 DEFFNRD(I)=INT(RND(1)*I+1)
90 GOTO60000
9000 B=N
9010 T=0:FORJ=1TOB-1:IFB$(J)>B$(J+1)THENT$=B$(J):B$(J)=B$(J+1):B$(J+1)=T$:T=J
9020 NEXT:IFTTHENB=T:GOTO9010
9030 RETURN
10000 T=FNRU(LOG(N)/LOG(2)):P=2^(T-1)                      :REM  STEP 1
10020 Q=2^(T-1):R=0:D=P                                    :REM  STEP 2
10030 S=P/RR:G=N-D-1:FORK=RTOGSTEPS*2:H=K+S-1:IFG<HTHENH=G :REM  STEP 3
10040 FORI=KTOH:J=I+1
10050 IFAS$(J)>AS$(J+D)THENT$=AS$(J):AS$(J)=AS$(J+D):AS$(J+D)=T$ :REM  STEP 4
10060 NEXT
10070 NEXTK
10080 IFO<>PTHEND=0-P:Q=Q/2:R=P:GOTO10030                  :REM  STEP 5
10090 P=INT(P/2):IFPTHEN10020                              :REM  STEP 6
10100 RETURN
60000 REM          BENCH TEST
60010 FORI=1TON:AS$="":FORJ=1TOFNRD(4)+2:AS$=AS$+CHR$(FNRD(26)+64):NEXT
60020 AS$(I)=AS$:B$(I)=AS$:PRINTAS$:NEXT:PRINT
60030 PRINT"BATCHER",:TIS$="000000":GOSUB10000:X$=TIS
60040 PRINT"BUBBLE",:TIS$="000000":GOSUB9000:Y$=TIS
60060 X=0:FORI=1TON:IFAS$(I)<AS$(I-1)THENX=1
60070 NEXT:FORI=1TON:IFB$(I)<B$(I-1)ORAS$(I)<>B$(I)THENX=1
60080 NEXT:IFX=0THENPRINT"ARRAYS SORTED CORRECTLY":GOTO60100
60090 PRINT"ERROR DISCOVERED IN CHECKING ARRAYS":STOP
60100 PRINT"BATCHER SORT TOOK: "X$:PRINT"BUBBLE SORT TOOK: "Y$

```

• **Step 3:** The algorithm should read at this point: for $l = 0$ to $n-d-1$: if $(i$ and $p) = r$ then do step 4. This is however wasteful as it means that, each time through the loop, i must be incremented at all stages between 0 and $n-d-1$. It becomes clear on studying the operation of this algorithm that i follows a set pattern. It is, possible, therefore, to obviate the need to test i at all. We set s equal to p or r , and g equal to the top limit of $n-d-1$. K then becomes the various starting points for the i loop and h is the end of each small loop. The only test necessary is to check before entering the loop that h is not greater than g . Lines 10030 and 10040, although longer than the line above, operate very much faster. J is simply $i + 1$ to avoid 1 being added in six times on line 10050.

• **Step 4:** This is the straightforward test and exchange using the elements pointed to by j and $j + d$. It is possible to use i instead of j in this line but I had decided that I did not wish the zero element of the array to be included in the sort.

• **Step 5:** 0 is now tested against p . If they are not yet equal, then d becomes the difference between q and p , q is halved and r is set to p . We must then return to step 3 for the new values of q , d and r .

• **Step 6:** When q and p become equal, we halve p and return to step 2. The reason for the integer function is that it forces p to end at 0 giving us a clean exit.

The program lines from 60000 onwards compare the Batcher sort with the speeded-up version of the bubble sort. When the program is run, the user is prompted for a value of n . Line 60010 then generates n random strings of length between 2 and 6. These are put into a(i)$ and b(i)$. The Batcher method then sorts the $a$$ array and the bubble sort the $b$$ array. The time taken to sort each array is recorded in $x$$ and $y$$ respectively.

Time trials

Line 60060 checks that the $a$$ array is correctly sorted. Similarly, line 60070 checks that the $b$$ array is correctly sorted and that the two arrays still contain identical data. If any discrepancy is discovered then an appropriate message is printed. Otherwise, the message

Arrays sorted correctly
is printed and the timings for the two sorts are listed.

If the program is run for values up to about 25 elements, it will be seen that the bubble sort is indeed quicker. This is simply because the Batcher spends a good deal of time setting pointers and initialising variables. However, from about 25 elements onwards, the Batcher

sort moves into its own. When sorting 40 strings, the bubble sort takes about twice as long as the Batcher: for 100 strings the time saving becomes something like 70 percent and for 1,000 strings, the Batcher takes about 10 minutes as opposed to marginally less than three hours for the bubble sort. These timings were made under Basic 4.0.

Under Basic 2.0 the times saved would be substantially greater because of the garbage-collection problems in moving the strings so many times. Interestingly, for large arrays a Batcher sort written in Basic may even out-perform a bubble sort written in assembler. On the other hand, the machine-code version of the Batcher sort which I have developed will sort an array of 1,000 elements in less than 10 seconds.

The Batcher sort is a most efficient algorithm for sorting volumes of data *in situ*. If anyone would like a copy of the assembler sort, send a cheque for £15 plus VAT — £17.25 — and I will send him a disc with both the source code and absolute code. Please state the disc format — 3040, 4040 or 8050. Basic 2.0 and Basic 4.0 versions will be included on the disc. □

How shell method orders strings

Eric Dale scrutinises the shell algorithm as a solution for faster sorting.

TO ORDER a list alphabetically is an everyday requirement in data processing. For efficient use of computing time, the ordering routine should be very fast in its response. Certain string-sorting techniques require data to be moved about in memory until it is positioned correctly. Such an upheaval can be compared to moving house, lock stock and kitchen sink.

For example, a street of five homes, which house families C, A, D, B, and E, has been selected for reorganisation in such a way that family A will live at number 1, family B at number 2 and so on. Imagine the uproar and chaos such a move would cause.

A simple solution to the problem is that the door numbers should be altered so that the new street numbers appear as 3, 1, 4, 2 and 5. This answer is sometimes used in string sorting, especially where long strings are involved. At first data must be compared letter by letter, but then on completion of the comparison only the addresses need be changed.

Having decided on the method of mobilising data, it is important to choose an algorithm or set of rules for selecting the pieces of data for comparison and when this will take place. The sorting algorithm I have chosen is a shell sort.

In brief, the idea is to start with a coarse adjustment to the list and as rapidly as possible make finer and more detailed movements until the sort is completed. In a list of 20 elements the sort

starts by comparing entries displaced by 10 positions and ordering them. Having completed the cycle through the list, the displacement is halved and the sort begins again. The whole operation is repeated until the order is alphabetic.

If two strings are out of order, the exchange is treated as an interrupt and the current position in the list is stored — a case of "Mind my place in the queue while I am away". The addresses of the strings are exchanged and a reverse-direction comparison begins, allowing the misplaced element to bubble up the list.

The servicing of the interrupt is terminated when the element has achieved its rightful position, and the proceedings can continue as before — "I have returned to claim my place in the queue".

To time any program sort is very difficult, since it depends so much on the original data. You can, however, use the times taken to complete the sorting with the original data in the following orders:

- Alphabetic — already sorted
- Random order
- Reverse order

The test data should be of the worse possible type. It should have two properties:

- strings all the same length
- only the last letter is different

For example,

```
aaaaaaaaaaaaaaaaah
aaaaaaaaaaaaaaaaab
aaaaaaaaaaaaaaaaa
```

would take longer to sort into order than

```
h
aaaaaaaaaaaaaaaaab
aaaaaaaaaaaa
```

The program should be stored in the top of memory at 32000 — 7D00 hexadecimal — and appropriate protection should be given to it by changing locations 49, 51 and 53 to 124 (7C). Entry is made by a Sys call. The string array to be ordered is stored with the title A\$, but this can be altered by changing the contents of locations H and H+1.

The program begins by finding the location of the start-of-string storage and searches for the required string-array name — A\$ in this case. Failure to find the array returns the user to Basic. If the name A\$ is encountered, the data concerning the number of members is stored and used to compute the first offset for comparing the members. Each member of the array called A\$ has its details stored in three bytes,

- The first byte contains the string length.
- The second byte contains the low-byte address of the start of the string
- The third byte contains the high-order byte.

Two members are compared letter by letter. Some strings will be longer than others and in such a case the number of letters in the shorter string will be the maximum number of comparisons to be considered. For example,

```
          9999
will require three comparison operations
when considered against
```

```
          999
The outcome will be
          999
          9999
```

Very fast times for sorting have been recorded with this program and there may be scope for its use with floating-point numbers.

```
0001 0000 ;SOURCE FOR STRING SORT USING SHELL METHOD
0002 0000 ;MODIFIED STRINGS FOR 32K PET
0003 0000 ;NEW NAME STRINGS
0004 0000 ;PROG TO SORT STRING A$ STARTING
0005 0000 ;AT A$(C1)
0006 0000 ;14 AUGUST 81 ED
0007 0000
0008 0000
0009 0000
0010 7D00 A5 20 LO = #57
0011 7D02 85 57 HI = #58
0012 7D04 8D 82 7F *=#7D00 ;START ADDR 32000
0013 7D07 A5 20 LDA #2C ;LO ADDR START OF STRINGS
0014 7D09 85 58 STA LO
0015 7D0B 8D 83 7F STA LODUP ;DUPLICATE
0016 7D0E A5 20 LDA #2D ;HI ADDR START OF STRINGS
0017 7D0E A8 00 STA HI
;PICK UP 7 BYTES STA HIDUP ;DUPLICATE
LDY #0 ;CLEAR Y REG (continued on page 111)
```

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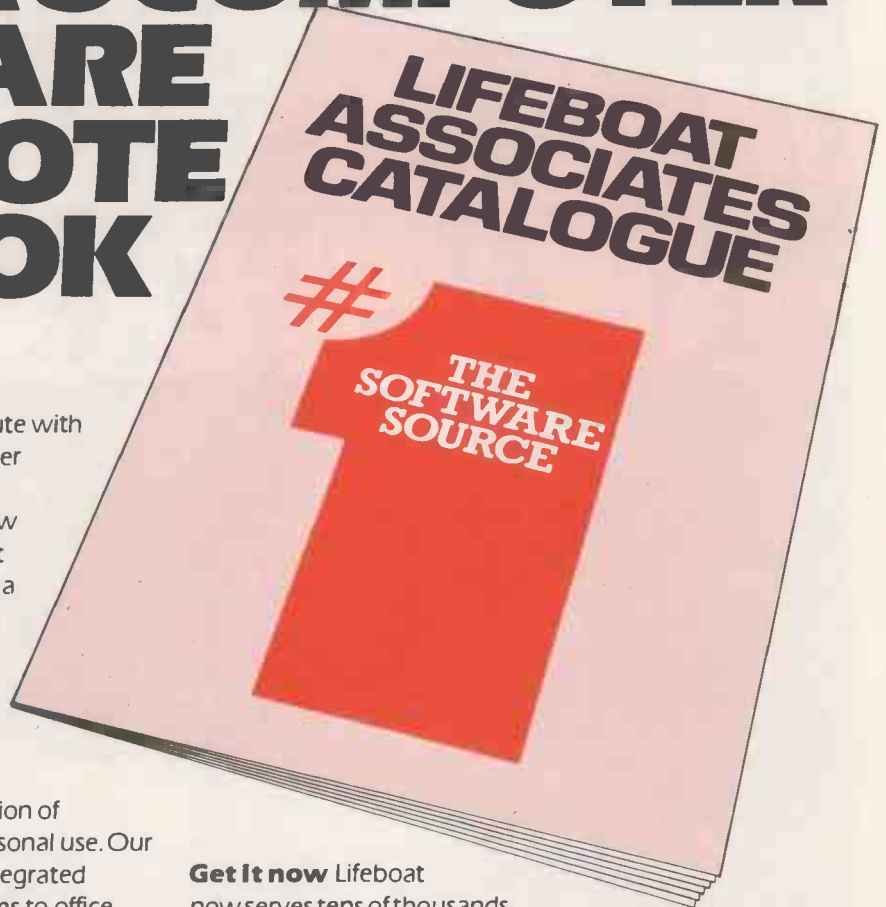
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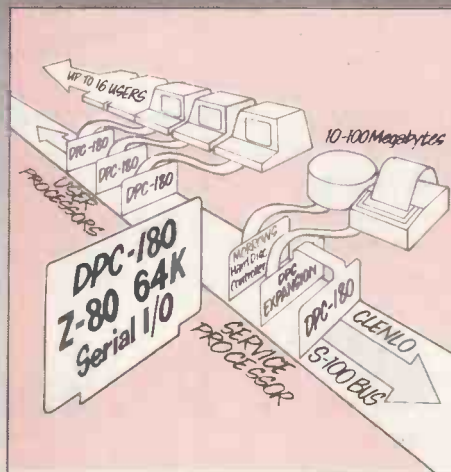
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(continued from page 108)

0018	7D10	B1 57	L1	LDA (LO),Y	
0019	7D12	99 86 7F		STA RD1,Y	
0020	7D15	C8		INY	
0021	7D16	C8 07		CPY #7	
0022	7D18	00 F6		BNE L1	
0023	7D1A	AD 86 7F		LDA RD1	
0024	7D1D	CD 70 7F		CMP H	;IS IT THE RIGHT HEADER
0025	7D20	D0 29		BNE L2	;NO
0026	7D22	AD 87 7F		LDA RD1+1	
0027	7D25	CD 71 7F		CMP H+1	;IS RIGHT TYPE
0028	7D28	D0 21		BNE L2	; NO
0029	7D2A				;THIS IS THE RIGHT STRING
0030	7D2A	AD 8B 7F		LDA RD1+5	;GET DATA ON STRING
0031	7D2D	8D 75 7F		STA NH	;ELEMENT NUMBERS
0032	7D30	AD 8C 7F		LDA RD1+6	
0033	7D33	8D 74 7F		STA NL	;& STORE IT (HI & LO)
0034	7D36	18		CLC	
0035	7D37	AD 88 7F		LDA RD1+2	;SET UP NEXT STRING-
0036	7D3A	65 57		ADC LO	;ADDRESS SO AS NOT TO-
0037	7D3C	8D 84 7F		STA NSL	;OVERRUN
0038	7D3F	A5 58		LDA HI	
0039	7D41	6D 89 7F		ADC RD1+3	
0040	7D44	8D 85 7F		STA NSH	
0041	7D47	18		CLC	
0042	7D48	4C 66 7D		JMP RETR	;RETURN
0043	7D4B	18	L2	CLC	;LOOK FURTHER ON
0044	7D4C	AD 88 7F		LDA RD1+2	
0045	7D4F	65 57		ADC LO	
0046	7D51	85 57		STA LO	
0047	7D53	AD 89 7F		LDA RD1+3	
0048	7D56	65 58		ADC HI	
0049	7D58	85 58		STA HI	;SET UP NEW SEARCH AREA
0050	7D5A	18		CLC	
0051	7D5B	A0 00		LDY #0	
0052	7D5D	A5 2F		LDA #2F	;CHECK IF GONE TOO FAR
0053	7D5F	69 01		ADC #1	
0054	7D61	C5 58		CMP HI	
0055	7D63	10 AB		BPL L1	;ACC-HI SHOULD BE +
0056	7D65				;IF NOT STOP
0057	7D65	60		RET RTS	
0058	7D66			;RETRIEVAL SBR	
0059	7D66	18		RETR CLC	;START TO PRODUCE S=(N+1)/2
0060	7D67			;BUT 1ST SEE IF A*(0) EXISTS	
0061	7D67	AD 82 7F		LDA LODUP	
0062	7D6A	69 07		ADC #7	
0063	7D6C	85 57		STA LO	
0064	7D6E	A9 00		LDA #0	
0065	7D70	6D 83 7F		ADC HIDUP	
0066	7D73	85 58		STA HI	
0067	7D75	18		CLC	
0068	7D76	A0 00		LDY #0	
0069	7D78	B1 57		LDA (LO),Y	
0070	7D7A	F0 05		BEQ L19	;NO A*(0) DOES NOT EXIST
0071	7D7C	A9 07		LDA #7	;YES IT DOES
0072	7D7E	8D AD 7D		STA L21+1	;MOD PROG ACCORDINGLY
0073	7D81	AD 74 7F	L19	LDA NL	;1ST TIME THRO
0074	7D84	8D 76 7F		STA SL	;
0075	7D87	AD 75 7F		LDA NH	
0076	7D8A	8D 77 7F		STA SH	
0077	7D8D	4C A1 7D		JMP L5	
0078	7D90	18	L10	CLC	;OTHER THAN 1ST TIME
0079	7D91	AD 76 7F		LDA SL	
0080	7D94	69 01		ADC #1	
0081	7D96	8D 76 7F		STA SL	
0082	7D99	A9 00		LDA #0	
0083	7D9B	6D 77 7F		ADC SH	
0084	7D9E	8D 77 7F		STA SH	
0085	7DA1	18	L5	CLC	
0086	7DA2	4E 77 7F		LSR SH	;DIVIDE S HI BY 2
0087	7DA5	6E 76 7F		ROR SL	; " LO
0088	7DA8	18	L4	CLC	(continued on next page)
0089	7DA9	AD 82 7F		LDA LODUP	;SET PRIMARY POINTER=1ST
0090	7DAC	69 0A	L21	ADC #10	;OFFSET DEPENDS ON THE EXISTANCE

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(continued from previous page)

```

OF #*(0)
0091 7DAE 80 78 7F STR PL
0092 7DB1 80 7A 7F STR PLOUP ;TAKE DUPLICATE
0093 7DB4 AD 83 7F LDA HI0UP
0094 7DB7 80 79 7F STR PH
0095 7DBA 80 7B 7F STR PHDUP ;TAKE COPY
0096 7DBD 18 CLC
0097 7DBE ;SET COMPARISON POINTER
0098 7DBE ; C=P+S (SHELL SORT)
0099 7DBE
0100 7DBE
;MULTIPLY BY 3 SBR
0101 7DBE AD 76 7F MUL LDA SL
0102 7DC1 2A ROL A
0103 7DC2 80 72 7F STR DUM1 ;#2
0104 7DC5 AD 77 7F LDA SH
0105 7DC8 2A ROL A
0106 7DC9 80 73 7F STR DUM2
0107 7DCC 18 CLC
0108 7DCC AD 76 7F LDA SL
0109 7D00 6D 72 7F ADC DUM1 ;#3
0110 7D03 80 72 7F STR DUM1
0111 7DD6 AD 77 7F LDA SH
0112 7DD9 6D 73 7F ADC DUM2
0113 7DDC 80 73 7F STR DUM2
0114 7DDF 18 CLC
0115 7DE9 AD 72 7F L15 LDA DUM1 ;RETURN FROM #3 SBR
0116 7DE9 AD 72 7F ADC PL
0117 7DE6 80 7C 7F STR CL
0118 7DE9 AD 73 7F LDA DUM2
0119 7DEC 6D 79 7F ADC PH
0120 7DEF 80 7D 7F STR CH
0121 7DF2 18 CLC
0122 7DF3 AD 76 7F LDA PL
0123 7DF6 85 57 STR LO
0124 7DF8 AD 79 7F LDA PH
0125 7DF8 85 58 STR HI
0126 7DFD A0 00 LDV #0 ;CLEAR OFFSET
0127 7DFF
0128 7DFF
;GET SECTION
0129 7DFF B1 57 GET1 LDA (LO),Y
0130 7E01 EA NOP
0131 7E02 99 86 7F STR RD1,Y
0132 7E05 C8 INH
0133 7E06 00 03 CPY #3;GET 3 BYTES
0134 7E08 00 F5 BNE GET1
0135 7E0A AD 7C 7F LDA CL
0136 7E0D 85 57 STR LO
0137 7E0F AD 7D 7F LDA CH
0138 7E12 85 58 STR HI
0139 7E14 A0 00 LDV #0
;GET SECOND 3 BYTES
0140 7E16 B1 57 GET2 LDA (LO),Y
0141 7E18 99 89 7F STR RD1+3,Y
0142 7E1B C8 INH
0143 7E1C 00 03 CPY #3
0144 7E1E 00 F6 BNE GET2
;
;COMPARE LENGTHS OF STRINGS
0145 7E20 LDA #0
0146 7E20 A9 00 STR A
0147 7E20 8D 6D 7F STR RD1+3 ;FLAG FOR 2ND STRING BEING SHORTER
0148 7E22 8D 6D 7F CMP #0
0149 7E25 8D 6D 7F CMP #0 ;IS IT EMPTY?
0150 7E28 00 03 BNE L14 ;IF NOT EMPTY
0151 7E2A 00 03 BNE L14 ;IF EMPTY
0152 7E2C 4C 58 7F JMP EXIT1
0153 7E2C 4C 58 7F JMP EXIT1
0154 7E2F CD 86 7F CMP RD1
0155 7E32 10 06 BPL L3
0156 7E34 EE 6D 7F INC F ;2ND SHORTER
0157 7E37 4C 3D 7E JMP ON
0158 7E3A AD 86 7F LDA RD1
0159 7E3D EA ON
0160 7E3E 8D 6F 7F STR J
0161 7E41 8D 87 7F LDA RD1+1 ;SET UP CHARACTER COUNTER
0162 7E44 8D 8C 7E STR STRP+1
0163 7E47 AD 88 7F LDA RD1+2
0164 7E4A 8D 9D 7E STR STRP+2 ;SETUP ADDR OF 1ST STRING
0165 7E4D AD 8A 7F LDA RD1+4
0166 7E50 8D 5F 7E STR STRC+1
0167 7E53 AD 8B 7F LDA RD1+5
0168 7E56 8D 60 7E STR STRC+2 ;SETUP ADDR OF 2ND STR
0169 7E59 A2 00 LDX #0
0170 7E5B 8D 00 80 STRP LDA #8000,X
0171 7E5E CD 00 80 CMP #8000,X ;COMPARE LETTERS
0172 7E61 EA NOP
0173 7E62 F0 07 BEQ ON1 ;SAME SO CONTINUE TEST
0174 7E64 EA NOP
0175 7E65 10 17 BPL REV ;WRONG ORDER, SO SWAP
0176 7E67 EA NOP
0177 7E68 4C 01 7F JMP EXITN ;IN ORDER, SO EXIT
0178 7E68
;
ON1 INH ;CONTINUE TESTING
0179 7E68 EB CMP J ;DONE ALL?
0180 7E6C 5C 6F 7F BNE STRP ;NO
0181 7E6F 00 EA BNE STRP
0182 7E71 A9 00 LDA #0
0183 7E73 CD 6D 7F CMP F ;WHICH IS SHORTER
0184 7E76 8D 6D 7F STR F ;CLEAR FLAG
0185 7E79 00 03 BNE REV ;2ND WAS SHORTER
0186 7E7B 4C 01 7F JMP EXITN ;EXIT NORMAL
0187 7E7E
;
;REVERSE ORDER
0188 7E7E REV LDV #0
0189 7E7E LDA PL ;PRIMARY LO
0190 7E7E A0 00 STR LO ;READY TO SWAP
0191 7E80 AD 78 7F STR LO
0192 7E83 85 57 LDA PH
0193 7E85 AD 79 7F LDA PH
0194 7E88 85 58 STR HI
0195 7E8A B9 89 7F PUT1 LDA RD1+3,Y
0196 7E8D 91 57 STR (LO),Y
0197 7E8F C8 INH
0198 7E90 C0 03 CPY #3
0199 7E92 D0 F6 BNE PUT1
0200 7E94 A0 00 LDV #0
0201 7E96 AD 7C 7F LDA CL
0202 7E99 85 57 STR LO
0203 7E9B AD 7D 7F LDA CH
0204 7E9E 85 58 STR HI
0205 7E99 B9 86 7F PUT2 LDA RD1,Y
0206 7E93 91 57 STR (LO),Y
0207 7E95 C8 INH
0208 7E96 C0 03 CPY #3
0209 7E98 D0 F6 BNE PUT2
0210 7E9A ;ALL DONE
;
0211 7E9A EXITR LDA #1 ;SET RF FLAG TO 1
0212 7E9A A9 01 NOP
0213 7E9C EA CMP RF ;REVERSED BEFORE?
0214 7E9D CD 6E 7F BEQ L26 ;YES
0215 7E9B F0 18 STR RF
0216 7E92 8D 6E 7F LDA CH ;SAVE YOUR PLACE
0217 7E85 AD 7D 7F STR CHWAS
0218 7E8B 8D 7F 7F LDA CL ;SAVE YOUR PLACE
0219 7E8B AD 7C 7F STR CLWAS
0220 7E8E 8D 7E 7F

```

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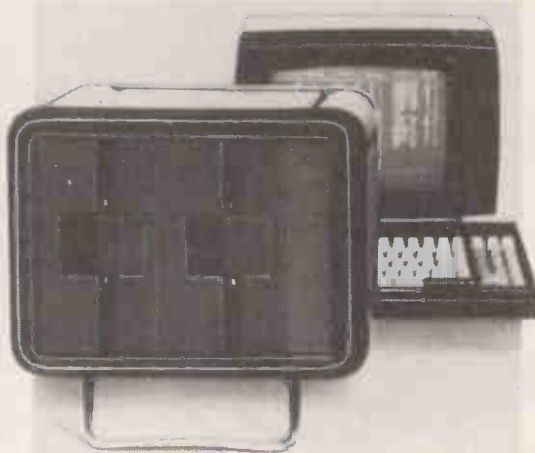
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0221 7EC1 AD 78 7F      LDA PL          ;SAVE YOUR PLACE
0222 7EC4 80 80 7F      STA PLHWS
0223 7EC7 AD 79 7F      LDA PH         ;SAVE YOUR PLACE
0224 7ECA 80 81 7F      STA PHHWS
0225 7ECD AD 79 7F      LDA PH         ;DROP BACK ONE & RETEST
0226 7ED0 80 7D 7F      STA CH
0227 7ED3 AD 78 7F      LDA PL
0228 7ED6 80 7C 7F      STA CL         ;COMPARISON TAKES CURRENT
0229 7ED9 38           SEC             ;PRIMARY POINTER VALUE
0230 7EDA ED 72 7F      SBC DUM1       ;SET UP DOUBLE PRECISION
0231 7EDD 80 78 7F      STA PL         ;SUBTRACTION
0232 7EE0 AD 79 7F      LDA PH         ;CL-S=PL
0233 7EE3 ED 73 7F      SBC DUM2
0234 7EE6 80 79 7F      STA PH
0235 7EE9             ;CHECK IF NEW PRIMARY POINTER STILL IN RANGE
0236 7EE9             ;THE NEW PRIMARY POINTER MUST BE >=
0237 7EE9             ;TO THE ORIGINAL (PHDUP+PLDUP)
0238 7EE9 AD 78 7F      LDA PL         ;SO PH/PL - PHDUP/PLDUP
0239 7EEC 38           SEC             ;SHOULD BE POSITIVE
0240 7EED ED 7A 7F      SBC PLDUP
0241 7EF0 AD 79 7F      LDA PH
0242 7EF3 ED 7B 7F      SBC PHDUP
0243 7EF6 EA           NOP
0244 7EF7 EA           NOP
0245 7EF8 EA           NOP
0246 7EF9 10 03       BPL L10        ;OK
0247 7EFB 4C 01 7F      JMP EXITH      ;NOT OK
0248 7EFE 4C F2 7D      JMP L8
0249 7F01 18           ;EXIT NO REVERSAL
0250 7F02 A9 00       LDA #0         ;HAS PREVIOUS OP A REVERSAL?
0251 7F04 CD 6E 7F      CMP RF
0252 7F07 F0 1B       BEQ L22
0253 7F09 80 6E 7F      STA RF
0254 7F0C AD 80 7F      LDA PLHWS
0255 7F0F 80 78 7F      STA PL
0256 7F12 AD 81 7F      LDA PHHWS
0257 7F15 80 79 7F      STA PH
0258 7F18 AD 7F 7F      LDA CHHWS
0259 7F1B 80 7D 7F      STA CH
0260 7F1E AD 7E 7F      LDA CHHWS
0261 7F21 8D 7C 7F      STA CL
0262 7F24 AD 78 7F      LDA PL
0263 7F27 18           CLC
0264 7F28 69 03       ADC #3
0265 7F2A EA           NOP
0266 7F2B 8D 78 7F      STA PL         ;INCREMENT PRIMARY POINTER
0267 7F2E 90 04       BCC L6
0268 7F30 EE 79 7F      INC PH         ;THERE WAS CARRY
0269 7F33 18           CLC
0270 7F34 AD 7C 7F      LDA CL         ;INCREMENT COMPARISON PTR
0271 7F37 69 03       ADC #3
0272 7F39 8D 7C 7F      STA CL
0273 7F3C 90 04       BCC L7
0274 7F3E EE 7D 7F      INC CH
0275 7F41 18           CLC
0276 7F42 AD 7C 7F      LDA CL
0277 7F45 CD 84 7F      CMP NSL
0278 7F48 F0 03       BEQ L11
0279 7F4A 4C F2 7D      JMP L8
0280 7F4D AD 7D 7F      LDA CH
0281 7F50 CD 85 7F      CMP NSH
0282 7F53 F0 03       BEQ EXITH1    ;YES
0283 7F55 4C F2 7D      JMP L8        ;NO
0284 7F58 AD 77 7F      LDA SH
0285 7F5B C3 00       CMP #0        ;YES DONE ONE RUN.
0286 7F5D F0 03       BEQ L12
0287 7F5F 4C 90 7D      JMP L10
0288 7F62 AD 76 7F      LDA SL
0289 7F65 C9 01       CMP #1
0290 7F67 F0 03       BEQ RBAS
0291 7F69 4C 90 7D      JMP L10
0292 7F6C 60         RTS
0293 7F6D 60         F             ;FLAG FOR SECOND STRING SHORTER T
0294 7F6E 00         RF          ;.BYTE 0
0295 7F6F 00         J           ;FLAG FOR REVERSAL/RECYCLE
0296 7F70 41         H          ;LETTER COUNTER FOR COMPARING STR
0297 7F71 80         H          ;.BYTE #41
0298 7F72 00         H          ;.BYTE #80
0299 7F73 00         DUM1       ;.BYTE 0
0300 7F74 00         DUM2       ;.BYTE 0
0301 7F75 00         NH         ;.NUMBER OF ELEMENTS
0302 7F76 00         SL         ;.BYTE 0
0303 7F77 00         SH         ;.BYTE 0
0304 7F78 00         PL         ;.BYTE 0
0305 7F79 00         PH         ;.BYTE 0
0306 7F7A 00         PLDUP      ;.BYTE 0
0307 7F7B 00         PHDUP      ;.BYTE 0
0308 7F7C 00         CL         ;.BYTE 0
0309 7F7D 00         CH         ;.BYTE 0
0310 7F7E 00         CHHWS     ;.BYTE 0
0311 7F7F 00         CHHWS     ;.BYTE 0
0312 7F80 00         PLHWS     ;.BYTE 0
0313 7F81 00         PHHWS     ;.BYTE 0
0314 7F82 00         LODUP     ;.BYTE 0
0315 7F83 00         HIDUP     ;.BYTE 0
0316 7F84 00         NSL       ;.BYTE 0
0317 7F85 00         NSH       ;.BYTE 0
0318 7F86 00         RDI       ;.BYTE 0
0319 7F87 00         ;.BYTE 0
0320 7F88 00         ;.BYTE 0
0321 7F89 00         ;.BYTE 0
0322 7F8A 00         ;.BYTE 0
0323 7F8B 00         ;.BYTE 0
0324 7F8C 00         ;.BYTE 0
0325 7F8D 00         ;.BYTE 0
0326 7F8E 00         ;.BYTE 0
0327 7F8F         .END

ERRORS = 0000
SYMBOL TABLE
SYMBOL VALUE
CH 7F7D CHHWS 7F7F CL 7F7C CHHWS 7F7E
DUM1 7F72 DUM2 7F73 EXITH1 7F58 EXITH 7F01
EXITR 7EAA F 7F6D GET1 7DFF GET2 7E16
H 7F70 HI 0058 HIDUP 7F03 J 7F6F
L1 7D10 L10 7D90 L11 7F4D L12 7F62
L14 7E2F L15 7DE0 L18 7EFE L19 7D81
L2 7D48 L21 7D4C L22 7F24 L26 7EED
L3 7E3A L4 7D48 L5 7D41 L6 7F34
L7 7F42 L8 7D2F L0 0057 LODUP 7F82
MUL 7DBE NH 7F75 HL 7F74 NSH 7F85
NSL 7F84 ON 7E30 ONI 7E6B PH 7F79
PHDUP 7F7B PHHWS 7F81 PL 7F78 PLDUP 7F7A
PLHWS 7F80 PUT1 7E8A PUT2 7EA0 RBAS 7F6C
RF 7F86 RET 7D65 RETR 7D66 REV 7E7E
RDI 7F87 SH 7F77 SL 7F76 STRC 7E5E
STRP 7E5B
END OF ASSEMBLY
    
```

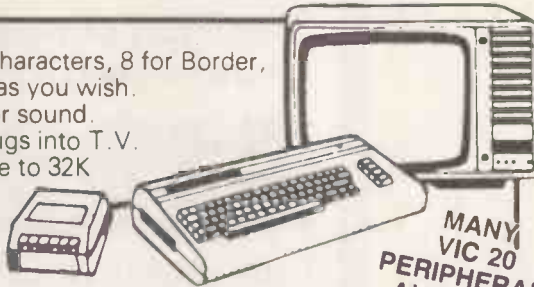

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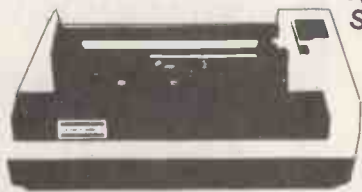
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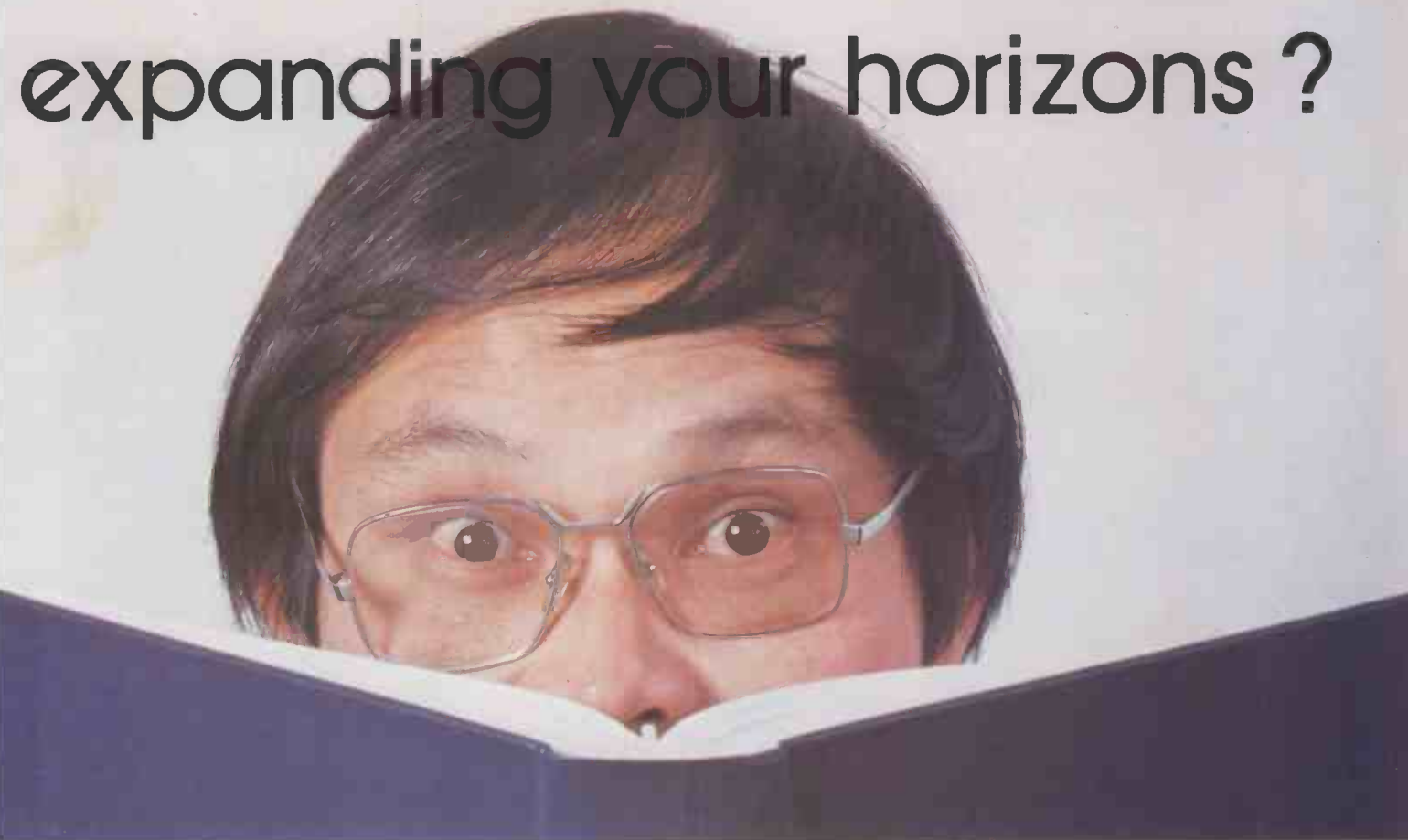


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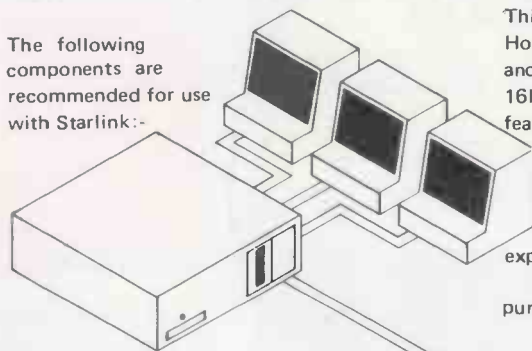
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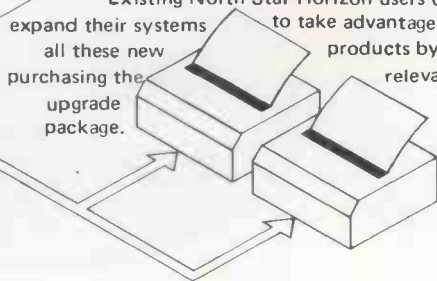
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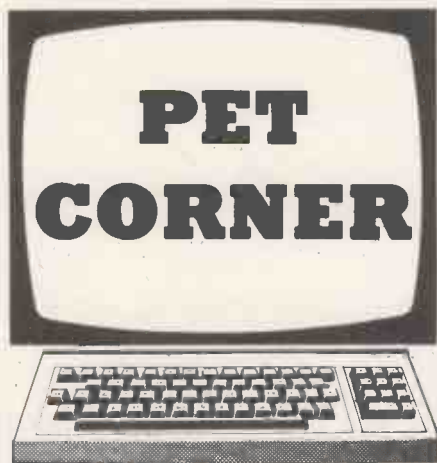
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Open File

This new section of *Practical Computing* will be appearing in the magazine each month, incorporating Tandy Forum, ZX-80/81 Line-up and the other software interchange pages.

Open File is the part of the magazine written by you, the readers. All aspects of microcomputing are covered, from games to serious business and technical software, and we welcome contributions on CP/M, BBC Basic, Microsoft Basic, Apple Pascal and so on, as well as the established categories.

Each month the best contribution will be awarded £20; others receive £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.



Cassette files

I ENCOUNTERED recently an interesting bug in the way the Pet opens cassette files, writes David Haslam of Stockport, Greater Manchester. One program I was

Pet Corner: Cassette files bug; Screen Print for 4000 series; Going down for the lower-case descenders; Othello; Kaleidoscope	117
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Guidelines for contributors

Programs should be accompanied by documentation which explains to other readers what your program does and, if possible, how it does it. It helps if documentation is typed or printed with double-line spacing — cramped or handwritten material is liable to delay and error.

Program listings should, if at all possible, be printed out. Use a new ribbon in your

printer, please, so that we can print directly from a photograph of the listing and avoid typesetting errors. If all you can provide is a typed or handwritten listing, please make it clear and unambiguous; graphics characters, in particular, should be explained.

We can accept material for the Pet, Vic and Sharp MZ-80K on cassette, and material for the larger machines can be sent on IBM-format 8in. floppy discs.

working on stored as lines of text as a Basic file. I wrote the following subroutine to read the line numbers into L3 and the line of text into L\$.

As I was not interested in using the link bytes, line 50 merely skips those in passing, they are in LA\$,LB\$ if needed. Lines 60 and 70 are needed because the Get statement interprets a zero as a null string. I use this property to terminate line 90 on the end of line zero byte of the Basic text.

This routine worked satisfactorily on all subsequent lines, except for the first line of text in the stored file. The file in F\$ had been opened for read by the command Open 1,1,0,F\$.

Here is the bug. The first line would read correctly if I deleted LA\$ from line 50, thus indicating that the first cassette buffer pointer is one byte too high immediately after the Open command. So the solution which worked was to have this on the same line as the Open command.

POKE 187,PEEK(187)-1

Finally, for those who might wonder why I did not use Input # instead of Get # on line 90, the reason is simply that although it would be satisfactory on lines of text with no embedded quotation marks — it would terminate on the zero byte — problems arise when the line of

(continued on next page)

```

50 L$= " ": GET#1,LA$,LB$,LL$, LH$: REM STRIP LINK BYTES & LINE NUMBER
60 IF LL$="" THEN LL$=CHR$(0)
70 IF LH$="" THEN LH$=CHR$(0)
80 L3=ASC(LL$)+256*ASC(LH$) : REM LINE NUMBER = L3
90 GET#1, Q$: IF Q$<>" " THEN L$=L$+Q$:GOTO 90
95 RETURN : REM LINE OF TEXT = L$

```


(continued from previous page)

text contains, say, just one embedded quotation, in which case there is a continued read until usually a file data error occurs.

Screen print

MAY I offer a small contribution to the excellent screen printer program by J Dick and M Valentine which appeared in Pet Corner last June, writes D A Harris of Surbiton, Surrey. Altering a few lines allows the program to be used with a series 4000 Pet and 4022 printer. The listing shows the lines which need to be altered.

```

27 DATA A9,04,20,E2,F2,A9,06,20
28 DATA E2,F2,A5,35,35,02,60,EA
33 DATA 18,20,46,BB,20,A6,F2,A9
37 DATA 05,A9,11,20,46,BB,18,B1
46 DATA 69,40,85,0F,A9,92,20,46
47 DATA BB,4C,BD,XX,85,0F,A9,12
48 DATA 20,46,BB,A5,0F,20,46,BB
50 DATA D0,9C,20,DF,BA,A2,00,A5
53 DATA A6,F2,60,A5,D2,A6,D3,A9
55 DATA 63,F5,A6,D2,20,FE,F7,60

```

Going down

THE DOT-MATRIX printers supplied by Commodore for use with the Pet, though robust and reliable, are in some ways annoying and quixotic, writes A D Maude at Aberystwyth, Dyfed. One of their shortcomings is the inability to print characters with tails which go below the line, known as "descenders", such as q,g or p.

Some models, such as the 3022, have the facility to move the paper on by a fraction of a line separation, and to print special characters designated by software. This program uses these facilities to produce descenders at the cost of a slower rate of printing.

As the main line and descenders are printed on separate sweeps of the printer head, paper in a traction-feed printer must be under a slight tension. Otherwise, it may not move on by quite the correct

Going down

```

1 REM PRINTING WITH DESCENDERS
10 CLR:GOSUB 5000
20 DIM X$(7)
30 PRINT#6,CHR$(29):FOR K=1 TO 7:READ X$(K):PRINT#4,X$(K):NEXT K
40 PRINT#4:PRINT#4:PRINT#4
50 FOR K=1 TO 7:A$=X$(K):GOSUB 4000:NEXT K
60 CLOSE 4:CLOSE 5:CLOSE 6:STOP
4000 REM
4010 REM *** SUBROUTINE FOR PRINTING A$ ***
4020 CP=1:B$="":REM CP=1/0 FOR UPPER/LOWER CASE
4030 FOR N=1 TO LEN(A$):C$=MID$(A$,N,1)
4040 IF C$="I" THEN CP=1
4050 IF C$="M" THEN CP=0
4060 IF CP=1 THEN 4090
4070 IF C$="P" OR C$="Q" OR C$="Y" OR C$="G" THEN C$=" "
4080 IF C$="J" THEN C$=CHR$(254):REM THE DOT FOR A J
4090 B$=B$+C$:NEXT N
4100 PRINT#5,D1$(0):PRINT#6,CHR$(5):PRINT#4,B$
4110 REM PRINT DESCENDERS
4120 CP=1
4130 FOR J=1 TO 5:FOR N=1 TO LEN(A$):C$=MID$(A$,N,1):D$=" "
4140 IF C$="I" THEN CP=1:GOTO 4180
4150 IF C$="M" THEN CP=0:GOTO 4180
4160 IF C$=C1$(J) AND CP=0 THEN D$=CHR$(254)
4170 PRINT#4,D$:
4180 NEXT N
4190 PRINT#5,D1$(J):PRINT#6,CHR$(1):PRINT#4:NEXT J
4200 PRINT#6,CHR$(12):PRINT#4:RETURN
5000 REM
5010 REM *** SET UP SPECIAL CHARACTERS AND PREPARE PRINTER ***
5020 DIM D1$(5),C1$(5)
5030 OPEN 4,4:OPEN 5,4,5:OPEN 6,4,6:RESTORE
5040 FOR J=0 TO 5:D1$(J)=" "
5050 FOR N=1 TO 6:READ A:D1$(J)=D1$(J)+CHR$(A):NEXT N
5060 READ C1$(J):NEXT J:RETURN
5100 REM
5110 REM SPECIAL CHARACTER DATA
5120 DATA 0,0,0,64,0,0," "
5130 DATA 2,1,1,126,0,0,"J"
5140 DATA 127,40,68,68,56,0,"P"
5150 DATA 56,68,68,40,127,0,"Q"
5160 DATA 113,9,5,9,126,0,"Y"
5170 DATA 56,69,69,69,62,0,"G"
5200 REM
5210 REM TEXT TO BE PRINTED
5220 DATA "COMMODORE PRINTING WITH DESCENDERS"
5230 DATA "-----"
5240 DATA "A.D.MAUDE, JUNIORITY COLLEGE OF WALES, ABERYSTWYTH,"
5250 DATA "THE DOT MATRIX PRINTERS SUPPLIED BY COMMODORE FOR USE WITH"
5260 DATA "THE PET) ARE ROBUST AND RELIABLE, BUT IN SOME WAYS ARE JUST A"
5270 DATA "LITTLE ANNOYING AND QUIXOTIC. ONE OF THEIR SHORTCOMINGS IS THEIR"
5280 DATA "INABILITY TO PRINT CHARACTERS WITH TAILS WHICH GO BELOW THE LINE."

```

distance, and so the descenders may be slightly displaced.

Othello

TWO PEOPLE can play Othello on the program from Stephen Cronk of Litlington, near Royston, Hertfordshire. The program checks for legal moves and scores and

outputs suitable verbal remarks and instructions at various points during the game via the wideband Speakeasy speech synthesiser.

If you do not have the Speakeasy unit, delete line 60010. The £ sign in line 80 is the graphic character " - " and the % in the following lines is the character "I".

Othello

```

0 POKE59459,255:POKE59468,205
1 P=33005:K1=33085:Y1=33125:W1=33205:B1=33285:P1=2:BT=2:WT=2
2 GOSUB6000
5 PRINT"":DIMB(9,9,2)
10 REM OTHELLO: NOT BY SHAKESPEARE
20 REMARKABLY COMMITTED BY S.CRONK 15/5/1981
21 REM CONNECT WIDEBAND SPEAKEASY SPEECH UNIT
22 REM---IF YOU DARE!!!!-----
23 REM-----
30 PRINTSPC(16);"OTHELLO"
40 PRINTSPC(15);"EEEEEEEEEE"
50 PRINTSPC(12);"BY STEVE CRONK"
60 PRINT
70 PRINTSPC(11);"1 2 3 4 5 6 7 8 PLAYER"
80 PRINTSPC(10);"OEEEEEEEEEEEEEE EEEEEEEEEEE"
90 PRINTSPC(9);"A%";SPC(23);"X"
100 PRINTSPC(10);"%";SPC(23);"Y"
110 PRINTSPC(9);"B%"
120 PRINTSPC(10);"% "
130 PRINTSPC(9);"C%"
140 PRINTSPC(10);"% "
150 PRINTSPC(9);"D%":PRINTSPC(10);"%":PRINTSPC(9);"E%":PRINTSPC(10);"% "
160 PRINTSPC(9);"F%":PRINTSPC(10);"%":PRINTSPC(9);"G%"
170 PRINTSPC(10);"%":PRINTSPC(9);"H%"
180 DATA33020,33100,33180,33260,33340
190 DATA33420,33500,33580
195 RESTORE
200 FORJ=1TO8
210 READA:A=A+39:FORK=ATO(A+15)STEP2:L=L+1
220 B(L,J,1)=K:B(L,J,2)=46
230 NEXTK:L=0:NEXTJ
240 GOSUB5000
250 B(4,4,2)=87:B(5,4,2)=81:B(4,5,2)=81:B(5,5,2)=87
260 GOSUB5000
270 P1=1:GOTO276
275 P1=2
276 REM
280 GOSUB6000:IF G=1 THEN 510
290 IFB(XM,YM,2)=46THEN301
300 GOSUB10200:POKE33078,133:FORJ=1TO500:NEXT:POKE33078,32:GOTO280
301 C=87:C1=B1:R=0
305 IFP1=1THENC=B1:C1=87
310 XT=XM:YT=YM
315 R=0
316 IFRND(1)>.9THENGOSUB10400
320 W=0:Z=0:GOSUB7000
330 Z=1:GOSUB7000
340 Z=-1:GOSUB7000
350 W=1:Z=0:GOSUB7000
360 Z=1:GOSUB7000
370 Z=-1:GOSUB7000
380 W=-1:Z=0:GOSUB7000
390 Z=-1:GOSUB7000
400 Z=1:GOSUB7000
410 IFR=OTHEN300
420 R1=R+1:GOSUB5000
500 IFR1=6OTHEN9500
510 IFP1=1THEN275
520 IFP1=2THEN270
525 FORJ=1TO2000:NEXT
530 PRINT"":SPC(10);
535 IFWT>BTTHEN560
540 PRINT"BLACK WON BY";BT-NT
550 GOTO570
560 PRINT"WHITE WON BY";WT-BT
565 GOSUB10300
570 END
5000 FORX=1TO8:FORY=1TO8
5010 POKEB(X,Y,1),B(X,Y,2)
5020 NEXTY:NEXTX:RETURN
6000 IFP1=1THENPOKEP,49
6001 G=0:GOSUB10100
6009 POKEY1,32
6010 IFP1=2THENPOKEP,50
6020 POKEX1,32:GETA$:IFA$<" "THEN6040
6030 POKEX1,102:GOTO6020
6040 IFA$="N"THENG=1:RETURN
6045 IFA$<"1"OR"2"OR"3"THEN6020
6050 POKEX1,VAL(A$)+4B1XM=VAL(A$)
6060 POKEY1,32:GETA$:IFA$<" "THEN6080
6070 POKEY1,102:GOTO6060
6080 IFA$<"A"OR"2"OR"3"THEN6060

```

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```

6090 POKEY1,ASC(A*)-64:YM=ASC(A*)-64
6100 RETURN
7000 XT=XM:YT=YM:F=0
7010 XT=XT+Z:YT=YT+W
7020 IFB(XT,YT,2)=CORB(XT,YT,2)=46THEN7500
7025 IFYT<1DRYT>8DRXT<1DRXT>8THEN7500
7030 XT=XT+Z:YT=YT+W
7040 IFB(XT,YT,2)=CTHENF=1
7050 IFYT>8DRXT<1DRYT>8DRYT<1THEN7070
7060 GOTD7030
7070 IFF=0THEN7500
7080 XT=XM:YT=YM:B(XM,YM,2)=C
7090 XT=XT+Z:YT=YT+W
7100 IFB(XT,YT,2)=CTHEN7500
7110 B(XT,YT,2)=L:R=R+1
7120 GOTD7090
7500 RETURN
8000 PRINT"":SPC(13):"INSTRUCTIONS"
8005 GOSUB10000
8010 PRINTSPC(12):"EEEEEEEEEEEEEE"
8020 PRINT
8030 PRINT"THE PLAYER MUST PLACE A COUNTER IN A"
8040 PRINT"FREE SQUARE ADJACENT TO AN OCCUPIED"
8050 PRINT"SQUARE IN SUCH A WAY THAT AT LEAST ONE"
8060 PRINT"OF THE OPPONENT'S COUNTERS LIES BETWEEN"
8070 PRINT"THE CURRENT COUNTER AND ANOTHER OF HIS"
8080 PRINT"OWN COUNTERS IN STRAIGHT LINE"
8090 PRINT"ALL THE OPPONENTS COUNTERS SO"
8100 PRINT"SANDWICHED BECOME CAPTURED"
8110 PRINT:PRINT" PLAYER 1=0"
8120 PRINT:PRINT" PLAYER 2=W"
8130 PRINT:PRINT" PRESS ANY KEY TO START"
8140 GETA$:IFA$=" "THEN8140
8150 RETURN
9000 GOTD9000
9500 PRINT" GAME OVER":FORX=1TO8:FORY=1TO8
9510 IF B(X,Y,2)=B1THENWT=WT+1
9520 IF B(X,Y,2)=B7THENBT=BT+1
9530 NEXT: NEXT: RETURN
10000 RESTORE
10010 READ A5: IFA5<>230THEN10010
10020 READA5: IFA5<-1THENRETURN
10030 GOSUB60000
10040 GOTD10020
10100 RESTORE
10110 IFF1=2THEN10160
10120 READA5: IFA5<>240THEN10120
10130 READA5: IFA5<-1THEN10150
10140 GOSUB60000: GOTD10130
10150 FORA6=1TO7: READA5: NEXTA6: GOTD10180
10160 READA5: IFA5<>250THEN10160
10170 READA5: IFA5<-1THEN10180
10175 GOSUB60000: GOTD10170
10180 READA5: IFA5<-1THENRETURN
10190 GOSUB60000: GOTD10180
10200 RESTORE
10210 READA5: IFA5<>270THEN10210
10220 READA5: IFA5<-1THENRETURN
10230 GOSUB60000: GOTD10220
10300 RESTORE
10310 READA5: IFA5<>290THEN10310
10320 READA5: IFA5<-1THENRETURN
10330 A5=A5+64: GOSUB60000: GOTD10320
10400 RESTORE
10410 READA5: IFA5<>300THEN10410
10420 READA5: IFA5<-1THENRETURN
10430 GOSUB60000: GOTD10420
60000 POKES9457,A5: POKES9468,237: POKES9468,205
60010 IF PEEK(59469)/4=INT(PEEK(59469)/4) THEN60010
60020 RETURN
61000 DATA30, 52,57,59,24,38,63,14,21,0,41,63,31,42,44,15,2,13,63
61010 DATA25,25,23,61,13,25,27,63,-3
61015 DATA240,45,35,0,41,42,27
61020 DATA-3,250,14,24,47,0,25,-3,42,54,55,55,63,12,55,55
61030 DATA15,63,-3
61040 DATA270,56,2,0,42,31,63,16,44,42,10,20,63,-3
61050 DATA290,25,50,13,27,92,87,111,94,26,35,152,134,33,17,35,13,18,63,63
61080 DATA-3
61090 DATA300,56,39,31,63,139,137,146,63,29,50,49,13,63,-3
READY.

```

Kaleidoscope

THIS GAME has been devised on the Pet 4032 by Ian Payton of Winnersh, Berkshire. Kaleidoscope is fully portable and requires no special graphics or cursor controls. All that needs to be changed are the variables:

TL — top-left of VDU, SD — screen depth, SL — screen length, RW — reverse blank, BD — half-density block, OB— ordinary blanks.

You are asked first whether you would like a negative or positive kaleidoscope effect. If you choose 'Negative' the screen is filled with reverse blanks, if not, it is simply cleared.

A border is then drawn around the screen in half-density blocks and the arrays are set up.

The program then goes through a routine which plots reverse blanks on the screen, or ordinary blanks if the space is already occupied. After you press the space key, it waits for another key.

```

READY.
100 REM ***** KALEIDOSCOPE *****
110 TL=32768
120 SD=24
130 SL=40
140 TR=TL+(SL-1)
150 BL=TL+((SD-1)*SL)
160 BR=BL+(SL-1)
170 RW=160
180 BD=102
190 OB=32
200 FORX=1TOSD/2
210 PRINT
220 NEXTX
230 PRINTTAB((SL-12)/2)"KALEIDOSCOPE"
240 PRINT
250 PRINT
260 PRINTTAB((SL-12)/2-1)"BY I.P. PAYTON"
270 FORX=1TOSD/2
280 PRINT
290 NEXTX
300 FORX=1TO1500
310 NEXTX
320 PRINT"DO YOU WANT A NEGATIVE OR POSITIVE"
330 PRINT
340 PRINT"KALEIDOSCOPE EFFECT (N/P) ?"
350 FORX=1TOSD/2
360 PRINT
370 NEXTX
380 GETNP$
390 IFNP$="N" THEN420
400 IFNP$="P" THENGOSUB900: GOTD460
410 GOTD380
420 GOSUB900
430 FORNL=TLTOBR
440 POKENL,RW
450 NEXTNL
460 FORPL=TLTOTR
470 POKEPL,BD
480 NEXTPL
490 FORPL=TLTOBLSTEPSL
500 POKEPL,BD
510 POKEPL+(SL-1),BD
520 NEXTPL
530 FORPL=BLTOBR
540 POKEPL,BD
550 NEXTPL
560 POKEPL,BD
570 LC(1)=TL
570 LC(2)=TR
580 LC(3)=BL
590 LC(4)=BR
600 D1(1)=1
610 D1(2)=-1
620 D1(3)=1
630 D1(4)=-1
640 D2(1)=SL
650 D2(2)=SL
660 D2(3)=-SL
670 D2(4)=-SL
680 XX=INT((SL-1)/2)
690 YY=INT((SD-1)/2)
700 FORX=1TO4
710 L2(X)=LC(X)
720 NEXTX
730 X=INT(XX*RND(1)+1)
740 Y=INT(YY*RND(1)+1)
750 FORZ=1TO4
760 L2(Z)=L2(Z)+(X*D1(Z))+(Y*D2(Z))
770 NEXTZ
780 IFPEEK(L2(1))<>OBTHENCR=OB: GOTD800
790 CR=RW
800 FORZ=1TO4
810 POKEL2(Z),CR
820 NEXTZ
830 GETGG$
840 IFGG$<>" " THEN890
850 GETGG$
860 IFGG$=" " THEN890
870 IFGG$="S" THENGOSUB940: END
880 GOTD850
890 GOTD700
900 FORX=1TOSD/2
910 PRINT
920 NEXTX
930 RETURN
940 FORX=1TOSD
950 PRINT
960 NEXTX
970 RETURN
READY.

```




Solving polynomials

THE SCIENTIFIC use of a computer usually concerns Numerical Analysis, writes Daniel Zlatnik of Mozkin, Israel. Most commercial systems software contains Numerical Methods as an important part of their library.

I am using my Nascom 2 micro-computer to run numerical methods with much success. This short program calculates the roots of a given polynomial. The simplest example is the linear equation of the form:

$$ax + b = 0$$

where a and b are known constants and $a \neq 0$.

The root of the equation will be x_0 , the value of x that will satisfy the equation. For this equation $x_0 = -b/a$.

Another simple standard equation is the quadratic equation:

$$ax^2 + bx + c = 0$$

where $a \neq 0$, and b and c are given constants. For this second order equation we have two roots:

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

$$x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

These roots will be identical when $b^2 - 4ac = 0$

or

$$b^2 = 4ac$$

For $b^2 < 4ac$ there are two other roots called-complex roots.

Two more complex examples are the trigonometric equation

$$x^2 + x \sin x = \cos x$$

and the polynomial equation in the common form:

$$P_n(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_{\mu-1} x + a_{\mu} = 0$$

This program for the Nascom 2 computer is based on a method that is good for any sort of one-variable equation as well as for polynomial equations, which is defined in line 350. Any other equation

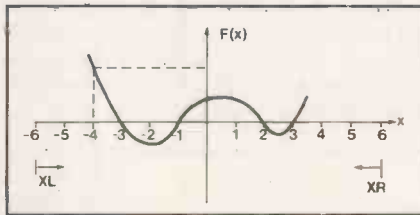


Figure 1.

can be defined in this statement, using the algebraic functions provided by the computer. The initialised printing formats will have to be changed as well, according to the equation structure and constants.

Figure 1 shows a graph of a function $F(x)$ which crosses the x-axis at $x = -3$, $x = -1$, $x = 2$, and $x = 3$. These values are roots of this function for starting to search for the first root of this function. The program asks for an X_L defined as the left limit of x. X_R , the right limit of X is equal to $-X_L$. If for example you take

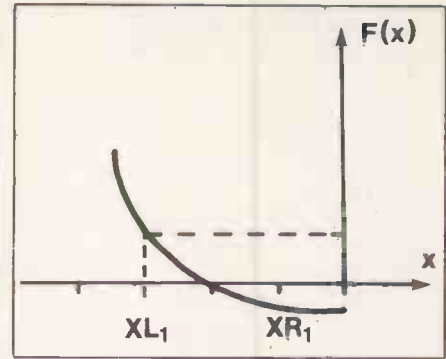


Figure 4.

$X_L = -6$, the program will search for roots which are between $X_L = -6$ and $X_R = +6$.

The program starts by putting $X_{L1} = X_L$, $X_{R1} = X_{L1} + 1$, it calculates the values of $F(X_{L1})$ and $F(X_{R1})$ and then it checks the three possible cases. First, if $F(X_{L1}) * F(X_{R1}) = 0$, then X_{L1} or X_{R1} is an exact roots of the function, the root is printed and the search to the right is carried on.

Secondly, if $F(X_{L1}) * F(X_{R1}) > 0$, then there is no root between X_{L1} and X_{R1} because they are both positive, and the search to the right is carried on — see figure 3. If $F(X_{L1}) * F(X_{R1}) < 0$, then there is a root between these limits (X_{L1} , X_{R1}) so the program starts a loop successively approximates to the root.

Each step of the loop halves the interval between X_L and X_R . The loop ends when the statement

$$X_R - X_L < EPS$$

is true.

Figure 3.

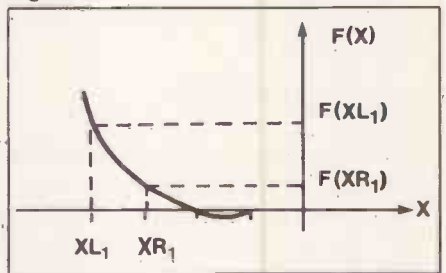
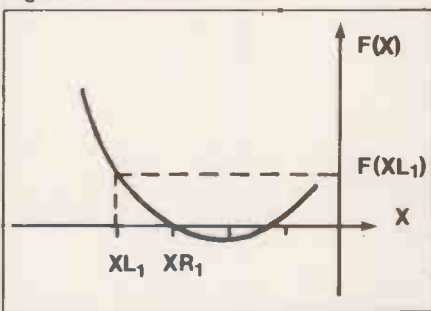


Figure 2.



```

10 REM*** INITIALIZATION ***
20 CLS
30 PRINT" *****"
40 PRINT" * POLINOMIAL ROOTS *"
50 PRINT" *****"
60 PRINT" WRITTEN BY D. ZLATNIK."
70 PRINT" THIS PROGRAM FINDS THE ROOTS OF A-
80 PRINT" GIVEN POLINOM WITH THE FOLLOWING"
90 PRINT" FORM:"
100 PRINT"      5 4 3 2 1 0"
110 PRINT" P(X)=AX +BX +CX +DX +EX +FX"
120 PRINT
130 PRINT" DATA REQUESTED IS:A,B,C,D,E,F"
140 PRINT" AS REAL OR INTEGER CONSTANTS, AND"
150 PRINT" EPS (REAL NUMBER LESS THAN : 1)THE"
160 PRINT" DEGREE OF ACCURACY(ERROR LIMIT)"
170 REM *** INPUT DATA ***
180 PRINT" ENTER DATA: A=";:INPUT A
190 PRINT"      D=";:INPUT D
200 PRINT"      C=";:INPUT C
210 PRINT"      E=";:INPUT E
220 PRINT"      F=";:INPUT F
230 PRINT
240 PRINT
250 PRINT" ENTER EPS (AS 0.1,0.01 ETC.)"
260 PRINT" EPS=";:INPUT EPS

270 PRINT
280 PRINT" FOR FINDING THE ROOTS ENTER"
290 PRINT" XL (XL<0) FOR THE LEFT LIMIT OF X."
300 PRINT" XR (THE RIGHT LIMIT) IS TAKEN AS:"
310 PRINT" XR=XL. THE ROOT IS SUPPOSED TO"
320 PRINT" BE FOUND BETWEEN THESE LIMITS"
330 PRINT" XL=";:INPUT XL
340 REM *** MAIN PROGRAM ***
350 DEF FNP(X)=A*X^5+B*X^4+C*X^3+D*X^2+E*X+F
360 CLS
370 X1=ABS(XL)
380 YL=FNP(XL)
390 XR=XL+1
400 YR=FNP(XR)
410 IF YL*YR=0 THEN GOTO 640
420 IF YL*YR>0 THEN GOTO 600
430 XS=XR
440 X=(XL+XR)/2
450 Y=FNP(X)
460 IF YL*Y=0 THEN GOTO 520
470 IF YL*Y>0 THEN GOTO 550
480 XR=X
490 YR=Y
500 IF XR-XL<EPS THEN GOTO 520
510 GOTO 440

520 PRINT" ROOT IS BETWEEN:XL=";XL,"AND:XR=";XR
530 XL=XS
540 GOTO 580
550 XL=X
560 YL=Y
570 GOTO 500
580 IF XL>X1 THEN GOTO 710
590 GOTO 380
600 IF XR>X1 THEN GOTO 710
610 XL=XR
620 YL=YR
630 GOTO 390
640 IF YL=0 THEN GOTO 690
650 PRINT" ROOT IS: XR=";XR
660 IF XR>X1 THEN GOTO 710
670 XL=XR+1
680 GOTO 380
690 PRINT" ROOT IS: XL=";XL
700 GOTO 600
710 PRINT" LIMITS EXCEEDED. IF MORE ROOTS ARE"
720 PRINT" TO BE FOUND, ENTER: RERUN WITH"
730 PRINT" LARGER LIMITS. IF NOT PRINT END."
740 INPUT AS
750 IF AS="RERUN" THEN GOTO 330
760 END
    
```

sinclair ZX81 PERSONAL COMPUTER



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

1980 saw a genuine breakthrough – the Sinclair 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.



Printer-



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 instructions.

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.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay

by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR.

Order

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	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	
	Post and Packing.			2.95

Please tick if you require a VAT receipt

TOTAL £

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

Please print.

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed.

PRC 04

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, GO SUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING FUNCTIONS	CHR S	●	●		●	●		●
	LEN	●		●	●	●		●
NUMBERS	ASC(CODE), STR S , VAL, INKEY S	●				●		●
	FLOATING PT ±10 ⁻³⁸	●			●	●	●	●
NUMERIC VARIABLES	INTEGERS		●	●	●	●		●
	A-Z			●			●	
STRING VARIABLES	AA-ZØ				●	●		●
	An-Zn, n= any alphanumeric string	●	●					
NUMERIC ARRAYS	A S & B S						●	
	A S to Z S	●	●	●				
DISPLAY	An S to Zn S n= any alphanumeric character				●	●		●
	SINGLE DIMENSIONAL		●	●			●	
SPECIAL FEATURES	MULTI DIMENSIONAL	●			●	●		●
	ROWS	24	24	16	24	25	16	16
SPECIAL FEATURES	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.



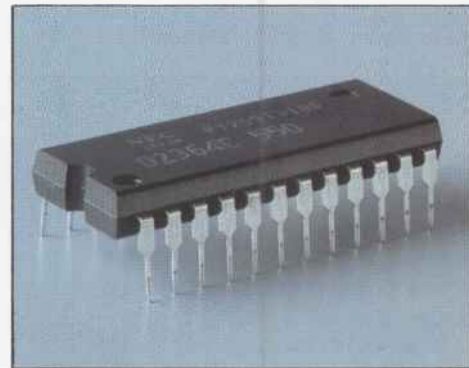
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

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.

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Menu drive

WHEN YOU want a menu for your new program, says F Williams of Llangollen, Clwyd, you should be able to go back to that rather successful routine you used last time, and with your renumber utility patch parts of the old program into your new one. After a few changes it ought to work well and — more important — it is free from bugs. Program 1 is a skeleton for a typical menu routine.

All this is fine as far as it goes, but it is not really as easy as all that. In reusing an old routine you will still have to make a number of alterations especially if you want a tidy layout. Because you have skimped on planning the bugs come swarming in.

Program 2 is therefore the next stage. It provides a standard routine that you can patch straight into any program: all you need do then is write the required words into the Data lines. The program first reads strings from the Data statements in lines 1340 onwards. The main title is read first, as $MS(0)$, followed by the words of each "choice" line. The string "-" terminates this operation. The Read operation takes Data in the order it occurs anywhere in the program, so if you have more than one Read operation in the program you may find it reading the wrong list of data.

While reading the strings, the length of the longest one is measured in line 1110. The program jumps out of the Read loop when it reads a string as "-", and the variable X is adjusted to become the number of lines. S is used to denote the number of unused lines on the screen — line 1140 — and then to denote the size of the three free spaces in the layout.

H is the size of left-hand margin, calculated to put first the title, then the longest string, symmetrically on the screen. Then the title is printed, followed finally by each line of the menu in a loop in lines 1240 to 1290.

Lines 1310 and 1320 input the number of your choice, and verify it. This is carried back to the main program because the action to be taken will vary from program to program. It could be covered in a simple ON I GOSUB -,-,-...

statement or could be much more complex.

General-purpose routines like this one can be used to build into a library of useful subroutines. You can even put the whole library in, the first few thousand lines of every program you write.

Routines to read and write random-access files are particularly useful, though certain standardisation of the file-record structure is necessary. The disadvantages are that your finished program is unnecessarily long and complex and some routines may not even be called by every

program. These snags can be reduced if the program is "crunched".

The best alternative is to write a program-writing program. Using the Apple's Exec command, such a program will write the simple subroutine itself, and splice just the simple subroutine — not the general-purpose one — into your program. This sort of program-writing can be recommended for steadying the nerves.

Though no other micro will do it, the Apple accepts direct commands from a

(continued on next page)

Program 1.

```

10 REM EXAMPLE PROGRAM
100 REM MENU SUBROUTINE
110 HOME : VTAB 3: HTAB 11: PRINT "---- MENU NO.1 ----"
120 HTAB 11: FOR Y = 1 TO 17: PRINT "-";: NEXT : PRINT
130 VTAB 8
140 HTAB 6: PRINT "1. YOUR FIRST ALTERNATIVE."
150 PRINT
160 HTAB 6: PRINT "2. ANOTHER ALTERNATIVE."
170 PRINT
180 HTAB 6: PRINT "3. OR THIS ONE."
190 PRINT
200 HTAB 6: PRINT "4. OR TRY AGAIN."
210 PRINT
220 HTAB 6: PRINT "5. END."
230 PRINT
240 PRINT : HTAB 20: INPUT "ENTER ITEM NO. ";AE
250 IZ = VAL (AE): IF IZ < 1 OR IZ > 5 THEN VTAB PEEK (37) -
2: GOTO 2 40
260 RETURN

```

Program 2.

```

1000 REM MENU SUBROUTINE NO.2
1010 REM GENERAL PURPOSE ROUTINE
1020 REM
1030 DIM ME(20)
1040 REM READ LINE WORDING
1050 HOME : RESTORE : J = 0
1060 READ ME(0)
1070 FOR X = 1 TO 20
1080 : READ ME(X)
1090 : IF ME(X) = "-" THEN GOTO 1130
1100 : IF LEN (ME(X)) > 35 THEN PRINT CHR$ (7);"LINE ";X;" IS TOO LONG
: MAX IS 35 CHRS": STOP
1110 : IF LEN (ME(X)) > J THEN J = LEN (ME(X)): REM FIND LONGEST LINE
1120 NEXT
1130 X = X - 1
1140 S = 20 - X: IF X < 8 THEN S = 20 - (2 + X)
1150 S = INT (S / 3): FOR Y = 1 TO S: PRINT : NEXT : REM SPACE
1160 H = (40 - LEN (ME(0))) / 2: HTAB H: PRINT ME(0): REM H IS LEFT MARG
IN WIDTH
1170 HTAB H: FOR L = 1 TO LEN (ME(0)): PRINT "-";: NEXT
1210 FOR Y = 1 TO S: PRINT : NEXT
1220 H = 18 - (J / 2)
1230 REM PRINT MENU LINES
1240 FOR Y = 1 TO X
1250 : HTAB H: PRINT Y;" ";
1260 : IF Y < 10 THEN PRINT " ";
1270 : PRINT ME(Y)
1280 : IF X < 8 THEN PRINT
1290 NEXT
1300 PRINT : PRINT
1310 VTAB 22: HTAB (22 + J / 2): INPUT "";AE
1320 I = VAL (AE): IF I < 1 OR I > X THEN GOTO 1310
1330 RETURN
1340 DATA MENU NO.2
1350 DATA FIRST CHOICE.
1360 DATA OR THIS.
1370 DATA OR ADD MORE YOURSELF!
1380 DATA -

```


(continued from previous page)

text file, instead of from the keyboard, and in exactly the same way. To write a program from the text file, it must contain all the same key strokes you would make if you were writing the program yourself. When you sit down at your keyboard to write a new subroutine into the program you are working on your type:

```
LOAD XXXXXX
1500 REM MENU ROUTINE
1510 PRINT
```

and so on, and that, letter for letter, is what must be Printed into the text file. Because you cannot write text files directly from the keyboard, the next job is to write a program that will write that file.

To summarise:

- Your program works everything out and then writes the text file.
- The text file commands the Apple, and keys in the routine.
- The routine is, at that stage, in Apple's memory. Save it to disc before running it.

The first part of the program 3 is a straight forward Input section. It Inputs from the keyboard the menu title and the words to go on each line, and also Inputs the name of the main program you want to add your routine to, and the line at which you want to add it.

It is followed by a short section that calculates the line spacings and margin settings, as in program 2. Text-file handling is done in lines 340, 350 and 570 just as in any other file writing. Note the $D\$$ in the commands, and do not confuse these lines with the lines that actually write the text into the file.

For the other lines, think exactly what you do when you key in a new program, and make your program Print those key strokes into the text file. Include the commands you would use to insert this new routine into your main program.

You can use variables in this program, and the Apple will substitute values for them when it Prints to the file. Just include the variables among the strings in the Print statements, with the usual use of the quote marks and semicolons between them.


Because the quote marks are used to mark the beginning and end of strings, the Apple cannot also accept them as part of a string — it obeys them instead of Printing them. However, you must enter quote marks into your file somehow, so that it can output them later. The Apple will accept them if they are called by $CHR\$(34)$. To avoid typing $CHR\$(34)$ every time, you can call it $C\$$.

L is the variable used for the line number, and is incremented by 10 each time it is used. S and H are the same as in Program 2, and $M\$(0..)$ are the strings of words.

From line 360 to line 560, all the initial Prints are instructions to write the line to the text file, and all the remainder of the

line is interpreted by the computer and then written to the file.

When run, this program writes the text file. It then commands EXEC TEXT FILE and the Apple abandons your program — so be sure to save it first — and looks to the text file for all its input instructions.

It accepts these as direct commands, and loads your main program, writes the new lines as dictated by the text file, and even tidies up by deleting the text file itself. It renames your program "Original ..." in case anything has gone wrong, and saves the completed program. 

Program

```
10 REM MENU EXAMPLE 3.
20 DIM L$(20)
30 REM PROGRAM TO WRITE A MENU PROGRAM
40 REM
50 REM FIRST INPUT STRINGS
60 HOME : VTAB 6: HTAB 10: PRINT "WRITE A MENU SUBROUTINE"
70 HTAB 6: PRINT "-----"
80 VTAB 9: PRINT "ENTER THE NAME OF YOUR PROGRAM:-"
90 VTAB 12: PRINT "INSERT MENU ROUTINE AT WHICH LINE?"
100 VTAB 15: PRINT "ENTER:- MENU HEADING:"
110 VTAB 18: HTAB 20: INPUT " ";NE: REM PROGRAM
120 IF LEN (NE) > 33 THEN PRINT CHR$ (7);"TOO LONG. MAX LENGTH IS 33
    CHR$." : GOTO 110
130 VTAB 13: HTAB 20: INPUT " ";AE:L = VAL (AE): IF L < 1 OR L > 65999 GOTO
    130: REM LINE
140 VTAB 16: HTAB 20: INPUT " ";M$(0): REM HEADING
150 VTAB 22: HTAB 10: PRINT "(ENTER -- TO STOP.)"
160 POKE 35,21: VTAB 18
170 FOR X = 1 TO 20
180 : PRINT "LINE ";X;" WORDING: ";: INPUT " ";M$(X)
190 : IF M$(X) = "-" THEN GOTO 230
200 : IF LEN (M$(X)) > 33 THEN PRINT CHR$ (7);"TOO LONG. MAX LENGTH IS
    33 CHR$." : GOTO 180
210 : IF LEN (M$(X)) > J THEN J = LEN (M$(X))
220 NEXT
230 X = X - 1: POKE 35,24: CALL - 958
240 PRINT : HTAB 10: INPUT "ARE ALL ENTRIES CORRECT? ";AE: IF LEFT$ (AE
    ,1) < > "Y" GOTO 60
250 REM
260 REM NEXT CALCULATE VARIABLES
270 S = 20 - X: IF X < 8 THEN S = 20 - (X + 2)
280 S = INT (S / 3)
290 H = INT ((40 - LEN (M$(0))) / 2)
300 DE = CHR$ (4):CE = CHR$ (34): REM CTRL-D & "
310 REM
320 REM FINALLY WRITE THE TEXT FILE
330 REM ENTER LINE 'HOME' & 'PRINT DE;"MON I,C,O"' HERE IF YOU WANT TO
    SEE THE ACTION
340 PRINT DE;"OPEN TEXT FILE"
350 PRINT DE;"WRITE TEXT FILE"
355 REM PRINT TO TEXT FILE
360 PRINT "NEW"
370 PRINT "LOAD ";NE
380 PRINT L;" REM MENU SUBROUTINE":L = L + 10
390 PRINT L;" HOME:VTAB ";S;":HTAB ";H;":PRINT ";CE;M$(0);CE:L = L + 10
400 PRINT L;" HTAB ";H;":FOR Y = 1 TO "; LEN (M$(0));":PRINT ";CE;";";CE
    ";:NEXT:PRINT":L = L + 10
410 PRINT L;" VTAB ";(S * 2) + 2:L = L + 10
420 H = INT ((35 - J) / 2)
430 FOR Y = 1 TO X
440 : PRINT L;" HTAB ";H;":";
450 : PRINT "PRINT ";CE;Y;". ";
460 : PRINT M$(Y);CE
470 :L = L + 10
480 : IF X < 8 THEN PRINT L;" PRINT":L = L + 10
490 NEXT
500 PRINT L;" PRINT: HTAB 20: INPUT ";CE;"ENTER ITEM NO. ";CE;":AE:L =
    L + 10
510 PRINT L;" IX = VAL(AE): IF IX < 1 OR IX > ";X;"THEN VTAB PEER(37) -
    2: GOTO ";L - 10:L = L + 10
520 PRINT L;" RETURN"
530 REM NOW DO HOUSEKEEPING
540 PRINT "RENAME ";NE;" ORIGINAL ";NE
550 PRINT "SAVE ";NE
560 PRINT "DELETE TEXT FILE"
565 REM TEXT FILE WRITTEN
570 PRINT DE;"CLOSE TEXT FILE"
580 STOP : REM REMOVE THIS LINE AND SAVE PROGRAM ON DISK BEFORE RUNNING
    IT
590 PRINT DE;"EXEC TEXT FILE"
```

For "E" read "S" throughout this listing.



Tape catalogue

THIS PROGRAM was written to run a mail-order catalogue, writes Gavin Smith of Farnham, Surrey, and greatly eased the number of sheets of paper which were scattered across the table whenever it was time to send in the collected money. It can be used for other purposes with very little modification.

On running the program you are given ten options:

- Load file from tape.
- Save file on to tape.
- List of all the customers in memory.
- Examine a file from the customer's name.
- Examine a file from the account number.
- Alter a customer's file.

- Create a file.
- Clear all files from memory.
- Delete a single file.
- End program.

The first two options are routines to load to and from tape, and are machine-dependent. Anyone modifying these sections for their machines will have to change the command Input#-1 to their equivalent command to load a variable from tape; the command Print#-1 is used to load a variable on to tape.

The third routine lists the names of all the customers which are currently stored in the computer. If more than ten names are stored the computer will stop after every ten names and wait for you to read the names and then press Enter before continuing to the next ten names.

The fourth and fifth routines are similar, except that the program first asks for the name of the customer. It then scans through the names until what was typed in corresponds with the first part of the customer's name. So if you have a customer named John and you want to find his file, you could type Joh: it would find it unless there was a second file, which was before John's, and also started with the letters Joh. The fifth option asks you to type in the customer's account number. It then scans through all the account numbers in memory until a match is found. When a match is found in either this routine or the routine which

uses the name of the customer, the program displays all the information which is stored for that customer.

The sixth option first asks you for the customer's name whose file you wish to alter. It then displays all the information on that person, and asks you which item you wish to change and how you wish to change it.

The seventh option asks you to input all the information about the customer to the list of other customers, but will not clear the other customers which are stored in memory.

The eighth option is used when you wish to delete all the files in memory so that you can start afresh. Before deleting the files, the program asks you to confirm that you want it to destroy the files. If you type "Y" it will destroy the files; any other input will return you to the menu.

The ninth option is used to delete a file for which you have no more use. If at anytime you type 10 for your option before saving the files on to tape, you should type Goto 30 rather than Run if you wish to retrieve them.

Input functions

THIS SUBROUTINE for the TRS-80 lets you input a function to the program that you are running, writes R J Broughton of Grantham, Lincolnshire. The function is converted to the code by which the com-

(continued on next page)

```

0 CLEAR 6000
5 PRINT "*** CATALOGUE INFORMATION *** (C) G. SMITH 3/4/81 ***"
6 FOR Z=1 TO 2000: NEXT
10 DIM NA$(50), AN$(50), AD$(50), TE$(50), AO$(50), WI$(50), DA$(50)
20 NF=0
30 PRINT "---MENU---"
40 PRINT "1-LOAD FILES FROM TAPE"
50 PRINT "2-SAVE FILES FROM TAPE"
60 PRINT "3-LIST OF THE CUSTOMERS IN MEMORY"
70 PRINT "4-EXAMINE A FILE FROM A CUSTOMERS NAME"
80 PRINT "5-EXAMINE A FILE FROM AN ACCOUNT NUMBER"
90 PRINT "6-ALTER A CUSTOMERS FILE"
100 PRINT "7-ADD ANOTHER FILE"
110 PRINT "8-CLEAR ALL FILES FROM MEMORY"
120 PRINT "9-DELETE A SINGLE CUSTOMER"
130 PRINT "10-END PROGRAM"
140 INPUT "TYPE IN THE NUMBER OF YOUR CHOICE": CH
150 CH=INT(CH): IF CH=10 THEN END
160 IF CH<1 OR CH>9 THEN 30
170 ON CH GOSUB 1000,2000,3000,5000,6000,7000,8000,9000,10000
180 INPUT "HIT ENTER TO CONTINUE": AA$
190 GOTO 30
1000 INPUT "POSITION THE TAPE, PRESS ENTER WHEN THE TAPE IS IN POSITION": X$: INPUT
#-1, NF
1010 FOR X=1 TO NF
1020 INPUT "#-1, NA$(X), AN$(X), AD$(X), TE$(X), AO$(X), WI$(X), DA$(X)"
1030 NEXT
1040 RETURN
2000 PRINT "HIT ENTER WHEN THE CASSETTE IS READY": AS$: PRINT #-1, NF
2010 FOR X=1 TO NF
2020 PRINT "#-1, NA$(X), AN$(X), AD$(X), TE$(X), AO$(X), WI$(X), DA$(X)"
2030 NEXT
2040 RETURN
3000 FOR X=1 TO NF
3010 PRINT NA$(X)
3020 IF X/10=INT(X/10) THEN 3050
3030 NEXT
3040 RETURN
3050 INPUT "HIT ENTER TO CONTINUE": AA$
3060 GOTO 3030
5000 INPUT "WHAT IS THE NAME OF THE FILE YOU WANT TO SEE": H$:
5010 FOR X=1 TO NF
5020 IF LEFT$(NA$(X), LEN(H$))=H$ THEN 5060
5030 NEXT
5040 PRINT "FILE NOT FOUND"
5050 RETURN
5060 PRINT "FILE FOUND"
5070 PRINT NA$(X); " ACCOUNT NUMBER": AN$(X)
5080 PRINT AD$(X)
5090 PRINT "TELEPHONE NUMBER": TE$(X)
5100 PRINT "AMOUNT OWING $": AO$(X)
5110 PRINT "WEEKLY INSTALLMENTS $": WI$(X)
5120 PRINT "THE LAST PAYMENT WAS MADE ON": DA$(X)
5130 RETURN
6000 INPUT "WHAT IS THE ACCOUNT NUMBER OF THE CUSTOMER": H$:
6010 FOR X=1 TO NF
6020 IF AN$(X)=H$ THEN 6060
6030 NEXT
6040 PRINT "FILE NOT FOUND"
6050 RETURN
6060 PRINT "FILE FOUND"
6070 PRINT NA$(X); " ACCOUNT NUMBER": AN$(X)
6080 PRINT AD$(X)
6090 PRINT "TELEPHONE NUMBER": TE$(X)
6100 PRINT "AMOUNT OWING $": AO$(X)
6110 PRINT "WEEKLY INSTALLMENTS $": WI$(X)
6120 PRINT "THE LAST PAYMENT WAS MADE ON": DA$(X)
6130 RETURN
7000 INPUT "WHAT'S THE NAME OF THE FILE YOU WANT TO ALTER": H$:
7010 FOR X=1 TO NF
7020 IF LEFT$(NA$(X), LEN(H$))=H$ THEN 7060
7030 NEXT
7040 PRINT "FILE NOT FOUND"
7050 RETURN
7060 PRINT "FILE FOUND"
7070 PRINT "THE FILE BEFORE ALTERATION:"
7080 PRINT NA$(X); " ACCOUNT NUMBER": AN$(X)
7090 PRINT AD$(X)
7100 PRINT "TELEPHONE NUMBER": TE$(X)
7110 PRINT "AMOUNT OWING $": AO$(X)
7120 PRINT "WEEKLY INSTALLMENTS $": WI$(X)
7130 PRINT "THE LAST PAYMENT WAS MADE ON": DA$(X)
7140 INPUT "WHICH ITEM DO YOU WISH TO CHANGE,
1=NAME, 2=ACCOUNT NO., 3=ADDRESS, 4=TEL. NO., 5=AMOUNT OWING,
6=WEEKLY INSTALLMENTS, 7=LAST PAYMENT DATE": ICH
7150 CH=INT(CH): IF CH<1 OR CH>7 THEN 7070
7160 ON CH GOTO 7170,7190,7210,7230,7250,7270,7290
7170 INPUT "WHAT IS THE NEW NAME": FN$(X)
7180 GOTO 7300
7190 INPUT "WHAT IS THE NEW ACCOUNT NUMBER": AN$(X)
7200 GOTO 7300
7210 INPUT "WHAT IS THE NEW ADDRESS": AD$(X)
7220 GOTO 7300
7230 INPUT "WHAT IS THE NEW TELEPHONE NUMBER": TE$(X)
7240 GOTO 7300
7250 INPUT "WHAT IS THE NEW AMOUNT OWING": AO$(X)
7260 GOTO 7300
7270 INPUT "WHAT IS THE NEW WEEKLY INSTALLMENTS": WI$(X)
7280 GOTO 7300
7290 INPUT "WHEN WAS THE LAST DATE A PAYMENT WAS MADE": DA$(X)
7300 INPUT "WHAT TO CHANGE ANYTHING ELSE(Y/N)": AA$
7310 IF AA$="Y" THEN 7080
7320 RETURN
8000 NF=NF+1
8010 INPUT "WHAT IS THE CUSTOMERS NAME": NA$(NF)
8020 INPUT "WHAT IS THE ACCOUNT NUMBER": AN$(NF)
8030 INPUT "WHAT IS THE ADDRESS": AD$(NF)
8040 INPUT "WHAT IS THE TELEPHONE NUMBER": TE$(NF)
8050 INPUT "HOW MUCH DO THEY OWE": AO$(NF)
8060 INPUT "WHAT ARE THE WEEKLY INSTALLMENTS": WI$(NF)
8070 INPUT "WHEN WAS THE LAST PAYMENT MADE": DA$(NF)
8080 RETURN
9000 INPUT "ARE YOU SURE YOU WANT ALL THE FILES DELETED(Y/N)": AN$:
9010 IF AN$="Y" THEN RETURN
9020 NF=0: PRINT "FILES DELETED"
9030 RETURN
10000 INPUT "WHAT IS THE NAME OF THE FILE YOU WANT DELETED": H$:
10005 IF NF="" THEN PRINT "ILLEGAL": GOTO 10000
10010 FOR X=1 TO NF
10020 IF LEFT$(NA$(X), LEN(H$))=H$ THEN 10060
10030 NEXT
10040 PRINT "FILE NOT FOUND"
10050 RETURN
10060 PRINT "FILE BEING DELETED"
10065 IF X=NF THEN NF=NF-1: GOTO 10160
10070 FOR V=X+1 TO NF
10080 NA$(V-1)=NA$(V)
10090 AN$(V-1)=AN$(V)
10100 AD$(V-1)=AD$(V)
10110 TE$(V-1)=TE$(V)
10120 AO$(V-1)=AO$(V)
10130 WI$(V-1)=WI$(V)
10140 DA$(V-1)=DA$(V)
10150 NEXT: NF=NF-1
10160 PRINT "FILE DELETED": NA$(NF+1)="" : AN$(NF+1)=0
10170 RETURN

```


(continued from previous page)

puter stores program lines, and placed in line 40 of the subroutine.

You access the function by a Gosub command further down the program. You enter the function in the form that you want it, e.g.,

$$Y = \text{SIN}(X)$$

$$T = U*V+W/3$$

or you can even enter sequential steps,

$$S + \text{SIN}(X): A = (S+4)/2.5$$

The subroutine can be repeated as often as is necessary as each new function will overwrite the previous one, and a new colon and Rem is placed at the end of that new function.

The TRS-80 Basic remembers its arithmetic functions in specific codes, so it is necessary to search the inputted string for these functions. Line 110 performs this task, with the arithmetic functions stored in array F2\$(n). If one such function is found, the respective code is stored in the array F3(n). This loop then repeats for the next letter in the inputted string.

If an arithmetic function is not found, the program moves on to the next line 120, and compares the character with the arithmetic operator codes in the array F1\$(n). If there is a match, the specific code is stored in array F3(n) and the program moves on to the next character in the string F\$.

If the operator is not found, the program moves on to line 130 and checks the ASCII value of the character. If it lies in the valid range, the value is stored in the array F3(n).

The program takes the next character in the inputted string and repeats the process until the entire string has been coded. The program now moves on to line 150 and Pokes the array F3(n) values into the space left in line 40, beginning at address 17241. A colon and Rem are Poked in immediately afterward to make all the remaining dots valid.

There are 55 dots in line 40 after the Rem. If you anticipate entering a function with more than 55 characters, put more dots in line 40. Poking out the five-byte code for the line number is fatal.

If you run line 170, it will show the contents of line 40 as stored by the computer, 10 lines at a time. When using the subroutine as part of a program, the program can be placed from line 160 onwards. If you miss out the Rem statements in lines 10 and 30 you must change the Poke address numbers in line 150 to suit the new placing of line 40 in the memory.

The following variables and arrays are used:

- I%: integer counter for F\$, data, & Poke routines,
- I1%: integer counter for F1\$ array,
- I2%: integer counter for F2\$ array,
- I3%: integer counter for F3 array,
- F1: array for arithmetic operator codes,
- F2: array for arithmetic function codes,
- F3: array of F\$ codes to be Poked into line 40,

```

10 REM *** SUBROUTINE TO INPUT LINE INTO THE PROGRAM ***
20 GOT060
30 REM *** FUNCTION WILL BE PUT INTO LINE 40
40 REM.....
50 RETURN
60 REM *** SUBROUTINE TO INPUT FUNCTION
70 CLEAR 500 : DIM F1$(12),F1(12),F2$(13),F2(13),F3(50)
90 DATA =,213,+,205,-,206,*,207,/;208,C,209,SGN,215,INT,216,ABS,217,SQR,221,RND,
222,LOG,223,EXP,224,COS,225,SIN,226,TAN,227,ATN,228,RND,222,FIX,242
90 FOR I%=1 TO 6:READ F1(I%),F1(I%):NEXT I%:FOR I%=1 TO 13:READ F2$(I%),F2(I%):
NEXT I%
100 INPUT"ENTER FUNCTION REQUIRED ";F$:I3%=1
110 FOR I%=1 TO LEN(F$):FOR I2%=1 TO 13:IF MID$(F$,I%,3)=F2$(I2%) THEN F3(I3%)=F
2(I2%):I3%=I3%+1:I%=I%+2:NEXT I2%:ELSE NEXT I2%
120 FOR I1%=1 TO 6:IF MID$(F$,I%,1)=F1$(I1%) THEN F3(I3%)=F1(I1%):I3%=I3%+1:NEXT
I1%:ELSENEXT I1%
130 F4%=ASC(MID$(F$,I%,1)):IF F4%>=35 AND F4%<=90 THEN F3(I3%)=F4%:I3%=I3%+1
140 NEXT I%
150 FOR I%=1 TO I3%-1:POKE17240+I%,F3(I%):NEXT I%:POKE17240+I%,58:POKE17241+I%,14
7
160 REM *** START OF MAIN PROGRAM
170 REM A%=0:FOR I%=17236 TO 17295:PRINT I%,PEEK(I%),CHR$(PEEK(I%)):IF A%=10 THEN INPUT
X%:A%=0:NEXT I%:ELSE A%=A%+1:NEXT I%:REM DISPLAYS CONTENTS OF LINE 40
In the listing ↑ is represented by ↓ (line 80)

```

- F\$: inputted function to be Poked into line 40,
- F1\$: array of arithmetic operators,
- F2\$: array of arithmetic functions.

Binary clock

THE IDEA for this binary clock program first occurred to Killian McCourt of Avoca Lawns, Warrenpoint, County Down, while he was working on a base converter.

The decimal-binary converter is contained in the subroutine from line 5000 onwards. It works by dividing the integer part of the variable T by 2. If the result is a whole number, 0 is added to T, otherwise

I is added. After several loops when T is less than one, T contains the binary equivalent of the initial decimal value of T.

Lines 290 to 340 contain the routine which formats the display, using strings to make the time display neater. The clock part of the program is in lines 360 to 420, where the hours, minutes and seconds are calculated and added up.

The program is intended as a novelty only. The For-Next loop in line 350 gives approximately a one-second delay after all the conversions and calculations have been done in the other parts of the program. The speed of the program depends on the length of the strings.

```

10 REM *****
20 REM * 24-HOUR BINARY CLOCK *
30 REM * VERSION 4 1.9K *
40 REM * COPYRIGHT (C) *
50 REM * KILLIAN MC COURT *
60 REM * 16-8-1981 *
70 REM *****
80 CLEAR 150
90 CLS :PRINT CHR$(23); :PRINT@151,"24-HOUR" :PRINT@216,"BINARY CLOCK" :PRINT
CHR$(28);
100 FOR I= 1 TO 1000 :NEXT
110 PRINT@513,"ENTER THE CORRECT TIME IN THE FORM OF HOURS, MINUTES & SECONDS"
:PRINT
120 INPUT"THE HOUR (IN DECIMAL) IS":OH
130 OH=INT(OH) :IF OH<0 OR OH>23 THEN 120
140 INPUT"THE MINUTES (IN DECIMAL) ARE":OM
150 OM=INT(OM) :IF OM<0 OR OM>59 THEN 140
160 INPUT"THE SECONDS (IN DECIMAL) ARE":OS
170 OS=INT(OS) :IF OS<0 OR OS>59 THEN 160
180 FOR I=1 TO 3
190 OH I GOTO 200, 210, 220
200 T=OH :GOSUB5000 :H=T :GOTO230
210 T=OM :GOSUB5000 :M=T :GOTO230
220 T=OS :GOSUB5000 :S=T :GOTO230
230 NEXT
240 REM *****
250 REM * START OF CLOCK ROUTINE *
260 REM * STRINGS ARE USED *
270 REM * TO FORMAT DISPLAY *
280 REM *****
290 H$=STR$(H) :M$=STR$(M) :S$=STR$(S)
300 LH=LEN(H$)-1 :LM=LEN(M$)-1 :LS=LEN(S$)-1
310 RH$=RIGHT$(H$,LH) :RM$=RIGHT$(M$,LM) :RS$=RIGHT$(S$,LS)
320 HH$=STRING$(5-LH,"0") :MM$=STRING$(6-LM,"0") :SS$=STRING$(6-LS,"0")
330 H%=HH$+RH$ :M%=MM$+RM$ :S%=SS$+RS$
340 CLS :PRINT@402,H%+" " :"+M%+" " :"+S%
350 FOR I=1 TO 230 :NEXT :*** APP. 1 SECOND COUNT
360 IF S=111011 THEN 380
370 OS=OS+1 :T=OS :GOSUB5000 :S=T :GOTO230
380 IF M=111011 THEN 400
390 S=0 :OS=0 :OM=OM+1 :T=OM :GOSUB5000 :M=T :GOTO230
400 IF H=10111 THEN 420
410 S=0 :OS=0 :M=0 :OM=0 :OH=OH+1 :T=OH :GOSUB5000 :H=T :GOTO230
420 H=0 :OH=0 :S=0 :OS=0 :M=0 :OM=0 :GOTO230
5000 REM *****
5010 REM * DECIMAL TO BINARY CONVERSION ROUTINE *
5020 REM *****
5030 T$=""
5040 T=T/2 :IF T=INT(T) THEN T$="0"+T$ ELSE T$="1"+T$
5050 IF T<1 THEN 5070 ELSE 5060
5060 T=INT(T) :GOTO5040
5070 T=VAL(T$) :RETURN

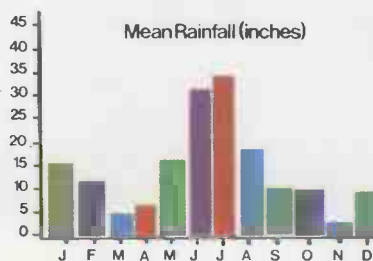
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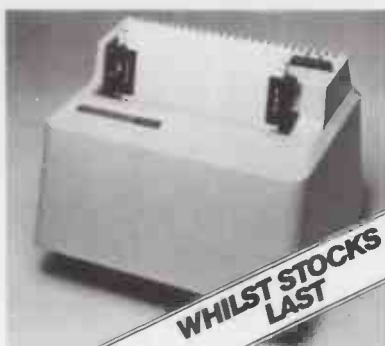
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Extending Basic

TO ALLOW my UK 101 to control a TRS-80 Line Printer VII I wrote this program by using added Basic com-

mands, writes R A Shackelford of Hamilton. It also illustrates a method of extending Basic by adding user commands to it.

The TRS-80 Line Printer VII is a dot-matrix Printer similar to the Seikosha GR-80. In addition to the Centronics interface it has a 600 baud serial interface as standard. By providing switching between 300 and 600 baud on a UK 101 or Superboard, and adding some circuitry to indicate to the UART, through the CTS line, when the Printer is busy, control of the Printer can be effected through the use of the Save flag. Printer-mode selection, head positioning and other control functions can be controlled by turning on the Save flag by a Poke 517,0 and then using PrintChr\$(X) statements where X is the required control code for printing.

A better way to control the printer would be to create Basic commands which could be embedded as statements

in any Basic program. One method of doing this without excessively slowing the execution of Basic is by attaching a command Parser to the Control-C check routine to check each statement for the presence of added commands. Adding a machine-code routine of about 240 bytes allows the addition of eight commands to Basic to control printer output.

The program uses two bytes of page-zero memory \$EE and \$EF for temporary storage. It only requires changes to two bytes to relocate it to another area in memory. To use the routine

- Press Reset.
- Press C. answer memory size with 7900.
- Press Reset.
- Press M then key in program from "1F00".
- Enter "021C/0B, Carriage-return then 1F".
- Enter "0000G to return to Basic via the Warmstart routine".

The additional commands are then available in Basic. After any Reset, re-enter the monitor and execute the last two steps to point the Control-C vector back to the new routine.

The program operates by intercepting the jump to the routine for the Control-C key check which is stored at locations 21C/D. It first tests to see if the computer is in immediate mode. If it is, it skips the additional command routines. To speed up the routine, a check is made only if a colon is found, since the beginning of a new line is a special case which would require much more code to implement and would, in consequence, run more slowly. This also means that if an added command is to be used at the beginning of a line of code it is necessary to precede it by a colon.

The routine then looks at the first character following the colon to see if it is the letter P which is used to precede all the added commands. Otherwise the statement is re-scanned by the normal interpreter for execution.

If a P is found, the program checks for one of a series of command tokens to decide what action is required. These tokens are those generated by the interpreter from the normal Basic keywords to speed up program execution. If no valid token is found, an error is indicated.

The program uses a number of routines in the Basic interpreter as well as some entry points in the monitor. Users of monitors other than the Synmon and MonUK01 may have to change some of the monitor entry points.

The following are added:

PON. All subsequent output goes to the printer and not the screen.

PSTOP. All subsequent output goes to the screen and not the printer.

PPRINT. Prints contents of the printer buffer and performs carriage return without line feed.

PDEF S. Sets printer to single-width print mode.

```

20 0000 ;CODE IN 6502 ASSEMBLY LANGUAGE
30 0000 ;TO ADD COMMANDS TO BASIC.
40 0000 ;COPYRIGHT R A SHACKLEFORD
50 0000 ; 24 JAN 1982
60 1F00 * = $1F00
90 1F00 ;STOP LINE FEED FROM PRINTING
100 1F00 C90A POUTV CMP #10A
110 1F02 D004 BNE NOLF
120 1F04 ;EXPANSION LINK FOR FORM FEED CONTROL
130 1F04 EA NOP
140 1F05 EA NOP
150 1F06 EA NOP
160 1F07 60 RTS
170 1F08 4C81FC NOLF JMP $FCB1
180 1F08 ;CONTROL-C VECTOR BREAK FOR ADDED COMMANDS
190 1F08 A588 CVECT LDA $88
200 1F0D C9FF CMP #FF
210 1F0F D003 BNE NOTIMM
220 1F11 4C3BFF JMP #FF9B
230 1F14 ;SAVE PRESENT C3,C4 POINTER VALUES
240 1F14 A5C3 LDA #C3
250 1F16 85EE STA $EE
260 1F18 A5C4 LDA #C4
270 1F1A 85EF STA $EF
280 1F1C ;CHECK FOR COLON
290 1F1C 20C200 JSR #00C2
300 1F1F C93A CMP #3A ; CHECK
310 1F21 D02A BNE RSTOR2
320 1F23 ;RESTORE UNLESS NEXT IS "P"
330 1F23 20BC00 JSR #00BC
340 1F26 C950 CMP #50 ;P CHECK
350 1F28 D01B BNE RSTORE
360 1F2A ; "ON" TOKEN ?
370 1F2A 20BC00 JSR #00BC
380 1F2D C990 CMP #90 ;ON TOKEN
390 1F2F F01F BEQ PON
400 1F31 ; "STOP" TOKEN ?
410 1F31 C98F CMP #8F ;STOP TOKEN
420 1F33 F02C BEQ PSTOP
430 1F35 ; "PRINT" TOKEN ?
440 1F35 C997 CMP #97 ;PRINT TOKEN
450 1F37 F034 BEQ PPRINT
460 1F39 ; "DEF" TOKEN ?
470 1F39 C995 CMP #95 ;DEF TOKEN
480 1F3B F037 BEQ PDEF
490 1F3D ; "POKE" TOKEN ?
500 1F3D C996 CMP #96 ;POKE
510 1F3F F054 BEQ PPOKE
520 1F41 ; "POS" TOKEN ?
530 1F41 C9B2 CMP #B2 ;POS
540 1F43 F071 BEQ PPOS
550 1F45 ;RESTORE IF NO VALID TOKEN
560 1F45 A5EE RSTORE LDA $EE
570 1F47 85C3 STA #C3
580 1F49 A5EF LDA $EF
590 1F4B 85C4 STA #C4
600 1F4D 4C3BFF RSTOR2 JMP #FF9B
610 1F50 ;
620 1F50 ;
630 1F50 ;
640 1F50 ;
650 1F50 ;
660 1F50 ;
670 1F50 ;
680 1F50 ;*****COMMAND HANDLERS*****
690 1F50 ;PON
700 1F50 ;OUTPUT TO PRINTER NOT SCREEN
710 1F50 A900 PON LDA #100
720 1F52 8D1A02 STA #021A
730 1F55 A91F LDA #1F
740 1F57 8D1B02 STA #021B

```

(listing continued on next page)

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PDEF D. Sets double-width print mode on the printer.
 PDEF G. Sets printer graphic mode.
 PPOS (X). Positions print head to character position defined by variable X.
 PPOKE (X). Positions head to dot X.

Double vision

WHILE EXAMINING the character-generator chip of my UK 101 I found that joining pins 23 and 24 together gives a permanent lower case, writes Chris Thompson of Orpington, Kent. Characters 65 to 90 appear in lower case, as do characters 97 to 122. Other characters, including the cursor, also changed position.

Joining pins 1, 2, and 3 of IC 70 create inverse video reminiscent of the ZX-80 screen, without the flicker. If pins 2 and 3 are joined, about 80 percent of the screen appears normal, while the remainder contains a repeated image of the last line and half of the top section.

Random Poking

WHEN I WAS asked to write a graphical program for the UK 101, writes Jonathan Sunderland of Berkhamsted, Hertfordshire, I came up with a program that generates four random characters and Pokes them so that the first character is repeated to fill a quarter of the screen. The next character fills the next quarter and so on.

Once the process is complete it starts over again using four more random characters.

```

LIST
20 A=INT(RND(130)*254+1)
30 B=INT(RND(130)*254+1)
40 C=INT(RND(130)*254+1)
50 D=INT(RND(130)*254+1)
60 IFA=BORA=CORA=DTHEN20
70 IFB=AORB=CORB=DTHEN30
80 IFC=AORC=BORC=DTHEN40
90 IFD=AORD=BORD=CTHEN50
100 FORU=53259T053282:POKEU,A:NEXTU
110 FORU=53323T053346:POKEU,A:NEXTU
120 FORU=53387T053410:POKEU,A:NEXTU
130 FORU=53451T053474:POKEU,A:NEXTU
140 FORU=53515T053538:POKEU,A:NEXTU
150 FORU=53579T053602:POKEU,A:NEXTU
160 FORU=53643T053666:POKEU,A:NEXTU
170 FORU=53707T053730:POKEU,A:NEXTU
180 FORU=53771T053794:POKEU,C:NEXTU
190 FORU=53835T053858:POKEU,C:NEXTU
200 FORU=53899T053922:POKEU,C:NEXTU
210 FORU=53963T053986:POKEU,C:NEXTU
220 FORU=54027T054050:POKEU,C:NEXTU
230 FORU=54091T054114:POKEU,C:NEXTU
240 FORU=54155T054178:POKEU,C:NEXTU
250 FORU=54219T054242:POKEU,C:NEXTU
260 FORU=53283T053306:POKEU,D:NEXTU
270 FORU=53347T053370:POKEU,D:NEXTU
280 FORU=53411T053434:POKEU,D:NEXTU
290 FORU=53475T053498:POKEU,D:NEXTU
300 FORU=53539T053562:POKEU,D:NEXTU
310 FORU=53603T053626:POKEU,D:NEXTU
320 FORU=53667T053690:POKEU,D:NEXTU
330 FORU=53731T053754:POKEU,D:NEXTU
340 FORU=53795T053818:POKEU,B:NEXTU
350 FORU=53859T053882:POKEU,B:NEXTU
360 FORU=53923T053946:POKEU,B:NEXTU
370 FORU=53987T054010:POKEU,B:NEXTU
380 FORU=54051T054074:POKEU,B:NEXTU
390 FORU=54115T054138:POKEU,B:NEXTU
400 FORU=54179T054202:POKEU,B:NEXTU
410 FORU=54243T054270:POKEU,B:NEXTU
420 GOTD20
DK
  
```

(listing continued from previous page)

```

750 1F5A 20BC00 PEKIT JSR $00BC
760 1F5D D0B5 POPOS BNE NOTIMM
770 1F5F F0B3 BEQ NOTIMM
780 1F61 ;PSTOP
790 1F61 ;OUTPUT TO SCREEN,STOP PRINTING
800 1F61 A969 PSTOP LDA #$69
810 1F63 8D1A02 STA $021A
820 1F66 A9FF LDA #$FF
830 1F68 8D1B02 STA $021B
840 1F68 D0ED BNE PEKIT ;ALWAYS BRANCH
850 1F6D ;PPRINT
860 1F6D ;CARRIAGE RETURN WITHOUT LINE FEED
870 1F6D A91A PPRINT LDA #$1A
880 1F6F 20B1FC JSR $FCB1
890 1F72 D0E6 BNE PEKIT
900 1F74 ;PDEF A
910 1F74 ;REPLACE A BY S,D OR G TO DEFINE MODE
920 1F74 20BC00 PDEF JSR $00BC
930 1F77 C953 CMP #$53 ;S
940 1F79 F00B BEQ SINGLE
950 1F7B C944 CMP #$44 ;D
960 1F7D F00B BEQ DOUBLE
970 1F7F C947 CMP #$47 ;G
980 1F81 F00B BEQ GRAFIC
990 1F83 4C9BFF JMP $FF9B ;ERROR OUTPUT
1000 1F86 A91E SINGLE LDA #$1E ;CONTROL CODE
1010 1F88 D006 BNE OPUT
1020 1F8A A91F DOUBLE LDA #$1F ;DOUBLE CONTROL
1030 1F8C D002 BNE OPUT
1040 1F8E A912 GRAFIC LDA #$12 ;GRAPHICS MODE
1050 1F90 20B1FC OPUT JSR $FCB1
1060 1F93 D0C5 BNE PEKIT
1070 1F95 ;
1080 1F95 ;
1090 1F95 ;
1100 1F95 ;PPOKE (X)
1110 1F95 ;OUTPUTS DOT POSITION FOR NEXT PRINTING
1120 1F95 ;BASED ON VARIABLE X,RANGE 0<X<479,
1130 1F95 20BC00 PPOKE JSR $00BC
1140 1F98 A91B LDA #$1B ;ESC
1150 1F9A 20B1FC JSR $FCB1
1160 1F9D A910 LDA #$10 ;POS
1170 1F9F 20B1FC JSR $FCB1
1180 1FA2 20F5AB JSR $ABF5
1190 1FA5 2005AE JSR $AE05 ;H/L IN RE/AF
1200 1FAB A9AE LDA $AE
1210 1FAD 20B1FC JSR $FCB1 ;H
1220 1FAF A9AF LDA $AF
1230 1FAF 20B1FC JSR $FCB1 ;L
1240 1FB2 D0A9 PLINK BNE POPOS
1250 1FB4 F0A7 BEQ POPOS
1260 1FB6 ;
1270 1FB6 ;
1280 1FB6 ;
1290 1FB6 ;
1300 1FB6 ;
1310 1FB6 ;PPOS (X)
1320 1FB6 ;POSITIONS PRINTER TO CHARACTER LOCATION
1330 1FB6 ;DEFINED BY X, RANGE 0<X<79
1340 1FB6 20BC00 PPOS JSR $00BC
1350 1FB9 A910 LDA #$10
1360 1FB8 20B1FC JSR $FCB1 ;POS
1370 1FBE 20F5AB JSR $ABF5
1380 1FC1 2005AE JSR $AE05
1390 1FC4 A9AF LDY $AF
1400 1FC6 A900 LDA $A0
1410 1FC8 F8 SED
1420 1FC9 18 BCDCON CLC
1430 1FCA 6901 ADC #$01
1440 1FCC 88 DEY
1450 1FCD D0FA BNE BCDCON
1460 1FCF D8 CLD
1470 1FD0 48 PHA
1480 1FD1 29F0 AND #$F0
1490 1FD3 4A LSR A
1500 1FD4 4A LSR A
1510 1FD5 4A LSR A
1520 1FD6 4A LSR A
1530 1FD7 0930 ORA #$30
1540 1FD9 20B1FC JSR $FCB1
1550 1FDC 68 PLA
1560 1FDD 29F0 AND #$0F
1570 1FDF 0930 ORA #$30
1580 1FE1 20B1FC JSR $FCB1
1590 1FE4 D0CC BNE PLINK
1600 1FE6 F0CA BEQ PLINK
1610 1FE8 .END
;D1F00,1FE8
0 1 2 3 4 5 6 7 8 9 A B C D E F
1F00 C9 0A D0 04 EA EA EA 60 4C B1 FC A5 98 C9 FF D0
1F10 03 4C 9B FF A5 C3 85 EE A5 C4 85 EF 20 C2 00 C9
1F20 3A D0 2A 20 BC 00 C9 50 D0 1B 20 BC 00 C9 90 F0
1F30 1F C9 8F F0 2C C9 97 F0 34 C9 95 F0 37 C9 96 F0
1F40 54 C9 B2 F0 71 A5 EE 85 C3 A5 EF 85 C4 40 9B FF
1F50 A9 00 8D 1A 02 A9 1F 8D 1B 02 20 BC 00 D0 B5 F0
1F60 B3 A9 69 8D 1A 02 A9 FF 8D 1B 02 D0 ED A9 1A 20
1F70 B1 FC D0 E6 20 5C 00 C9 53 F0 08 C9 44 F0 0B C9
1F80 47 F0 0B 4C 9B FF A9 1E D0 06 A9 1F D0 02 A9 12
1F90 20 B1 FC D0 C5 20 BC 00 A9 1B 20 B1 FC A9 10 20
1FA0 B1 FC 20 F5 AB 20 05 AE A5 AE 20 B1 FC A5 AF 20
1FB0 B1 FC D0 A9 F0 A7 20 BC 00 A9 10 20 B1 FC 20 F5
1FC0 AB 20 05 AE A4 AF A9 00 F8 19 69 01 88 D0 FA D9
1FD0 48 29 F0 4A 4A 4A 4A 09 30 20 B1 FC 68 29 0F 09
1FE0 30 20 B1 FC D0 CC F0 CA
  
```



Bar chart

THE HISTOGRAM PLOTTER program from Darren Moseby of Clay Cross, Derbyshire, fits into the ZX-81's rather limited memory. When Run, the program comes up with the prompt "No. columns", and a number between 0 and 11 should be entered. The prompt "Input No. n columns" comes up, where n is a number between 1 and a specified column number. A number between 0 and 20 should be entered in response.

When all the column values have been entered there is a short pause and the screen clears. The graph is then plotted, using two different graphics characters for the alternating columns.

The program can easily be expanded if more memory is available, and can be implemented on other micros that have a Print At X, Y command.

Line draw

A STRAIGHT LINE from a point with co-ordinates X1, Y1 to a second point X2, Y2 is constructed by the program from M Saiepour of Nottingham. It also determines whether a third point X3, Y3 lies on the line. The ZX-81 must be fitted with the 16K RAM.

```

Bar chart
10 REM * BAR-CHART *
20 SCROLL
30 PRINT "NO. COLUMNS ?"
40 INPUT A
50 SCROLL
60 PRINT TAB 6;A
70 DIM Z(A)
80 FOR B = 1 TO A
90 SCROLL
100 PRINT "INPUT NO.
";B;"COLUMN":
110 INPUT Z(B)
120 PRINT Z(B)
130 NEXT B
140 PAUSE 50
150 CLS
160 FOR E=0 TO 20
170 PRINT AT E,0;20-E
180 NEXT E
190 FOR C = 1 TO B-1
200 FOR D = 1 TO Z(C)
210 LET A$ = " "
220 IF C-2*INT(C/2)=0 THEN LET
A$ = "graphic H"
230 PRINT AT 20-D,c+1;A$
240 NEXT D
250 NEXT C

```

Line draw

```

5 REM PROGRAM BY M.SAIEPOUR B.Sc. M.Sc
10 INPUT X1
20 INPUT Y1
30 INPUT X2
40 INPUT Y2
50 LET X=X2-X1
60 LET Y=Y2-Y1
70 LET Z=ABS X
80 IF ABS Y>Z THEN LET Z=ABS Y
90 LET G=0
100 LET H=0
110 FOR F=1 TO Z
120 PLOT G+X1,H+Y1
130 LET G=G+X/Z
140 LET H=H+Y/Z
150 NEXT F
160 INPUT X3
170 INPUT Y3
180 IF (Y3-Y1)/(X3-X1)=(Y2-Y1)/(X2-X1)THEN GOTO 185
183 GOTO 190
185 IF X3>X1 AND X3<X2 OR X3<X1 AND X3>X2 THEN GOTO
188
186 GOTO 190
188 IF Y3>Y1 AND Y3<Y2 OR Y3<Y1 AND Y3>Y2 THEN GOTO
210
190 PRINT AT 0,0;" NO"
200 GOTO 160
210 PRINT AT 0,0;"YES"
220 GOTO 160

```

If the gradient of the line is equal to the gradient of the line from X1, Y1 to X3, Y3, and X3 lies between X1 and X2, and Y3 lies between Y1 and Y2, then the point X3, Y3 lies on the line. For values of X and Y which are off the screen, the plot statement must be removed from line 120.

Print At programs

A SUITE of programs demonstrating the use of the Print At statement comes from D Stocqueler of Exeter. The programs were originally written for an 8K-Rom ZX-80 and can be converted for use on a ZX-81 by slight alterations to the Pause statements.

An adequate explanation of the Print At statement is given in the Sinclair manual, it does away with calculating the address of the shifting display RAM and then having to Poke characters into this area.

The Etch-a Sketch program simulates the simple, children's drawing toy. A line

Etch-a-sketch

```

10 LET A=11
20 LET B=16
30 PRINT AT A,B;
"graphic space"
40 PAUSE 10
50 LET A$=INKEY$
60 IF A$="5" THEN LET B=B-1
70 IF A$="6" THEN LET A=A+1
80 IF A$="7" THEN LET A=A-1
90 IF A$="8" THEN LET B=B+1
100 IF A$="0" THEN CLS
110 IF A$="1" THEN PAUSE 200
120 GOTO 30
RUN

```

Skier

```

10 LET S=0
20 LET B=11
30 PRINT AT 20,RND*20;"Y"
40 SCROLL
50 IF B>2 THEN LET B=B-1
60 IF B<3 THEN LET B=B+4
70 IF INKEY$="B"
THEN LET B=B+2
80 IF B>20 THEN LET B=B-4
90 PRINT AT 10,B;.."
100 PAUSE 10
110 LET S=S+1
120 IF NOT PEEK
(PEEK 16398+256*PEEK
16399)=62 THEN GOTO 30
130 FOR F=1 TO 7
140 PRINT AT 7,5;"CRASH"
150 PAUSE 5
160 CLS
170 NEXT F
180 PRINT "YOUR SCORE IS ";S
190 PAUSE 100
200 RUN

```

is drawn in the direction of the arrows on keys 5,6,7 and 8 every time one of these keys is pressed. Pressing key 0 clears the screen and key 1 stops the flicker on the ZX-80 for long enough for you to examine what you have drawn. Do not draw lines to the very top, sides and bottom of the screen as weird thing begin to happen if you try.

The object of Skier is to manoeuvre yourself down a ski slope without colliding with any trees. As with most arcade games, there is no way of beating the machine; the object is to beat your own high score.

(continued on next page)

(continued from previous page)

The game auto-starts itself to save continually pressing Run, Newline etc. The skier automatically travels to the left and only moves to the right if B is pressed. The skill level can be changed by altering the value in line 100. Beware of trying to avoid the trees by moving to the edge of the screen as the program counters this tactic.

The short routine in Sliding Letters produces a most interesting display. The computer accepts a string input, prints it on the screen at different places and then scrolls. It will work on an 8K ZX-80 as long as

45 PAUSE 10

is added. For an effective display the inputted string should consist of inverse-video characters.

Sliding letters

```
10 INPUT A$
20 FOR F=1 TO 20
30 PRINT AT F,RND
   30:A$
40 SCROLL
50 NEXT F
60 GOTO 20
```

Card shuffle

THE FOLLOWING ROUTINE, entitled Card Shuffle will be useful to those intending to write their own card-game programs, writes Gary Nugent of Dublin, Ireland. The routine shuffles suited cards, which are required in Poker, for example.

Line 10 should be the first line of the program. Lines 11 to 20 can be placed anywhere within the main card-game program.

The cards and their suits can be read by Peeking locations 16427 to 16530; 16427 is the address of the first character after the Rem keyword.

The numerical values of the cards are found by Peeking the odd-numbered locations, and the suits are found by Peeking the even-numbered locations, starting at 16428.

Since ten is the only number in the deck which has two digits, it is represented by T, since this simplifies the routine. The suits are represented by their initial letters.

Card shuffle

```
10 REM AC2C3C4C5C6C7C8C9CTCJCK
   CKCAD2D3D4D5D6D7D8D9D10DQDKD
   AS2S3S4S5S6S7S8S9S10SJSQKSAH2
   H3H4H5H6H7H8H9HTHJHQHKKH
11 LET Z=16427
12 FOR I=0 TO 51
13 LET J=RND(52)-1
14 LET X=PEEK(Z+2*I)
15 LET Y=PEEK(Z+2*I+1)
16 POKE Z+2*I,X
17 POKE Z+2*I+1,Y
18 POKE Z+2*I+1,PEEK(Z+2*I+1)
19 POKE Z+2*I+1,Y
20 NEXT I
```

Think quick

THE GAME of Vitesse tests the participant's ability to think quickly, writes Douglas Fyffe of Exeter, Devon. When the program is run, an asterisk appears in one of 10 positions along the screen.

The first asterisk remains on the screen for one second and, in that time you must find the correct firing key and press it. The firing keys are

1 2 3 4 5 6 7 8 9 0

If you have chosen the right key, the asterisk explodes and the game speeds up. If you are wrong the game slows down.

After 15 asterisks have appeared, the game finishes and you are told how many you destroyed.

Vitesse

```
1 LET T=50
2 LET N=0
3 FOR S=1 TO 15
4 PRINT AT 83,P*3-1;"*"
6 PAUSE T
7 POKE 16437,255
8 LET C$=INKEY$
9 IF C$="0" THEN LET C$="10"
10 IF C$=STR$ P THEN GOTO 16
11 LET T=T*1.1
12 CLS
13 NEXT S
14 PRINT "YOU GOT ";N
15 STOP
16 PRINT AT 8,P*3-1;"inv*inv"
17 LET T=T*0.9
18 LET N=N+1
19 GOTO 12
```

Flight of fancy

SPIREFIRE puts you into the cockpit of a Second World War fighter. Ahead you see a squadron of hostile aircraft: By carefully manoeuvring your plane, you must line your targets up with the cross-

Spiritfire

```
1 LET H=100
2 LET S=0
3 LET Y=INT (RND*22)
4 LET X=INT (RND*30)+1
5 CLS
7 LET X=X+INT (RND*3)-1
8 LET Y=Y+INT (RND*3)-1
9 PRINT AT 9,14; "anaphYanaph"
10 PRINT AT 9,16; "anaphTanaph"
11 PRINT AT 11,14; "anaphTanaph"
12 PRINT AT 11,16; "anaphYanaph"
15 PRINT H
16 IF H<1 THEN GOTO 35
17 PRINT AT Y,X-1;
   "anaphTGyanaph"
20 LET A$=INKEY$
21 IF A$="6" THEN LET Y=Y-2
22 IF A$="5" THEN LET X=X+2
23 IF A$="7" THEN LET Y=Y+2
24 IF A$="8" THEN LET X=X-2
25 IF INT (RND*6)+1=1 THEN LET
   H=H-INT (RND*15)+1
26 IF A$="1" THEN GOTO 28
27 GOTO 5
28 IF X=15 AND Y=10 THEN GOTO 30
29 GOTO 5
30 PRINT AT 10,14; "inv***inv"
31 LET S=S+1
32 PAUSE 50
33 POKE 16437,255
34 GOTO 3
35 PRINT "YOU GOT ";S
```

hairs on the canopy and blast it with your guns.

The aim is to shoot down as many enemy craft as possible before you are finally destroyed yourself. You should control your craft, not the enemy.

If you lose sight of the enemy squadron, you are forced to return to base.

The controls are

1 — Fire
5 — Left
6 — Down
7 — Up
8 — Right

The length of the game can be altered by changing the value of H in line 1, or changing the 6 in line 25.

Read data

STEPHEN CARSON-ROWLAND'S Read Data routine for the ZX-81 — ZX-80/81 line-up, December 1981 — is very pretty but it is not really necessary, explains J Arotzky of St Helens, Merseyside. The Sinclair instruction book gives a hint of how to do it. There are two relevant points to consider:

- The ZX-81 allows a string of any length. The only limitation is the amount of memory available.
- Sinclair Basic has superb string handling.

These two factors can be used to provide a very acceptable substitute for Read Data. For example, the program shown here is a machine-code load routine, with all the appropriate Poke values accommodated in a string. A full-stop is used as a data separator as it is easier to type than a comma. Obviously you can use any separator that you wish.

The program is an adaptation of Christopher Clarke's program from the December ZX-80/81 line-up. When it has run, remove all the lines except line 10 and proceed as described in the article. The same method can also be used with strings. For example, the program in listing 2 still leaves 500 bytes free.

If you want to edit line 10, then stepping along it is extremely tedious. Does anyone know how to use machine code to

(continued on page 141)

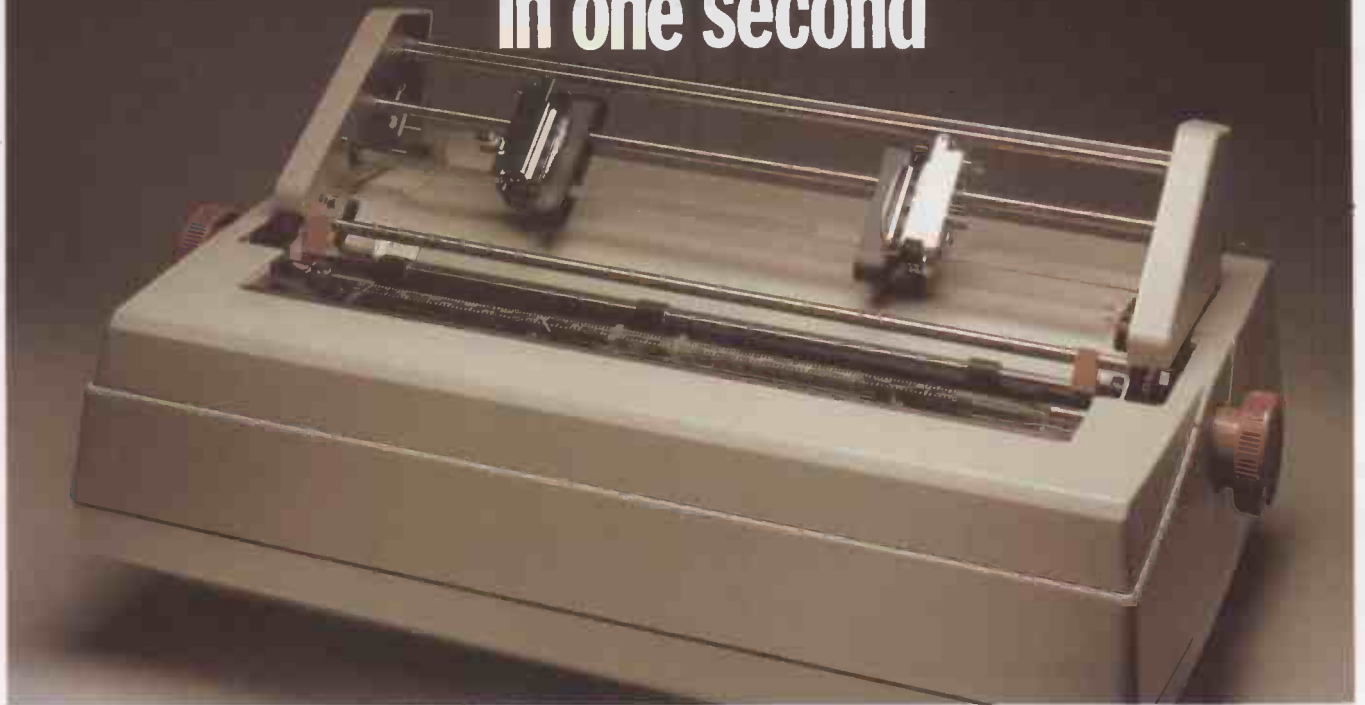
Read data — listing 1.

```
10 REM 123456789123456789
20 LET B=1
30 LET C=16514
40 LET A$="237 115. 54. 64. 42. 54. 64.
   237. 75. 28. 64. 237. 66. 68. 68. 77. 77.
   201. 201."
50 FOR A=1 TO LEN A$
60 IF A$(A)=". " THEN GOSUB 200
70 NEXT A
80 STOP
200 POKE C,VAL(A$(B TO A-1))
210 LET B=A+1
220 LET C=C+1
230 RETURN
```

Read data — listing 2.

```
10 LET A$="JANUARY .FEBRUARY .MARCH
   .APRIL .MAY .JUNE .JULY .AUGUST
   .SEPTEMBER .OCTOBER .NOVEMBER .DECEMBER
   ."
20 LET B=1
30 FOR A=1 TO LEN A$
40 IF A$(A)=". " THEN GOSUB 200
50 NEXT A
60 STOP
200 PRINT A$(B TO A-1)
210 LET B=A+1
220 RETURN
```

0 to 60^{ch's} in one second



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AUTO LOGIC SEEKING	Yes	No	Yes	No	Yes
PROPORTIONAL PRINT CAPABILITY	Yes	Yes	Yes	No	Yes
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Read data — listing 3.

```

10 LET A$=" "
20 INPUT B$
30 IF B$="END" THEN
   GOTO 100
40 LET A$=A$+B$+"."
50 GOTO 20
100 PRINT A$

```

(continued from page 136)

Poke an alteration in the line? This is easy enough if you wish merely to alter a character, but if you want to alter the length of A\$. This is a particular problem if you want to use the string as a data base, storing the words and clues for Hangman for example.

One way round this problem is to create the string not a program line — see listing 3, which produces an A\$ which can readily be altered though, Run destroys all your words and clues for Hangman.

The money program

A RECENT Apple-Pet item gave a routine for printing sums of money in conventional £.p form so that columns line up, notes WE Thomson. A ZX-81 cannot use the same method because of its different string-handling procedures, but these, plus the ZX-81's logical functions, provide a neat solution to this problem.

In this test program, the four lines 100 to 130 constitute the line-up procedure. The routine has two operands: D, the column in which the decimal point has to appear; and F, a positive sum of money expressed in pounds and fractions of a pound that do not necessarily correspond to whole numbers of pence. Line 100 converts F to pence, rounded off to the nearest integer.

Lines 30 to 60 allow the input, and printing in the form in which it is input, of an expression such as

69.95/1.15

the basic cost of an item whose cost including VAT is £69.95. It is followed by its value in pounds and fractions of a pound, and its value in pounds and pence correctly lined up.

The routine always prints at least one pound figure: 50p becomes 0.50; 5p becomes 0.05, 0p becomes 0.00. If the forms .50, .05, .00 are preferred, delete

("0" AND F < 100) +

in line 110.

Hex loader

IN RESPONSE to G J Langford's letter — Feedback, January 82 — J Chalmers of East Grinstead, West Sussex has written a hex loader program for the ZX-81.

The program was written using 3K of RAM, but can be converted to fit into 1K by reducing the amount of information displayed at any one time. This is achieved by making the display file a maximum of one line long just before every scroll is executed. Poking the sys-

Money program

```

10 PRINT AT 1,28;"$. F"
20 LET D=29
30 INPUT E$
40 PRINT E$
50 LET F=VAL E$
60 PRINT F;
95 REM START OF LINE-UP ROUTINE
100 LET F=INT (100*F+0.5)
110 LET F$=("0" AND F<100)+("0" AND F<10)+STR$ F
120 LET L=LEN F$-2
130 PRINT TAB D-L;F$(TO L);".";F$(L+1 TO)
135 REM END OF LINE-UP ROUTINE
200 GOTO 30

```

tem variable DF-SZ (16418) with 23 performs this task.

Operation of the program is simple. After Run, a string-input prompt is displayed along with a decimal address and the present contents of that address. If you wish to change the byte, enter the new byte in hex and press Newline; otherwise just press Newline. To stop the programming mode press S and a message will appear inviting you to check the program. Pressing L will set the counter to the start of your program and it can be stepped through and be inspected byte by byte. It can also be altered if necessary.

A special feature of the program is the inbuilt decimal to hex converter. During machine-code programming, entering H will access this routine. On access you simply enter a decimal number smaller

than 65535, and it will be automatically printed along with its hex equivalent.

When your machine code has been perfected, the hex loader program can be deleted, leaving only line 1 which contains the code. To run machine code you must use the USR function. If the statement

LET L = USR X

is executed, where X is the starting address of your machine code, the code will be executed until a return is found indicating a return to Basic. A full set of machine-code instructions can be found in appendix A of the Sinclair manual, and an appropriate return — e.g. C9h — can be selected from there. On return to Basic in this example the variable L will contain a value corresponding to the contents of the bc register pair.

Hex loader

```

1 REM (PUT HERE ONE X PER BYTE OF MACHINE CODE)
2 REM MACHINE CODE LOADER FOR ZX
10 LET X=16514
20 LET A=PEEK X
30 GOSUB 1000
40 SCROLL
50 PRINT X;A$;
60 INPUT A$
70 IF A$(1)="H" THEN GOTO 400
80 IF A$(1)="S" THEN GOTO 200
90 IF A$(1)=" " THEN GOTO 130
110 PRINT " ";A$
120 POKE X,16*CODE A$ + CODE A$(2)-476
130 LET X=X+1
140 GOTO 20
210 SCROLL
220 PRINT "PRESS""L"" TO CHECK"
230 IF INKEY$ ="L" THEN RUN
240 GOTO 230
410 SCROLL
420 INPUT A
430 PRINT A;
440 GOSUB 1000
450 PRINT A$
460 GOTO 20
1000 REM DECIMAL TO HEX CONVERSION
1010 DIM A$(4)
1020 LET D=4096
1030 FOR I = 1 TO 4
1040 LET A$(I)=CHR$(INT(A/D)+28)
1050 LET A = A-D*INT (A/D)
1060 LET D = D/16
1070 NEXT I
1080 IF A$(1) ="0" AND A$(2) ="0" THEN LET A$ = A$(3 TO 4)
1090 RETURN

```




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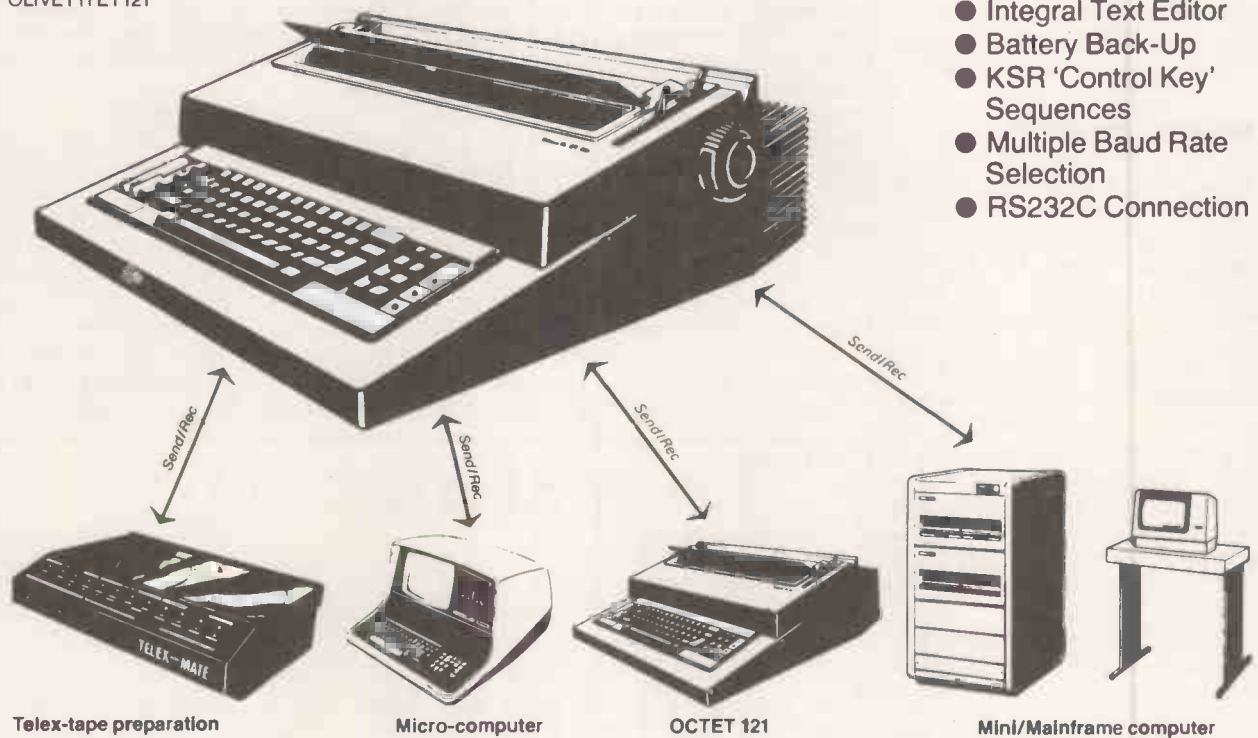


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● Circle No. 180

The heat is on

Micromouse maze enthusiasts all over the U.K. are counting down to this year's Euromicro Euromouse Contest. The lucky winners will be sponsored to compete in the European Finals at Haifa, Israel in September. John Billingsley reports.

THE MICE WILL BATTLE it out at the Computer Fair in London's Earls Court from April 23 to 25, 1982, after "limbering up" a week earlier at the London Computer Club's own Computer Fair in the theatre of the Polytechnic of North London.

The contest was originally modelled on the Micromouse Maze Contest, first devised by IEEE Spectrum, in which mice entered the maze at one corner and left by another. Simple-minded wall followers could find their way through.

The Euromicro Contest demanded more intelligence from the mice by setting the target at the middle of the maze so that a cunning arrangement of passageways would have the wall followers running in circles.

The maze consists of 16 by 16 squares and each mouse starts in the bottom left corner so that the location of the centre target is well defined. The 1980 maze was built to accommodate American micromice in the hope of tempting one or two of them across the Atlantic. Although a few registered for the contest, none arrived to compete.

In the 1980 maze the walls were supported between pegs inserted into holes in the base. Unfortunately the manufacturer bonded hardboard to the bottom of the chipboard, causing the whole base to warp slightly, which was enough to baffle one or two particularly fastidious mice.

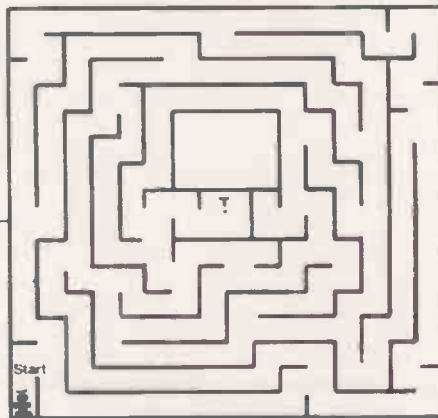
Honourable bunch

Mouse builders are on the whole an honourable bunch, and the judges have a relatively easy time. Nevertheless, there have been one or two points of contention in the past. When a mouse has a dazzling array of control buttons it is always possible that the handlers are pul-

ling a fast one by choosing a bias towards left or right-handedness, or by signalling "that last route wasn't bad, go flat out and don't try to improve it".

The starting procedure must therefore be written down before the beginning of the contest so that matters of strategy are left to the mouse, not to the handler.

Although it is not mentioned in the rules, the judges' job will be made much easier if a mouse announces its arrival at the centre either audibly or by simply flashing an LED. The mouse must not pollute or damage the maze — one or two mice have a reputation for hurling themselves against the maze walls, and this practice will be strongly discouraged.



Sample competition maze.

EUROMOUSE Maze Contest — British Heat, Earls Court, April 23 to 25 1982. Rules of competition.

1. Dimensions

The maze consists of 16 by 16 squares. The squares are based on a 7in./18cm. matrix. The walls of the maze are 0.5in/12mm. thick, and the passageways are thus 6.5in./16.5cm. wide. The walls are 2in./5cm. high, painted white with red tops. The target post at the centre, 1in./2.5cm. square, is 8in./20cm. high, and can be removed if desired. The starting square is at the 'bottom left' corner of the maze, and the mouse is initially orientated so that the target is diagonally to its right. The running surface is chipboard, sprayed with black paint.

2. Tolerances

Dimensions should not be assumed to be more accurate than five percent: the maze may be made up to metric or imperial dimensions, and quoted figures may be approximations (to five percent). Joins in the maze base will not involve steps of greater than 0.5mm. — possibly covered with tape. However, warping of the maze base during transport or storage may result in a change in gradient at a join of as much as 4°.

3. Contest rules

(a) Each mouse is allowed a maximum total of 15 minutes to perform. The judges have the discretion to request a mouse to retire early if by its lack of progress it has become boring, or if by erratic behaviour it is endangering the state of the maze.

(b) If the mouse can succeed in finding its way from the start to the maze centre, the time is noted. The handlers can then restart the mouse, so that it can profit from any learning ability in making a second run. Within the 15-minute limitation any

number of runs can be made, and the mouse is credited with the shortest time of a successful run.

(c) If a mouse "gets into trouble", the handlers can ask the judges for permission to abandon the run and restart the mouse at the beginning. If any other handling occurs, the judges may impose an appropriate time penalty, and a mouse which has been so handled will be beaten by any other mouse which has reached the centre without handling. A mouse may not be restarted merely because it has taken a wrong turning — the judges decision is final. The judges may add a time penalty for a restart.

(d) Within reason, and at the judges' discretion, battery changes and minor repairs may be made — however the 15-minute timer must continue running.

(e) If no successful run has been made, the judges will make a qualitative assessment of the mouse's performance, based on distance achieved, "purposefulness" versus random behaviour and quality of control.

(f) If a mouse elects to retire before three minutes have elapsed, the judges may at their discretion permit it to perform again, with a 10-minute limit, later in the contest.

(g) The judges will use their discretion to award the prizes, which in addition to the major prize may include prizes for specific classes of mouse — perhaps lowest cost, most ingenious, best presented, etc.

(h) Before the maze is unveiled the mice must be accepted and caged by the contest officials. The handlers will place the mice at the start under the officials' instructions.

(i) Although the superstructure of the mice may "bulge" above the top of the maze walls, mice must be subject to the following size constraints — width 25cm., length 25cm. There is no height limit but beware of toppling! Mice must be completely self-contained and must receive no outside assistance. The method of wall sensing is at the discretion of the builder, however, the mouse must not exert a force on any wall likely to cause damage. The method of propulsion is at the discretion of the builder provided that the power source is non-polluting — internal-combustion engines would probably be disqualified on this count. If the judges consider that a mouse has a high risk of damaging or sullyng the maze they will not permit it to run. Nothing may be deposited in the maze. The mouse must negotiate the maze; it must not step over or otherwise illegally cross any maze wall. The means of locomotion of the mouse is again at the discretion of the designer.

4. Virtuoso Display

Mice have 10 minutes to display their abilities. Their dimensions must be such that they could run in the maze. Their performance must be limited in travelling range to be accommodated either within the maze, or on an eight foot (2.4 metre) square surface of hardboard. Handling will be discouraged.

The Micromouse Maze Contest was first held in the U.S. by IEEE Spectrum.

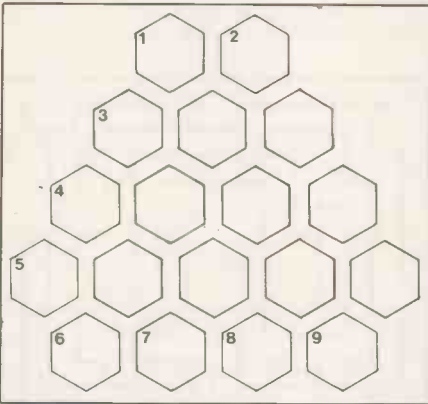
Crossing the hexagons

by Tony Roberts

Clues

Across →

1. Square.
3. Cube.
4. See 7U.
5. Square.
6. Twenty more than the sum of all the three-figure numbers, 5U and 2D.



Up ↓

5. Same digits as 2D but in a different order.
6. See note below.
7. Sum of three times the total of all two-digit numbers, the total of all the three-digit numbers, 3D, 4A, and half 9U.
8. Cube.
9. Square.

Down ↓

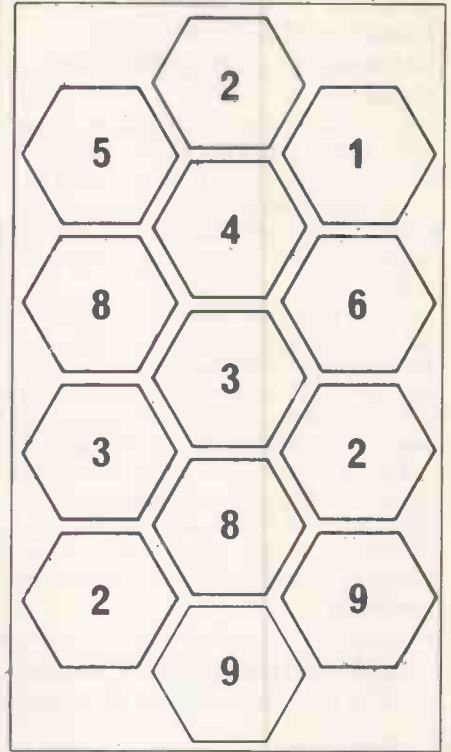
1. See note.
2. See 5U.
3. See 7U.
4. Cube.
5. Square.

Notes

- 2-digit numbers are consecutive squares.
- 3-digit numbers are consecutive cubes.
- 5-digit numbers are each made up of digits sharing a common total.

Solution to February puzzle

Remember the numerical bees? They managed to fill that honeycomb after all — even without the hive's new Bee Bee Cee computer, which really is due for delivery any day now.



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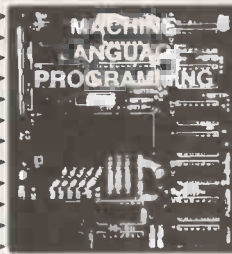
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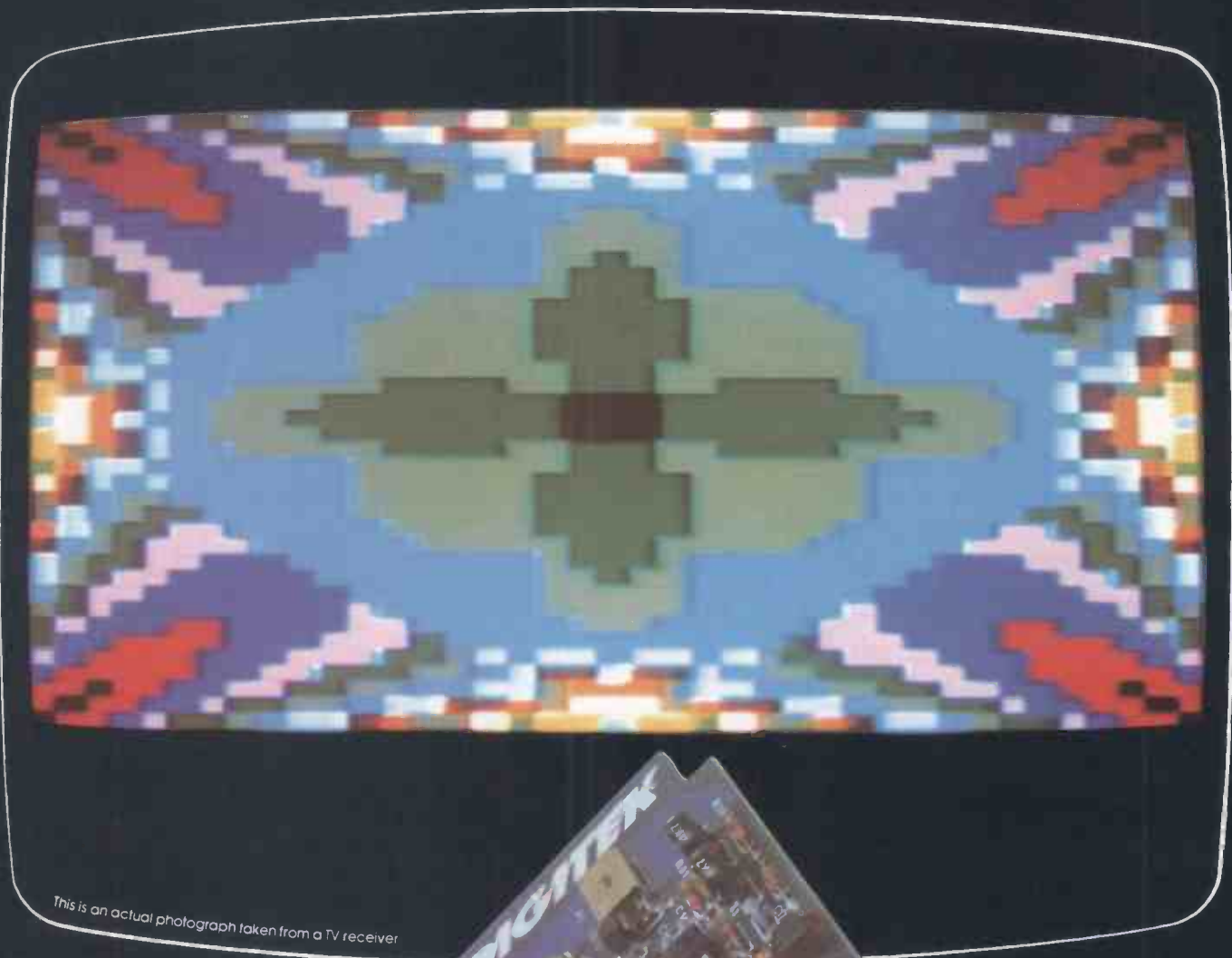
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The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

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 other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 - if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 - including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 and the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



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.

TEMP - Volumes, temperatures - and their combinations.

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	25	Cassette 5 - Junior Education	£3.95	
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● Circle No. 188

Pet holds the purse-strings

The idea of writing your own business software should not necessarily fill you with trepidation. Roger Valentine and John Hartopp turned their hands to the task and created a complete payroll suite, which they present here.

IN A CHOICE likened by many to re-inventing the wheel, we decided at the outset that we would write all our own business software. As a bureau offering professional services, we needed a program which could handle a large number of clients with diverse problems. More importantly, we were not at all impressed by the programs available on cassette from software suppliers.

The rest is free

After much shopping around and budget-stretching we had decided to buy a 32K Pet, a Commodore printer and a cassette unit. With the advent of inexpensive micros such as the Vic, it becomes increasingly likely that many more small, low-budget companies will consider taking a tentative step towards computerisation.

Cheap and effective business software is therefore a must. If you buy a computer just to run this program, you can produce a year's payroll for under £20 a week, which is about what we would charge our clients. The advantage of doing it yourself is that you have the computer for other jobs too and subsequent payrolls cost you nothing.

Anyone opting to write their own A sample pay-slip.

NAME	D. BROWN	
PAY. NO.	5	
INS. NO.	LT 62 66 60 B	
TAX CODE	175T	
WEEK NO.	35	
W/E	05.12.81	
PAY - NORMAL TIME	30.00	
OVERTIME (1)	1.88	
OVERTIME (2)	20.00	
SICK PAY	10.00	
HOLIDAY PAY	10.00	
BONUS/ADJUSTMENT	25.00	
GROSS PAY	96.88	
TAX	18.90	
N.I.	7.50	
ADJUSTMENT	.30	
TOTAL DEDUCTIONS	26.70	
NET PAYABLE	70.18	
GROSS PAY TO DATE	1296.88	
TAX TO DATE	33.60	



payroll program from scratch should start by obtaining the specifications laid down by the Inland Revenue and the Department of Health and Social Security for computerised payroll routines. They are extremely complex, but you must follow them to the letter.

It is simple to write a program which is technically more accurate than the manual tax and national-insurance tables, but unfortunately this is not what is required. The manual tables incorporate a number of roundings and approximations designed to make life simple for the non-computer user, so a computer routine must use the same approximations as would a manual system.

Although the variety of tax codes that you are actually likely to encounter in practice is rather limited, there are three different types of code, all of which must be catered for:

Numeric codes with suffix are by far the most common, and many employers could probably manage with a program which covers these alone. They present no real problem, except that, because manual tables only go up to code 360, a special routine must be included to cover higher codes; otherwise the computer's results will be "too accurate".

Numeric codes with prefix are rather rare, D and F prefixes do sometimes occur, and each requires a separate routine.

The non-numeric codes are NT, BR, and OT. NT means no tax is deducted and usually — but not always — that no tax should be refunded. BR means that the whole of the pay is taxed at the basic rate, and is not the same as OT, which means that the whole of the pay is taxed, but at whichever rate is normally applicable. Note that though OT is really a normal suffix code, it may be read as "OT", so it is safer if your program accepts it as a valid non-numeric code.

All the above code types may be either Week 1 or cumulative. Anyone who operates a payroll, or who has ever paid



EMPLOYEE PAY SUMMARY - WEEK NO. 35 W/E 05.12.81					
NAME	GROSS	TAX	N.I. (EE)	N.I. (ER)	N.I. (TOT)
N. CLARK	100.00	2.10	7.77	13.73	21.50
B. BROWN	96.88	18.90	7.50	13.25	20.75
MS. J. BROWN	.00	.00	.00	.00	.00
TOTAL	196.88	21.00	15.27	26.98	42.25

The tabulated printout of an employee's pay summary.

too much tax, will be familiar with what this means. D codes are never cumulative; F codes may very rarely be. Fortunately, special Week-1 tables, W1, are no longer in use, so Week 1 codes can be treated exactly the same as the others, but on a non-cumulative basis. There are six different NI rates, a to f, but since this program is designed only for not-contracted-out employers, it uses only rates a, b, and c.

The program requires about 22K, most of which is taken up by the employee arrays. A 32K machine will hold data for more than the 100 employees, but we have chosen that number to allow ample room for modifications to the program.

The screen display is for a 40-column Pet. The 3 cursor right; *, 3 cursor left routine which appears first in line 210 is a standard Pet trick to avoid crashing the program with Return. There are no Peeks, Pokes or other machine-dependent features, but you must be able to use massive two-dimensional arrays which may be difficult on old-ROM Pets. In the program all arrays have been dimensioned even though this is not essential on a Pet. Val should return zero for a non-numeric string otherwise some of the validation routines must be modified.

Special formats

The printer formatting should be adjusted for your particular printer. Most of the formatting — subroutine 7500 in program 1; 9500 in program 2 — is conventional, but for the weekly summary in lines 12000 to 14300 of program 2 we have cheated by using the Pet printer's own formatting facilities. These involve using a template, defined by the row of 9s and As in lines 13060 and 14070.

The Pet defines device number 3 as the screen, and 4 as the printer. We have used this to copy information directly from screen to printer, but you may have a Copy facility to do this even more simply.

Variables used in the program are listed in table 1, and the arrays are listed at the end of program 1. This is more than just a service to the user: the Pet's chaining facility is dependent on the second program being shorter than the first. Rather than adjust the various pointers at addresses 44 to 49 to make program 1 artificially long, we have simply extended the listing. For that reason, Pet users should not omit the Rems or lines 12000

on words, unless they are adding a routine of equivalent length.

The most interesting feature of program 1 is subroutine 6000 which searches for an employee by name, or by part of a name. For example, "Smith" will find A Smith, Smith A., B. Smithson, etc. If all names have initials with at least one full stop, "." will find them all. Otherwise program 1 is a standard database routine.

Program 2 opens with a long list of tax and NI parameters, most of which should be instantly recognisable to payroll users. All the data which is likely to be amended in successive budgets is held here, so up-dating is easy. Line 6180 relates to the old W1 tables. It has been pushed out of the way with a Rem statement, rather than deleted, just in case it is needed again. GPTR, short for GPoint

(continued on next page)

Table 1.

All arrays used are listed at the end of program one.

T, Q, T\$, Q\$, AND T() are local variables which occur throughout the programs.

- N\$ Week number -->W
- D\$ Date of run
- DA\$ Date temporary
- CL\$ Company name
- NE\$ Number of employees -->NE
- Q1\$ Formatting string
- Q2\$ Formatting string
- T\$ Standard input to questionnaire (numeric)
- Q\$ Standard input to questionnaire (alphabetic)
- H\$ Standard input to payroll
- GP (also called GPTR) GPointer
- X Number of bandwidths
- Z Number of pay-slips to be printed — set to 1
- W Week number of run
- N Week number (temporary)
- NN Week number for tax
- NE Number of employees
- EN Employee number
- NI Employee's NI
- ER Employer's NI
- G Gross pay
- G1 Gross pay for tax
- GN Gross pay for NI
- B Band
- F Free pay
- TP Taxable pay
- TA Tax
- DV Logical device number
- O Obligatory print flag

K, L and M are loop-control variables
 J is the main loop-control variable, which usually defines the employee being processed
 Sample printouts
 Listings

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Company tax and National Insurance details.

(continued from previous page)

ter, is a parameter used for BR and D codes. X is the number of bandwidths.

The heart of the program is in lines 5000 to 6320 and subroutine 8000 where the tax and NI calculations are performed. Line 6700 starts the routine for D codes, 6800 to 6850 for F codes. Subroutine 7000 is a tedious way of dealing with codes above 360, using one of the spare arrays. T() has been dimensioned to 10 — line 10 in program 1 and line 500 in program 2 — so will hold codes up to 3600. If you ever have to handle a code greater than this, simply re-dimension T().

Copies required

Subroutine 8000 advances the week, e.g., for holiday pay in advance, and 8400 requests a date for such pay-slips. Only the current pay date is actually stored. Lines 9000 to 9260 print the pay-slips, first to the screen and then to the printer, using variable DV to decide which. Lines 10000 to 10140 update the employee data, and lines 10200 to 10205 update the weekly summary. Note that the period summary is not updated until lines 11500 to 11540.

Business programs should be able to make countless copies of everything. The routine at lines 16150 to 17000 in program 2 and option 7 in program 1 allow security copies of the data tape to be made at will. Similarly, all printouts can be duplicated. Only the number of pay-slips printed is not under the user's control; it is pre-defined by variable Z in line 900 of program 2, and we have set this to 1 so that you can race through the payroll in no time at all. If you do not use carbonised stationery you may set this to whatever you like.

Formatting is for either individual or continuous A5 pay-slips. They need not be pre-printed, but you will probably adjust the formatting to suit your own stationery. Note that the variable O is the obligatory print flag. Only the obligatory lines, for which O=1 will be printed unless there is actually an amount to print that, for example, those employees who are not paid overtime, holiday pay, etc.

need never know that they exist. On the other hand, if you have pre-printed stationery, or simply want all pay-slips to have the same format, set O permanently to 1.

Program 1 sets up and amends payroll data, and when you first start you will use option 1. All other options lead to the dead-end of asking for a data tape; though option 7 at least has the courtesy of returning you to the menu. Option 1 leads to a question-and-answer routine, where you are asked for two pages of data for each employee. At the end of each page you have the option of correcting that page or continuing.

There are three distinct classes of user:

- New companies setting up a payroll for the first time.
- Existing companies bringing in the computer payroll from Week 1 of a tax year.
- Existing companies bringing in the computer payroll at any other time in a tax year.

If you are in the first two categories, page two of the data questionnaire is easy. Users in the third category must be sure to transfer all their existing manual records on to the computer including data for employees who have already left, otherwise the program will not provide accurate end-of-year information.

The "paid to week" question is to prevent the inadvertent double-payment of employees who, for example, have already received holiday pay in advance. If therefore refers to the week number for which you have paid each employee. For new starters, enter 0, not the week shown on their P45, as double-payment by different employers is quite normal.

At the end of the questionnaire — as at the end of all options which allow you to change data — you may record a data tape, or return to the menu. Do not forget to record the tape later, of course, using Option 7.

Option 2 uses the same routine to add new employees. Option 3 deletes employees by reference to either their name or number. Note that "deleting" an employee does not involve destroying any data; the employee is merely flagged as having left, and is omitted from future payroll runs. Data for ex-employees can



be examined as easily as that for current employees.

Option 4 allows any employee's data to be examined, amended, or printed out, again by reference to name or number. You may amend any one of the 16 fields of data per employee. Any change to pay, tax, or NI, details will not be incorporated into the current-period summary, so fraudulent alterations will show up as unexplained imbalance at the period end. Key in 17 to exit from this mode or to examine next employee.

Option 5 prints out an up-to-date P35 listing. This is not just a year-end facility, but may be used at any time to check payroll controls you may be keeping.

Option 6 is used only rarely. It enables you to change certain suffix tax codes *en masse*, which will be necessary only on instructions from the tax office. Only codes L, H, P, and V may be changed in this way, as they are the only codes which will be covered by such a blanket instruction. Instructions of this kind are frequently issued after a budget.

Play it safe

Option 7 allows you to record a data tape. Option 8 loads and runs the payroll program itself. You can use both programs without this option, but you will often find it necessary to make some last-minute data amendments just before the payroll run. You can run straight into option 8 without first recording any amendments — whether or not you do so is up to you. In general it is safer not to do this in case a major disaster in the payroll run forces you to start over again.

Program 2 asks first for the tax week and current pay date. It must be eight characters long so use DD.MM.YY If it has not been run from program 1 it will request your data tape.

Each current employee will then be

displayed in turn, together with a full menu if the employee has not yet been paid, or a very much abbreviated menu otherwise. Option 1 enables you to run quickly through the payroll in all simple cases. It will pay the employee the normal gross wage, and print a pay-slip immediately. Options 2 to 8 allow you to compile a pay-slip in the normal way, and Option 9 prints out the compiled pay-slip.

The pay-slip is first displayed on the screen. You may either key C to cancel it and return to make adjustments; or key P to print it out. Alternatively press R to record the pay details while skipping the printing, should you ever need to do this.

Cassettes available

The other two options on the full menu, and the only two on the abbreviated menu, are W to advance the week — e.g., to pay holiday pay in advance — or X to skip to the next employee. On a full menu, use of option 9 on its own will result in the employee receiving no pay but possibly a tax refund. Option X will simply leave an employee off the current week's payroll, and he will receive any tax rebate which may be due when he is next paid.

At the end of the payroll run, print out the weekly summaries, period summary if required — it will be zeroed after printing, otherwise carried forward — and lastly record the data tape. The average run time for 100 employees is 45 minutes, or 25 minutes if Option 1 is applicable.

Copies of these programs are available on cassette for £5 for the two programs from: R G Valentine, c/o V&H Accountancy Services, 182c Kingston Road, Staines, Middlesex. Anyone using the programs, can receive free up-dates whenever tax or NI changes occur by sending a stamped, addressed envelope to the same address.

Program 1.

```

1 REM ***** PAYROLL: TWO PROGRAMS BY R.G.VALENTINE: 1981 *****
4 GOTO10
5 PRINT"PRESS SPACE WHEN READY"
6 Q$="":GETQ$:IFQ$=""THEN$
7 RETURN
10 DIME(100,14),E$(100,3),P(6),T$(4),T(10)
20 X=5:GPTR=1:REM:SEE LINE 8325 & PROG 2
100 PRINT"*****V&H PAYROLL: SET-UP AND AMMENDMENTS"
101 PRINT"*****"
110 PRINT"NO 1: SET UP NEW PAYROLL
120 PRINT"NO 2: ADD EMPLOYEE
130 PRINT"NO 3: DELETE EMPLOYEE
140 PRINT"NO 4: AMMEND/INSPECT EMPLOYEE DETAILS
141 PRINT"NO 5: P35 LISTING
142 PRINT"NO 6: 'BLANKET' TAX CODE CHANGES
143 PRINT"NO 7: RECORD CHANGES
144 PRINT"NO 8: RUN PAYROLL
145 GOSUB$
150 IFQ$<"1"ORQ$>"8"THEN145
160 ONVAL(Q$)GOTO200,1000,2000,3000,7600,9000,3900,10000
200 PRINT"*****"
210 INPUT"COMPANY NAME *****":CL$
215 IFCL$=""*THEN210
220 INPUT"NO. OF EMPLOYEES *****":NE$
225 IFNE$=""*THENPRINT"TY":GOTO220
230 NE=VAL(NE$):IFNE>100ORNE<1THENNE$=""*:GOTO225
235 EN=1:GOSUB240:GOSUB3950:GOTO100
240 PRINT"*****ENTER DETAILS OF ALL CURRENT EMPLOYEES"
245 PRINT"*****AND EMPLOYEES WHO HAVE LEFT DURING THE"
250 PRINT"*****"
255 PRINT"CURRENT TAX YEAR.":GOSUB$
260 FORJ=ENTONE
270 PRINT"EMPLOYEE NUMBER":J
280 INPUT"NAME *****":E$(J,1)
    
```

(continued on next page)

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(continued from previous page)

```

285 IFE$(J,1)="*"THENPRINT"TT":GOTO280
290 INPUT"MN.1. NUMBER";E$(J,2)
295 IFE$(J,2)="*"THENPRINT"TT":GOTO290
300 INPUT"MTAX CODE";Q$
310 EN=J:GOSUB8300
320 IFQ$="*"THENPRINT"TT":GOTO300
335 E$(J,3)=Q$
340 INPUT"WEEK 1 (Y/N)";Q$
350 IFQ$="Y"THENE(J,4)=1:GOTO370
360 IFQ$="N"THEN370
365 PRINT"TT":GOTO340
370 INPUT"FOUND / HOUR";T$
375 IFT$="*"THENPRINT"TT":GOTO370
377 E(J,1)=VAL(T$)
380 INPUT"NORMAL WEEKLY PAY";T$
385 IFT$="*"THENPRINT"TT":GOTO380
387 E(J,5)=VAL(T$)
390 INPUT"MN.1. RATE A/B/C";Q$
400 IFQ$="A"THENE(J,3)=1:GOTO420
405 IFQ$="B"THENE(J,3)=2:GOTO420
410 IFQ$="C"THENE(J,3)=3:GOTO420
415 PRINT"TT":GOTO390
420 PRINT"MPRESS C TO CANCEL : SPACE TO CONTINUE":GOSUB6
421 IFQ$="C"THEN270
425 INPUT"CGROSS PAY TO DATE";T$
426 IFT$="*"THEN425
427 E(J,7)=VAL(T$)
430 INPUT"MTAX TO DATE";T$
435 IFT$="*"THENPRINT"TT":GOTO430
436 E(J,8)=VAL(T$)
440 INPUT"MP. P. -PREV. EMPLOYMENT";T$
445 IFT$="*"THENPRINT"TT":GOTO440
446 E(J,11)=VAL(T$)
450 INPUT"MTAX -";T$
455 IFT$="*"THENPRINT"TT":GOTO450
456 E(J,12)=VAL(T$)
460 INPUT"MPRID TO WK. NO. (OR 0)";T$
465 IFT$="*"THENPRINT"TT":GOTO460
466 E(J,13)=VAL(T$)
470 INPUT"MN.1. (A) TO DATE (OR 0)";T$
475 IFT$="*"THENPRINT"TT":GOTO470
476 E(J,9)=VAL(T$)
480 INPUT"MN.1. (B) TO DATE (OR 0)";T$
481 IFT$="*"THENPRINT"TT":GOTO480
482 E(J,10)=VAL(T$)
485 INPUT"MN.1. (ER) TO DATE (OR 0)";T$
486 IFT$="*"THENPRINT"TT":GOTO485
487 E(J,14)=VAL(T$)
490 INPUT"MHAS THIS EMPLOYEE ALREADY LEFT(Y/N)";Q$
495 IF Q$="Y"THENE(J,6)=0:GOTO500
496 IF Q$="N"THENE(J,6)=1:GOTO500
497 PRINT"TT":GOTO490
500 PRINT"MPRESS C TO CANCEL : SPACE TO CONTINUE":GOSUB6
501 IFQ$="C"THEN425
510 NEXTJ
515 RETURN
1000 IFCL$=""THENGOSUB5000
1010 NE=NE+1:IFNE>100THENNE=100:GOTO100
1015 EN=NE:GOSUB260
1020 PRINT"DO YOU WANT ANY MORE?"
1030 GOSUB6
1040 IFQ$="Y"THEN1010
1050 IFQ$="N"THEN1070
1060 GOTO1030
1070 GOSUB3950:GOTO1000
2000 IFCL$=""THENGOSUB5000
2005 PRINT"DO YOU WANT ANY MORE?"
2010 INPUT"EMPLOYEE NUMBER (N=N/K)";T$
2020 IFT$="*"THENPRINT"TT":GOTO2010
2030 IFT$="N"THENGOSUB6000
2040 EN=VAL(T$):IFE(EN,3)=0THEHT$="*":GOTO2020
2050 E(EN,6)=0
2060 PRINT"DO YOU WANT ANY MORE?"
2070 GOSUB6
2080 IFQ$="Y"THEN2010
2090 IFQ$="N"THEN1070
2110 GOTO2070
3000 IFCL$=""THENGOSUB5000
3005 PRINT"DO YOU WANT ANY MORE?"
3010 INPUT"EMPLOYEE NUMBER (N=N/K)";T$
3020 IFT$="*"THENPRINT"TT":GOTO3010
3030 IFT$="N"THENGOSUB6000
3040 EN=VAL(T$):IFE(EN,3)=0THEHT$="*":GOTO3020
3050 GOSUB8000
3060 PRINT"DO YOU WANT ANY MORE?"
3070 GOSUB6
3080 IFQ$="Y"THEN3010
3090 IFQ$="N"THEN1070
3110 GOTO3070
3900 IFCL$<>"*":GOTO3910
3905 PRINT"NO DATA TO RECORD":FORM=1TOS00:NEXTM:GOTO100
3910 GOSUB4000:GOTO100
3950 PRINT"MPRESS R TO RECORD"
3960 PRINT"MPRESS M TO RETURN TO MENU"
3970 GOSUB6
3980 IFQ$="M"THENRETURN
3990 IFQ$<>"R"THEN3970
4000 PRINT"MPRESS R TO RECORD DATA TAPE"
4010 GOSUB5
4020 OPEN1,1,1

```



```

4030 PRINT"*****WRITING ";CL$
4040 PRINT#1,CL$
4050 PRINT#1,NE
4055 FORJ=1TO6:PRINT#1,P(J):NEXTJ
4060 FORJ=1TONE
4070 PRINT#1,E$(J,1)
4080 PRINT#1,E$(J,2)
4090 PRINT#1,E$(J,3)
4100 NEXTJ
4110 FORJ=1TONE
4115 FORK=1TO14
4120 PRINT#1,E(J,K)
4125 NEXTK
4130 NEXTJ
4140 CLOSE1
4150 RETURN
5000 PRINT"*****LOAD DATA TAPE"
5010 GOSUB5
5020 OPEN1,1,0
5030 INPUT#1,CL$
5040 PRINT"*****READING ";CL$
5050 INPUT#1,NE
5055 FORJ=1TO6:INPUT#1,P(J):NEXTJ
5060 FORJ=1TONE
5070 INPUT#1,E$(J,1)
5080 INPUT#1,E$(J,2)
5090 INPUT#1,E$(J,3)
5100 NEXTJ
5110 FORJ=1TONE
5115 FORK=1TO14
5120 INPUT#1,E(J,K)
5125 NEXTK
5130 NEXTJ
5140 CLOSE1
5150 RETURN
6000 PRINT"*****"
6010 INPUT"EMPLOYEE NAME *****";T$
6020 IFT$="*"THENPRINT"IT":GOTO6010
6030 FORJ=1TONE
6040 FORK=1TOLEN(E$(J,1))-LEN(T$)+1
6050 T=0:IFMID$(E$(J,1),K,LEN(T$))=T$THENGOSUB7000
6055 IFT=1THENG100
6060 NEXTK
6070 NEXTJ
6080 PRINT"*****NAME NOT FOUND":GOTO6010
6100 T$=STR$(J):RETURN
7000 PRINT"*****FOUND":E$(J,1)
7020 PRINT"IS THIS CORRECT?"
7030 GOSUB6
7040 IFO$="Y"THEN T=1:RETURN
7050 IFO$="N"THENRETURN
7060 GOTO7030
7500 IFO<>E(EN,1)THENQ=INT(Q*100+.5)/100
7505 Q1$=STR$(Q)
7510 FORK=1TOLEN(Q1$):IFMID$(Q1$,K,1)="."THEN7540
7520 NEXTK
7530 Q1$=Q1$+"."00":GOTO7560
7540 K=LEN(Q1$)-K
7550 IFK=1THENQ1$=Q1$+"0"
7560 IFO=1THENPRINTQ$;Q1$
7570 RETURN
7600 IFCL$="*THENGOSUB5000
7602 PRINT"*****LISTING P35"
7604 OPEN4,4
7605 PRINT#4,CHR$(1)CL$
7606 PRINT#4
7608 PRINT#4," NAME N. I. TAX"
7609 PRINT#4
7610 L=0:M=0:FORJ=1TONE
7620 Q$=E$(J,1):Q=E(J,8):L=L+Q:GOSUB7500:Q2$=Q1$:Q=E(J,9)+E(J,10)+E(J,14):M=M+Q
7625 GOSUB7500
7630 GOSUB7700
7640 NEXTJ
7643 PRINT#4
7645 Q$="TOTAL":Q=L:GOSUB7500:Q2$=Q1$:Q=M:GOSUB7500:GOSUB7700
7650 CLOSE4
7660 GOTO100
7700 IFLEN(Q$)<25THENQ$=Q$+" ":GOTO7700
7710 IFLEN(Q1$)<10THENQ1$=" "+Q1$:GOTO7710
7720 IFLEN(Q2$)<10THENQ2$=" "+Q2$:GOTO7720
7730 PRINT#4,LEFT$(Q$,20);Q1$;TAB(40-(20+LEN(Q1$)));Q2$
7740 RETURN
8000 IV=3:O=1:PRINT"IV";
8005 OPEN4,IV:CMD4
8010 PRINT"EMPLOYEE NUMBER ";EN
8015 PRINT" 1:NAME ";E$(EN,1)
8020 PRINT" 2:N. I. NO ";E$(EN,2)
8030 PRINT" 3:TAX CODE ";E$(EN,3)
8040 PRINT" 4:WK.1 ";IFE(EN,4)=0THENT$="NO"
8041 IFE(EN,4)=1THENT$="YES"
8045 PRINTT$
8050 Q$=" 5:PAY/HOUR ";Q=E(EN,1):GOSUB7500
8060 Q$=" 6:PAY/WEEK ";Q=E(EN,5):GOSUB7500
8070 PRINT" 7:NI RATE ";
8080 IFE(EN,3)=1THENT$="A"
8081 IFE(EN,3)=2THENT$="B"
8082 IFE(EN,3)=3THENT$="C"
8085 PRINTT$
8090 Q$=" 8:GP TO DATE ";Q=E(EN,7):GOSUB7500
8100 Q$=" 9:TAX TO DATE ";Q=E(EN,8):GOSUB7500
    
```

(continued on next page)

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(continued from previous page)

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8110 Q$="10:GF (PREV.) :":Q=E(EN,11):GOSUB7500
8120 Q$="11:TAX(PREV) :":Q=E(EN,12):GOSUB7500
8130 PRINT"12:PAID TO WEEK :":E(EN,13)
8150 Q$="13:HI (A)TO DATE :":Q=E(EN,9):GOSUB7500
8160 Q$="14:HI (B)TO DATE :":Q=E(EN,10):GOSUB7500
8170 Q$="15:HI(ER)TO DATE :":Q=E(EN,14):GOSUB7500
8180 PRINT"16:CURRENT/LEFT :":
8190 T$="CURRENT":IFE(EN,6)=0THENT$="LEFT"
8200 PRINTT$
8202 PRINT#4:CLOSE4:IFDV=4THEN8000
8205 PRINT"17:CORRECT!"
8208 PRINT" (ENTER P TO COPY TO PRINTER)"
8210 INPUT"ENTER FIELD NO. TO BE AMENDED:";T$
8220 IFT$="*"THENPRINT"1":GOTO8210
8225 IFT$="P"THENDV=4:GOTO8005
8230 T=VAL(T$):IFT<1ORT>17THENT$="*":GOTO8220
8240 IFT=16THENE(EN,6)=-1*(E(EN,6)=0):GOTO8000
8245 IFT=4THENE(EN,4)=-1*(E(EN,4)=0):GOTO8000
8250 IFT=17THENO=0:RETURN
8270 INPUT"ENTER NEW DATA:";Q$
8280 IFT<3THENE(EN,T)=Q$:IFT=3THENGOSUB8300
8290 IFQ$="*"THENPRINT"1":GOTO8270
8295 GOTO8350
8300 E(EN,2)=VAL(Q$)
8305 IFQ$="BR"THENE(EN,2)=0:GOTO8340
8310 IFQ$="OT"ORQ$="OT"THENE(EN,2)=-1
8315 IFQ$="NT"THENE(EN,2)=2000
8320 T$=LEFT$(Q$,1):IFT$="D"ORT$="F"THENE(EN,2)=VAL(RIGHT$(Q$,LEN(Q$)-1))
8325 IFE(EN,2)+OP>XANDT$="D"THENQ$="*"
8330 IFE(EN,2)=0ANDT$<"D"THENQ$="*"
8340 RETURN
8350 IFT=7AND(Q$="A"ORQ$="B"ORQ$="C")THEN8370
8360 IFT<7THEN8400
8365 Q$="*":GOTO8200
8370 IFQ$="A"THENE(EN,3)=1
8371 IFQ$="B"THENE(EN,3)=2
8372 IFQ$="C"THENE(EN,3)=3
8400 Q=0:IF(T=5ORT=13ORT=14)THENQ=T-4
8410 IF(T>9ANDT<13)THENQ=T+1
8420 IF(T<5ANDT<10)OR(T=15)THENQ=T-1
8430 E(EN,Q)=VAL(Q$)
8440 GOTO8000
9000 IFCL$=""THENGOSUB5000
9005 PRINT"USE THIS SECTION ONLY ON RECEIPT OF"
9006 PRINT"
9010 PRINT"P7X AUTHORITY FROM TAX OFFICE"
9020 PRINT"ADD SUFFIX ADD TO CODE"
9021 PRINT"
9025 PRINTTAB(15);"(TO REDUCE CODE"
9026 PRINTTAB(15);"USE LEADING MINUS)"
9030 PRINT"
9035 FORM=1T04
9040 INPUT" ";T$(M)
9050 IFT$(M)="*"THENPRINT"1":GOTO9040
9060 PRINT"
9070 NEXTM
9080 PRINT"PRESS C TO CANCEL : SPACE TO CONTINUE":GOSUB6
9090 IFQ$="C"THEN9005
9095 FORJ=1T04:T(J)=VAL(T$(J)):NEXTJ
9100 FORJ=1TONE
9110 IFRIGHT$(E$(J,3),1)="H"THENE(J,2)=E(J,2)+T(1):E$(J,3)=STR$(E(J,2))+H"
9120 IFRIGHT$(E$(J,3),1)="L"THENE(J,2)=E(J,2)+T(2):E$(J,3)=STR$(E(J,2))+L"
9130 IFRIGHT$(E$(J,3),1)="P"THENE(J,2)=E(J,2)+T(3):E$(J,3)=STR$(E(J,2))+P"
9140 IFRIGHT$(E$(J,3),1)="V"THENE(J,2)=E(J,2)+T(4):E$(J,3)=STR$(E(J,2))+V"
9150 NEXTJ
9160 GOTO100
10000 IFCL$=""THENGOSUB5000
10005 PRINT"PRESS SPACE TO LOAD PAYROLL"
10010 GOSUB6
10020 LOAD"PAYROLL"
12000 :
12010 :THIS SECTION IS FOR INFORMATION ONLY.
12020 :IT IS NEVER CALLED:HENCE ABSENCE OF 'REM'
12030 :E$(J,1)=EMPLOYEE NAME
12040 :E$(J,2)=N. I. NUMBER
12050 :E$(J,3)=TAX CODE
12060 :
12070 :E(J,1)=PAY/HOUR
12080 :E(J,2)=TAX CODE(NUMERIC)
12090 :E(J,3)=N. I. RATE
12100 :E(J,4)=WK.1 FLAG
12110 :E(J,5)=NORMAL WEEK'S PAY
12120 :E(J,6)=CURRENT EMPLOYEE FLAG
12130 :E(J,7)=GROSS PAY TO DATE
12140 :E(J,8)=TAX TO DATE
12150 :E(J,9)=N. I. (A) TO DATE
12160 :E(J,10)=N. I. (B) TO DATE
12170 :E(J,11)=PREV EMPLOYMENT:-G. P.
12180 :E(J,12)=PREV EMPLOYMENT:-TAX
12190 :E(J,13)=PAID TO WEEK NO.
12200 :E(J,14)=N. I. (EMPR.) TO DATE
12210 :
12220 :S(J,1)=GROSS PAY THIS WEEK
12230 :S(J,2)=TAX THIS WEEK
12240 :S(J,3)=N. I. (A) THIS WEEK
12250 :S(J,4)=N. I. (B) THIS WEEK
12260 :S(J,5)=N. I. (EMPR.) THIS WEEK
12270 :
12280 :P(1)=GROSS PAY FOR PERIOD
12290 :P(2)=TAX FOR PERIOD

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12300 :P(3)=TOTAL N.I. FOR PERIOD
12310 :P(4)=EMPEE. N.I. FOR PERIOD
12320 :P(5)=EMPR. N.I. FOR PERIOD
12330 :P(6)=TOTAL N.I. & TAX FOR PERIOD
12340 :
12350 :ARRAYS C,K,R,N FOR TAX/N.I.DATA
12360 :
12370 :C( )=CUMULATIVE BANDWIDTHS
12380 :R( )=TAX RATES
12390 :K( )=CUMULATIVE ANNUAL TAXES
12400 :N(1)=N.I.RATE A
12410 :N(2)=N.I.RATE B
12420 :N(3)=N.I.RATE C
12430 :N(4)=N.I.RATE (EMPLOYER)
12440 :
12450 :ARRAYS T$,T,G FOR TEMPORARY STORAGE
READY.
    
```

Program 2.

```

4 GOTO100
5 PRINT"PRESS SPACE WHEN READY"
6 Q$="":GETQ$:IFQ$=""THEN$
7 RETURN
100 REM: I.R. & D.H.S.S. DATA
110 X=5
115 DIMC(X),R(X+1),K(X),N(4)
120 C(1)=11250
121 C(2)=13250
122 C(3)=16750
123 C(4)=22250
124 C(5)=27750
130 R(1)=.3
131 R(2)=.4
132 R(3)=.45
133 R(4)=.5
134 R(5)=.55
135 R(6)=.6
140 K(1)=3375
141 K(2)=4175
142 K(3)=5750
143 K(4)=8500
144 K(5)=11525
150 GPTR=1
170 N(1)=.0775
171 N(2)=.0275
172 N(3)=0
173 N(4)=.137
180 NU=200
181 NL=27
490 DIMS(100,5),G(7)
495 IFCL$<" THEN$900
500 DIME(100,14),E$(100,3),P(6),T(10)
900 Z=1:REM**NO. OF COPIES OF PAYSLIP**
1000 PRINT"*****PAYROLL
1001 PRINT"*****"
1005 GOSUB8500
1010 D$=DA$
1020 PRINT"D$"
1025 INPUT"ENTER WEEK NO *****";N$
1030 IFN$=""* THEN1025
1035 W=VAL(N$):IFW<10R>54THENN$=""*:GOTO1025
1037 IFCL$<" THEN1110
1040 PRINT"D$"
1045 PRINT"LOAD PAYROLL TAPE":GOSUBS
1050 OPEN1,1,0
1055 INPUT#1,CL$
1060 PRINT"*****LOADING *****";CL$
1065 INPUT#1,NE
1066 FORJ=1TO6:INPUT#1,P(J):NEXTJ
1070 FORJ=1TONE
1075 FOR K=1TO3
1080 INPUT#1,E$(J,K)
1085 NEXTK:NEXTJ
1086 FORJ=1TONE
1087 FORK=1TO14
1090 INPUT#1,E(J,K)
1095 NEXTK
1100 NEXTJ
1105 CLOSE1
1110 FORJ=1TONE
1111 IFE(J,6)=0THEN11000
1115 FORK=1TO7:G(K)=0:NEXT
1116 N=W
1120 PRINT"*****";E$(J,1);
1121 PRINTTAB(30);"*****WEEK*****";N
1122 IFE(J,13)>NTHENPRINT"*****PAID TO WEEK*****";E(J,13):GOTO1165
1125 PRINT"*****1: PAY AS NORMAL"
1130 PRINT"*****2: HOURS WORKED"
1135 PRINT"*****3: OVERTIME AT TIME AND A HALF"
1140 PRINT"*****4: OVERTIME AT DOUBLE TIME"
1145 PRINT"*****5: SICK PAY (HOURS)
1150 PRINT"*****6: HOLIDAY PAY (HOURS)
    
```

(continued on next page)

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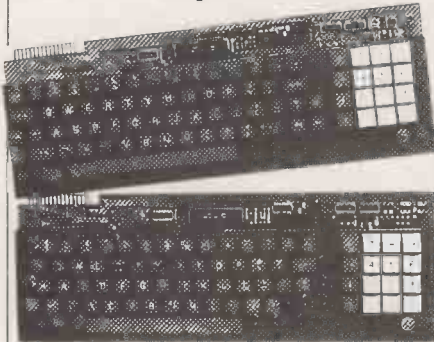
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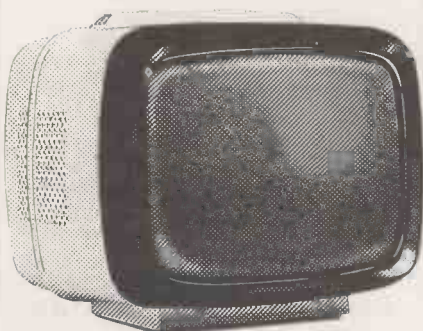
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(continued from previous page)

```

1155 PRINT"07: BONUS PAY (POUNDS)
1160 PRINT"08: POST-TAX ADJUSTMENTS
1162 PRINT"09: NO MORE ENTRIES
1165 PRINT"0A: SKIP (NO PAY:NO REFUND)
1167 PRINT"0B: CHANGE WEEK
1170 GOSUB6:Q=VAL(Q$)+1
1171 IFQ$="X"THEN11000
1172 IFQ$="W"ANDQ<2000>10THEN1170
1175 ONQGOTO2000,1200,1210,1250,1300,1350,1400,1450,1550,5000
1200 G(1)=E(J,5):GOTO5000
1210 PRINT"01";E$(J,1);"0000"
1220 INPUT"02:HOURS (1X)";H$
1225 IFH$="*"THEN1220
1235 G(1)=INT(VAL(H$)*E(J,1)*100+.5)/100
1240 GOTO1120
1250 PRINT"01";E$(J,1);"0000"
1255 INPUT"02/T HOURS (1.5X)";H$
1260 IFH$="*"THEN1255
1270 G(2)=INT(VAL(H$)*E(J,1)*1.5*100+.5)/100
1275 GOTO1120
1300 PRINT"01";E$(J,1);"0000"
1305 INPUT"02/T HOURS (2X)";H$
1310 IFH$="*"THEN1305
1320 G(3)=INT(VAL(H$)*E(J,1)*2*100+.5)/100
1325 GOTO1120
1350 PRINT"01";E$(J,1);"0000"
1355 INPUT"02/SICK HOURS";H$
1360 IFH$="*"THEN1355
1370 G(4)=INT(VAL(H$)*E(J,1)*100+.5)/100
1375 GOTO1120
1400 PRINT"01";E$(J,1);"0000"
1405 INPUT"02/HOLIDAY HOURS";H$
1410 IFH$="*"THEN1405
1420 G(5)=INT(VAL(H$)*E(J,1)*100+.5)/100
1425 GOTO1120
1450 PRINT"01";E$(J,1);"0000"
1455 INPUT"02/BONUS PAYMENT";H$
1460 IFH$="*"THEN1455
1470 GOSUB1700
1475 G(6)=T
1480 GOTO1120
1550 PRINT"01";E$(J,1);"0000"
1560 PRINT"ADJUSTMENT IS NORMALLY A DEDUCTION"
1565 PRINT"02/USE LEADING MINUS SIGN FOR ADDITION"
1570 INPUT"03/AMOUNT OF ADJUSTMENT";H$
1575 IFH$="*"THEN1570
1580 GOSUB1700
1585 G(7)=T
1600 GOTO1120
1700 FORK=1TOLEN(H$)
1710 IFMID$(H$,K,1)=". "THEN1730
1720 NEXTK:GOTO1740
1730 H$=LEFT$(H$,K)+MID$(H$,K+1,2)
1740 T=VAL(H$):RETURN
2000 N=N+1:IFN>54THENN=1
2010 GOTO1120
5000 G=G(1)+G(2)+G(3)+G(4)+G(5)+G(6)
5010 G=INT(G*100+.5)/100
6000 NI=0:ER=0
6010 IFG<NLTHENG=100
6020 GN=NU
6030 IFG<NLTHENGN=INT(G*2)/2+.25
6040 IFG<NLTHENGN=NL
6050 NI=INT(GN*N(E(J,3))*100+.49)/100
6060 ER=INT(GN*N(4)*100+.49)/100
6100 IFLEFT$(E$(J,3),1)="D"THEN6700
6103 IFLEFT$(E$(J,3),1)="F"THEN6300
6105 T=E(J,2):IFT>360THENGOSUB7000:GOTO6120
6110 GOSUB8000
6120 G1=G+E(J,7):IFE(J,4)=1THENG1=G
6130 NN=N/52:IFE(J,4)=1THENNN=1/52
6140 IFF>=61THENNTA=0:GOTO6310
6150 TP=INT((G1-F)*100+.0001)/100
6160 IFTP>INT((C(1)*NN+1)ANDT<>0)THEN6200
6170 TA=INT(TP)*R(1)
6180 REM:N/A 81:IFE(J,4)=1THENNTA=(INT(TP*4)/4)*R(1)
6190 GOTO6300
6200 B=1:FORK=2TOX
6210 IFTP>INT((C(K)*NN+1)THENB=K
6220 NEXTK
6230 TA=ABS((INT((C(B)*NN*10^4)/10^4)-INT(TP))
6240 TA=TA*R(B+1)
6250 TA=TA+(INT((C(B)*NN*10^4)/10^4)
6300 TA=INT(TA*20)/20
6310 IFE(J,4)=1THEN6500
6320 TA=INT((TA-E(J,8))*100+.5)/100
6500 PRINT"01":GOTO9000
6700 TA=INT(G)*R(GP+E(J,2)+1):GOTO6300
6800 TP=G
6810 IFE(J,4)=0THENTP=G+E(J,7)
    
```



```

6830 TP=INT(G*4)/4
6850 TA=TP*(E(J,2)/2)/100:GOTO6300
7000 L=INT(T/360)+1
7010 T(1)=INT(T/L):T(0)=0
7020 FORK=1TOL:T(K)=T(1):T(0)=T(0)+T(K):NEXTK
7030 IFT(0)=TTHEN7100
7040 FORK=1TOL
7050 T(K)=T(K)+1:T(0)=T(0)+1:IFT(0)=TTHEN7100
7060 NEXTK
7070 GOTO7040
7100 T(0)=0:FORM=1TOL
7110 T=T(M):GOSUB8000:T(0)=T(0)+F:NEXTM
7120 F=T(0):RETURN
8000 NN=N:IFE(J,4)=1THENNN=1
8005 F=NN*INT((INT(T*10+9)/52*10+4)/10+4+.049)*20)/20
8010 IFT<1THENF=0
8020 RETURN
8400 PRINT"PAYROLL TAX WEEK":N;"0000"
8500 INPUT"ENTER DATE (DDMMYY)";DA$
8510 IFDA$="*"THEN8500
8520 IFLEN(DA$)<>8THENDDA$="*":GOTO8510
8530 RETURN
9000 DA$=D$:IFN<D$THEN8000:PRINT"0"
9001 FORM=1TO2+1
9002 DV=3:IFM>1THENDV=4
9005 OPEN4,DV:IFDV=3THEN9030
9010 PRINT#4,CHR$(1)CL$
9020 PRINT#4
9030 PRINT#4,"NAME";E$(J,1)
9035 IFDV=3THEN9090
9037 PRINT#4,"PAY. NO. ";J
9040 PRINT#4,"INS. NO. ";E$(J,2)
9050 PRINT#4,"TAX CODE ";E$(J,3)
9055 PRINT#4
9060 PRINT#4,"WEEK NO. ";N
9070 PRINT#4,"W/E ";DA$
9075 PRINT#4
9080 PRINT#4
9090 Q=1:Q$="PAY - NORMAL TIME":Q=G(1):GOSUB9500
9100 Q=0:Q$="OVERTIME (1)":Q=G(2):GOSUB9500
9110 Q$="OVERTIME (2)":Q=G(3):GOSUB9500
9120 Q$="SICK PAY":Q=G(4):GOSUB9500
9130 Q$="HOLIDAY PAY":Q=G(5):GOSUB9500
9140 Q$="BONUS/ADJUSTMENT":Q=G(6):GOSUB9500
9145 PRINT#4
9150 Q=1:Q$="GROSS PAY":Q=G:GOSUB9500
9160 PRINT#4
9170 Q$="TAX":Q=TA:GOSUB9500
9180 Q$="N. I. ":Q=NI:GOSUB9500
9190 Q=0:Q$="ADJUSTMENT":Q=G(7):GOSUB9500
9200 Q=1:Q$="TOTAL DEDUCTIONS":Q=INT((TA+NI+G(7))*100+.5)/100:GOSUB9500
9205 PRINT#4
9210 Q$="NET PAYABLE":Q=INT((G-Q)*100+.5)/100:GOSUB9500
9215 PRINT#4
9220 Q$="GROSS PAY TO DATE":Q=E(J,7)+G:GOSUB9500
9230 Q$="TAX TO DATE":Q=E(J,8)+TA:GOSUB9500
9250 CLOSE4
9260 IFDV=4THEN9300
9270 PRINT"PRESS C TO CANCEL: P TO PRINT
9280 PRINT"PRESS R TO RECORD WITHOUT PRINTING"
9285 GOSUB6
9287 IFQ$="C"THEN1115
9289 IFQ$="P"THEN9300
9290 IFQ$="R"THEN10000
9295 GOTO9285
9300 NEXTM
9350 GOTO10000
9500 IFQ=0ANDQ=0THENRETURN
9510 Q1$=STR$(Q)
9520 FORK=1TOLEN(Q1$):IFMID$(Q1$,K,1)="."THEN9525
9521 NEXTK
9522 Q1$=Q1$+",".00":GOTO9535
9525 K=LEN(Q1$)-K
9530 IFK=1THENQ1$=Q1$+"0"
9535 H=30-LEN(Q1$):IFDV=4THENH=H-LEN(Q1$)
9540 PRINT#4,SPC(5)Q1$TAB(H)Q1$
9550 RETURN
10000 E(J,7)=E(J,7)+G
10005 E(J,8)=E(J,8)+TA
10010 IFE(J,3)=3THEN10030
10020 E(J,E(J,3)+8)=E(J,E(J,3)+8)+NI
10030 E(J,14)=E(J,14)+ER
10040 E(J,13)=N
10100 E(0,7)=E(0,7)+G
10110 E(0,8)=E(0,8)+TA
10115 E(0,1)=E(0,1)+G(7)
10120 IFE(J,3)=3THEN10140
10130 E(0,9)=E(0,9)+NI
10140 E(0,14)=E(0,14)+ER
10200 S(J,1)=G+S(J,1):S(J,2)=TA+S(J,2):S(J,3)=NI+S(J,3)
    
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(continued on next page)

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(continued from previous page)

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10205 S(J,4)=ER+S(J,4):S(J,5)=NI+ER+S(J,5)
10500 PRINT"XXXXXXXXXXPRESS S FOR SAME EMPLOYEE"
10510 PRINT"XOR SPACE FOR NEXT EMPLOYEE"
10520 GOSUB6
10530 IFQ$="S"THEN1115
10540 IFQ$<" " THEN10520
11000 NEXTJ
11400 FORJ=1TONE:FORK=1T05:S(0,K)=S(0,K)+S(J,K):NEXTK,J
11500 P(1)=P(1)+E(0,7)
11510 P(2)=P(2)+E(0,8)
11520 P(3)=P(3)+E(0,14)+E(0,9)
11530 P(4)=P(4)+E(0,9)
11535 P(5)=P(5)+E(0,14)
11540 P(6)=P(2)+P(3)
12000 PRINT"XXXXXXXXXXPRESS SPACE FOR FINAL SUMMARY"
12010 GOSUB6
12020 PRINT"J"
13000 OPEN4,4:OPEN3,4,2:OPEN2,4,1
13010 PRINT#4,CHR$(1)CL$
13020 PRINT#4
13030 PRINT#4,"WEEKLY SUMMARY - WEEK NO."W W/E "D$
13040 PRINT#4
13050 PRINT#4
13060 PRINT#3,"AAAAAAAAAAAAAAAAAAAAAAAA 99999.99-"
13070 PRINT#2,"GROSS PAY THIS WEEK"CHR$(29),E(0,7)
13080 PRINT#2,"TAX PAID THIS WEEK"CHR$(29),E(0,8)
13090 PRINT#2,"N. I. -EMPLOYEE"CHR$(29),E(0,9)
13095 PRINT#2,"(ADJ.)"CHR$(29),E(0,1)
13100 PRINT#2
13105 T=INT((E(0,7)-E(0,9)-E(0,1)-E(0,8)+.0001)*100)/100
13115 PRINT#2,"N. I. -EMPLOYER"CHR$(29),E(0,14)
13120 PRINT#2,"N. I. COMBINED"CHR$(29),E(0,9)+E(0,14)
13130 PRINT#2
13135 PRINT#2,"NET PAYABLE"CHR$(29),T
13140 FORJ=1T010:PRINT#2:NEXTJ
14000 PRINT#4,"EMPLOYEE PAY SUMMARY - WEEK NO."W W/E "D$
14010 PRINT#4
14020 PRINT#4,"";
14030 PRINT#4,"N. I. N. I. N. I."
14040 PRINT#4,"NAME GROSS TAX ";
14050 PRINT#4,"(EE) (ER) (TOT)"
14060 PRINT#4
14070 PRINT#3,"AAAAAAAAAAAAAAAAAAAAAAAA 99999.99- 99999.99-";
14080 PRINT#3,"9999.99- 9999.99- 9999.99"
14090 FORJ=1TONE
14095 IFE(J,6)=0THEN14110
14100 PRINT#2,E$(J,1)CHR$(29) S(J,1) S(J,2) S(J,3) S(J,4) S(J,5)
14110 NEXTJ
14115 PRINT#4
14120 PRINT#2,"TOTAL"CHR$(29) S(0,1) S(0,2) S(0,3) S(0,4) S(0,5)
14300 CLOSE2:CLOSE3:CLOSE4
14400 PRINT"XXXXXXXXXXPRESS R TO REPEAT SUMMARY"
14410 PRINT"XOR SPACE TO CONTINUE"
14420 GOSUB6
14430 IFQ$="R"THEN13000
14440 IFQ$=" " THEN14460
14450 GOTD14420
14460 PRINT"XXXXXXXXXXPRESS P TO PRINT PERIOD SUMMARY"
14470 PRINT"XOR SPACE TO FINISH"
14480 GOSUB6
14490 IFQ$="P"THEN14520
14500 IFQ$=" " THEN15060
14510 GOTD14580
14520 DV=4:OPEN4,DV
14530 PRINT#4,"PERIOD SUMMARY"
14540 PRINT#4
14550 Q=1:Q$="GROSS PAY FOR PERIOD":Q=P(1):GOSUB9500
14560 Q$="P. A. V. E. TOTAL":Q=P(2):GOSUB9500
14570 Q$="N. I. TOTAL":Q=P(3):GOSUB9500
14580 PRINT#4
14590 Q$="N. I. (EMPLOYEE)":Q=P(4):GOSUB9500
14600 Q$="N. I. (EMPLOYER)":Q=P(5):GOSUB9500
14605 PRINT#4
14610 Q$="TOTAL TAX AND N. I.":Q=P(6):GOSUB9500
14670 CLOSE4
14700 FORJ=1T06:P(J)=0:NEXTJ
15060 PRINT"XXXXXXXXXXNOW RECORD NEW DATA TAPE"
15070 GOSUB5
16000 OPEN1,1,1
16010 PRINT"XXXXXXXXXXWRITING ";CL$
16020 PRINT#1,CL$
16030 PRINT#1,NE
16035 FORJ=1T06:PRINT#1,P(J):NEXTJ
16040 FORJ=1TONE
16050 PRINT#1,E$(J,1)
16060 PRINT#1,E$(J,2)
16070 PRINT#1,E$(J,3)
16080 NEXTJ
16090 FORJ=1TONE
16100 FORK=1T014
16110 PRINT#1,E$(J,K)
16120 NEXTK
16130 NEXTJ
16140 CLOSE1
16150 PRINT"XXXXXXXXXXPRESS R FOR SECURITY COPY"
16160 PRINT"XOR SPACE TO FINISH"
16165 GOSUB6
16170 IFQ$="R"THEN16000
16180 IFQ$=" " THEN17000
16190 GOTD16165
17000 PRINT"J":END
READY.

```

BUYERS' GUIDE

The Buyers' Guide to microcomputers is a summary of low-cost computers available in the U.K. It appears every third month; we add new computers and amend existing information, as required, to keep it up-to-date. Systems are listed by manufacturer.

Microcomputers

ACORN COMPUTERS

Systems 1, 2, 3, 4, 5: 6502-based. 1-32K RAM COS or DOS. Hex or full keyboard. Personal, scientific business or educational use. Disc module, CMOS RAM Card, 80-by-25 character VDU interface, 8K static memory, analogue interface, daisywheel printer interface, cassette interface, VDU, laboratory interface, in-circuit emulator, universal interface, PROM program, Econet interface, switched-mode PSU. Software includes, Pascal, Lisp, Forth, floating-point extension, ONLI extension. System 1-3 Reviewed September 1979.

Atom: 6502, 2-12K RAM, up to 40K external memory, full keyboard, Basic in ROM, high-resolution graphics, cassette and TV interface, parallel port, I/O lines. Should eventually be able to link into a ring. Acorn Computers Ltd., 4a Market Hill, Cambridge CB2 3NJ (0223) 312772. Reviewed November 1980.

BBC Micro: 6502A or Z-80, 2MHz, second-processor option with up to 96K RAM, 32K in normal operation, full keyboard, cassette and disc interfaces, Centronics type interface, A-D interface, integral loudspeaker and sound generator. Options include: clock, voice synthesiser, Econet, teletext adapter and a 16-bit processor. VDU; eight modes including text and colour. Reviewed January 1982.

ALAN PEARMAN LTD

Maple: Z-80A, 16-64K RAM, S-100 bus, CP/M, 8in. discs, RS232 serial and parallel. Sold mainly as Micro-APL system. Alan Pearman Ltd., Maple House, Mortlake Crescent, Chester CH3 5UR. (0244) 46024.

ALPHA MICRO

AM-1010, AM-1051: WD-16, 64K-16MB RAM, S-100, four 8in. up to 90MB hard discs, RS232 up to 20 ports. Alpha Micro, 13 Brunswick Place, London N1 6ED. (01) 250 1616.

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ACS-8600 series: 8086 based, with 8089 DMA, 128K to 1Mbyte RAM, 10-80Mbyte hard disc, magnetic tape back-up, up to eight users, Xenix or MP/M-86. Business and educational use. *From £8,950*

APPLE COMPUTER

Apple II Plus: 6502, 16-48K RAM, 8K ROM, colour graphics, 5¼ in. discs, general use. Own bus. Reviewed October 1979. *From £695*

Apple III: 6502A with supporting chips, giving it a superset of 6502 instruction set. 96-128K RAM, colour graphics, integral 5¼ in., RS232, four 50-pin expansion slots. Apple Computer (U.K.) Ltd., Finway House, Hemel Hempstead, Hertfordshire HP2 7PS. (0442) 48151. *P.O.A.*

ATTACHE

Attache: 8080, 64K RAM, S-100, parallel port, 8in. discs, business system. Colt Computer Systems, Fairfield Works, Fairfields Road, Hounslow, Middlesex. (01) 577 2686 *From £1,737 to £7,000*

BASF

System 7100: Z-80A, 64K RAM, RS232, 5¼ in. discs, business systems. MPR, 4 Fitzroy Square, London W1. (01) 388 4200. *From £4,937*

BILLINGS

BMS: Z-80A, 64K RAM, 8in. 200MB hard discs, business system. Mitech Data Systems, 8 Guildford Road, Woking, Surrey. (04862) 23131. *From £4,295*

BL MICROELECTRONICS

Biproc: Z-80 or TMS9980 kit, 1K RAM, 2K monitor, RS232, cassette, TV. BLM, 1 Willow Way, Loudwater, High Wycombe, Buckinghamshire HP11 1JR. (0494) 443073. *From £150*

BLEASDALE COMPUTER SYSTEMS

UDS: 8080, Z-80, 6809, 32K-1MB, Multibus, CP/M, 5¼ in., 8in., hard, RS232, four parallel ports, IEEE 488, development system. Bleasdale Computer Systems, Francis House, Francis Street, London SW1. (01) 828 6661. *P.O.A.*

BMG MICROSYSTEMS

BMG MS 5000 range: 8085 or 8086, 64-768K RAM, CP/M, MP/M, BOS 8in. discs or Hard Disc — 40Mbytes, 20Mbytes of which are in an exchangeable cartridge. Up to 8 remote VDU's and printers. BMG Microsystems Ltd., Micro House, Hawkestone, Swindon, Wiltshire SN2 1DZ. (0793) 37813. *From £6,000*

BRUTECH ELECTRONICS

BEM: Single-board processor with 6502 and no RAM. Data Precision Equipment, 81 Goldsworth Road, Woking, Surrey GU21 1LJ. (04862) 67420. *From £133*



BYTRONIX MICROCOMPUTERS

Megamicro: 8080/Z-80, 64K RAM, 8in. discs, CP/M. Business and University use. Bytronix, 83 West Street, Farnham, Surrey GU9 7EN. (0252) 726814.

CANON BUSINESS MACHINES

Canon BX-1/BX-1d: 6800, 64K RAM, 5¼in. integral, RS232, V24 ports, business use. Canon Business Machines, Wadden House, Stafford Road, Croydon, Surrey. (01) 680 7700. *From £3,250*

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Communicator range: Z-80A, 64K RAM, S-100 bus, scientific, educational, research and business use. CP100/200; twin 5.25in. drives, CP-500; single 5.25in. and mini-Winchester hard disc giving 4.8byte CP/M, MP/M-II. Reviewed June 1981. *From £1,995*

COMMODORE BUSINESS MACHINES

Pet: 6502, 8-32K RAM, IEEE ports, integral 9in. screen, personal and general use. Reviewed August 1979. *From £460*

8000 Series — SuperPet: Upgrade of original Pet. 12in. screen, 5¼in. discs, business and general use. Reviewed October 1980. *From £895*

Vic 20: 6502, 5K RAM, 16K ROM, keyboard, personal and game use, IEEE interface, uses special cassette £35, disc and printer soon, RS-232, Modem use, low-resolution colour graphics. Commodore Business Machines, 818 Leigh Road, Slough Industrial Estate, Slough, Berkshire. (75) 74111. *From £165*

COMP SHOP

UK101: 6502, 4-8K RAM, TV interface, RS232, full keyboard, single-board, personal use, similar to Ohio Superboard. Comp-shop, 14 Station Road, New Barnet, Hertfordshire EN5 1QW. (01) 441 2922. Reviewed May 1980. *From £199 for kit*

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Compucolor II: Z-80, 8-32K RAM, 5¼in. integral discs, 13in. colour VDU, RS232. General use. Dyad Developments, The Priory, Great Milton, Oxfordshire OX9 7PB. (08446) 729. Reviewed June 1979. *From £998*

Copernicolor II: 8080A, 8-32K RAM, 5¼in., 8in. and Winchesters available, VDU, RS232 bus, standard ASCII keyboard with optional keyboards available, graphics 128 by 128, Basic, assembler, Fortran. Based on Compucolor II, wide range of software. General use. Copernicus Ltd., 7 Wey Hill, Haslemere, Surrey. (0428) 52888. *From £1,200*

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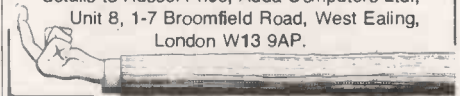
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Panasonic: 8085, 56K RAM, full keyboard, integral 24 by 80 VDU, integral twin 5¼ or 8in. floppy drives. Three RS232, business use. Panasonic Business Systems, 9 Connaught Street, London W2. (01) 261 3121. Reviewed June 1979.

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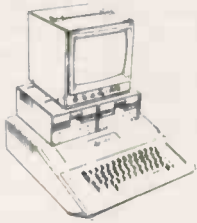
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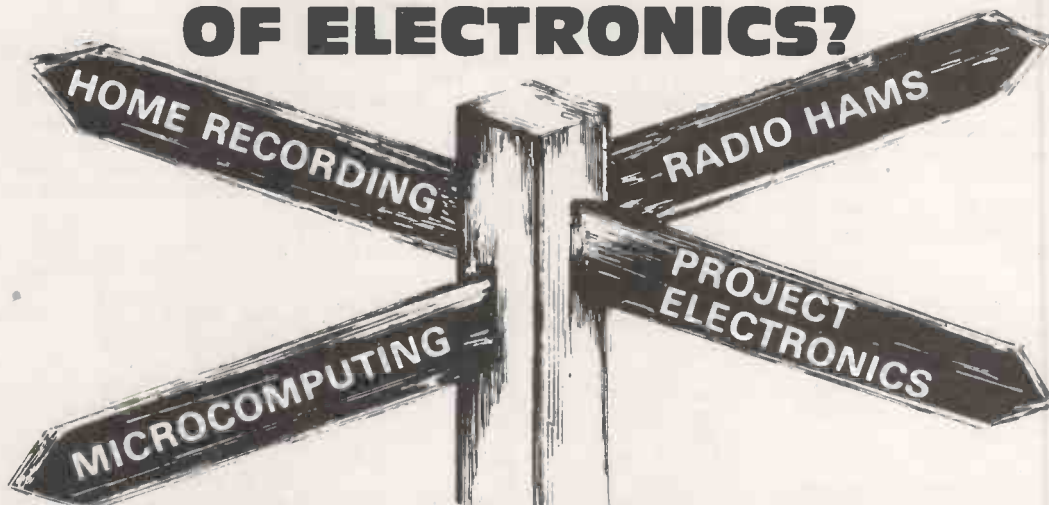
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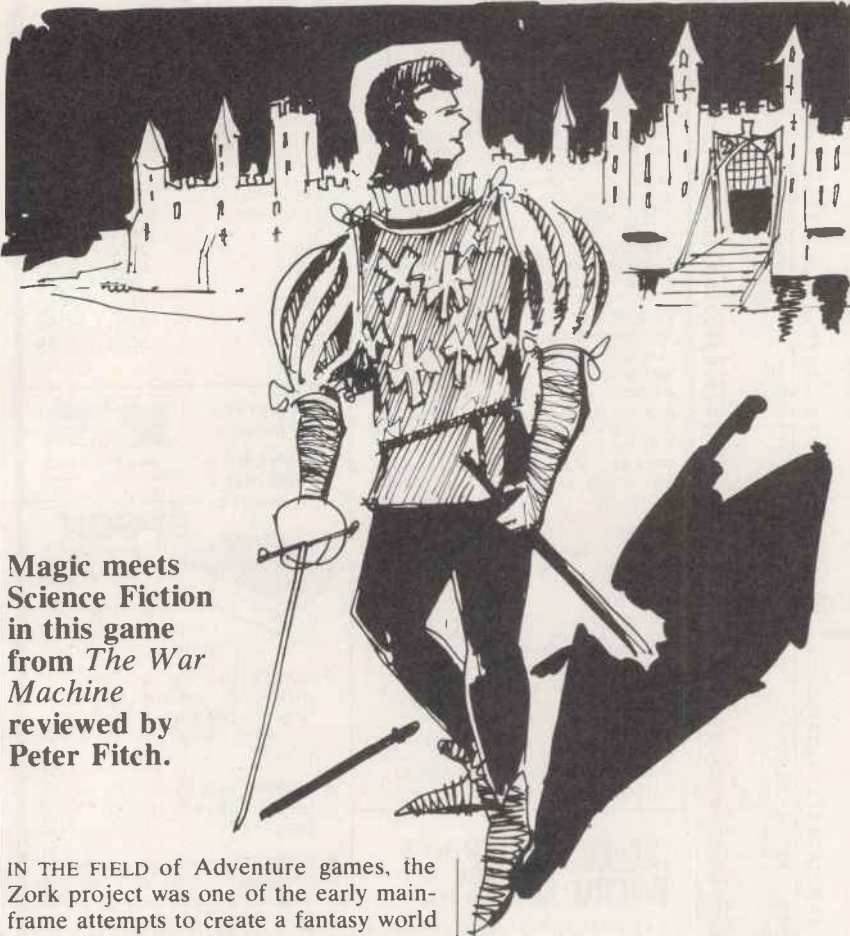
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ZORK



**Magic meets
Science Fiction
in this game
from *The War
Machine*
reviewed by
Peter Fitch.**

IN THE FIELD of Adventure games, the Zork project was one of the early main-frame attempts to create a fantasy world that a player could wander through and manipulate. Subsequent microcomputer Adventures owe a great deal to it.

Unfortunately, Zork itself — which has now been condensed to fit on to disc-based micro systems — suffers by comparison with more recent Adventures. They have improved on features originally devised by the Zork programming team, and they incorporate flashier graphic effects which make the games more visually appealing although, inevitably, less complex and rewarding. Only so much can be crammed into a given amount of memory, and an Adventure programmer never has enough.

Unfair to Trolls

Zork is a 48K game marketed on floppy disc for the Apple II and other computers. It is a classic machine-code Adventure type game and leans heavily on the original. I have never had the pleasure of playing Adventure on a main-frame, so I cannot compare Zork with it. I can only say that it is the best of the class I have come across.

It is an open-ended Adventure without any in-built time limit, though there are the normal internal time limitations. It is a game of points for objects and actions, which is rather a pity. I would have preferred a more substantial goal.

The game is supplied in a plastic zip-lock bag containing the disc and a well-printed explanatory booklet. There is an evil Troll-like entity on the cover which I

assume is the one I keep killing near the beginning of the game. He is being intimidated by a sword-carrying Hero type. It is a pity that no-one has started a "Save the Trolls" campaign. At the rate Adventure players go through them, the population must be dropping very rapidly since the advent of micros.

The disc loaded without problems, giving a standard description/action screen display. The booklet explains the context and aims for the uninitiated and the grammar for inputting commands to the puppet in the Adventure world. As movement occurs in the world, the computer updates from the disc, but not so often or so much as to upset the flow of the game.

Conclusions

Zork is an enjoyable Adventure game, though it is not very original apart from its presentation.

- As a puzzle it is good but it would have been improved by a few new ideas.
- After playing Zork for three months there were still some areas of the game which remained unsolved.

● Ratings:	
Physical quality	Very good
Perceived complexity	Very good
Subject complexity	Fair
Realism	Fair
Play balance	Very good
Overall	Good

The puppet is manipulated as one has come to expect in this type of game. Commands such as "Go west", "W", "tie rope" and "take skull" can be inputted and obeyed. It is pleasing that the grammar is sophisticated enough to allow more complex orders to be inputted in what approximates to English, for example, "Go west and take rope"; "Tie rope to railings and climb down".

A sequence of orders can be inputted and obeyed although each action counts as a time unit. Handling is tremendously improved. The vocabulary is very large too, compared to many other Adventure games, and there is little searching for the correct word as in some games. Active response from the puppet is limited.

There is no bartering for equipment at the beginning of the game. This is unfortunate since this useful part of the game could easily be chained in.

Sufficiently complex

The surface environment is quite large and well-described and laid out. It does not seem like rooms, which can sometimes happen in other games which use the surface. It is bounded by the usual impenetrable woods and mountains, and contains a river, a dam with power station, a lake, a falls and other atmospheric touches. This is a complete contrast to other games where you are forced to crawl round dank tunnels all the time, without a sight of sunlight. The underground part of the game which, thanks to the foresight of the programmer, sometimes comes to the surface, is large enough, complex enough and varied enough for many hours of pleasure.

Magic plays some part in the game and not always in context, which could be annoying. Magic should be logical and not arbitrary if it is to exist. There is a Troll quite near the beginning of the game but little else in the way of dangerous beings.

The only other mobile danger is that other well-tried character, the thief. He is quite lethal if attacked, and steals a little too often and at times illogically. Can you really believe that he could take away your only light without you noticing or attempting to stop him? He is also very difficult to kill.

There are no major bugs, though I would suggest that you avoid inserting elements out of context. They seem to hang around in the background even when they have disappeared for the purposes of the game. □

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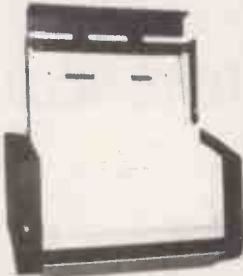
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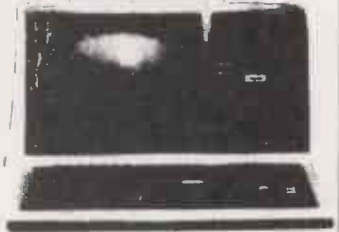
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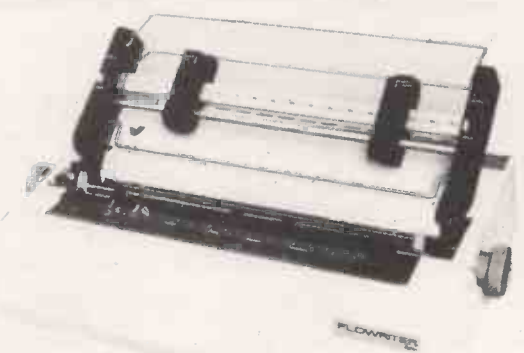
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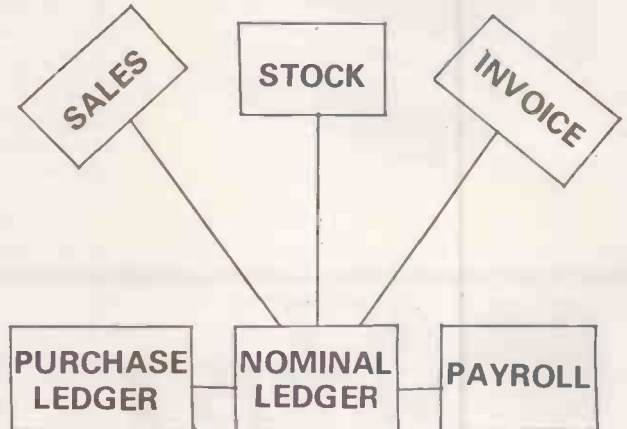
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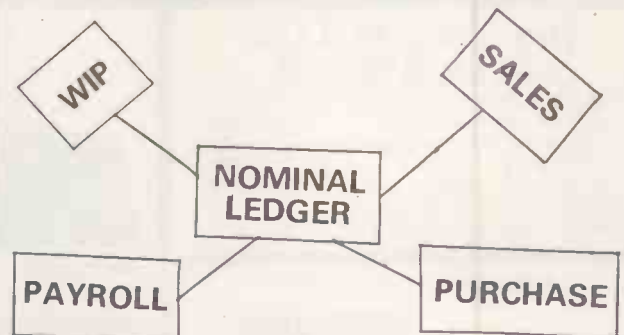
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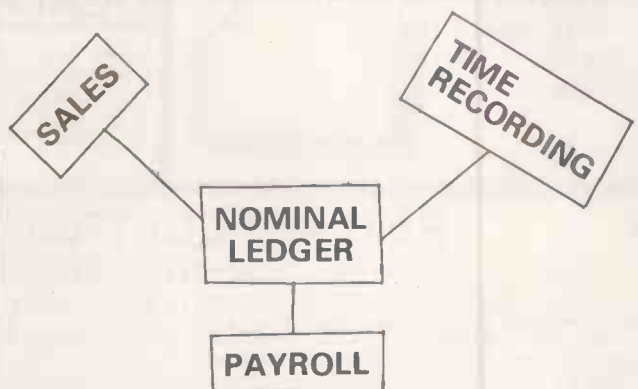
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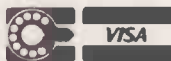
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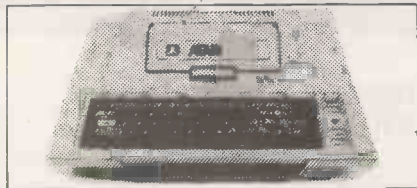
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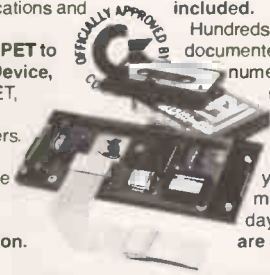
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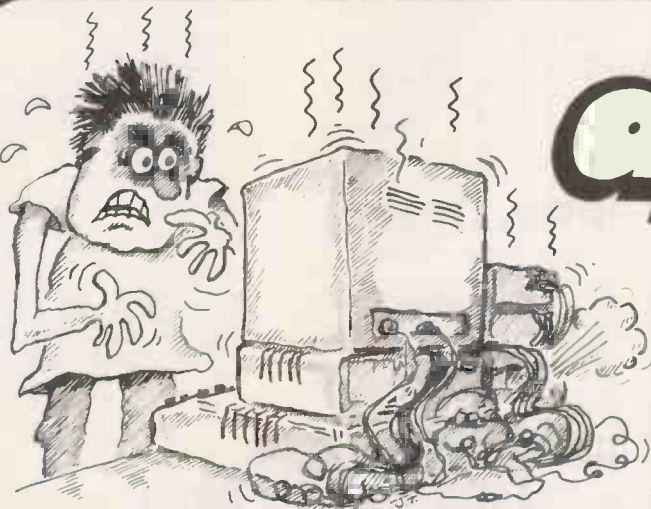


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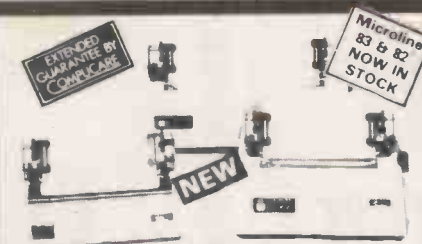
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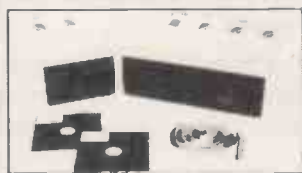
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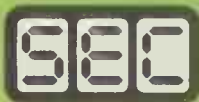
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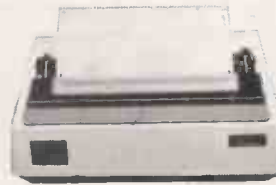


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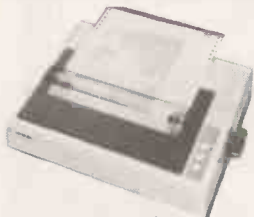


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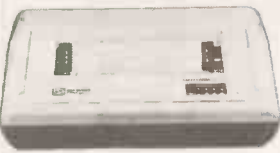


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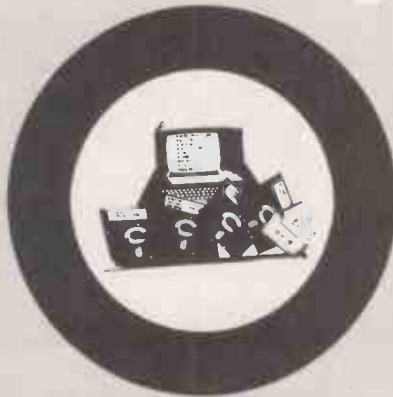
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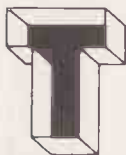
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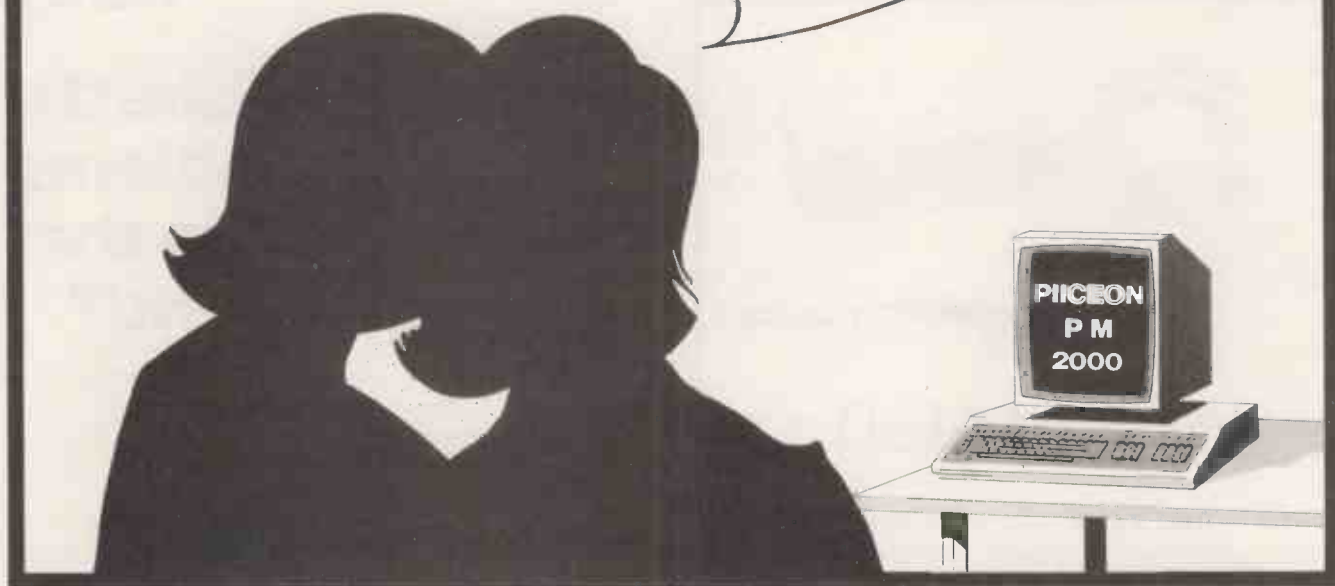
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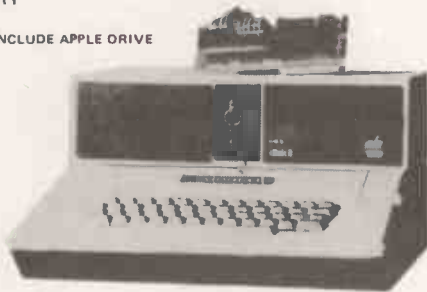
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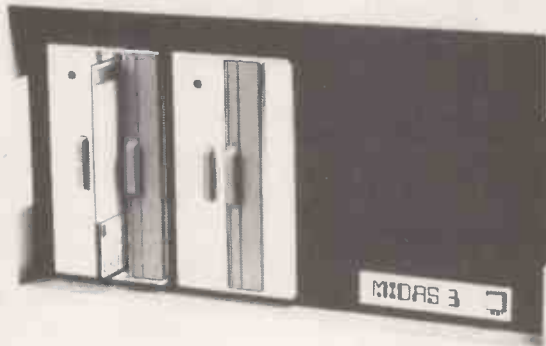
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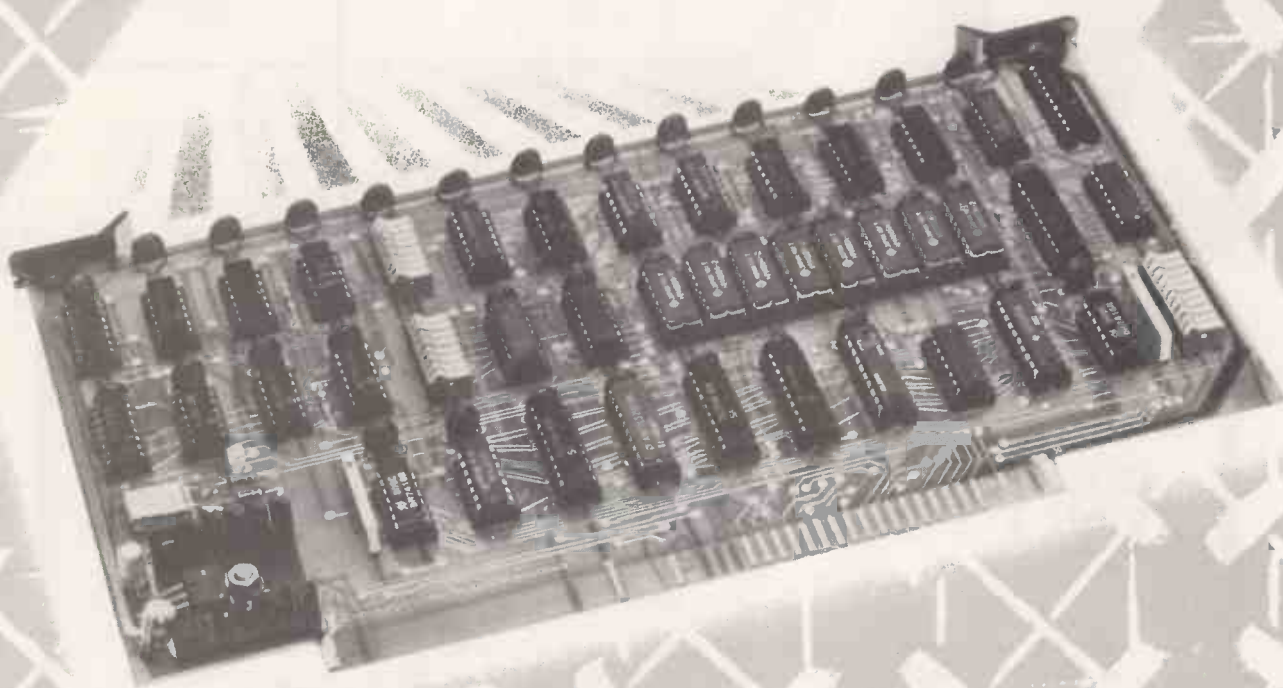
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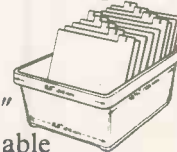
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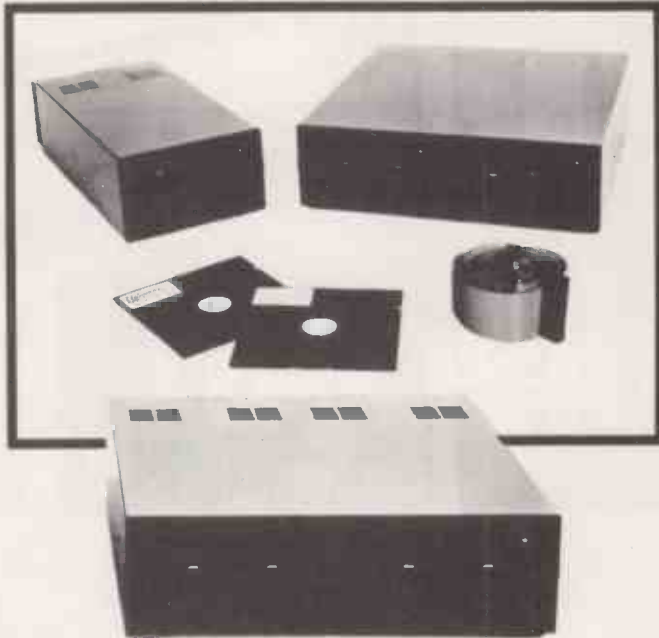
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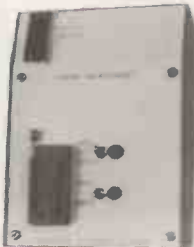
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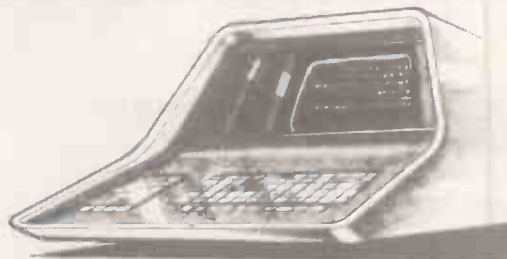
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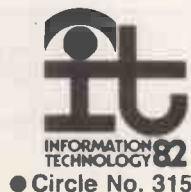
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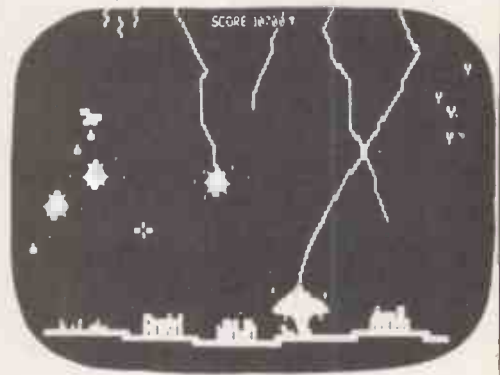
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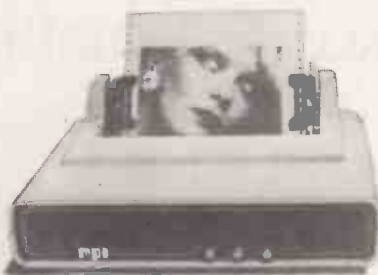
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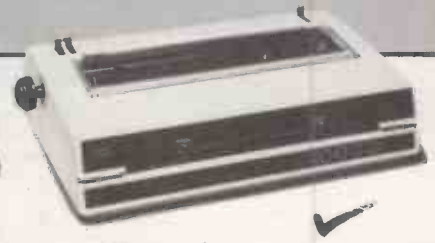
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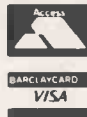
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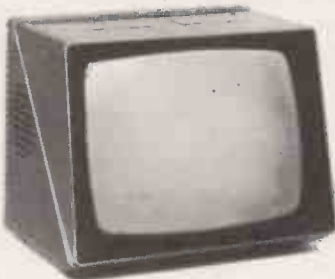
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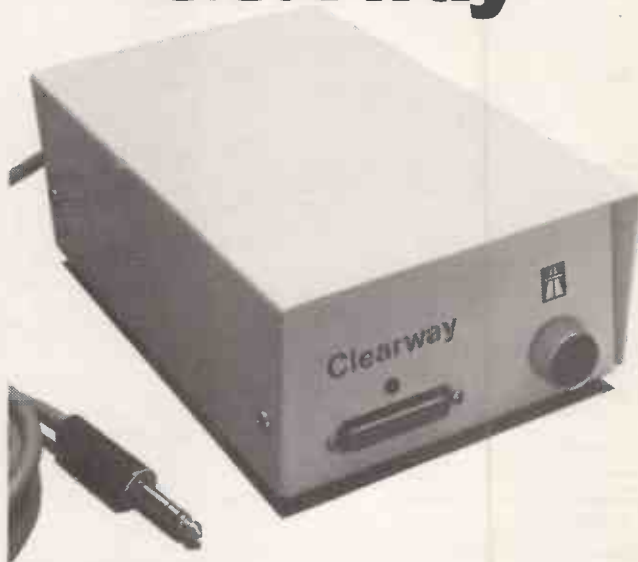
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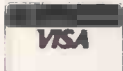
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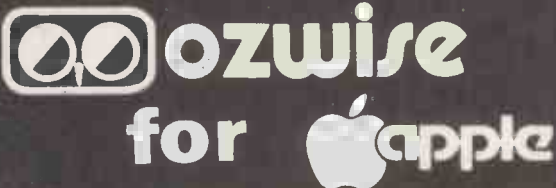
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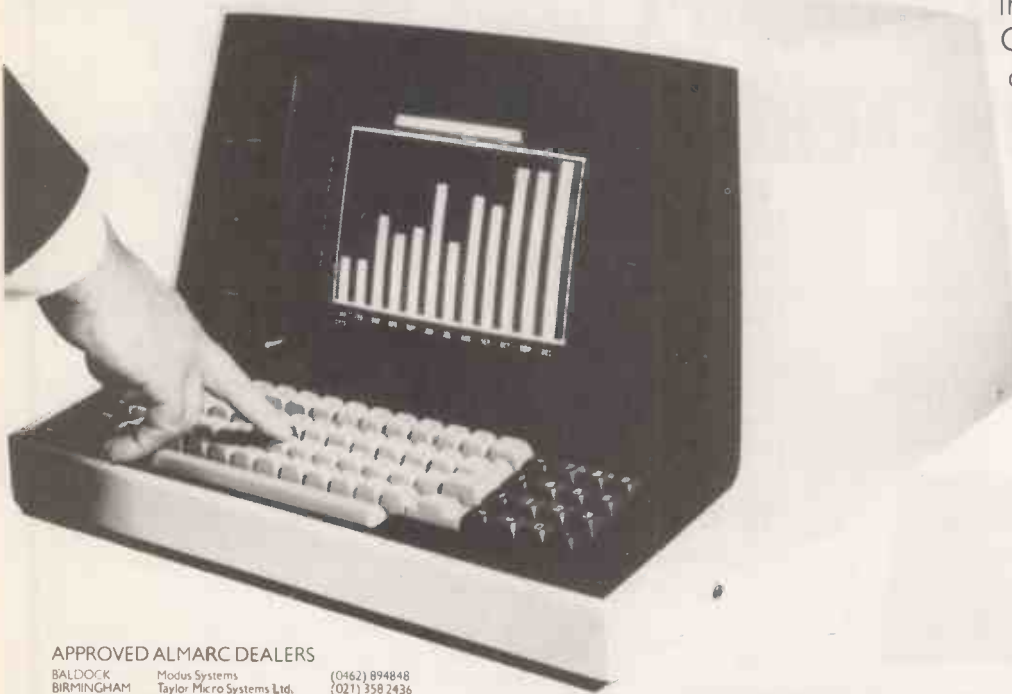
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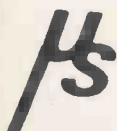
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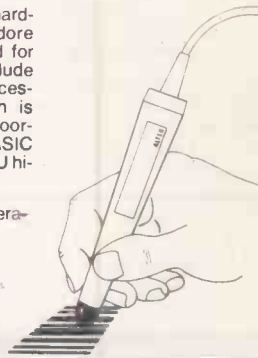
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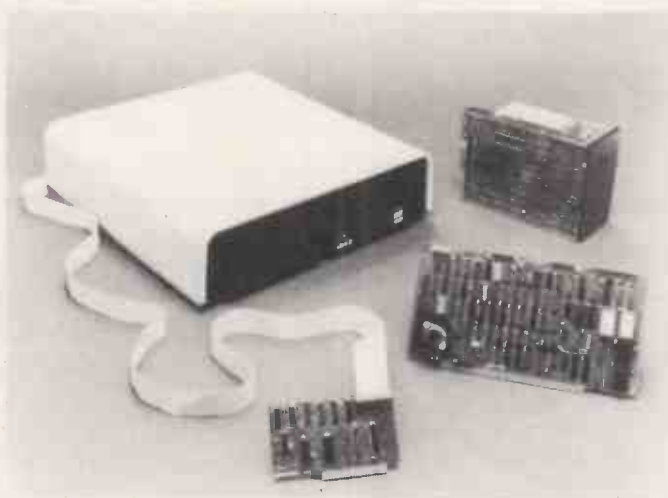
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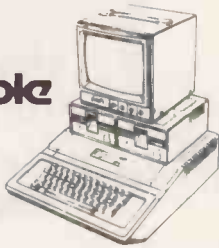
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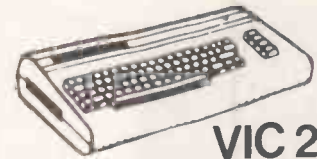
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