Practical Computing

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November 1981

Volume 4 Issue 11



Modelling the software market

Reviews:

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Genasys
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Comal - better than Basic?

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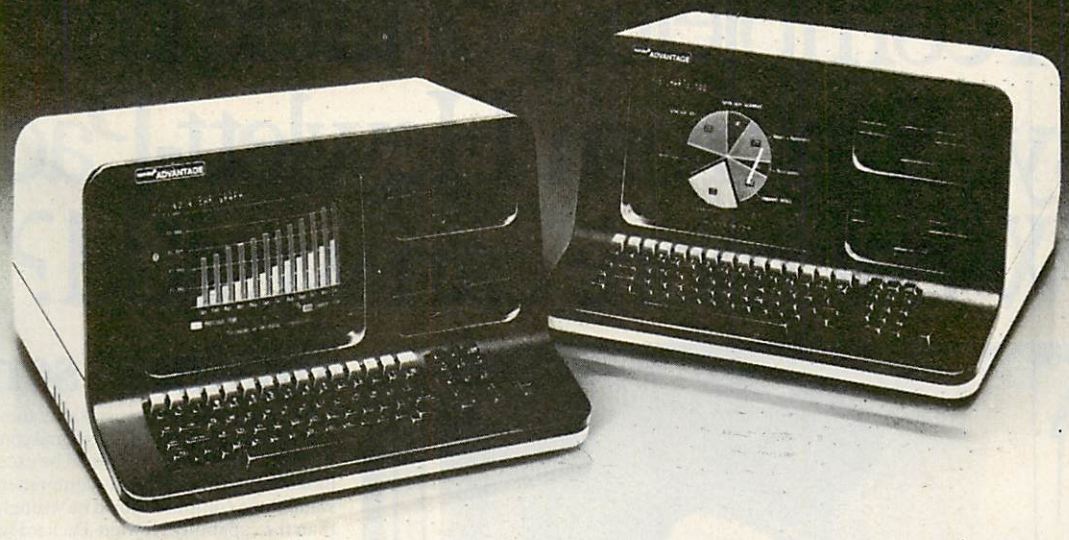
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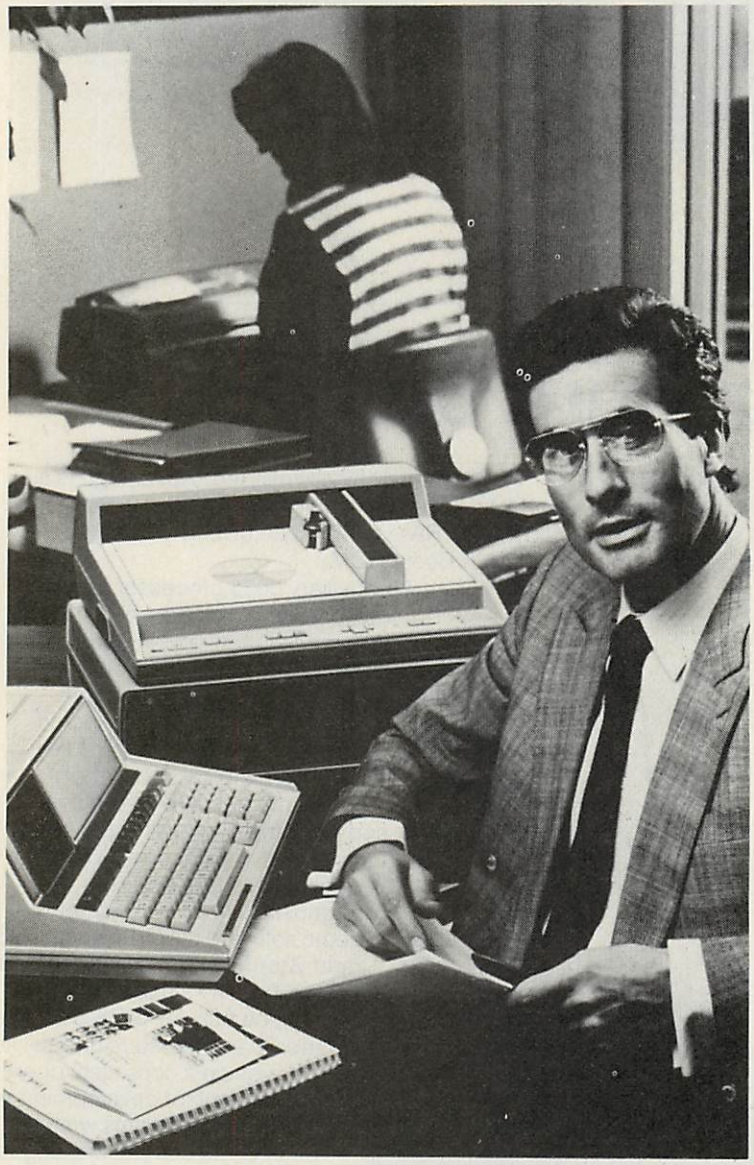
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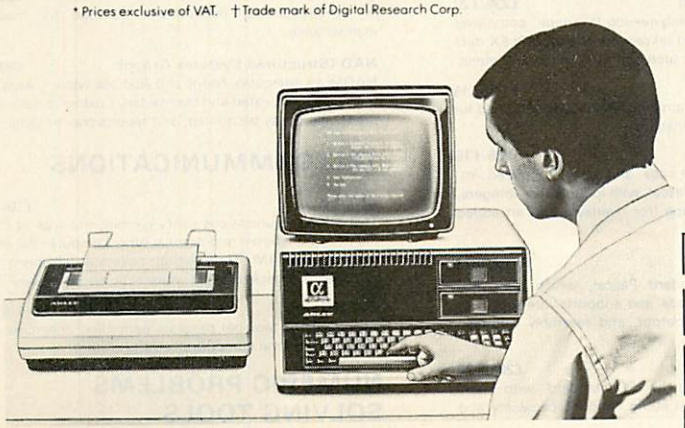
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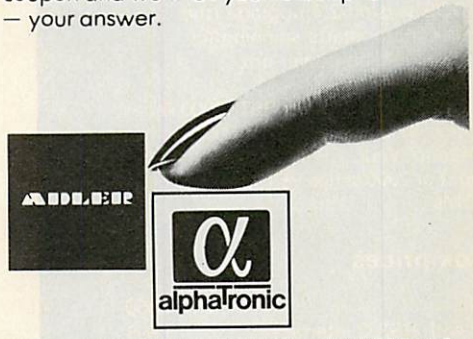


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This disk consists of the CRUNCH-14 compacting utility to reduce the size of and increase the speed or programs written in Microsoft BASIC-80. Also included is DPFUN, a set of double precision routines including square root, natural log, sinh, arcin - runs at high speed.

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A powerful, comprehensive forms contol and display system for key-to-disk data entry. DATASTAR is menu driven with built-in learning aids such as help messages on the screen, and input fields may be verified by length, mask, or type (upper or lower case, numeric).

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A screen editor which automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats.

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A sophisticated, versatile ISAM file management support system for use with CBASIC-2 and BASIC-80 business applications, allowing real-time enquiries, updates, additions and deletions

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M/SORT FOR COBOL-80 £130/£12
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PSORT £55/NA
A high speed machine language sort-merge utility for files with fixed length, aligned field records, such as random access files created under BASIC-80.

QSORT (Structured Systems Group) £55/NA
A fast sort/merge program written in 8080 assembly language for files with fixed record length but variable field length. It can sort on up to five ascending or decending keys.

STRING/80 £50/£15
A set or routines to allow string handling as well as direct CP/M BDOS calls from FORTRAN-80 and other compiled Microsoft languages.

STRING/80 SOURCE CODE available separately £185

STRING BIT £40/£15
FORTRAN character handling routines allowing the FORTRAN user to find, fill, pack, move, separate, concatenate and compare strings.

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ULTRASORT II £105/15
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SYSTEM TOOLS

MAC (Digital Research) £65/£15
A full Intel standard macro assembler including the pseudo-ops RPC, IRP, REPT, TITLE, PAGE and MACLIB. Macro libraries are included for CP/M sequential field access, assembling Z80 instructions (uses non-standard mnemonics), etc.

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An 8080 symbolic debugger with full trace, pass count, and breakpoint facilities plus back-trace and histogram utilities. SID works uses symbol files produced by MAC or the Microsoft linker to give a full symbolic display of user labels.

ZSID (Digital Research) £70/£NA
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MACRO-80 (Microsoft) £85/£15
A Microsoft utility package comprising a powerful macro assembler which will accept both 8080 and Z80 mnemonics producing a relocatable output file compatible with COBOL-80, FORTRAN-80 and compiled BASIC object files.

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PASM (Phoenix Software Associates) £70/£15
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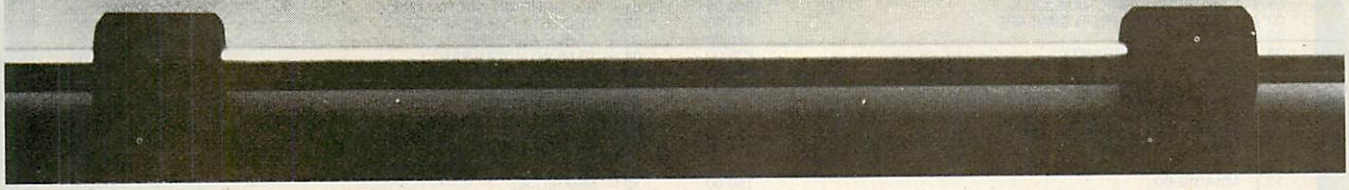
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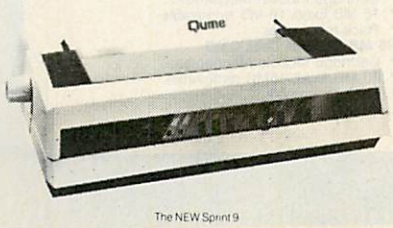
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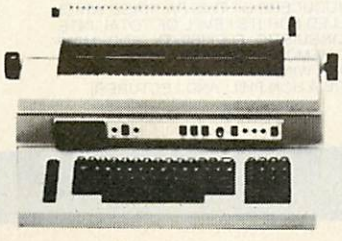
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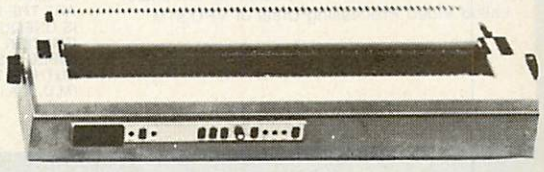
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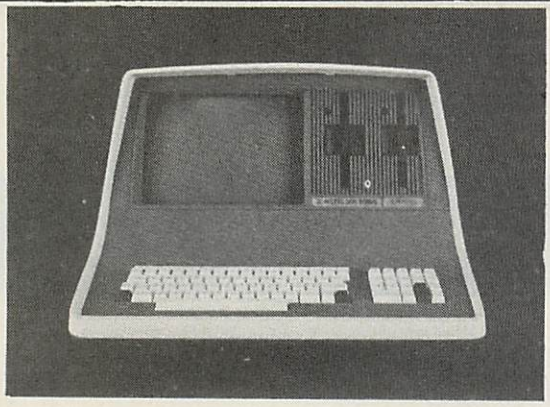


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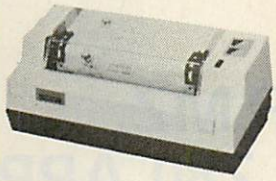
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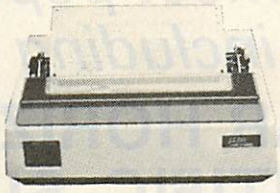


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OKI MICROLINE 83

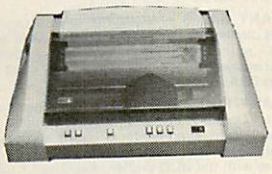


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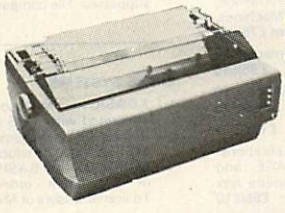


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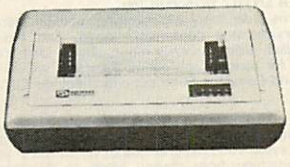


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SOFTWARE SYSTEMS

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MICRO FOCUS

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☐ **Z80 Development Package** — Consists of (1) disk file line
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☐ **ZDT** — Z80 Debugger to trace, break and examine registers
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Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model 1 computers.

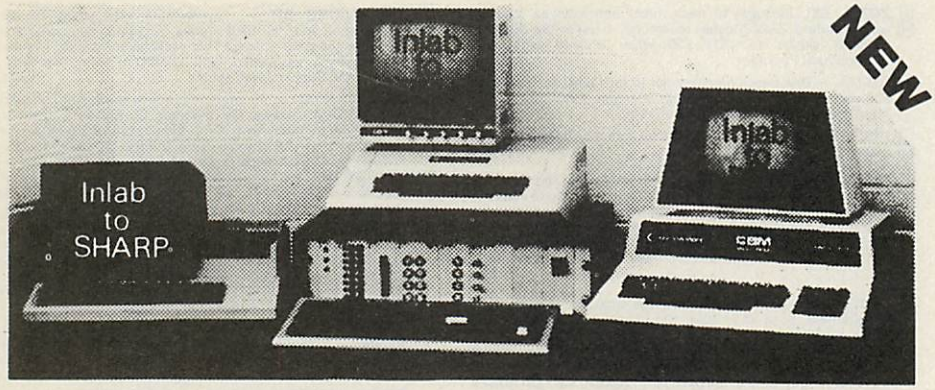
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3D Digital Design & Development, the specialists in the field, present their new modular system for configuring convenient, moderately-priced, and versatile multi-channel input/output systems. Specially designed for use in industrial and laboratory environments – the industry standard Eurocard based 19" rack can be driven from most popular microcomputers.

Main features

- monitoring analog signals from thermocouples, strain gauges, pressure transducers etc.,
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- actuating external circuits, lamps, heaters, motors, alarms etc.
- controlling instruments with BCD or logical inputs
- sensing contact closures, limit microswitches
- driving analogue signals into proportional power controllers, DC motors, with accurate indexing
- communicating information with remote terminals over a serial link
- any variations on these themes

LINK-UP

LINK-UP is a firmware package allowing several Commodore computers to share the same peripherals (disk drives, printers etc.) and, in its enhanced version, communication between computers themselves.

MAIN FEATURES

- Simple installation – NO external hardware.
- Solves the file handling problems with both sequential AND random access files.
- Makes the user aware of the 'transactions' on the IEEE Bus by displaying messages on the screen's status line.
- No theoretical limit on the number of computers in the system. Practically limited only by length of IEEE cable and peripheral access time.
- Three modes of operation; transparent; programmer – controllable; and stand-alone.
- Low cost compared to existing hardware solutions.

FUTURE ENHANCEMENTS

- Programming aids
- Printer spooling
- Messages between PET's
- File security options

INSTALLATION

The whole system consists of two EPROMS, one to exchange the existing F-ROM and another in 9$ – or A$ – slot (both versions are available).

FILE HANDLING

The firmware has been designed to cope with the problem of two computers reading simultaneously from the same file, so that no errors occur.

SCREEN MESSAGES

While the Bus is not free, a message is displayed on the screen of a computer that tries to access the disk, so that the user is aware of the fact and doesn't have to worry about the idea of the system having 'hung up'.

MODES OF OPERATION

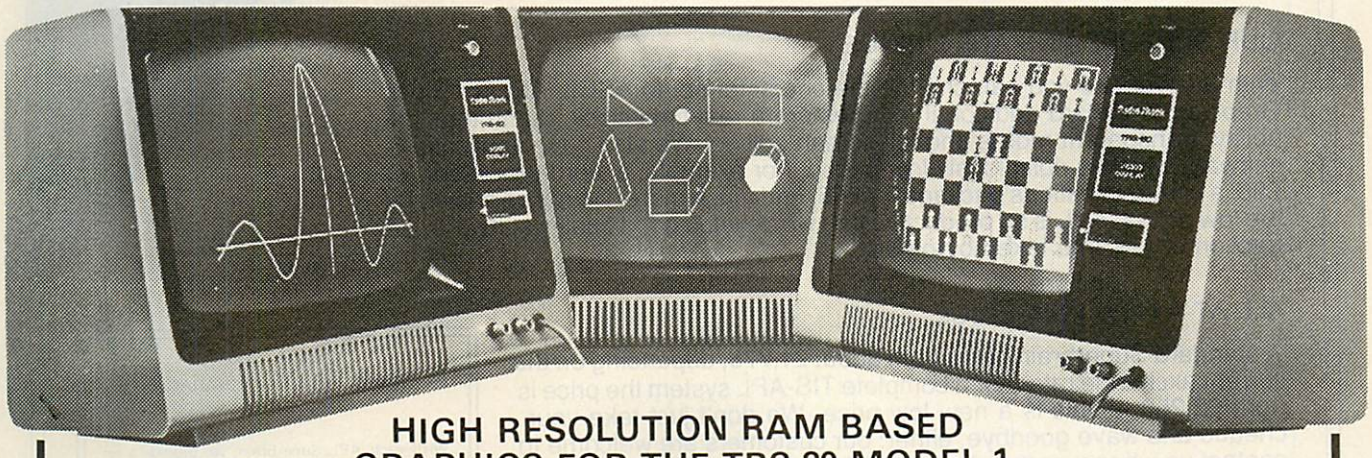
In the transparent mode the computer performs as if it were the only one in the system.
In the manual mode Bus access can be fully programmed so that in an application package, the disk and printer handling can be optimized for a distributed processing environment.
In the stand-alone mode the computer would act exactly as in a stand-alone system.

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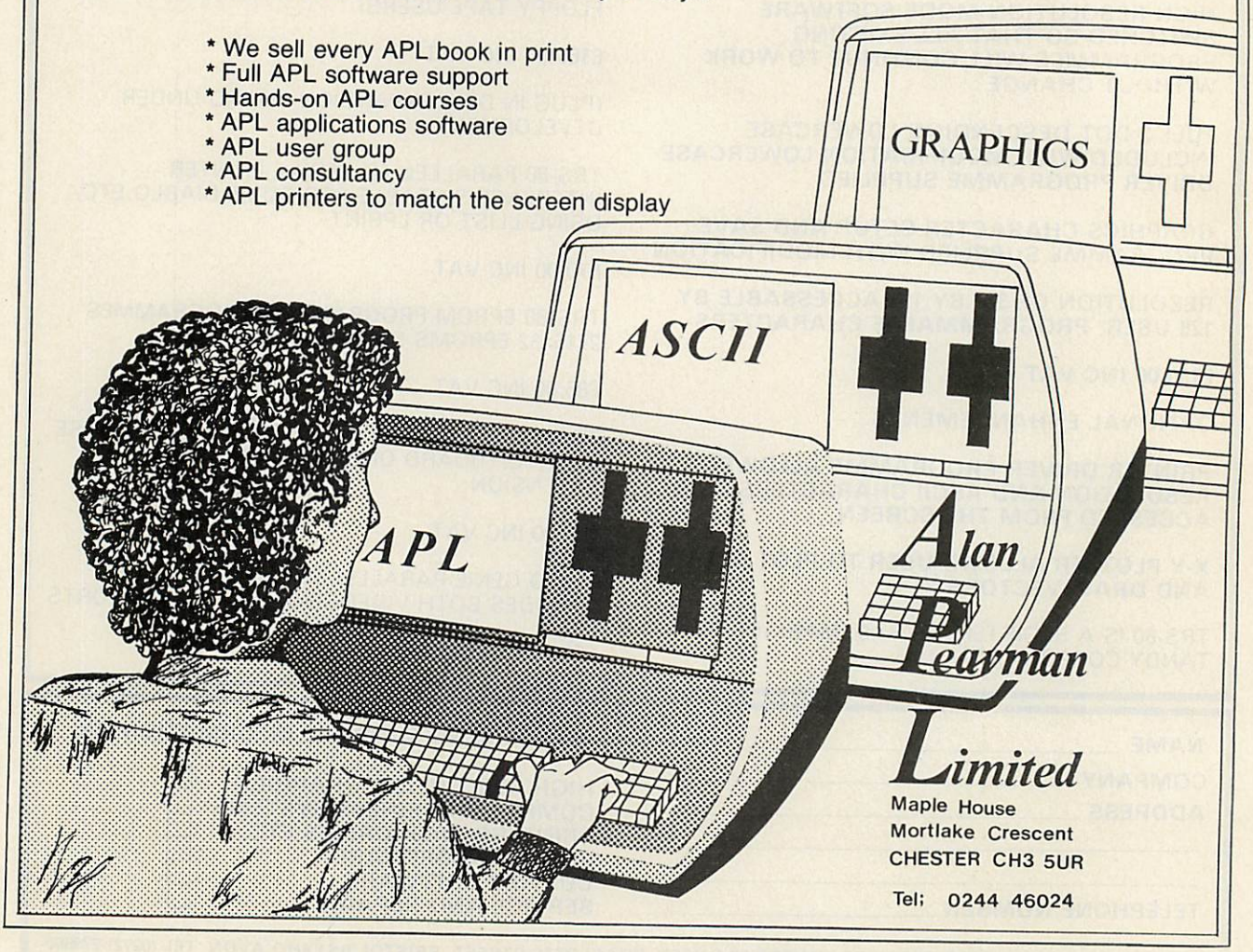
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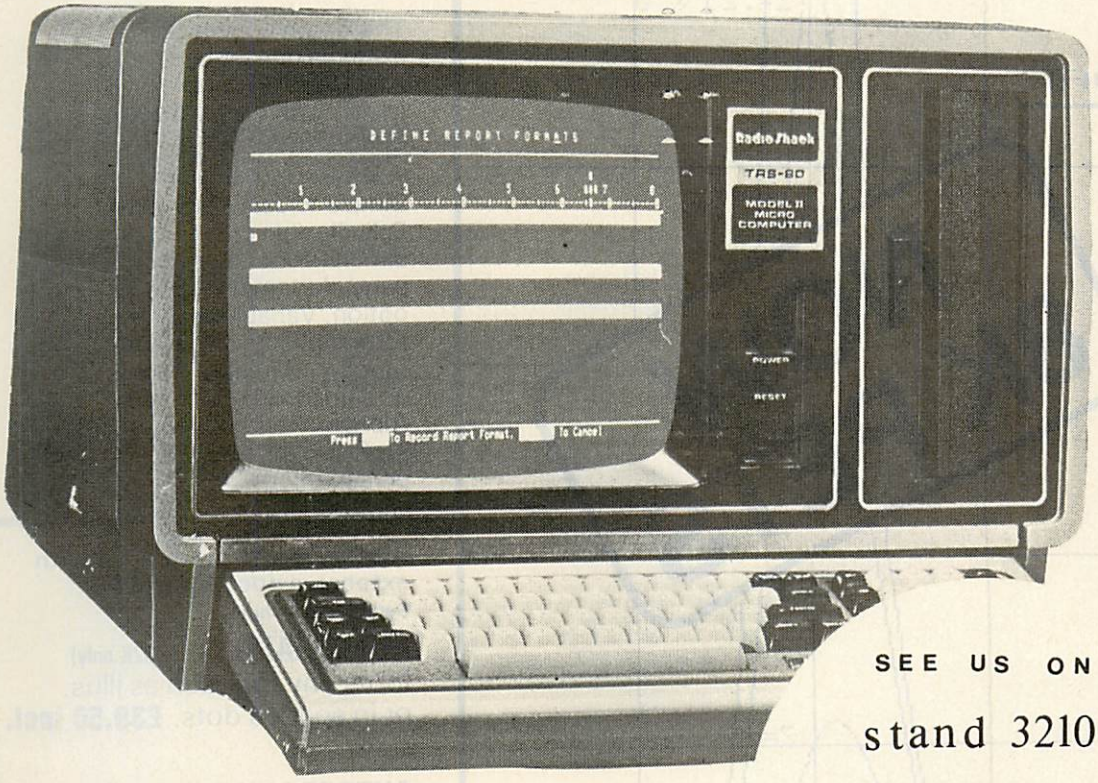


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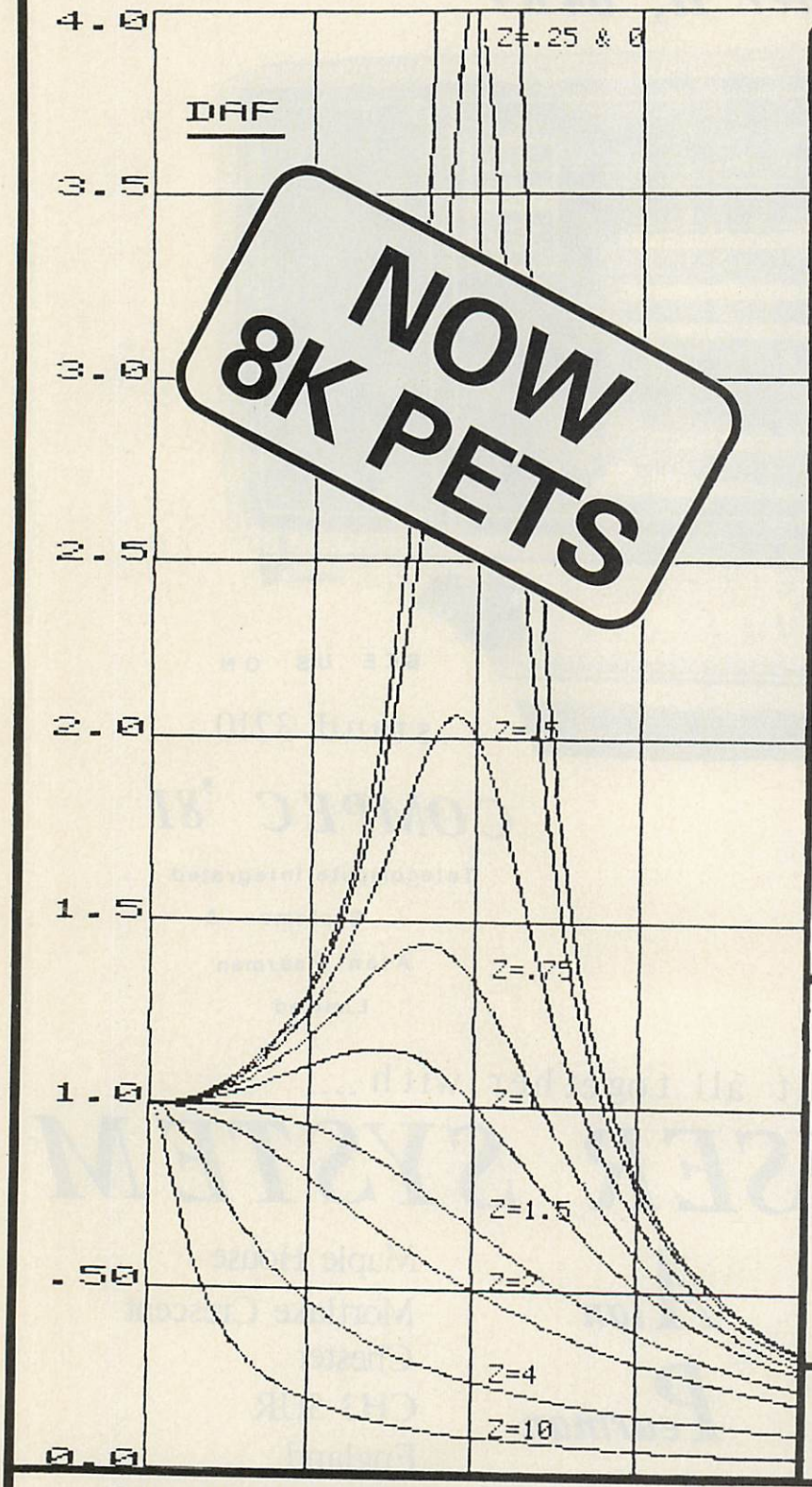
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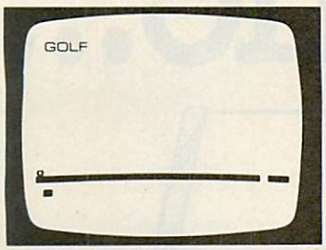
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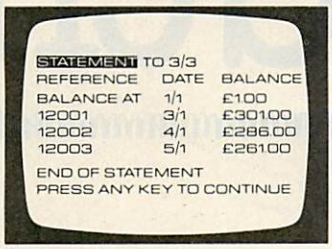
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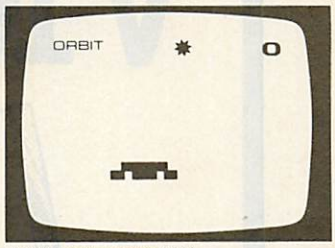
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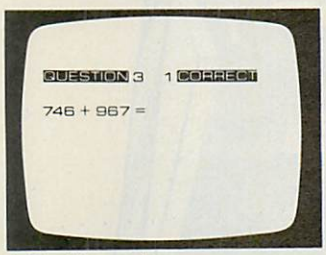
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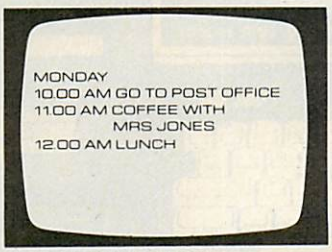
*Keep the rundown on friends, everything from their telephone numbers to birthdays.



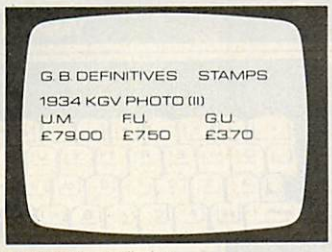
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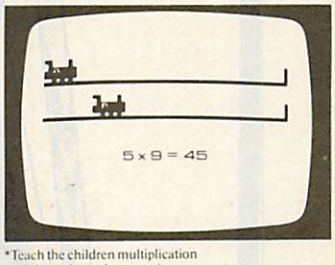
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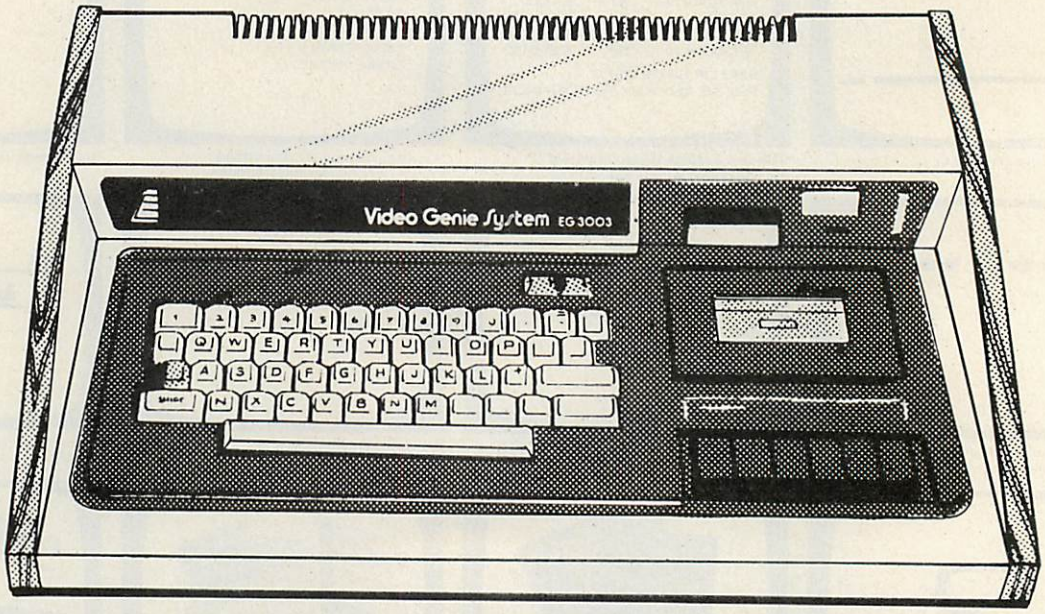
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Video Genie...



Are you a home enthusiast taking your first tentative steps into the enthralling world of micro-computers? If so, the Video Genie is the ideal complete system for you!

It's a real micro-computer, not a pocket one, yet it only needs connecting to a domestic T.V. set to produce superb results.

The Genie is compatible with the popular TRS|80 16K level 2, the best selling computer of all time. As well as its lower price, the Genie offers an in built cassette deck, 16K RAM, 12K ROM with BASIC interpreter, full size keyboard and a stylish carrying case. So it is not only excellent value for money, but an ideal "First computer" on which to learn programming.

There are literally 1000's of pre-recorded programs available, including educational, leisure and small-business applications, and simple BASIC language means you can write your own programs with ease.

Extended BASIC.

The Microsoft extended BASIC has many powerful features, including double precision variables, scientific functions, formatted printing, extended editing sub-commands, automatic line numbering, multiple dimensional arrays, complete string manipulation, direct access to graphics and machine language sub-routines.

Memory.

The Genie EG 3003 model has 16K of internal RAM expandable externally to 48K using the special Expansion unit. 12K of ROM contains the Microsoft BASIC.

Cassette.

Two cassette interfaces are provided for both the internal and an external cassette unit.

CPU.

The machine uses the industry Standard Z80 micro-processor.

Display.

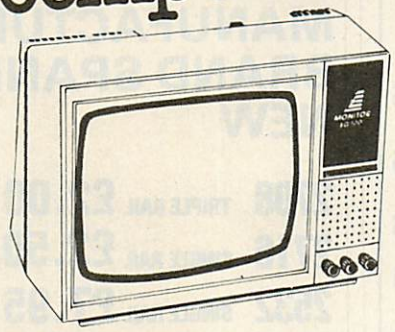
64 or 32 characters × 16 lines are available on the full display.

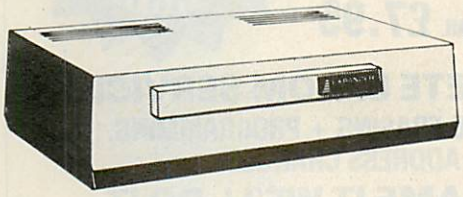
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one giant step for micro-computer systems

The additional purchase of the EG 100 Monitor offers 3 distinct advantages

- It gives a considerably better quality display.
- It does not interfere with domestic T.V. viewing.
- It comes in an attractive matching style.



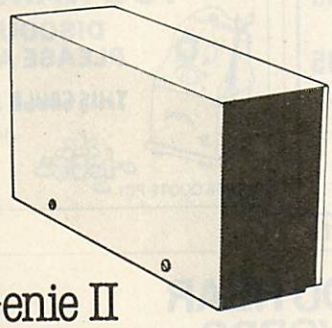


Expander.

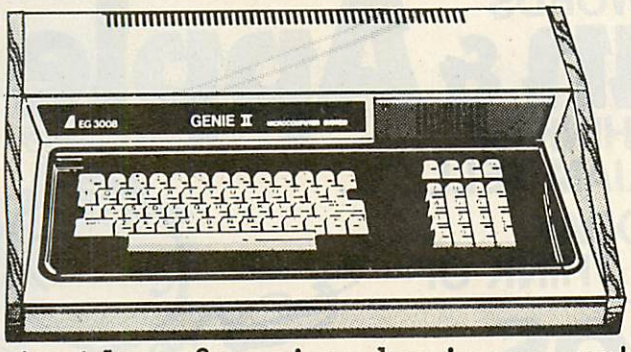
The expansion box unleashes the full possibilities of the Genie. It contains a selection of interfaces, allowing the connection of up to 48K RAM, 4 disk drives, printers and S100 cards.

Disk Drive.

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



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. . . one giant leap for micro, business systems!

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

- Numeric keyboard
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- Extension to BASIC
- Basic business commands
- Fully expandable for same peripherals.

For full details and demonstrations of the Video Genie system or Genie II contact your local dealer, or write directly to the sole importers at the address below.

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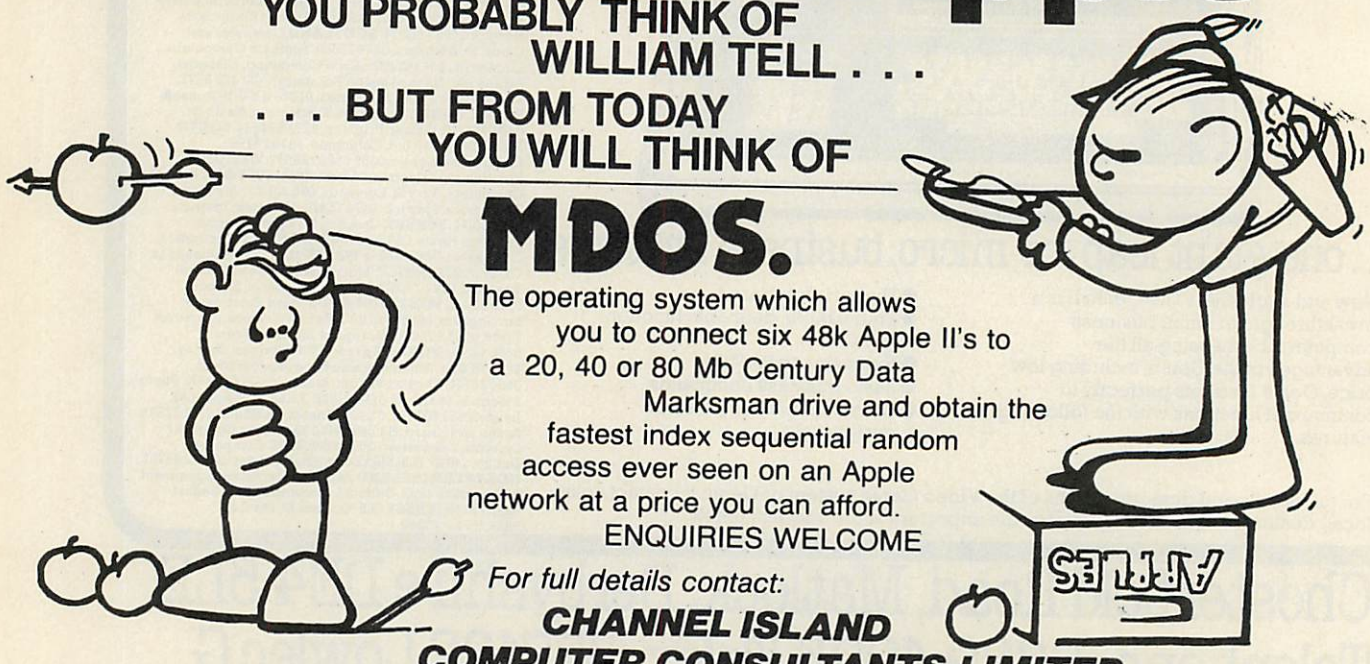
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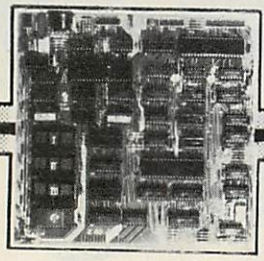
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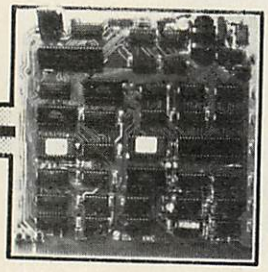
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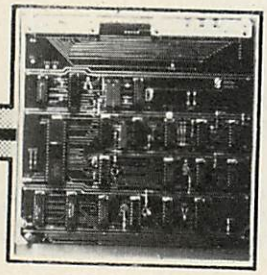
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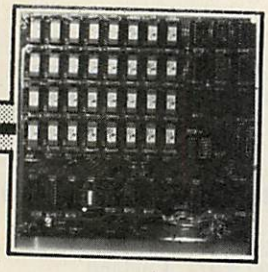
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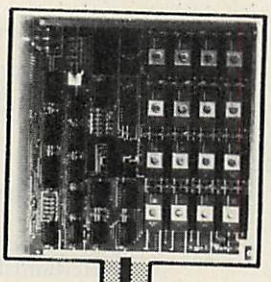


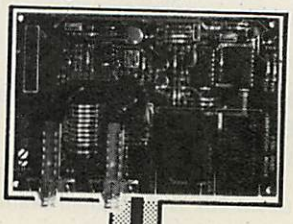


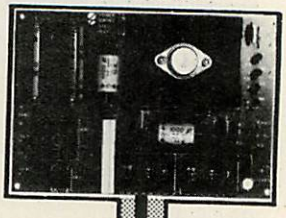












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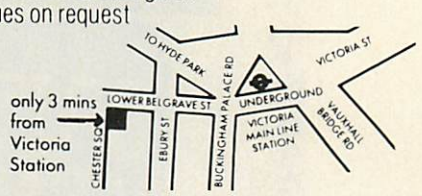
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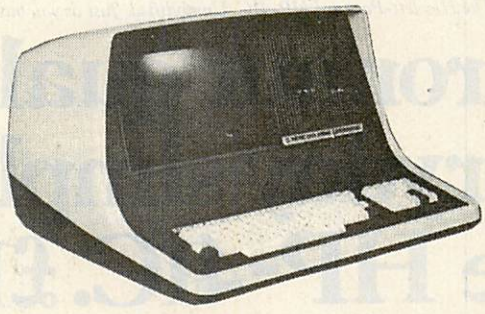
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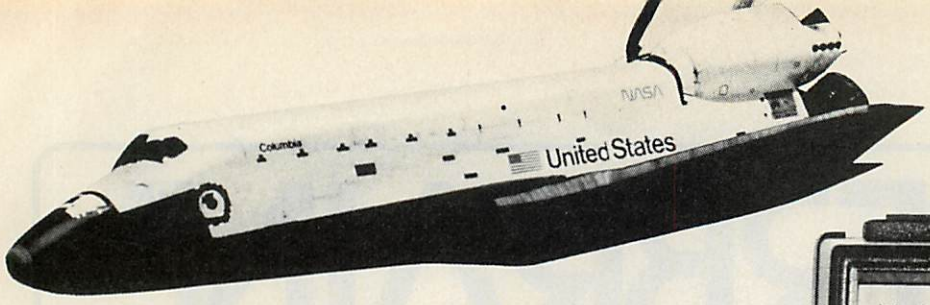
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On the edge of the atmosphere, space shuttle Columbia was about to lose all contact with Earth: for 21 agonising minutes, touch-down would be touch-and-go.
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Astronaut quality. Everyday simplicity. The HP-41C. £165 inc VAT*

Sooner or later, a basic calculator is too basic.

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The friendly calculator with power in reserve.

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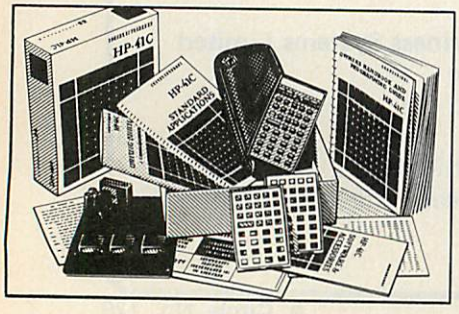
It gives you read-out in letters, as well as figures and symbols, so the display can talk to you in an easy, simple way



Yet, inside, it has the effortless, problem-solving power normally associated with computers.

Among other things, that means the HP-41C is fully programmable. You can feed its built-in 400-line memory with ready-made programs or develop your own. Its friendly style makes it surprisingly easy. And, because the memory is continuous, what you put into it stays in – even when you switch off.

But that's not the end of the story by any means. Because, unlike any other advanced programmable calculator you are likely to see, the HP-41C has behind it a highly developed package of software support representing many years of heavy investment by Hewlett-Packard. So when you buy the HP-41C you don't just *own* a powerful system; you can put it powerfully to *work*.

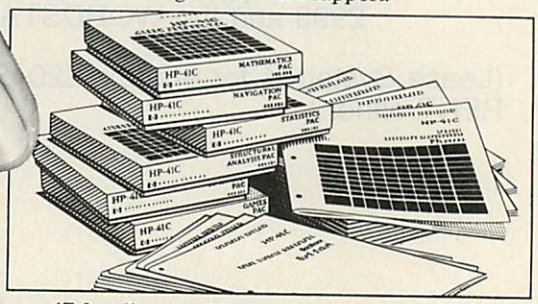


The HP-41C hand-held 'computer' in a box. £165 brings you the calculator, a comprehensive 270-page manual, owner's handbook, and programming guide, a standard applications handbook, customising overlays, HP Users' Library membership reply card, free one year's subscription to HP's User's Newsletter, batteries, carrying pouch and 12 months' full guarantee.



Proven software support – at your fingertips.

Here, the HP-41C really comes into its own with an unrivalled range of software support.



17 Application Modules – miniature plug-in solutions: maths, electrical engineering, financial decisions, games...

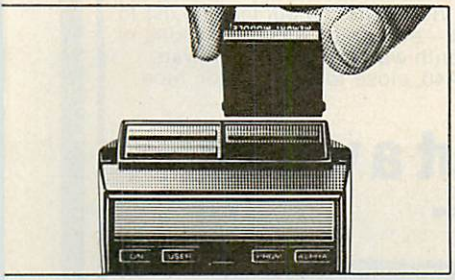
29 Solutions Books – each with up to 15 programs drawn from the best of 10,000 user-submitted programs. Each book provided with Bar Codes – for instant program entry with the HP wand.

11 Application Pacs – pre-recorded magnetic cards covering over 2,000 programs, entered through the card reader.

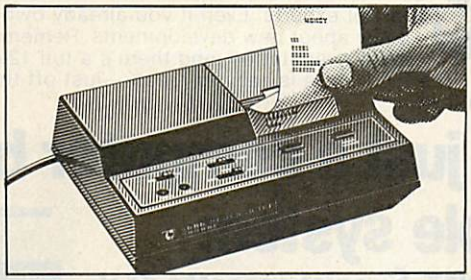
All software and peripherals are optional extras.

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Two ways to make your system grow...

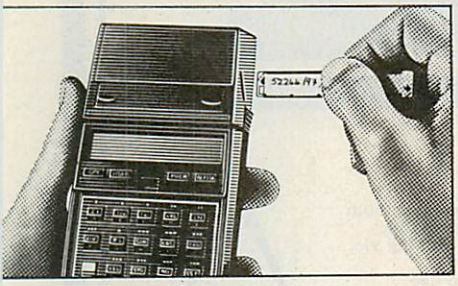


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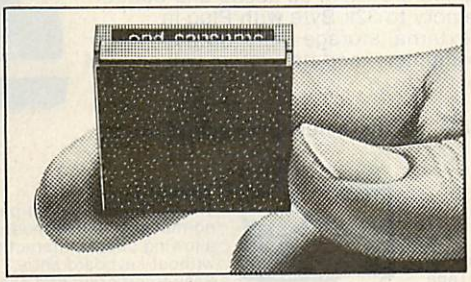


Plug-in a printer. *The HP-41C printer handles upper and lower case, in alpha, numeric and graph-plotting modes. Use it for final hard copy, or to follow program execution.*

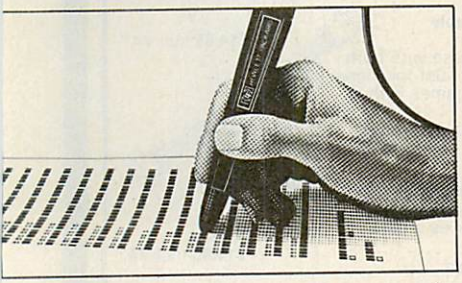
Four ways to program your HP-41C...



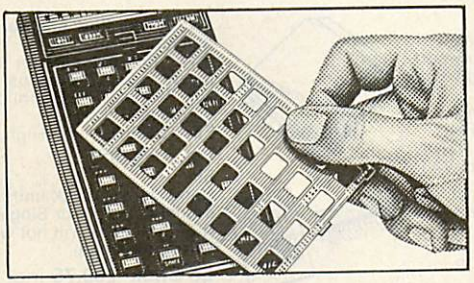
Card reader. *This reads pre-programmed magnetic cards. It can also record and read your own programs and data.*



Application modules. *These are plug-in modules each containing a whole range of ready-made programs on your chosen subject.*



Bar code reader. *A quick and easy way of loading any one of the software packages. The wand simply 'lifts' the coded program straight off the page of your HP-41C solution books.*



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Thousands of easy ways to solve problems.

Think of a problem! As an HP-41C owner you won't have far to look for the solution – or long to wait before it's locked in your system's memory. Any of HP's hundreds of pre-programmed solutions can be easily entered in any of the four ways we illustrate above. You'll certainly want to devise your own solutions, too. The guidance manual in your basic pack tells you how. If you develop an original one you could submit it to the HP-41C Users' Library. It already contains thousands of tested programs which 10,000 users world-wide are happy for you to share.

Quality from HP – the big computer manufacturer.

The HP-41C is made from the chip upwards by Hewlett-Packard, a world leader in computers. And you can tell! By the detail like the permanent inlaid key notations, tough ABS case, and gold-plated port contacts. By the elegant simplicity designed into the HP-41C's operating style. By the sort of software support only a computer giant would be capable of. By the utter reliability that is the HP hallmark throughout the world of computers.

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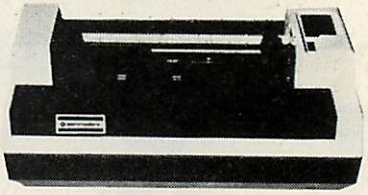
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Not just a computer but a whole expandable system



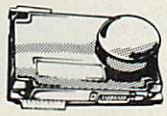


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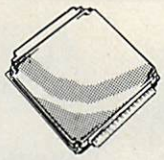
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FEATURE. Plug-in zero force sockets are available as optional extras to help eliminate pin damage to valuable ROMS.

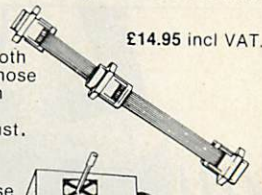
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e.g. Menu selection. Non-keyboard entry. Teaching Games.
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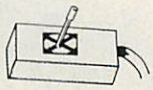
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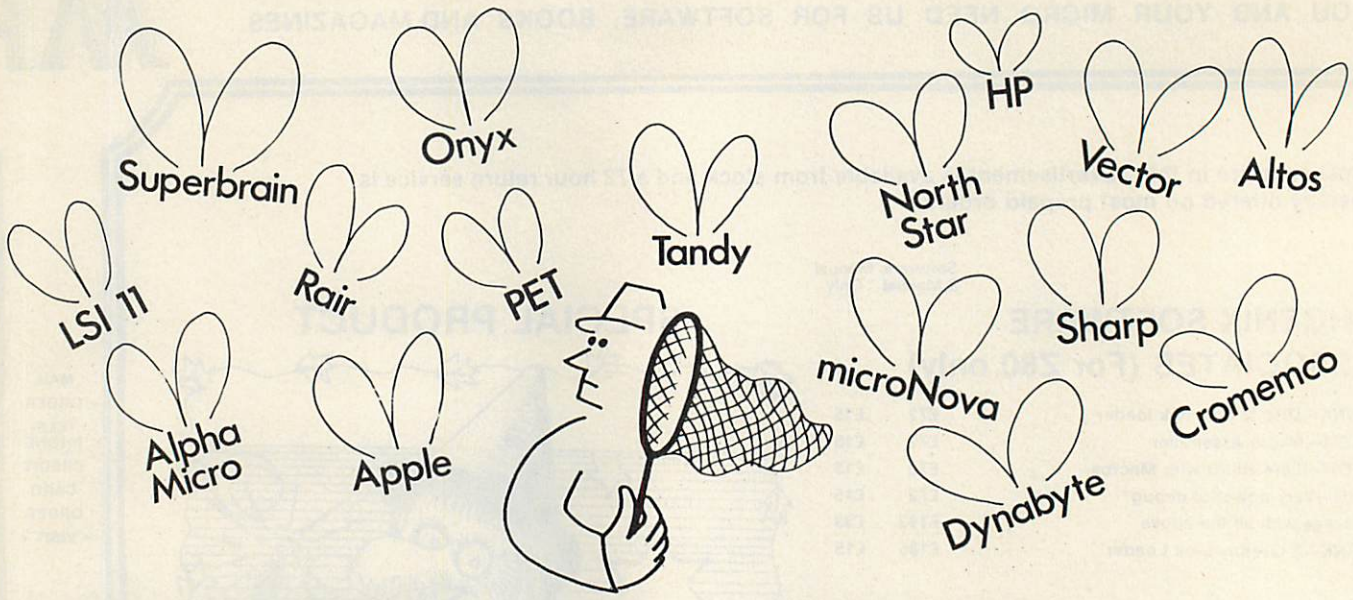
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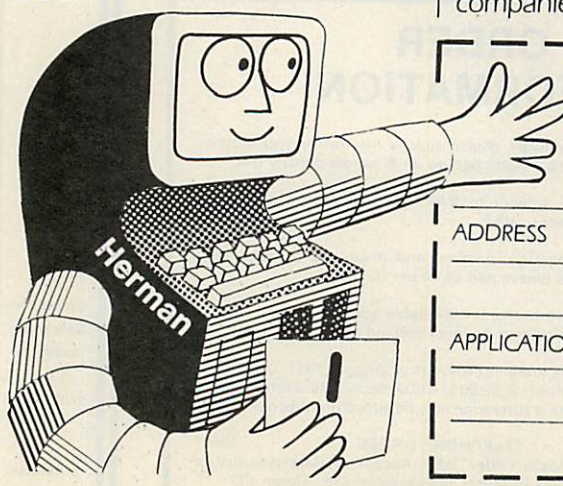
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Program generators or programmers?

THE CURRENT excitement about programs that write programs provokes two reactions: first a renewed surprise at how amazed people can be, and second, a questioning of how far one can actually go in the direction of automatic code generation.

With regard to the first, we would not wish to sully these pages with any trace of cynicism. No! We shall, as always, present only cheerful and improving material to our readers.

As to the second, automatic code generators are nothing new. In fact, ever since the first computer winked its red eyes, programmers have been looking for easier ways of taming the beast. Machine code generates microcode. Assembler generates machine code. High-level languages generate assembler. Why not, many people must ask, have something that will generate high-level language?

They ask because they find high-level languages difficult and boring — abrasive on the mind and causes of nervous prostration. It seems a reasonable enough question until one looks at why high-level languages are tiresome.

At the lowest level a computer can only do two things: subtract one number from another and jump on the result. It takes a lot of such simple stuff to do anything interesting to a human; this is why assemblers and high-level languages are useful. They give the user large chunks of code which are used over and over again. However, the process of pre-packaging code into functions — Add, Subtract, Print and so on — can only go so far. After a while the river of meaning, which flowed in a narrow and controllable channel, spreads out over a wide plain of possibilities, eventually trickling away into a marsh of uncertainty.

In less geographical terms: once you get beyond the simple and brutal functions, the number of possible activities rises very sharply. Look, for instance, at the number of possible ways of printing numbers or text. You can range right and left, truncate characters and decimals, jump to tabs and so on. Even so, making a program produce tidy output is a major coding chore.

If there was a program generator which wrote the code for you, it would still need to be told, in some way, which of the almost infinite number of possible ways of arranging a piece of text on the page was what you wanted. What you want to say is something like Print Nicely, in the hope that the computer's idea of "nicely" is the same as yours.

There's the rub. A real program generator would work like a human assistant. To do its job it would have to draw on all sorts of knowledge about the world around it that computers just do not have. Just to produce "nicely" formatted text it would need to have done a good deal of reading itself. It would need to know about A4 and A3 and A5 — things that many people aren't too sure about. It would have to know that businessmen like two decimal places while scientists like none or sixteen, according to pedantry. It would have to be able to decide whether its job was businesslike or scientific. If it decided to produce text justified on both sides, it would have to think about hyphenating words that were too long. And hyphenation is something that few humans can do properly.

These problems relate just to printing text. Problems within the program are even more horrendous.

If you want a *real* program generator, you have to hire a programmer, because only a human understands enough about the world to understand all the implications of a concept like "nicely". Conversely, any language — or program generator, for such a thing is no more that a higher-level language — that aspires to offer a similar service will require such a profusion of commands that it becomes unworkable.

The Pearl, The Last One, Genasys — in order of their emergence — are half-way houses into which current program generators try to crawl. They escape the intractable variety of real life by taking advantage of the numbing banality of business affairs. In business you do not do anything very exotic to your numbers. You add, subtract and very occasionally multiply. Your text comes out in cryptic but not very varied lumps and is spattered more or less at random across invoices and reports. The structure of your programs tends to be simple — take a customer record, look at his credit rating, compare it to his debt, send him an unpleasant letter.

Within this very limited field of discourse it may be possible to find conceptual chunks that can be turned into slabs of code. However, a program to do this trick is only a time saver. It cannot sidestep the real trouble with using a computer, which is telling the wretched thing just what you want it to do. You want a program that you can order to "Do the VAT return", and when it asks whether the rate is 12.5 or 15 percent, will go off and find out if you haven't the faintest idea. Computer programs in whatever form they are written are great sticklers for detail and procedures and these are just the things that cause humans trouble.

It is hard to see how any of these programs can be much help to people who know nothing about computing, because they demand logical thought and planning of the job in a way that the underlying structure of the machine can handle. On the other hand, people who know enough about computing to cope with that would probably be just as happy to write the code themselves, taking advantage of the flexibility which the lower-level language gives.

To return to an earlier point, the higher the level of the language, the more commands lie to your hand and the harder it is to manipulate them. If you have N commands, there are N! possible relationships between them — a number that grows astronomically as soon as N gets at all large. The very richness of high-level languages makes them unhandleable: there are too many possibilities for the programmer to bear in mind. The only way to control them is to limit what they can do and, paradoxically, that can make a higher-level language less flexible and so, therefore, less useful.

There is no doubt that we shall see a number of programming tools emerging, and that these will help people who understand computing to write programs more easily and more quickly than they can at the moment. It is unlikely that the "Press the button and stand back" approach will ever work properly, or that people will want it once they are moderately computerate.

No doubt when books first became widespread there were rich, powerful and illiterate men who thought they could hire someone to do the reading for them. In the long run it turned out to be a mistake. No matter how rich or powerful you were you still had to be able to read and write, and the same is probably going to be true about computing.

That is, until machines get as clever as people. In which case they will not need to be told what to do anyway.

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Legal judgments

I READ with interest Martin Hayman's article on computerising a solicitors' office in the August 1981 issue of *Practical Computing*. It is good to hear of firms of solicitors following the advice of the Royal Commission on Legal Services and exploring the ways in which computers and indeed modern business techniques generally can be employed in solicitors' offices.

Martin Hayman's article, while welcome on those grounds, nevertheless reveals some of the difficulties faced by solicitors in becoming acquainted with computers and by computer people in dealing with the special needs of solicitors.

It is, of course, absolutely proper to adopt a practical approach "without losing sight of the ultimate possibilities of improved efficiency and access to a broad range of information". There are very many points arising from the article on which I would like to comment.

- Information services for lawyers such as Lexis, Eurolex, Lawtel, are at present largely confined to case law although statute law is being added and secondary sources may be available in the future.
- Word processing quickly proves its value in solicitors' offices — chiefly for the production of any document which goes through a draft and approval stage but not in most practices for the production of letters.
- You say: "A third category of documents which is eminently suitable for word processing is probate". A grant of probate issues from one of the Probate Registries — it is not drafted by solicitors.
- Accounts are not as you suggest straddled somewhere between general correspondence and word processing. They are a distinct and specialised matter in a solicitors' office. While in future some degree of convergence will be possible for the sake of extracting information from both databases, that stage has not yet been reached.
- Solicitors' accounts are not, as you say, audited by the Law Society on any kind of regular basis. Indeed, most firms would hope never to be audited by the Law Society since this is an exercise set in motion only when there is some suggestion that the solicitor is not maintaining accounts properly.
- The requirement to record disbursements on behalf of a client is not limited to legal-aid work. The Law Society's advice contained in the pamphlet *The expense of time* sets out suggestions for ensuring that the costs of the office are reasonably apportioned to each client. It is not always true that the most significant part of the legal-aid bill or any other bill is reflected in the time spent on the case. Time is merely one element in solicitors' fees.

Finally, I note that these solicitors are now to have a specification for putting the accounts on a computer. I shall be interested to hear from anyone who offers to write a full-scale integrated accounts and time-recording system for solicitors at anything less than £100,000.

Some 24 firms already offer integrated systems written in a variety of languages available on a variety of hardware and mostly already running in solicitors' offices.

Peter Soar,
Editor, *The Solicitor's Practice,*
London.

Cart before horse

THE ARTICLE on the solicitors' micro in your August 1981 issue interested and surprised me. I feel that several statements made in it are not valid. Does the consultant really consider floppy-disc machines unsuitable for data-security reasons? Does he mean that they are unreliable or cannot hold sufficient data? Unreliable, never — and there are a few practices where the files are too large to fit on to a diskette for security. Yet his files are too large, is he not aware of cartridge back-up?

Does he really doubt that the user staff cannot handle MP/M at such an advanced level? MP/M is no different to CP/M. In any well-designed application system, the user should be almost totally unaware of the technicalities of the operating system. They are handled by job-control files.

"5Mbyte fixed and 5Mbyte removable made good sense". If the consultant thinks that MP/M is difficult, how can he impose the operational difficulties of such devices on the user? Perhaps he is intending only using half of the available storage, 5Mbyte fixed, and only using the other half for back-up?

That the hardware was selected before a specification of the accounts system was produced is surely going against all accepted system-selection standards. It is the classic "cart before the horse".

Unless the prospective user has made the decision to write, or have written, his own software, then the evaluation of hardware is truly the secondary function. The whole tenor of the article was, in my opinion: "Find the hardware, now what shall we do with it"?

J P Meehan,
Mountain Software Growers,
Grantham,
Lincolnshire.

Display record

IN THE August 1981 issue of *Practical Computing*, ZX-80/81 Line-up, Ivor Bradley gives his program for the game of Life which works on a 12-by-12 matrix and says: "I think it would be difficult to achieve a larger display without resorting to machine code".

In fact, in the November 1980 issue, there is a very elegant program by Peter Ansell which works within 1K up to 13-by-13. Is this the record?

G J Suggett,
Chichester,
West Sussex.

Poole consumables

THE MICRO industry and the many applications it has made possible have prompted me to start a business dealing in peripherals and consumables — paper particularly.

I am interested in locating a paper manufacturer and a reliable source of tapes/discs. Could anyone supply me with some names and addresses of wholesalers or manufacturers? My address is 75 Bridport Road, Parkstone, Poole, Dorset.

Fred Thorp,
Poole,
Dorset.

Unkind to Pets

R P HOPE and I Powis of the University of Bradford Management Centre are being unkind to their Pet. The fault lies not in the machine but in their program which obviously expects more of a computer than is computerly possible — "Zero Bugs", Pet Corner, July 1981.

Their demonstration program begins by assigning to Z the value of 248.11/SQR(61558.5721). Using exact arithmetic, this expression has the value 1. Yet the computer cannot use exact arithmetic on numbers input as decimal fractions.

The binary representation of the numbers in both numerator and denominator recur infinitely, as does the decimal representation of one-third. Starting with the binary approximation to 61558.5721, it calculates approximately the value of its square root and divides into the binary approximation for 248.11.

(continued on page 45)

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(continued from page 43)

The result will be a number differing infinitesimally from 1 — enough to fail an equality test, but when printed as output rounded to 9 SF has the value 1.

The solution to the difficulty they experience in their statistical program is to avoid equality tests altogether to allow for the difference between stored and output variables. It is an absolutely essential trick for anyone concerned in writing educational programs where decimal calculations are invited from the program user. If their program line 20 is replaced with

```
20 IF ABS(1-Z)<1E-10 THEN 50
```

the program will not output a contradiction. Indeed, it is an extremely interesting exercise to vary the size of the negative exponent to see where in the computed value of Z the inescapable error lies.

Expecting a binary digital device to handle decimal fractions exactly is rather less reasonable than expecting my Jack Russell to write good programs.

Tony Peterson,
Greenford, Middlesex.

New Horizons

AS VERY satisfied educational users of North Star Horizons, we are investigating the feasibility of running them under MP/M. Unfortunately, we are unable to locate a North Star implementation of the software.

If anyone could supply us with this missing information, we would be very grateful. Write to me at the College of Further Education, Science and Mathematics Department, Kings Road, Devonport, Plymouth PL1 5QG.

Stuart Bell,
College of Further Education,
Plymouth.

Expressive power

MAY I offer some thoughts, the first prompted by Mark Walker's article on algorithms in the July 1981 issue. As a practising OR scientist, I find that algorithms of all kinds are very much my stock in trade, and the expressive power of APL has been enormously helpful in this field. For example some of the matrix operations used by Mark Walker become:

```
A+B . . . add A to B
A+.×B . . . multiply A and B
⍉A . . . tranpose A
⌹A . . . invert A
X←B⌹A . . . solve a system of equations
for X
```

I cannot help feeling that the imminent availability of APL on 16-bit hardware could have a profound impact on the micro scene.

Secondly, having been raised on PL/1, I have found the lack of structure in APL remarkably liberating when programming dialogues. Structured languages tend to channel you into trees of menus and yes-no interludes; with Goto you can easily move straight to where you want to be without feeling guilty about it. Maybe poor maligned Basic is not such a villain after all.

Adrian Smith,
Operational Research,
Rowntree Mackintosh Ltd,
York.

Apple Pascal output

COULD anyone advise me on setting the contents of the Monitor-output register locations 54-55 for directing output to a printer when using the Pascal system on an Apple II plus?

I have an assembler procedure for dealing with output via a parallel interface which I wish to have in RAM — rather than in the memory locations allotted to slot 1. I have tested this and it works. The problem is ensuring that all output to the printer is directed to this procedure.

I have tried the steps suggested in Note 7 on page 105 of the DOS Manual but with no success. As the Apple Pascal reference manual does not explain this matter at all, an explanation will probably be of interest to a large number of Apple owners.

A J Weeks,
Bedford.

Easy 380-Z hard copy

I NOTE letters regarding hard copy of 380-Z graphics — particularly in your recent Z-80 Zodiac pages. Providing the machine is running Basic 5 and is connected to a printer like the Microline 80 which is capable of reproducing the 380-Z character set, the following program, called as a subroutine will work admirably.

```
1000 FOR Y = 60 TO 0 STEP -3
1010 FOR X = 0 TO 80 STEP 2
1020 LET P$ + CHR$ (POINTS(X,Y))
1030 NEXT X
1040 LPRINT P$:P$ = " "
1050 NEXT Y
1060 RETURN
```

The program examines each character location in turn, adds the character present to a string and prints it at the end of each line. If the picture is to be stored as a file, P$ may be printed to a file which has been opened in the normal way. A disc file of pictures can thus be created.

Paul Wagg,
Luton,
Bedfordshire.

Wiltshire club

I WOULD like to help start a computer club in the Chippenham and Calne area of Wiltshire. I am prepared to liaise with people who are interested in helping to start it and run it, and those who just want to attend its meetings. I aim to make it into a multi-machine, multi-language — varieties of high- and low-level languages — multi-processor club to cover everything. Its main two aims will be:

- To spread ideas from machine to machine and language to language.
- To enable newcomers to learn and choose a computer for themselves.

If you are interested, please write to me at Pinhills, Bowood, Calne SN11 0LY, giving details of your machine, interests, what you can do to help the club and on what day you would like it to meet, enclosing an SAE.

Matthew Jones,
Calne,
Wiltshire.

Exercising control

A CONFERENCE on the use of microcomputers in physics teaching, confirmed my strong suspicion that in our country — Scotland, I don't know about England — there is insufficient interchange of ideas or techniques in the sphere of microcomputer hardware, control applications and interfacing systems.

At our conference, there were many extremely good examples of software applications but almost no discussion about hardware. Also to my horror there was much talk about Apples and Pets, but virtually no mention of the Rockwell Aim 65 which is far better for control and assembly-program development.

It is far easier for micro users, particularly those new to computing, to play games successfully with their machines than, say, make physical measurements or control equipment with them.

Consequently, the recent explosive flood of micros into our society — particularly in education — has led to a very developed software consciousness. As might have been predicted a few years ago. There is now a very sensible organised sharing of ideas which can only be of great advantage to all involved.

The same trend has not taken place in the realm of hardware and control and I would like to stress the point, from first-hand experience, that there must be many individual cases where good things are being done but few learn of them.

I have developed several interface circuits and systems for teaching the new technology and there is nothing like them available on the market. I am certain that there are others in the same boat and possibly, among all of us, there may be potential, ideas and products which could provide much-needed jobs and give Britain a boost in markets which are still untapped.

I should like to hear from anyone in my area who has a common interest and may feel that a regular exchange of ideas would be beneficial. My address is 84 Newhouse Drive, Kilbirnie, Ayrshire. I would be glad to advise anyone becoming involved in microhardware and control. I can offer circuit designs, constructional details, etc., to personal callers at my home address.

David Kelly,
Kilbirnie,
Ayrshire.

IBM's 'fun machine' for work and play



FIVE YEARS after the first personal computer appeared, the world's largest computer manufacturer, IBM, has entered the personal-computer market. Although available only in the U.S. and Canada at the moment, the IBM personal computer is set to become a major competitor in the personal and microcomputer markets.

The system will retail for as little as $1,565 — about £700 — and it will be sold through IBM product centres, ComputerLand and Sears, Robuck and Co. IBM has no firm date for the machine's U.K. launch. According to IBM vice-president C B Rogers, Jr.: "This is the computer for just about everyone who has ever wanted a personal system at the office, on the university campus or at home".

The machine will utilise an enhanced version of Microsoft Basic and will arrive complete with manuals which should enable even the most inexperienced user to run programs within a few hours.

Many applications are already in the pipeline or available. Easywriter — a word-processing package — VisiCalc, Pascal, CP/M, and Microsoft Adventure are among the packages already available on the IBM micro.

The system has an 83-key adjustable keyboard, making it ideal as a word processor, an upper limit of 250Kbyte user memory, a bi-directional printer and automatic self-testing of system components. The main advantage of the machine is the huge size of the IBM corporation, which means that a user should find little problem having a machine repaired if ever something does go wrong.

Uncharacteristically, IBM decided that this is going to be a fun machine. This means that the computer has colour and graphic capabilities. There is a built-in loudspeaker for sound and music and, of course, the Microsoft Adventure game.

Digital Research — the Californian software house — has been contracted by IBM to supply its CP/M-86 microcomputer operating system. In clinching such a deal, IBM effectively gives all purchasers of its new micro a very wide choice of applications software. CP/M-86 is a version of the CP/M operating system designed to run on the 16-bit Intel 8086 and 8088 microprocessor.

In a move which is almost certain to cause excitement in the microcomputer world, IBM has announced its intention to accept programs from outside contributors. Anybody, whether an IBM employee or not, can submit software to be considered for acceptance.

Before submitting any software, though, prospective programmers must follow the instructions contained in the Software Submission Packet, which is not available in the U.K.

Criticism for package that copies protected software

APPLE Orchard of Milton Keynes, Buckinghamshire, has begun marketing a controversial new software package. The device is designed to copy most currently available diskettes, including protected software packages, in less than 60 seconds. The Package is known as Copy II Plus and it has already enjoyed considerable sales in the U.S.

The software will be of most use to schools, where a number of copies of one disc of proprietary software can be made, the original disc being safely locked away out of harm's reach.

It will undoubtedly be popular with micro users who will no longer have to experience that long wait between a disc crashing and the replacement being sent by post. When it has been used, the Copy II Plus is an invaluable device which keeps any Apple installation working.

The Copy II Plus has, like all similar products, been subjected, understandably, to considerable criticism — in the main from software writers and suppliers because of its potential use as an illegal device.

It could be used to enable pirate copies of copyrighted programs to be made on a commercial basis. The program itself is also vulnerable to pirating, it has been deliberately designed so that it can copy itself, but further copies cannot be made from a copy.

The supplier of the disc, Apple Orchard Ltd., is encouraging users to make their own copies of the disc in the belief that the market for legitimate use of the product will far outweigh any pirating.

John Chesney of Apple Orchard says: "Copy II Plus is open to abuse in much the same way as photocopiers and video recorders are, but in the long term this program will prove to be an invaluable aid to the effective use of microcomputers".

Copy II Plus costs £39.99 including VAT and will run on the Apple II plus 48K with at least one disc and 3.3 DOS. It is available from Apple Orchard Ltd., Software Sales, 7a Church Lane, Loughton, Milton Keynes, Buckinghamshire MK8 0AS. Telephone: 0908 53595.

These two terminals represent the top of the Ann Arbour range. Supplied in the U.K. by Digital Services Ltd of Portsmouth, the terminals have 48 function keys which can hold up to 64 down-loaded strings for transmission or internal use. There is a non-volatile memory for holding set-up instructions and power-up commands. For further details, contact Digital Services Ltd, Fitzherbert Road, Farlington, Portsmouth, PO6 1RU. Telephone: 0705-324934.



W H Smith to sell ZX-81

THE HIGH-street newsagent chain W H Smith is to enter the microcomputer market. For a trial period more than 100 of the stores will be selling the popular Sinclair ZX-81 microcomputer, following an agreement between the two firms.

Clive Sinclair commented: "Both parties view the agreement as an experiment. We accepted Smith's approach because they have clearly researched the subject carefully and take the new operation very seriously".

The initial agreement will last for five months, 300 members of Smith's staff have been specially trained to demonstrate the micro. Sinclair Research will continue its mail-order business and the W H Smith deal will supplement this. The prices will be the same as for mail-order computers — the difference is that the new printer and build-it-yourself kits will not be available in W H Smith stores initially.

Casio programmable puts more power in hand

CASIO HAS developed a remarkable little Basic computer, the FX-702P, which should neatly fill that gap which exists between programmable calculators and microcomputers. The machine will undoubtedly be a boon to those who need processing power which is truly portable — for example, the engineer who works on site. The neat little machine is encased in plastic which should be able to take its fair share of knocks.

Capable of simultaneously holding up to 10 different Basic programs, with subroutines nested up to 10 levels and looping up to eight levels, this machine is very powerful. When programming, a count of the remaining memory is given, the capacity being between 1,680 steps with 26 memories, and 80 steps with 226 memories.

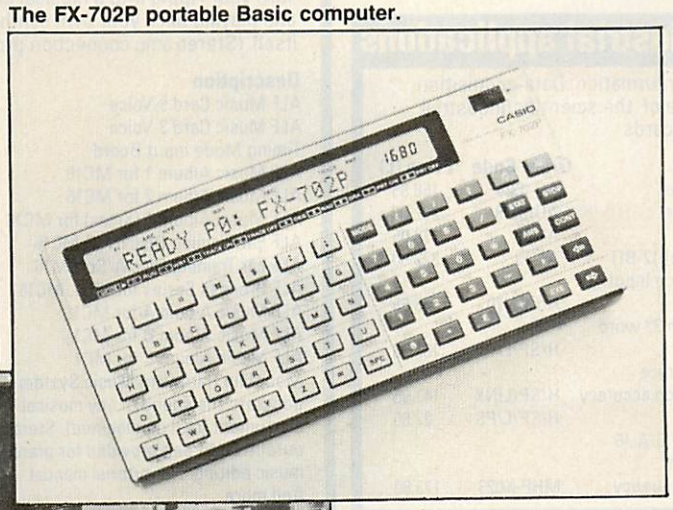
There are 55 single-key routines including logic, arithmetic, trigonometric and hyperbolic functions. Statistical routines include two types of standard deviation, regression analysis and the correlation coefficient. These functions may be used either within a program or in the immediate mode.

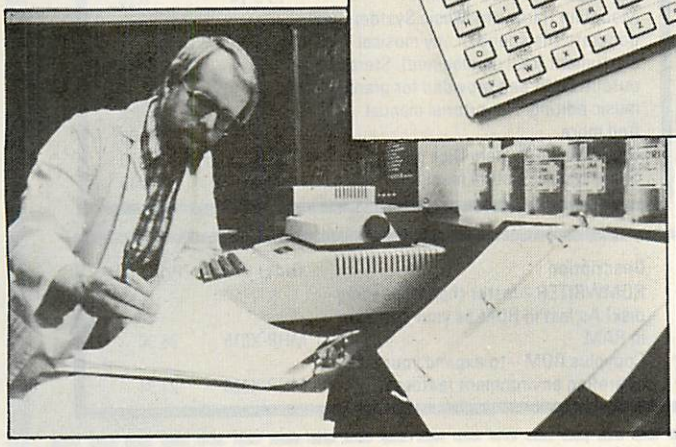
The liquid-crystal display has a contrast control, and the power is supplied by lithium batteries which should last for 240 hours' continuous operation.

The life of the batteries are conserved by a feature which turns the power off after eight minutes of non-use. During power-off, memory data and programs are not lost — even when the batteries are removed.

The Casio FX-702P retails for £134.95 and is complete with an instruction booklet and a program library. A cassette interface will soon be available as well as a printer and possibly some extra RAM. Contact Casio at 28 Scrutton Street, London EC2A 4TY. Telephone: 01-377 9087.

The FX-702P portable Basic computer.





Apple takes control with IEEE-488 card

WITH THE addition of the Apple IEEE-488 card, an Apple computer can be used to program and operate virtually any test, measurement or control instrument which is bus-compatible with the IEEE interface standard. The card plugs into any of the Apple expansion slots. This, of course, will be of most interest to those users in the scientific or industrial-research field.

Suitable instrument systems for use with the card are frequency generators, digital multimeters, and other such equipment. There is some powerful resident software to enable the user to program instrument control in Basic or assembly code with no need to worry about signal protocol, which is handled by the software.

The card is available through the usual network of Apple dealers. Required configuration is any Apple III, a Apple II plus, with 32K memory, or a Apple disc II with controller.

Hard choice becomes soft option

OFF-THE-SHELF Winchester technology at a price which will not break the bank is now available from British company Comart. Its CP-100 Communicator, which was the subject of a generally-favourable review in *Practical Computing,* June 1981, now sports an integral 5in. Winchester hard-disc option from California-based company Seagate. Comart managing director John Lamb said that he had shipped "tens" of the new machines, which is designated Communicator CP-500.

The CP-500's hard disc is the ST-509 twin-disc, sealed unit with MWDC disc controller and provides up to 6.4MByte of unformatted data storage. Practically, this is rounded down to 4.8MByte. A single double-sided, double-density floppy disc with 790KByte is retained for back-up.

The St Neots, Cambridgeshire-based manufacturer claims that the new machine stores the equivalent of 30 floppy discs' worth of information, sufficient to support an accounting system of up to 5,000 accounts, a word-processing system of up to 750 pages of text, or a direct mail system of up to 12,000 names and addresses.

Other features of the Communicator remain unchanged: Z-80A processor, S-100 bus, CP/M 2.2 system software. Price of the new machine is £3,795 plus VAT.

The hard-disc option would make the Communicator especially useful, when it is equipped with Hi-Tech Prestel boards, as a stand-alone editing terminal.

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Speech Link 2000 – 64 word voice recognition capability with high accuracy	H/SP/LINK	147.95
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ALF Music Album 1 for MC16	13-3-2	6.20
ALF Music Album 2 for MC16	13-3-4	6.20
ALF Music Album 0 (Xmas) for MC16	13-3-5	6.20
ALF Ear Training Disc INTG MC16	13-3-9	20.68
ALF Ear Training Disc A/Soft M16	13-3-10	20.68
ALF Process Series for MC1, MC16	13-3-11	20.68
ALF Music Album A for MC1	13-3-12	6.20
ALF Music Album B for MC1	13-3-13	6.20
ALF Music Album C for MC1	13-3-14	6.20
Mountain Hardware Music System – will generate the sound of any musical instrument (real or imagined). Stereo output. Light pen provided for graphic music editing. Full tutorial manual. And more	MHP-X022	270.00
Spare Music System Disk pack	MHD-D007	18.70
Spare Music System manual	MHM-X011	8.80

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Description	Order Code	Price (£)
Clock/Calendar Card – provides 365 day Clock/Calendar with 0.001% accuracy	MHP-X003	139.10
Supertalker	MHP-X006	149.05
ROM – Plus Board – sophisticated firmware for 2K Eproms	MHP-X007	104.35
ROMWRITER – faster than a speeding disk! As fast in ROM as your software in RAM	MHP-X015	86.90
Copyplus ROM – to expand your disk operating environment features	MHP-X026	27.34

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New S-100 colour card

HI-TECH Electronics of Southampton has announced the latest addition to its range of S-100 boards, a high-definition, colour graphics board. The SID1 is a bit-mapped red, green, blue display using three bits per pixel plus one bit which is shared between two pixels.

There are 312 pixels by 290, giving a total of 90,480 individual points which can be any one of eight colours. Syncs and blanking are programmable.

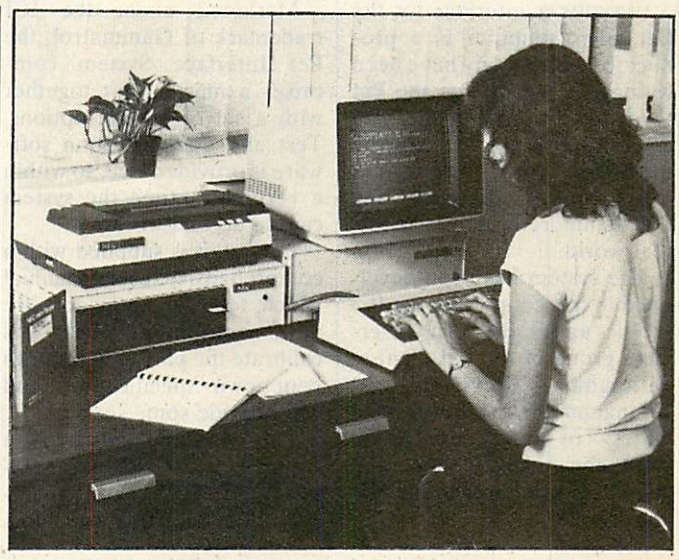
The dot size in the display is the same as in a viewdata unit, so the 40-by-24 viewdata display can easily be achieved. A related product is SID2 which provides similar features but with 340 horizontal pixels.

The display from both cards fills the entire active area of the display. For around £400, it is possible to purchase the card as well as full documentation and supporting software. Hi-Tech can be contacted on 0703 581555.

NEC micro aims to lead the European market

THE NEC microcomputer system has been launched in the U.K. A technically-advanced computer with an impressive selection of peripherals, is how the Nippon Electric Company describes the PC-8000 series. Already the most successful personal computer in Japan, the PC-8000 has been on sale there for the last two years and has won 45 percent of the market. The machine is now ready to be launched in Europe where it is expected to become a market-leader.

The system is based on the NEC uPD 780 processor which is compatible with the Z-80A microprocessor and contains 32K of dynamic RAM, 24K of ROM and holds the Basic interpreter. These components together with the CRT display controller, and various interfaces are all housed in the keyboard unit.



The PC-8000, already dominant in the Japanese market.

In addition to the standard QWERTY keyboard, there is a numeric/calculator-type keypad, cursor-movement keys, and five user-programmable function keys.

Software available on the PC-8000 includes a Microsoft Basic called N-Basic, the CP/M operating system and a wide selection of standard software packages covering such activities as; sales/purchase ledger, nominal ledger, invoicing, word processing, data management and so on.

The graphics facilities are of an extremely high quality — especially when the machine is used in conjunction with the colour video monitor. A total of eight colours are available. Other optional add-ons are a green CRT display, dot-matrix printer, a light pen, an intelligent, dual mini-disc drive and a choice of two 32K expansion/interface units.

The system will be marketed by IBR Microcomputers, which is forming a nationwide dealer network for the PC-8000. In case anything should go wrong with your machine there are the NEC servicing facilities.

For details, contact IBR microcomputers, Unit 57, Suttons Industrial Park, London Road, Earley, Reading, Berkshire. Telephone: 0734-664111.

Schools' programs now available for the TRS-80

THE SCHOOLS Council computers in the curriculum project has broadened the potential user base of its educational software packages. The economics and geography programs are now available on cassette for the Tandy TRS-80 level I computer.

Already available for the RML 380-Z, Apple and Pet machines, the programs can be purchased from Edward Arnold Ltd, Woodlands Park Avenue, Woodlands Park, Maidenhead, Berkshire.

Included in the economics package are programs dealing with international trade, multiplier, fiscal policy, elasticity of demand, price fluctuations, price stabilisation, theory of the firm, banking and monetary policy.

The geography package covers human-population growth, a joint-stock trading game, drainage-basin morphology, a windmill game, a farm game, a south-eastern railway game and statistics.

The economics package costs £22 and the geography one £20.80. Information on microcomputer software can be obtained from the Educational Computing Section, Chelsea College, Manresa Road, London SW3 6LX.

BBC machine offered as top prize in building competition

IF YOU think you can devise a method which enables a microcomputer to help a manager in a building organisation then you could win a new BBC microcomputer. The competition is designed to stimulate interest in the use of microcomputers among the future generation of managers in the building industry.

The entrant will be expected to specify an application for a microcomputer which could be used in the construction industry, and the entries will be judged by a panel of construction managers and computing specialists who will be looking for originality.

Entrants need not feel too constrained by the technical limitations of microcomputer systems, providing the subject has been well researched and that there is a strong possibility of technology catching up.

The first prize of a BBC microcomputer is being donated by Construction Programming Services, and there are an additional three cash prizes for the most original entry, the best documented entry and the most practical entry. The additional prizes are being donated by the other competition sponsors: The Chartered Institute of Building, Shepherd Construction Ltd, and William Irwin and Co.

Guidelines for prospective entrants can be obtained from Paul Barton, School of constructional studies, Leeds Polytechnic, Brunswick Terrace, Leeds. Telephone: 0532 463232. The competition closes on January 31, 1982.

Universal interface opens new doors for Pet

A UNIVERSAL interface for the Pet microcomputer is a product for which many have been waiting. It means that the Pet — or for that matter the Vic-20 — can be used to control, monitor, test, sequence, experiment or perform any one of hundreds of tasks in the real world.

The system has been developed in this country by the ICI Physics and Radioisotopes services group of the ICI plant at Billingham, Clevelend. At Billingham the Pet is used for a variety of tasks, everything from the measurement and control of processes to making cups of tea.

Marketed under the ICI trademark of Gammatrol, the Pet Interface System comprises a master unit together with a set of plug-in options. Test and demonstration software is provided free, so within a very short time the system can be up and working.

Each unit is supplied with a comprehensive users' manual which tells you how to wire your equipment. ICI will calibrate the parts you order to your own specification, and will provide some support.

The boards include a pulse counter, £120, 12-bit analogue input, £195, 12-bit analogue output, £220, a watchdog, £120, an eight-bit analogue input, £150, eight-bit analogue output, £155, 16-bit digital input, £120, 16-bit digital output, £130, eight-bit digital output, £160. All boards slot into the master unit and they can be mixed and matched to suit the individual application.

For more information contact Physics and Radioisotope Services, ICI, PO Box 2, Billingham, Cleveland, or ring 0642 553601.

Conference for Pets

PETED 1 is a conference for Pet users in the educational environment. Topics such as frame-handling, laboratory experiments, graphics, school curriculum, special education and schools administration will be covered in the three days of the conference.

The conference dates are November 27 to 29. Fees are £60 residential and £45 non-residential. Contact Dr Christopher Smith on 01-937 5411 ext. 429 in the day or 01-485 8632 evenings.

First U.K. export for States-side Apples

THE FIRST applications program to be imported by Apple to the U.S. from Britain is the Apple project manager, APM. It is a network-analysis system, written by Construction Programming Services of Bradford.

The program allows the creation and storage of an infinite number of large networks any of which may be recalled, updated and analysed in a few moments. The nine different output reports include bar-charts and are in real-date format. Construction Programming Services has been involved in microcomputers and project management for three years and previously marketed Apple project manager under the name Micronet.

For further details, contact Geoff Reiss or Robert Fearnley on 0274-671859.

Now Sinclair can print

THE NEW Sinclair printer is now available. Designed to complement the best-selling ZX range of microcomputers and software, the printer will cost a mere £49.95 including VAT. It is a thermal printer, and features high-resolution graphics as well as the full alpha-numeric character set.

Interfacing directly to the ZX-81 and new-ROM ZX-80, the new printer means that hard copies of listings, results of computations, graphics and so on will become both commonplace and easy to obtain.

A special feature is the Copy function, which prints out exactly what is on the TV screen without any further instructions. The printer is complete with a 65ft. roll of aluminised paper, additional rolls are available at £11.95 for a pack of five.

Expanding network of bulletin boards

THERE ARE now six Forum 80 bulletin boards in operation in Europe — five of them in the U.K. A bulletin board is an American idea, whereby computer owners can contact each other via the telephone network and a central computer.

Electronic mail can be down-loaded at a certain computer to be loaded at a later date by another computer. When a computer logs on to the system, a message will be displayed informing the operator if there is any mail for him.

The Bulletin board can be more than just a centralised electronic mailing system, though: software can be disseminated via libraries, and lists of available products and services may be distributed.

The present list of Forum 80 bulletin boards is: Hull, system operator, Frederick Brown, 0482-859169; London, system operator, Leon Jay, 01-286 6207; Milton Keynes, TRS-80 user group 80-Net, system operators Leon Heller and Brian Pain, 0908 566660; Holland, system operator, Nico Karssemeyer, 010-313512 633; CBBS London, operator, Peter Goldman, 01-399 2136; and Wembley, system operator, Victor Saleh, 01-902 2546.

Anybody wishing to learn more about Forum 80, or who wants to start a bulletin board of their own, contact Frederick Brown, 431 Endike Lane, Hull.

Greater data security is MP/M II's strong point

DIGITAL Research, instigator of the industry standard CP/M microcomputer operating system, has released MP/M II. MP/M is an operating system for multi-user microcomputer systems and MP/M II features record and file locking as well as optional password protection for data security.

The minimum requirements for a MP/M II system are: 8080, 8085, or Z-80 processor, 48K of RAM a clock-timer interrupt, one disc subsystem and a console. Up to 16 consoles can be used, together with 16 disc drives and 16 printers. A total online storage of 8gigabytes can be supported. Up to 400Kbytes of RAM can be managed by the system but the nucleus of the system occupies only 16K: the remainder is eight banks of 48K and is switchable.



MP/M II is available on a standard format 8in. disc, and an upgrade kit is available to those users who already posses SES MP/M. The system is supported by the Digital Research Software Performance Reporting System. In Europe, the system is marketed and supported by Victor International, of Belgium. Telephone: 32(016) 202496.

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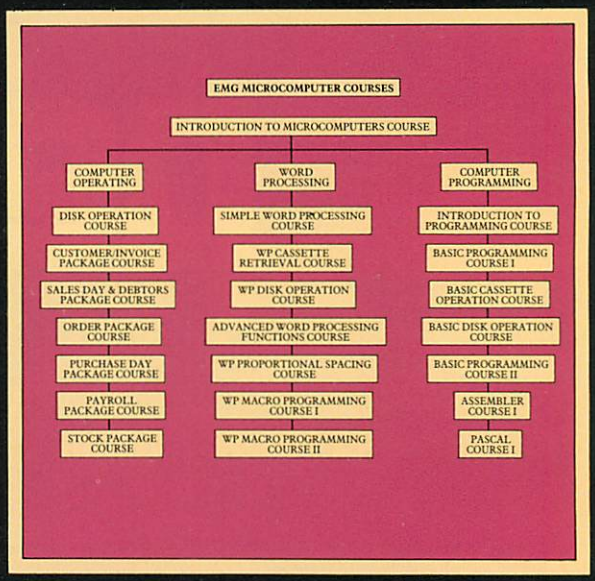
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Waiting for 'The Rocket'

Practical Telesoftware is shaping up, our concerned readers will be glad to hear. Although it is early days, those who sent us messages via Prestel, or who wrote to us, politely or otherwise, to enquire about the whereabouts of our loudly-trumpeted software database, may now get a taste of what the future holds in store by checking out *357#.

Admittedly we were hoist with our own petard . . . the "ready next week" flag still hangs over many sections of the database, but the most important areas are, we believe, starting to fill out. The problems are not those of database design — this is not difficult, although it does require some thought to design a structure which does not send the incautious down a "mineshaft" or otherwise lose him in a loop from which he cannot escape. Those who ever tried to find out local train times from the British Rail Prestel timetables may have some idea of what this means.

Our problems are those of content: its quality and its presentation. Taking second first, we have agonised, along with industry heavies sitting in committee meetings and *ad hoc* discussions, over the protocols which would best correspond with our needs, and those of the predicted market for programs delivered by telephone line. Committees breed committees; the tendency of any bureaucracy is

by Martin Hayman

to extend its own power, preferably without taking decisions. It is very difficult to get anyone to agree anything, especially when there is a potentially huge market at stake.

One such meeting was held by B&B Computers' John Blackburn, who in June invited everybody he knew in telesoftware to the Skyways Hotel, and tried to get them to agree on exactly how software should be presented on the screen. It was an impressive attempt and it was invigorating to see, for example, Acorn's Hermann Hauser in earnest discussion with Commodore's communications man, Rod Wellburn, after some earlier terse exchanges.

Our feeling about telesoftware is that customers are likely to decide what they want. Our collaborator and mentor within the Post Office, Tony Stillwell, who is about to take up a post with the U.S. telecoms giant AT&T, rather felicitously described the search for telesoftware standards as akin to the Rainhill railway trials which were held in the 1830s and resulted in the adoption of *The Rocket* as a prototype for steam locomotion. What will be *The Rocket* of the telesoftware market? We think that that will only emerge through use.

Peter Blower has already analysed the several systems in use already, and Mike Brown, CET's programmer, has written a counter-blast — see last month's *Practical Computing* — to Blower's criticisms. The system which will finally be acceptable to the software-buying public will be the one which pulls the train.

Recently we have devoted a lot of attention to the problem of sending Pet programs by Prestel. The Pet, like the Sharp, uses a non-standard keyset with graphics which fall outside the range of the Prestel character set. This is difficult to explain, but a comparison of the Prestel codes contained in British Telecom's technical specification *Prestel – the Technology* and those of the Pet contained in Nick Hampshire's book *The Pet Revealed* will elucidate. It is tempting to ignore this problem, but since the Pet, like it or loathe it, is one of Britain's most popular micros, this is not an issue which can be fudged.

Dave Heaton of B&B suggested the following system in order to get round this problem. ASCII codes 32-160 represent the basic alpha-numeric set on the Prestel keyboard — and include reverse, which need not concern us since Prestel has a choice of colours. These codes, then, take care of themselves. Only those below 32 and above 160 need to be tackled.

The useful ones below 32 are mostly cursor-control characters. Since it is desirable to exploit to the full the characters on the Prestel keyboard which do not correspond to any on the Pet keyset, he thought the best thing would be to assign the following meanings to these keys: cursor left (←); cursor right (→); cursor up (↑); cursor down (ll); cursor home (÷); reverse on (¾); reverse off (¼); clear screen (½).

Now the tricky stuff follows. If any character is higher than 160, it should be represented by its equivalent character 128 further down the ASCII scale. To do this, the receiving software has to be alerted that this is the intention. The way round this is to send a Prestel dedicated code — say, red alphagraphics. This has the dual advantage that the special graphics mode is picked out in red. This shift mode continues until cancelled by the sending of alphagraphics white, returning the statement lines to their normal white and instructing the receiving software to go back to ordinary mode.

This may seem clumsy and perhaps even contradictory. After all, one of the declared objectives of *Practical Telesoftware* is that program listings should be, at least in the first instance, readable by eye. Is this not a contradiction? For graphics you are going to get some kind of garbled code that does not exist anywhere outside the Prestel screen — except that it's picked out in red; but try thinking out any other way. There is the literal way of doing it, but imagine how stupid it would look on the screen — and wasteful of screen space and hence transmission time, if, in order to move the cursor up the lines, one had to transmit Print CHR£ (145) ten times.

So far this system, which is only provisional, has not been tested. If anyone has a better idea, why not let us know? We are confidently expecting you all to vote for telesoftware with your wallets, so why not get your vote in early?

A rosy future

We are not the only ones who expect a rosy future from telesoftware. In a slight shift in its marketing policy, Tangerine Computers is now going for the micro market with its Tantel, which has had software modes to bring it more into the micro user's useful area at no extra cost. As explained recently in *Practical Computing's* news pages, this excellent little device now offers three distinct advantages for the micro user. It is a dumb Prestel terminal; it is a colour display unit; and it can now be used to send alpha-numeric data from the micro's keyboard to Prestel.

To move from the amateur device to a more professional tool, the Comart Communicator, which we have been using to build up the *Practical Telesoftware* database, has proved a great success. This is not least because of the superb quality of its RGB monitor, which is as sharp as you could hope any VDU would be. For those who spend a great deal of time peering into a screen, this is most important. In fact, it is down to the Hi-Tech Prestaid card. The editing facilities are somewhat crude, but only by comparison with the so-called Superedit system on the PDP-11 TM-3 installed here at Quadrant House, which is a dedicated system.

The lack of file space in the Communicator means that it is not possible to emulate the full treeing structure required — the actual programs in *Practical Telesoftware* are at the nine-digit, i.e., bottom level, which is well out of range of the version of CP/M supported by the Communicator which can cause some headaches. However, with a little ingenuity and a piece of paper and pen — still astonishingly useful tools — it is possible to keep track of where everything is. We will have more on the Communicator next month.

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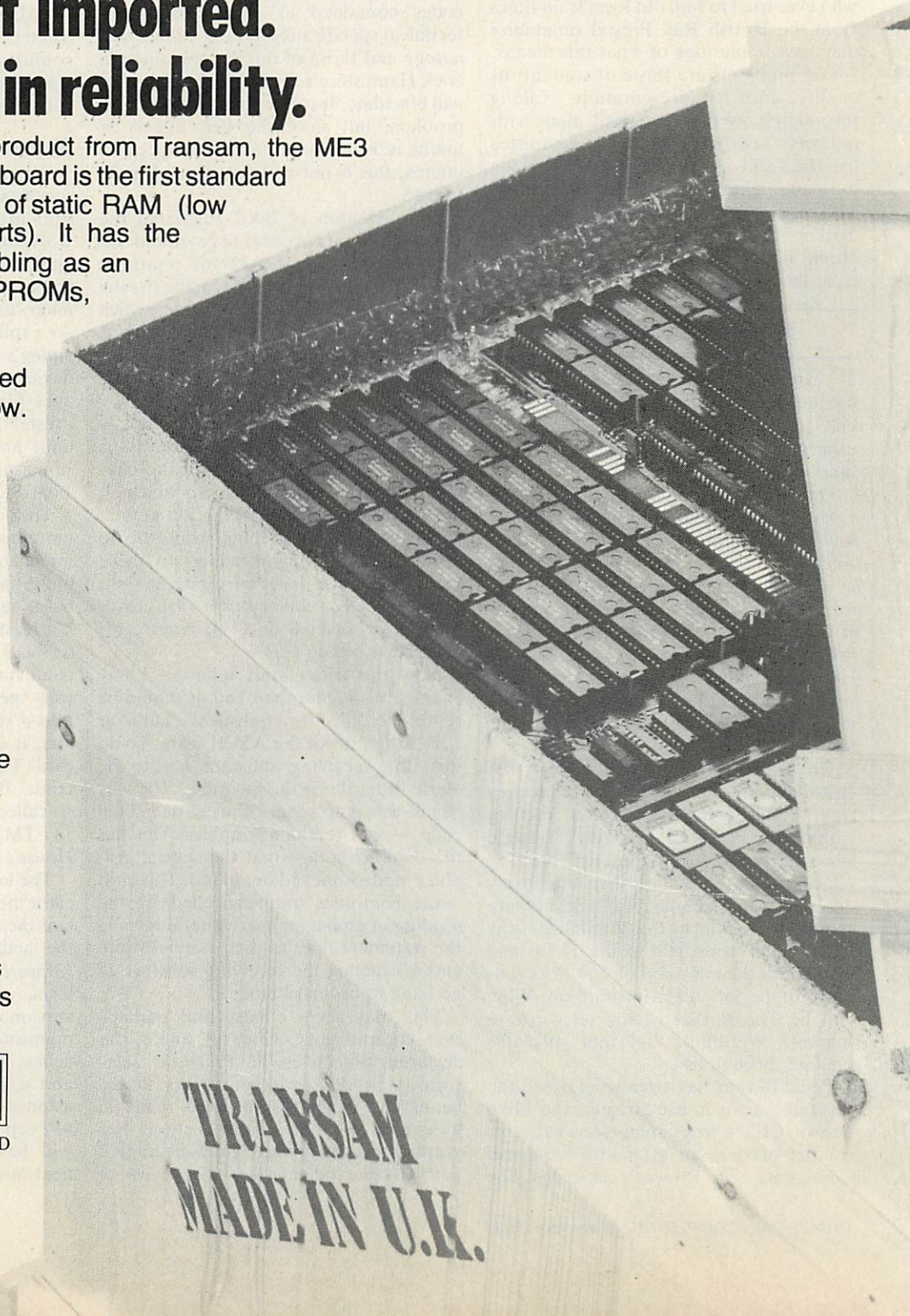
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● Circle No. 141

This year's Compec is being held on November 17-20 in the Grand Hall, Olympia, London. We take a brief look at some of the new equipment which is being shown in the U.K. for the first time.

Compec '81 preview

COMPEC is Britain's biggest and most successful computer exhibition and it is still growing. This year, more than 350 exhibitors are filling Olympia with computers, small business systems, peripherals, and new software packages. More than 100 companies will be taking part in Compec for the first time — and in a special new "software village" section of the exhibition, software companies will be grouped together.

Admission is £2, but if you send off the coupon on the Compec '81 advertisement on page 231 you can save £1.

Some of the key developments at Compec include the new BBC computer from Acorn; the Vic-20 from Commodore, which is at last entering the U.K. in production quantities; the Epson with the new MX-130 printer; Osbourne with the computer in a briefcase; Lucas Logic — the new name for Nascom; Rair with the 3/30 including the built-in 5.25in. hard disc; Research Machines with the new 480-Z microcomputer, and Tandy with the new Tandy Model III and the Tandy Colour Computer. Compec '81 will be the official European launch of this colour computer.

BBC computer

Grundy Business Systems is also at the exhibition — it will be interesting to see if the newly-acquired NewBrain hand-held computer will be on display.

When the BBC first reached an agreement with Acorn about the design and manufacture of its computer, the BBC estimated that it would sell at least 12,000. That estimate now looks wildly pessimistic.

Our own guess, however, judging purely from the level of interest in the system, is that Acorn will take more than 15,000 orders a month — how many Acorn will be able to supply is another matter.

The attractions of the system are the impressive strength of the Basic and the extraordinary growth path. All in all, it looks like being the best value on the market. If you can find the space to squeeze yourself on to stand 2224, it will certainly be worth a look.

The smaller ranges of personal computer seem to have dominated the market this year, with the phenomenal success of the Sinclair ZX-81 and the advanced publicity and numerous U.K. launches of the Commodore Vic-20 drawing most attention.

The Vic-20 still offers excellent value for money as a personal computer. Despite all the delays and setbacks to the system, it should now be available in reasonable quantities from the new production plant in West Germany.

In vain, Commodore reportedly applied as much pressure as it could muster to persuade the BBC to use the Vic-20 with the computer literacy series — or at least to use a version of Basic compatible with the Pet or the Vic. Despite the fact that these proposals were not accepted, the Vic-20 should prove to be a great success. See it for yourself on stand 5231.

Printer revolution

Some of the Vic peripherals will also be on display, including a Commodore label version of the Seikosha GP-80 printer, a single-disc drive unit and the Commodore Vic expansion board. Commodore will also be showing its micromainframe computer.

The effects of the revolution in the printer market of the past 18 months have been widely felt — and most have been to the advantage of Epson. In the U.S. the Japanese share of the market has grown from nothing two years ago to 75 percent by the end of this year. Epson is the leader with 30 percent of the U.S. market held by its low-priced models. On stand 8115 Epson will be showing the new MX-130 printer which has a speed of 135cps and is supplied complete with friction tractor and high-resolution graphics. The printer will also be shown by Epson's largest British distributor, Microperipherals, on stand 8127.

One of the more successful British manufacturers of microcomputers, Research Machines Ltd, takes another substantial leap forward at Compec: on stand 3190, it is showing the new 480-Z microcomputer. This micro is a compact Z-80, 32K-minimum machine packed into a rather large keyboard and a new 80-character screen.

The 480-Z has many possible contacts with the outside world — cassette paddles, parallel and serial ports, and all with doubling options. Add-ons include high-resolution graphics, 16K Basic in ROM, 32K of extra RAM, IEEE-488 port and a floating-point arithmetic chip — very useful for jobs like calculating perspective in three-dimensional graphics.

The most attractive of the planned add-ons is the networking system running CP/Net. By adding a board to any 380-Z, the predecessor to the 480-Z, vast numbers — say, 64 — 480-Zs can be daisy-chained together to share the same programs and data on disc or to access the same expensive peripherals.

One of the new business systems which has entered the market this year is the Triumph Adler Alphatronic system, backed with software from the Dutch-British software house of Microtrend. The company is still gearing itself for the U.K. market with a variety of new business software packages to be sold with the system. You can see them demonstrated on stand 6140.

On the small system side, Ingersoll is parading its Atari 400 and 800 personal computer systems on stand 9001. At the very least it is worth trying the Atari Space Invaders program — one of the best on a computer system outside the arcade games.

Value for money

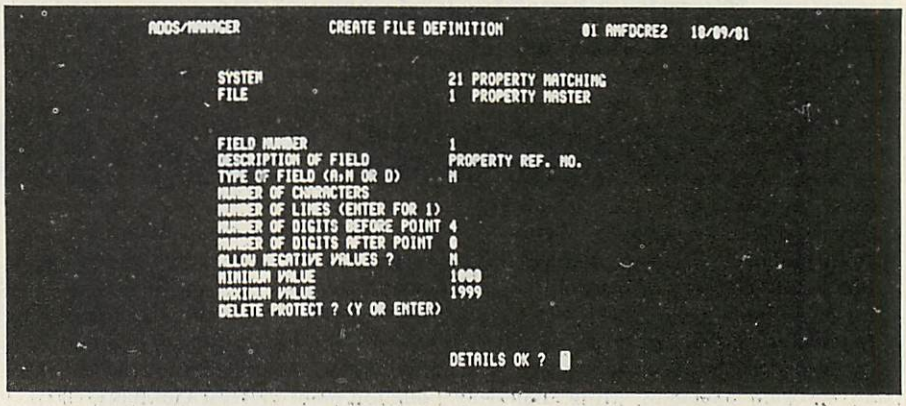
Tandy is exhibiting to Compec for the first time — one of the 100 new entries to the exhibition — and is using the occasion as the official European launch of the new Tandy Colour Computer, on stand 2214. Also on show will be the Tandy Model III, the new stand-alone system with a built-in keyboard, screen and dual 5.25in. floppy-disc drives. Both represent good value for money.

If you are interested in add-ons, you will find the new company Arfon on stand 7181 with a new range of light-pens, a speech box and one of the first expansion boards for the Vic-20. This is already regarded as being of better value than the Commodore version.

Another new piece of hardware is the Oasis from Hal Computers. It is a flexible multi-peripheral exerciser which can be used to test, drive, or demonstrate any computer peripheral commonly found in use on micro or minicomputers. The whole package is contained in a suitcase and is on show on stand 9042.

If software is your line, you will find 26 companies in the software village all presenting their latest packages. All in all, with 350 companies from which to choose, you will not be short of people offering a solution to your particular computing problem. If you have any questions to ask any of us on *Practical Computing*, we shall all be on stand 2131. We look forward to seeing you.

David Watt looks at another recent aid for program generation.



Genasys

LIKE THE much-publicised program The Last One, Genasys is a development tool which prompts the user for information to generate applications programs. It does not, however, pretend to offer the definitive solution to systems development implicit in The Last One's name.

Genasys grew from the experience of Surrey-based Compact Accounting in the field of applications packages and bureaux services. The system allows you to define files, specifying each field and which fields are to be keys. You can set up links between files and then generate file-update and report programs.

Genasys was developed using ADDS Multivision equipment: Multivision Basic is Microsoft Basic with the addition of an advanced ISAM facility (Indexed Sequential File Access Method). ISAM allows a file to have up to 256 keys and multiple records may have the same key value. Records may be accessed using only part of a key, and keys can be built up using fields from various positions in the data record. The maximum length of a key is 26 characters and the b-tree method of accessing them is used. The operating system, MUON, is CP/M compatible — Compact is producing a version of Genasys to run on CP/M machines.

To test the package, I used a Multivision 1 which is a 64Kbyte system, using the Intel 8085A processor and two double-sided double-density floppy discs giving 700Kbytes of on-line storage. At the rear of the machine are two RS-232C serial interface ports, one for the Multivision VDU and the other for a special enabling device called dongle.

This has been designed by Compact to provide a method of protecting its software from being copied. Each Genasys package sold is supplied with its own individual dongle without which that particular system will not run.

Programs generated by the Genasys system do not, however, require the dongle — it is only the package which is protected in this way. For the review, I also used a 132-character matrix printer.

The software was supplied on a set of six diskettes, accompanied by a single manual of about 50 pages. I was not supplied with operating or installation instructions for the Multivision. They would have been useful — particularly when using the menu program. However, I quickly discovered that pressing the carriage-return key instead of entering one of the options offered caused the system to display the previous menu.

On the whole the manual was very good. It explained clearly the various parts of the system and how to use them. There were also plenty of good examples showing screen formats and sample reports, and explaining what was being done. A simple personnel system was used as an example throughout the manual. I used this personnel system to test the thoroughness of the instructions. Having set up the system, it became apparent that there were some errors in the manual and several facilities were described which are not yet implemented. At the end of the manual the file lay-outs of all the system parameter files should prove useful to programmers tailoring a system.

The six diskettes supplied consisted of Adds Security, Manager and Reporter programs, parameter files, one for generated programs and one for generated files. The names of these subsystems are changed for systems sold on equipment other than the Multivision.

The Security diskette contained a set of utility programs which could be used to create new diskettes, change the system date, or make copies of diskettes.

These utilities are accessible only if you possess a secret password. This gives a measure of protection against unauthorised users making copies of your diskettes, or overwriting diskettes and destroying your data. This diskette also contains the main menu for the Genasys system.

The system is menu-driven and screen formats lead you through every step of system generation. When the Multivision is switched on, it goes through some self-test procedures and then asks you to type "B" to boot the system or "R" to re-test.

If you type "B", the computer asks you to input the date and then loads the operating system from the disc in drive A which should be the Security diskette if you intend to use Genasys. The main menu is then automatically displayed. That allows you to select the Security, Manager or Reporter subsystems, or any systems which you have generated.

Before you set up a system, you should establish what files you need, the fields they should contain and the update and report programs required. In other words, you should do the systems analysis work before touching the keyboard. It would be useful if Compact provided sample forms to aid this step as part of the documentation.

The Manager system menu displays the following options:

Create a system definition
Create a file definition
Print a file definition
Create file linkages
Create an update program

Each system you define may have a 20-character name, a two-character prefix for generated program names, and is automatically given a number in the range 20 to 99. Numbers 1 to 19 are reserved for Compact Accounting applications packages which are also compatible with systems generated by Genasys.

The file-definition program allows you to specify the name of the file in up to 20 characters, and asks you to detail whether it is a master or transaction file. Master files are used to contain static information on particular items, while transaction files are used to maintain records of particular events.

Thus in the example personnel system, a department file and a personnel file were set up as master files, and a salary-history transaction file was used to record each change of salary for personnel. See figure 1.

Having input these parameters, each field in the file must be defined. A field description — again, of up to 20 characters — may be input followed by the field type. The main field types allowed are alpha-numeric, numeric or date. In addition there are several types of field available for interfacing to Compact Accounting application packages.

For alpha-numeric fields you must also specify the number of lines the field may use. This is used for address fields, and the number of characters in each line. For numeric fields, you may specify how many digits before and after the decimal point, whether negative values are allowed, and the maximum and minimum values for the field.

Finally, you can protect a field from

deletion; if a field is delete-protected, a record may not be deleted if the revelant field has a value stored.

When all the fields have been defined, the program asks you to specify the key fields. The names of all the fields in the record are displayed, and for each key, a key description and the number of the field to be used may be entered. The field name is re-displayed beside the field number.

If an alpha-numeric field is selected, the program also asks how many characters are to be used for the key. When a file definition has been completed, you may obtain a print which is useful for checking for mistakes and also for reference during later stages of system generation.

Having defined all your files, the next stage in generating your system is to create the file linkages. Two types of linkage may be created: the first, a key-to-key link, as in the case of the personnel file and salary-history files mentioned where each file is linked by the personnel number.

The second type of link is the field-to-key link. For instance, the department number in the personnel file provides a link to the department file. See figure 2.

The linkages are used so that when you are updating a file, information from other files can be displayed at the same time. For example, when creating a new personnel record, you can display the department description when the department number is input. The linkages could also be used to allow other files to be updated.

So, if the department record has a field containing the number of personnel in the department, this field could be automatically incremented as each new personnel record is set up. Or, if an employee's salary is increased, a salary-history record is set up and the salary on the personnel record updated automatically.

Unfortunately, this facility was not available in the review system. An update program may be created to input all fields in a record, or selected fields only. Links may be set up between files in different systems if required.

All programs are generated in Basic source code and then compiled. The file parameters are included in the generated programs. This is more efficient than reading the file parameters when a program is run, although the second method allows file definitions to be changed without having to edit programs.

Having created the update programs, you can now set up files. Each generated system includes a file-create program. Each file must be created with the maximum number of records defined before any data is input.

Update programs generated for master files have Create, Amend, Review or Delete options available. For Create, the field descriptions are displayed on the screen and the fields may be entered in sequence. When all the fields are input the program asks you to enter Y, N or Can for cancel.

For Amend, the requested record is displayed and the program asks which field you wish to amend. When you have amended all the fields you wish to, you can type End in place of a field number and the program will ask you to accept or reject the amendments.

Delete displays a selected record before asking you to confirm deletion. Review allows you to examine any record.

For transaction files, a batch update program is generated which allows a record to be input and then accepted and written to the file. It may be amended before being accepted, or cancelled.

Genasys may also be used to generate report programs. Eventually the intention is to allow five types of report program to be generated:

Label programs
Complete master-file reports
Selected master-file reports
Formatted reports
Word processing

Only the completed or selected master-file reports were available on the review system.

Label programs print self-adhesive labels using names and addresses from data records. Formatted reports are generated to print data and headings from several files at once.

So, it is possible to produce a report from the salary-history file showing the dates when an employee's salary was increased but with his name, address and department taken from his personnel record.

The word-processing option will be used to select fields from data records to pass in special files to a word-processing system. A common use of this is for names and addresses to be extracted from a data file and repetitively included in a standard letter.

The master-file reports allow you to specify the page size and width, and two lines of headings. The selected-file report prints fields in the order selected which may not be the same as the order on the record. Fields can also be printed from linked files, and computed fields can be printed.

When the fields to be printed have been selected, you can request a test print which will show you the format of the report with an X printed for each alpha-numeric field and a 9 for each numeric one.

You can change the format of the report if you wish, altering the field head-

(continued on next page)

Figure 1. Field descriptions for personnel and salary-history files.

Field number	Description	Type	Number of lines	Number of characters	Before point	After point	Negative values	Minimum	Maximum	Deletion protected
A.										
1	Personnel number	N	1	—	4	0	N	1001	2000	N
2	Employee surname	A	1	30	—	—	—	—	—	—
3	Employee initials	A	1	4	—	—	—	—	—	—
4	Employee address	A	3	30	—	—	—	—	—	—
5	Telephone number	A	1	16	—	—	—	—	—	—
6	Date of birth	D	—	—	6	0	N	—	—	—
7	Date joined	D	—	—	6	0	N	—	—	—
8	Annual salary	N	—	—	5	2	N	—	—	—
9	Date last review	D	—	—	6	0	N	—	—	—
10	Department number	N	—	—	2	0	N	10	75	N
11	Job description	A	1	20	—	—	—	—	—	—
B.										
1	Personnel number	N	—	—	4	0	N	1001	2000	N
2	Date of increase	D	—	—	6	0	N	—	—	—
3	Previous salary	N	—	—	5	2	N	—	—	N
4	New salary	N	—	—	5	2	N	—	—	N
5	Comments	A	1	20	—	—	—	—	—	—

A. Field descriptions for personnel master file. System: 21 personnel. File: 1 personnel master.
B. Field descriptions for salary-history file. System: 21 personnel. File: 2 salary-history.

(continued from previous page)

ings and the spacing between each field. Finally, you can also select fields for totals and subtotals.

When you have specified all the parameters for update or report programs, you can generate a temporary or permanent program. A permanent program is generated and stored in the disc for permanent use; a temporary program is generated and then run — on completion, the program will be erased. This could be useful for *ad hoc* reports. Generated report programs allow a range of records to be selected for printing.

There is little in the way of amendment facilities in the current version of Genasys. Once a file definition has been created, there is no way to amend or delete parameters. Similarly, once a permanent program has been generated, it can not be modified or removed by Genasys. Because the system creates Basic source code for generated programs, a programmer, however, can amend the code and re-compile the program.

Even if you have committed to paper all the parameters you intend to set up before you use Genasys — which you certainly should — it is still easy to mis-type a field description, for instance, and not notice this until it is too late to amend. You have to live with the mistake, or re-input the file definition leaving the incorrect file on the system.

So, it is wise to take frequent copies of the system as you are developing it, so you may return to a previous copy if you make a mistake. Of course, if it were possible to amend file definitions, it would also be necessary to provide methods of regenerating programs which use those files.

Genasys costs £1,000, and an optional £50 annual maintenance fee entitles you to receive new versions of the system as they are released. Compact Accounting regards Genasys as a package which is to be developed further, and that is confirmed by the list of facilities not yet available. So, the maintenance contract ensures you receive these facilities as soon as they are available.

The system is aimed at dealers and others who have some programming expertise, who wish to use it to develop application systems. The basic application can be defined by Genasys and then the generated programs may be edited to tailor the system as necessary.

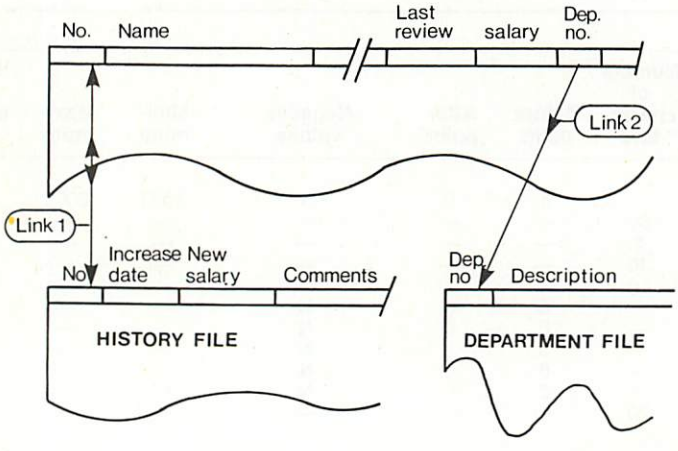
The first release of Genasys, under the name ADDS Manager, was in March of this year. The latest release should include the formatted report facility. Part of the reason for the early release of the first version was so that Compact Accounting could receive feedback from customers as to what additional facilities were required, as well as to uncover any bugs lurking in the system.

The first system I had for evaluation had a fault at the end of the file-definition program, but this was quickly corrected when I informed Compact Accounting. Apart from this, I had no problems with the system.

Conclusions

- **Genasys is straightforward to use: it allows you to develop a system in a natural fashion, defining the files first, then generating the update programs and finally the report programs.**
- **The menus and screen formats are easy to follow, and the manual explains the system very clearly.**
- **The only factor making Genasys difficult to use is the lack of facilities for amending file definitions and regenerating programs, although it is possible to cancel your input, or return and amend fields if you spot the mistakes soon enough. I am told Compact is working to improve these features.**
- **Genasys will also become much more powerful when the additional facilities for updating fields using links, and producing formatted reports are available: the label-printing and word-processing options will also be of interest to many people.**
- **Genasys will shortly be able to run under the popular CP/M operating system with Microsoft Basic. The generated programs are compiled, which means they are more efficient than interpreted programs. If you want to do any special processing, the source code of the generated programs can be changed easily and then re-compiled by someone with programming experience.**
- **The parameter files defining the system, data files, and links are used only when programs are generated to produce the code necessary to read and update records — this makes the programs more efficient to run.**
- **It is advisable to design your system before you attempt to use Genasys because it is very easy to make mistakes if you have not planned it adequately. I suggest, before you attempt to use the package for the first time, you should take a complete copy of all the diskettes, and you try setting up the personnel system described in the manual to familiarise yourself with the operation of the system. Also you should take frequent copies of the parameter files, and generated programs and files during development of a system.**
- **Genasys uses the powerful ISAM facilities of Multivision Basic; the CP/M version will have a similar facility. At present, keys may be only single fields.**
- **The system is aimed at computer system suppliers and dealers. Considering the program development time which might be saved by using Genasys — it took me only a few hours to set up the personnel system — the price of £1,000 seems reasonable. The maintenance fee of £50 also seems a worthwhile investment.**
- **How well you like Genasys will depend to some extent on whether you are willing to accept certain constraints. For instance, the way data input is handled and the way reports are formatted. If, however, you are prepared to accept these features, Genasys allows you to define a good basic system.**

Figure 2. Schematic diagram of field-to-key link.



Diagramatic representation of two types of file linkages

Link 1 – key to key link
Link 2 – field to key link

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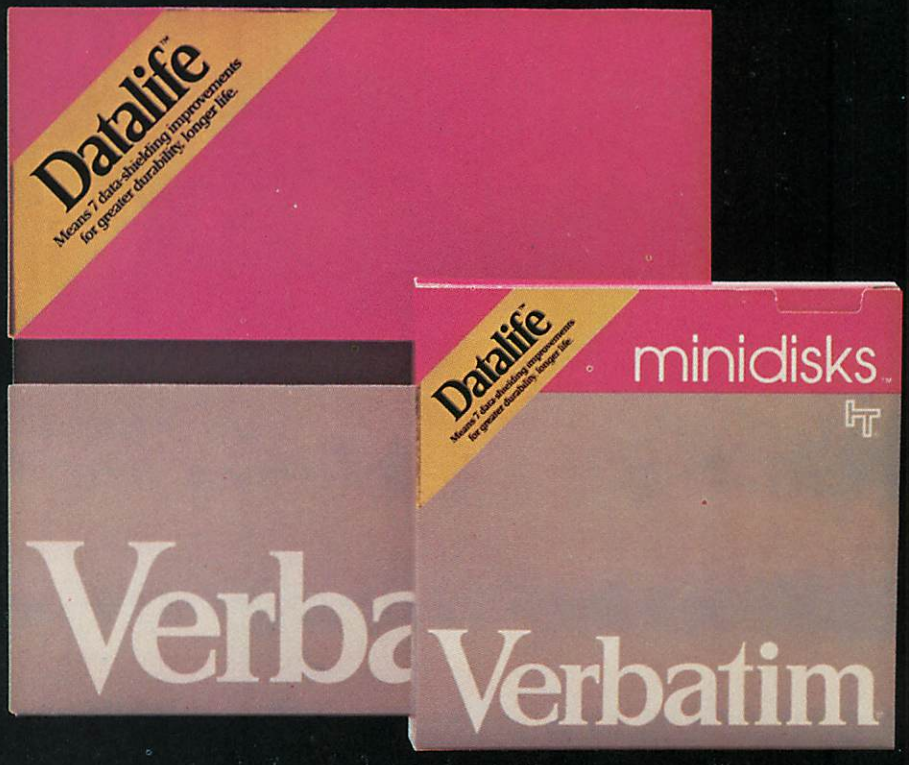
4. Advanced polishing techniques. Our burnishing makes our disks uniformly smooth, for better data transfer, less head wear.

5. Reinforcing hub rings. For critical applications, Verbatim disks are available with hub rings to aid in registration, eliminate slippage, reduce errors, and give you better alignment repeatability.

6. Testing standards that go far beyond industry standards. Every Verbatim disk meets or exceeds the most demanding of IBM, Shugart, ANSI, ECMA, and ISO standards–because we insist on Verbatim being the industry standard of excellence.

7. A 100% Error-Free Certification. Our certification is not based on random sampling, or statistical averaging, it is based on extensive testing of every single disk. Therefore we can state that our disks really are 100% error-free, and back it up with a **full one-year warranty.**

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A look at the new general-purpose package from Bristol Software Factory.

Silicon Office

LAUNCHED earlier this year, Silicon Office will turn the 8096 Pet into a secretarial work station capable of emulating any application package the user cares to think of. The Silicon Office package comprises three integrated elements: a sophisticated word processor, a flexible database-management system, and a communications option for use over the dial-up public switched telephone network, PSTN. The description "database-management system" really does apply, as Silicon Office permits up to six independent files to be in use and linked during operation. This represents the first

by Mike McDonald

true database system that we have come across for running on a micro. Silicon Office is written completely in 6502 machine code and is available from most Commodore dealers, priced at £800.

Silicon Office is a natural extension of the Ozz package, and relies to a large extent on the syntax and structure of Ozz. As a database system, Silicon Office permits the users to design their own record structures and files, and process information through the use of a program file of Silicon Office commands. Fields of data may be read from any file on the system and calculated, transferred or printed out.

The linkage between different file structures allows almost any application to be set up on Silicon Office including payrolls, stock systems and ledgers, not to mention the more traditional applications for database systems such as fleet management, patient records, and customer records. Reports may be user-designed within the text editor and any field from any of the available files may be inserted cleanly into documents such as tabular reports or mailing letters.

The document editor is unique to the Pet and takes advantage of the large memory to permit virtual paging. This means that text may be considered to exist continuously in memory up to the limit of the disc capacity — about 160 A4 pages.

The communications option within Silicon Office will permit the user to communicate with any other Silicon Office-based machine through an acoustically-coupled dial-up link. The link may be either through an internal telephone or over the PSTN and the machines may be used in a telex mode — sending and receiving directly-keyed messages — or for automatic transmission of text, data, or work files. The system is designed for use with the Commodore 8010 acoustic coupler and carries out its own error checking on the transmission.

The overall concept of Silicon Office is that the user may set up a series of files that will be accessed from an Office Program containing up to 100 steps of Silicon Office instructions. The program language is comprehensive and very simple to understand and mainly uses the direct mode commands for manipulating records, while allowing calculations to be carried out and logic tests to be performed with conditional branching. Multiple files may be accessed, data retrieved, massaged and passed back to the original or other files or to the text editor if required in the user's report.

The file structure of Silicon Office varies greatly from that of Ozz. There are three types of file created and used by the package:

- **Data file** — for the actual storage of data input through a specific record format. Up to three data files may be held on a single floppy disc — data disc — and each file may not exceed 186Kbytes or characters in size.
- **Program file** — this may be one of many office programs that are stored on a separate disc called a work disc. The program file that is required may be loaded into the machine at run time and the disc removed to allow two data discs to be in place for a run. In this way up to six files, three per data disc, can be accessed simultaneously.
- **Text file** — this is created by the text editor and may be a pure document, e.g., word-processing type of data, or a report format or letter to be used by Silicon Office for insertion of data from a run; a report format will again be loaded into the machine at run time. Two text-file types are permitted — WP text files and paragraph files, for insertion and document-compilation purposes.

Maximum flexibility

Work discs may be organised at the discretion of the user to contain all text files or all program files or a mixture of both, and there is no limit to the number of either work or data discs that may be set up and used. This organisation of the file types provides the user with maximum flexibility given that floppy discs have a very limited storage capacity.

Once hard discs are implemented the need for such a structure is no longer necessary, given mass storage volumes, but the structure is still logical and lends itself to being transferred from one medium to another. It is also this structure that means that any one of the three file types may be transmitted through the communications option to another Silicon Office machine.

Silicon Office is provided in the form of a sectionalised, attractive A4 manual and program-master floppy disc. The program is automatically loaded into the Pet with a single keystroke, and once there will remain until an exit is made. Silicon Office is written entirely in machine code and remains totally native to the computer. The program disc is then removed to free both disc drives for applications discs.

The command repertoire of Silicon Office may be broken down and defined into three categories of:

- **Set-up and program** — likely only to be used by a qualified user when implementing systems on Silicon Office.
- **Usage** — these are interactive type commands which an operator would issue in the course of using the system as set up for him/her.
- **Housekeeping** — utility commands for disc organisation and handling.

Set-up commands

Copy Screen: This simply produces a hard-copy printout of exactly what is portrayed on the screen. A useful command for producing printouts of screen record formats for use when setting up Office programs or report formats.

Create Record: This is not an interactive command, but one for use within the program for the creation of a data record as a result of the program running. It creates an invoice record as a result of accessing a customer record, and several stock-part records to produce an invoice. Create Record may be followed by a filename option if the currently logged file is not the correct one.

Edit Program: This permits the user to access any program currently held in memory for modification or for the creation of a new program.

Edit Text: This command gives the operator access to the word-processor section and has a dual role within our definitions. It may be used for the setting up and modification of report formats or for use of the system as a word processor.

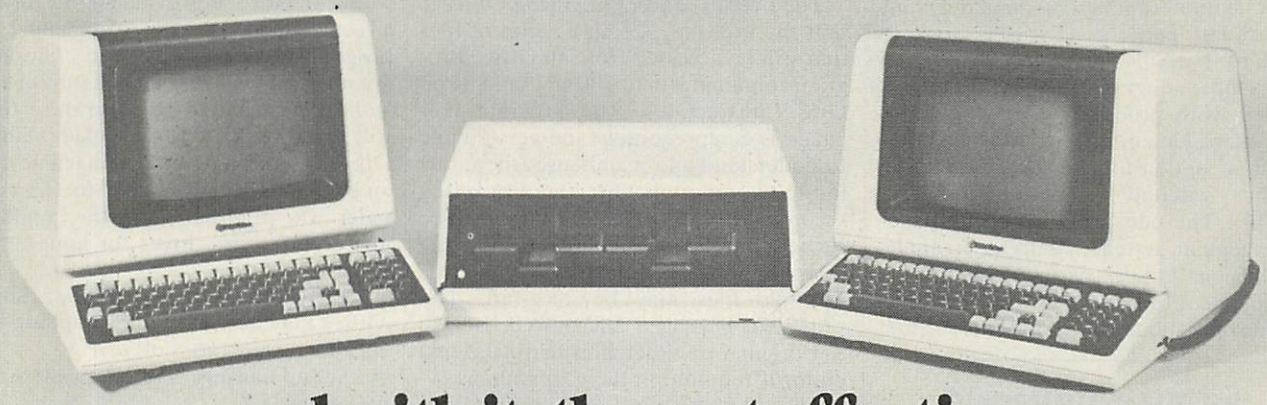
Evaluate: Causes the evaluation of an algebraic-type equation which may or may not include numeric field names from the currently referenced file, for example,

Goods amount = retail price × quantity

Format File: Permits the user to set up a new file structure simply by the entry of a record format on the screen. Field names followed by a field start and finish character are placed at will on the screen.

(continued on page 63)

The Network has arrived...



and with it, the cost effective alternative to dumb terminals and expensive minimainframes.

The TeleVideo computer family from Entocel puts total processing power where it's needed — in the hands of the user — while allowing expansion without compromise to individual terminal performance.

MmmOST* and CP/M together protect both software investment and the route to upwards expansion. They provide all the house-keeping required to run a multiple user database and ensure that application programs will not have to be re-written no matter how big the system gros. Any of today's most popular languages, such as **COBOL, BASIC** and **FORTRAN** can be used.

The TeleVideo family will expand from the stand-above System I with its 64Kbytes of user RAM and IMbytes of floppy disk up to the 16-user System III with its 70Mbytes of hard disk Winchester, without hardware redundancy.

Furthermore, the RS422 800Kbit/second data links make each highly intelligent terminal look like a mainframe.

Only the low price says it isn't.

For instance the six terminal System 2 with its 10Mbytes of hard disk and 384Kbytes memory starts at around **£10,000†.**

As expected from a world class terminal manufacturer like TeleVideo the TS80 terminals used to expand Systems 2 and 3 are exceptional. The 64Kbytes of RAM, serial printer port and separate processors for compute and display ensure that they will never lack power.

And that the user will never be out of pocket.

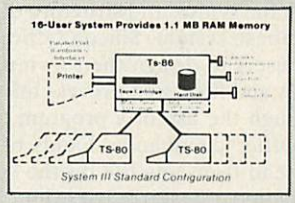
**Multiuser multitask multiprocessor Operating Systems Technology®*

†based on 2$ exchange rate.

Specifications

System I

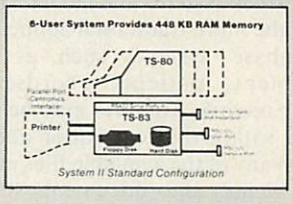
Single-board processor
containing 1 Z80A 64K of RAM memory.
4K EPROM for diagnostics
1.0Mbytes of on-line mini-floppy disk storage
TeleVideo Model 910 CRT terminal
with all Model 910 capabilities (950 terminal optional).
£2,280.00



System III Standard Configuration

System II

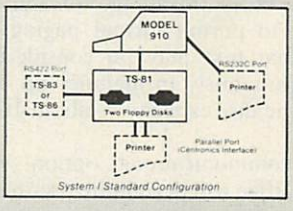
Supports up to six users
Single board design
Z80A, 64K of RAM memory
4K EPROM
10Mbytes 5¼" Winchester disk drive
1.0Mbyte mini-floppy disk back-up unit
Parallel port and two serial ports for printer attachment and servicing
With one TS80 **£5,130.00**



System II Standard Configuration

System III

Supports up to 16-users processing network contains,
Z80A, 64K of RAM memory,
4K EPROM
23.5Mbyte 8" Winchester disk drive
MmmOST* Service Processing System. 2 x TS80 **£12,022.00**



System I Standard Configuration

TS 80 Satellite User Station

6502 CPU for video control Z80A for computing
64K of RAM memory 4K EPROM RS 422 Networking Serial Port
Full-screen editing and graphics capabilities **£1,026.00**

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● Circle No. 144

(continued from page 61)

Escape T defines a text field and Escape N a numeric field. This allows the user maximum flexibility in the design of the record format or data entry screen.

Silicon Office automatically keeps a count at the bottom of the screen of how many of the maximum of 254 characters have been used — only the fields themselves are counted and this does not include the field names. Any errors such as unterminated fields are thrown back at the operator for correction.

Goto .n.: This is an unconditional command forcing the control of an Office program to continue at a statement number n that must follow the Goto command.

If . . . Goto: This is a conditional branch whereby an expression is tested and, subject to a true condition, execution will proceed to the given Goto number. Otherwise the program will carry on to the next line. For example,

```
If invoice total × credit limit Goto
```

Tests may include equals, not equals, less than, greater than, less than or equal to, greater than or equal to.

Input: This allows the program to prompt the operator for data entry of specific information which may be character data or a numeric. For example,

```
Input a£
Input b
```

Printer Control n: This will send a printer control character down the line to the print device allowing the user to take advantage of special printer facilities.

Printer Select: This tells Silicon Office what kind of printer is being used. Printers supported currently include all models of CBM, Qume, Diablo, the NEC Spinwriter 5510 and 5520, the Ricoh RP1600, and any other standard ASCII device; 10,12 or 15 pitch and line feed options may also be specified.

Set Decimal n: This forces a pre-determined number of decimal places, n, to be calculated for variables.

Store Program: Once a program has been developed in memory, this command is used to store it on floppy disc for later retrieval by the operator by any name entered after the command.

Display Memory: Displays a nominated variable and its current value at the bottom of the screen. The input may also be a complex expression to which a displayed answer is required. For example,

```
DM:b£
DM: (price/1.8325)x(stock+sparesx1.15)
```

Zero Memory: This will cause any temporary variables to be zeroised in the computer memory.

User commands

Get Record: This is the main method of accessing the data records and displaying them on the screen. The Get Record command works on the keyfield; records may be accessed in terms of their sequential number in the system, or by an indexed search and match of the keyfield against any search string input. The keyfield is always the first text field on the record format, such as stock code, customer name, and company name. A file name may be specified if the user wishes to retrieve data from another data file, otherwise the search will be confined to the current file in use. In addition to the record number or name option, a string-variable name may also be specified such as a£. This permits the set Get Record function to be used under the control of the Office Program. For examples;

```
Get Record: Bloggs
Get Record: #277
Get Record: Johnson (Customer File)
Get Record: f£ (Stock File).
```

Once the record is obtained it is displayed on the screen in the appropriate format for that current or selected file.

Amend Record: If issued directly this command allows the operator to Get Record and then cursor around the resulting displayed record and alter fields accordingly. The syntax of this command is the same as for the Get Record function. Any amendments are automatically written to the disk file.

Delete Record: Has the same syntax as Amend Record and Get Record but asks for confirmation from the operator before deleting the chosen record from the file.

Insert Record: Will clear any record displayed in the current format and then permit the user to enter a new record. A file name may be specified after this command, otherwise the current file is presumed to be required.

Search File: A powerful command to allow the user to enter a text string for which a search is made anywhere in the current file — not confined to the keyfield. A file name may be added after this command to force a search in another file and the string may be directly entered or may be expressed as a string-variable name. For example,

```
Search File: b£ (Customer File)
```

Next Record: This command is self-explanatory and allows the operator to step forward to the next record on the current file for display. The sequence in which Next Record will display the output is dependent on whether the last record accessed was by keyfield or record number; if keyfield, the records will be fetched in alphabetical order; if by record number Next Record will produce the next record by sequential number. A further option of a new file name may be input with this command.

Prior Record: Used in the same way as Next Record, but for display of previous entries.

Help: Displays a two-page list of the Silicon Office commands and their abbreviated format as well as a cross-reference page in the user manual.

Get Program: Retrieves an Office program from the disc and loads it into the program area in memory.

Run Program: Runs the currently loaded Office program. May be followed by a statement number to begin the run midway through a program.

Executive Program: This has the same effect as the above two commands and is followed by the program name to be loaded and run.

Exit to Basic: This terminates the run of Silicon Office and returns the user to Commodore Basic.

Print Text: Causes output to the printer from a text file and has a number of options that may be selected when issuing the command:

:J: will switch on right justification and supports provides full proportional spacing on supported printers.

:NJ: switches off right justification.

:R: Report output mode. This causes data to be inserted into a report format without causing re-shuffling of the text to fit the input. This is required for tabular reports. Numbers are all right justified.

: NR : Switches off report mode allowing text to be inserted and spaces filled automatically by the text editor; for example, insertion of variable length names and addresses into a standard mailing letter format.

: M : The M option forces output to the MODEM instead of to the printer for transmission on to another Silicon Office machine.

: P ff-ll : P specifies the page range to be printed. Output will be limited to the range specified ff to ll.

: L ff-ll : Similar to P this option limits the lines to be printed to the range set by ff to ll.

: O nn : Optional O sets the left margin offset to nn.

Link Modem : Causes Silicon Office to establish a link with another Silicon Office machine through the acoustic coupler. Once the link is established the operator may use the system in a Telex mode to send and receive messages which are displayed as actioned on the screen — incoming messages are displayed in reverse field. The data flow may be echoed on to the local printer by pressing the Tab key and the link may be terminated by the Stop key.

Transmit Modem : Causes the batch transmission of a specified file name and type through the link to another Silicon Office machine. The transmitted file may be a program, text, or data type. On reception at the other end the file will be automatically saved on the floppy disc system for the operator.

Most of these commands will be used most often in the guise of a Silicon Office program which will prompt the operator for actions or input and carry out the data processing required. These procedure files are built up in a memory area reserved for up to 100 statements and each statement is given a line number which may be used for the purposes of

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executing branches within the program.

Commands issued without a file-name entry are applied to the last file accessed. Therefore the user may take full control of the running of the system and, given the ability to store hundreds of program files on disc, he can set up program functions to cover almost every possible operation that could be needed in an application system. It is this setting up of systems that gives Silicon Office its apparent unlimited capacity to meet a variety of application systems.

Housekeeping commands

Copy Disc n : This command will automatically copy the contents of the floppy disc on drive n to the other drive. The contents and status of each drive are displayed for operator confirmation before the copy is carried out, to help prevent accidental erasure.

Disc Status n : Produces a display overlayed on the screen showing: drive number, disc type — data or work, bytes free, disc name, serial number, creation date, followed by a scrolling list of file names and their types; for example, text, program or para. Option n in the command is the desired drive number.

Prepare New Disc : Silicon Office runs its own disc-security system and floppy discs must be prepared under program control before they may be used with the system. The operator is prompted for the name, serial number and type before a disc is formatted and any existing contents displayed before execution to avoid erasure of valuable information. Drive number may be specified after the command syntax.

Scratch File: A file name and type are specified for execution of this command. File types may be: C — Silicon Office program file, P — Paragraph File, T — WP text file.

Verify Database: This command will attempt to restore any files that may have become corrupt through hardware failure, damage or other causes.

The Edit Text feature was mentioned under the heading of set-up commands, but it is also an operational command that is likely to be used extensively to gain access to the word-processor features of Silicon Office. The text editor is a fully-blown word-processing feature that could stand alone in its own right as a useful and innovative piece of software.

Upon issuing the Edit Text Command, the system prompts the user for an old and new file name. These are the respective files from which a document is about to be retrieved for edit and storage upon completion. If a new document is to be produced, the old field is left blank and a new name inserted. The user is then prompted for the page length and width to which they will be working. These values automatically default to 72 and 80, but may be altered. When complete, a text processor screen is displayed along with any document nominated for edit.

The implementation of the word processor is quite ingenious and boasts a number of features, some of which are unique:

Direct formatting on the screen of entered text. For example, justification, multi-columns, and so on.

Sideways screen scroll for documents that exceed the display width of 80 columns.

Virtual memory paging – documents are entered as pages and, irrespective of the number of pages, appear as one long, continuous document in memory. Therefore if paragraphs are inserted or deleted this will not alter the pagination as the change in size will automatically be reflected right down through the length of the file. There is also no size constraint if building up lengthy documents from standard paragraphs such as is needed in a legal environment.

Multiple columns of semi-proportionally spaced text are supported.

Direct calculation or algebraic expressions accessing record fields may be inserted directly into text for printing or evaluation only. For example,

1.15 x 173.268/2.

Day, Month, Year calculations are fully supported and may be used with the system date or input or accessed date variables.

Word processor

The visual effect of some of these features cannot be expressed in mere words; you must see them to enjoy the mind-boggling sensation that results. The Silicon Office word processor has a command set of its own — and a Help facility — that is not available until the Edit Text command has been issued. Text may be typed in directly to the screen and the command set provides the macro commands for the powerful editing features normally associated with word processing. The commands are defined as follows:

Abandon Edit – Aborts the user from the current edit leaving all files intact.

Centre text – Places the cursor in the centre of the page or to the current locked tab and inputs the text centrally around the cursor.

Clear Para – Erases the paragraph currently under the cursor which is highlighted prior to execution.

Clear Down – Clears any text below the current cursor position within a tab area if tab lock is set.

Clear Up – As per clear down.

Clear Tabs – Clears all tab settings from below the current cursor position.

Delete Line – Deletes the line on which the cursor lies. If tab lock is set then this will only be applied to lines existing within the tab area.

Display Status – As per the Silicon Office command set.

Finish Edit – Normal termination of the edit causing files to be completed and closed, and return of control to Silicon Office.

Find Word – Carries out a string search of the entire text file for a given input string from the current page. Continuous searching is permitted after each match.

Help – As per Silicon Office command.

Insert Line – Insert a blank line under the current position and all text is shuffled down one line throughout the file.

Insert Para – Inserts a named paragraph from disc into the document at the current cursor position and re-shuffles all subsequent text.

Justify Text – Causes screen right justification of text and with side scrolling.

Next Page – Stores the current page on to the output file and reads in the next page from the input file.

Repeat Line – Repeats the line currently under the cursor and re-shuffles the text down.

Replace Word – A search and replace function.

Rule Footer – Permits a footer line to be placed where required.

Rule Header – as per footer command.

Rule Tab – Rules a tab line from the current cursor position to the bottom of the page.

Store Para – Stores the paragraph currently under the cursor on disc under a user-supplied name for future insertion in other documents.

Underline – flags all following input to be underlined when printed — shown as a reverse field on the screen.

Underline Off – switches off the underline feature.

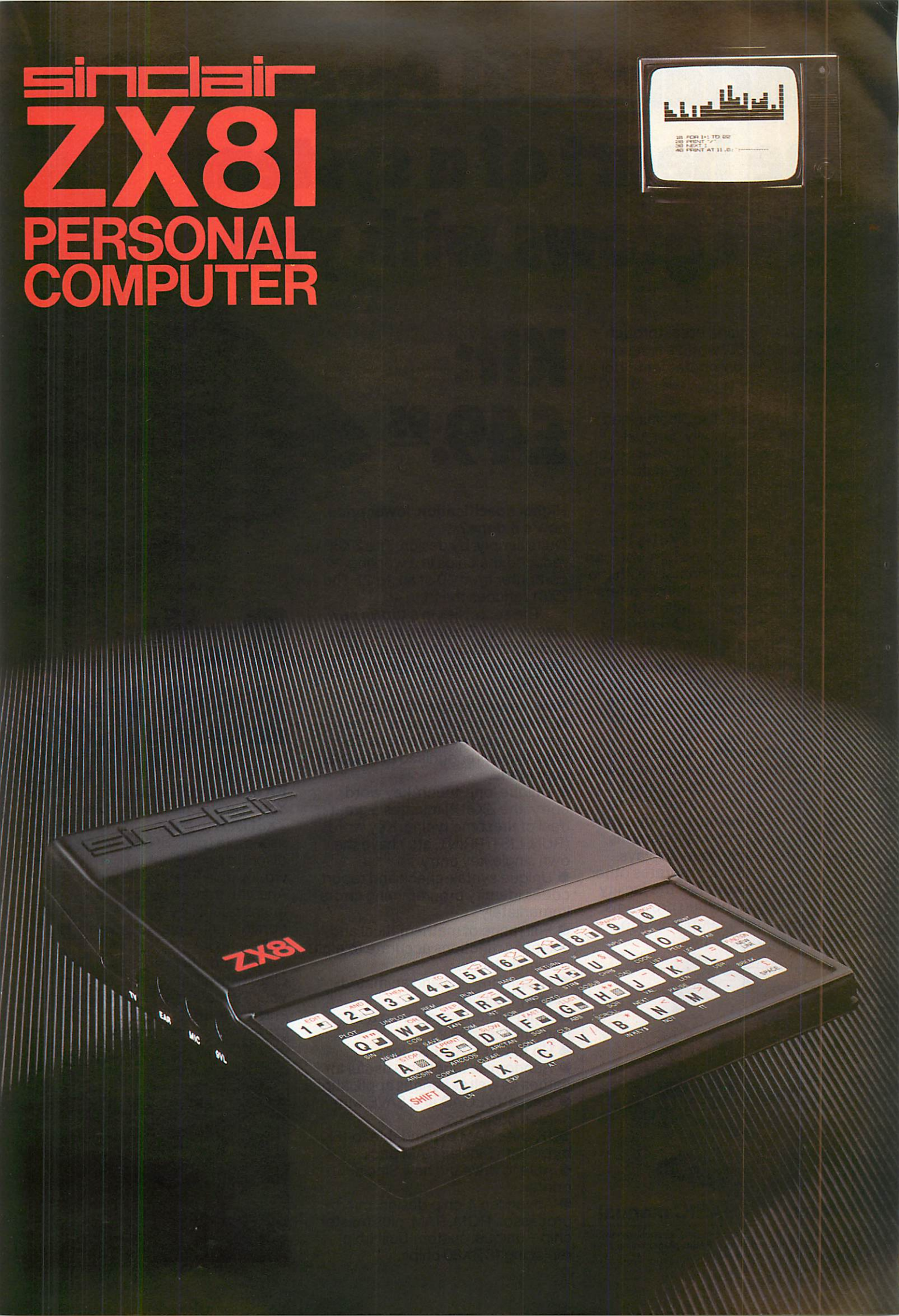
In addition to the above features any data from any field may be specified for inclusion in the document format. It is the greater or lesser extent of the data insertion that will permit Silicon Office to be used for almost any application. Tabular reports may be generated with almost no text other than titles or column headings right through to standard contracts with minimal inserted variable data.

The Bristol Software Factory is planning an application support service as more systems are installed, for the purpose of sharing the likely wealth of Silicon Office applications that will be set up by various users. This communal library of knowledge will be available to users for a nominal sum, and will eventually boast a wide variety of Office systems.

At £800 Silicon Office is unbelievable value for money, given that the package is a database system, a word processor, and office communications system all rolled into one.

Silicon Office is the first true database management system that we have encountered on a micro whereby up to six files may be open and accessed simultaneously during a run. It is also the first system we have seen that permits intercommunication with fellow machines and users.

sinclair ZX81 PERSONAL COMPUTER



Sinclair ZX81 Personal Comp
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.

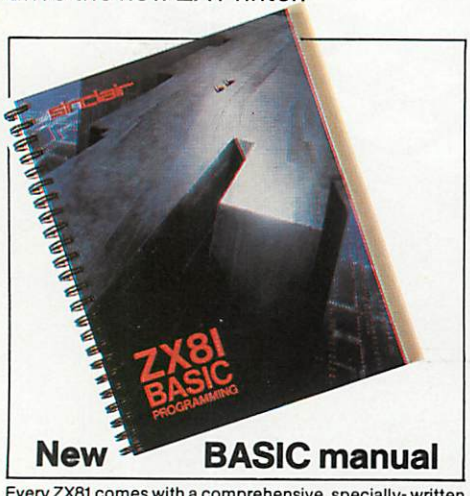
In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

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!

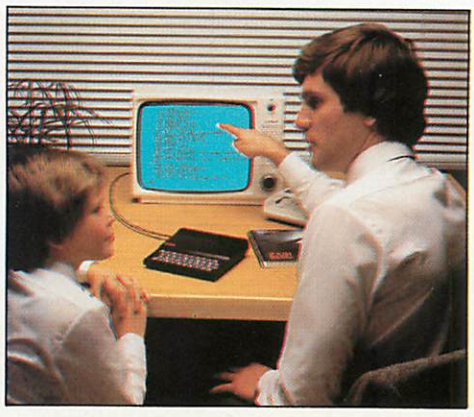
New, improved specification

- 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.





Available now- the ZX Printer for only £49.95

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

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

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

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

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

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

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

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

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

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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

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sinclair ZX81

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Tel: (0276) 66104 & 21282.

How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING	CHR$	●	●		●	●		●
FUNCTIONS	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm 10^{\pm 38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC	A-Z			●			●	
VARIABLES	AA-ZØ				●	●		●
	An-Zn, n = any alphanumeric string	●	●					
STRING	A$ & B$						●	
VARIABLES	A$ to Z$	●	●	●				
	An$ to Zn$ n = any alphanumeric character				●	●		●
NUMERIC	SINGLE DIMENSIONAL		●	●			●	
ARRAYS	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL	USR (CALL, LINK)	●	●	●	●	●		●
FEATURES	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

Sinclair software on cassette.

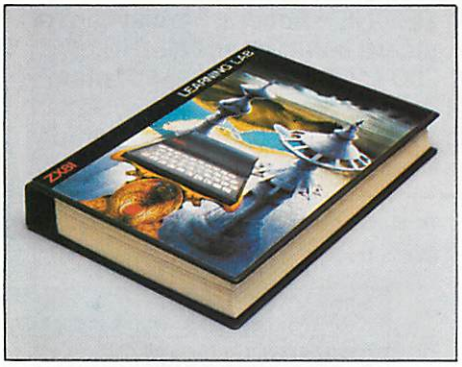


The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

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.



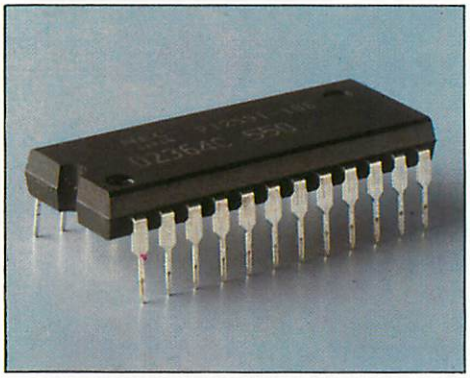
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

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.

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ZX81

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Commodore printers

Peter Wood reports on new dot-matrix and daisywheel units.

THE TREND towards greater use of Commodore Pet equipment in business has led Commodore U.K. to expand its range of printers considerably in recent months.

The launch of the 8032 Pet, often called the SuperPet, coincided with the arrival of a larger disc unit, the 8050, and a new matrix printer, the 8024. Closely following the 8024 came the 8026 daisywheel typewriter and the 8027 daisywheel printer. Finally, the 3022 matrix printer was superseded by the 4022, to complement the 4032 Pet and 4040 disc unit.

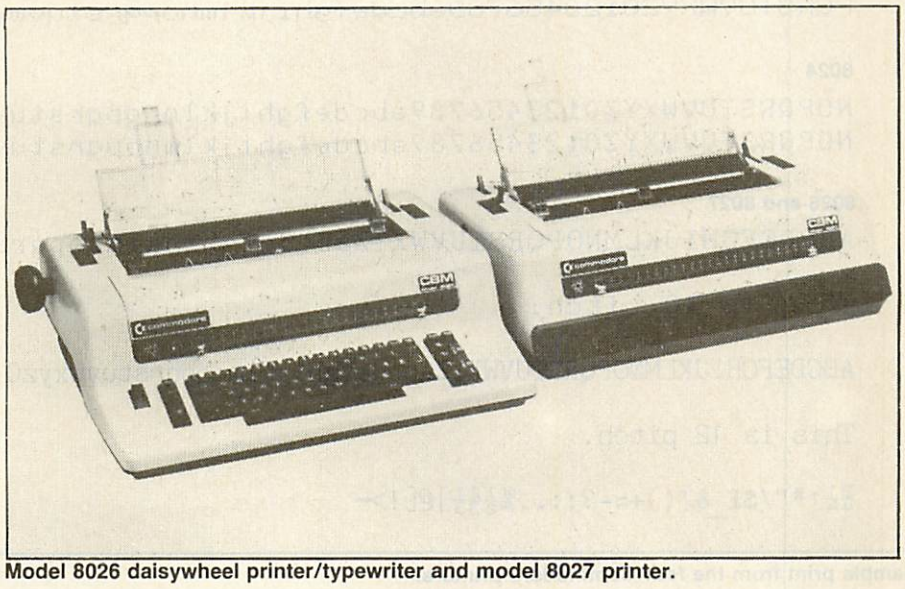
While all of these printers are based on well-known brands such as Mannesman Tally, Epson and Olympia, they have been specially modified to facilitate easy connection to the Pet via its IEEE-488 bus, and, in the case of the matrix printers, to allow printing of the special graphics characters of the Pet.

The characteristics of these four printers differ considerably, and are designed to cater for as wide a range of applications as possible. While all of them may be connected successfully to any existing Pet computer, the model numbers seem to indicate the configurations that Commodore have in mind. For example, the 4022 printer is a general-purpose machine which is most likely to be used with the 4032 and 4040 disc. It is priced towards the lower end of the market, whereas the 8024, 8026 and 8027 are more expensive — and more specialised — and are likely to be connected to an 8032 computer and 8050 disc.

The 4022 matrix printer appears to be based around the Epson MT-70, having a IEEE-488 interface and some interesting firmware features added. The head gives a 6- by 8-dot matrix, with all of the normal ASCII upper- and lower-case characters as well as full Pet graphics and reverse — white on black — of all characters. The printer is uni-directional, left to right, which we thought disappointing, but it has the intelligence to move the carriage only as far across the page as the end of the printed line, which is a distinct improvement over its predecessor, the 3022, which had to move the full width of the platen before starting a new line.

Model 8024 dot-matrix printer.





Model 8026 daisywheel printer/typewriter and model 8027 printer.

The 4022 has adjustable tractors, allowing paper between 1.5 and 9.5 in. width to be used. Friction feed is not possible on this printer, so sprocket-holed paper is essential — which is acceptable for a matrix printer. The maximum print width is 8 in., corresponding to 80 characters at 10 pitch. The quoted print speed is 30 lines per minute which equates to approximately 40 characters per second, but the real time for a document to be printed will depend very much on the length of the lines on the page and the number of blank lines. We timed the 4022 printing a full page of 66 lines of 80 characters at normal line spacing at around 2.5 minutes. This should be the very worst case possible, and printing, for instance, address labels was considerably faster at 44 seconds for the same number of lines.

Like the 3022, the 4022 offers a number of fascinating features not normally found on standard ASCII printers. While the majority of these features may be of little use in the everyday commercial environment, they are very useful for the production of patterns, bar graphs and even company logos. The special features are accessible via either a number within a CHR$ statement sent to the printer — for example, CHR$(1) will effect double-width printing — or the IEEE-488 secondary address codes, depending on the feature required. A number of different facilities may be enabled simultaneously, there being 10 secondary address codes in all, as shown below.

SECONDARY ADDRESS	FUNCTION
0	Print data as received
1	Print data in previously defined format
2	Set format for printing
3	Set number of lines per page
4	Enable diagnostic messages
5	Define programmable character
6	Set number of lines per inch
7	Set upper/lower case
8	Select ASCII/graphics
9	Suppress diagnostic messages

Any legal secondary address may be used in the Pet open statement; for example, Open 3,4,3. Secondary address zero need not be specified as this is the printer's default condition. Assuming you wish to produce a nicely-formatted financial report, with bold headings, columns of figures all with the decimal point aligned and leading zeros removed, on a page 8 in. long and with a line spacing of eight lines per inch, the small Basic program below would suffice, using the 4022 printer.

```
10 OPEN 4,4 : REM OPEN FILE FOR
   NORMAL PRINTING (UN-FORMATTED)
20 OPEN 1,4,1 : REM OPEN FILE FOR
   FORMATTED DATA
30 OPEN 2,4,2 : REM OPEN FILE FOR
   FORMATTING REPORT
40 OPEN 3,4,3 : REM OPEN FILE FOR
   SETTING NUMBER OF LINES PER PAGE
50 OPEN 6,4,6 : REM OPEN FILE FOR
   SETTING NUMBER OF LINES PER INCH
60 PRINT#3,CHR$(64) : REM SET 64 LINES
   PER PAGE
70 PRINT#6,CHR$(24) : REM SET 8 LINES
   PER INCH
80 REM WE ARE PRINTING 64 LINES AT 8
   PER INCH GIVING 8 INCHES OF PRINT
90 PRINT#4,CHR$(1) "FINANCIAL
   REPORT" : REM WIDE HEADING
100 PRINT#2, "AAAAAAAA AAA AAA AAA" :
   REM FORMAT FOR COLUMN HEADS
```

(continued on next page)

4022

PQRSTUVWXYZ0123456789abcdefghijklmnopqrstuvwxyz<>/?;+[]=-*:)('&%$
PQRSTUVWXYZ0123456789abcdefghijklmnopqrstuvwxyz<>/?;+[]=-*:)('&%$

8024

NOPQRSTUVWXYZ0123456789abcdefghijklmnopqrstuvwxyz<>/?;+=-*:)('&%£
NOPQRSTUVWXYZ0123456789abcdefghijklmnopqrstuvwxyz<>/?;+=-*:)('&%£

8026 and 8027

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789

This is 10 pitch.

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789

This is 12 pitch.

¾¼↑*"/$£_&'()+=-?;:.,%½⅔]@[!><

Sample print from the four Commodore printers.

(continued from previous page)

```
110 PRINT#1, "EXPENSE" CHR$(29) "JAN"
  CHR$(29) "FEB" CHR$(29) "MAR"
  CHR$(29)
120 PRINT#2, "AAAAAAAA 99.99 99.99
  99.99" : REM FORMAT FOR COLUMN
  DATA
130 FOR I=1 TO N : REM DATA IS NOW
  PRINTED USING SEC ADDRESS #1
140 FOR J=1 TO 4 : REM EACH PIECE OF
  DATA MUST BE SEPARATED BY
  CHR$(29)
140 PRINT#1,A$(I,J) ;CHR$(29) : REM
150 NEXTJ : NEXTI
```

It is debatable whether the 4022 is up to heavy commercial use, and certainly serious business users will require greater speed and a sturdier construction. The Commodore printer for these users is the 8024.

Based on a Mannesman Tally design, the 8024 is businesslike and robust in appearance, with a very fast and clean print quality. The print head is much larger than that on the 4022, and gives a 9- by 7-dot matrix for more readable lower-case characters. The quoted print speed of the 8024 is 160 characters per second, with full logic-seeking print-space redundancy and bi-directional printing over a full 132-character line. The 8024 working flat-out is impressive; our tests showed only 50 seconds to print a full page of 66 lines of 80 characters, and 17 seconds for address labels totalling the same number of lines. Paper between 2 in. and 15 in. width can be catered for because the machine has a double set of adjustable tractors, to feed the paper both in and out of the platen. This sensible arrangement must lead to fewer paper jams and tearing. The 8024 has three front-panel controls: mains on/off; print on/off, which is a local/remote switch; and line feed/form feed. The mains switch is a rocker type with a positive action. The print on/off switch disables printing when in the off position, where it will allow local line- and form-feeding from the third front panel switch. There are three indicator LEDs; power, print and paper. The first is lit as soon as power is applied, the second when the print switch is on and the third if the 8024 detects lack of paper.

The 8024 does not have all the fancy facilities of the 4022, but is intended for the real commercial world, and so offers reliability and speed. There remains the ability to format fields with secondary addresses 1 and 2, and a number of CHR$ functions. A technical manual was not available to us, so we were unable to fully experiment in these areas.

Since the 8024 is likely to be used with standard business software, we tried it out with some of the more popular programs for the 8000-series hardware. The programs were chosen purely according to what was available at the time, so the selection does not reflect any bias on our part.

Most business programs allow the printer option to be set at some time prior to printing, although the method varies between authors. With the latest version of Ozz, the selection is made at start-up, the 8024 being selected as CBM ASCII. It performs well, upper and lower case being represented correctly, and some of the graphics symbols being cleverly translated into exclamation marks and dashes to facilitate the drawing of tables and boxes. WordPro 4-Plus should be set to output to a CBM printer when using the 8024, Wordcraft 80 as 8024, both programs working well under test with no hiccups. The Commodore Stock Controller, and Anagram's Sales and Purchase Ledgers require the 8024 to be designated as P for Pet printer, with line feed *on* and also *allow bad printer status,* which, we understand, takes care of the 8024's habit of returning a status of 1 when the programs expect 0. Again, no problems were experienced in using these packages during tests.

VisiCalc has been modified to allow this *bad status,* and now works well, taking full advantage of the 132-column width of the 8024. A number of less-sophisticated programs, operating only in upper-case mode on the Pet, printed only in lower case, and programs written to use all the features of the older 3022 did not line up correctly on the 8024. Anyone writing their own software for this printer should have little difficulty, providing they allow for the non-zero status check.

With word processing becoming a very popular application for microcomputers, many more daisywheel printers are appearing on the scene. Commodore's initial steps in this direction are represented by the 8026 typewriter and 8027 printer. The 8026 is a sophisticated electronic typewriter manufactured by Olympia, and fitted with the IEEE-488 interface. The interface is uni-directional, allowing the 8026 to act as a letter-quality printer for the Pet, but not catering for input to the Pet from the 8026 keyboard.

Unfortunately there are two versions of the 8026 around, the original being called 8026/1 and the current model 8026/2. They can be distinguished by the position of the IEEE connector on the rear of the unit, the 8026/1 having the connector at the opposite end to the mains lead, the 8026/2's located above the mains lead. The earlier version had a few problems when used with WordPro 4-Plus, and the later with Wordcraft 80, although Dataview is modifying the program to take care of these. We assume that all future printers will be of the 8026/2 variety, and are basing this review on that model.

As a typewriter, the 8026 is very clever and a delight to use. A lever to the left of the unit causes the paper to be power-loaded into the printer while automati-

cally freeing the platen. There are keys to allow half-line paper advance or reverse, which repeat if pressed down further. Margins and tabs may be set or cleared from the keyboard, and the 8026's memory remembers your last margin and tab settings even after the machine has been switched off overnight. All the usual typewriter features are there, plus a lift-off erase facility, which allows the removal of any typed character anywhere in the current line. This is achieved by the 8026 remembering all of the line you have typed until you press the carriage-return key. Additional facilities include tab left and right, a repeat key which repeats the last character typed, and manual pitch selection of either 10 or 12 characters per inch.

As an output device for a computer, the 8026 is not so satisfactory. With a quoted print speed of 17 characters per second, the 8026 can appear unbearably slow, especially when printing full pages of text, as might be normal in a word-processing environment. None of the special letter-quality printer features are there — using WordPro 4-Plus we were unable to achieve underlining or over-printing, and use of the underline command actually seems to cancel centring. The pitch selection is purely manual, as is the number of lines per inch, and neither can be controlled from the normal word processing software.

It is not possible to switch off the 8026/2's auto line feed, so that any program which sends a carriage return followed by a line feed will cause double line spacing to occur. The 8026/1, on the other hand, did have a switch to de-select this function. Underlining is only possible if the program sends a backspace and underline — ASCII 224 — which explains why the word processor failed to produce this. There is no obvious way to move the paper to the top of page as in a form feed command, so the program must keep its own internal line count to perform pagination.

It is obvious from its price that the 8026 was never meant to compete with the Spinwriter, Qume, Diablo and so on. It must be borne in mind that this device is first and foremost a typewriter, and only secondly a computer peripheral. It is certainly good value as a typewriter for those wishing to perform only limited amounts of word processing, and the relatively slow speed may not be a problem if the print-spooling facility of the word-processing software is used to full advantage. We found the style of type given by the standard 8026 daisywheel very acceptable, and the suppliers say it is easy to change wheels, although we understand a special tool is required. The ribbon is held in a cartridge, so changing is quick and simple. The lift-off tape is, however, a twin spool and consequently a little more fiddly.

The 8027 printer is essentially an 8026 without keyboard, although the interface differs considerably, providing many extra functions under software control. There are over 30 different control codes, but these are not, as yet, included in any commercial software we have seen.

HEX CODE	FUNCTION
08	Backspace
0D	Return
1B 00	Set right margin
0A	Line feed
09	Horizontal tab right
1B 0A	Horizontal tab left
1B 07	½ line feed negative
1B 03	½ line feed positive
1B 04	Line feed negative
1B 0B	Margin release
07	Bell
1B 01	Set horizontal tab
1B 02	Clear all tabs
1B 08	Selective tab clear
1B 09	Set left margin
1B 0C nn	Define vertical tab
1B 0D nn	Pitch
1B 05	Move carriage left to right
1B 06	Move carriage right to left
1B 0E	Programmable mode
1B 0F	Exit from Programmable mode
7F	Correction marker
1B 6C	Clear correction marker
1B 4n nn	Vertical tab negative
1B 2n nn	Vertical tab positive
1B 40 00	Fast platen move negative
1B 20 00	Fast platen move positive
11	Switch off auto line feed
1B 3n nn	Horizontal tab to absolute address
1B 10	Bold on/off
1B 11	Double printing on/off
1B 50	Auto line feed on/off
1B 12	95 print wheel
1B 13	96 print wheel

Note: 'n' indicates a value for movement.

Table 1. 8027 printer control codes.

The 8027 runs with much the same constraints as the 8026 when used with standard programs, so we tried to find out more about the special control codes. They provide a wide variety of facilities as shown in table 1. These include alteration of pitch under program control allowing wide-spaced headings and so on to be produced from the standard daisywheel. There is a special Programmable mode, which, when switched on, allows proportional spacing — a rare treat on a printer costing less than some office typewriters. Both horizontal and vertical fast tabulation is possible, to an accuracy of around 0.5mm. allowing X-Y plotting to be achieved if sufficient programming effort is put in. All in all, some fairly subtle software needs to be written in order to take full advantage of these special features, which could be of tremendous use in both scientific and analytical operations.

Conclusions

- **The 4022 is a general-purpose, low-cost printer, ideal for low-volume applications. It has several useful programmable options, and is compatible with most standard programs. Price: £395.**
- **The 8024 is a professional, high-volume printer with very fast throughput suitable for full commercial installations. It has limited programmable options, and is compatible with most business programs. Price: £1,160.**
- **The 8026 is an excellent typewriter, suitable for low-volume word processing jobs, or where print speed is unimportant. It has very limited special options, and is compatible with several business packages. Price: £995.**
- **The 8027 is a very versatile programmable printer, for which no software yet exists as far as we know. It will be excellent for scientific and educational installations where specialised output is required. It is also a slightly cheaper alternative to the 8026 for word-processing applications where print speed is unimportant. Price: £850.**

Summary of facilities

4022
8 x 6 dot-matrix typeface
Tractor feed
Paper width from 1.5 to 9.5 in.
10 special programmable features
Full ASCII and Pet graphics
Minimum 40 cps print speed
Uni-directional print
Cartridge ribbon

8024
9 x 7 dot-matrix typeface
Double tractor feed
Paper width from 2 to 15 in.
Special programmable features
Full ASCII and Pet graphics
160 cps print speed
Bi-directional logic seeking print
Cartridge ribbon

8026
Daisywheel typeface
Friction feed
Paper width up to 13 in.
Some programmable features
ASCII character set
Uni-directional printing
Cartridge ribbon
Twin spool lift-off ribbon
Full typewriter keyboard

8027
Daisywheel typeface
Friction feed
Paper width up to 13 in.
Over 30 programmable features
ASCII character set
Uni-directional printing with fast fourway tabulation
Cartridge ribbon
Twin spool lift-off ribbon

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1	24	1338	679	333	210	352	17396000	-23204	0
2	55	2911	1154	1003	178	1810	37837900	-57571	0
3	110	5679	2082	2275	151	7224	73833300	-117207	0
4	202	10262	2922	4545	129	24421	133404000	-210792	0
5	348	17389	3816	8356	109	72302	226052000	-341268	0
6	565	27471	4915	14045	93	190343	357127000	-491500	0
7	868	41102	5984	22326	79	449409	534320000	-625455	0
8	1267	58276	6917	33571	67	957249	757583000	-687355	0
9	1761	78353	7619	47771	57	1848740	1018590000	-615941	71413
10	2337	99966	8030	64347	49	3253560	1299550000	-368556	247385
11	2967	121101	8141	82071	41	5245840	1574310000	56307	424862
12	3617	139378	7987	99140	35	7795610	1811920000	612049	555743
13	4247	152478	7640	113448	30	10749700	1982220000	1219170	607126
14	4823	158617	7188	122999	25	13859000	2062020000	1795700	576522
15	5317	156938	6722	126356	22	16843200	2040190000	2286610	490912
16	5716	147703	6317	122999	18	19466300	1920140000	2678090	391478
17	6019	132224	6038	113448	16	21586800	1718920000	2992500	314408
18	6236	112566	5934	99140	13	23170300	1463360000	3270770	278278
19	6382	91104	6055	82071	11	24267200	1184350000	3552930	282152
20	6474	70065	6463	64347	10	24974500	910840000	3864770	311843
21	6529	51176	7254	47771	8	25400600	665284000	4213680	348914
22	6560	35479	8586	33571	7	25640900	461224000	4591590	377905
23	6576	23331	10735	22326	6	25768100	303305000	4981510	389919
24	6585	14544	14185	14045	5	25831200	189072000	5364310	382800

The future in your hands

Peter Laurie's prognosis of the future of micro software is based on facts drawn from U.K. and transatlantic surveys. You can also forecast future conditions with this program in Basic written to mimic the market's prevailing mechanisms.



MAX BORN, the inventor of the electron wave, once said: "Prediction is difficult, especially about the future".

Many people badly want a prediction about the destination of the micro market. Our own interest is the software business, and that obviously depends on hardware developments. So, when recently a joker asked how we saw the market moving in the next 20 years, we bit back the scornful remark that it isn't two years old yet and hasn't really started, and instead began work at the computer to make a model. Because we all know that what the computer tells us three times is true.

The first step was to look at the existing micro-software market. This proved interesting, but not very encouraging.

Our estimate is that the micro-software industry spent £31,000 on advertising during July 1981. If it is further assumed that July represents the mean for the year, and that the software business spends 20percent of its gross revenue on advertising, the turnover of the industry for the year is £1.86 million.

Since the average package price is £356 and there are 294 packages, this suggests that the average U.K. package sells about 18 copies a year.

At the moment the market is fragmented and confused. There are a few star products — such as VisiCalc, Wordstar and MicroModeller — that do very well, selling several thousand copies a year, but a large number do very badly.

Success goes to firms like Apple and Commodore which offer total hardware and software support to the naive customer.

This is obviously a very immature market, whose characteristics will change dramatically over the next few years.

The market under consideration is the long-term supply of software for professionally-used personal microcomputers in the English-speaking world.

Reader surveys conducted in the U.K. by *Practical Computing* and in the States by *Byte* and published in late 1980 revealed that there were then 11,000 and 43,000 micros with discs in the two countries respectively. *Practical Computing's* Software Buyers' Guide for May 1981 listed 294 packages with an average price of £356. Similar information is not available for the U.S., but it is assumed that there are altogether 1,000 software packages in the market. It is also assumed from reliable indicators that in 1980 the U.K. market doubled in size. There is no reason to think that the U.S. market did less well.

The market for these machines and the software they run will be large, and can be expected to grow for at least a decade.

How big might the market become? If we estimate that there are about 350 million people in the English-speaking developed countries, that 50percent of them are employed, that 50percent of workers now handle information and that conservatively, one in eight of those will end up using a micro, then we have a saturated market of some 11 million users, each with his or her own machine.

(continued on next page)

```
5 INPUT"PRINT Y/N";I$
10 DIM PROD(30,6)
20 SPRICE=290
25 YPRICE=SPRICE
35 ADVANCE=2000
40 WIDTH LPRINT 132
50 SALRY=13000'INC OVERHEADS
65 STARTPROD=1000/882*1001!'TO GET 1000 IN Y
EAR 2
70 'NEWTITLES=STARTPROD:GOSUB 10000
75 INV=1
80 STARTM=55000!'START MARKET AT YEAR 3
85 ADPERHD=1200/50000!'COST OF 1/4 PAGE PER
READER PER YEAR
95 BLDUP=0'FLAG SET DURING START PERIOD
100 SUITE=1
110 PRINT CHR$(12)
160 MAINTAIN=1/3'PEOPLE PER PROG
170 CREATE=1'PEOPLE PER PROG PER YEAR
185 IF I$="N" THEN 1000
186 LPRINT,TAB(30);"PRACTICAL COMPUTING - 20
 YEAR MARKET FORECAST""
187 LPRINT;TAB(30);"************************
**********************
190 LPRINT USING "\ \       ";"Yr ";:LPRINT U
SING "\           \";"MACHINES";"STAFF";"AUTH
 INC";"IN PRINT";"PRICE";"AD COST";"STAFF CO
ST";"BALANCE";"PROFIT"
200 LPRINT USING "\ \         ";"    ";:LPRINT
USING "\           \";"(,000s)";"";"(#)";"";"
(#)";"(#,000s)";"(#,000s)";"(#,000s)";"(#,00
0s)"
1000 'MM IS MICRO MARKET IN YEAR Y.SET A=.7
FOR ABOUT 5M TOTAL
1020 A=.65
1060 A=A*1E+06
1080 M=12:MM=1:PST=100000!'M IS HALF PERIOD
IN YEARS
1120 GOSUB 1360
1138 '******************
1139 'YEAR LOOP STARTS HERE
1140 FOR Y=0 TO 2*M
1160 GOSUB 1320
1200 MM=MM+DM
1215 MFR=MM/STARTM
1220 'LPRINT Y TAB(5+INT(MM/PST))"+"'TAKE OU
T THE FIRST REM AND THIS WILL PRINT A GRAPH
OF THE MARKET
1221 IF Y=0 THEN STSUITE=1/MFR
1222 SUITE=STSUITE*MFR
1225 GOSUB 30000
1300 NEXT Y
1317 STOP
1318 '*****************
1319 'TO CALC INC. MARKET IN YEAR Y
1320 DM=A*EXP((-1*((Y-M)^2))/B)
1340 RETURN
1358 '******************
1359 'TO CALC PARAMETERS FOR MODEL
1360 B=-((3-M)^2)/(LOG(STARTM/A))
1380 RETURN
9997 '
9998 '**************************
9999 'ADD NEWTITLES TO STOCK
10000 'FOR K=1 TO NEWTITLES
10001 DATA .1,.2,.4,.2,.1
10002 RESTORE 10001
10003 FOR L=1 TO 5' NEWTITLES GO INTO STOCK
A YEAR AFTER CREATION
10006 PROD(Y+L,0)=PROD(Y+L,0)+NEWTITLES'TOTA
L TITLES IN PRINT
10008 READ F
10015 PROD(Y+L,L)=PROD(Y+L,L)+F*NEWTITLES'TI
TLES' MARKET SHARE IN EACH YR
10018 NEXT L
10021 'NEXT K
10023 TADV=TADV+ADVANCE*NEWTITLES'KEEP  ADVA
NCES BALALANCE
```

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How fast might the market grow? Foreseeable improvements in today's chip technology will cause the cost per unit of computing power to halve every 2½ years for some years yet, leading to a pocket-sized machine with the capabilities of today's mainframes by about 1990. However, these hardware developments will not alone cause an explosion in the use of personal computers. That will be driven by the availability of simple, powerful and useful software.

Spelling correction

Given the right software, these machines will replace, in part, the book and periodical publishing industries and many of the professions. For instance, a word processor incorporating spelling correction and some editing skills will tend to reduce the sale of dictionaries and the employment of copy editors and typesetters. An accounting and tax package will reduce the sale of reference books, and reduce employment in this field.

Software will also disseminate information that is today supplied in print by annuals, brochures, catalogues, tables, journals. This information will be updated — in some cases minute by minute, through Prestel and its derivatives. Supplying it will become an important and profitable function of the new commercial software publishing houses.

In the early days the spread of computer literacy will, of course, be important for growth. However, by the middle of the period modelled, one can assume that unfamiliarity with computers will not be a limit to growth since familiarity will be more widespread and software easier to use.

So far the software industry has concentrated on the client. He is dealt with face to face; his problems are identified and to some extent solved — at great cost. The programmer is regarded as a craftsman whose place is just one of a team.

In order to draw on the vast range of skills needed for the new software industry, the programmer must be regarded by the industry in the same way that the book-publishing business regards the author. That is, he works for a small advance and the hope of sharing in a substantial reward if his product is successful. The customer benefits because the publishing house can offer, at a modest cost, a large range of titles. The publishing house benefits because it can acquire enough titles to insulate it from the failure of any particular one.

Although the software publisher only pays an advance for the author's work, he has then to check it for quality, document, advertise and distribute it — just as a book publisher has to now. The main difference is that the cost of reproduction in the micro market is negligible — £10 in an average package price of £350 — and likely to fall even faster than software costs as electronic methods of distribution are introduced. Furthermore, software distribution costs are virtually independent of the "print run".

Economic emphasis

The program Longplan.BAS constructs a conventional S-shaped curve, the integral of the normal distribution, to fit these facts. It predicts that the market saturates at 6.4 million machines in year 20, 18 years from now. This seems conservative, if only because no allowance has been made for economic or population growth or for a further shift in economic emphasis from manufacturing to information handling.

Assumptions are as follows.

- The price of software decreases at 15percent a year. In other words, the nominal price stays constant and inflation reduces the real price. This assumption may seem odd until one reflects that the real cost of a package to its user includes a period of familiarisation which may take between a fortnight and several months. This hidden cost will always outweigh the price of the package, so that the market can be expected to be price insensitive.
- The number of packages in the market increases in proportion to the number of machines, as new users with new interests

are drawn in. In other words, the ratio of packages to users remains constant throughout the model.

- Each user maintains a suite of software, starting at one package in year 0, and rising in proportion to the market to about 800 packages in year 24. A software package in the year 2003 might well be the computing equivalent of a paperback book.
- Each package has a commercial life of five years, doing 10percent of its business in the year after its introduction, 20percent in the next, 40percent in the next, then 20percent and 10percent. In each year, new customers buy a complete suite of software; existing customers buy one-fifth of the current suite.
- The cost of presenting a quarter of a page of advertising to a single customer for a year is assumed to stay at its present rate of 24p.
- The advertising cost in the model is the cost of a quarter-page per head, multiplied by the current suite, multiplied by one-fifth of the market — in other words, advertising is directed mainly at the replacement business on the assumption that most new users will buy a micro in order to run a single package. Having bought it, they will automatically buy a full suite to go with it.
- A team of two programmers can introduce two new packages a year or maintain six live ones. For each team of two there are four more employees in administration and sales. Each employee costs an average of £13,000 a year in salary and overheads.

The assumptions about software price and the costs of advertising imply that competition between publishers will be almost entirely in the arena of publicity — rather like the film or record businesses today — and that as the market matures these costs will become considerable.

The columns in the printout show, reading from left to right:

Yr – the year.

Machines – the number of micros in use — or, the number of users.

Staff – the number of people employed in the software industry.

Auth Inc – the average income for its author earned by each software package during the year.

In print – the number of active programs in the market.

Price – the average price of a software package.

Ad cost – the total spending on publicity by the whole industry.

Staff cost – other overheads, which are almost entirely people and their personal equipment.

Balance – is the cumulative annual cash-flow.

Profit – the annual profit if any.

It takes a while for the market to become big enough to generate enough income to support the considerable overheads of a proper software publishing industry. Once that point is reached, in year nine, business is very good. However as the number of new recruits, buying complete suites, dries up, the business becomes less profitable.

Of course, it is likely that developments in hardware will alter the shape and size of the market curve. But although these developments may increase the speed and depth of penetration of micros, they will probably not affect arguments about the software market. In fact, as machines become cheaper, smaller and more powerful, so the complexity and cost of software to exploit these capabilities may rise.

For instance, we will probably see a pocket-calculator-sized machine in the next five years that will contain as much information as a large book. Every profession will want a version containing its own dogma — which may alter as often as day by day. The work of creating and maintaining this information will be far greater than the labour of making the hardware.

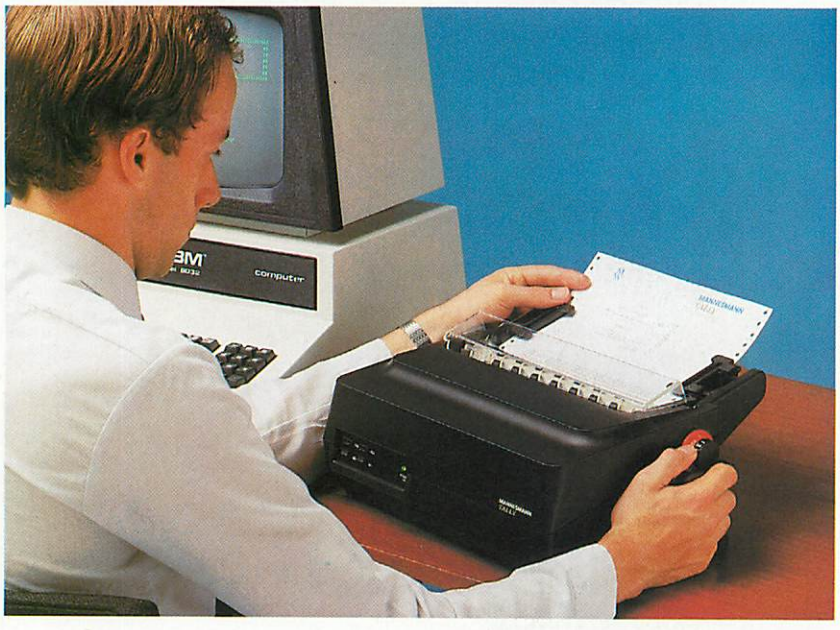
So, although the model will almost certainly be wrong about the exact size and time-scale, it does show the mechanisms of the market.

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```
10024 RETURN
10999 '******************
12000 NEWBUS=DM*SUITE
12004 OLDBUS=(MM-DM)*SUITE/5
12008 YCOPIES=NEWBUS+OLDBUS
12012 SALEPERT=YCOPIES/PROD(Y,0)
12016 RETURN
12997 '
12998 '****************
12999 'STAFF/STOCK RELATIONSHIP
13000 LSTOCK=STOCK
13010 STOCK=STARTPROD*MFR
13020 NEWTITLES=STOCK-LSTOCK
13030 STAFF=NEWTITLES*CREATE+MAINTAIN*PROD(Y
,0)
13040 GOSUB 10000
13100 RETURN
13999 '*****************
14000 'COSTS
14010 STAFFCOST=3*STAFF*SALRY
14020 ADCOST=ADPERHD*SUITE*MM/5
14030 YCOST=STAFFCOST+ADCOST
14040 RETURN
19999 '*****************
20000 'INCOME FROM SALES
20020 YSALE=0
20023 FOR LL=1 TO 5
20026 YSALE=YSALE+PROD(Y,LL)
20029 NEXT LL
20030 YSALE=YSALE*SALEPERT
20033 INCOME =YSALE*YPRICE
20034 AINC=.2*INCOME/PROD(Y,0):IF AINC>10000
0! THEN AINC=0
20035 INCOME=.6*INCOME'ALLOW 20% ROYALTY AND
 THE SAME FOR DEALER COMMISSIONS
20036 RETURN
20997 '
20998 '*****************
20999 'KEEP BALANCE, CALC INVESTMENT
21000 TINC=TINC+INCOME
21010 TCOST=TCOST+YCOST
21020 BALANCE=TINC-TCOST
21021 IF BLDUP=1 THEN RETURN
21022 IF BALANCE<INV THEN INV=-1*BALANCE
21030 RETURN
21997 '
21998 '***************
22000 'KEEP CASH FLOW AND ADJUST PRICES
22010 YPRICE=YPRICE*.85'PRICE DRIFTS DOWN
22020 GOSUB 14000'COSTS
22030 GOSUB 20000'INCOME
22040 GOSUB 23000'PROFIT AND LOSS
22210 GOSUB 21000
22220 RETURN
22997 '
22998 '***************
23000 'INVESTMENT AND RETURN
23010 PROFIT=INCOME-YCOST
23020 IF PROFIT<0 THEN PROFIT=0
23030 RETN=100*PROFIT/INV
23040 RETURN
23997 '
23998 '***************
24000 RETURN'PAY ROYALTIES
24010 ROYALTIES=.25*INCOME'INC 80% OF ITSELF
 FROM 20034
24020 IF TADV>=ROYALTIES THEN TADV=TADV-ROYA
LTIES:ROYALTIES=0:GOTO 24200
24200 INCOME=INCOME+ROYALTIES
24210 RETURN
29999 '***************
30000 GOSUB 12000
30010 GOSUB 13000
30013 GOSUB 10000
30014 GOSUB 22000
30015 IF I$="N" THEN 30019 ELSE LPRINT USING
 "## "; Y;:LPRINT USING "##############";INT(M
M/1000);3*STAFF;AINC;PROD(Y,0);YPRICE;ADCOST
;STAFFCOST;BALANCE/1000;PROFIT/1000
30019 IF I$="N" THEN PRINT TROYAL/PROD(Y,0)
30020 RETURN
```

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Bob Merry describes his program for filing and indexing genealogical information. Details of up to 30 ancestors, stretching back four generations, can be stored and displayed, with room for extra information on selected individuals.

Climbing the family tree

SOME TIME AGO I became interested in researching my family history. After several visits to St Catherine's House for various birth, marriage and death certificates and research in other record offices and libraries, I had collected a fair amount of information, which was becoming a little difficult to keep tabs on. I needed some form of filing and indexing system, so that I could see more easily the various relationships involved and decide where next to concentrate my research. This was an obvious application for my 8K old-ROM Pet, so I developed a program to handle the task.

The object of the program is to record the basic details of a family over five generations, including your own; that is, back to your 16 great-great-grandparents. This involves 30 ancestors plus

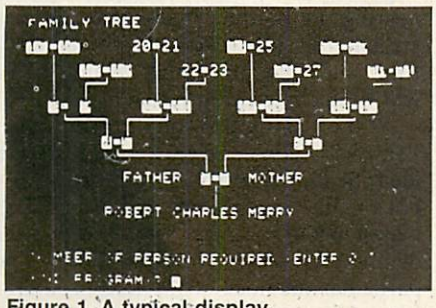


Figure 1. A typical display.

yourself and possibly your spouse; a total of 32 sets of information. In the case of your spouse, only the name will be recorded, but for the others, including yourself, there is space to record name, date of birth, date of marriage, date of death, any certificates obtained and whether a more detailed file exists.

The program relies heavily on the use of tape files for recording data, so if your system cannot handle them, it is unlikely that a worthwhile program could be adapted from this. Because the program needs nearly all the available 8K of memory for manipulating data, there is no room in the program for detailed instructions or explanatory Rems. This article is intended to act as instructions in the use of the program and as a guide to its main features for anyone attempting to adapt it to other systems.

Like Caesar's Gaul, the program is divided into three main parts. In the first a family tree is displayed, and this acts both as a menu to select the next person to be studied and as a guide to your progress. A typical display is shown in figure 1 where you will see that some of the numbers in the tree are displayed in reverse field. This indicates that the name of this person is known and on file. The members of the family tree are numbered from 2 to 31, starting from your parents. In each case, the male member of a couple is on the left and is represented by an even number. You are represented by the number 1 and your spouse, if any, is represented by 0. You may have guessed by now that the data will be recorded using string arrays and that the numbers correspond to the elements in the array.

The main string array used is N$(X), which contains all the basic data. Each element of this array is 64 characters long except N$(0) which only holds the name of your spouse. The first 25 characters are reserved for the name, which is followed by the three key dates of birth, marriage and death, each being allocated 10 characters. The next six characters allow you to record any certificates you have obtained, while the final three will be used to identify a more detailed file. When you start a family tree, each string in the array will be filled with 64 Xs, but as your research progresses, these become replaced with data, which will be transferred to the latest version of your family-tree file on cassette.

Once you have selected a number from the tree, the appropriate string will be displayed. The different parts of the string are separated and displayed in the form shown in figure 2. You will notice that the spouse's name is also displayed, having been obtained from the corresponding string. This is made possible because we know that all the male members of the family have even-numbered strings, and their wives can be found in the next highest string, while the ladies are odd — sorry about that — and their husbands are one string lower. The exception to this is your own string, which is 1 whatever your gender. Your spouse's name is found, still following the general rule, by looking at the next lowest string, N$(0).

The third part of the program concerns the modification of data. This can be of a general type, changing the parts of the basic string array, or you may build up a more detailed file on a separate cassette adding such information as brothers and sisters, other marriages, the existence of

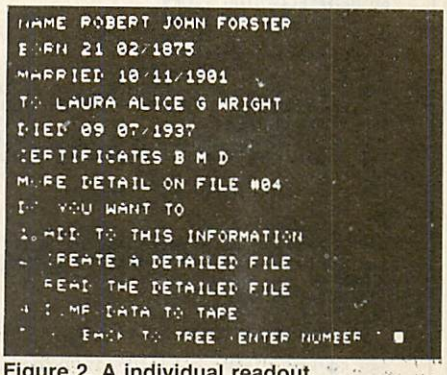


Figure 2. A individual readout.

wills or inquest reports, and so on. This can be done by using one full screen, or to be more precise, 23 lines of information. These can be easily displayed without any scrolling problems. When a detailed file is recorded on cassette, it is assigned an identification consisting of the hash sign and the array number of the person in question. This will be displayed in future readouts for that person — as shown in figure 2 — to show that it is available.

The detailed file itself consists of another string array, X$(X), where X = 0 to 22. Each element of the string is a line of the display, so it is important when entering the information not to exceed 40 characters per line and to avoid the use of characters which can be misinterpreted by the system, such as commas or colons. These provoke the reply Extra Ignored as the Pet thinks you are trying to enter two strings when it only is expecting one.

Now let us take a look at the program itself. Remember, this is written for the old-ROM Pet, but details of the minor modifications needed for a new-ROM are given later. Line 100 dimensions the arrays we are to use: N$(X), as we have said, contains the basic information about the members of the family tree; X$(X) is used to build up more detailed files; Z$(X) will contain the numbers used in the initial display — where a name is known, Z$(X) will be modified to give reverse field. Initially, line 110 loads the numbers 1 to 31 into Z$(X).

Lines 120-130, together with the commonly used Get R$ subroutine 1110-1120, ask whether you have a data tape. Only on the first run of a program for a particular family tree, would you answer N and then the program would branch to line 160, where elements 1 to 31 of N$(X) are filled with 64 Xs and element 0 is filled with 32 Xs. Normally, however, you would be invited to load your family tree file and N$(X) is filled from this.

Lines 210-220 are used to decide the people whose names you know; this is done by searching through N$(X) looking for elements that do *not* start XXX and putting the corresponding element in

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```
10 REM***FAMILY TREE**
20 REM**BY R.C.MERRY**
30 REM****************
40 REM****MAY 1980****
50 REM****************
60 REM*RECORDING YOUR*
70 REM*FAMILY HISTORY*
80 REM**ON AN 8K PET**
90 REM****************
100 DIMN$(31),X$(22),Z$(31)
110 FORI=1TO31:Z$(I)=RIGHT$(STR$(I),LEN(STR$(I))-1):NEXT
120 PRINT"■FAMILY TREE":PRINT"■DO YOU HAVE A FAMILY TREE FILE (Y/N)":GOSUB1110
130 IFR$="N"THEN160
140 PRINT"■LOAD FAMILY TREE FILE":PRINT"■PRESS ANY KEY WHEN READY.":GOSUB1110
150 OPEN1,1,0,"FAMILY TREE":FORI=0TO31:INPUT#1,N$(I):NEXT:CLOSE1:GOTO210
160 FORI=1TO31:N$(I)="X"
170 FORJ=1TO6:N$(I)=N$(I)+N$(I)
180 NEXTJ,I
190 N$(0)="X"
200 FORJ=1TO5:N$(0)=N$(0)+N$(0):NEXT
210 FORI=2TO31:IFLEFT$(N$(I),3)<>"XXX"THENZ$(I)="■"+Z$(I)+"■"
220 NEXT
230 PRINT"■FAMILY TREE
240 A$="     ":B$="   |  "
250 PRINT"■"Z$(16)"="Z$(17);A$;Z$(20)"="Z$(21);A$;Z$(24)"="Z$(25);A$;Z$(28)"="Z
$(29)
260 PRINT"   |"SPC(9)"|"SPC(9)"|"SPC(9)"|
270 PRINTB$;Z$(18)"="Z$(19);B$;Z$(22)"="Z$(23);
280 PRINTB$;Z$(26)"="Z$(27);B$;Z$(30)"="Z$(31);
290 PRINT"   |  ┌─┘     |  ┌─┘     |  ┌─┘     |  ┌─┘
300 PRINT"   |  |       |  |       |  |       |  |
310 PRINT"  "Z$(8)"= "Z$(9);A$;Z$(10)"="Z$(11);A$;Z$(12)"="Z$(13);A$;Z$(14)"="Z
$(15)
320 PRINT"    └──┐  ┌──┘           └──┐  ┌──┘
330 PRINTSPC(7)"|  |"SPC(17)"|  |
340 PRINTSPC(7);Z$(4)"="Z$(5);SPC(17);Z$(6)"="Z$(7)
350 PRINTSPC(8)"└─────┐  ┌─────┘
360 PRINTSPC(17)"|  |
370 PRINTSPC(9)"FATHER  "Z$(2)"="Z$(3)"  MOTHER
380 PRINTSPC(18)"|
390 PRINTSPC(18)"|
400 IFLEFT$(N$(1),3)<>"XXX"THENPRINTSPC(7);LEFT$(N$(1),25):GOTO420
410 PRINTSPC(18)"1
420 PRINT"■■■NUMBER OF PERSON REQUIRED (ENTER 0 TO
430 INPUT"■END PROGRAM)";N
440 IFN=0THEN1230
450 IFINT(N/2)=N/2THENM=N+1:GOTO470
460 M=N-1
470 PRINT"■NAME:";LEFT$(N$(N),25)
480 PRINT"■BORN:";MID$(N$(N),26,10)
490 PRINT"■MARRIED:";MID$(N$(N),36,10)
500 PRINT"■TO:";LEFT$(N$(M),25)
510 PRINT"■DIED:";MID$(N$(N),46,10)
520 PRINT"■CERTIFICATES:";MID$(N$(N),56,6)
530 PRINT"■MORE DETAIL ON FILE ";RIGHT$(N$(N),3)
540 PRINT"■DO YOU WANT TO:
550 PRINT"■1)ADD TO THIS INFORMATION
560 PRINT"■2)CREATE A DETAILED FILE
570 PRINT"■3)READ THE DETAILED FILE
580 PRINT"■4)DUMP DATA TO TAPE
590 INPUT"■5)GO BACK TO TREE (ENTER NUMBER)";R
600 ONRGOTO610,920,1000,1060,210
610 PRINT"■NAME:";LEFT$(N$(N),25)
620 GOSUB1100
630 IFR$="N"THEN680
640 INPUT"■NAME";R$
650 IFLEN(R$)>25THENPRINT"■PLEASE USE 25 LETTERS/SPACES OR LESS":GOTO640
660 IFLEN(R$)<25THENR$=R$+" ":GOTO660
670 N$(N)=R$+RIGHT$(N$(N),39)
680 PRINT"■BORN:";MID$(N$(N),26,10):GOSUB1100
690 IFR$="N"THEN720
700 GOSUB1130
710 N$(N)=LEFT$(N$(N),25)+R$+RIGHT$(N$(N),29)
720 PRINT"■MARRIED:";MID$(N$(N),36,10):GOSUB1100
730 IFR$="N"THEN760
740 GOSUB1130
750 N$(N)=LEFT$(N$(N),35)+R$+RIGHT$(N$(N),19)
760 IFN<>1THEN810
770 PRINT"■TO:";N$(0):GOSUB1100
```

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Z$(X) into reverse-field display mode.

Now we come to the initial display, for which you can use figure 1 as a guide as to the intended result. A$ and B$ are two commonly-used sections of this display: A$ consists of five spaces; B$ is two spaces, a vertical line — formed by shifting the right square bracket — followed by two more spaces. You may notice that two of the lines, 250 and 310, appear to be longer than the maximum 80 characters. This is because Print is entered as ? and is stored in the program as a token. If you make a mistake in entering one of these lines do not try to edit it after you have listed it, or you will lose the overflow. Instead, start afresh, using ? as usual.

At the end of the initial family tree display, you enter the number of the person you desire to study. Entering 0 allows you to exit the program. Lines 450-460 determine where to find the name of the spouse by seeing whether the inputted number, N, is even or odd and setting M accordingly. Then the data contained in the string is displayed — lines 470-590. This leads to a choice of one of five options being entered. The first option is to add to the data in the string under scrutiny and this routine begins at line 610. Each item of data is printed out in turn and you are asked if you wish to change this — subroutine 1100-1120. In the case of the name, we use 25 characters of the string, so line 650 rejects longer entries, whilst line 660 extends shorter ones to 25 by adding the appropriate number of blank spaces.

The next three entries are dates, so some elements of their entry can be contained in a common subroutine, 1130-1150. When it comes to the marriage date, there is also the provision to enter the name of your own spouse into N$(0). This only occurs when the current value of N is 1 — line 760. Otherwise the program branches to line 810.

After the dates, brief details of certificates are entered in the form of initials. This completes the modification of the string and the program returns to 470 and displays the new data and the option menu again.

Detailed information

The next option is to create a detailed file, consisting of 23 lines of information. This starts at line 920. It has been found that problems can arise when long strings are entered from near the bottom of the screen. Not only the line of information is entered, but also the ? prompt.

Line 930 looks at the position of the cursor, as stored in memory locations 224 and 225 (old-ROM), and starts at the beginning of the screen if this location is nearing the bottom. If less than 23 lines are entered, this is indicated by entering End and the remaining elements of X$(X) are filled with Nil.

At the start of this routine, subroutine 1160 was called and this compiles a file identification number using the hash symbol and the current value of N. This is also added to N$(N) so that you will see that a detailed file exists when you display this particular member of the tree in future. Lines 970-990 record the file on cassette. Subroutine 1190 is the usual fix needed with old-ROM Pets to get a reliable record — it turns the cassette motor on briefly between each block of data. The Pokes in line 980 ensure that a good header is written on to the tape.

Reading the detailed file is done with the routine starting at 1000. This is fairly straightforward, although some problems could arise with a line that is exactly 40 characters long, since this would move the cursor to the start of the next line. To prevent this causing double spacing, line 1030 detects such lines and adds a Cursor Up followed by a semicolon. The file is printed on to the screen and after reading it you can press any key to return to line 470.

The next option is the recording of the family-tree data on a cassette file. When you have updated all the information after your latest research you can create a new file. Since all the family-tree files consist of the same number of variables and strings and these are always the same length, I keep my file at the start of a tape

and always over-record the old tape with the new. This option is carried out by the routine starting at line 1060, another standard filing routine.

The final option is to return to the opening display, updating Z$(X), where you can select another branch of the tree or can exit the program. This, then, is my way of keeping tabs on my ancestors. Although the program itself is quite short, you will find that, once N$(X) and X$(X) are filled, there is precious little of your 8K left. For those of you with new-ROM Pets here are the modifications you need:

- Omit lines 1190-1220.
- Omit Gosub1190 in lines 980 and 1080.
- Omit the Pokes in lines 980 and 1070.
- In line 930 change the Peek addresses from 224 and 225 to 196 and 197.

If you wish to extend your researches back over more generations you can start family trees for selected ancestors. In this case you might wish to change the simple file identification used in line 1070 for one that might allow you to discriminate between files. Perhaps LEFT$(N$(1),9) would be suitable.

Genealogy, especially of your own family, is a fascinating study, but beware — it can prove costly, both in time and money. If you are prepared to spend hours delving in dusty record offices and want to know more about your roots, you will find it an absorbing hobby and it can provide yet another use for your home microcomputer.

(continued from previous page)

```
780 IFR$="N"THEN810
790 PRINT"■SPOUSE'S NAME
800 INPUT"■";N$(0)
810 PRINT"■DIED:";MID$(N$(N),46,10):GOSUB1100
820 IFR$="N"THEN850
830 GOSUB1130
840 N$(N)=LEFT$(N$(N),45)+R$+RIGHT$(N$(N),9)
850 PRINT"■CERTIFICATES:";MID$(N$(N),56,6):GOSUB1100
860 IFR$="N"THEN470
870 PRINT"■ENTER CERTIFICATES OBTAINED E.G.'B M D'
880 INPUT"■";R$
890 IFLEN(R$)>6THENPRINT"■ENTRY TOO LONG":GOTO870
900 IFLEN(R$)<6THENR$=R$+" ":GOTO900
910 N$(N)=LEFT$(N$(N),55)+R$+RIGHT$(N$(N),3):GOTO470
920 GOSUB1160:PRINT"□ENTER FILE; IF LESS THAN 23 LINES":PRINT"■PUT 'END'■
930 FORI=0TO22:INPUTX$(I):IFPEEK(224)+256*PEEK(225)>33648THENPRINT"□";
940 IFRIGHT$(X$(I),3)<>"END"THEN960
950 FORJ=I+1TO22:X$(J)="NIL":NEXT:I=22
960 NEXT
970 PRINT"□LOAD FILE ";B$:PRINT"■PRESS ANY KEY WHEN READY":GOSUB1110
980 POKE244,2:POKE243,122:OPEN1,1,1,B$:FORI=0TO22:PRINT#1,X$(I):GOSUB1190
990 NEXT:CLOSE1:GOTO470
1000 GOSUB1160:PRINT"□LOAD FILE ";B$:PRINT"■PRESS ANY KEY WHEN READY":GOSUB1110
1010 OPEN1,1,0,B$:FORI=0TO22:INPUT#1,X$(I):NEXT:CLOSE1
1020 FORI=0TO22:IFX$(I)="NIL"THENX$(I)=""
1030 PRINTX$(I):IFLEN(X$(I))=40THENPRINT"□";
1040 NEXT
1050 PRINT"PRESS ANY KEY WHEN READY":GOSUB1110:GOTO470
1060 PRINT"■LOAD FAMILY TREE FILE TAPE":PRINT"■PRESS ANY KEY WHEN READY":GOSUB1
110
1070 POKE244,2:POKE243,122:OPEN1,1,1,"FAMILY TREE"
1080 FORI=0TO31:PRINT#1,N$(I):GOSUB1190
1090 NEXT:CLOSE1:GOTO470
1100 PRINT"■DO YOU WISH TO CHANGE THIS (Y/N)?
1110 GETR$:IFR$=""THEN1110
1120 RETURN
1130 INPUT"■NEW DATE";R$
1140 IFLEN(R$)<>10THENPRINT"■ENTER DATE IN THE FORM 03/05/1941":GOTO1130
1150 RETURN
1160 B$=STR$(N):IFLEN(B$)=2THENB$="#0"+RIGHT$(B$,1):GOTO1180
1170 B$="#"+RIGHT$(B$,2)
1180 N$(N)=LEFT$(N$(N),61)+B$:RETURN
1190 IFPEEK(625)<180THENRETURN
1200 POKE59411,53:T=TI
1210 IFTI-T<12THEN1210
1220 POKE59411,61:RETURN
1230 END
```


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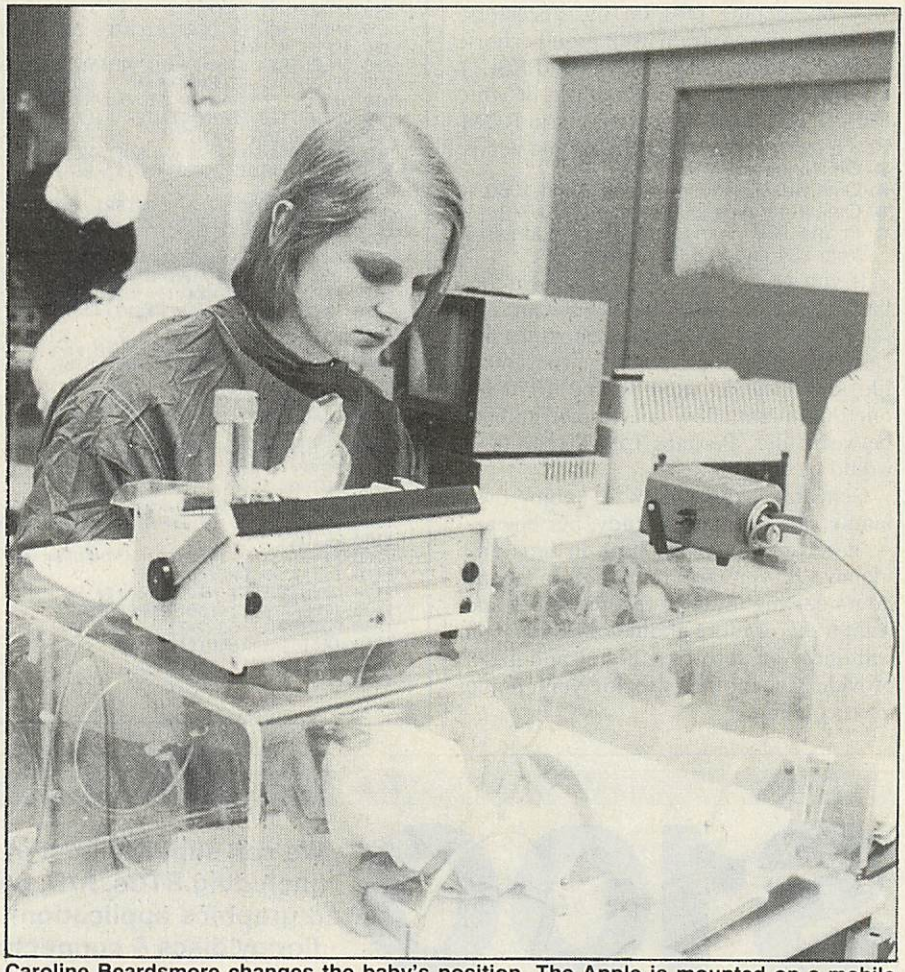
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On-line Apple brings help to premature babies

At London's Hammersmith Hospital an Apple is being used on-line to monitor the breathing patterns of premature infants. Martin Hayman reports on this life-saving project.



Caroline Beardsmore changes the baby's position. The Apple is mounted on a mobile trolley which can be parked next to the patient's cot.

ONE OF the most uncomfortable and disconcerting interfaces between microcomputers and the "real world" is in the caring professions, and nowhere more so than in that of medicine. To many who work within that field, the micro may represent a useful, if possibly problem-ridden, administrative tool. But the idea of using it to help treat patients in potentially life-and-death situations must seem like anathema to the new Luddites; and even the most ardent advocate of the microprocessor would be advised to tread lightly here. Scepticism may certainly be healthy.

These considerations have not deterred micro enthusiast Dr Charlie Wong, a Hong Kong-born research student, and physiologist Caroline Beardsmore at the Hammersmith Hospital. Working together under Dr Mike Silverman, lecturer in child health, in a prefabricated annexe to the premature baby unit, they have developed and implemented an Apple-based system to monitor the lungs of children up to the age of about one year, with special emphasis on prematurely-born babies.

Lung failure is the principal cause of death in premature babies or, to use the sinister-sounding medical jargon, pre-term morbidity — computing is not the only activity which generates its own impenetrable argot. In a baby born at its full term, a chemical is released in the final weeks of pregnancy which acts upon the lungs to increase their compliance, ready for the infant to emerge into the world and start breathing for itself. But pre-term infants' lungs are still stiff at birth, inhibiting or preventing oxygen from getting to the heart.

Recent developments in "aggressive" treatment have put hardware at the disposal of baby-care units which artificially inflates and deflates the child's lungs, giving it a much better chance of survival, and this has been one of the reasons for the falling death rate among new-born babies in the Western world. Some of this ventilating equipment, though, is comparatively crude and, though it may permit the infant to survive, may damage the lungs by over-inflation. Too much pressure can have several side-effects, including blindness; too little oxygen results in brain damage. Finding the happy medium is not an easy task, because it is extremely difficult to measure the compliance of the child's lungs exactly. This is exactly what Wong's programs for the Apple, which is dedicated to this purpose, achieve. There have also been longer-term benefits in statistical analysis and pattern recognition, of which more later.

Significant patterns

Like many original and useful micro applications, though, the idea did not descend from the skies in the proverbial flaming custard-pie. In fact it is a development of an existing idea. The difference is that the micro has improved throughput of work fantastically by permitting on-line calculations. This means that that statistically significant "patterns" of lung function can be drawn on the screen and printed out even as the patient is under examination.

With the previous equipment, an oscillograph which drew an analogue trace of individual parameters — there are five inputs — on light-sensitive paper, computations of one input plotted against another could be performed only by hand. This involved hours of tedious calculation after the baby had been disconnected from the pressure monitors. If it was discovered that the data was unsatisfactory for any reason, the patient would have to be prepared and connected up again. Obviously it is best to avoid this, because it involves putting a tube down the child's throat and, possibly, mild sedation.

In simple terms the monitoring equipment consists of a baby-sized box with a Perspex hermetic lid — as Wong drily remarked, rather like a small coffin — with five sensor lines to measure the atmospheric pressure inside and outside the box, the pressure out at the mouth, the oesophagal pressure — measured at the top of the lungs, hence the need for a tube down the patient's throat — and a flowmeter to measure volume. The complete apparatus is known as a "whole-body plethysmograph".

The pressure sensors need to be extremely accurate, because the pressure changes measured are less than 1cm. of water. This means that random external factors can cause either a sudden fluctuation if, for example, a door is opened, or a general drift in the readings if the sun comes out — the pre-fab hut, with no air conditioning, is not helpful in this respect.

Typically, a baby would stay in the plethysmograph for a period of from 40 minutes to three hours. Full fail-safe precautions are in force: the box has quick-release catches and there is resuscitation equipment on hand; Silverman reckons that the baby is probably as safe here as anywhere. Parents, too, are said not to feel too worried about seeing their child "wired-up" in a Perspex coffin; many babies will have been referred from other natal departments where survival apparatus is even more daunting in its complexity.

The main thrust of the lung function experiments, both before and after micro control was introduced, is twofold: to measure the effects of prematurity on the lungs and to assess treatment, and to monitor lung function during the immediate post-natal period. The first is a long-term programme to collect data and monitor the effects of the servo type of ventilator. This sort of system is also amenable to microprocessor control and an installation, for some arcane reason known as Twiggy, designed by Paul Collins and also implemented at the Hammersmith Hospital, was described in the January 1980 issue of *Practical Computing*.

To recap briefly, this system monitors the level of oxygen in the child's bloodstream, and uses a Motorola 6800-based machine with EPROM servo control to pressurise the baby's lungs. The machine requires a high level of electronic skill to manipulate, but hopes that it would prove commercially marketable have not yet met with any reward. This sort of ventilator's performance can be monitored in the long term with Wong's Apple system; the intention is to assess which factors, if any, lead to long-term lung damage.

No action

The second part of the Wong/Beardsmore project has a much more immediate use — modifying treatment to the individual baby, either on-line or extremely rapidly. The oscilloscope is for this reason mounted on a trolley which can be parked alongside the baby's cot. The trolley is now dominated by the Apple while the oscilloscope lurks below.

The project is funded by Action Research — the National Fund for Research into Crippling Diseases — and the budget is not huge. Here lies the real nub of the story. Silverman had made some enquiries about the possibilities of computerising the system in early 1979, but had decided on no action. The original plan was to link with the University College, London mainframe by telephone, but the prospect of depending on a service run by others had not enchanted him. A telephone connection to a digitising tablet attached to the mainframe, in order to convert the analogue signals from the plethysmograph, did not hold out great promise of reliability.

Cheaper hardware

Later in 1979 the blow fell: the price of silver, and along with it all light-sensitive photographic materials, went through the roof. The oscilloscope, with its high-cost rolls of paper, suddenly looked like a liability. The budget to feed it for the agreed duration of the research programme, 2½ years, would be something like £2,500 — in other words, greater than the cost of a micro. There was also every prospect that the price of silver would continue to rise, while that of electronic hardware would continue to decline. Action Research agreed with admirable promptness to the purchase of an Apple, and Wong, who had what he describes as "minimal knowledge" of programming at the time — he had just bought a TRS-80 a few months previously — got to work.

The system was intended from its inception to be dedicated solely to the purpose of monitoring the plethysmograph, and the Apple included in its specification an A102 card for analogue-to-digital conversion. There had been a plan to get a 12-bit converter to improve screen resolution for plotting, but this was found to be unnecessary. The Apple is otherwise standard. It was supplied by Lombardy Computers of Berkhamsted which is run by biochemist Dr Brian Millard, who is now a full-time supplier of micros for laboratory installations.

Wong wrote the programs in Basic, six of them, occupying nearly 8K each, which means that each program must be loaded separately, or no room is left for the screen graphics. He admits that they would be faster, in computer terms, with a Basic compiler but finds that, for the purpose, the machine is adequately fast, returning a single-breath analysis in about a minute. He calls this "intelligent plotting" — any two signals can be plotted against one another on XY axes, or two signals can be integrated to give one.

This is extremely useful in, for example, the RP Plot program, which plots the pulmonary resistance — resistance to breathing in and out — during the course of a single breath. The signal for the value of pressure can be "cleaned up" — demodulated, as Wong described it — by subtracting the value of volume-related pressure, the change in pressure caused by the actual volume of air within the lungs. This yields a more accurate comparison of volume and pressure and hence of lung compliance.

Previously it would have taken hours to make these calculations for a couple of breaths; now the read-out is in real time and results can be re-checked immediately if necessary. This is important since in such a vulnerable patient even the most banal factors or can have a significant influence on breathing. A change in the child's posture can easily make a fundamental change to the compliance plot and invalidate data.

This plot, with X and Y axes intersecting in the middle of the screen, with co-ordinates sampled at 1/100th second intervals, is used to assess the severity and the site of an individual's lung obstruction, and to monitor progress. In the long term it is used to pick up the causes of lung disease by building up a database of recognisable patterns of lung function, though post-diagnosis follow-up can be difficult from the administrative point of view; experimental units such as this one tend to work in isolation.

One pointer to the sort of follow-up implications is that a cortisone-type drug used to treat lung diseases in prematurity, over which some safety doubts had been cast as a result of animal experiments, has been cleared after a year's sampling of a group of children treated with the drug, compared with a control group which was not so treated. However, despite the long-term usefulness of the technique, Wong says that his Apple system should not be regarded as a diagnostic tool — "It's hardly Nobel Prize-winning stuff", he cracked.

Hard money

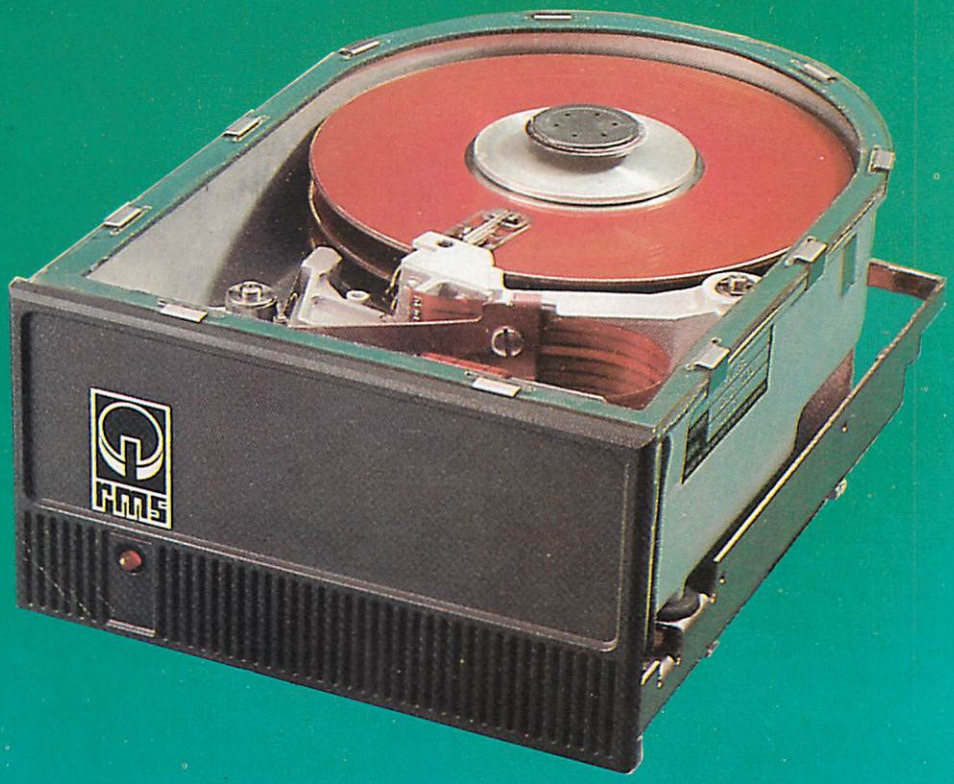
Wong's programs were originally checked out against the existing oscilloscope techniques on about 20 babies; there were a few problems getting the Apple to output both to the screen and to the sensitised-paper plotter. The oscilloscope is not totally redundant; programmed with paper tape, it is still used to develop new ideas which are subsequently implemented on the Apple. Although the system is intriguing and is doubtless capable of further refinements — converted to machine code on an EPROM as a dedicated device, it could link in with the Twiggy system — Wong has now done two years of research which is about all the career of a young doctor can take, and he is now returning to Hong Kong to resume clinical work.

In any case, the project is all funded by so-called "soft money" and there is no assurance of continuity, so this is one project which is likely to stumble until someone with a comparable mix of medical and computing skills can be found — and paid hard money to develop the work further.

Wong's project demonstrates the micro's well-canvassed ability to improve productivity. In this case, more knowledge is acquired — knowledge which is potentially life-saving. Luddites please take note.

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Message in a bottle

by Geraint Day

At last it had happened. People had dreamt of this moment for years and the pages of countless works of fiction were filled with detailed and sometimes lurid descriptions of the consequences . . . a message from the stars.

So mused Dr Thomas Anderson, chief administrator for astronomical research, as he sat in the passenger lounge of the shuttlecraft Vesta. He was on his way to the lunar base at Grimaldi on the western limb as seen from Earth.

Two hours earlier he had been on an official inspection of the Galaxy space station when he had received a call from the Lunar Science Officer. According to the Teletyped copy he now held, a mysterious signal had been detected by one of the arrays at the lunar far-side radio observatory. From its content — entirely regular — there seemed no doubt that its origin was a non-human intelligence somewhere. But Where?

Anderson was 29 years old and it was six years since he had left Caltech, back in 2016. While studying there he had often wondered at the possibility of such a contact between Man and, well, Others. In comparison with his normal everyday work the receipt of a message from an extraterrestial civilisation would be astounding. How banal the everyday researches of his colleagues now seemed to him.

He remembered the first zeta-wave reception and the associated peculiar bursts of energy from the Galactic centre; he had been closely involved in the development work on the new detection apparatus. Then had followed three years of analysing all the available data before a definitive statement on the exact physical processes involved could be made. Scientific research *could* be extremely tedious. An alien message was completely different of course; he was on the verge of the most amazing breakthrough yet.

"Please be seated. The *Vesta* will be touching down at Lunar Base Grimaldi in five and one-half minutes", came the voice of the steward over the intercom. "Kindly remain in your seats until I give confirmation of landing".

Dr Anderson sat at the head of a long plastic table facing some 16 other persons. Each was a senior scientist in his or her own field and each wore a light blue tunic decorated with the emblem of USE, the United Scientific Earth organisation.

The rostrum door opened and in walked the Moon's most respected personality, Dr Krebs. The bearded physicist addressed the assembly:

"Ladies and gentlemen. Two days ago one of the sky-surveying radio telescopes at Tsiolkovskii Observatory detected the following signal". He flicked the switch of a large graphical display.

"Here we have the output trace obtained following computer processing to remove background noise. Observe the regular spacing between each of the peaks, corresponding to a period of 6.7 milliseconds . . . here, here and here. The intensity measurements appear to show a sort of oscillation. It is the opinion of the radio astronomers that this trace represents our first contact with an extra-terrestial civilisation . . .

"Dr Anderson, whom all of you know, has been invited here to take over the work on interpreting the signals received so far. Measurements made at Tsiolkovskii show that the source is located on the sky near the star 61 Cygni. As senior physical scientist I have been given overall responsibility by the USE Council for subsequent work on this matter. Further results, following Dr Anderson's appointment to analyse the radio signals, will be reported to individual departments as they become available. Dr Anderson, I welcome you to our base . . ."

So it was going to be one of those laborious data-analysing tasks, as Anderson had reckoned at that first session . . . not an instant step forward in human experience. Sitting at the paper-covered desk with his head resting on his hands, he stared for the thousandth time at the lists of figures.

He had arranged the digitised data in binary form, and in number bases of three, four, five, all the way to 400. Without the computer, decoding the message would probably be impossible.

While arranging the digits in a base of 206, Anderson thought he had found something, a message in a bottle, as it were. The computer caused a matrix array to be spewed out on the re-usable paper strip. The array seemed possibly to depict an image of the physical form of the creature which had sent the message across the light years. But the outline was very odd indeed.

So far he had been able to discern that the creature was bipedal and seemed to 'stand' vertically. Curious protuberances were attached to what could be the head. There were symbols too, tens of them, which he was unable to comprehend. He would have to hand this problem over for the time being. Six months of number-crunching had left him bored, listless and frustrated and had certainly played havoc with his private life.

Why had he become a scientist anyway? After all, if he had gone to the astronauts' training course he might now be the commander of one of the gigantic solar-system shuttle ships. What was the use? On with the work.

The office door slid open and in strode a man bearing the insignia of an officer of the World Security Patrol. He led in another man, slight and balding and with a fair nippy moustache. Though he was evidently under arrest, there was a jauntiness to his step and an ironic twinkle in his eye which sorted ill with Anderson's mood.

"Well officer, what is it"? he snapped.

"Dr Anderson, I believe you have been engaged for some time on the analysis of some observations made at the lunar far-side observatory", remarked the policeman circumstantially.

"That's right. But what have my researches to do with you"? he asked testily.

"I think I had better let this character explain. Go ahead, Saunders".

"Well, er, it's like this. I was a systems engineer at Tsiolkovskii six months back. I like performing practical jokes, you see. I found a way of tapping the connection cables of the big 'scope. I could feed in any signal so that it would appear on the final display as if it had been picked up naturally. The whole thing I had working was, as near as dammit, indistinguishable from the real data".

Thomas Anderson, MSc, PhD, FRS, FRAS turned white. Then he went red, then puce. He stood and glared furiously at Saunders.

"Why the hell didn't you let us know before now"? he screamed. "Er, well . . . I got a transfer soon after setting up my tapping device and forgot that I hadn't taken it out of the circuits. By then of course, the whole USE had got onto the job and I couldn't really do anything. Eventually, after hearing of your "discovery" of the aliens' form, I just *had* to tell someone. Which is why I'm here now. I've brought along the program to decode my 'message' properly".

He took a small disc from his pocket. Anderson snatched it from him and plugged it into his console. A few moments later the screen brightened to reveal in clear and unequivocal detail the form of the "extraterrestrial". It was a familiar figure. It was standing on two legs and had a large head, monstrous ears and a single pair of skinny arms. It was clad in colourful clothes and on its face was a broad smile.

Anderson groaned and glanced sheepishly at his own version of this image, which was lying on his desk. The picture on the screen vanished and was replaced by the "message".

Mickey Mouse says: "EVER BEEN HAD"?

Unscrambling Rubik's

THE RUBIK'S CUBE program is designed so the user can key in details of his muddled Rubik's cube and the program will solve it for him. The program will tell the user which piece of cube to rotate and by how many degrees.

To make the moves easier to follow, a three-dimensional picture of the cube is displayed on the screen. Before each move is implemented on the screen, the user is required to press a key so the program will progress at the user's speed.

The program is in two parts, so it will run on any 40-column Pet. The first program is a set-up program. This sets up the look-up tables and the machine-code routines. The machine code rotates any piece of the cube and prints the new cube on the screen. The look-up tables are

by Andrew Whitfield

used by the machine-code routines and the main Basic Rubik's cube program.

The second program is the Rubik's cube program. It solves the cube in Basic, but uses the machine-code routines for rotating any part of the cube and printing the cube on the screen. The user has the following options when using the program:

1. To key in their own cube — a letter or a symbol represents each of the separate 54 squares on the cube.
2. To key in a symbol for each side of the cube — there are six letters or symbols for the six sides of the cube.
3. To randomise the cube. The user chooses how many random moves are to be done.
4. To manually move the cube on the screen. Any part of the cube can be moved 90 degrees, 180 degrees or -90 degrees.
5. The program solves the cube for you.
6. Ends the program.

The set-up program. Rewind either side of the cassette to the beginning and load the set-up program and run it. It takes about eight seconds to run. The look-up tables and machine-code routines are now set up.

The Rubik's cube program. A three-dimensional front view of the cube is displayed on the screen for all the following options. The view of the cube on the right of this, is the back view of the cube. The cube has been turned 180 degrees about the vertical axis. The user's cube can be compared with the screen's cube to check they are the same.

Key Load without rewinding the cassette to load the Rubik's cube program. When the program has loaded, key Run. It will print out Which Option (1-6)? The six options available are as follows:

Option 1: Typing in your own cube. First of all decide on your symbols or graphics

The set-up program.

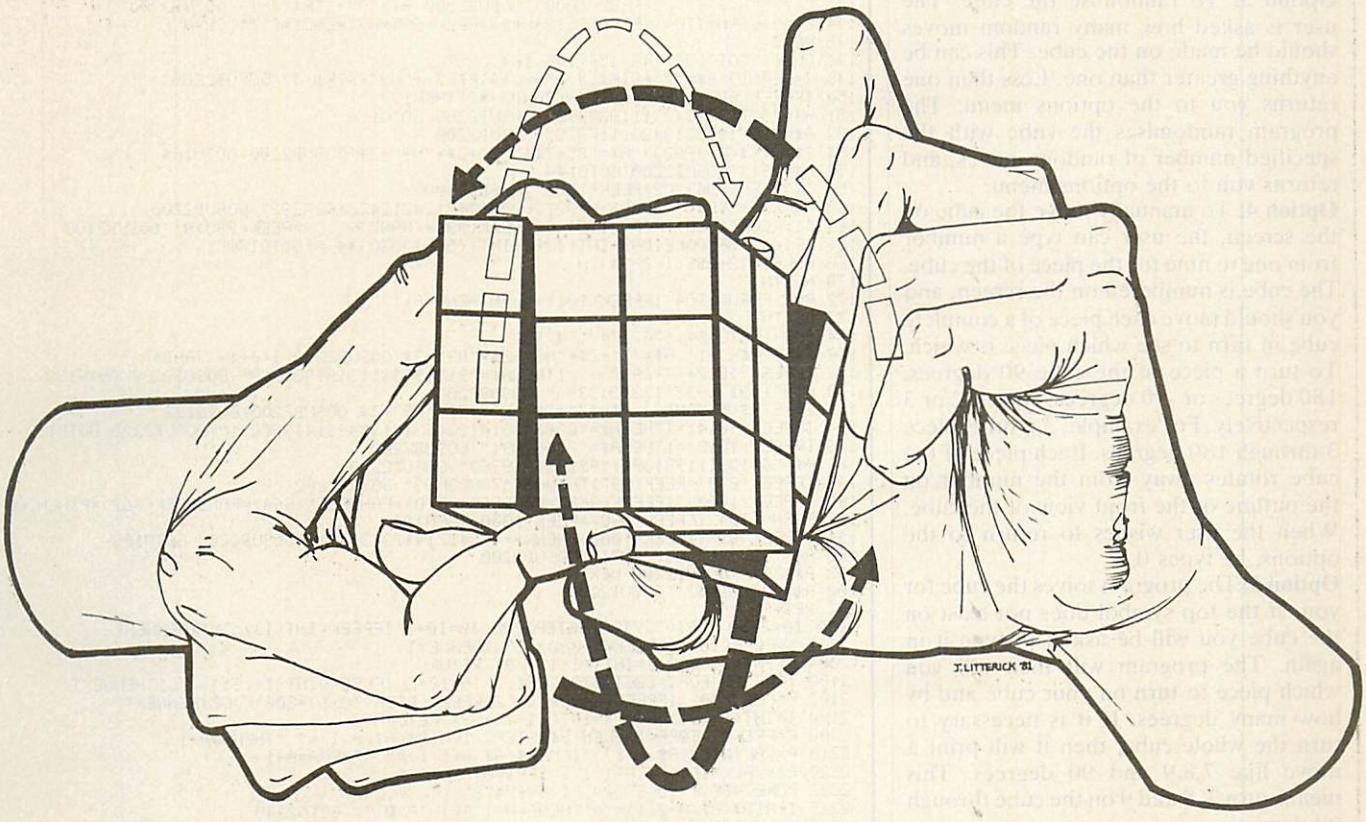
```
5 PRINT"■■■THE DATA IS BEING POKED IN."
6 PRINT"■■THIS WILL TAKE ABOUT 8 SECONDS."
10 A=32897:POKE989,0
20 FORB=880TO987STEP2:READC:D=INT((A+C)/256):E=INT(((A+C)/256-D)*256.5)
30 POKEB,D:POKEB+1,E:NEXTB
40 FORA=7168TO7935:READB:POKEA,B:NEXTA
50 END
20999 REM DATA FOR THE POSITIONS OF THE SYMBOLS ON THE CUBE ON THE SCREEN
21000 DATA312,395,478,432,515,598,552,635,718,481,404,327,601,524,447,721,644
21010 DATA567,213,136,59,333,256,179,453,376,299,62,145,228,182,265,348,302
21020 DATA385,468,192,115,39,275,199,123,359,283,206,460,544,627,536,620,704
21030 DATA613,696,780
21199 REM DATA FOR THE SECOND PART OF THE LOOK-UP TABLE FOR MOVING THE CUBE
21200 DATA68,234,71,235,74,236,110
21210 DATA68,107,71,104,74,92,110,89,107,86,104,95,92,98,89,101,86
21220 DATA234,95,235,98,236,101,69,234,72,235,75,236,109,69,106,72,103
21230 DATA75,91,109,88,106,85,103,96,91,99,88,102,85,234,96,235,99
21240 DATA236,102,76,238,79,239,82,76,83,79,84,82,81,83,78,84,77
21250 DATA81,238,78,239,77,73,234,74,235,75,236,82,73,83,74,84,75
21260 DATA91,82,92,83,93,84,64,91,65,92,66,93,234,64,235,65,236
21270 DATA66,103,238,104,239,105,103,108,104,111,105,110,108,109,111,106,110
21280 DATA238,109,239,106,70,234,71,235,72,236,79,70,80,71,81,72,88
21290 DATA79,89,80,90,81,61,88,62,89,63,90,234,61,235,62,236,63
21300 DATA67,234,68,235,69,236,76,67,77,68,78,69,85,76,86,77,87
21310 DATA78,58,85,59,86,60,87,234,58,235,59,236,60,94,238,97,239
21320 DATA100,94,101,97,102,100,99,101,96,102,95,99,238,96,239,95
21399 REM DATA FOR EXTRA MACHINE CODE FOR MOVING THE CUBE
21400 DATA0,206,242,3,206,242,3,76,78,29,0
21599 REM DATA FOR LOOK-UP TABLE FOR THE RELATION BETWEEN PIECES OF THE CUBE
21600 DATA55,62,68,35,189,189,73,61,41,79,28,68,70,44,189,189,79
21610 DATA34,50,77,37,70,64,53,189,189,77,43,59,71,46,64,62,26
21620 DATA189,189,71,52,32,73,26,55,53,46,189,189,35,28,44,37,52
21630 DATA59,61,32,189,189,43,50,34,41,0,0,65,58,38,76,69,31
21640 DATA47,78,67,40,56,74,63,49,29,72,54,27,45,36,60,51,33,42,0,0,0
21799 REM DATA FOR MACHINE CODE FOR MOVING THE CUBE
21800 DATA162,30,142,242,3,160,50,162,1,169,76,202,240,28,160,30,24
21810 DATA105,50,144,4,76,211,28,24,202,240,14,160,50,24,105,30,202
21820 DATA240,6,24,105,50,76,65,29,140,150,29,162,1,141,129,29,141
21830 DATA136,29,173,242,3,141,130,29,141,137,29,76,126,29,202,240,3
21840 DATA76,116,29,96,160,0,185,44,1,141,142,29,200,185,44,1,141
21850 DATA145,29,173,231,3,141,231,3,200,24,192,10,240,3,76,128,29
21860 DATA76,119,29,0,0,0,0,0,0,0
21999 REM DATA FOR PRINT OUT MACHINE CODE ROUTINE
22000 DATA160,54,162,112,142,183,29,232,142,207,29,162,58,142,222,29,173
22010 DATA218,3,141,226,29,141,231,29,141,238,29,141,3,30,141,20,30
22020 DATA141,38,30,141,47,30,173,219,3,141,225,29,141,230,29,141,237
22030 DATA29,234,234,234,174,111,3,236,141,131,240,75,142,141,131,234,238
22040 DATA237,29,142,141,131,24,105,41,141,2,30,141,19,30,144,7,24
22050 DATA238,3,30,238,20,30,142,182,131,192,19,48,16,206,19,30,192
22060 DATA49,208,3,206,20,30,142,182,131,76,48,30,56,233,39,141,37
22070 DATA30,234,234,234,234,234,234,142,143,131,56,233,41,141,46,30,142
22080 DATA102,131,136,240,18,238,222,29,238,183,29,238,183,29,238,207,29
22090 DATA238,207,29,76,182,29,96,0,0,0,0,0,0
22199 REM DATA FOR THE FIRST PART OF THE LOOK-UP TABLE FOR MOVING THE CUBE
22200 DATA58,234,61,235,64,236,105,58,104,61,103,64,84,105,81,104,78
22210 DATA103,96,84,95,81,94,78,234,96,235,95,236,94,87,238,90,239
22220 DATA93,87,92,90,91,93,88,92,85,91,86,88,238,85,239,86,59
22230 DATA234,62,235,65,236,108,59,107,62,106,65,83,108,80,107,77,106
22240 DATA99,83,98,80,97,77,234,99,235,98,236,97,60,234,63,235,66
22250 DATA236,111,60,110,63,109,66,82,111,79,110,76,109,102,82,101,79
22260 DATA100,76,234,102,235,101,236,100,69,238,68,239,67,69,70,68,73
22270 DATA67,74,70,75,73,72,74,238,75,239,72,67,234,70,235,73,236
22280 DATA111,67,108,70,105,73,93,111,90,108,87,105,94,93,97,90,100
22290 DATA87,234,94,235,97,236,100,58,238,59,239,60,58,63,59,66,60
22300 DATA65,63,64,66,61,65,238,64,239,61
READY.
```

Rubik's cube program.

```
1 REM   >>>THIS PROGRAM WAS WRITTEN BY ANDY WHITFIELD<<<
5 P=FRE(0):CLR:POKE994,0
10 INPUT"■■■WHICH OPTION (1-6) ■■■■■■■";A:IFINT(A)<>AORA<1ORA>6THEN10
20 ONAGOSUB30000,30000,40000,45000,45,40
25 PRINT"■■ PRESS ANY KEY TO RETURN TO THE OPTIONS ■"
30 FORN=1TO2000:NEXTN:FORN=1TO9:GETZ$:NEXTN
32 GETZ$:IFZ$=""THEN32
35 P=FRE(0):GOTO10
40 P=FRE(0):CLR:END
43 DATA0,3,2,1,5,4
45 IFPEEK(994)=0THENGOSUB30015:GOSUB6000
46 C1=PEEK(994):I=0:FORN=0TO5:IFPEEK(830+N*9)=C1THENI=1
47 NEXTN:IFI=1THEN53
48 PRINT"■■■ ' ' DOES NOT EXIST ON THE CUBE":POKE32850,C1:POKE994,0:GOSUB6000
49 GOTO45
```

(listing continued on next page)

cube



to be used for the six colours. It is best to use the first letter of each colour — for instance Y for yellow, W for white, and so on. It is even better if the letters are in reverse field. To obtain reverse field, press RVS and all further characters typed in will be in reverse field. Also a 1 appears in the top left-hand corner of the screen to signify the reverse field is on. To turn the reverse field off, just press RVS again without the shift key, and the reverse field will be turned off. An O appears in the top left-hand corner of the screen to show the reverse field has been turned off.

If you have made a mistake, press Delete and the last character typed in will disappear. To see just where the characters appear on the cube, try running this option a couple of times. When you have typed in all of the 54 squares on the cube, press any key to continue.

The program will then request the Top Symbol. This is asking which symbol is to go at the top of the cube for when the program solves it. The reverse key works in the same way as before but there is no delete option. When this has been done it asks you to press any key to return to the options. There is a short delay before it will respond to the keys.

Option 2: To type in the symbols for each side of a correct cube. This routine works exactly the same as the last option except

(continued on next page)

(listing continued from previous page)

```
53 GOSUB20000:GOSUB5000:C2=0:C3=0:GOSUB2100:ONJGOTO54,56,54,56,60,58
54 A$="1"+STR$(J)+"N2"+STR$(J)+"N3"+STR$(J):GOSUB2200:GOTO60
56 A$="4"+STR$(J-1)+"N5"+STR$(J-1)+"N6"+STR$(J-1):GOSUB2200:GOTO60
58 A$="12N22N32":GOSUB2200
60 FORN=990TO995:P=PEEK(830+9*(N-990)):POKEN,P:NEXTN
62 FORN=1TO4:C2=PEEK(989+N):GOSUB2000:IFI=65THEN68
63 IFJ=5ANDN=1THENA$="9"+STR$(K/9-3):GOSUB2200:GOTO68
64 P=J:IFP<5THENP=(I-INT(I/9)*9)/2+1
66 ONPGOSUB74,78,80,76,70,72
68 A$="71N81N91":GOSUB2200:NEXTN:GOTO82
70 P=(I-1)/2-32:A$=STR$(6/P)+"27"+STR$(2/P)+"42":GOSUB2200:RETURN
72 A$="7"+STR$(INT(K/9)-3)+"42":GOSUB2200:RETURN
74 A$=STR$(5-J+(J+2AND8)/2)+"2":GOSUB2200
76 A$="7"+STR$(J-1)+"41933191":GOSUB2200:RETURN
78 P=J-SGN(J-1.5)*2:A$="7"+STR$(P)+"N8"+STR$(P)+"41":GOSUB2200:RETURN
80 P=JAND3:A$="7"+STR$(P)+"N8"+STR$(P)+"43":GOSUB2200:RETURN
82 FORN=1TO4:C2=PEEK(990+N-(NAND4)):C3=PEEK(989+N):GOSUB2100:IFI=68THEN88
84 P=J:IFP<5THENP=I-INT(I/9)*9:P=(P+1)/2-(PAND8)/3.2
86 ONPGOTO94,92,96,98,90,100
88 A$="71N81N91":GOSUB2200:NEXTN:GOTO102
90 J=INT(K/9)-1
92 P=5-J+(J+2AND8)/2:A$=STR$(P)+STR$((JAND2)+1)+"71"+STR$(P)+STR$(3-(JAND2))
93 GOSUB2200:GOSUB2100:GOTO84
94 P=5-J+(J+2AND8)/2:A$=STR$(P)+STR$(3-(JAND2))+"73"+STR$(P)+STR$((JAND2)+1)
95 GOSUB2200:GOSUB2100:GOTO84
96 A$="7"+STR$(J+1AND3)+"437141":GOSUB2200:GOTO88
98 A$="7"+STR$(JAND3)+"337331":GOSUB2200:GOTO88
100 A$="7"+STR$(INT(K/9)-3)+"43724172337331":GOSUB2200:GOTO88
102 C1=PEEK(990):C2=0:C3=0:GOSUB2100:A$="7"+STR$(J-1)+"N8"+STR$(J-1):GOSUB2200
104 A$="42N52N62":GOSUB2200
105 RESTORE:FORN=996TO1001:READI:P=PEEK(I+990):POKEN,P:NEXTN
106 FORN=1TO4:C1=PEEK(995+N):C2=PEEK(996+N-(NAND4)):GOSUB2000:IFI=31THEN112
108 P=J:IFP<5THENP=(I-INT(I/9)*9)/2+1
110 ONPGOTO122,114,116,110,124
112 A$="71N81N91":GOSUB2200:NEXTN:GOTO130
114 J=(J+2AND3)+1
116 J=J-1:A$="7"+STR$(J)+"N8"+STR$(J)+"N9"+STR$(J)+"639132923292329161"
118 GOSUB2200:A$="7"+STR$(4-JAND3)+"N8"+STR$(4-JAND3)+"N9"+STR$(4-JAND3)
120 GOSUB2200:GOSUB2000:GOTO108
122 A$="9"+STR$(J+1AND3)+"639132923292329161":GOSUB2200:GOTO112
124 A$="9"+STR$(K/9-2AND3)+"139342924292429311":GOSUB2200:GOTO112
130 C1=PEEK(1000):C3=0:FORN=1TO4:P=5:IFPEEK(818+9*N)=C1THENP=N
131 POKE1011+N,P:C3=C3+P:NEXT
132 C3=C3-9:ONC3GOTO140,132,132,138,134,138,134,138,132,132,142
134 A$="9"+STR$(INT(C3/6))+"611391119363":GOSUB2200:GOTO142
138 A$="9"+STR$((C3-(PEEK(1013)+PEEK(1014)-2AND8)/2)/2AND3)+"619113931163"
139 GOSUB2200:GOTO142
140 A$="61139111936372N82N92619113931163 72N82N92":GOSUB2200
```

(listing continued on next page)

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that whenever a key is pressed, a whole side of a cube appears. The top symbol is then requested as above.

Option 3: To randomise the cube. The user is asked how many random moves should be made on the cube. This can be anything greater than one. Less than one returns you to the options menu. The program randomises the cube with the specified number of random moves, and returns you to the options menu.

Option 4: To manually move the cube on the screen, the user can type a number from one to nine for the piece of the cube. The cube is numbered on the screen, and you should move each piece of a complete cube in turn to see which piece is which. To turn a piece of the cube 90 degrees, 180 degrees or -90 degrees, type 1, 2 or 3 respectively. For example, 3,2 turns piece 3 through 180 degrees. Each piece of the cube rotates away from the number on the outline of the front view of the cube. When the user wishes to return to the options, he types 0,1.

Option 5: The program solves the cube for you. If the top symbol does not exist on the cube you will be asked to type it in again. The program will then tell you which piece to turn on your cube and by how many degrees. If it is necessary to turn the whole cube, then it will print a move like 7,8,9 and 90 degrees. This means turn 7, 8 and 9 on the cube through 90 degrees.

This also applies if you need to turn two layers at once. The middle layers of the cube are never turned on their own as this is hard to do on a real cube. Every time the program is ready with the next move it will print it out on the screen and print a letter P in the top right-hand corner of the screen. The letter P tells the user to press any key on the keyboard, for the program to rotate the cube on the screen. No keys should be pressed until P appears. When the cube is finished it will return to the options.

Option 6: Ends the program.

Notes on the program.

- **It is important that options 1 or 2 are run before 3, 4 or 5 as otherwise there will not be a cube set up.**
- **There was not enough memory to write a routine to check a legal cube had been typed for options 1 and 2 so if the cube is illegal the program will crash.**
- **The program is very tight on memory so you must not add any lines as this will corrupt some of the look-up tables. This also applies to 16K and 32K machines.**
- **The average run time for option 5, if it is not waiting for the user to press a key, is 45 seconds.**
- **The solution of Rubik's cube is based on David Singmaster's solution.**
- **Andrew Whitfield can supply this program on cassette for 40-column Pets. Send £3 and a self-addressed envelope to him at: 31 Norwood Drive, N. Harrow HA2 7PS.**

(listing continued from previous page)

```
142 C1=PEEK(996):C2=PEEK(1000):GOSUB2000:A$="9"+STR$(J-1):GOSUB2200
144 C1=0:FORN=1TO4:IFPEEK(818+N*9)=PEEK(995+N)THENC1=C1+1:C2=N
145 NEXT
146 ONC1+1GOTO158,148,156,146,164
148 J=C2AND3:A$="7"+STR$(J)+"N8"+STR$(J)+"N9"+STR$(J):GOSUB2200
150 IFPEEK(827)=PEEK(998+J-(JAND2)*2)THEN152
151 A$="32713313423111927332":GOSUB2200:GOTO154
152 A$="32719233134231117332":GOSUB2200
154 Z$=STR$(4-JAND3):A$="7"+Z$+"N8"+Z$+"N9"+Z$:GOSUB2200:GOTO164
156 A$="91":GOSUB2200:GOTO144
158 C1=PEEK(996):C2=PEEK(1000):GOSUB2000
160 A$="9"+STR$(J+2AND3)+"32726273124212421242716272 32":GOSUB2200
164 C1=PEEK(1000):FORN=1TO4:C2=PEEK(996+(NAND3)):C3=PEEK(995+N):GOSUB2100
166 IFI<62THENPOKE1009+INT(I/9)+INT((56-I)/30)*4,N:GOTO170
168 POKE1012+ABS(I/2-34),N
170 NEXTN
172 P=0:FORN=1TO4:IFPEEK(1011+N)=NTHENP=P+1:J=N
173 NEXTN
174 ONP+1GOTO184,176,174,174,192
176 Z$=STR$(J-1):A$="7"+Z$+"N8"+Z$+"N9"+Z$:GOSUB2200:I=J+1-(JAND4)
178 IFPEEK(1012+(J+2AND3))=ITHENA$="9131933113191339313":GOSUB2200:GOTO182
180 A$="11913193331331913393":GOSUB2200
182 Z$=STR$(5-JAND3):A$="7"+Z$+"N8"+Z$+"N9"+Z$:GOSUB2200:GOTO192
184 IFPEEK(1014)=1THENA$="33624331413343314133433141336231":GOSUB2200:GOTO192
186 IFPEEK(1013)=1THENA$="71N81N91":GOSUB2200
188 A$="61139111931391119391119363":GOSUB2200
190 IFPEEK(830)=PEEK(997)THENA$="73N83N93":GOSUB2200
192 P=PEEK(1000):IFPEEK(868)=PANDPEEK(870)=PANDPEEK(864)=PANDPEEK(862)=PTHEN200
193 FORN=1TO4:IFPEEK(868)=PEEK(1000)THEN198
194 IFPEEK(835)=PEEK(1000)THENA$="7343714173437141":GOSUB2200:GOTO198
196 A$="4373417143734171":GOSUB2200
198 A$="91":GOSUB2200:NEXTN
200 A$="42N52N62":GOSUB2200:
202 RETURN
2000 I0=7450:FORI=827TO879STEP2.25:I0=I0+1:IFPEEK(INT(I))<>C1THENNEXT
 2002 K=PEEK(I0):IFPEEK(K+800)<>C2THENNEXT
 2004 I=INT(I)-800:J=INT((I-17)/9):RETURN
 2100 I0=7387:FORI=826TO879STEP1.8:I0=I0+2:IFPEEK(INT(I+.81))<>C1THENNEXT
 2102 K=PEEK(I0):IFPEEK(K+800)<>C2ORPEEK(PEEK(I0+1)+800)<>C3THENNEXT
 2104 I=INT(I+.81)-800:J=INT((I-17)/9):RETURN
 2200 P=FRE(0):FORA=1TOLEN(A$)STEP2:IFMID$(A$,A,1)=" "THENA=A+1
 2210 P=VAL(MID$(A$,A,1)):IFMID$(A$,A+1,1)=" "THENA=A+1
 2220 P1=VAL(MID$(A$,A+1,1)):IFP1=0THEN2238
 2222 POKE7486,P:POKE7524,P1:SYS7478
 2225 IFMID$(A$,A+2,1)="N"THENA=A+1:PRINTP"■,":GOTO2240
 2227 GOSUB5010
 2230 GETZ$:PRINT"S■■■■■■P":IFZ$=""THEN2230
 2235 PRINT"S■■■■■■ ":GETZ$:SYS7590:GOTO2240
 2238 IFMID$(A$,A+2,1)="N"THENA=A+1
 2240 NEXT:P=FRE(0):RETURN
 5000 PRINT"S PIECE(S)      DEGREE(S)":RETURN
 5010 PRINTP"■      S■■■■■■■■■■■■■■■■■■■■";((P1+1AND3)-1)*90;"■ ":RETURN
 6000 PRINT"SR       PRESS ANY KEY TO CONTINUE      ■"
 6002 GETZ$:IFZ$=""THEN6002
 6004 RETURN
20000 PRINT"■■■■■■■■■■■■■■■■■■■
```

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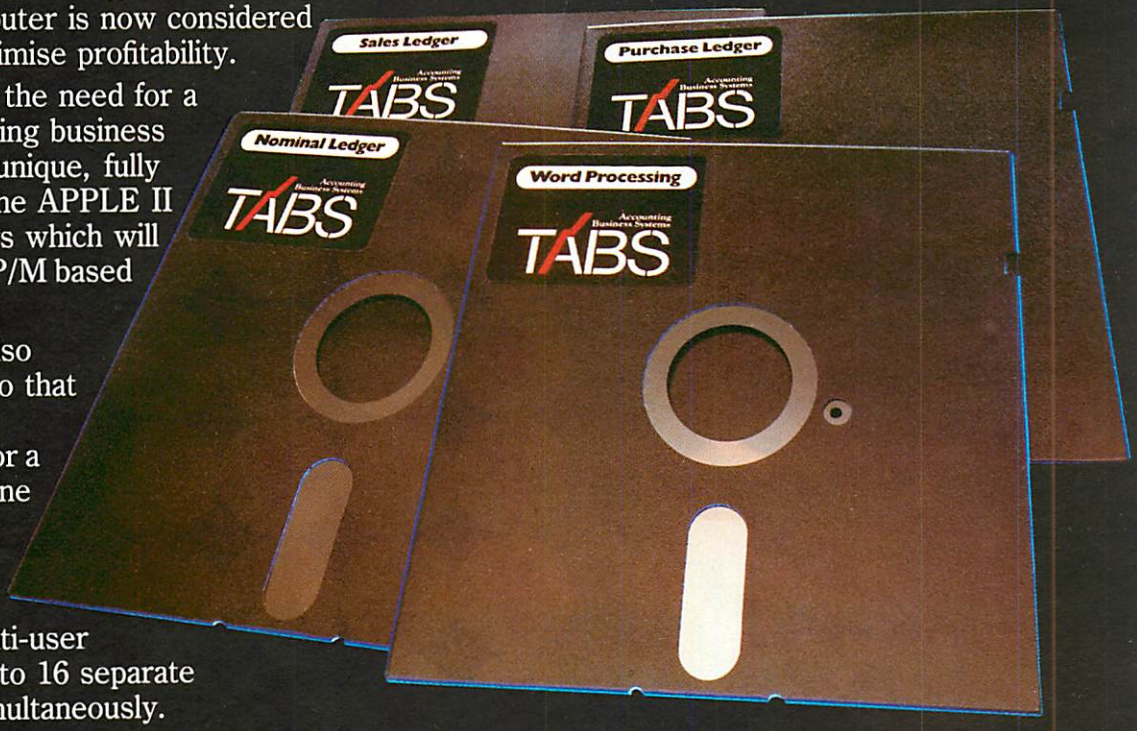


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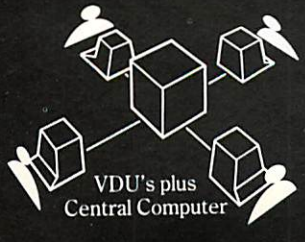


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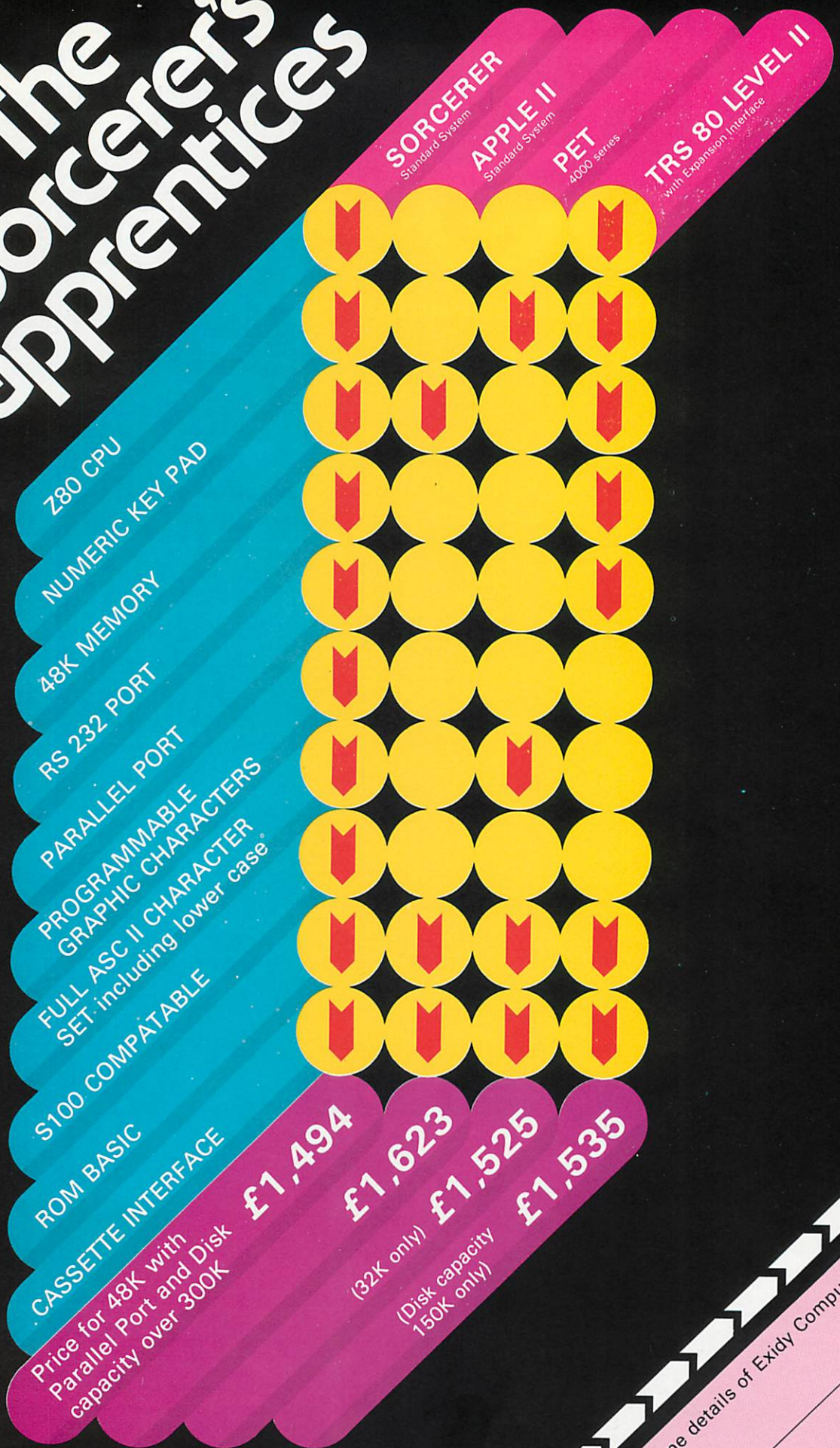
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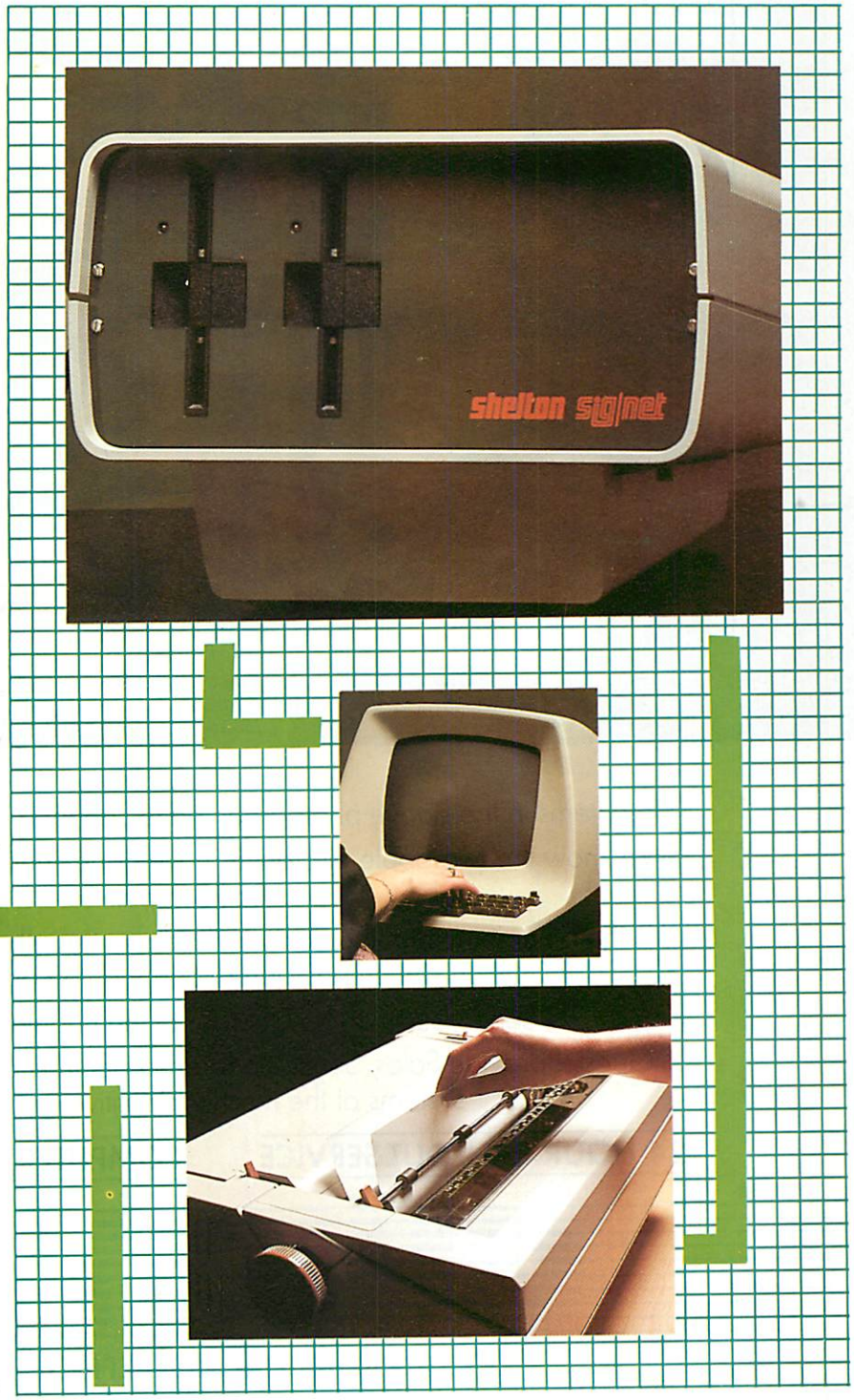
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Closed procedures in Comal-80

The availability of closed procedures is a distinctive feature of Comal-80. Mogens Christiansen explains their characteristics and uses.

COMAL-80 is a language, related to both Basic and Pascal, which contains both a series of facilities to help produce structured, easy-to-understand programs, and a syntax check which works during programming to give instant error messages and to recommend ways to a correct program.

In the June issue of *Practical Computing*, Roy Atherton presented a good description of Comal-80, spotlighting six essential elements of structure. I want to draw more attention to the sixth element, closed procedures.

Closed procedures allow the decomposition of a program into smaller self-contained programs, and it has been said that

by Mogens Christiansen

decomposition is the cornerstone of structured programming.

One of the greatest advantages of Comal-80 in comparison with Basic is the presence of genuine procedures with formal parameters as found in most other high-level languages — such as Algol and Pascal. The reserved word Ref indicates that the formal parameter immediately following it is a call-by-reference parameter. All other formal parameters are call-by-value parameters.

Of course any formal parameter used for returning a value from the procedure must be specified as Ref. Moreover the syntax of Comal-80 requires all formal parameters of type array to be specified as Ref. This is in order to avoid excessive data copying when the procedure is called.

A procedure may be specified as Closed. This feature greatly facilitates the choice of variables in large programs with many procedures and helps avoid disturbing side-effects due to unintentional use of the same variable inside and outside a procedure.

Localised variables

When a procedure is specified as Closed, all variables inside the procedure are strictly local to the procedure — except, of course, Ref-specified formal parameters — even though the same variable may appear outside the procedure. In the latter case, the variable inside the procedure and the one outside will be treated as two completely separate variables.

In some cases, however, it is convenient to have access from inside to a few variables outside the procedure, without having to include them as parameters each time the procedure is called. In other words, it is often convenient to have certain global variables in a procedure otherwise closed. If a procedure is not specified as Closed, all variables inside it are global. Such variables may be specified as Global in a closed procedure.

Except for Ref-specified formal parameters and Global-specified variables, a closed procedure cannot in any way affect a variable outside the procedure. This feature has another great advantage: if you do not use the Global specification in a closed procedure you may use the same procedure in many different main programs without ever worrying about what variables are used in the main program.

Black box procedures

When you have made sure that the procedure works correctly, you can use it as a kind of "black box" in any main program. You only need to know what arguments it takes and what values it returns to the main program, whereas the detailed internal calculations are completely irrelevant from the point of view of the main program.

You can build up — or have someone else supply — a library of closed procedures which can be used in any main program, because there will never be any conflict between variables in the closed procedure and variables in the main program. In this way you can have your own extended version of Comal-80, so to speak.

The program Polynom illustrates the use of closed procedures. All procedures in Polynom take real polynomials as arguments, and most of them return polynomials to the main program. A polynomial is stored in an array — say, A — in the following way.

The degree of the polynomial is stored in A(-1) and the coefficients are stored in A(0) through A(A(-1)) with the coefficient of the term of degree I in A(I) for I = 0, 1, ..., A(-1). This utilises another feature of Comal-80: the range of indices in an array may be from any integer to any greater integer. DIM A(L:H) means that lowest and highest index are L and H, respectively. By default DIM A(H), where H is a positive integer, is taken to mean DIM A(1:H). Thus it is possible to stick to old habits from Basic, if you are prepared to renounce the greater flexibility of Comal-80.

The listing of the program together with the following short explanations should make it possible to see how the procedures work.

PRT(REF A()) CLOSED — prints the degree and the coefficients of a polynomial stored in array A from the highest-degree term to the constant, degree 0, term.

EVALUATE(X, REF V, REF A()) CLOSED — evaluates the value of a polynomial stored in array A at the point X. The value is returned in the formal parameter V.

ASGN(REF B(), REF A()) CLOSED — assigns polynomial B to polynomial A, that is it copies array B from B(-1) through B(B(-1)) into array A from A(-1) through A(B(-1)). Variables of which the last character is # are integer variables. They are more economic than real variables, both in storage and computer time.

CHS(REF A()) CLOSED — changes A(I) to –A(I) for I = 0, 1, ..., A(-1).

ADD(REF A(), REF B(), REF R()) CLOSED — adds the two polynomials stored in A and B and returns the sum in array R. Missing terms in the polynomial of lowest degree are set to 0 before the addition.

SUB(REF A(), REF B(), REF R()) CLOSED — analogue to ADD but subtracts the polynomial in B from the one in A. The polynomial in B is unaffected which it would not be by the execution of first CHS(B) and then ADD(A, B, R).

MUL(REF A(), REF B(), REF R()) CLOSED — multiplies the polynomials in A and B and returns the product in R.

DERIVE(REF A(), REF R()) CLOSED — calculates the derivative of the polynomial stored in A and returns the result in R.

DRVFRAC(REF NUMERA(), REF DENOM()) CLOSED — calculates the derivative of a fraction of which the numerator and the denominator are polynomials stored in arrays NUMERA and DENOM respectively. The result is a polymial fraction, of course. Its numerator and denominator are returned in the same arrays NUMERA and DENOM. Thus CHS and DRVFRAC are the only procedures in this program which destroy the arrays supplied to them as arguments. Of course, if DRVFRAC had been given four formal parameters it needed not destroy its arguments.

The procedure DRVFRAC illustrates several features of Comal-80.

First, any procedure may call any procedure defined anywhere in the main program. It may even call itself; Comal-80 supports recursive procedures. The latter facility is not used in program Polynom.

Second, note that the arrays R1, R2 and R3 are local to DRVFRAC since the storage for them is allocated inside the

(continued on next page)

(continued from previous page)

closed procedure DRVFRAC. R1, R2 and R3 are used for intermediate results only, and the data they store may be discarded on return from the procedure to the main program. When a Dim-statement appears inside a closed procedure, storage is allocated dynamically every time the procedure is called and is again de-allocated upon return from the procedure. Thus, no matter the number of times the procedure is called, there will be no error message Out Of Storage or the like, if no such error message occurs on the first call.

By using local arrays for intermediate results, you can economise on storage if several different procedures need large arrays for storing intermediate results. Think of procedures for multiplication and other operations on matrices, for instance.

As an example, the main program in this case has been constructed to calculate the derivative of

$$\frac{3X^5 - 2X^4 + 4X^3 + 6X^2 - 3X + 1}{-4X^4 - 6X^3 + 7X^2 - 3X + 5}$$

and the value of the derivative at X = 2.

The programs shown have been executed on a Comet microcomputer marketed by ICL in Denmark, running the Metanic Comal-80.

Calculation of the derivative of fractional function using Polynom.

```
0010 // POLYNOM 81.07.20
0020 DIM A(-1:50), B(-1:50)
0030 DIM PRT$ OF 3
0040 INPUT "OUTPUT TO: ": PRT$
0050 SELECT OUTPUT PRT$
0060 DATA 5
0070 DATA 3, -2, 4, 6, -3, 1
0080 DATA 4
0090 DATA -4, -6, 7, -3, 5
0100 READ A(-1)
0110 FOR I:=A(-1) DOWNTO 0 DO
0120  READ A(I)
0130 NEXT I
0140 READ B(-1)
0150 FOR I:=B(-1) DOWNTO 0 DO
0160  READ B(I)
0170 NEXT I
0180 EXEC DRVFRAC(A,B)
0190 EXEC PRT(A)
0200 EXEC PRT(B)
0210 V1:=0; V2:=0
0220 X:=2
0230 EXEC EVALUATE(X,V1,A)
0240 EXEC EVALUATE(X,V2,B)
0250 PRINT
0260 PRINT "X = ",X,": DERIVATIVE OF FRACTION = ",V1/V2
8000 //-----------------------------------------------------//
8002 PROC PRT(REF A()) CLOSED
8003  PRINT
8004  PRINT "DEGREE = ",A(-1)
8006  FOR I:=A(-1) DOWNTO 0 DO
8008   PRINT A(I);" ";
8010  NEXT I
8012  PRINT
8016 ENDPROC PRT
8018 //-----------------------------------------------------//
8020 PROC EVALUATE(X, REF V, REF A()) CLOSED
8022  V:=A(A(-1))
8024  FOR I:=A(-1)-1 DOWNTO 0 DO
8026   V:=X*V+A(I)
8028  NEXT I
8030 ENDPROC EVALUATE
8032 //-----------------------------------------------------//
8034 PROC ASGN(REF B(), REF A()) CLOSED
8036  MAT A:=0
8038  DGR#:=TRUNC(B(-1))
8040  FOR I#:=-1 TO DGR# DO
8042   A(I#):=B(I#)
8044  NEXT I#
8046 ENDPROC ASGN
8048 //-----------------------------------------------------//
8050 PROC CHS(REF A()) CLOSED
8052  FOR I:=0 TO A(-1) DO
8054   A(I):=-A(I)
8056  NEXT I
8058 ENDPROC CHS
8060 //-----------------------------------------------------//
8062 PROC ADD(REF A(), REF B(), REF R()) CLOSED
8064  MAT R:=0
8066  IF A(-1))B(-1) THEN
8068   DGR:=A(-1)
8070   FOR I:=B(B(-1)+1) TO DGR DO
8072    B(I):=0
8074   NEXT I
8076  ELSE
8078   DGR:=B(-1)
8080   FOR I:=A(A(-1)+1) TO DGR DO
8082    A(I):=0
8084   NEXT I
8086  ENDIF
8088  R(-1):=DGR
8090  FOR I:=0 TO DGR DO
8092   R(I):=A(I)+B(I)
8094  NEXT I
8096 ENDPROC ADD
8098 //-----------------------------------------------------//
8100 PROC SUB(REF A(), REF B(), REF R()) CLOSED
8102  MAT R:=0
8104  IF A(-1))B(-1) THEN
8106   DGR:=A(-1)
8108   FOR I:=B(-1)+1 TO DGR DO
8110    B(I):=0
8112   NEXT I
8114  ELSE
8116   DGR:=B(-1)
8118   FOR I:=A(-1)+1 TO DGR DO
8120    A(I):=0
8122   NEXT I
8124  ENDIF
8024  FOR I:=A(-1)-1 DOWNTO 0 DO
8026   V:=X*V+A(I)
8028  NEXT I
8030 ENDPROC EVALUATE
8032 //-----------------------------------------------------//
8034 PROC ASGN(REF B(), REF A()) CLOSED
8036  MAT A:=0
8038  DGR#:=TRUNC(B(-1))
8040  FOR I#:=-1 TO DGR# DO
8042   A(I#):=B(I#)
8044  NEXT I#
8046 ENDPROC ASGN
8048 //-----------------------------------------------------//
8050 PROC CHS(REF A()) CLOSED
8052  FOR I:=0 TO A(-1) DO
8054   A(I):=-A(I)
8056  NEXT I
8058 ENDPROC CHS
8060 //-----------------------------------------------------//
8062 PROC ADD(REF A(), REF B(), REF R()) CLOSED
8064  MAT R:=0
8066  IF A(-1))B(-1) THEN
8068   DGR:=A(-1)
8070   FOR I:=B(B(-1)+1) TO DGR DO
8072    B(I):=0
8074   NEXT I
8076  ELSE
8078   DGR:=B(-1)
8080   FOR I:=A(A(-1)+1) TO DGR DO
8082    A(I):=0
8084   NEXT I
8086  ENDIF
8088  R(-1):=DGR
8090  FOR I:=0 TO DGR DO
8092   R(I):=A(I)+B(I)
8094  NEXT I
8096 ENDPROC ADD
8098 //-----------------------------------------------------//
8100 PROC SUB(REF A(), REF B(), REF R()) CLOSED
8102  MAT R:=0
8104  IF A(-1))B(-1) THEN
8106   DGR:=A(-1)
8108   FOR I:=B(-1)+1 TO DGR DO
8110    B(I):=0
8112   NEXT I
8114  ELSE
8116   DGR:=B(-1)
8118   FOR I:=A(-1)+1 TO DGR DO
8120    A(I):=0
8122   NEXT I
8124  ENDIF
8126  R(-1):=DGR
8128  FOR I:=0 TO DGR DO
8130   R(I):=A(I)-B(I)
8132  NEXT I
8134 ENDPROC SUB
8136 //-----------------------------------------------------//
8138 PROC MUL(REF A(), REF B(), REF R()) CLOSED
8140  MAT R:=0
8142  A#:=TRUNC(A(-1)); B#:=TRUNC(B(-1)); R(-1):=A(-1)+B(-1)
8144  FOR I#:=0 TO A# DO
8146   FOR J#:=0 TO B# DO
8148    K#:=I#+J#; R(K#):+A(I#)*B(J#)
8150   NEXT J#
8152  NEXT I#
8154 ENDPROC MUL
8156 //-----------------------------------------------------//
8158 PROC DERIVE(REF A(), REF R()) CLOSED
8160  FOR I:=1 TO A(-1) DO
8162   R(I-1):=I*A(I)
8164  NEXT I
8166  R(-1):=A(-1)-1
8168 ENDPROC DERIVE
8170 //-----------------------------------------------------//
8172 PROC DRVFRAC(REF NUMERA(), REF DENOM()) CLOSED
8174  DGR:=NUMERA(-1)
8176  IF 2*DENOM(-1))DGR THEN DGR:=2*DENOM(-1)
8178  DIM R1(-1:DGR), R2(-1:DGR), R3(-1:DGR)
8180  EXEC DERIVE(NUMERA,R1)
8182  EXEC MUL(R1,DENOM,R2)
8184  EXEC DERIVE(DENOM,R1)
8186  EXEC MUL(NUMERA,R1,R3)
8188  EXEC SUB(R2,R3,NUMERA)
8190  EXEC MUL(DENOM,DENOM,R2)
8192  EXEC ASGN(DENOM,R2)
8194 ENDPROC DRVFRAC


DEGREE = 8
-12  -36  91  -16  121  -84  81  46  -12

DEGREE = 4
-4  -6  7  -3  5

X = 2: DERIVATIVE OF FRACTION = 8.235294
```

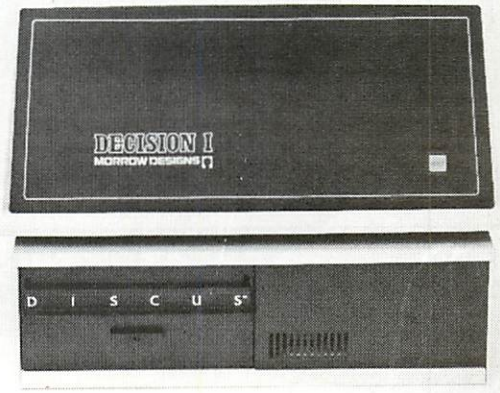
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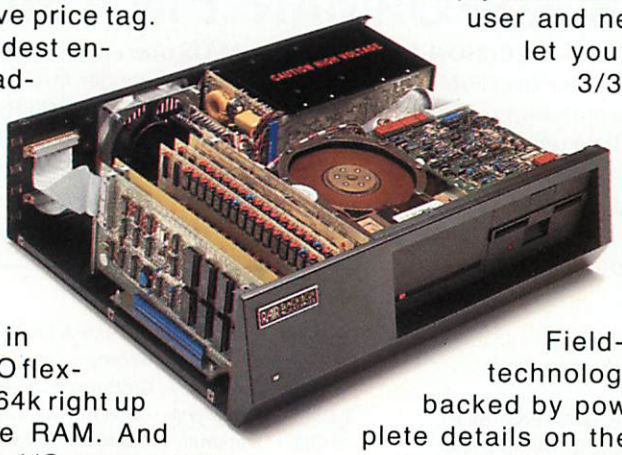
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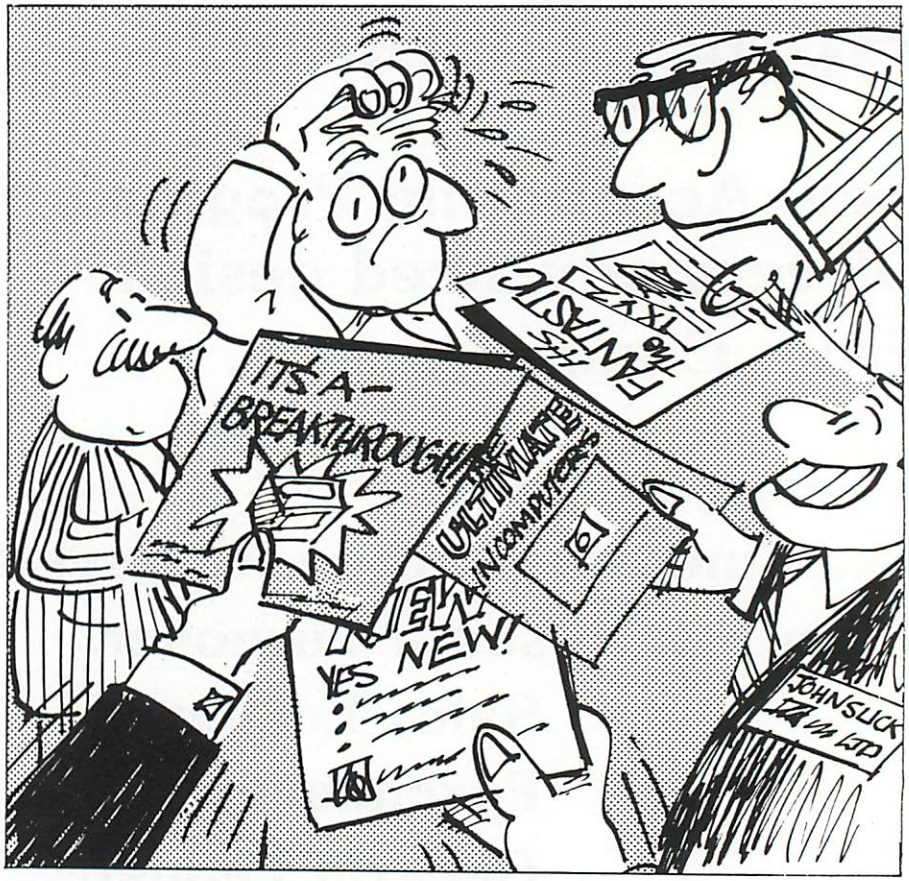
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Customers and manufacturers both have a stake in making every systems demonstration a success. Raymond Franks passes on the benefit of his experiences with salesmen and buyers.



A DEMONSTRATION of a business microcomputer system represents an investment in time for both the supplier of the system and its prospective user, and it is important for neither to waste the opportunity afforded.

The supplier can safely assume that the people attending have something more than a passing interest in acquiring the product, while those attending are able to form a first-hand impression as to the quality and suitability of the system. Both parties, therefore, have a keen interest in maximising the effectiveness of the session.

That is the theory. The practice, however, often differs radically. Demonstrations of systems frequently consist of a shambles of broken-down machines and overwritten discs on the one hand, and a variety of tangential questions and irrelevant concerns on the other.

As a consultant specialising in the small-computer field, I spend a lot of time at demonstrations of various business hardware and software products. This is essential for me to advise my clients with any degree of credibility, particularly as I have learned from bitter experience that one cannot always rely upon advertising claims.

I assume that the various approaches adopted by companies to systems demonstrations reflect, to a large extent, the manner in which they run other aspects of their operations. In that case it is surprising that some have stayed in business. The attitude of some potential users who attend demonstrations is also amazing. Many seem to throw common sense, never mind business acumen, out of the window — is this also the fate of an unsatisfactory system. once purchased? Of course, the perfect demonstration is subjective, and what is appreciated will differ between people possessing varying levels of knowledge and areas of interest. A number of general points can be made about demonstrations, however, and I have compiled some golden rules for both demonstrators and potential users.

As a consultant, I am always grateful to suppliers for demonstrating their products, particularly as I do not always represent a direct sale. I don't profess to be an expert in sales techniques. My comments are made from the user's viewpoint and relate to areas where demonstrations have been rendered useless, both as sales aids and as information gathering exercises.

Demonstrations of computer systems generally take place in one of three environments: trade exhibitions and fairs; reference sites; at the supplier's premises.

Establish interest

Demonstrations at exhibitions must be fairly superficial, and serve to establish or confirm an interest rather than to give a detailed review of the system to the potential user. Just try concentrating on the finer points of control account maintenance in a computerised ledger system with six people craning over your neck, five other people talking to the demonstrator, four spotlights beaming in your eyes, three hours since you last had any food or drink, two more systems to look at that afternoon and only one thought in your head — to go home and rest your feet.

Demonstrations at reference sites serve a very useful purpose, particularly if the reference company's activities are very much akin to your own. Remember, however, that suppliers are unlikely to recommend "bad" or "difficult" users as reference sites. Anyway, no-one is likely to own up too readily to having "bought a pup".

The demonstration at the supplier's premises tends, therefore, to be the most important for both parties.

From the supplier's viewpoint, the demonstration offers an excellent opportunity to consolidate a sale and, because a demonstration has been asked for, it can usually be assumed that the system in question has reached some kind of short-list status in the potential user's mind. The likelihood of that sale being confirmed, however, can be reduced considerably by the way in which the demonstration is performed, rather than failings of the system itself.

Here are some important points for suppliers to bear in mind when arranging their demonstrations.

Have the machine and demonstration data ready, and the appropriate software loaded, or ready to load. It will save time and improve your credibility if you know in advance that "the system is playing up a bit today".

Beware also of the faulty machine, as inexperienced users will not be too concerned about distinguishing between hard and soft errors. It helps considerably if a printer is connected for the demonstration so that the user can see the production of reports and take these away as useful reminders of the system.

Make sure you have suitable demonstration data and a plan of how the demonstration should proceed. While it is

easy to ask the user "What would you like to do next?", and there is little point in adhering rigidly to a routine, users often prefer to be shown in a logical fashion what the system can do rather than poke about at random. A system is much easier to assimilate if demonstration data is plausible; for example, all principal transaction types should be represented. You should tell inexperienced users that demonstration data volumes are lower than they would be in practice, and that this may well affect the processing and response times in a live environment, although the program logic is still the same.

Loss of confidence

You must have at least a reasonable degree of knowledge, both about how the system works in computing terms — and the application. This may sound trite, but if the demonstrator lacks this knowledge, it is frustrating for the potential customer and can cause a loss of confidence on his part. Even worse is the death knell of all responses: "Oh, you'll have to ask so-and-so about that, and he/she is on holiday/sick/on a course/otherwise unavailable, and won't be back until next week/month/year". This does not bode well for on-going support and maintenance.

Be realistic about the constraints of the system in certain circumstances and be willing to admit, if appropriate, that there may be areas where your system would be unsuitable through lack of facilities, storage capacity or whatever. With some of the bodges suppliers try to pass off, it is not surprising that users are sometimes completely disenchanted with the system they have acquired.

For example, when demonstrating sales and purchase ledger systems, it is slightly dubious to produce listings of customer and supplier accounts in alphabetical order when the accounts are allocated numerical code numbers sequentially on input. Unless the user is sure that his next three customers are going to be called, say, Xerxes, Yosanov and Zachariah (in that order), the alphabetical sequence will soon be disrupted in real life.

As a demonstrator you should not avoid questions. Always follow up questions not answered at the demonstration, and send any literature/printouts which you promise to the prospective customer. I could probably paper the Great Wall of China with reports and brochures which "we'll run off and pop in the post to you".

Don't treat the users as imbeciles. While they may not be experts in computerised systems, they are capable of thought. An example of patronising behaviour towards the user is the ubiquitous demonstrator who, holding a floppy disc in both hands rather limply, as though it were a slightly dubious piece of fish, proceeds to wave it up and down whilst patronisingly crooning "this is a



floppy disc . . . as you can see it is like a disc . . . and it is floppy".

Conversely, don't overdo the computer jargon. Many is the glazed look which I have seen come into people's eyes while a string — literally? — of bits, bytes and bootstraps emerge from the demonstrator's mouth. A "cold-boot routine in the EPROM" should earn him/her a warm boot in the pants.

Do not waste time during the demonstration and try to ensure that you are not continually interrupted — no good will come of it, and any continuity in the session will be ruined. If you are that important, have someone else do the demonstrating while you get on with running the business.

From the user's viewpoint, the demonstration is likely to be of fundamental importance in determining which system to acquire and he/she should be properly prepared to extract the maximum amount of information and firm conclusions from the time spent. Advertising literature, product profiles and sample printouts cannot compare with seeing a system in operation, albeit only in a demonstration environment, and forming an impression of its viability for a particular task.

Keeping the following points in mind should help the user when approaching the demonstration.

Ask the questions which are of fundamental importance to you. So many discussions at demonstrations concern peripheral matters — pun only slightly intended — such as whether the reports would be better in upper or lower case or whether a particular input field would be better if entitled differently. To be really useful the real discussion should centre around such points as "How will the system cope with the number of accounts on my sales ledger?" and "How can my particular invoice requirements be catered for?" and "How can control over the system be established specifically in my organisation?" The demonstration is by far the best opportunity to have such questions answered and, preferably, to see these answers demonstrated. If you don't know which questions are fundamental to your requirements, you should seek help before attending demonstrations. You will save yourself a lot of time and trouble.

Ask to "have a go" at performing various functions on the system — for example, setting up an account or entering a batch of transactions. In this way you assess the feel of the system and see how

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easy, or otherwise, it will be to use.

You will also, perhaps unintentionally, discover how the system reacts to various error conditions — such as invalid codes, and incorrectly formatted fields — and be able to judge how robust the system is likely to prove in practice where, initially, a variety of input errors will be likely. Be particularly wary of systems which constantly require re-booting — turning the system off and on again — in such circumstances.

The user should be tolerant of minor breakdowns and mishaps occurring during the demonstration. Demonstration machines, which may also be used for in-house development work, and diskettes take an above-average bashing and the software may be a pre-release version. The demonstrator should make this clear at the outset, however. It is unreasonable to expect that nothing will ever go wrong but there must be a limit to the credibility of the time-honoured phrase: "This won't happen in the system that you'll be getting". Try to be discerning about the types of error which occur, and be particularly concerned with those that appear to be inherent in the software — those are the ones that you may have to get used to living with.

You must find out all the costs involved in acquiring a system from the supplier, including the price of operating and other special software, interface cables and ports, any special firmware cards, delivery, training if offered, installation and maintenance. The seemingly cheap option can often prove to be the most expensive by the time an operational system is configured. It may still be the best system, but you should know all the facts before making your choice.

Emphasis on software

Do not expect to see every facility in a system demonstrated in depth — there will rarely be sufficient time unless you go through at breakneck speed. Concentrate on the facilities which you consider to be crucial, and ensure that you understand how the system deals with these.

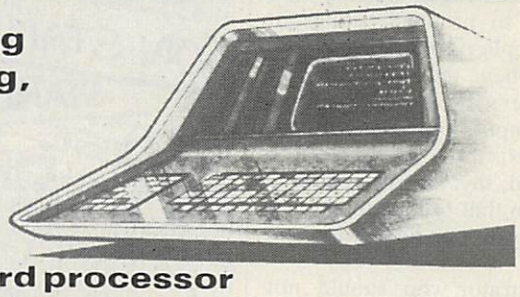
You should not place undue emphasis on the demonstration hardware, unless it is the precise equipment which you are to acquire. Remember that printers and visual display units — VDUs — can usually be attached to suit your particular requirements, and that the system may also operate with a different disc configuration. In most cases the software should be considered of overriding importance. There are far too many demonstrations where the principal point of debate has been the colour of the display characters on the VDU. While this is an important consideration for potential users, there is little point in berating the demonstrator about the colour, or the make of the VDU screen being used, when there is a choice available.

Do not attach undue importance to plush surroundings. Some of the best microcomputer suppliers are pushed for space, often because they are successful, and the demonstration, therefore, may take place near or even within their workshop or development area. While I am not advocating that farmyard conditions should be taken as a good sign, the "informal" demonstration surrounding can often provide the potential user with a good insight into how the supplier operates and the way in which user telephone enquiries are handled. This may — or may not — give the user some additional assurance as to the level of support and understanding that he can expect after acquiring a system.

If this article has made you feel that your grandmother is sucking eggs better than ever, good for you — I hope she keeps very well on them. If, however, you detected a slight twinge of conscience/guilt/rage then just think on a little as to whether you are getting the most from demonstrations. "Why did we lose Mr Smith as a customer? He seemed so keen when he arrived for the demonstration", and "How on earth did we end up with this system? At least our ledgers used to balance", may become questions of the past. Anyway, I must stop, I'm just off to a demonstration.

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This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

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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.

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Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

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

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

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

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

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

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

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

For ZX81 with 16K RAM pack

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

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

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

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

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

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

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

Cassette 3 – Business and Household

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

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

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Cassette 4 – Games

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

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

TWENTYONE – a dice version of Blackjack.

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

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

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

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

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

For ZX81 (and ZX80 with 8K BASIC ROM)

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

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

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

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

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

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	24	Cassette 4 – Games	£3.95	
	25	Cassette 5 – Junior Education	£3.95	
	17	*8K BASIC ROM for ZX80	£19.95	
	18	*16K RAM pack for ZX81 and ZX80	£49.95	
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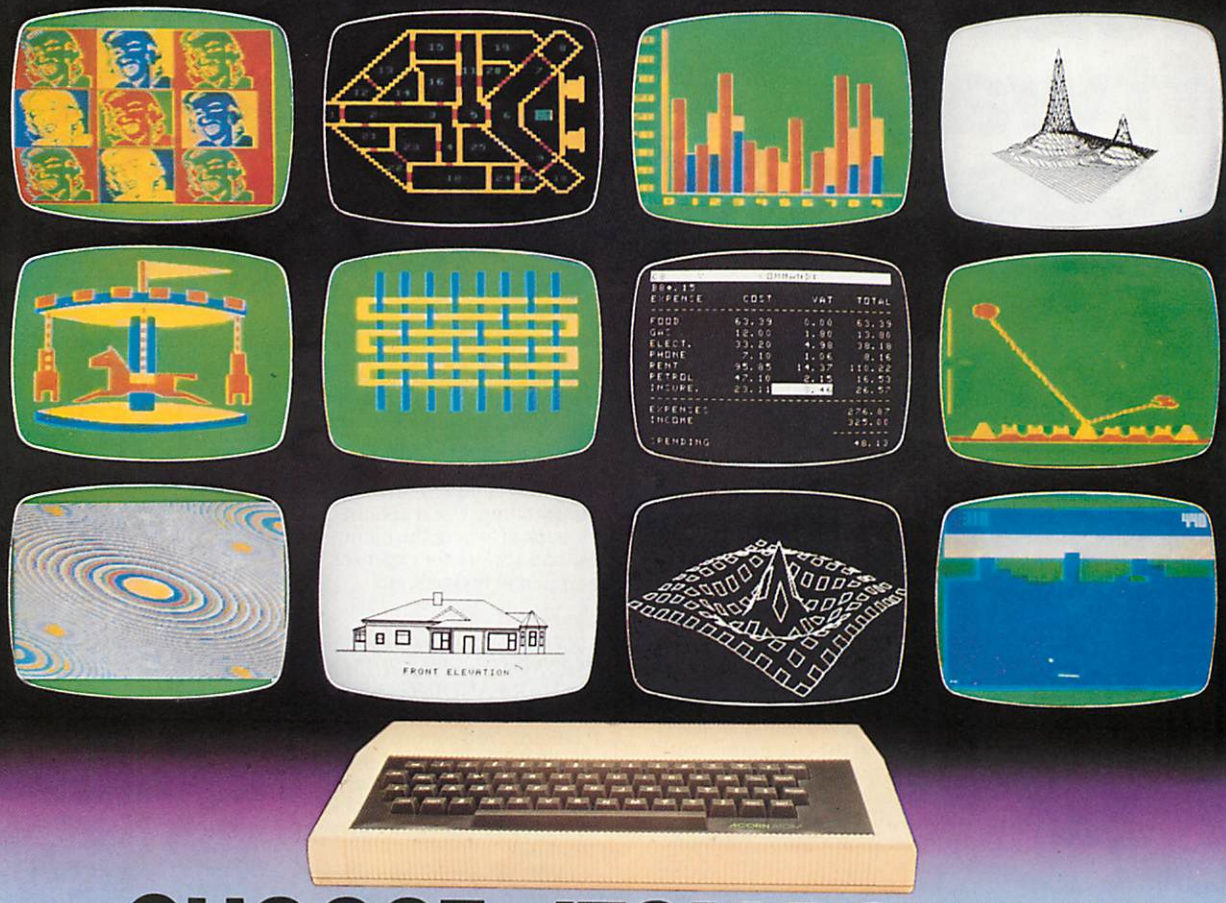
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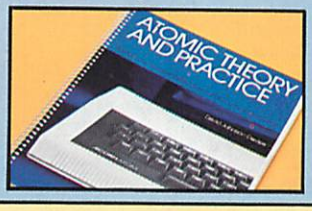
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Sprechen Sie Apfeldeutsch?

by Hugh Dobbs

APFELDEUTSCH is a German-teaching package published by Wida Software, who are actually Graham Davies and Tony Williams, an active member of the British Apple systems user group. It comes in three main sections: two textbooks, six audio cassettes, and nine discs of Apple programs.

The package grew from a Munich-based German course, *Grundkurs Deutsch,* and the first textbook is taken straight from that course. It is a reader, starting with simple dialogue and taking a humorous approach. The topics covered are practical, and if you follow the full course you should have no difficulty in taking a taxi, ordering lunch or moving inevitably towards an early divorce. . . .

The second textbook provides the supporting grammar exercises and glossary, and is partially translated from the original by Ingrid and Tony Williams, who have supplied English instructions for the first five lessons. Thereafter instructions are given in German, but helpful comments are given in diminishing doses until by the end of the book English appears only in the word-lists.

Educationally this approach seems sound, but a complete beginner might find the pace too fast at the start.

Throughout the second book a cassette symbol is printed by any exercise which is to be dealt with orally. The book refers to "Two cassettes with the texts of the textbook" and "Two cassettes with oral exercises" — but these are not the cassettes which are supplied in the package. Instead, the six cassettes provided proceed through the two books in parallel, reading from the reader, then going through the oral exercises based on that section, and continuing with *Hörverständnis* or aural-comprehension passages without written versions.

The dialogues seem dry at first, but they are always clearly read, although slightly under-acted. It is disconcerting to have to flip from one book to the other to see where the next passage comes from — sometimes it is from neither — and it means that you need both books, which is inefficient. Extra copies of the books are available from Wida, and these would be essential for class use.

The oral exercises are well-timed, with satisfactory pauses for your own efforts before the official answer is given. This is the standard audio-visual method, but it could be extended by using a second tape-recorder to record your responses. The aural passages are simple, not taken too fast, and are closely related to what came before them.

The computer-aided part of the course comprises a slim booklet entitled Apfeldeutsch, and a box containing nine discs. These are Wida's contribution, and tie the whole system together.

The booklet starts by giving a quick account of the origins of the package, and a flowchart for using it. The discs are intended for self-assessment, and fit into the general pattern: listen to cassette; listen again, this time following the passages in the textbooks; try the oral exercises; use the wordbook and read up on the grammar used; *then* use the appropriate disc; repeat until satisfied, then go on to the next lesson. The booklet also gives brief and simple instructions on how to start up your Apple, what to do if you hit Reset, and so on. Even hitting Reset is unlikely to cause any problems, because the package does not keep a record of your progress, and therefore there is no time when a disc-write could be interrupted — the usual cause of disc trouble.

Using a standard Apple for German has a few disadvantages, because the Apple character generator has only the 64-character ASCII set: only capital letters, no umlaut on vowels, no β. There is no satisfactory way around the first problem, unless you adopt the Apple-writer method of showing real capitals as black-on-white. It is a serious problem because German nouns always start with a capital letter, but the main intention of the course is that one should learn to speak rather than write in German. The Teletype convention is followed for umlauts, so that *Herr Müller* becomes *HERR MUELLER,* and so on. The symbol β, which often appears in written German, is simply replaced by a double s.

The discs contain a total, by my count, of 111 programs which test vocabulary, grammar, usage and so on. I have not tested every single program exhaustively. The booklet gives a list of contents for each disc, which corresponds closely, but not exactly, with the actual contents. There are at least four types of program: ordinary fixed questions, randomly-generated questions, animations, and last but not least a German version of Dave Bolton's Hangman. I left Hangman on the school Apple for a couple of hours, after which a pirate version appeared in English.

Each disc starts with the Apfeldeutsch logo. Disc 1 then gives you the chance of going through an introduction to the package, or of getting fuller instructions on how to work your Apple, before you proceed to the menu. The introduction is displayed one page at a time, with the particularly attractive feature of being able to read backwards through it in case you missed something.

The menu gives a list of all the programs on the disc, arranged according to the lesson number in the workbook, with a single-letter code for each. Pressing A will run the first program on the list, while on Disc 1, I will return you to the introduction. The ESC key returns you to Basic, which may or may not be desirable. At the end of each program you have the option of returning to the menu or to Basic, but you can leave before the end if you wish.

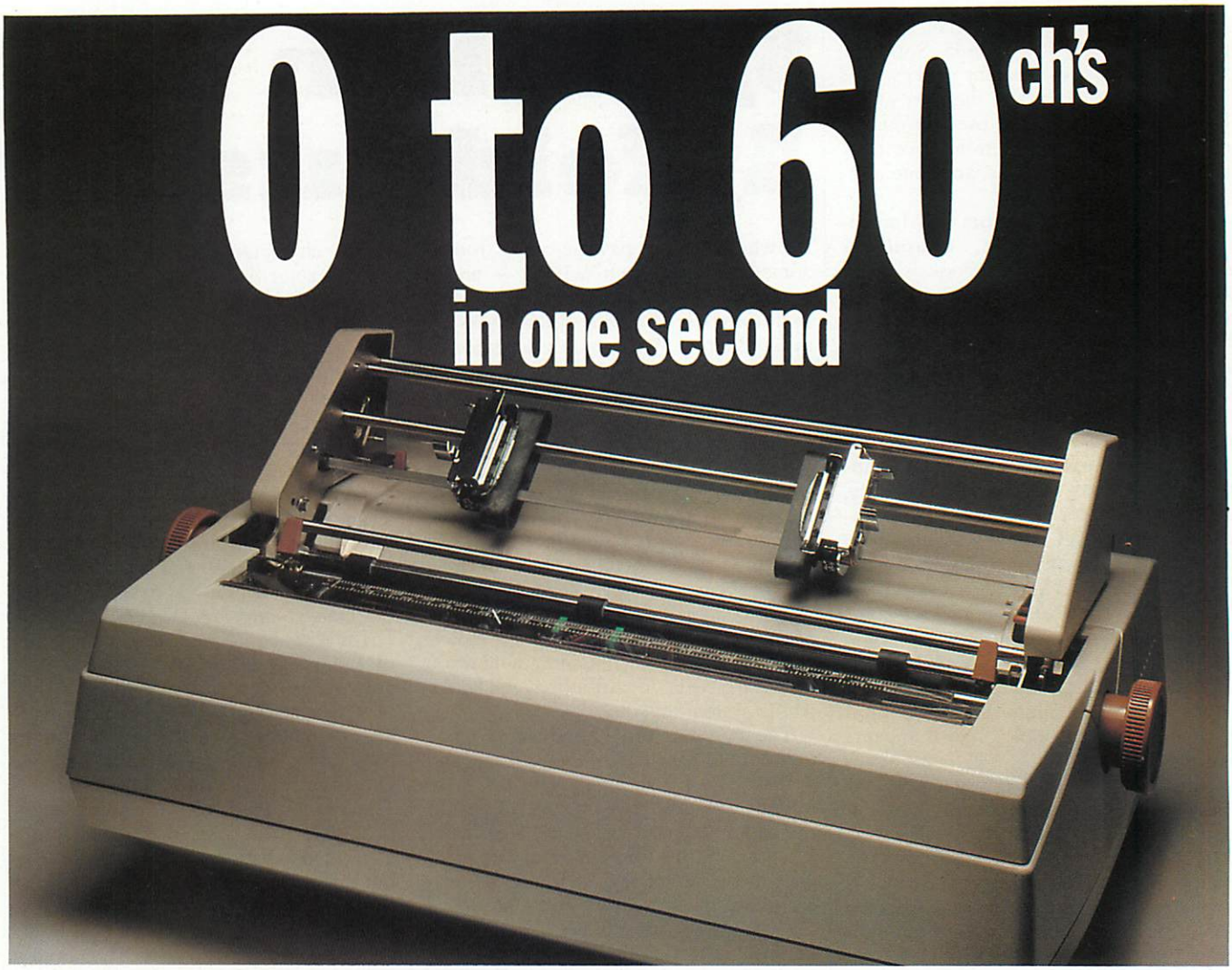
The first type of program, which has fixed questions and answers, is data-driven. In other words the question itself, any helpful notes, hints and the range of acceptable answers are all read from Data statements. The program structure allows a maximum of 10 strings for all of these.

The question is displayed, with the helpful notes if any, and you get two

(continued on page 103)



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PRINT ELEMENT	DAISY-WHEEL	DAISY-WHEEL	THIMBLE	DOUBLE DAISY-WHEEL	**DOUBLE DAISY-WHEEL**
AUTO BIDIRECTIONAL	Yes	No	No	No	**Yes**
AUTO LOGIC SEEKING	Yes	No	Yes	No	**Yes**
PROPORTIONAL PRINT CAPABILITY	Yes	Yes	Yes	No	**Yes**
EXTENDED CHARACTER SET	No	No	Yes	Yes	**Yes**
LETTER QUALITY PRINT	Yes	Yes	Yes	Yes	**Yes**
CUSTOM INTER-FACE OPTION	No	No	No	No	**Yes**
PRICE	£1675	£1950	£1950	£1450	**£1450**

The above information was gathered from distributors and abstracted from their current literature. Prices shown are those advertised at the present time.

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The Apfeldeutsch package includes nine diskettes and six audio cassettes.

(continued from page 101)

chances to answer it. If your first answer is wrong, the hint, if any, is displayed after the error message. I had never imagined that there were so many ways of saying "wrong!!!!" in German. Finally, if your second answer is also wrong, the first of the acceptable answers appears. If there is more than one answer, the only way of finding out what the others are, apart from actually hitting on them, is to List the program. If you get three questions wrong in succession, you may receive some useful advice. Not all the programs have this feature implemented yet; some simply have a line which says

```
REM INSERT HELP NOTES HERE
```

which is very helpful.

Input statements

In any case any question that you do not answer correctly at the first attempt will be asked before you leave the test or, in long tests, before you leave that section. You are scored on the number of correct answers as a percentage of the number of attempts, though this is only for your own amusement — or perhaps annoyance — since no records are kept by the programs.

The programs do not use the ordinary Applesoft Input statement, because of the difficulty of handling commas which are essential for the input of text in any natural language. Instead, Get is used to build up the input string. The backspace, left-arrow, acts as usual, except that when you reach the left-hand end you get a message Backspaced Too Far. The Re-type key, right-arrow, cannot be used; you have to re-type anything to the right of your mistake.

The input string is pre-processed by removing any excess spaces before it is compared with the various official answers. It should be emphasised that the questions and answers are based on the texts, as the questions can otherwise be slightly confusing. I watched one of our German students — German by origin, that is — wrestling with a problem: "Yes, quite a long way" said the program. *Ja, ein ziemlich langer Weg,* or something similar, said the student who was furious when the answer turned out to be simply *Ja, ziemlich.*

Because the answers are stored as Data statements, an answer such as *Ja, ziemlich* has to be enclosed in quotation marks in the program, or it would be Read as two separate pieces *Ja* and *Ziemlich* – two alternative answers. In at least one case the quotes are missing, and the official answer to quite a long question is simply *Gut.*

If you do not know the answer to a question you can call up the Help notes by typing H. This may simply produce a message such as "I can't really give you much help with this sort of test", or it may give a really detailed summary of a difficult topic. Alternatively you can type X to give up and have the answer displayed immediately, rather than wait until after your second wrong answer. In desperation you can even break into Irish. To break out of the program, type SOS followed by break or rest, and you escape with only a rude message from the authors.

At the end of a program you can either return to the Menu, quit, or choose to repeat the test. In at least one case, choosing to repeat causes a program crash. Line 1920 of Exercise 1-2 reads

```
1920 CLEAR : GOTO 50
```

where it should read

```
GOTO 3.
```

The Clear, among other things, clears an array. The Goto 50 avoids the Dimension statement for the array, so the Basic interpreter gives it the default size of 10- or 11 elements. The re-test proceeds smoothly until it reaches Question 11, when it crashes.

There are a few other bugs in the programs that I have tested. One repeats the same questions in an infinite loop — an error of logic that I have not located yet — but mostly there are minor problems with badly-edited Data statements. Print statements also give trouble: the screen formatting is inconsistent, and occasionally lines wrap around when they should not.

Tabs are interspersed with long quoted strings, and I despaired of getting a decent printout, especially as the particular program I was wrestling with at the time included a sequence of Control characters which actually turned off the printer. Since I was using the Silentype as a terminal at the time, in the absence of our television, this seemed a bit inconsiderate.

All of the programs expect answers in German only: translation is strictly a one-way process. This makes it the more surprising that at the start of each exercise, when you are asked "Do you need instructions for this test", the only answers accepted are Y and N, not J for Ja. In general there is a lot more English in the programs than elsewhere in the course.

A simple variation of the standard test is one where you fill in the missing conjunction, article, and so on. This works in the same way as the straight test, and again a few bugs appeared such as a missing "—" so that you can't tell where the blank is.

Intensive drills

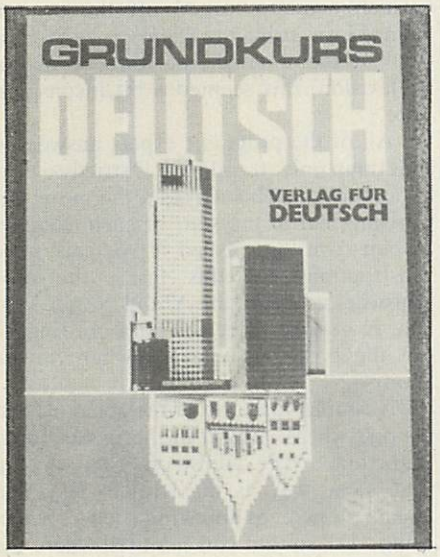
The animation routines show the ways in which word order changes under certain circumstances. For example, if you take a sentence with subject-verb-adverb, you can emphasise the adverb by putting it first, but the subject must move to a position after the verb. Thus *Sie gehen geradeaus* could become *Geradeaus gehen sie.* You are offered a sentence to re-arrange, by putting something other than the subject first. When your answer has been processed, as before, you are shown the original sentence. The phrase to be moved then goes to the front while the rest of the sentence shuffles along to make room for it. Finally, the verb and the subject change places while you watch.

The random-generator programs deal with time, numbers, money, and the conjugation of verbs — anything where intensive drill is likely to be useful. There is a relatively small range of options which can be put together at random to give a very large number of possible questions. For instance, if you combine 12 hours with 12 times past the hour, and combine that with perhaps eight different ways of actually expressing the time, you end up with 12*12*8=1152 questions. The program on time was one which I found particularly helpful, and it has the added attraction of a digital clock formed from stars.

(continued on next page)

(continued from previous page)

Hangman is entirely in German, and chooses words at random from data based on the first few chapters of the books. Articles — der, die, das — are included, but no space separates them from the nouns. In fact the program is intolerant of spaces in the data, as it encodes the letters as the ASCII value minus 64, and uses this as a pointer into an array. Because ASCII space is 32, this generates an illegal-quantity error. This happens for one word in the program, where there is a space right at the end of one Data statement; the only way to spot the source of trouble is to List the program in Inverse.



Low resolution is used for the man who is to be hung, and your wrong guesses are displayed in alphabetical order — a nice touch — until your final chance, when they suddenly vanish and you are left to take your last shot in the dark. If you set the word right, the reprieved victim waves his thanks before volunteering to risk his life again. It has the general fault of Hangman programs, of having not quite enough words, but there is no reason not to add to the list. It could be improved by allowing spaces to give:

— — — — — — —

becoming *das Taxi* rather than

— — — — — — —

becoming *dasTaxi.*

Testing program

There are bound to be bugs to be found in such a large collection of programs, and I must emphasise that every crash that occurred could be recovered from by following the instructions in the booklet. Because of the simplicity of the system, all that is needed is PR # G from Basic — or, rather faster, Run Menu. If you have the old F8 ROM, then a re-set will leave you in Monitor, but all you have to do is to repeat the cold-start procedure.

At the end of every program you can get back to the Menu, and because this has the same name on all the discs you can switch discs at this point to get the next Menu instead.

Apfeldeutsch is about as foolproof as any system I have seen, apart from VisiCalc which is in a class of its own. The structure of the programs is obviously applicable to other languages, and Wida sells a general-purpose testing program to which you add your own data.

The final judgement of any such package will depend on its effectiveness as an aid to teaching or learning. I cannot see the entire package being used for class teaching, though the cassettes and workbooks will probably be adopted for that purpose. The Apple part of the package is essentially individual, although it attracts interested onlookers, and it will be very useful for self-teaching and for reinforcement and correction of material covered in class. This use in turn depends on pupil motivation and on the correctness of the content, and on both these counts Apfeldeutsch scores highly. It will provide a most valuable background resource for German teaching and especially learning. The only trouble will be to organise the necessary amount of machine time.

Apfeldeutsch is obtainable from Wida Software, 2 Nicholas Gardens, London W5 5HY. It is guaranteed for one year against almost anything. It costs £99.00. The version tested here is recorded under DOS 3.2.1, but can be transferred to DOS 3.3 with no problems. ◻

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Business software: formatting for printed output

Charles Somerville continues his series with a description of the subroutines needed when information is to be supplied as hard copy.

WE HAVE defined a standard format for a VDU screen which would be used by all programs — see the July issue of *Practical Computing*. Use of a standard format allowed the bulk of the task of screen formatting to be undertaken by common subroutines.

The same approach can be adopted for printed output from a system. The standard format which we will use is demonstrated by the layout of the full listing report from the Historic Car Register system as shown in table 1.

If we analyse the report format shown in the table, it is made up as follows:

report date report title page number

(underlining for emphasis)

column headings for the detail lines which follow, printed in two lines for better use of space.

detail lines

This format is repeated on each subsequent page of the report.

To produce the report in this format, we will need coding to:

- read records from the car file, and select the correct ones for printing;
- print a detail line from each selected record;
- maintain line and page counts, and detect when a new page is required;
- print the title, page number and column headings after skipping to a new page.

In the coding given here, these functions are performed by a number of subroutines. The required calling sequence is demonstrated in lines 16000 to 16999, which form the coding for the menu option Print Full Listing in the Historic Car Register program.

DATE: 12/09/81 HISTORIC CAR REGISTER — FULL LISTING PAGE: 1

CAR NUMBER	MAKE	MODEL	REGISTRATION NUMBER	DATE FIRST REGISTERED
90	FERRARI	275 GTB4	SF 275	12/11/65
702	LOTUS	11 LE MANS	XTT 512	08/09/57
1002	JAGUAR	XK120	PRS 45	23/01/49
2034	MERCEDES	300SL COUPE	300 MER	20/09/60
2109	TRIUMPH	1800 ROADSTER	JRR 67	12/08/48
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

Table 1. Full listing of historic car register.

The calling routine first specifies the report title and column headings to be used. Title$ is loaded with the report title required, and Heading1$ and Heading2$ are set to the first and second lines of the column headings. It is a good idea to form the report title from the system name and the menu selection which produced the report. The recipient of the report then knows how to obtain another copy.

A call to the subroutine at line 50000 completes the building of the title line and the initialisation of line and page numbers. It is assumed that Today$ contains the current date, read in during system initialisation using the standard input routines.

A loop from lines 16050 to 16080 begins by calling the subroutine at line 51000, which reads the next record from the car file, and decides whether it is to be printed. In this case, all records are printed except where the car-number field is set to zero, showing that the record is unused. Toprint% is set to either Yes% or No% by the subroutine, to show whether the record has been selected for printing or not.

If, on return from this subroutine, a record is to be printed, a call is first made to the subroutine at line 52000. This checks whether there is room for the line on the current page. If not, it skips to the next page, and prints the title line and column headings. Note that the variable FF$ is printed to cause the printer to skip to a new page. Most printers use the ASCII-form feed code, Hex 0C, but to ensure portability of the program, FF$ should be loaded from the configuration file as with the VDU control characters.

The Read, Select, Page check, Print cycle is repeated until all records in the file have been read. The record-selection and printing subroutines (51XXX and 54XXX) will differ from one report to another. You should write those for your own application using the examples given as a guide.

A further point is that if you have an 80-column printer, you should replace 132 by 80 in line 50040.

This standard report layout may not suffice for some applications. In particular, where a report contains financial information, it is often desirable to total a particular field and to print the total at the end of the report.

For example, if we add a new field — estimated value — to each record of the car file, we can produce a report as shown in table 2.

(continued on next page)

Table 2. Amended listing, including estimated values.

DATE: 12/09/81 HISTORIC CAR REGISTER — SUMMARY BY MAKE PAGE: 1

CAR NUMBER	MAKE	MODEL	REGISTRATION NUMBER	DATE FIRST REGISTERED	ESTIMATED VALUE
90	FERRARI	275 GTB4	SF 275	12/11/65	£16,000.00
2209	FERRARI	365 GTB	DAY 1	02/01/70	£20,000.00
2498	FERRARI	275 GTS	ARC 566	30/04/65	£23,000.00
3287	FERRARI	SUPERFAST	500 FAS	19/09/66	£20,000.00
TOTAL FOR MAKE £79,000.00					
702	LOTUS	11 LE MANS	XTT 512	08/09/57	£11,000.00
.					
.					
.					
2167	MASERATI	3500	3500 TI	03/08/63	£9,500.00
TOTAL FOR MAKE £102,750.00					
TOTAL FOR ALL MAKES £1,360,300.00					

```
LISTING 1 - CODE FOR 'PRINT FULL LISTING ' AND PRINT FORMATTING

16000    'PRINT FULL LISTING
16010    TITLE$ = "HISTORIC CAR REGISTER - FULL LISTING "
16020    HEADING1$ = SPACE$(10) + "CAR" + SPACE$(12) + "MAKE" + SPACE$(26) + "MO
           DEL" + SPACE$(25) + "DATE FIRST" + SPACE$(8) + "REGISTRATION"
16030    HEADING2$ = SPACE$(10) + "NUMBER" + SPACE$(69) + "REGISTERED" + SPACE$(
           8) + "NUMBER"
16040    GOSUB 50000
16050    WHILE NOT EOF(CARFILE%) OR LINE% = 99
16060        GOSUB 51000
16070        IF TOPRINT% THEN
                 GOSUB 52000:
                 GOSUB 54000
16080    WEND
16999    RETURN

50000    'SET UP VARIABLES FOR NEW REPORT
50010    LINE% = 99
50020    PAGE% = 1
50030    RECORD% = 1
50040    FILLER$=SPACE$((132-25-LEN(TITLE$))/2)
50050    TITLE1$="DATE: " + TODAY$ + FILLER$ + TITLE$ + FILLER$ + "PAGE:"
50060    TITLE2$="---------------" + FILLER$ + STRING$(LEN(TITLE$),"-") + FILLER$
         + "---------"
50070    LASTBREAK$ = ""
50080    RETURN

51000    'GET A RECORD AND DECIDE WHETHER TO PRINT
51010    GET CARFILE%, RECORD%
51020    RECORD% = RECORD% + 1
51030    IF CARNUMBER$ = MKI$(0) THEN
             TOPRINT%=NO%
         ELSE
             TOPRINT% = YES%
51040    RETURN

52000    'CHECK IF A NEW PAGE AND TITLES ARE REQUIRED
52010    IF LINE% < 58 THEN
             RETURN
52020    LPRINT FF$ TITLE1$ PAGE%
52030    LPRINT TITLE2$
52040    LPRINT
52050    LPRINT HEADING1$
52060    LPRINT HEADING2$
52070    LPRINT
52080    LINE% = 7
52090    PAGE% = PAGE% + 1
52100    RETURN

53000    'CHECK IF A CONTROL BREAK AND SUBTOTAL ARE REQUIRED
53010    IF LASTBREAK$ = "" THEN
             SUBTOTAL# = 0:
             TOTAL# = 0:
             LASTBREAK$ = BREAK$ :
             RETURN
53020    IF BREAK$ <> LASTBREAK$ THEN
             LASTBREAK$ = BREAK$ :
             TOTAL# = TOTAL# + SUBTOTAL#
             LPRINT : LPRINT USING FORMAT1$; SUBTOTAL#: LPRINT :
             LINE% = LINE% + 3:
             SUBTOTAL# = 0
53030    ON LEN(AMOUNT$) GOSUB 53100 , 53200 , 53100 , 53300 , 53100 , 53100 ,
         53100 , 53400
53040    RETURN
53100    'ADD ONE TO SUBTOTAL
53110    SUBTOTAL# = SUBTOTAL# + 1
53120    RETURN
53200    'ADD INTEGER FIELD TO SUBTOTAL
53210    SUBTOTAL# = SUBTOTAL# + CVI(AMOUNT$)
53220    RETURN
53300    'ADD SINGLE PRECISION FIELD TO SUBTOTAL
53310    SUBTOTAL# = SUBTOTAL# + CVS(AMOUNT$)
53320    RETURN
53400    'ADD DOUBLE PRECISION FIELD TO SUBTOTAL
53410    SUBTOTAL# = SUBTOTAL# + CVD(AMOUNT$)
53420    RETURN

54000    'PRINT A DETAIL LINE
54010    LPRINT SPC(10)
54020    LPRINT USING "#####"; CVI(CARNUMBER$);
54030    CODE$="MAKES"
54040    CODING$=CARMAKE$
54050    GOSUB 36000
54060    LPRINT TAB(26) DECODE$;
54070    CODE$="MODELS"
54080    CODING$=CARMODEL$
54090    GOSUB 36000
54100    LPRINT TAB(56) DECODE$ TAB(86) CARDATENEW$ TAB(104) CARREGNO$
54110    LINE%=LINE%+1
54120    RETURN

55000    'PRINT FINAL TOTAL
55010    TOTAL#=TOTAL#+SUBTOTAL#
55020    LPRINT
55030    LPRINT USING FORMAT1$; SUBTOTAL#
55040    LPRINT : LINE%=LINE%+3
55050    GOSUB 52000
55060    LPRINT USING FORMAT2$; TOTAL#
55070    RETURN
```

(continued from previous page)

You will see that the file has been sorted into make order before printing. Whenever there is a change of make during printing, a subtotal line is printed, showing the total value of all cars of that make. At the end of the report, a grand total for all the cars is given.

Two further subroutines are required to produce these enhancements. One maintains the totals and checks a specified field to note when it changes value. This change is termed a control break. On a control break, the routine prints out the subtotal line in the required format.

The second subroutine prints out the subtotal for the final section of the report. It then prints out the final total, again in a specified format.

Summary by make

The use of these subroutines is demonstrated by the code to produce the Summary By Make listing, lines 17000 to 17999. The check routine for totalling and control break is called the prior-to-the-end-of-page check routine. The final-totals routine is called after the end of the input file is encountered.

To specify the field to be used as a control field, and that to be totalled, a second Field statement is used for the file being printed. This is shown by the line 20220. The field being used as a break field is defined as Break$ and the field to be totalled as Amount$.

Break$ can be of any length, and may contain any type of data. It could even cover two or more adjacent fields — say, Carmake$ and Carmodel$ to give a control break and subtotal on a change of make *or* model.

Amount$, on the other hand, will normally define a numeric field, which was converted to string format in the file by a MKI$, MKS$ or MKD$ function call. If the field is two characters long, it is assumed to contain an integer value. Four characters are assumed to contain a single precision value and eight a double precision value. The subroutine will carry out the correct conversion and addition.

To obtain a simple count of records printed, define Amount$ as a one-character field. The totals will then be incremented by one for each record read, regardless of the field's contents.

The subtotals and final total are printed using statements Lprint Using in the subroutines. The format specifications to be used are supplied by the calling routine. Lines 17050 and 17060 show how Format1$ and Format2$ have been set up for the subtotals and total respectively for this report. For more details on setting up formatting strings, you should consult the manual for our implementation of Basic.

If you want to start a new page on each control break, simply replace Line%=Line%+3 by Line%=60 in line number 53020. This will force a new page when the next detail record is printed.

Sorting the car file into the correct order is not a topic covered here, because sorting has been dealt with at length in recent issues of *Practical Computing*.

You should now extend the Historic Car Register program as follows:

- Add the estimated value field to each record on the file. If you have already put some effort into building up a car file to try out these routines, you can copy and extend it using the program in listing 3. Listing 2 includes the new Open and Field statements to be used with the file.
- Update the Add New Car and Display Update Car Details routines to allow for the value field. Use the latter routine to update the values of the cars on file if you have copied an existing file as described.
- Write the code for the menu option Print Details For One Car. Let the Record Read/selection routine ask for the number of the car in question, and remove the While and Wend statements used in the other printing routines so that only one line is printed.

LISTING 2- CODE FOR 'PRINT SUMMARY BY MAKES'

```
20200     OPEN "R" , CARFILE% , "CARFILE" , 28
20210     FIELD CARFILE% , 2 AS CARNUMBER$ , 8 AS CARDATENEW$ ,
              8 AS CARREGNO$ , 1 AS CARMAKE$ , 1 AS CARMODEL$ ,
              8 AS CARVALUE$
20220     FIELD CARFILE% , 18 AS FILLA$ , 1 AS BREAK$ , 1 AS FILLB$ ,
              8 AS AMOUNT$


17000     'PRINT SUMMARY BY MAKE WITH VALUATIONS
17010     CALL sort to put file in make order
17020     HEADING1$ = SPACE$(10) + "CAR" + SPACE$(12) + "MAKE" + SPACE$(26) + "MO
          DEL" + SPACE$(25) + "DATE FIRST" + SPACE$(8) + "REGISTRATION" + SPACE$(
          6) + "ESTIMATED"
17030     HEADING2$=SPACE$(10) + "NUMBER" + SPACE$(69) + "REGISTERED" + SPACE$(8)
          + "NUMBER" + SPACE$(12) + "VALUE"
17040     TITLE$ = "HISTORIC CAR REGISTER - SUMMARY BY MAKE"
17050     FORMAT1$="TOTAL VALUE FOR MAKE $$######.##"
17060     FORMAT2$="TOTAL VALUE FOR ALL MAKES $$#########.##"
17070     GOSUB 50000
17080     WHILE NOT EOF(CARFILE%) OR LINE% = 99
17090          GOSUB 51000
17100          IF TOPRINT% THEN
                    GOSUB 53000:
                    GOSUB 52000:
                    GOSUB 54000
17110     WEND
17120     GOSUB 55000
17130     CALL  sort to restore file to original order
17999     RETURN
```

LISTING 3 COPYCAR FILE ADDING VALUE FIELD

```
1000      OLDFILE%=1
1010      NEWFILE%=2
1020      OPEN "R" , OLDFILE% , "CARFILE" , 20
1030      FIELD OLDFILE% , 20 AS CARDATA$
1040      OPEN "R" , NEWFILE% , "CARFILE.NEW" , 28
1050      FIELD NEWFILE% , 20 AS COPYDATA$ , 8 AS CARVALUE$
1060      LSET CARVALUE$=MKD$(0)
1070      FOR RECORD% = 1 TO 9999
1080           GET OLDFILE%, RECORD%
1090           LSET COPYDATA$=CARDATA$
1100           PUT NEWFILE% , RECORD%
1110           NEXT RECORD
1120      CLOSE
1130      KILL "CARFILE"
1140      NAME "CARFILE.NEW" AS "CARFILE"
1150      RESET
1160      END
```

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Practical systems for speech synthesis

Simulated speech can now be provided by a number of single-chip devices. M Lancaster gives an overview of the principles of speech synthesis and the ways of overcoming the problems of putting the principles into practice.

THERE ARE now several speech-synthesis products coming on to the market for personal computers, and there are quite a few different ways to synthesise speech for computers. Although these methods have been known for some time, custom designed and produced LSI — large-scale integration — chips are a recent development.

There is a vast number of potential applications for these speech-synthesis products. The field of computer technology alone offers a multitude of applications. With speech-synthesis techniques the computer operator need no longer be tied to the visual display unit; he can perform other tasks while the computer gives him information in the most widely-used form of human communication — everyday speech.

At present computers cannot interact with non-readers such as young children, illiterate adults or the blind. Programs to teach reading or simply interact with such people would be extremely useful.

Synthetic speech is not limited to use in computer peripherals. When used with, say, a dedicated microcomputer or digital controller, a stand-alone device could be produced. Such a unit might be a reading machine for the blind or a communications aid for those unable to speak properly. Such a device could be produced using today's technology, and would be about the size of a calculator, and use batteries for its power supply.

Other applications areas for speech-synthesis include entertainments such as talking chess, card games, star trek, and so on. These applications are limited only by the programmers' imaginations.

The first known practical machine to generate speech was developed in 1791 by Wolfgang von Kempelen, a Hungarian engineer whose machine was based on a surprisingly detailed understanding of the mechanisms of human speech. He was not taken seriously at the time because he had previously produced a chess-playing machine which was found to contain a legless Polish chessmaster.

In 1820 a Viennese professor called Joseph Faber built a machine which could carry on a normal conversation when operated by an exceptionally skilled person. The machine was demonstrated in London where it sang *God Save The Queen*. Both the von Kempelen and Faber machines were mechanical analogues of the human speech system. Bellows were provided to simulate the lungs, reeds for the vocal cords and various resonant cavities were used to simulate the mouth and nasal passages.

Rapid development

The basic method of modelling the human vocal tract was again used in the late 1930s at Bell Laboratories in the U.S. This time the vocal tract analogue was electrical. The Voder (Voice Operation DEmonstratoR) was first shown at the 1939 World Fair in New York. This system consisted of a signal generator producing a buzz to simulate the vocal cords, a noise generator to simulate the rush of expired air, and a series of frequency filters to imitate the resonant or preferred frequencies of the human vocal tract, called format frequencies. The original Voder had to be played by highly-trained operators using an organ-like keyboard.

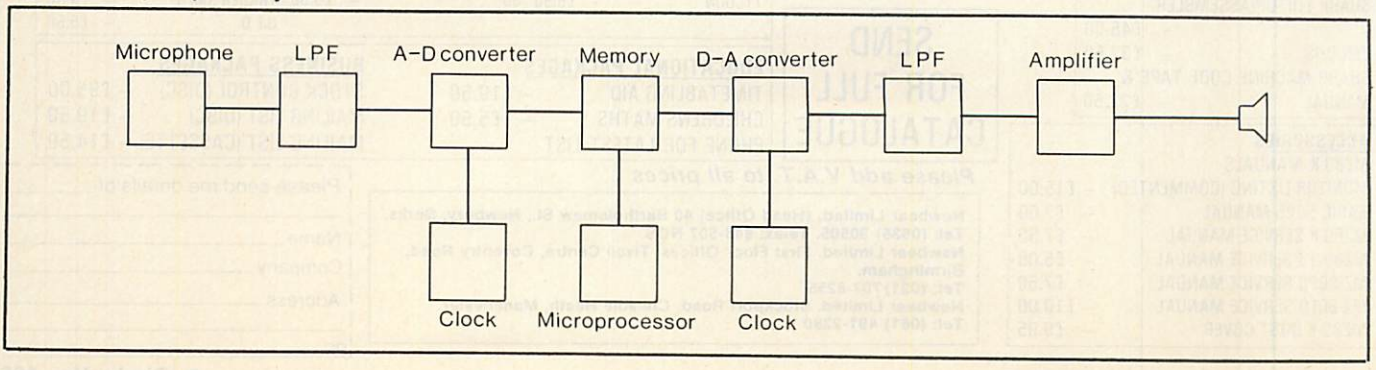
With the advent of computers speech synthesis has developed rapidly. The simplest method concept of producing speech output from a computer is detailed in the block diagram of figure 1. Speech is taken from a microphone and then sampled by an analogue-to-digital converter. This changes the level of the speech signal from the microphone to a digital number which is then stored in memory. When the computer needs to speak, the digitised values are sent to a digital-to-analogue converter, put through a low-pass filter to get rid of the sample frequency, and then passed via an audio amplifier to the speaker.

If we assume human speech has a maximum frequency of 8kHz, we need to sample this speech by the analogue-to-digital converter at 16Hz to reproduce the speech correctly. If we do this, we have effectively recorded the speech. It is possible to sample the speech at 6kHz and still get understandable speech back.

Consider a sample frequency of 6kHz. On every sample a single byte number representing the level of the audio signal at a particular time is obtained. This means that we need 6,000 bytes of memory for every second of speech, clearly this technique would require a large amount of memory and a disc system would be required to store any significant amount of vocabulary. When outputting the data, the computer needs to output a value every 0.17ms. — a data rate of 4,800 bits per second. This will allow the computer little time to do anything else.

The major problem in producing speech-synthesis units has been how to reduce the memory storage requirements and data-rate output from the computer while maintaining good-quality speech. This has been solved in two main ways. First by data-compression techniques on the sampled data and custom-integrated circuits to decompress the data on output. Second, by using an electronic model of

Figure 1. Simple speech system.



the human vocal tract as was done in the original voice synthesisers.

The Digitalker DT-1050 from National Semiconductor is one of the new LSI integrated circuits which produces speech. This circuit is based on data compression techniques on sampled data. When the speech is digitised and put into memory, the data is put into a more compressed form. The DT-1050 chip uses internal circuitry to expand the compressed data and produce an audio output. Words are stored in ROM and currently cannot be encoded by the user; the vocabulary is fixed at 144 words which can be stored in two 64K ROMs.

The data-compression technique uses an algorithm developed by Forest Mozer at the University of California, Berkeley. The main compression technique is delta modulation, which compresses data by storing the difference between the values of successive samples. This difference is lower than the actual sample magnitudes, and therefore can be stored in fewer bits — four in the case of the DT-1050. During reconstruction successive values are added to the previous values to give the correct audio waveform. This system also uses two other compression techniques — phase-angle adjustment and half-period zeroing.

Phase-angle adjustment uses the fact that the intelligibility of human speech is not affected by the phase-angle of the fourier, or frequency, components of the waveform, so that the data can be reduced by half. Half-period zeroing compresses by reproducing as zero certain low-amplitude areas of the waveform.

Using this method, speech output for a computer can be generated with a board containing two 64K ROMs and a little interfacing circuitry. The method produces good speech in return for reasonable memory requirements and low data rates from the computer. Currently it offers only a limited vocabulary, however.

The digitisation of speech as a method of making a computer talk has only come about by the use of fast-sampling analogue-to-digital converters. The original way to make a machine talk was to model the human vocal tract. In fact this method is widely used today, as it offers very low data-rates and extremely low memory requirements.

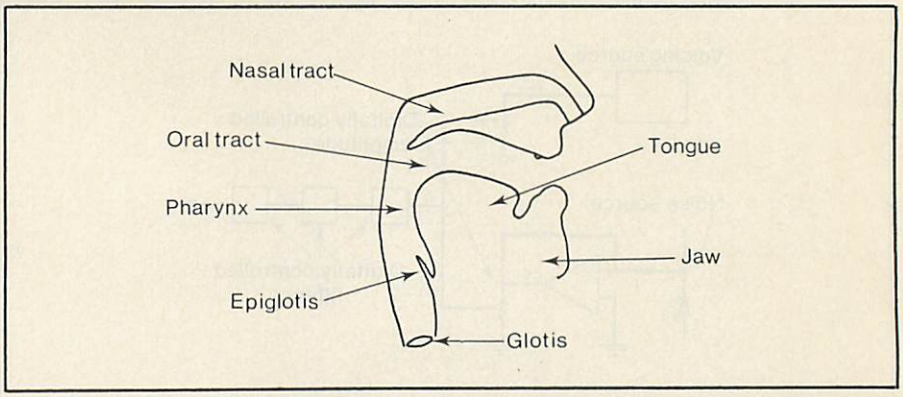


Figure 2. The human voice tract.

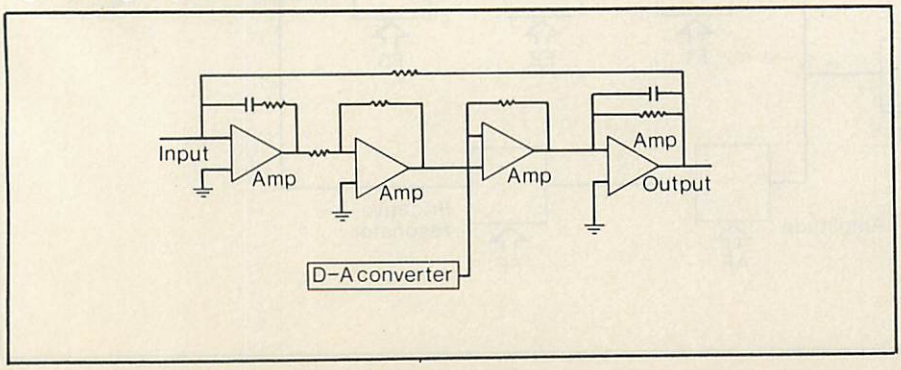
The human vocal tract is shown in figure 2. The vocal system consists of an air-filled tube about 16-18cm. long, together with several other structures and cavities which make the air respond in different ways. The tube begins at the glottis or vocal cords where an initial buzz is made by air passing over them. Because of the tube and cavities the buzz resonates at preferred frequencies dependent upon the size of the cavities. These resonant frequencies are called format frequencies. These cavities are not constant in size, however, so the format frequencies can be raised or lowered.

To model this part of the speech system we need only a signal generator to produce the buzz and a selection of digitally-controlled filters to model the resonant cavities — the digital control would alter the resonant frequencies of the filters. A typical filter is shown in figure 3. A set of these filters — perhaps three — is enough to generate all the vowel sounds in the English language. For certain vowels, like those in *bay* and *boy*, it is necessary to sweep the format frequencies; this corresponds to moving the tongue rapidly from one position to another in the mouth.

Most consonant sounds consist of various pops, hisses and interruptions imposed on the vibrating column of air. There are various ways of stopping the air — by the lips, tongue to teeth, or tongue on to the roof of the mouth. When the air is released it produces a burst of noise as air rushes out. The shape of the vocal tract also has an effect upon this sound. To model this we need to add a noise source to our model as is shown in figure 4. This consists of a zener diode whose breakdown voltage is applied to it. This voltage is amplified to give noise which is passed to a digitally-controlled amplitude circuit, and then to the filters.

Another group of consonants — m, ng, n — consist of nasal sounds. These can be generated easily by another filter tuned to a frequency of about 1,400Hz. Finally another group of consonants are fricatives — s, sh, z, zh, fv, th, and the related ones, ch, j. These are, again, noise pulses but differ from the others in that they do not use the vocal tract, so this noise can be directly outputted. The final model is shown in figure 5. We have now nine digitally-controllable parameters for the computer to control.

Figure 3. Digitally-controlled filter.



Microspeech 50

To drive this system from a computer requires a rather lengthy program. Usually the program translates phonetic code into the correct controlling parameters. A phonetic code is a code used to describe the particular sounds in the language; by combining them in the correct order it is possible to construct any word relatively easily. This type of system has a very low memory requirement, typically 15 bytes or less per second of speech, but with the use of the driver program, the data-rate output from the computer is higher. An example of such a device is the Microspeech 50 designed by Tim Orr for the 6800 microprocessor; a large driving program for the conversion of phonetic code is provided.

Vortrax is an American company which has been producing speech synthesisers for quite a long time. Until recently, however, the company produced discrete-component units like the one described above using the vocal-tract model method. Now it has announced the SC-01, a single-chip speech synthesiser. The chip is contained in a 22-pin dual-in-line package fabricated using CMOS technology. Latched parallel inputs provide a direct connection to a microcomputer data bus or parallel port. A master clock input on the SC-01 permits a variety of voice effects, and highly-textured sound

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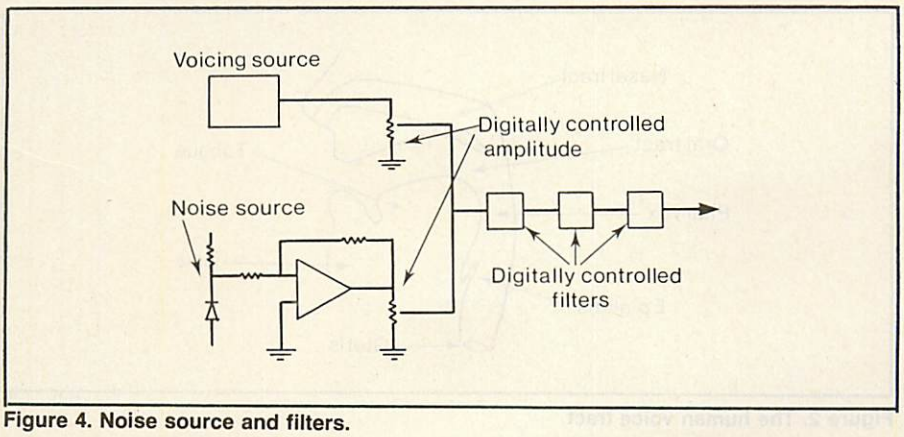


Figure 4. Noise source and filters.

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effects can be generated. The chip is based on the model of the vocal tract already described. It has four format frequency filters, a voiced source — the buzz — and a fricative source — noise. In addition it has phoneme-to-control parameter algorithm on the clips, and allows direct input of phonetic code. This offers a data rate of only 70 bits per second for continuous speech.

Unlimited vocabulary

The phonetic-code input to the SC-01 requires six bits per phoneme; there are therefore 64 phonemes. The device offers 25 different consonant sounds, 36 basic vowel sounds and two pause phonemes, the 36th being a Stop phoneme. This code is compatible with previous discrete Vortrax speech synthesisers. An example of this code, using Vortrax mnemonics is

T-W-EH2-N-T-Y.

When this is input, the synthesiser says "twenty". There are only 36 bits — 4.5 bytes — needed to store this word. A 1,000-word vocabulary would require about 6,000 bytes of storage which compares favourably with the other methods. There is also the advantage of an unlimited vocabulary.

The Texas Instruments TMS-5100 is also a new single-chip speech synthesiser. It differs from the other devices in the method used to encode the speech data. The method used in this case is called linear predictive coding, and can be described as a mixture of the above two methods. The speech is sampled and stored as with the Digitalker, but the method of data compression is completely different. A complex algorithm is used to transform the data. Instead of compressing the data in the time domain, this algorithm first transforms the data to the frequency domain. In other words, it finds the different frequencies which make up the sound.

The results will be similar to the data used to drive the vocal-tract model, because this also uses a frequency-domain approach. This data is then stored in ROMs. The TMS-5100 is fed this linear-predictively coded data, and uses it to drive a 10-pole digital filter, similar to the format-frequency filters in the vocal-tract model. The speech is then reconstructed. The linear-predictive method can reproduce the character of the original sound including accent, dialect, intonation and pitch. An example of this kind of speech can be heard in the TI Speak & Spell spelling toy; this uses the TMC-0281 NL chip, which contains exactly the same data and processing circuitry as the TMS-5100.

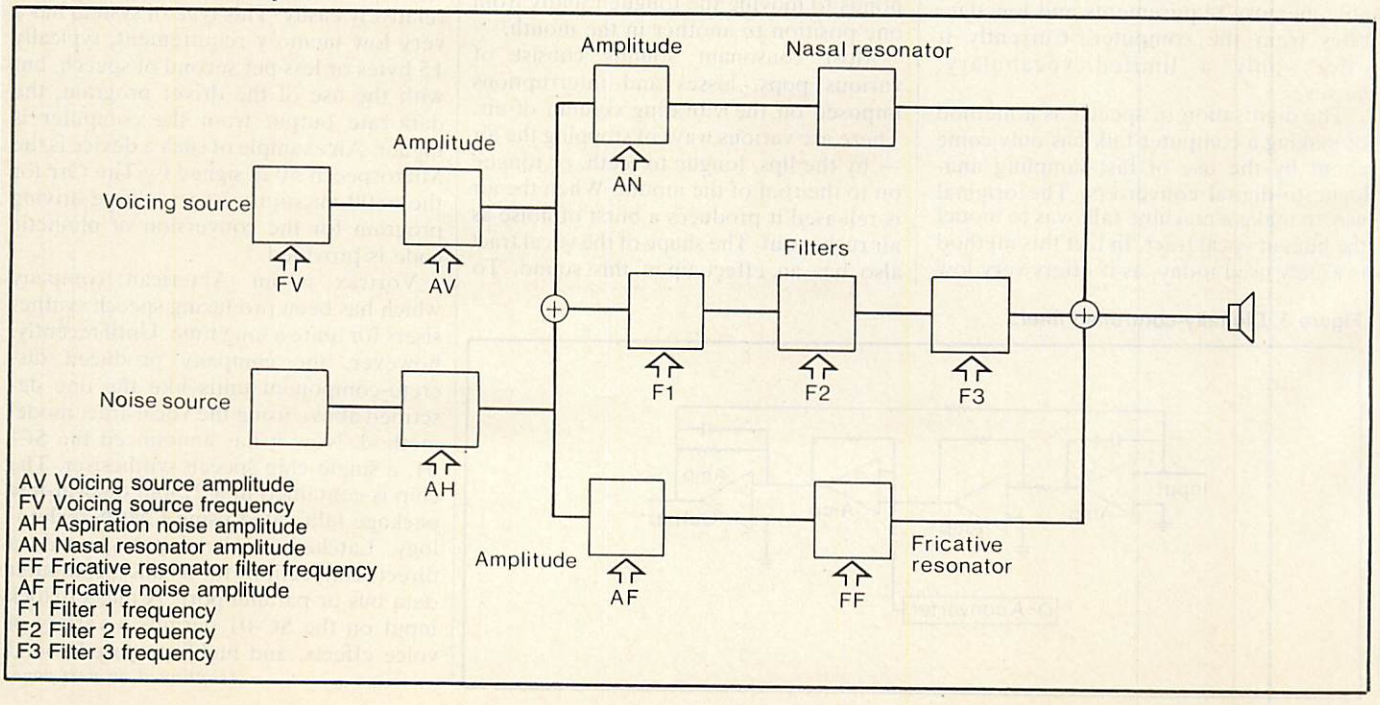
The storage requirements are low. From four to 49 bits are needed to store each sound pattern, which is updated every 20 milliseconds. This results in an overall data rate of 2,400 bits per second. A 64Kbyte ROM will store approximately 600 words.

Different techniques

The TMS 5100 can be configured as a computer peripheral by the addition of ROMs for data storage, control interface circuitry, a ROM address counter, a data multiplexor and an audio amplifier.

The three devices described above are not the only single-chip speech synthesisers on the market, but they demonstrate the main techniques. General Instruments and Intel use the format synthesis or vocal tract model method, Matsushita the linear-predictive coding method. The main aim of these different techniques is to reduce the amount of data, and hence reduce the amount of memory required to store words. There is usually a trade-off between storage requirements and speech quality. The Vortrax synthesiser does not produce such good-quality speech as the other two devices described, but makes up for this failing by its unlimited vocabulary. This is a very important advantage when the device is used for personal computer applications, but is not so vital when used for a specific voice application.

Figure 5. The complete system.



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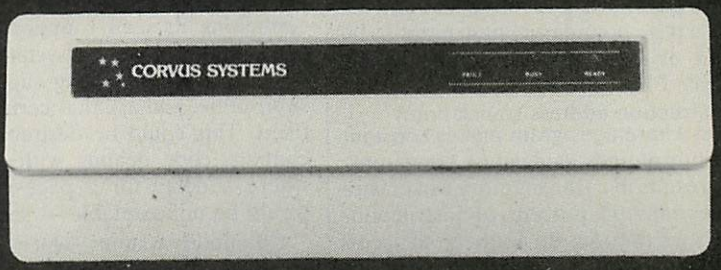
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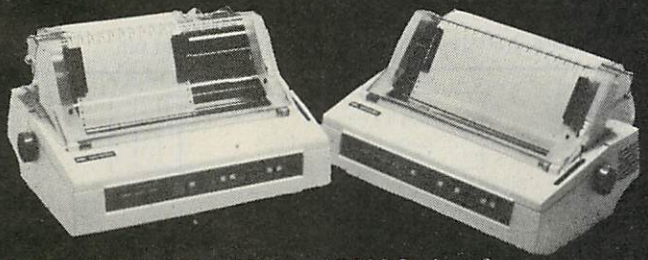
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Making the most of virtual storage systems

by Michael Bloor

THERE ARE two main ways to increase the speed of the simple system of virtual storage demonstrated in the October issue of *Practical Computing*. We can speed up the memory accesses needed for translation, or reduce the number required.

To speed page-table access, the page table could be held in a section of memory with a shorter access time than the main memory. Many mini and mainframe computers incorporate a small — in proportion to the size of main memory — 'cache' storage with a relatively fast access time. Part or all of this storage can be used to hold the page table.

Cache memory tends to cost more than the standard memory, however, and it is not always feasible to devote much of it for address-translation purposes. We reach a compromise solution, therefore, by keeping the results of the last few address-translations in the cache memory.

This can be surprisingly effective. In most cases an instruction address to be translated will be contained in the same virtual-storage page as the previous instruction. This will not be the case if the program executes a branch to code in another page, or consecutive instructions bridge a page boundary, but in perhaps 90 percent of cases the translation can be performed merely by referring to the last instruction address translation.

Even where a program makes constant use of subroutines, saving just a few translation results in cache memory can ensure that perhaps 95 percent of instruction-address translations do not need to access main memory.

Remember each result refers to a complete page containing 500 or more machine-code instructions.

Data may also be grouped in a small number of pages, depending upon the programming language used and the style of the programmer, so we might expect 80 percent or more of all translations to be performed without accessing main storage.

In some machines, separate cache memories exist for address translation and for other purposes. Where such a memory is solely devoted to address translations, it is sometimes known as the translate look-aside buffer.

Translation results held outside the main page table must not be allowed to become inaccurate when paging operations between memory and disc take place. Paging will only take place once in many thousand translations, so we can dispense with results currently held in cache memory after a paging operation, and start building a new list from scratch.

We may page-out some parts of the operating system, but we should not, for example, page-out the paging supervisor.

The paging supervisor must have some way of knowing what pages are to remain 'fixed' in memory. It is possible to use the low-order bit of each entry in the page table to show if the page is currently in memory. This is because page-frame addresses always end with 11 bits of zeros in a system with 2K pages. Another of these bits can be used to mark that a page is fixed in memory.

When the system is initialised, the paging supervisor will mark as fixed the pages containing its own routines and crucial parts of the operating system. Programs can also call the paging supervisor as a subroutine, and ask that certain pages be fixed. This could be desirable if a page contains code dealing with applications where a delay for a page-in operation would be unacceptable — see figure 1.

Computer systems which incorporate virtual storage will normally be multi-user systems, and users will usually be allocated memory for program and data storage by an allocation subroutine in the operating system. In contrast, many small, single-user systems assume that all the memory left after the operating system has been loaded is available for a single user.

Systems allocating memory to separate users commonly implement some kind of storage-protection arrangement. This will be designed to stop a user referencing or altering memory allocated to another user. It will also prevent references to unallocated memory, on the grounds that these must be erroneous. As part of the storage-protection arrangement, we can use another bit in each page-table entry to show that the page is invalid, in that it has not been allocated to any user. If a program attempts to use such a page, the translation hardware will intercept the operation and signal an error — see figure 2.

To make sure that such errors are noted as early as possible in the translation process, a system may use a number of page tables and a segment table instead of a simple page table. Elements of the segment table point to page tables rather than page frames. Thus a 4Mbyte computer system might have 64 page tables, each mapping 64K of virtual storage. Each page table would have 32 entries, one for each 2K page. The segment table would have 64 entries, each pointing to a page table.

A complete 64K block of unallocated virtual storage can be shown by a segment-invalid bit in the appropriate element of the segment table — see figure 3.

Translation now takes place using the segment table followed by the appropriate page table. Since the segment table is small, it can be held entirely in cache memory. If the system allocates memory to users in 64K blocks, all references to unallocated memory will be detected by the translation hardware using information in the cache memory alone. Since we are referring to virtual memory, 64K is not as large a figure as it may seem.

Programs can be prevented from reading or updating memory owned by another user by having an ownership key associated with each page of virtual stor-

Figure 1. Page-table entry with page-fixed bit.

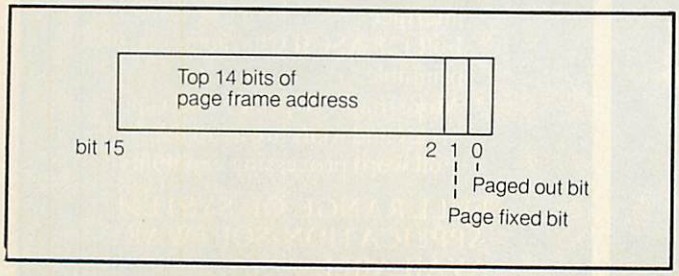
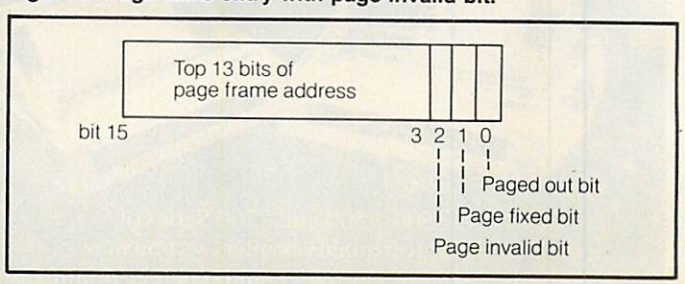


Figure 2. Page-table entry with page-invalid bit.



age. Each current user is given an identification number by the operating system, and the memory-allocation routine sets the key of each page allocated to the identification number of the new owner. The key can be just a single byte in cache memory, which would allow for up to 256 concurrent users.

Whenever information is read from or written to memory, the computer hardware can check the identification number of the current user against the ownership key for the page accessed. An illegal attempt at referencing or updating another user's memory can thus be intercepted and an error reported.

In practice, the scheme may be rather more complicated. Some systems maintain ownership keys for page frames rather than pages. This means that page-in operations must update the ownership key of the page frame filled. A user may also be allowed to read, but not alter, certain parts of storage which he does not own. In particular, we may want programs to be able to read information from memory used by the operating system.

If a page-in is required when all the page frames of real memory are occupied, the paging supervisor must select a page currently held in memory for replacement. Paging can be reduced by an appropriate method of selection.

The system may maintain a usage key for each page frame as an aid to the paging supervisor. Once again the keys may be held in cache memory. When data is read from a page frame, a page-frame-referenced bit will be set on in the usage key. If data is written to a page frame, including data read in from peripherals, a page-frame-updated bit will be set on.

When a page must be replaced, the paging supervisor inspects the usage keys, searching for a page frame which has not been updated. Such a page can be replaced without a page-out, as an identical copy of it already exists in the page file. The paging operation will therefore need only one input/output operation rather than two.

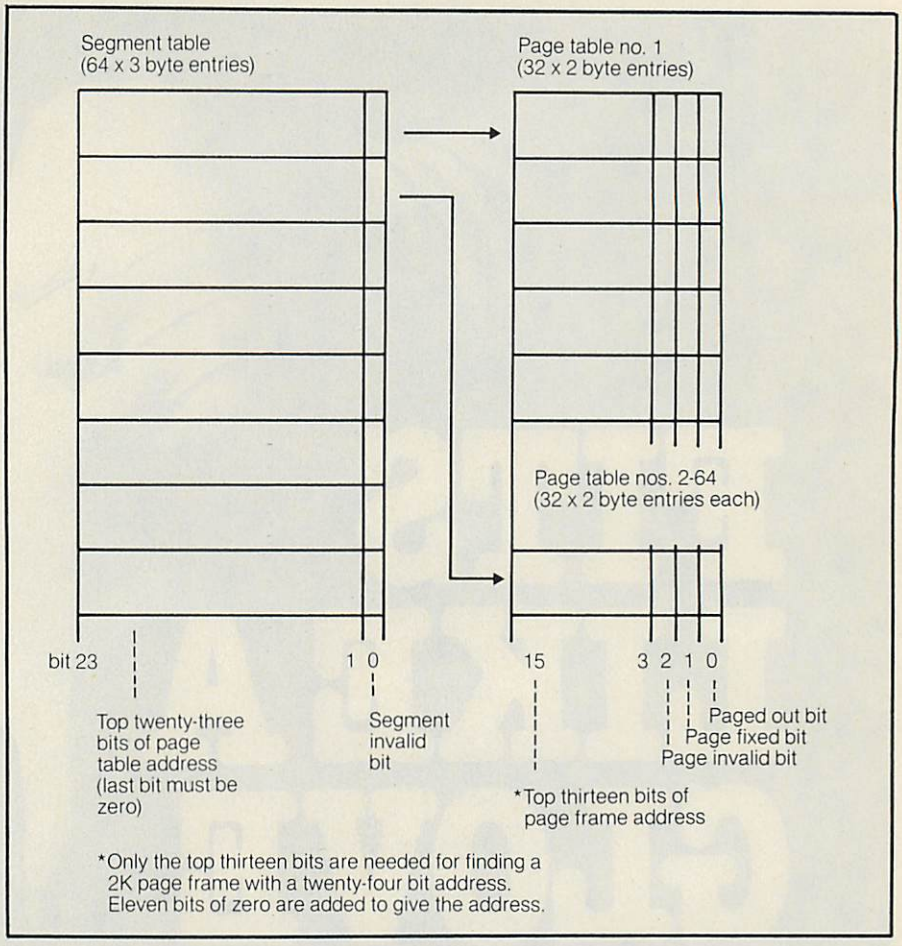


Figure 3. Segment and page-tables for 4Mbyte system.

If a page is found which has been neither updated nor referenced, then it must be memory allocated to a user but not in use. This too can be replaced without a prior page-out, and is an even better candidate for replacement.

After the new page is paged in, the usage key of the page frame selected is reset to the not-referenced, not-updated state — see figure 4.

A more sophisticated paging supervisor will make periodic inspections of the usage keys. It will note the status of each key before re-setting it to the not-referenced, not-updated state. In this way the paging supervisor will know not only whether pages have been referenced and/or updated, but also how recently.

Using this knowledge, the paging supervisor maintains page queues from which it selects pages for replacement. The layout of the queues is shown in figure 5.

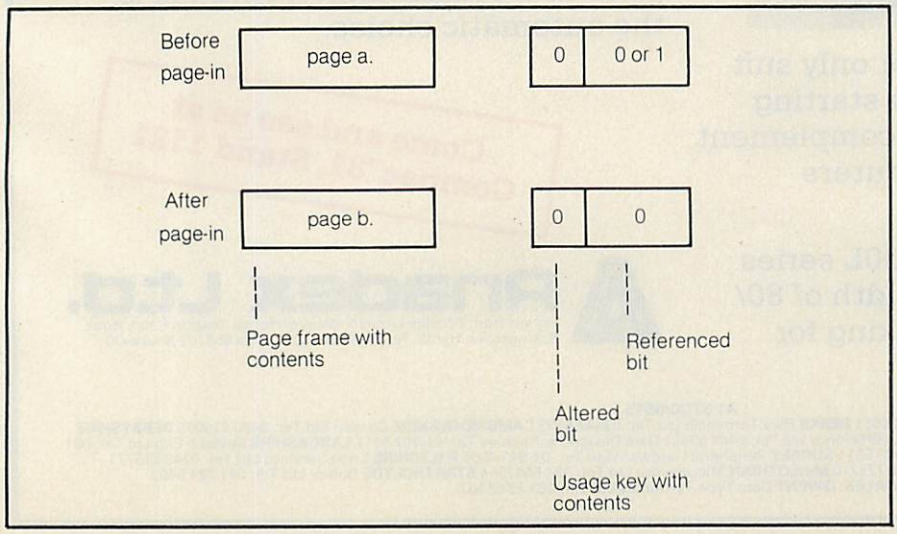
Pages for replacement are selected, when possible, from queue 1. Pages at the top of the queue, the least recently used, are selected first. If queue 1 becomes empty at any point — that is, all pages in real memory have been updated at some time — the page supervisor chooses a page for replacement from queue 2, and so on. Pages which are fixed cannot be replaced, and are excluded from the queues.

The paging queues could also be arranged so that pages belonging to high-priority users are lower down the queues, and therefore less likely to be replaced. This is unlikely to be necessary, however, as a high-priority user will be able to make frequent use of his pages, and they are therefore unlikely to come to the head of a queue.

Many computer systems use direct-memory access, DMA, controllers for input and output. With these, the CPU does not have to transfer each byte between memory and an I/O port.

(continued on page 123)

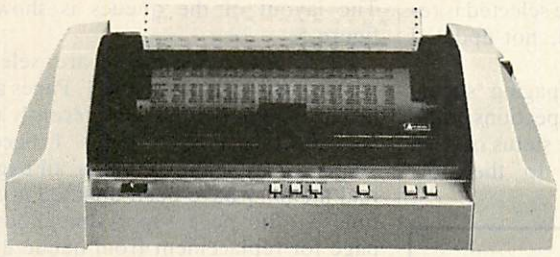
Figure 4. Replacement of pages without page-out.





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(continued from page 121)

Instead it informs the DMA controller of the address of the data buffer, the length of the buffer, the peripheral being used and the direction of transfer — input or output.

The CPU's work lies in initiating, not undertaking, data transfer, and it is free to carry out work for one user while I/O for another takes place under the control of a DMA controller. In large systems there may be a number of DMA controllers, or channels as they are sometimes known, all of which can operate concurrently.

A program expects, of course, that data read in for its use will be placed in contiguous locations in virtual storage. Similarly, it expects to write out data from a contiguous buffer. If a buffer is contained in a single page of virtual storage, then the virtual address of the buffer can be translated to a real address before data transfer takes place, either by the CPU or the DMA controller itself.

Should the buffer span virtual storage pages, the translation becomes more complex. Although the pages which contain the buffer will be contiguous, the page frames containing the pages need not be. This means that if the page table contains the information shown in figure 6, a simple request to read in 4,000 bytes to the buffer at hex EF00, virtual, may have to be translated to requests to:

- Read 256 bytes into Hex 3F00, real, onwards.
- Read 2,048 bytes into Hex 8800, real, onwards.
- Read 1,696 bytes into Hex 3000, real, onwards.

Before this translation can take place, all the pages concerned must be paged in. They must also be marked as fixed for the duration of the I/O. This prevents the paging supervisor re-allocating the page frames used, after the CPU has initiated the I/O, but before the DMA controller has completed it. As we have already noted, page frames into which data is read must also have the altered bit set on in their usage keys.

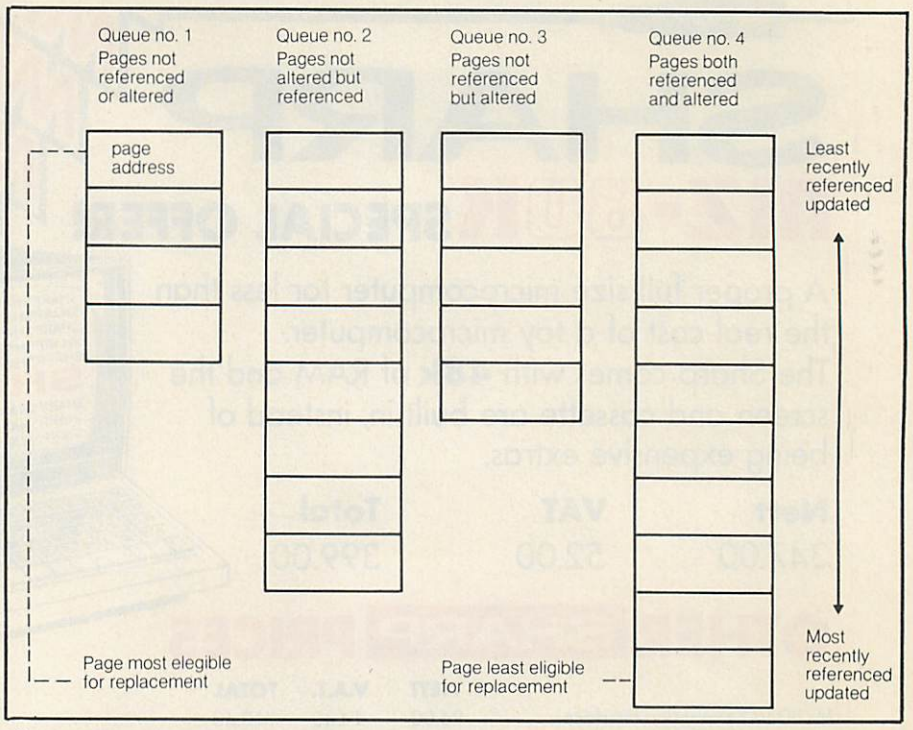


Figure 5. Page queues.

By a variation of Parkinson's Law, the size of programs and the number of users will increase to fill even the virtual memory available. A computer which seemed to allow for all foreseeable requirements with 24-bit addressing may seem very limiting once 16Mbyte of virtual storage is insufficient.

If 16Mbyte of real storage is still insufficient, there is a technique which allows virtual storage to be practically unlimited, and gives each user the illusion of sharing the complete 16Mbyte address range only with the operating system.

A separate page table is used for each user so that each user receives a different impression of the way virtual storage is laid out. This means that different users may use the same virtual addresses for their own use. As long as the identical virtual addresses used by the different users are translated to different real addresses, there is no conflict in the storage of data.

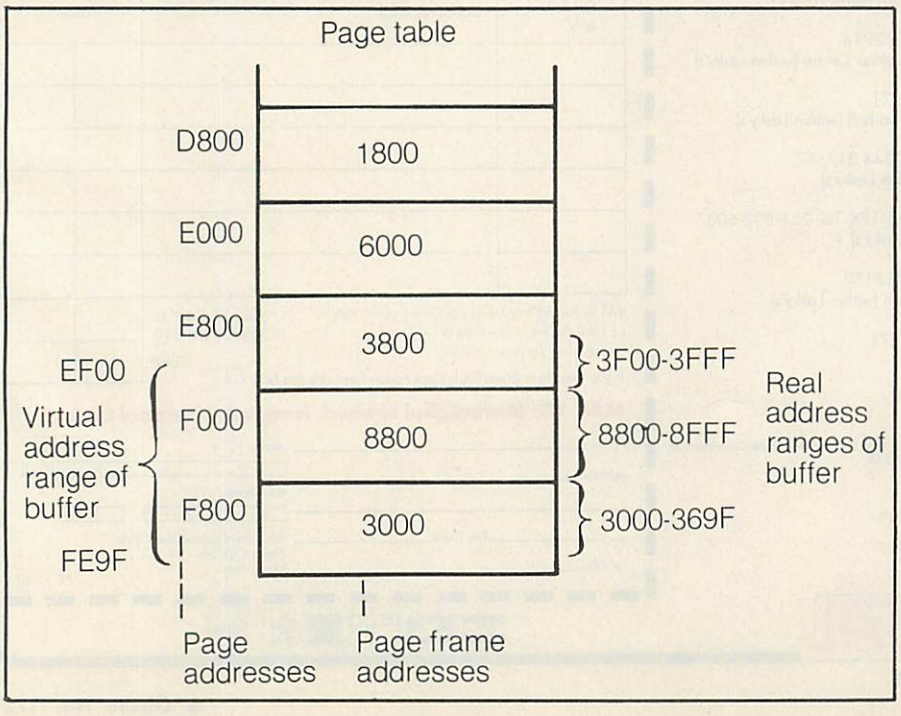
To ensure that the correct translation of each virtual address is made, the translation hardware holds a pointer to the page table currently being used for translation. Each time a new user gains control of the CPU, the page-table pointer is updated. Figure 7 shows a two-user system with user 1 currently in control.

If we limit our 16Mbyte, real storage, computer to 50 users, with 3Mbyte of each user's address range taken up by the operating system, the computer will have 50 x 13Mbyte = 650Mbyte of virtual storage available for user allocation.

Numbers like these might give the impression that a computer using virtual storage can undertake many times the amount of work it could handle previously. This is not true. Using a reasonable ratio of virtual memory to real memory will probably bring about marked performance improvements. Additionally, the system designer's and programmer's jobs will be made easier. If too large a ratio is used, however, a vastly degraded performance can result, because paging becomes excessive with a large virtual memory/real memory ratio.

(continued on page 125)

Figure 6. Translation of input/output requests.

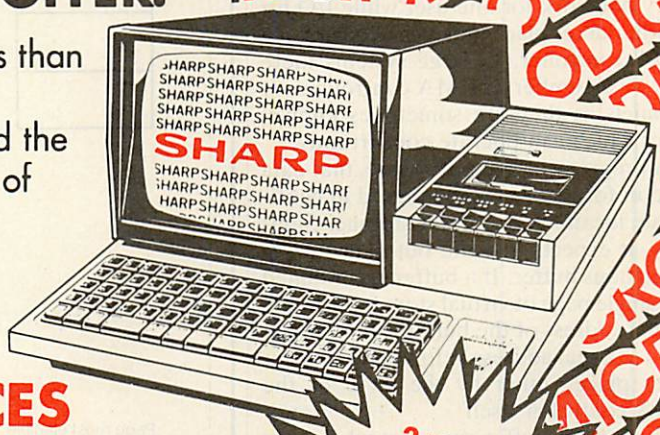


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(continued from page 123)

When the operating system hands control to a new user, it is likely that the pages the user needs will have to be paged in — having previously been paged out to make room for a previous user. By the time they are paged in again, it may be time for the user to relinquish control, especially if I/O for a higher-priority user has been completed by a DMA controller in the meanwhile.

In a bad case, this phenomenon, known as thrashing, can result in almost no useful work being done as paging uses up all the computer's capacity. Such a situation can be avoided by careful design and use of a computer system, but precautions can also be taken by the paging supervisor itself.

If the paging supervisor finds that it is carrying out more than a certain rate of paging operations, it can ask the operating system to lock out one or more low-priority users until the computer is less heavily loaded. Virtual storage is designed to be transparent to the application programmer, the only noticeable effect being the extra memory available. In fulfilling its original design aims, virtual storage has opened up a whole new range of opportunities to make computer systems easier to use and faster in operation.

Whole libraries of subroutines can be permanently held in virtual storage. They will only be paged into real storage when they are used and need not be included in a user's program. If the page supervisor knows that a certain address range is reserved for these subroutines, they do not even have to be loaded from disc when the computer is started, as they will already be contained in the page file from the last time the computer was used.

In this way, the subroutines are instantly available to all programs, but need take up no more room on disc than if they were in a separate library file. User programs will take up less space both in memory and on disc, because the subroutines no longer have to be included in every program which uses them.

Many facilities previously required in programs and operating systems become redundant with the introduction of virtual storage, as they were provided originally only because of memory limitations. Small work files can be dispensed with and the data held in memory. A word-processing program could read the whole of the text to be manipulated into virtual storage, and let it be paged in and out as required. The program need no longer concern itself with moving data between disc and memory in the midst of alterations.

A program where modules were previously loaded and run depending on a menu selection can be kept completely in virtual storage. This simplifies sharing data between modules, and extending programs to handle multiple terminals.

Imagine a computer system designed from the outset around virtual storage concepts. Such a machine would perhaps use 32-bit addressing to allow it to access up to 4,096Mbyte.

The whole disc storage of a purpose-designed system would act as a paging file. This means that all the programs and all the data on the system would be permanently held in virtual storage.

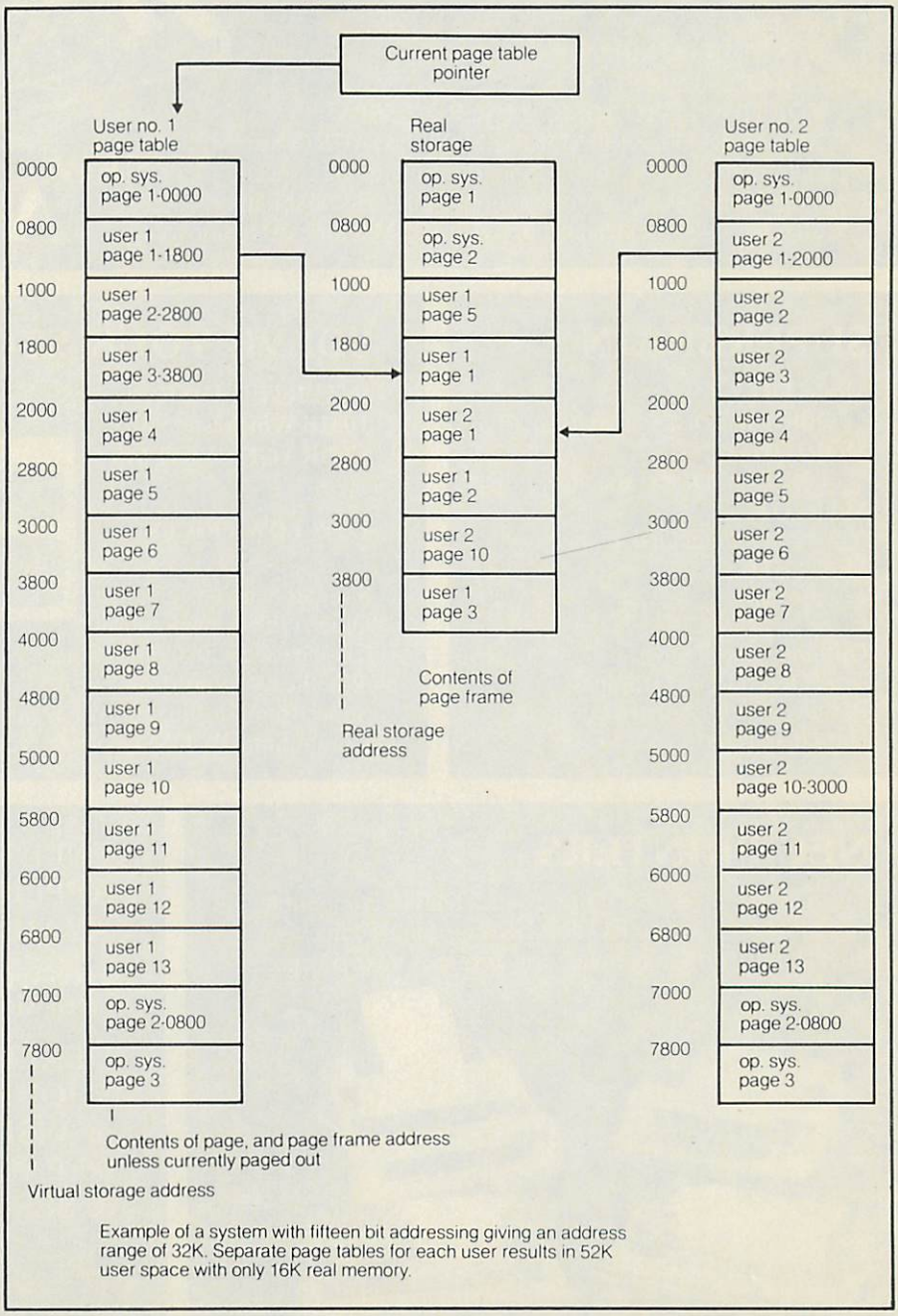
All data could be accessed simply by using its virtual address, and any program could be executed simply by branching to its virtual starting address. The paging supervisor would detect when the virtual-storage address given referred to a page not currently held in real storage, and would perform a page-in.

There would be a memory directory, the equivalent of a disc directory, which could be searched when the address of the required data or program was not known. Ideas such as disc drives, tracks and sectors would now only concern the paging supervisor.

Concepts such as loading programs before they can be run and the use of data buffers would no longer be needed. Conventional ideas of opening, closing, reading and writing files could still be used to access data, but unless the data was held in a complex order, it would normally be easier to refer to each record in a file in the same way as a program would currently refer to the elements of an array.

Such systems are not merely a possibility for the future. They are feasible today, and are held back merely by problems of compatibility with existing systems, and reservations of computer people used to a more conventional, and more complex, ideology.

Figure 7. Multiple virtual-storage system.



Example of a system with fifteen bit addressing giving an address range of 32K. Separate page tables for each user results in 52K user space with only 16K real memory.

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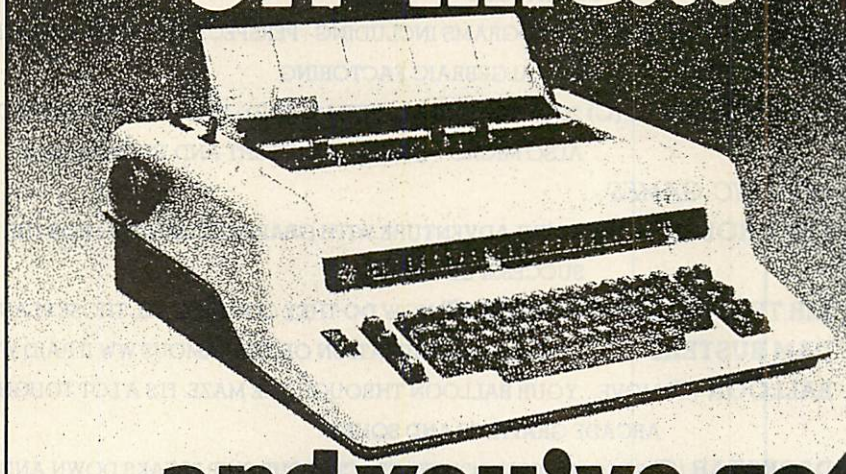
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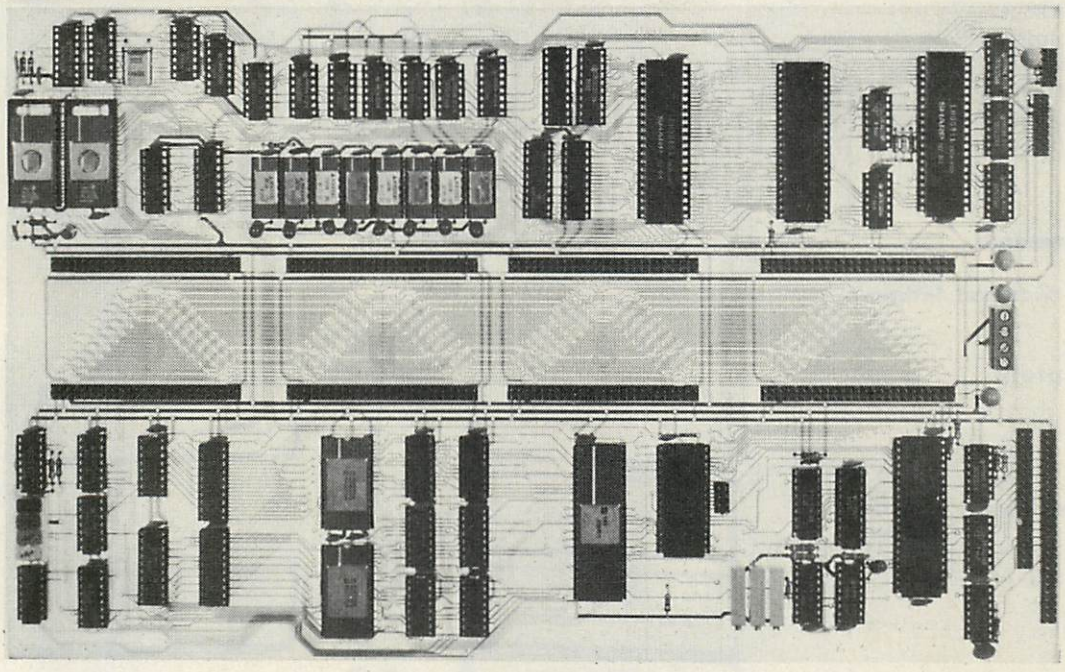
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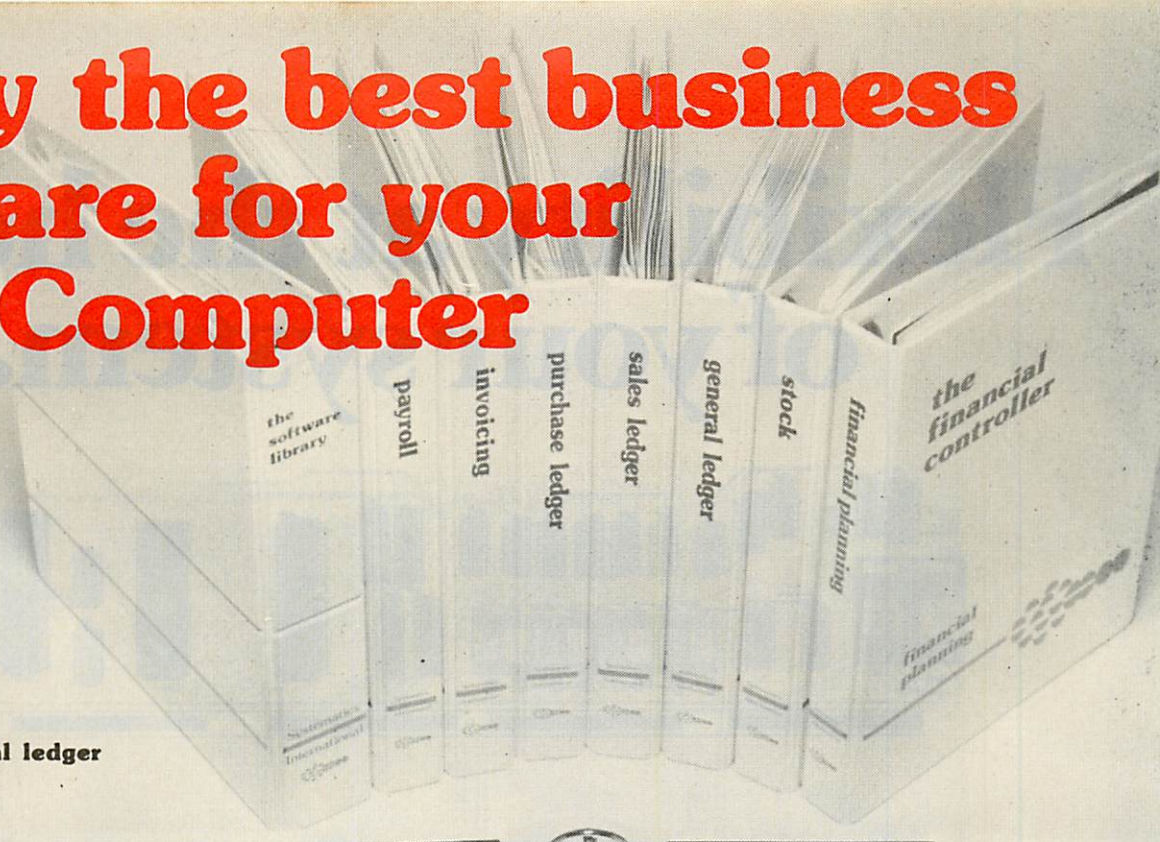
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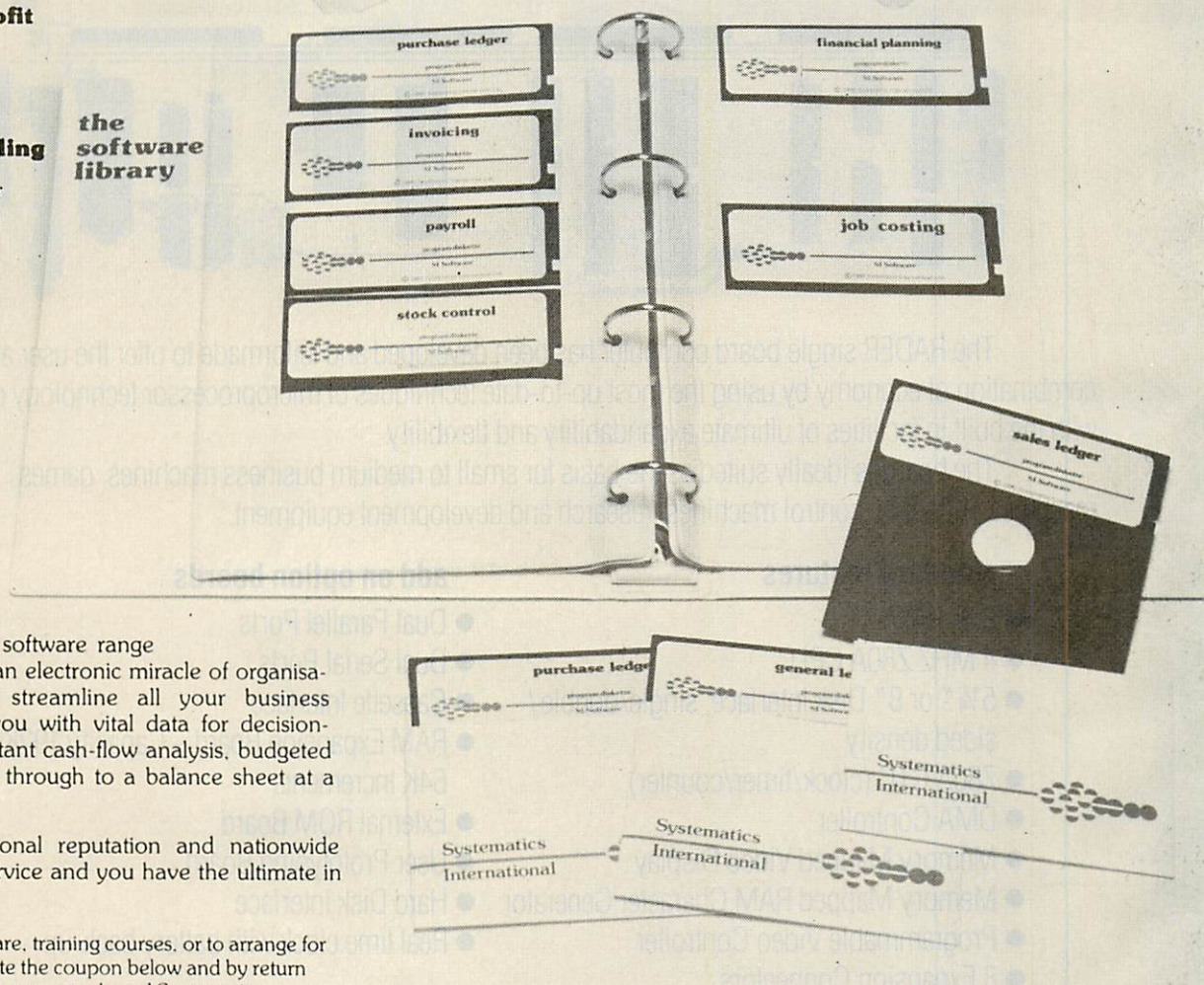
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TRS-80 to Nascom

MIKE FOX of Birkdale, Auckland, New Zealand has developed this package to read TRS-80 Basic program cassettes into a Nascom II. The conversion requires both hardware as well as software and is for TRS-80 Level 2 Basic, Video Genie in the U.K., PMC-80 in the U.S., System 80 in Australia and New Zealand. As the cassettes are written in a totally different format, it is necessary to use a small circuit and input via the port. The tape is written at 500 baud with an 80μs. clock pulse every 2ms. and a data pulse also of 80μs. in the middle for a one bit.

First, enter Nascom II Basic by J and then exit by Monitor or the Reset button to initialise memory. Next, load the attached conversion program with the correct delay values. Start the program by E 0C80 and start the TRS-80 cassette, with the output pluggged into the port via the supplied circuit. After loading has been completed and Nas-Sys has returned, re-enter Basic by the warm start command Z. Now the TRS-80 Basic program can be listed and may be run.

The cassette volume and tone setting is very critical. If nothing appears on the screen, re-run program with 0C8E as 00 to stop synchronous checking and 0CC0 as 00 to disable program ending on reading the first null characters. The program will have to be terminated by using the reset button; the second part of the program will not have been executed. Adjust the volume and tone until the display appears.

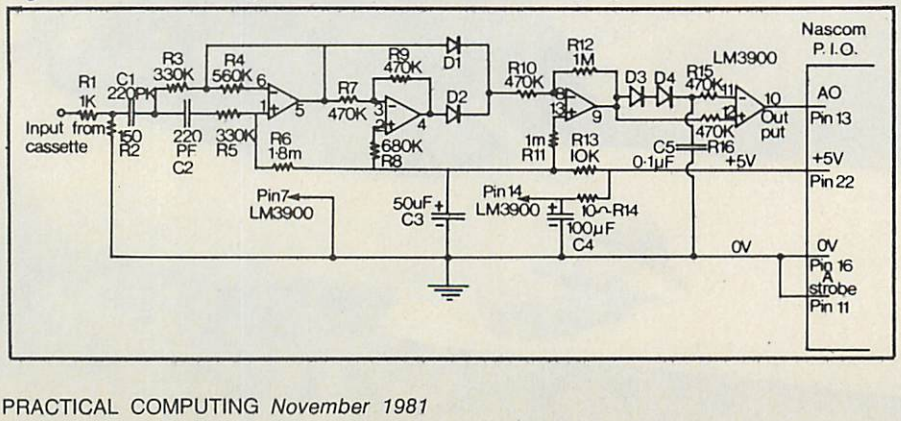
If when doing a Basic List of the TRS-80 program, it starts properly and then gives rubbish, it is most likely the result of mis-reading of the line-address pointers: re-adjust the volume or tone and try again.

It is possible to have a Basic cassette tape from a TRS-80 disc system, where the starting address is 6A46. The result will be that only the first line will List correctly and the rest will be rubbish. Replace the subtraction values at 0D16 with 4C and at 0D1B with 59. Do not forget the different delay settings for 2MHz or 4MHz. The values are, 2MHz and then 4MHz.0CC8 = 26 or 53, 0CDA = 3C or 81, 0CE1 = 1D or 3D.

The token-conversion program will halt if the screen is full of non-convertible tokens. Write down the details and press any key to continue.

```
                0010 ;  PROGRAM TO READ TRS-80 LEVEL 2 BASIC
                0020 ;  PROGRAM TAPES INTO NASCOM II.
                0030 ;  THEN CONVERT FOR RUNNING UNDER
                0040 ;  NASCOM BASIC.
                0050 ;
                0060 ;  BY: MIKE FOX, 53,HELLYERS STREET,
                0070 ;      BIRKDALE, AUCKLAND, NEW ZEALAND.
                0080 ;
                0090 ;      14th, JULY, 1981.
                0100 ;
0C80            0110        ORG  0C80
0C80 0E00       0120        LD   C,#00      ; RESET COUNTER
0C82 210A08     0130        LD   HL,#080A   ; VDU LINE 1 ADDRESS
0C85 11F610     0140        LD   DE,#10F6   ; START OF BASIC ADDRESS
0C88 CD250C     0150 NSYSC  CALL SUB        ; SUB TO GET BIT
0C8B FEA5       0160        CP   #A5        ; IS IT SYNC BYTE A5 ?
0C8D 20F9       0170        JR   NZ,NSYSC   ; IF NO LOOP
0C8F CD250C     0180 NEXT   CALL SUB        ; OK NOW GET 8 BITS
0C92 CD250C     0190        CALL SUB
0C95 CD250C     0200        CALL SUB
0C98 CD250C     0210        CALL SUB
0C9B CD250C     0220        CALL SUB
0C9E CD250C     0230        CALL SUB
0CA1 CD250C     0240        CALL SUB
0CA4 CD250C     0250        CALL SUB
0CA7 77         0260        LD   (HL),A     ; LOAD BYTE TO VDU SCREEN
0CA8 12         0270        LD   (DE),A     ; LOAD BYTE TO BASIC MEMORY
0CA9 7D         0280        LD   A,L        ; FOR END OF LINE CHECK
0CAA FE39       0290        CP   #39        ; END OF LINE ?
0CAC 2803       0300        JR   Z,EOL
0CAE 2C         0310        INC  L          ; CONTINUE ON THIS LINE
0CAF 1802       0320        JR   INLINE
0CB1 2E0A       0330 EOL    LD   L,#0A      ; BACK TO START OF LINE
0CB3 1A         0340 INLINE LD   A,(DE)     ; RECALL BYTE
0CB4 13         0350        INC  DE
0CB5 FE00       0360        CP   #00        ; IS IT 00
0CB7 2008       0370        JR   NZ,NOZERO  ; CHECKING FOR END OF TAPE
0CB9 0C         0380        INC  C          ; INCREMENT COUNTER
0CBA 79         0390        LD   A,C
0CBB FE03       0400        CP   #03        ; HAVE WE HAD 3 IN A ROW
0CBD 2004       0410        JR   NZ,NOTEND
0CBF 1B4F       0420        JR   TOKEN      ; TO TOKEN PROGRAM
0CC1 0E00       0430 NOZERO LD   C,#00      ; RESET COUNTER
0CC3 18CA       0440 NOTEND JR   NEXT       ; LOOP FOR NEXT BYTE
                0450 ;
                0460 ; SUB ROUTINE TO GET A BIT
                0470 ;
0CC5 C5         0480 SUB    PUSH BC
0CC6 F5         0490        PUSH AF
                0500 ;*********************************
0CC7 0653       0510        LD   B,#53      ; 26=2 MEGHZ OR 53=4 MEGHZ
                0520 ;*********************************
0CC9 10FE       0530 LP1    DJNZ LP1        ; LOOP IN DELAY
0CCB DB04       0540 LP1A   IN   A,(04)     ; READ PORT NASCOM A0
0CCD EEFF       0550        XOR  #FF        ; INVERT IT
0CCF 1F         0560        RRA  ;          ; SET FLAG
0CD0 30F9       0570        JR   NC,LP1A    ; LOOP AGAIN IF NO CLOCK,
0CD2 DB04       0580        IN   A,(04)     ;   TO MAKE SURE
0CD4 EEFF       0590        XOR  #FF,
0CD6 1F         0600        RRA
0CD7 30F2       0610        JR   NC,LP1A    ; TRANSIENT SO CHECK AGAIN
                0620 ;*********************************
0CD9 0681       0630        LD   B,#81      ; 3C=2 MEGHZ OR 81=4 MEGHZ
                0640 ;*********************************
0CDB 10FE       0650 LP2    DJNZ LP2        ; DELAY AND WAIT
0CDD 00         0660        NOP  ;          ; BEFORE LOOKING
0CDE 00         0670        NOP  ;          ; FOR DATA PULSE
0CDF 00         0680        NOP
                0690 ;*********************************
0CE0 063D       0700        LD   B,#3D      ; 1D=2 MEGHZ OR 3D=4 MEGHZ
                0710 ;*********************************
0CE2 00         0720 LP3    NOP  ;          ; IN SEARCH "WINDOW"
0CE3 DB04       0730        IN   A,(04)     ; READ PORT
0CE5 EEFF       0740        XOR  #FF        ; INVERT IT
0CE7 1F         0750        RRA  ;          ; SET FLAG
0CE8 3804       0760        JR   C,GOT      ; PULSE FOUND-CHECK AGAIN
0CEA 10F6       0770        DJNZ LP3        ; NO PULSE LOOK AGAIN
0CEC 181C       0780        JR   NOGOT      ; WINDOW EXPIRED-NO PULSE
0CEE DB04       0790 GOT    IN   A,(04)     ; CHECK PULSE AGAIN
0CF0 EEFF       0800        XOR  #FF
0CF2 1F         0810        RRA
0CF3 3804       0820        JR   C,GOTONE   ; DEFINITELY A 1
0CF5 10EB       0830        DJNZ LP3        ; TRANSIENT LOOK AGAIN
0CF7 1811       0840        JR   NOGOT      ; STILL IN WINDOW ?
0CF9 F1         0850 GOTONE POP  AF         ; RESTORE REGS
0CFA 00         0860 END    NOP  ;          ; TO END WINDOW
0CFB 00         0870        NOP  ;          ; USING NOP AS DELAY
0CFC 00         0880        NOP
0CFD 00         0890        NOP
0CFE 00         0900        NOP
0CFF 00         0910        NOP
0D00 00         0920        NOP
0D01 00         0930        NOP
0D02 10F6       0940        DJNZ END        ; STILL IN WINDOW ?
0D04 C1         0950        POP  BC         ; WINDOW END RESTORE REGS
0D05 07         0960        RLCA ;          ; SHIFT ACCUM
0D06 CB87       0970        RES  0,A        ; ZERO AND ...
0D08 3C         0980        INC  A          ; SET BIT ZERO TO 1
0D09 C9         0990        RET  ;          ; RETURN
0D0A F1         1000 NOGOT  POP  AF         ; NOT GOT A DATA PULSE
0D0B C1         1010        POP  BC         ; RESTORE REGS
0D0C 07         1020        RLCA
0D0D CB87       1030        RES  0,A        ; SET BIT TO 0
0D0F C9         1040        RET  ;          ; RETURN
                1050 ;
                1060 ;  PROG TO CONVERT TOKEN FROM TRS80 TO
                1070 ;  NASCOM. ALSO SETS UP POINTERS AND
                1080 ;  CORRECT LINE ADDRESS CODES BY
                1090 ;  SUBTRACTING 31EF (OR 594C FOR DISC).
                1100 ;
0D10 E5         1110 TOKEN  PUSH HL
0D11 21FA10     1120        LD   HL,#10FA   ; START WAS 10F6 FOR SSSn
0D14 7E         1130 NEXTL  LD   A,(HL)     ; LOW LINE ADDRESS
0D15 D6EF       1140        SUB  #EF        ; SUBTRACT EF (DISC=4C)
0D17 77         1150        LD   (HL),A     ; RE-WRITE
0D18 23         1160        INC  HL
0D19 7E         1170        LD   A,(HL)     ; HIGH LINE ADDRESS
0D1A DE31       1180        SBC  A,#31      ; SUBTRACT 31 (DISC=59)
0D1C 77         1190        LD   (HL),A     ; RE-WRITE
0D1D 23         1200        INC  HL
0D1E 5E         1210        LD   E,(HL)     ; SAVE LINE NUMBER
0D1F 23         1220        INC  HL         ; BY-PASS LINE NUMBER
0D20 56         1230        LD   D,(HL)     ; SAVE LINE NUMBER
0D21 23         1240 LOOP   INC  HL
0D22 7E         1250        LD   A,(HL)     ; LOAD THE BYTE OF BASIC
0D23 D600       1260        SUB  00
0D25 2805       1270        JR   Z,CHECKE   ; IF EOL, CHECK IF PROG END
0D27 FC480D     1280        CALL M,SUBT     ; IF HEX 80 OR MORE
                1290 ;                      ; TRANSLATE TOKEN
0D2A 18F5       1300        JR   LOOP       ; LOOP AGAIN
0D2C 23         1310 CHECKE INC  HL         ; BY-PASS LINE ADDRES
0D2D 23         1320        INC  HL
0D2E 7E         1330        LD   A,(HL)     ; LOAD THE BYTE
0D2F D600       1340        SUB  00
0D31 2803       1350        JR   Z,ENDT     ; IF ZERO ASSUME PROG END
0D33 2B         1360        DEC  HL         ; FOR RE DOING ADDRESS
0D34 18DE       1370        JR   NEXTL      ; NOT ZERO SO GO AGAIN
0D36 23         1380 ENDT   INC  HL
0D37 22D610     1390        LD   (#10D6),HL; LOAD END OF PROG ADDR
0D3A 22D810     1400        LD   (#10D8),HL
0D3D 22DA10     1410        LD   (#10DA),HL
0D40 21F910     1420        LD   HL,#10F9   ; RESTORE HEX 00 FOR RUNNING
0D43 3600       1430        LD   (HL),00
0D45 E1         1440        POP  HL
0D46 DF         1450        RST  #18        ; NAS-SYS MRET SUBROUTINE
0D47 5B         1460        DEFB #5B        ; RETURN TO NAS-SYS
                1470 ;
                1480 ;  SUBROUTINE TO CONVERT TOKENS
                1490 ;
0D48 E5         1500 SUBT   PUSH HL
0D49 21D90D     1510        LD   HL,TABLE   ; LOAD TABLE ADDRESS
0D4C F5         1520 AGAIN  PUSH AF         ; SAVE DATA BYTE
0D4D 7E         1530        LD   A,(HL)     ; LOAD BYTE FROM TABLE
0D4E D600       1540        SUB  00
0D50 280D       1550        JR   Z,NOTM     ; END OF TABLE ?
0D52 F1         1560        POP  AF         ; NO,SO RESTORE DATA BYTE
0D53 BE         1570        CP   (HL)       ; COMPARE DATA & TABLE
0D54 2804       1580        JR   Z,EQUAL    ; EQUAL ?
0D56 23         1590        INC  HL         ; NO SO LOOK AT NEXT ENTRY
0D57 23         1600        INC  HL
0D58 18F2       1610        JR   AGAIN      ; GO AROUND AGAIN
0D5A 23         1620 EQUAL  INC  HL         ; MATCH : POINT TO NEW
0D5B 7E         1630        LD   A,(HL)     ; TOKEN & SUSTITUTE
0D5C E1         1640        POP  HL         ; RESTORE BASIC PROG ADDR
0D5D 77         1650        LD   (HL),A     ; SUBSTITUTE FROM ACCUM
0D5E C9         1660        RET  ; DONE
                1670 ;
                1680 ;  NO MATCH SO CONVERT TO REM AND DISPLAY
                1690 ;  ADDRESS, LINE NUMBER (IN DEC) AND CODE
                1700 ;
0D5F F1         1710 NOTM   POP  AF
0D60 E1         1720        POP  HL         ; NOW DISPLAY ON SCREEN,
0D61 E5         1730        PUSH HL         ;  DETAILS OF EACH
0D62 DF         1740        RST  #18        ; NAS-SYS TYCO3 SUBROUTINE
0D63 66         1750        DEFB #66        ; DISPLAY MEMORY ADDRESS
0D64 62         1760        LD   H,D
0D65 6B         1770        LD   L,E
0D66 CD890D     1780        CALL HEXDEC     ; DO HEX TO DEC CONVERTION
0D69 DF         1790        RST  #18        ; NAS-SYS SP2 SUBROUTINE
0D6A 69         1800        DEFB #69        ; OUTPUT ONE SPACES
0D6B E1         1810        POP  HL
0D6C 7E         1820        LD   A,(HL)
0D6D DF         1830        RST  #18        ; NAS-SYS B2HEX SUBROUTINE
0D6E 68         1840        DEFB #68        ; ORGINAL TRS-80 CODE
0D6F DF         1850        RST  #18        ; NAS-SYS SP2 SUBROUTINE
0D70 7E         1860        DEFB #7E        ; OUTPUT TWO SPACES
0D71 DF         1870        RST  #18        ; NAS-SYS SP2 SUBROUTINE
0D72 69         1880        DEFB #69        ; OUTPUT ONE SPACES
0D73 3EBE       1890        LD   A,#BE      ; LOAD CODE FOR REM
0D75 77         1900        LD   (HL),A     ; RE-WRITE TOKEN AS REM
0D76 3A2A0C     1910        LD   A,(#0C2A)  ; CHECK IF FULL SCREEN
0D79 FE0B       1920        CP   #0B        ; CURSOR POSITION
0D7B 200B       1930        JR   NZ,NOTFUL  ; PASS UNLESS NEXT OUTPUT
0D7D 3A290C     1940        LD   A,(#0C29)  ;  WOULD SCROLL SCREEN
0D80 FEAA       1950        CP   #AA
0D82 2004       1960        JR   NZ,NOTFUL
0D84 CF         1970        RST  #8         ; WAIT FOR ANY KEY PRESSED
0D85 3E0C       1980        LD   A,#0C      ; LOAD CLEAR SCREEN CODE
0D87 F7         1990        RST  #30        ; NAS-SYS SUBROUTINE
0D88 C9         2000 NOTFUL RET
                2010 ;
                2020 ; SUBROUTINE TO CONVERT HEX LINE NUMBER
                2030 ; TO DECIMAL (NUMBER IN REG HL).
                2040 ;
0D89 0E04       2050 HEXDEC LD   C,#04      ; MAX LEADING SPACES
0D8B 0600       2060        LD   B,#00
0D8D D5         2070        PUSH DE
0D8E 110A00     2080        LD   DE,#000A   ; VALUE TEN
0D91 D5         2090        PUSH DE
0D92 C5         2100        PUSH BC
0D93 CD9C0D     2110 DODIV  CALL DIVIDE     ; TO DIVIDE SUBROUTINE
0D96 78         2120        LD   A,B
0D97 B1         2130        OR   C          ; IF ZERO THEN FINISHED
0D98 CAA30D     2140        JP   Z,DIVEND
0D9B E3         2150        EX   (SP),HL    ; SET UP ANOTHER DIV LOOP
0D9C 2D         2160        DEC  L
0D9D E5         2170        PUSH HL
0D9E 60         2180        LD   H,B        ; PUT VALUE IN HL
0D9F 69         2190        LD   L,C
0DA0 C3930D     2200        JP   DODIV
0DA3 C1         2210 DIVEND POP  BC
0DA4 0D         2220 LEADSP DEC  C          ; DEC. LEADING SPACES
0DA5 79         2230        LD   A,C
0DA6 B7         2240        OR   A          ; CHECK FOR SPACES LEFT
0DA7 FA800D     2250        JP   M,DONESP   ; IF MINUS THEN DONE
0DAA 3E20       2260        LD   A,#20      ; ASCII CODE FOR SPACE
0DAC F7         2270        RST  #30        ; OUTPUT SPACE
0DAD C3A40D     2280        JP   LEADSP
0DB0 5D         2290 DONESP LD   E,L        ; FIRST DIGIT
0DB1 7B         2300 OUTPUT LD   A,E        ; LOAD EACH DIGIT
0DB2 FE0A       2310        CP   #0A        ; COMPERE FOR TEN
0DB4 D1         2320        POP  DE         ; READY FOLLOWING DIGIT
0DB5 C8         2330        RET  Z          ; RETURN TO MAIN PROG
0DB6 C630       2340        ADD  A,#30      ; CHANGE DEC TO ASCII
0DB8 F7         2350        RST  #30        ; OUTPUT DIGIT
0DB9 C3B10D     2360        JP   OUTPUT
                2370 ; DIVIDE SUBROUTINE
0DBC E5         2380 DIVIDE PUSH HL         ; DIVIDE HL BY DE,
0DBD 6C         2390        LD   L,H        ;  PUTTING RESULT IN BC,
0DBE 2600       2400        LD   H,#00      ;  AND REMIANDER IN HL
0DC0 CDC70D     2410        CALL DIVLOP
0DC3 41         2420        LD   B,C
0DC4 7D         2430        LD   A,L
0DC5 E1         2440        POP  HL
0DC6 67         2450        LD   H,A
0DC7 0EFF       2460 DIVLOP LD   C,#FF
0DC9 0C         2470 DIVADD INC  C
0DCA CDD20D     2480        CALL DIVSUB
0DCD D2C90D     2490        JP   NC,DIVADD
0DD0 19         2500        ADD  HL,DE      ; ADD TEN IF CARRY
0DD1 C9         2510        RET
0DD2 7D         2520 DIVSUB LD   A,L        ; LEAST BYTE
0DD3 93         2530        SUB  E          ; SUBTRACT TEN
0DD4 6F         2540        LD   L,A
0DD5 7C         2550        LD   A,H        ; MOST BYTE
0DD6 9A         2560        SBC  A,D        ; SUB ZERO PLUS CARRY
0DD7 67         2570        LD   H,A
0DD8 C9         2580        RET
                2590 ;
                2600 ;  CONVERSION TABLE - TRS-80 THEN NASCOM
                2610 ;
0DD9 808081818  2620 TABLE  DEFB #80,#80,#81,#81,#82,#9D,#83,#9C
     829D839C
0DE1 84998782   2630        DEFB #84,#99,#87,#82,#88,#83,#89,#84
     88838984
0DE9 8A858886   2640        DEFB #8A,#85,#8B,#86,#8C,#87,#8D,#88
     8C878D88
0DF1 8E898F8A   2650        DEFB #8E,#89,#8F,#8A,#90,#8B,#91,#8C
     908B918C
0DF9 928D938E   2660        DEFB #92,#8D,#93,#8E,#94,#8F,#A0,#90
     948FA090
0E01 A1918094   2670        DEFB #A1,#91,#80,#94,#81,#95,#B2,#9E
     B195B29E
0E09 B39FB4A0   2680        DEFB #B3,#9F,#B4,#A0,#B8,#A1,#B9,#A2
     B8A1B9A2
0E11 BAA3BBA4   2690        DEFB #BA,#A3,#BB,#A4,#BC,#A5,#BD,#A6
     BCA5BDA6
0E19 BEA7C1B9   2700        DEFB #BE,#A7,#C1,#B9,#C6,#C7,#CA,#A9
     C6C2CAA9
0E21 CBAACCAB   2710        DEFB #CB,#AA,#CC,#AB,#CD,#AC,#CE,#AD
     CDACCEAD
0E29 CFAED0AF   2720        DEFB #CF,#AE,#D0,#AF,#D1,#B0,#D2,#B1
     D1B0D2B1
0E31 D3B2D4B3   2730        DEFB #D3,#B2,#D4,#B3,#D5,#B4,#D6,#B5
     D5B4D6B5
0E39 D7B6D8B7   2740        DEFB #D7,#B6,#D8,#B7,#D9,#B8,#DA,#BA
     D9B8DABA
0E41 DBBBDCBC   2750        DEFB #DB,#BB,#DC,#BC,#DD,#BD,#DE,#BE
     DDBEDEBE
0E49 DFBFE0C0   2760        DEFB #DF,#BF,#E0,#C0,#E1,#C1,#E2,#C2
     E1C1E2C2
0E51 E3C3E4C4   2770        DEFB #E3,#C3,#E4,#C4,#E5,#C5,#F3,#C8
     E5C5F3C8
0E59 F4C9F5CA   2780        DEFB #F4,#C9,#F5,#CA,#F6,#CB,#F7,#CC
     F6CBF7CC
0E61 F8CDF9CE   2790        DEFB #F8,#CD,#F9,#CE,#FA,#CF,#00,#00
     FACF0000
                2800 ; END
```

Figure 1. The circuit diagram for the TRS-80-to-Nascom program conversion.



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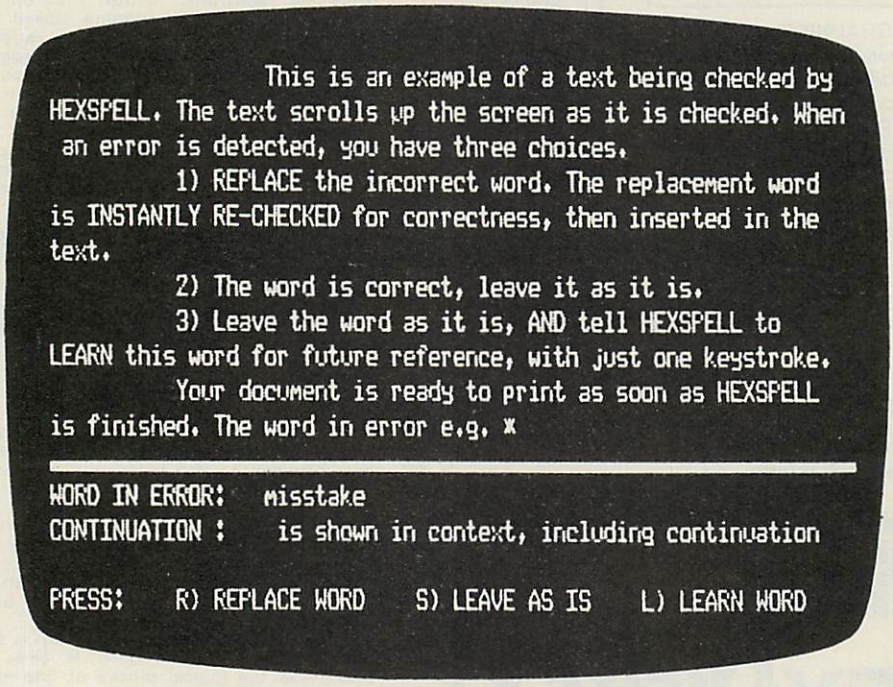
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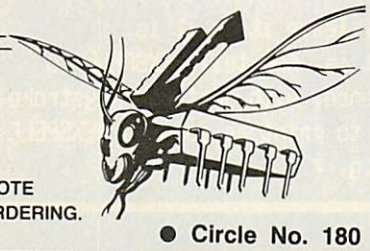
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```
10    REM  PROGRAM BY DR. C.T.F. ROSS
20    REM  DEPARTMENT OF MECHANICAL ENGINEERING,
30    REM  PORTSMOUTH POLYTECHNIC,
40    REM  PORTSMOUTH PO1 3DJ
50    PRINT  "SIMPSONS RULE FOR DETERMINING THE AREA UNDER A CURVE"
60    PRINT  "THE NUMBER OF ORDINATES MUST BE ODD AND >= 3"
70    PRINT  "NUMBER OF ORDINATES =";
80    INPUT N
85    PRINT N
90    DIM Y(N)
100   PRINT  "FEED THE (HEIGHT) OF EACH ORDINATE"
110   FOR I = 1 to N
112   IF I = 14 THEN CLS
114   IF I = 34 THEN CLS
116   IF I = 54 THEN CLS
120   PRINT  "ORDINATE NUMBER"; I;
130   INPUT Y(I)
135   PRINT  " = "; Y(I)
140   NEXT I
145   CLS
150   PRINT  "SPACING BETWEEN ANY 2 ADJACENT ORDINATES =";
160   INPUT H
165   PRINT H
170   LET S = ϕ
180   FOR I = 1  TO  (N-1)/2
190   LET J = 2*I-1
200   LET S = S + Y(J) + 4*Y(J + 1) + Y(J + 2)
210   NEXT I
215   PRINT
220   PRINT  "THE AREA UNDER THE CURVE ="; S*H/3
230   PRINT
240   PRINT
250   PRINT  "PROGRAM BY DR. C.T.F. ROSS"
```

Numerical integration

NUMERICAL integration is a means whereby one can determine the area under a curve, writes Carl Ross of Portsmouth Polytechnic. This is particularly important when the equation of the curve is unknown, and this problem frequently occurs in science, engineering, building, ship building, etc.

For such cases, the curve is drawn to scale and is then usually subdivided by equally-spaced ordinates, as shown in figure 1. Once this is done, integration can be performed on a computer.

If Simpson's rule is being used, the number of ordinates, N, must be odd and greater or equal to three. Simpson's rule states that the area under a curve is given by:

$$A = \frac{H}{3}(Y_1 + 4^* Y_2 + 2^* Y_3 + 4^* Y_4 + 2^* Y_5 + \ldots\ldots + \ldots\ldots Y_N)$$

where,

H = the spacing between any two adjacent ordinates.

Y_i = the "height" of the i^{th} ordinate.

The rule is based on the second order equation:

$$Y = C_1 + C_2{}^*X + C_3{}^*X^2$$

where,

C_1, C_2 and C_3 are constants.

Thus, it is necessary to choose the ordinate spacing, so that the curve between any three ordinates Y_{i-1}, Y_i and Y_{i+1}, can be represented by the equation. The computer program requires a 16K ZX-81, but smaller problems can be tackled on a 1K RAM machine, if the Rem and other similar statements are removed.

To illustrate its application, figure 2 will be solved on a ZX-81. The area under the curve of figure 2 is determined using Simpson's rule.

(continued on next page)

```
N   = 11      Y7  = 4.84
Y1  = 1.6     Y8  = 4.93
Y2  = 2.52    Y9  = 5.0
Y3  = 3.3     Y10 = 5.22
Y4  = 3.93    Y11 = 5.66
Y5  = 4.38    H   = 1
              ANSWER:-
Y6  = 4.7     Area = 42.48
```

Figure 1.

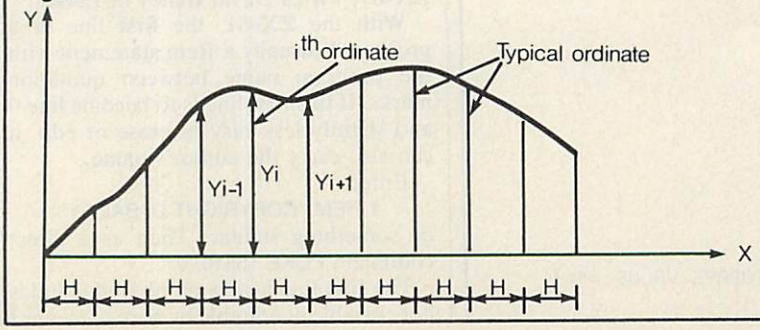
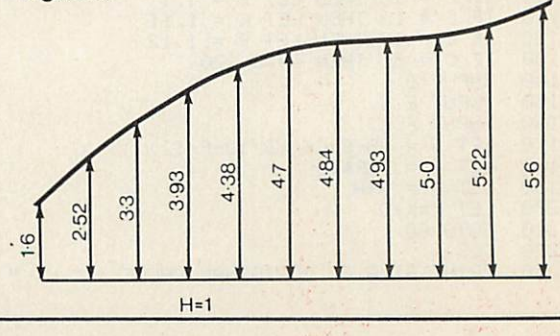


Figure 2.



```
TO PRINT TWO ROW OF FOUR LARGE LETTERS.

10   INPUT A$
20   FOR E = 0 TO 1
30   FOR F = 0 TO 3
40   LET I = 960 + CODE A$
50   FOR G = 0 TO 7
60   LET X = PEEK (8*I+G)
70   FOR H=0 TO 7
80   LET Z = INT(X/2**(7-H))/2
90   IF Z<> INT Z THEN PRINT AT G+8*E , H+8*F
; CHR$128
100  NEXT H
110  NEXT G
120  LET A$=A$(2 TO)
130  IF LEN A$ = 0 THEN STOP
140  NEXT F
150  NEXT E


TO PRINT TWO LARGE LETTERS ON THE SCREEN

10   INPUT A$
20   FOR F = 0 TO 1
30   LET I = 960 + CODE A$
40   FOR G = 0 TO 7
50   LET X = PEEK (8*I+G)
60   FOR N = 0 TO 1
70   FOR H = 0 TO 1
80   LET Z = INT (X/2**(7-H))/2
90   FOR M = 0 TO 1
100  IF Z <> INT Z THEN PRINT AT G*2+N,
H*2+M+16*F; CHR$ 128
110  NEXT M
120  NEXT H
130  NEXT N
140  NEXT G
150  LET A$ = A$(2 TO)
160  IF LEN A$ = 0 THEN STOP
170  NEXT F


TO PRINT 5 ROWS OF 8 LETTERS

10   INPUT A$
20   FOR E = 0 TO 5
30   FOR F = 0 TO 7
40   LET I = 960 + CODE A$
50   FOR G = 0 TO 7
60   LET X = PEEK(8*I+G)
70   FOR H = 0 TO 7
80   LET Z = INT (X/2**(7-H))/2
90   IF Z<> INT Z THEN PLOT H+8*F,42-G-8*E
100  NEXT H
110  NEXT G
120  LET A$=A$(2 TO)
130  IF LEN A$ = 0 THEN STOP
140  NEXT F
150  NEXT E
```

(continued from previous page)

Pattern extractors

THESE THREE programs are for the ZX-81. Now to the problem:

PRINT SQR(1/2*8) GIVES 2.
PRINT SQR(0.5*8) GIVES 5.4365637

In fact

SQR(0.5*8*2**N)

where N is any integer, seems to give a wrong answer. Has anybody else encountered this problem?

The programs extract patterns which are stored in ROM. They will work for any character which has a code less than 128 including graphics. If a 1K machine is used, some of the display will be missing, just how much depends on the number of black squares used.

Variable number

TO ANSWER John Thomas's request in the August 1981 issue, writes G Lingam of Worthing, West Sussex:

PRINT USR (2383) in command mode, gives a number which varies according to the number of bytes used.

It gives 917 just after New, so this can be used to calculate the bytes taken up so far. I have no certain way of proving whether this is the actual number of free bytes, or just some other memory-related quantity.

The routine is already in ROM, and I suspect, is the origin of the "4/n" error message.

Some other routines in ROM are:

USR(47)-gives "D-FILE" and is much shorter than PEEK(16396), etc.

USR(1208) acts as a reverse "Home", taking the line pointer to the last line in the program.

USR(8) stops the program, and is useful because it can be put on the end of a Print, avoiding the need for a Goto, e.g.,

IF SCORE=LIMIT THEN PRINT "WELL DONE"; USR(8).

Time savings

MOST PEOPLE who own a ZX-81 with 1K of RAM need to find useful applications for it in the home, so here is a little program which calculates the current value of different issues of National Savings Certificates, writes B J F Reilly, of Leicester.

This can be time-consuming to do manually, but with a ZX-81 it is easy — even for periods containing part years. I have included 14th, 16th, 18th and 19th issues, but anyone can alter these to whichever issues they wish to pocess. Just change the values of "c" and "r" in lines 90-120 and the print statement in line 70 appropriately.

```
NATIONAL SAVINGS CERTIFICATES
10   LET J = 0
20   LET K = 0
30   PRINT AT 6,0;" INPUT CURRENT YEAR N/L AND","CURRENT MONTH N/L"
40   INPUT A
50   INPUT B
60   CLS
70   PRINT AT 6,0; "INPUT ISSUE NO. N/L","ORIG.VALUE N/L  ","YEAR
BROUGHT N/L  ","MONTH BOUGHT N/L "," TO STOP, TYPE 0"
80   INPUT C
90   IF C = 14 THEN LET R = 1.08
100  IF C = 16 THEN LET R = 1.1
110  IF C = 18 THEN LET R = 1.11
120  IF C = 19 THEN LET R = 1.12
130  IF C = 0  THEN GOTO 220
140  INPUT D
150  INPUT E
160  INPUT F
170  LET G = (A-E) + (B/12-F/12)
180  LET H = D*R**G
190  LET J = J+H
200  LET K=K+D
210  GOTO 60
220  CLS
230  PRINT AT 6,0; "ORIGINAL VALUE ="; K, " TODAYS VALUE ="; J
```

Copyright line

HERE IS how you use program line zero to give a copyright of similar message on the ZX-81, writes David Bailey of Leeds.

With the ZX-81, the first line of a program is usually a Rem statement with the program name between quotation marks. If this first line is to become line 0 and slightly less easy to erase or edit, it can also carry the author's name.

Enter

1 REM "COPYRIGHT D. BAILEY"

or something similar. Then as a direct command. POKE 16510, 0.

The first line is now numbered 0 and is not erasable or editable by normal means.



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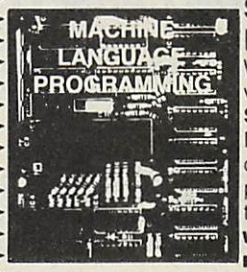
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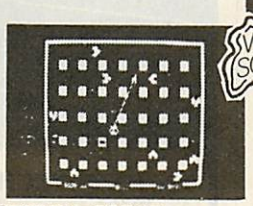
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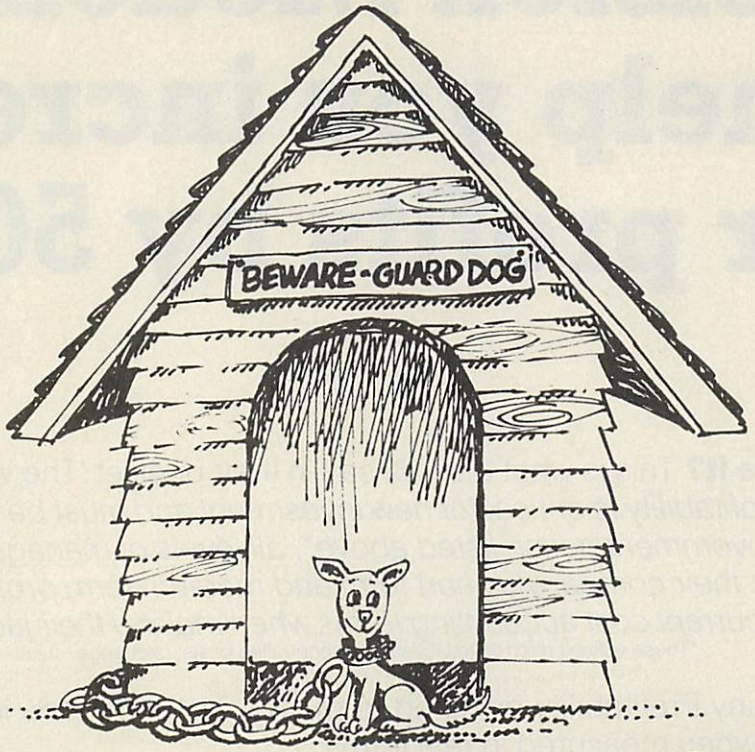
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THESE THREE programs are, I hope, all self-explanatory, writes Martin Rodgers of London SW16. They are Hoho — a simulation of "connect four", a non-graphic graphic one-liner and an all-graphics graphic one-liner. Try them and you will see what I mean.

Saving heartbreaks

AT LAST it is finished — you have just spent two or three hours, typing in "Racing Driver" or "Star Trek III", writes Gerald Kilpatrick of Preston, Lancashire. Your fingertips are rather sore from having entered all those Pokes, CHR$ and For loops. Slowly but surely, you type in the word "Run".

After a few seconds of black screen, which seems to go on for ever, you see the earth-shattering comment

MEMORY SIZE?

This short report should help you with this problem. In fact it should help you prevent the situation arising.

Although this step is not essential, it will be useful. Load a key-define program. Load my modify program. Disable the Break key by

POKE 16396,165

This will disable the Break key, but shift break will work just like Break.

I have spent a long time typing in a long line of text, only to press the Break key accidentally instead of Return and erase that line from memory. Carefully enter the program, making as much use of the key-define program as possible.

Remember to take great care when entering shifted characters, as shift and delete erases complete lines and not just characters. Shift A, although it looks like "A", does not compute as such.

CSave the complete program, including the modify program, on to cassette. Immediately after this, CLoad it. Run the program; this will run the modify program, and use it to change your program.

Delete the three lines of the modify program. Then run the program again; if all goes well, you will be a very happy programmer. If you obtain a syntax error, edit the program to remove it. Remember that errors may quote an incorrect line number — the error may be in a previous line.

If you have incorrectly defined a "USR" then it is likely that you will obtain a memory-size error. Do not be dismayed — CLoad your program again and continue as described. TRon and TRoff are very useful debugging aids.

Finally, CSave and CLoad the final working version on to another cassette. This will take about 15 minutes extra, but it could save you three hours.

On running the program, you are requested to input the statement/character from which you wish to change. Input the decimal, ASCII number of the character you wish changed. To the next prompt, input the decimal number to which you wish the last input to be changed.

If you used C instead of CLS enter: 67 and 132. The program will now change each C to CLS, and tell you what lines have been changed.

However, care must be taken with Print statements as each C will be changed. If, in a Print statement, a C should remain as it is, it should first be entered as, say, a ? or some other symbol which is not used elsewhere, and later changed with the modify program back to C. When the program has finished, it informs the user.

```
"HOHO" - A SIMULATION OF "CONNECT FOUR"

100 REM *** MAIN PROGRAM ***
110 CLEAR 200:LF$=CHR$(10)
120 P1$=CHR$(191)+CHR$(140)+CHR$(191)
130 P2$=CHR$(191)+CHR$(179)+CHR$(191)
140 CLS:GOSUB 400:GOSUB 440:CLS
150 PN$=N1$:PC$=P1$:GOSUB 330:GOSUB 190
160 PN$=N2$:PC$=P2$:GOSUB 330:GOSUB 190
170 GOTO 150
180 REM *** INPUT ***
190 PRINT@0,CHR$(30):PRINT@0,TAB(25)PN$"?";
200 IN$=INKEY$:IF IN$=""THEN 200 ELSE C=VAL(IN$)
210 IF IN$="O"THEN RUN ELSE:IF IN$="S"THEN GOSUB 400:GOTO 150
220 IF IN$="E"THEN CLS:END
230 ON C GOTO 240,250,260,270,280,290,300
240 AC=AC-1:X=AC:Y=1:GOTO 310
250 BC=BC-1:X=BC:Y=2:GOTO 310
260 CC=CC-1:X=CC:Y=3:GOTO 310
270 DC=DC-1:X=DC:Y=4:GOTO 310
280 EC=EC-1:X=EC:Y=5:GOTO 310
290 FC=FC-1:X=FC:Y=6:GOTO 310
300 GC=GC-1:X=GC:Y=7
310 IF X<0 THEN RETURN ELSE M$(X,Y)=PC$:RETURN
320 REM *** OUTPUT ***
330 PRINT@64,:FOR X=1 TO 6:FOR Y=1 TO 7
340 IF Y=1 THEN PRINT TAB(10) M$(X,Y)"   ";:GOTO 360
350 IF Y=7 THEN PRINT M$(X,Y)+LF$ ELSE PRINT M$(X,Y)"   ";
360 NEXT Y:NEXT X
370 PRINT@907,"1     2     3     4     5     6     7"
380 RETURN
390 REM *** FILL ARRAY ***
400 FOR X=1 TO 6:FOR Y=1 TO 7
410 M$(X,Y)="-*-":NEXT Y
420 NEXT X
430 AC=7:BC=7:CC=7:DC=7:EC=7:FC=7:GC=7:RETURN
440 PRINT@82,"-*-";" ";P1$;" ";P2$;" ";P1$;" ";P2$;" ";"-*-";
450 REM *** INSTRUCTIONS ***
460 PRINT@195,"EACH PLAYER IN TURN IS REQUIRED TO DROP A SYMBOL INTO";
470 PRINT@259,"ONE OF THE SEVEN COLUMNS BY PRESSING A CHOSEN KEY/COLUMN";
480 PRINT@323,"NUMBER.  EACH PLAYER WILL BE ALLOCATED A SPECIFIC SYMBOL.";
490 PRINT@387,"THE OBJECTIVE IS TO BE THE FIRST PLAYER TO ACHIEVE AN ";
500 PRINT@451,"UNBROKEN ROW OF FOUR OF YOUR SYMBOLS - EITHER VERTICALLY,";
510 PRINT@515,"HORIZONTALLY OR DIAGONALLY.";
520 PRINT:PRINT
530 LINE INPUT"   TYPE NAME/INITIALS OF PLAYER 1 & PRESS ENTER - ";N1$
540 LINE INPUT"   TYPE NAME/INITIALS OF PLAYER 2 & PRESS ENTER - ";N2$
550 PRINT@841,"S = START A NEW GAME   O = QUIT   E = END";
560 PRINT@910,"PRESS SPACE BAR TO BEGIN - NOW";
570 IF N1$=""THEN N1$="PLAYER 1 "
580 IF N2$=""THEN N2$="PLAYER 2 "
590 I$=INKEY$:IFI$=""THEN590ELSERETURN

A NON-GRAPHIC GRAPHIC "ONE-LINER"

1 CLS:FORR=1TO60:A=RND(R):XL=60-A:XR=60+A:A=RND(R/3):YT=23-A:YB=23+A:SET(XL,YT):
SET(XL,YB):SET(XR,YT):SET(XR,YB):NEXTR:FORD=1TO3000:NEXTD:GOTO1

AN ALL-GRAPHICS GRAPHIC "ONE-LINER"

10 CLS:C1=RND(62)+129:C2=RND(62)+129:P=RND(50):FORI=15360TO16382STEPP:POKEI,C1:F
OKEI+1,C2:NEXTI:FORD=1TO500:NEXTD:GOTO10
```

```
TRS80 MODIFY PROGRAM

0 DEFINT A-Z:A=PEEK(16548)+PEEK(16549)*256:FOR B=0 TO
2:A=PEEK(A)+PEEK(A+1)*256:NEXT:INPUT"STATEMENT/CHARACTER TO
CHANCE FROM (NUMBER) ";TC:INPUT"STATEMENT/CHARACTER TO CHANCE TO
";CT
1 NP=PEEK(A)+PEEK(A+1)*256:LN=PEEK(A+2)+PEEK(A+3)*256:FOR X=A+4
TO NP-1:IF PEEK(X)=TC THEN POKE X,CT:PRINT "JUST CHANGE LINE ";LN
2 NEXT X:A=NP:IF PEEK(A)+PEEK(A+1)=0 THEN PRINT "ALL DONE!":END ELSE 1
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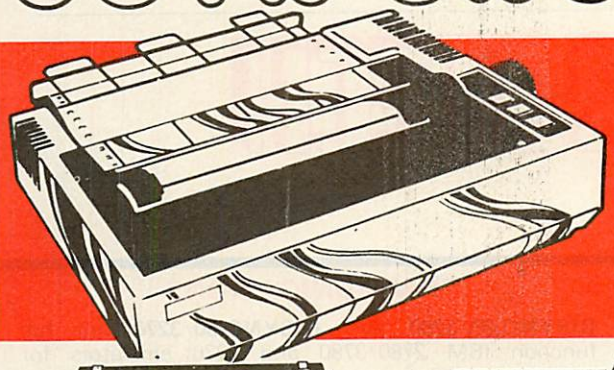
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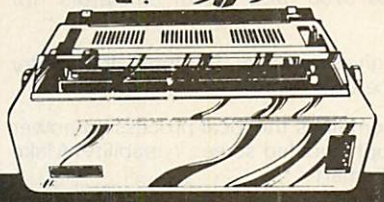
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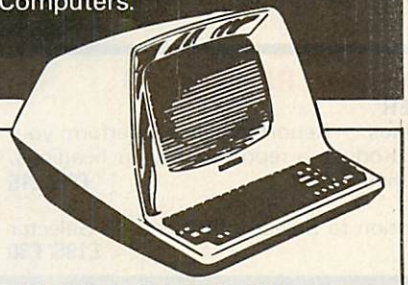


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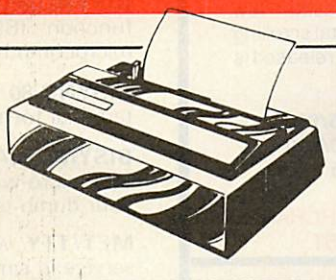
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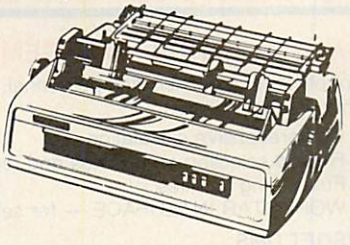


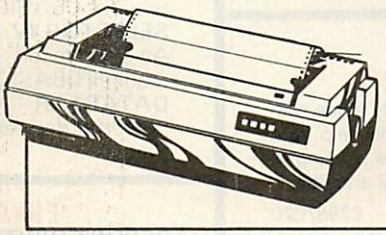
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Simple analogue input

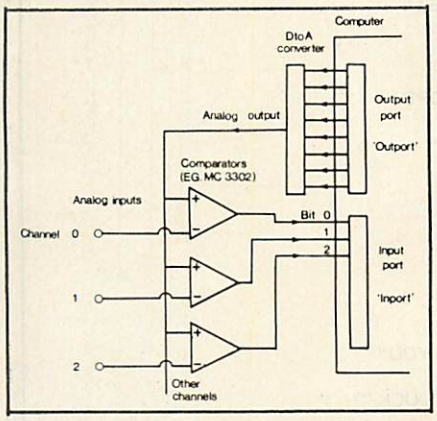
THIS PROGRAM and circuit enable an eight-bit, digital-to-analogue converter to work as an analogue-to-digital converter at very little extra cost, writes Graham Thomas of Hatfield, Hertfordshire. Each channel of the A-to-D converter consists of a comparator which compares a given input voltage to the voltage produced by the D-to-A converter.

The comparator output, which will either be high or low, is fed straight to one bit of an input port. The subroutine monitors this bit while changing the output of the D-to-A converter and thus deduces the value of the input voltage.

The routine uses two scratchpad locations ARG and BITPTN which should be in page zero to minimise execution time. The value in line 230 controls which input channel is read: this value should be 2^N to read channel N. The value of the analogue input is returned in ARG.

With the given subroutine, conversion time should be less than 0.3ms. with a 1MHz clock. If the D-to-A converter or the comparator has a response time much greater than μs. put a delay loop between lines 210 and 220.

The circuit diagram.



Zombie island

"PARACHUTED on to a remote island, you find yourself surrounded by Zombies. The appalling creatures cannot see but their acute sense of hearing enables them to move in your direction from the sound of your heartbeat".

So began the article by Trevor Lusty in the June 1979 issue of *Practical Computing*, writes John Fildes of Chelmsford, Essex. After exhausting the sample programs in the Compukit manual, I thumbed through the magazines which I had accumulated during the previous year.

```
 10 0000                ;*** ANALOG INPUT SUBROUTINE ***
 20 0000                ;D TO A CONVERTER IS AT 'OUTPRT'
 30 0000                ;OUTPUT FROM COMPARATOR(S) AT 'INPORT'
 40 0000                ;VALUE OF ANALOG INPUT RETURNED IN 'ARG'
 50 0000                ;
 60 0000                        *=$0000         ;IN PAGE 0 IF POSS.
 70 0001                ARG     *=*+1           ;VALUE RETURNED HERE
 80 0002                BITPTN  *=*+1           ;NEXT BIT TO TRY
 90 0002                ;
100 0002                INPORT=$9000            ;COMPARATOR OUTPUT(S)
110 0002                OUTPRT=$9001            ;D TO A CONVERTER
120 0002                ;
130 0002                ;SUBROUTINE ITSELF
140 3000                        *=$3000         ;LOCATE WHERE YOU LIKE
150 3000 A900           ANALOG  LDA #0
160 3002 8500                   STA ARG         ;INITIALISE RESULT
170 3004 A980                   LDA #128        ;HIGHEST BIT TO SCAN
180 3006 8501                   STA BITPTN
190 3008 A500           CVTLOP  LDA ARG         ;GET RESULT SO FAR
200 300A 0501                   ORA BITPTN      ;ADD NEXT BIT
210 300C 8D0190                 STA OUTPRT      ;O/P TO D-A
220 300F AD0090                 LDA INPORT      ;GET OUTPUT...
230 3012 2901                   AND #1          ;...FROM THIS COMPARATOR
240 3014 D006                   BNE SHIFT       ;IS 'ARG' TOO BIG?
250 3016 A500                   LDA ARG         ;NO- ADD THIS BIT
260 3018 0501                   ORA BITPTN
270 301A 8500                   STA ARG
280 301C 4601           SHIFT   LSR BITPTN      ;SHIFT BIT DOWN ONE
290 301E D0E8                   BNE CVTLOP      ;ROUND AGAIN
300 3020 60                     RTS             ;LOOPED 8 TIMES- END
```

Analogue input program.

The program was described as using standard Basic and used a Print format. I began typing — but my inexperience and the limitations of my machine meant that my hours at the keyboard were wasted. I moved to simpler projects but the Zombies were always at the back of my mind.

Eventually, the acquisition of a Cegmon Monitor ROM and experimentation with its screen-handling facilities suggested a few ideas. My version of the program is an attempt to produce a real-time graphics game using some of the extra facilities provided by Cegmon.

After the instructions have been displayed, Z-shaped island is drawn containing pot-holes. Five Zombies appear in random positions in the top half of the island and the player appears in the bottom half.

Each time the player moves, the Zombies all converge one space. It is not possible to outrun them — the only hope of survival is to lure them into a pot-hole or into the sea. The player must, of course, also avoid the pot-holes and the sea.

Each object is placed in position using the address of the top left-hand corner of the island and adding an X and Y displacement. Thus, the Zombies can be moved by comparing the X and Y displacements of each Zombie to that of the player.

Here are the program details:

5	Clear screen
10	Draw island
20	Format print window to right of screen
21	Home cursor
30	I/O random holes — can be increased to make game easier
40–70	Random position for player
80–120	Five random Zombies
130	Disable Control C
140–195	Scan keyboard for player input
200–268	Move player but check for pot-holes, Zombies and sea
300–700	Move Zombies by comparing co-ordinates of Zombie to those of player. Zombies are moved in turn and checks made for pot-holes, etc.
800–810	Check if all Zombies gone; return to keyboard scan
1000–1100	Subroutine to draw island
2000–3430	Comments printed during course of game
3900	Re-format screen to full display for instructions
4000	Instructions

The game as listed makes the Zombies wait until the player moves before starting the chase and when the player stops the Zombies stop. If line 195 is changed to read:

195 FOR D=1 TO 500: NEXT: GOTO 300

then the Zombies will start moving immediately and close in. To give yourself a chance, you had better also increase the number of holes in line 30.

```
M
 5 PRINTCHR$(26)
 6 INPUT" DO YOU NEED INSTRUCTIONS";A$
 7 IFLEFT$(A$,1)="Y"THEN3900
 10 GOSUB1000
 20 POKE546,12:POKE547,46:POKE548,208:POKE549,23
8:POKE250,211
 21 PRINTCHR$(12)
 30 FORA=1TO10:H=53331+INT(RND(8)*20)+INT(RND(8)
*14)*64:POKEH,6:NEXT
 40 X(6)=INT(RND(8)*20):Y(6)=INT(RND(8)*7)+7
 45 P=53331+X(6)+Y(6)*64
 50 IFPEEK(P)=32GOTO70
 60 GOTO40
```

(continued on next page)

(continued from previous page)

```
 70 POKEP,42
 80 FORA=1TO5
 85 X(A)=INT(RND(8)*20):Y(A)=INT(RND(8)*7)
 90 Z(A)=53331+X(A)+Y(A)*64
 95 IFPEEK(Z(A))=32THEN110
 100 GOTO85
 110 POKEZ(A),90
 120 NEXT
 130 POKE530,1
 140 KB=57088
 145 Y=0
 150 POKEKB,127
 160 IFPEEK(KB)=127THEN200
 170 IFPEEK(KB)=191THEN220
 180 IFPEEK(KB)=223THEN240
 190 IFPEEK(KB)=239THEN260
 195 GOTO150
 200 POKEP,32:Y(6)=Y(6)-1
 204 P=53331+X(6)+Y(6)*64
 205 IFPEEK(P)=187THEN2000
 206 IFPEEK(P)=6THEN2100
 207 IFPEEK(P)=90THEN3400
 208 POKEP,42
 210 GOTO300
 220 POKEP,32:Y(6)=Y(6)+1
 224 P=53331+X(6)+Y(6)*64
 225 IFPEEK(P)=187THEN2000
 226 IFPEEK(P)=6THEN2100
 227 IFPEEK(P)=90THEN3400
 228 POKEP,42
 230 GOTO300
 240 POKEP,32:X(6)=X(6)-1
 244 P=53331+X(6)+Y(6)*64
 245 IFPEEK(P)=187THEN2000
 246 IFPEEK(P)=6THEN2100
 247 IFPEEK(P)=90THEN3400
 248 POKEP,42
 250 GOTO300
 260 POKEP,32:X(6)=X(6)+1
 264 P=53331+X(6)+Y(6)*64
 265 IFPEEK(P)=187THEN2000
 266 IFPEEK(P)=6THEN2100
 267 IFPEEK(P)=90THEN3400
 268 POKEP,42
 300 IFZ(1)=0THEN400
 305 POKEZ(1),32
 310 IFX(1)>X(6)THENX(1)=X(1)-1
 320 IFX(1)<X(6)THENX(1)=X(1)+1
 330 IFY(1)>Y(6)THENY(1)=Y(1)-1
 340 IFY(1)<Y(6)THENY(1)=Y(1)+1
 350 Z(1)=53331+X(1)+Y(1)*64
 360 IFPEEK(Z(1))=187THENZ(1)=0:GOSUB3000
 370 IFPEEK(Z(1))=6THENZ(1)=0:GOSUB3100
 380 IFPEEK(Z(1))=42THENGOSUB3200
 390 POKEZ(1),90
 400 IFZ(2)=0THEN500
 405 POKEZ(2),32
 410 IFX(2)>X(6)THENX(2)=X(2)-1
 420 IFX(2)<X(6)THENX(2)=X(2)+1
 430 IFY(2)>Y(6)THENY(2)=Y(2)-1
 440 IFY(2)<Y(6)THENY(2)=Y(2)+1
 450 Z(2)=53331+X(2)+Y(2)*64
 460 IFPEEK(Z(2))=187THENZ(2)=0:GOSUB3000
 470 IFPEEK(Z(2))=6THENZ(2)=0:GOSUB3100
 480 IFPEEK(Z(2))=42THENGOSUB3200
 490 POKEZ(2),90
 500 IFZ(3)=0THEN600
 505 POKEZ(3),32
 510 IFX(3)>X(6)THENX(3)=X(3)-1
 520 IFX(3)<X(6)THENX(3)=X(3)+1
 530 IFY(3)>Y(6)THENY(3)=Y(3)-1
 540 IFY(3)<Y(6)THENY(3)=Y(3)+1
 550 Z(3)=53331+X(3)+Y(3)*64
 560 IFPEEK(Z(3))=187THENZ(3)=0:GOSUB3000
 570 IFPEEK(Z(3))=6THENZ(3)=0:GOSUB3100
 580 IFPEEK(Z(3))=42THENGOSUB3200
 590 POKEZ(3),90
 600 IFZ(4)=0THEN700
 605 POKEZ(4),32
 610 IFX(4)>X(6)THENX(4)=X(4)-1
 620 IFX(4)<X(6)THENX(4)=X(4)+1
 630 IFY(4)>Y(6)THENY(4)=Y(4)-1
 640 IFY(4)<Y(6)THENY(4)=Y(4)+1
 650 Z(4)=53331+X(4)+Y(4)*64
 660 IFPEEK(Z(4))=187THENZ(4)=0:GOSUB3000
 670 IFPEEK(Z(4))=6THENZ(4)=0:GOSUB3100
 680 IFPEEK(Z(4))=42THENGOSUB3200
 690 POKEZ(4),90
 700 IFZ(5)=0THEN800
 705 POKEZ(5),32
 710 IFX(5)>X(6)THENX(5)=X(5)-1
 720 IFX(5)<X(6)THENX(5)=X(5)+1
 730 IFY(5)>Y(6)THENY(5)=Y(5)-1
 740 IFY(5)<Y(6)THENY(5)=Y(5)+1
 750 Z(5)=53331+X(5)+Y(5)*64
 760 IFPEEK(Z(5))=187THENZ(5)=0:GOSUB3000
 770 IFPEEK(Z(5))=6THENZ(5)=0:GOSUB3100
 780 IFPEEK(Z(5))=42THENGOSUB3200
 790 POKEZ(5),90
 800 IFZ(1)=0ANDZ(2)=0ANDZ(3)=0ANDZ(4)=0ANDZ(5)=
0THEN3300
 805 IFY=1THENEND
 810 GOTO150
1000 FORF=53256TO54269:POKEF,187:NEXT
1010 M=53326:N=53355
1020 FORH=0TO256STEP64
1030 FORF=(M+H)TO(N+H):POKEF,32:NEXT:NEXT
1040 M=53650:N=53674
1050 FORH=0TO256STEP63
1060 FORF=(M+H)TO(N+H):POKEF,32:NEXT:NEXT
1070 M=53902:N=53931
1080 FORH=0TO256STEP64
1090 FORF=(M+H)TO(N+H):POKEF,32:NEXT:NEXT
1100 RETURN
1200 END
2000 PRINT:PRINT"SWIMMING?"
2010 PRINT
2020 PRINT"I FORGOT"
2030 PRINT"TO MENTION"
2040 PRINT"THE SHARKS!"
2050 PRINT
2060 PRINT"R.I.P..."
2070 END
2100 PRINT:PRINT"WHOOPS!"
2110 PRINT
2120 PRINT"THAT WAS "
2130 PRINT"A HOLE"
2140 PRINT
2150 PRINT"R.I.P..."
2160 END
3000 PRINT"SPLASH"
3010 RETURN
3100 PRINT"SPLASH"
3110 RETURN
3200 PRINT:PRINT"GOT YOU"
3205 Y=1
3210 PRINT:PRINT"BAD LUCK!"
3220 RETURN
3300 PRINT:PRINT"WELL DONE!"
3310 PRINT:PRINT"THE ISLAND"
3320 PRINT"IS NOW SAFE!"
3330 END
3400 PRINT::PRINT"INTO THE"
3410 PRINT"ARMS OF A"
3420 PRINT"ZOMBIE!"
3430 PRINT:PRINT"R.I.P."
3440 END
3900 POKE546,47:POKE547,12:POKE548,208
3910 POKE549,204:POKE550,211:PRINTCHR$(12)
3920 PRINTCHR$(26)
4000 PRINT"              ZOMBIE ISLAND"
4010 PRINT"              -------------"
4020 PRINT:PRINT"YOU ARE TRAPPED ON AN ISLAND"
4030 PRINT"SURROUNDED BY ZOMBIES":PRINT
4040 PRINT"ZOMBIES ARE BLIND BUT THEY CAN "
4050 PRINT"HEAR EVERY MOVE YOU MAKE!":PRINT
4060 PRINT"YOUR ONLY CHANCE OF SURVIVAL IS TO L
URE"
4070 PRINT"THEM INTO A POT-HOLE(";CHR$(6);") OR
 INTO THE SEA"
4080 PRINT:PRINT"USE KEYS-      1-UP      2-DOWN"
4090 PRINT"                3-LEFT    4-RIGHT"
4100 PRINT:INPUT"READY";A$
4110 IFLEFT$(A$,1)="Y"THEN10
4120 GOTO4100
```

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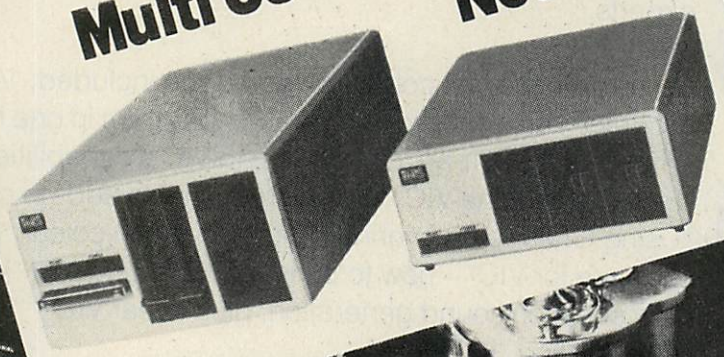
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Smooth operators

THIS two-line program may be of interest, writes I A Clark of London SW12:

```
10  A=A-1 * (A<40) - 40 * (A>39) + 41 *
(A>961) -80 * (A>1) * ((A-1)/40 - INT((A -
1)/40) = 0)
20  POKE 32767+A,209: IF A<> 41 THEN 10
```

It uses conditional operators in place of the conventional program using four For-Next loops. The character used in the border can be varied by changing the number 209 in line 20.

Restored to power

THERE SEEMS to be something lacking in the restore statement of my Pet computer, writes H V Blackmore of Bridgend, Mid Glamorgan. A statement such as

RESTORE 100

does not work. So I set to work and produced the following solution.

The solution is in the form of a machine-code program which may be called with

SYS848

If you wish to treat Data statements as if they were separate files held within one program, follow this procedure:

- Using Data statements enter a section of data which is to be separated from all others. It is important that there is a space between Data and the first data character.
- Poke a number into location 2; this will be used to identify the section of data just entered, e.g., Poke2, 1.
- Type Sys848. On listing the program, you will find that the Data statements have been converted to Rem statements. These statements will now be ignored when the program is run. Each of the Rem statements has embedded within it the number you Poked into location 2.
- Repeat these steps for as many sets of data you wish to include in your program. However, remember to Poke a different number into location 2 for each set.
- When you run your program, wishing to use, say, the second set of Data, then Poke the Data-identifying number into location 2 and perform a Sys902. Before the program



ends, perform a Sys848 which will restore the Data just used to Rem statements.

An example of a program which uses this routine is shown in listing 1. The machine-code program is listed in listings 2 and 3. Listing 2 is the disassembled version and can be typed using the machine-code monitor.

Listing 3 is a Basic loader of the same program. Once it is entered, it can be saved as an assembled machine-code program as follows: Type

SYS1024

press Return. Type

S "DATA RESTORE",01,033A,03B6

and press Return. Type X and press Return.

All legitimate Rem statements will be untouched by the procedure. The same is true for Data statements not immediately followed by a space. The numbers used to identify data sets can range from 0 to 255, but beware of using numbers between 32 and 90 inclusive.

Listing 2.

```
033A A900          LDA #00

033C 8500          STA 00
033E A904          LDA #04
0340 8501          STA 01
0342 C52B          CMP 2B
0344 D009          BNE 034F
0346 A903          LDA #03
0348 C52A          CMP 2A
034A D003          BNE 034F
034C 4C89C3          JMP C389
034F 60          RTS
0350 203A03          JSR 033A
0353 E600          INC 00
0355 A004          LDY #04
0357 B100          LDA (00),Y
0359 C983          CMP #83
035B D010          BNE 036D
035D C8          INY
035E B100          LDA (00),Y
0360 C920          CMP #20
0362 D009          BNE 036D
0364 A502          LDA 02
0366 9100          STA (00),Y
0368 88          DEY
0369 A98F          LDA #8F
036B 9100          STA (00),Y
036D 207903          JSR 0379
0370 C900          CMP #00
0372 D0E1          BNE 0355
0374 E000          CPX #00
0376 D0DD          BNE 0355
0378 60          RTS
0379 A000          LDY #00
037B B100          LDA (00),Y
037D AA          TAX
037E C8          INY
037F B100          LDA (00),Y
0381 8501          STA 01
0383 8600          STX 00
0385 60          RTS
0386 203A03          JSR 033A
0389 A98F          LDA #8F
038B 8D5A03          STA 035A
038E A502          LDA 02
0390 8D6103          STA 0361
0393 A920          LDA #20
0395 8502          STA 02
0397 A983          LDA #83
0399 8D6A03          STA 036A
039C 205303          JSR 0353
039F A983          LDA #83
03A1 8D5A03          STA 035A
03A4 AD6103          LDA 0361
03A7 8502          STA 02
03A9 A98F          LDA #8F
03AB 8D6A03          STA 036A
03AE A920          LDA #20
03B0 8D6103          STA 0361
03B3 2030C7          JSR C730
03B6 60          RTS
```

Listing 1.

```
0 INPUT"WHICH DATA SECTION";S
1 POKE2,S
2 :
3 REM LOCATION 2 HOLDS THE DATA SECTION NUMBER
4 :
5 SYS902
6 :
7 REM SYS902 CONVERTS ALL REM STATEMENTS EMBEDDED WITH THE NUMBER IN LOCATION 2
8 REM TO DATA STATEMENTS
9 :
10 READ N
11 IF N =-1 THEN SYS848:END
12 :
13 REM SYS848 REVERSES THE PROCESS OF SYS902
14 :
15 PRINT N;
16 GOTO 10
17 :
18 REM********************
19 REM* DATA SECTION 1 *
20 REM********************
21 REM1,2,3,4
22 REM5,6,7,-1
23 :
24 REM********************
25 REM* DATA SECTION 2 *
26 REM********************
27 REM8,9,10,11
28 REM12,13,-1
29 :
30 REM********************
31 REM* DATA SECTION 3 *
32 REM********************
33 REM14,15,16,-1
34 :
35 REM THE REM STATEMENTS IN DATA SECTION 1 ARE ENHANCED PRINTED BECAUSE OF
36 REM THE EMBEDDED 1
READY.

RUN
WHICH DATA SECTION ? 2
 8  9  10  11  12  13
READY.

RUN
WHICH DATA SECTION ? 1
 1  2  3  4  5  6  7
READY.

RUN
WHICH DATA SECTION ? 3
 14  15  16
READY.
```

Listing 3.

```
0 REM*************************************************************************
1 REM* BASIC LOADER FOR DATA TO REM CONVERTER                                 *
2 REM*                                                                       *
3 REM* SYS 848 CONVERTS ALL DATA STATEMENTS WITH A FOLLOWING SPACE TO REM     *
4 REM* STATEMENTS EMBEDDED WITH A NUMBER WHICH IS FIRST POKED INTO LOCATION 2 *
5 REM*                                                                       *
6 REM* SYS 902 REVERSES THE PROCESS I.E., CONVERTS ALL REM STATEMENTS WHICH   *
7 REM* HAVE AN EMBEDDED NUMBER EQUAL TO THAT IN LOCATION 2 TO DATA STATEMENTS *
8 REM*                                                                       *
9 REM* ALL LEGITIMATE REM STATEMENTS AND DATA STATEMENTS WHICH HAVE NO        *
10 REM* FOLLOWING SPACE ARE LEFT UNTOUCHED BY THIS ROUTINE                    *
11 REM*************************************************************************
12 FORI=826 TO 950
13 READ N
14 POKEI,N
15 NEXT I
16 DATA 169, 0, 133, 0, 169, 4, 133, 1, 197, 43, 208
17 DATA 9, 169, 3, 197, 42, 208, 3, 76, 137, 195
18 DATA 96, 32, 58, 3, 230, 0, 160, 4, 177, 0
19 DATA 201, 131, 208, 16, 200, 177, 0, 201, 32, 208
20 DATA 9, 165, 2, 145, 0, 136, 169, 143, 145, 0
21 DATA 32, 121, 3, 201, 0, 208, 225, 224, 0, 208
22 DATA 221, 96, 160, 0, 177, 0, 170, 200, 177, 0
23 DATA 133, 1, 134, 0, 96, 32, 58, 3, 169, 143
24 DATA 141, 90, 3, 165, 2, 141, 97, 3, 169, 32
25 DATA 133, 2, 169, 131, 141, 106, 3, 32, 83, 3
26 DATA 169, 131, 141, 90, 3, 173, 97, 3, 133, 2
27 DATA 169, 143, 141, 106, 3, 169, 32, 141, 97, 3,32,48,199,96
READY.
```

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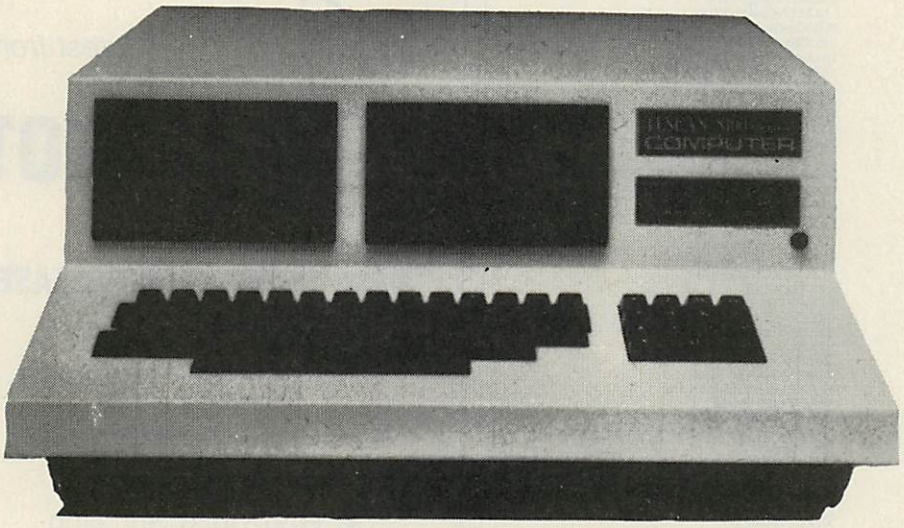
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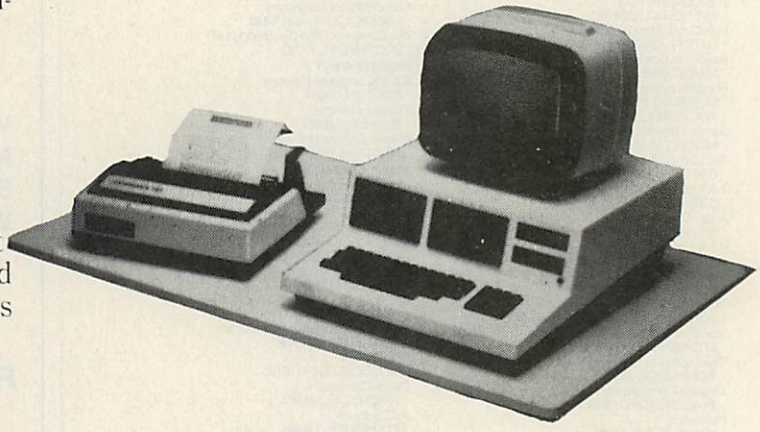
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Newed facts

THIS ROUTINE restores Newed programs, writes Malcolm Whapshott of Farnham, Surrey. It was designed to operate like the Acorn Atom's Old command which restores accidentally-deleted programs — but only if you have not started to type another program.

The program first looks for the end-of-line marker in the first line, then it puts the address of the next byte at the beginning of the first line. It starts looking for the end-of-program marker.

When it finds the end-of-program marker, the program adds two to it to give the end-of-program pointer which is also used as the pointer for the start of simple variables and as an array pointer.

If you expect to have a program in page three, restore can be re-located into page two, but it is likely to be destroyed by input from the keyboard. By saving restore as a binary file, "BRun restore" will restore the deleted program.

```
SOURCE FILE: OLD
0000:              1          DSECT
0000:              2 ********************
0000:              3 *                  *
0000:              4 * DELETED PROGRAM   *
0000:              5 *                  *
0000:              6 * RESTORER          *
0000:              7 *                  *
0000:              8 * BY               *
0000:              9 *                  *
0000:             10 * MALCOLM WHAPSHOTT *
0000:             11 *                  *
0000:             12 ********************
0035:             13 YSAV1   EQU  $35       ;TEMPORY STORAGE
0067:             14 START   EQU  $67       ;POINTER TO START OF PROGRAM
0069:             15 STRTVAR EQU  $69       ;POINTER TO START OF VARIABLES STORAGE
006B:             16 STRTARR EQU  $6B       ;POINTER TO START OF ARRAY STORAGE
009D:             17 LINADR  EQU  $9D       ;ZERO PAGE WORK SPACE
00AF:             18 END     EQU  $AF       ;POINTER TO END OF PROGRAM
E003:             19 BASIC2  EQU  $E003     ;JUMP TO BASIC WITH VARIABLES INTACT
FBE4:             20 BELL2   EQU  $FBE4     ;CTRL-G
FD8E:             21 CROUT   EQU  $FD8E     ;MONITOR LINE FEED ROUTINE
FDED:             22 COUT    EQU  $FDED     ;MONITOR PRINTING ROUTINE
0000:             23         DEND
----- NEXT OBJECT FILE NAME IS RESTORE
0300:             24         ORG  $300
0300:A5 67        25 LINKLN  LDA  START      ;TRANSFER THE STARTING
0302:A6 68        26         LDX  START+1    ;ADDRESS OF THE PROGRAM
0304:85 9D        27         STA  LINADR     ;TO THE WORK SPACE
0306:86 9E        28         STX  LINADR+1
0308:A0 04        29         LDY  #$04       ;JUMP THE ADDRESS AND LINE NUMBER
030A:B1 9D        30 NOLINK  LDA  (LINADR),Y ;LOAD A CHARACTER
030C:F0 05        31         BEQ  ISLINK     ;BRANCH IF END OF LINE CHARACTER
030E:C8           32         INY
030F:F0 5B        33         BEQ  ERROR      ;MORE THAN 252 CHARACTER READ IN
0311:D0 F7        34         BNE  NOLINK     ;JUMP
0313:C8           35 ISLINK  INY              ;POINTS TO BEGINING OF NEXT LINE
0314:84 35        36         STY  YSAV1
0316:18           37         CLC              ;SET UP ADDITION
0317:A5 9D        38         LDA  LINADR     ;ADD OFFSET TO THE
0319:65 35        39         ADC  YSAV1      ;STARTING ADDRESS
031B:A0 00        40         LDY  #$00       ;OF THE FIRST LINE
031D:91 67        41         STA  (START),Y  ;NUMBER AND SAVE AS THE
031F:85 9D        42         STA  LINADR     ;START ADDRESS OF THE
0321:90 02        43         BCC  NOINC      ;SECOND LINE
0323:E6 9E        44         INC  LINADR+1
0325:C8           45 NOINC   INY
0326:A5 9E        46         LDA  LINADR+1
0328:91 67        47         STA  (START),Y
032A:A0 01        48         LDY  #$01       ;USE ADDRESS OF LINE TO LOOK
032C:B1 9D        49 FINDLN2 LDA  (LINADR),Y ;FOR THE END OF THE
032E:F0 0B        50         BEQ  LSTLNE     ;PROGRAM
0330:AA           51         TAX              ;NOT FOUND, SO SAVE LINE ADDRESS
0331:88           52         DEY
0332:B1 9D        53         LDA  (LINADR),Y
0334:85 9D        54         STA  LINADR
0336:86 9E        55         STX  LINADR+1
0338:C8           56         INY
0339:D0 F1        57         BNE  FINDLN2    ;ALWAYS JUMP
033B:18           58 LSTLNE  CLC              ;ADD TWO TO THE ADDRESS TO
033C:A5 9D        59         LDA  LINADR     ;GIVE THE RIGHT VALUE
033E:69 02        60         ADC  #$02       ;FOR THE END OF PROGRAM
0340:85 AF        61         STA  END        ;POINTER
0342:85 69        62         STA  STRTVAR    ;AND RESET STORAGE POINTERS
0344:85 6B        63         STA  STRTARR    ;TO STOP APPLESOFT FROM
0346:90 02        64         BCC  NOINC2     ;OVERWRITING THE PROGRAM
0348:E6 9E        65         INC  LINADR+1   ;WITH STORED VARIABLES
034A:A5 9E        66 NOINC2  LDA  LINADR+1
034C:85 B0        67         STA  END+1
034E:85 6A        68         STA  STRTVAR+1
0350:85 6C        69         STA  STRTARR+1
0352:20 8E FD     70         JSR  CROUT      ;A LINE FEED TO FORMAT OUTPUT
0355:A0 0B        71         LDY  #$0B       ;LOAD LENGTH OF TEXT
0357:88           72 PRTEXT  DEY              ;DECREASE COUNTER
0358:30 09        73         BMI  RTN        ;BRANCH IF THE END OF STRING
035A:B9 72 03     74         LDA  TEXT,Y     ;LOAD CHARACTER
035D:20 ED FD     75         JSR  COUT       ;PRINT IT
0360:4C 57 03     76         JMP  PRTEXT     ;LOOP
0363:20 8E FD     77 RTN     JSR  CROUT      ;ANOTHER LINE FEED TO FORMAT
0366:4C 03 E0     78         JMP  BASIC2     ;A GRACEFUL RETURN TO BASIC
0369:20 E4 FB     79 ERROR   JSR  BELL2
036C:20 8E FD     80         JSR  CROUT
036F:4C 03 E0     81         JMP  BASIC2
0372:87 87 87     82 TEXT    ASC  /SSECCUS/ ;SUCCESS BACKWARDS AND FOUR CTRL-GS
0375:87 D3 D3
0378:C5 C3 C3
037B:D5 D3
*** SUCCESSFUL ASSEMBLY: NO ERRORS
E003 BASIC2      FBE4 BELL2       FDED COUT        FD8E CROUT
  AF END           0369 ERROR       032C FINDLN2     0313 ISLINK
  9D LINADR      ?0300 LINKLN       033B LSTLNE      034A NOINC2
0325 NOINC         030A NOLINK      0357 PRTEXT      0363 RTN
  67 START           6B STRTARR       69 STRTVAR     0372 TEXT
  35 YSAV1
  35 YSAV1           67 START         69 STRTVAR       6B STRTARR
  9D LINADR          AF END         ?0300 LINKLN       030A NOLINK
0313 ISLINK        0325 NOINC       032C FINDLN2     033B LSTLNE
034A NOINC2        0357 PRTEXT      0363 RTN         0369 ERROR
0372 TEXT          E003 BASIC2      FBE4 BELL2       FD8E CROUT
FDED COUT
```

Sacrificed clarity

I WOULD like to comment on the "Planet path plot" program published in Apple Pie, July 1981, writes D Hart of Nottingham: the program does not work. The major errors in the program are in lines 210 and 730 where the array V should have been used and not the array D.

The author has sacrificed clarity and structure for the sake of speed and efficiency. This program does not need to be particularly efficient and the techniques he has adopted do little to increase its speed — more time is spent doing complicated calculations. The program can be re-written in a much clearer fashion without any noticeable loss of efficiency.

Killing the planets when they move off the screen is a poor way of solving the problem of leaving the screen since the motion of the system will be affected by the loss of each planet.

The reason it is necessary is because the author uses HPlot old point and HPlot to new point to draw the orbits. In my opinion the straight-line orbits produced do not look as good as orbits drawn with just a series of dots. If this approach is adopted, the HPlot old point can be dropped and the HPlot to new point changed to HPlot new point.

The plotting is then done only if the planet is on the screen, but its motion continues to be tracked while it is off the screen.

```
10  REM  ORBITS
20  HOME : TEXT : HOME
30  PRINT "THIS PROGRAM PLOTS THE
      PATHS"
40  PRINT
50  PRINT "OF A NUMBER OF PLANETS
      IN ORBIT"
60  PRINT
70  PRINT "AROUND A NUMBER OF STA
    RS"
80  PRINT
90  PRINT "YOU MUST INPUT THE MAS
    S AND POSITION"
100  PRINT
110  PRINT "OF EACH OBJECT AND"
120  PRINT
130  PRINT "THE INITIAL VELOCITY
     OF EACH PLANET"
140  PRINT
200  REM  INITIALISE
210  INPUT "NUMBER OF STARS ";NS
220  IF NS < 0 OR NS <  > INT (N
     S) THEN  PRINT "POSITIVE INT
     EGER ONLY": GOTO 210
230  INPUT "NUMBER OF PLANETS ";N
     P
240  IF NP < 1 OR NP <  > INT (N
     P) THEN  PRINT "POSITIVE INT
     EGER ONLY": GOTO 230
250 NO = NS + NP
260  DIM M(NO),X(NO),Y(NO),VX(NP)
     ,VY(NP)
270  HOME : HGR : VTAB 21
280  IF NS = 0 THEN 500
300  REM  INPUT STARS
310  PRINT "FOR EACH STAR PLEASE
     INPUT"
320  PRINT "MASS, X CO-ORD, Y CO-OR
     D"
330  PRINT "5,5 IS TOP LEFT : 275
     ,155 BOTTOM RIGHT"
340  FOR S = NP + 1 TO NO
350  PRINT "S";S - NP;" ";
360  INPUT "MASS, X, Y ";M(S),DX,DY

370  IF M(S) <  = 0 THEN  PRINT "
     POSITIVE MASS ONLY": GOTO 35
     0
380  IF DX < 4 OR DY < 4 OR DX >
     275 OR DY > 155 THEN  PRINT
     "OUT OF RANGE": GOTO 350
400  REM  PLOT STAR
410  HPLOT DX - 2,DY - 1 TO DX -
     2,DY + 1
420  HPLOT DX + 2,DY - 1 TO DX +
     2,DY + 1
430  HPLOT DX - 1,DY - 2 TO DX +
     1,DY - 2
440  HPLOT DX - 1,DY + 2 TO DX +
     1,DY + 2
450 X(S) = DX
460 Y(S) = DY
470  NEXT S
500  REM  INPUT PLANETS
510  PRINT "FOR EACH PLANET PLEAS
     E INPUT"
520  PRINT "MASS, X CO-ORD, Y CO-OR
     D"
530  PRINT "X VELOCITY, Y VELOCITY
     "
540  FOR P = 1 TO NP
550  PRINT "P";P;" ";
560  INPUT "MASS, X, Y ";M(P),DX,DY

570  IF M(P) <  = 0 THEN  PRINT "
     POSITIVE MASS ONLY": GOTO 55
     0
580  IF DX < 0 OR DY < 0 OR DX >
     279 OR DY > 159 THEN  PRINT
     "OUT OF RANGE": GOTO 550
590  INPUT "X, Y VELOCITY ";VX(P),
     VY(P)
600  REM  PLOT PLANET
610  HPLOT DX,DY
620 X(P) = DX
630 Y(P) = DY
640  NEXT P
650  HOME : VTAB 21
1000  REM  REPEAT FOR A LONG TIME
1010  FOR T = 1 TO 1000
1020  REM  CALCULATE MOVEMENT OF
      PLANETS
```

(continued on next page)

(continued from previous page)

```
1030  FOR P = 1 TO NP
1040 AX = 0:AY = 0
1050  FOR O = 1 TO NO
1060  IF P = O THEN 1120
1070 DX = X(O) - X(P)
1080 DY = Y(O) - Y(P)
1090 NA = M(O) / (DX * DX + DY *
     DY) ^ 1.5
1100 AX = AX + DX * NA
1110 AY = AY + DY * NA
1120  NEXT O
1130 VX(P) = VX(P) + AX
1140 VY(P) = VY(P) + AY
1150  NEXT P
1200  REM  PLOT NEW PLANET POSITI
     ONS
1210  FOR P = 1 TO NP
1220 X(P) = X(P) + VX(P)
1230 Y(P) = Y(P) + VY(P)
1240  IF X(P) < 0 OR Y(P) < 0 OR
     X(P) > 279 OR Y(P) > 159 THEN
     1260
1250  HPLOT X(P),Y(P)
1260  NEXT P
1270  NEXT T
2000  REM  FINISHED
2010  HOME : TEXT : HOME : END
```

Shape-table plotter

HERE IS a low-resolution graphics shape-table plotter, writes Peter Nayler of Bexley Heath, Kent. The program is ITT 2020 and Apple 2 compatible. Its main use lies in drawing pre-defined shapes in games where speed is important.

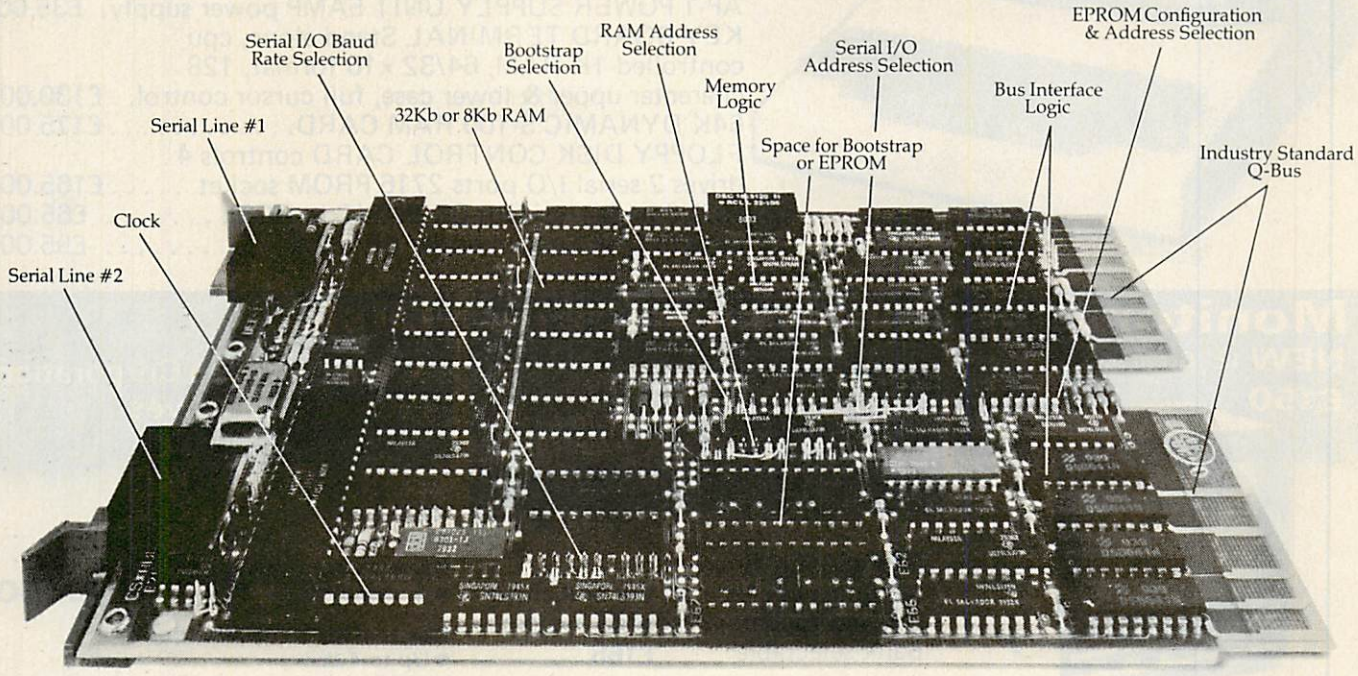
Any shape table written for high-resolution graphics on either computer will run equally well for the low-resolution plotter.

```
****************************************
LOW RES SHAPE TABLE ROUTINE BY P. NAYLER
****************************************
THIS SUBROUTINE PLOTS SHAPE TABLES ON
THE LOW RESOLUTION GRAPHICS SCREEN.
ITS PERPOSE IS TO SPEED THE DRAWING OF
SHAPES FOR GAMES ETC.
THE SHAPE TABLES USED FOR THE SUBROUTINE ARE
COMPLETELY COMPATABLE WITH THOSE USED IN
HIGH RESOLUTION GRAPHICS.BELOW ARE LISTED
THE SHAPE TABLES OF THE NUMERS 1 THOU'O
(370.3C9 HEX).THE BASE ADDRESS OF THE
SHAPE TABLE MUST BE STORED IN MEMORY
LOCATIONS $E8,$E9 IN THE SAME WAY AS IN
HI-RES.IN THIS CASE 70 IN $E8 AND 03 IN
$E9. THE COLOUR IS SET USING COLOR= IN
BASIC OR FROM MACHINE CODE. THE X COORD
IS STORED IN $E0 (224 DEC) AND Y IN $E1
(225). THE SHAPE NUMBER REQUIRED IS
STORED IN $E4 (228 DEC).
THIS PROGRAM IS FULLY RELOCATABLE AND
MAY BE USED FROM BASIC BY CALLING 768
BELOW IS LISTED A SHORT BASIC PROGRAM TO
ILLUSTRATE THE LOW RES SHAPE PLOTTER.
10  GR
20 X = 3:Y = 3:N = 1
30  COLOR= 1
40  POKE 228,N
50  POKE 224,X
60  POKE 225,Y
70 X = X + 5: IF X > 39 THEN X =
     3:Y = Y + 7
80 N = N + 1: IF N < 12 THEN  CALL
     768: GOTO 40
90 N = 1:1FY < 30 THEN 40
100  END
*300LLL
0300-   A0 00       LDY   £$00
0302-   B1 E8       LDA   ($E8),Y
0304-   C5 E4       CMP   $E4
0306-   30 15       BMI   $031D
0308-   A5 E4       LDA   $E4
030A-   18          CLC
030B-   0A          ASL
030C-   A8          TAY
030D-   B1 E8       LDA   ($E8),Y
030F-   85 E3       STA   $E3
0311-   A2 00       LDX   £$00
0313-   86 E2       STX   $E2
0315-   A4 E3       LDY   $E3
0317-   B1 E8       LDA   ($E8),Y
0319-   C9 00       CMP   £$00
031B-   D0 01       BNE   $031E
031D-   60          RTS
031E-   48          PHA
031F-   18          CLC
0320-   4A          LSR
0321-   4A          LSR
0322-   4A          LSR
0323-   90 07       BCC   $032C
0325-   A4 E0       LDY   $E0
0327-   A5 E1       LDA   $E1
0329-   20 00 F8    JSR   $F800
032C-   68          PLA
032D-   18          CLC
032E-   A2 00       LDX   £$00
0330-   4A          LSR
0331-   90 01       BCC   $0334
0333-   E8          INX
0334-   4A          LSR
0335-   90 02       BCC   $0339
0337-   E8          INX
0338-   E8          INX
0339-   E0 00       CPX   £$00
033B-   D0 02       BNE   $033F
033D-   C6 E1       DEC   $E1
033F-   E0 01       CPX   £$01
0341-   D0 02       BNE   $0345
0343-   E6 E0       INC   $E0
0345-   E0 02       CPX   £$02
0347-   D0 02       BNE   $034B
0349-   E6 E1       INC   $E1
034B-   E0 03       CPX   £$03
034D-   D0 02       BNE   $0351
034F-   C6 E0       DEC   $E0
0351-   4A          LSR
0352-   E6 E2       INC   $E2
0354-   A6 E2       LDX   $E2
0356-   E0 02       CPX   £$02
0358-   30 C4       BMI   $031E
035A-   C9 00       CMP   £$00
035C-   D0 C0       BNE   $031E
035E-   E6 E3       INC   $E3
0360-   D0 AF       BNE   $0311
0362-   00          BRK
0363-   00          BRK
0364-   00          BRK
*370.3CC

0370- 0A 00 16 00 1A 00 22 00
0378- 2B 00 31 00 38 00 3F 00
0380- 45 00 4E 00 55 00 36 36
0388- 06 00 1B 2D 36 3F 36 2D
0390- 05 00 36 36 3F 0C 38 0C
0398- 38 06 00 36 36 C4 27 24
03A0- 00 3F 36 2D 36 3F 04 00
03A8- 3F 36 36 2D 24 3F 00 1B
03B0- 2D 36 36 06 00 D2 27 2C
03B8- 35 36 3E 27 04 00 D2 27
03C0- 2C 35 36 36 00 36 36 3F
03C8- 24 24 2D 00 00
*300.362

0300- A0 00 B1 E8 C5 E4 30 15
0308- A5 E4 18 0A A8 B1 E8 85
0310- E3 A2 00 86 E2 A4 E3 B1
0318- E8 C9 00 D0 01 60 48 18
0320- 4A 4A 4A 90 07 A4 E0 A5
0328- E1 20 00 F8 68 18 A2 00
0330- 4A 90 01 E8 4A 90 02 E8
0338- E8 E0 00 D0 02 C6 E1 E0
0340- 01 D0 02 E6 E0 E0 02 D0
0348- 02 E6 E1 E0 03 D0 02 C6
0350- E0 4A E6 E2 A6 E2 E0 02
0358- 30 C4 C9 00 D0 C0 E6 E3
0360- D0 AF 00
*
```

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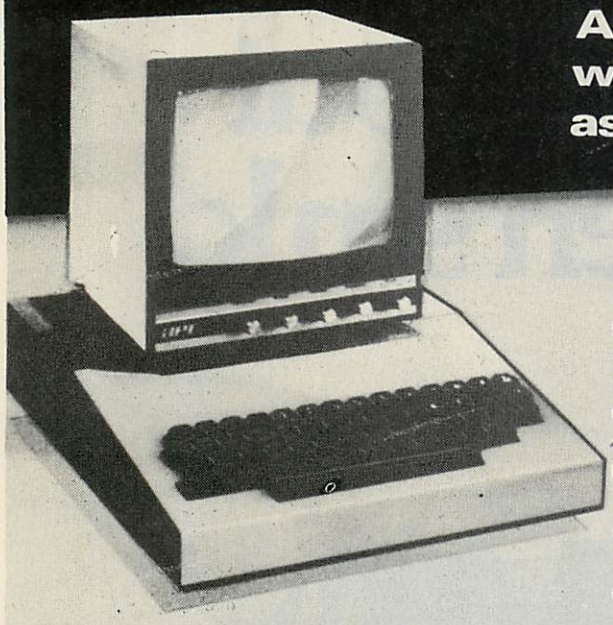
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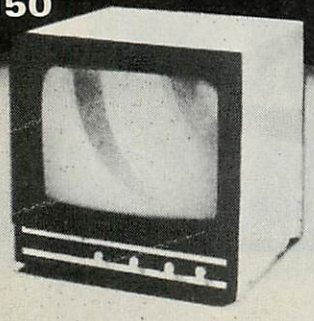


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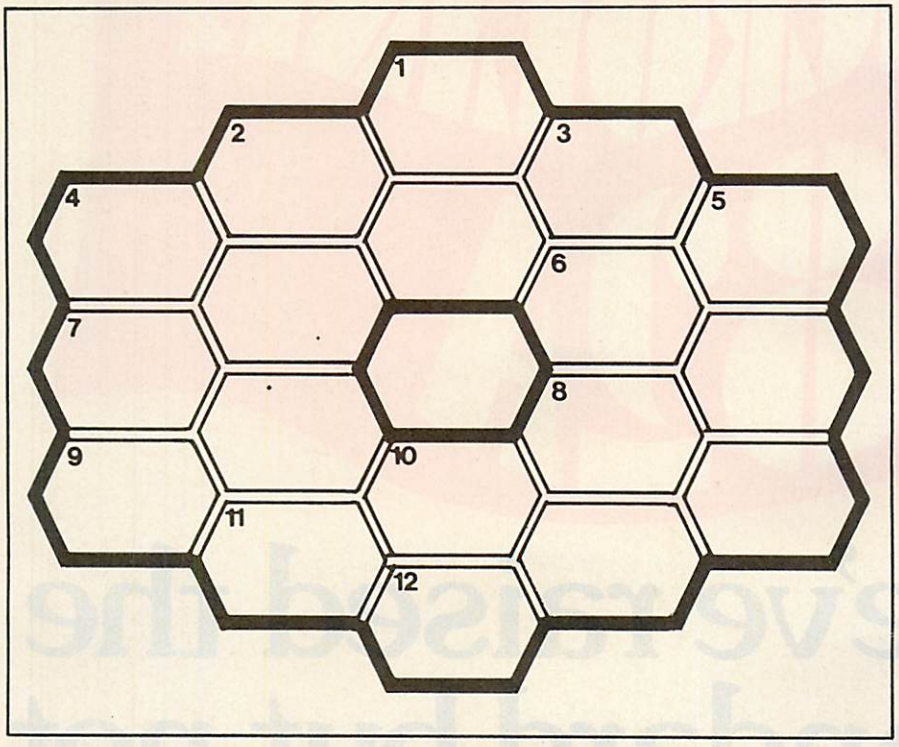
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Figure ring

Answers are placed as in a crossword. However, there are three directions: up, ↗ across ↘ and down ↓. All answers are integers.



Clues:

Up, ↗

4. Same as 4D
6. Sum of 4A and 9U
7. Product of a square and a cube
9. Number of guineas in exactly 8A pounds
11. One more than the sum of 7U, 2D and four times 9U.
12. A prime number

Across, ↘

1. One more than twice 4U
2. The square of the reversed digits of 8A
4. The root of 7A
7. The product of two squares
8. The root of 3D
9. A fourth power

Down, ↓

1. Two-thirds of 6U
2. Number of pounds in 6U stones
3. Number of feet in 7U yards
4. One less than 1A, halved
5. The number of yards in 7A feet
10. The product of two primes

The solution to the puzzle in the September issue, "The mystery of the cave painting" is that all prime numbers greater than two are passed. Our thanks to all who submitted answers – correct and incorrect alike.

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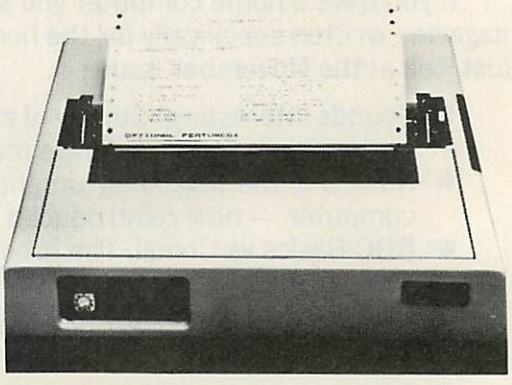
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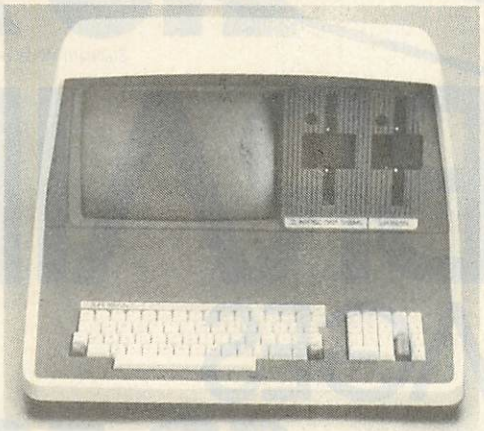
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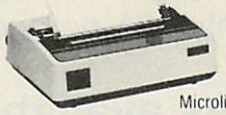
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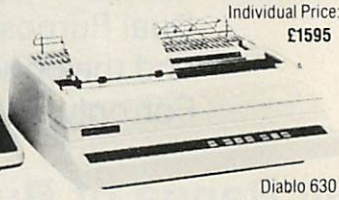
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Head-on collision

OUR PROGRAM called Head-on Collision can be run with minimal changes on any micro using Peek and Poke. All graphics symbols are defined in the first few lines: you should substitute your own after examining the graphics symbols shown in table 1.

There are two versions of the program with different player movements in each. Both use the same board, drawn using lines 5 to 280 and 1000 to 1030; the same scoring system using lines 910 to 970; and similar instructions, using line 2000 onwards. It is a good idea to enter this part of the program first and Save it for use in both versions.

The board consists of several lanes divided by walls. Movement between lanes is possible only at the four points of the compass as shown in figure 1. The human player's piece can move only clockwise around the board in version 1. The computer's piece travels only anticlockwise.

The player scores by hitting the initial symbols — IS — in his path. The score is reduced by the same amount if the computer hits an IS, and a new symbol — NS — is poked in its place when this occurs. An NS counts only half-value — HV — if the player hits it thereafter. The player scores more if he tries to pass through the regions of the board as yet uncovered.

If the player crashes into the computer's piece, the game ends. Otherwise play can continue indefinitely, as the board is replenished with IS once all symbols have been eliminated. The scoring values are raised if this occurs.

The computer's ability to track down its opponent depends upon which skill level — SL — it is set. Scoring is higher for higher skill levels.

In version 1 the player moves only clockwise or between lanes. In version 2 the player may move either north, south, east or west. In both cases the computer's movement capability is identical to the player's apart from it anticlockwise direction.

The program

Lines 5 to 85 initialise all variables. Superboard/UK101 owners need change only line 40; this gives the top left — TL — and top right — TR — memory locations for the board, as well as the line length for your micro. Make sure that TR – TL is an even number, and that the length of your board does not exceed the depth possible on your VDU. The board must be square in concept — although it will not appear so — for the program to work.

Change the graphics symbols, line 30, and non-Superboard/UK101 owners will also need to change line 20 which disables the keyboard on these micros.

If you are going to Poke the score using

(continued on next page)

Table 1. Variables list used in Head-on Collision.

GRAPHICS SYMBOLS
CS Computer's symbol
ES Explosion symbol
IS Initial symbol Poked onto paths at start
MS My symbol
NS New symbol, substituted when computer hits IS
RS Recent symbol; value depends upon what was present at the last position computer's piece occupied
WS Wall symbol

OTHER VARIABLES
BC Board centre
BL, LB Bottom left VDU
BR, RB Bottom right VDU
CM Computer movement direction
CP Computer position
CX, CY Computer coords. relative to BC
DT Distance along top of board
HL Half length of board side
HT Half top distance
HV Half number value — score value for NS
LL Line length
MM My movement direction
MP My position
MX, MY My co-ordinates, relative to BC
NC New computer position
NH Number of IS hit so far by human player
NV Number value — score value of IS
PM Present move direction — set equal to TM or MM
SL Skill level
SP Score position; where score is Poked on screen
TL, LT Top left VDU
TR, RT Top right VDU
TM Temporary move; for lane change, set at right angles to present movement
TN The number of IS Poked initially
TS The score
XC, YC Co-ordinates of board centre relative to TL
ZM Zero line movement; used for the computer's move and indicates present direction of lane change



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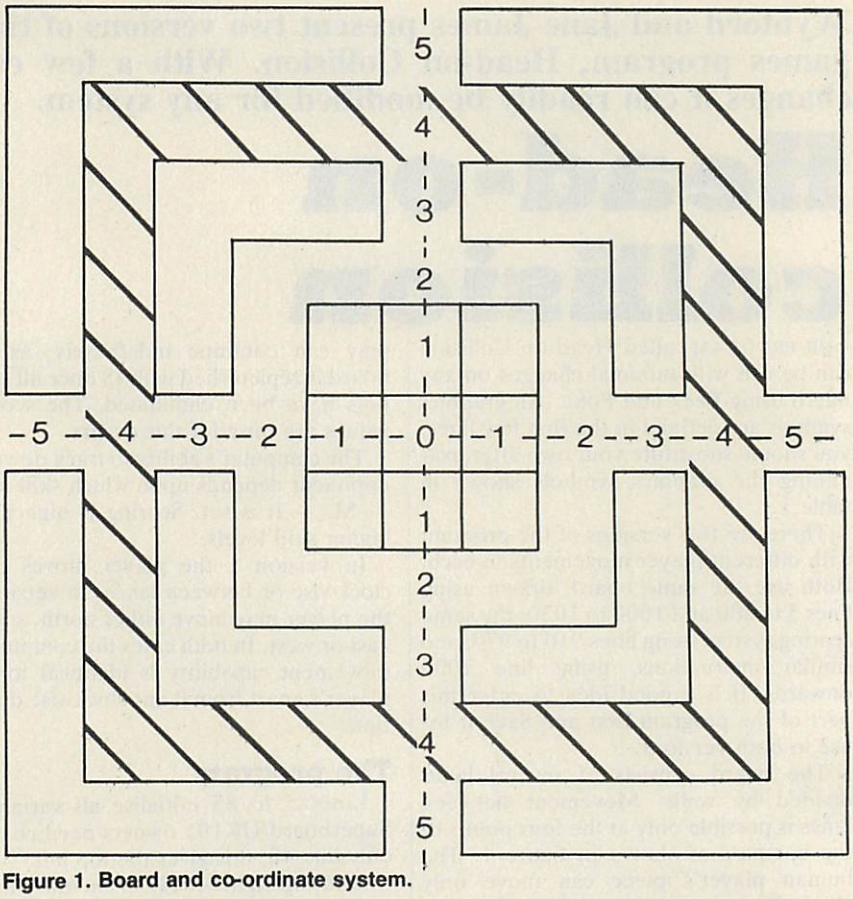


Figure 1. Board and co-ordinate system.

(continued from previous page)

910 to 940 ensure that there is enough room, two lines, beneath the board for it. Remember the board is as deep as it is long.

Lines 90 to 280 and subroutine 1000 draw the board and count the number — TN — of symbols poked. This section may appear complex, but it is only like this because many extra variables must be defined. The size of board and the value of TN will vary from machine to machine, for example.

Once this section has been entered, it is amusing to try various values of TL and TR on line 40. The board can be enlarged or shrunk with no other changes being made.

Movement

In the first version of the game, the program moved its piece between lanes at random, but this did not provide much of a challenge to more skilful players. It is difficult to see how the computer can detect the correct lane to travel down. If the board is made square in concept and the board centre BC is made the origin, the problem is solved.

The absolute value of the Y co-ordinate for horizontal paths and ABS(X) for vertical paths is the same for a particular rectangular lane. For example, in figure 1 the vertical shaded paths have ABS(X) = 4 and the horizontal shaded paths have ABS(Y) = 4.

The program decides which co-ordinate is the important one by examining the player's movement.

If the player is moving vertically, his ABS(X) value will give the lane co-ordinate, and the computer will move to this lane as soon as possible in order to be on a collision course.

The accuracy of lane change depends upon the value of SL. With SL at its maximum value lane change is perfect, but you still have a chance to survive as the computer may turn right or left. Lower values of SL mean that the computer is no longer infallible, but scoring is correspondingly lower.

Further details of the program are unnecessary, because no changes need be made except in the following lines. In version 1, lines 30. and 40 should be changed, as well as lines 310, 390 and 410 which Peek the keyboard: line 310 to see if the player wishes to move; line 390 if he wishes to change lanes up/left; or line 410 to change lanes down/right. Non-Superboard/UK101 owners should delete lines 20, 370, 740, and 970.

In version 2, the player may move in any of four directions as may the computer. If appropriate graphics symbols are available, their values should be substituted for the computer in line 35 and the player in line 36, in the order to indicate movement up, right, down and left respectively. The OSI Superboard II has both an arrow and tank symbol which are used here to indicate the different directions. If no such symbols are available, set C(1) to C(4) equal to the same value, that

of the computer symbol. Do similarly for line 36 for the player's symbol.

Lines 300 to 330 are keyboard symbols which check in which direction the player wishes to move: up, right, down or left respectively. Change these appropriately.

If you are short on symbols, NS can be eliminated by deleting lines 870 and 890. The score can be printed at the end rather than Poked during the course of the game. If you with to do this, delete lines 910 to 925.

Listing 1. Version 1 of Head-on Collision.

```
1 REM HEAD ON CRASH
5 GOSUB2000
20 K=57088:POKE530,1:POKEK,251
30 WS=161:IS=111:MS=250:CS=16:SD=WS:NS=42:ES=188
40 TL=53350:TR=53372:LL=32
50 DT=TR-TL:BL=TL+DT*LL:BR=BL+DT
60 CP=BR-LL-1:MP=TL+LL+1:CM=-LL:MM=1
70 HT=INT(DT/2):HL=INT((BL-TL)/2):BC=TL+HT-HL
71 BC=TL+HT+HL
75 YC=INT((BC-TL)/LL):XC=BC-(TL+(LL*YC)):HT=HT-1:HL=HL-LL
80 DC=2*(LL+1):TN=0:TS=0:SP=BL+DC+HT-2
85 NV=NV+10:NH=0:HV=NV/2:LT=TL:LB=BL:RT=TR:RB=BR
90 FORA=LTTORT:GOSUB1000:NEXT
100 FORA=LBTORB:GOSUB1000:NEXT
110 FORA=LTTOLBSTEPLL:GOSUB1000:NEXT
120 FORA=RTTORBSTEPLL:GOSUB1000:NEXT
180 LT=LT+LL+1:RT=RT+LL-1:LB=LB-LL+1:RB=RB-LL-1
190 IFLT=BC-DCTHENSD=IS:GOTO230
200 IFLT=BCTHEN260
210 IFSD=WSTHENSD=IS:GOTO90
220 IFSD=ISTHENSD=WS:GOTO90
230 FORA=BC-HTTOBC+HT:IFPEEK(A)=ISTHENTN=TN-1
235 POKEA,32:NEXT
240 FORA=BC-HLTOBC+HLSTEPLL:IFPEEK(A)=ISTHENTN=TN-1
245 POKEA,32:NEXT
250 GOTO90
260 IFPEEK(CP)=ISTHENTN=TN-1
270 IFPEEK(MP)=ISTHENTN=TN-1
280 POKECP,CS:POKEMP,MS:POKEBC,WS
299 REM PLAYER'S MOVE
300 MY=YC-INT((MP-TL)/LL):MX=MP-BC+(LL*MY)
310 TM=0:IFPEEK(K)=127THEN340
320 IFMX=0ORMY=0THEN390
330 GOTO700
340 NP=PEEK(MP+MM)
350 IFNP<>WSTHEN450
360 MM=-LL/MM:IFMX=MYTHENMM=-MM
370 MS=MS+2:IFMS>254THENMS=248
380 GOTO340
390 IFPEEK(K)<>251THEN410
400 TM=-LL/ABS(MM):GOTO430
410 IFPEEK(K)<>253THEN700
420 TM=LL/ABS(MM)
430 NP=PEEK(MP+TM)
440 IFNP=WSTHEN700
445 TM=TM*2:NP=PEEK(MP+TM)
450 IFNP=CSTHEN950
```

(continued on next page)

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(continued from previous page)

```
460 IFNP=ISTHENTS=TS+NV:NH=NH+1
470 IFNP=NSTHENTS=TS+HV:NH=NH+1
480 POKEMP,32
490 PM=MM:IFTM<>0THENPM=TM
500 MP=MP+PM:POKEMP,MS
699 REM COMPUTER'S MOVE
700 CY=YC-INT((CP-TL)/LL):CX=CP-BC+(LL*CY):PM=CM
710 TM=0:CA=PEEK(CP+CM)
720 IFCA<>WSTHEN760
730 CM=-LL/CM:IFCX=CYTHENCM=-CM
740 CS=CS-2:IFCS<16THENCS=22
750 PM=CM:GOTO850
760 IFCA=MSTHEN950
770 IFCX<>0ANDCY<>0THENZM=0:GOTO850
780 A=MM*MM:IFA=1THENB=ABS(MY):GOTO800
790 B=ABS(MX)
800 IFRND(1)>SLTHEN850
805 IFABS(CY)=BORABS(CX)=BTHENZM=0:GOTO850
810 TM=LL/ABS(CM)
815 IFPEEK(CP+TM)=WSTHENTM=-TM:ZM=TM
820 IFZM=0THEN830
825 IFZM<>TMTHENTM=-TM:GOTO815
830 TM=2*TM
840 IFTM<>0THENPM=TM
850 NC=PEEK(CP+PM):RS=32:IFNC=32THEN870
860 IFNC=MSTHEN950
870 IFF=1THENRS=NS:F=0
880 IFNC=ISTHENTS=TS-NV
890 IFNC=ISORNC=NSTHENF=1
900 POKECP,RS:CP=CP+PM:POKECP,CS
905 REM POKE SCORE
910 T$=STR$(TS):IFTS<0THENPOKESP+1,45
911 REM ABOVE POKES A MINUS IF SCORE IS NEGATIVE
915 IFTS>0THENPOKESP+1,32
920 FORU=2TOLEN(T$):POKESP+U,ASC(MID$(T$,U,1)):NEXT
925 POKESP+U,32
930 IFNH=TNTHENTS=TS+(NV*10):GOTO85
940 GOTO300
950 POKEMP,32:POKECP,ES:FORX=0TO1000:NEXT
955 PRINT:PRINT:PRINT"GAME OVER. YOU SCORED ";TS
970 POKE530,0:END
990 REM SUBROUTINE TO POKE BOARD
1000 IFPEEK(A)=ISORSD=WSTHEN1020
1010 TN=TN+1
1020 POKEA,SD
1030 RETURN
2000 FORX=0TO25:PRINT:NEXT
2005 PRINT"YOU SCORE BY HITTING THE SYMBOLS IN THE"
2010 PRINT"LANES. ORIGINAL SYMBOLS ARE WORTH TWICE"
2020 PRINT"THE VALUE OF SYMBOLS CREATED BY THE PATH"
2030 PRINT"OF THE COMPUTER'S PIECE. YOUR PIECE ONLY"
2040 PRINT"MOVES CLOCKWISE."
2050 PRINT"X MOVES YOUR PIECE, M ENABLES LANE CHANGE"
2060 PRINT"UP/LEFT, COMMA CHANGE DOWN/RIGHT."
2070 PRINT"INPUT SKILL LEVEL: 1 TO 5";:INPUTSL
```

```
2080 A=INT(SL):IFA<10RA>5THEN2070
2090 NV=A*2:SL=.5+SL/10
2100 FORX=0TO25:PRINT:NEXT:RETURN
```

Listing 2. Version 2 of Head-on Collision.

```
1 REM HEAD ON CRASH VERSION 2
35 C(1)=16:C(2)=18:C(3)=20:C(4)=22
36 M(1)=248:M(2)=250:M(3)=252:M(4)=254
45 D(1)=-LL:D(2)=1:D(3)=LL:D(4)=-1
299 REM PLAYER'S MOVE
300 M=0:IFPEEK(K)=251THENM=1
310 IFPEEK(K)=191THENM=2
320 IFPEEK(K)=253THENM=3
330 IFPEEK(K)=127THENM=4
340 IFM=0THEN600
350 MS=M(M):MM=D(M)
360 PM=MM
370 NP=PEEK(MP+MM):IFNP=WSTHEN600
380 IFNP=CSTHEN950
390 IFNP=ISTHENTS=TS+NV:NH=NH+1
400 IFNP=NSTHENTS=TS+HV:NH=NH+1
410 POKEMP,32:MP=MP+MM:POKEMP,MS
595 REM COMPUTER'S MOVE
600 MY=INT((MP-TL)/LL):CY=INT((CP-TL)/LL)
610 MY=YC-MY:CY=YC-CY
620 MX=MP-BC+(LL*MY):CX=CP-BC+(LL*CY)
630 DR=1:IF(CM*CM)=1THENDR=LL
640 CR=PEEK(CP+DR):CL=PEEK(CP-DR):CA=PEEK(CP+CM)
650 IFCA=WSTHEN800
700 IFCR=WSANDCL=WSTHEN850
710 IFRND(1)>SLTHEN850
720 A=PM*PM:IFA=1THENB=ABS(MY):GOTO740
730 B=ABS(MX)
740 IFABS(CM)=1ANDABS(CX)=BTHEN800
750 IFABS(CM)=1ANDCX=0ANDABS(CY)<>BTHEN800
760 IFABS(CM)=LLANDABS(CY)=BTHEN800
770 IFABS(CM)=LLANDCY=0ANDABS(CX)<>BTHEN800
775 REM 780 MAKES COMPUTER'S PIECE REVERSE AT TIMES
780 IFRND(1)>.95THEND=-4:GOTO810
790 GOTO850
800 D=1
810 S=S+D:IFS>4THENS=S-4
820 IFS<1THENS=S+4
830 CS=C(S):CM=D(S)
840 POKECP,CS
850 NC=PEEK(CP+CM):RS=32:IFNC=32THEN870
855 IFNC=WSTHEND=?:GOTO810
856 REM 860 TO 89J SAME AS VERSION 1
900 POKECP,RS:CP=CP+CM:POKECP,CS
901 REM 905 ON SAME AS VERSION 1 EXCEPT:
2050 PRINT"M MOVES UP, COMMA MOVES DOWN"
2060 PRINT"C MOVES RIGHT, X MOVES LEFT."
```




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Colour from the Apple

Roger Cullis begins a series on his Type-a-Graphics programs which make the most of Apple's facility for both low- and high-resolution graphics.

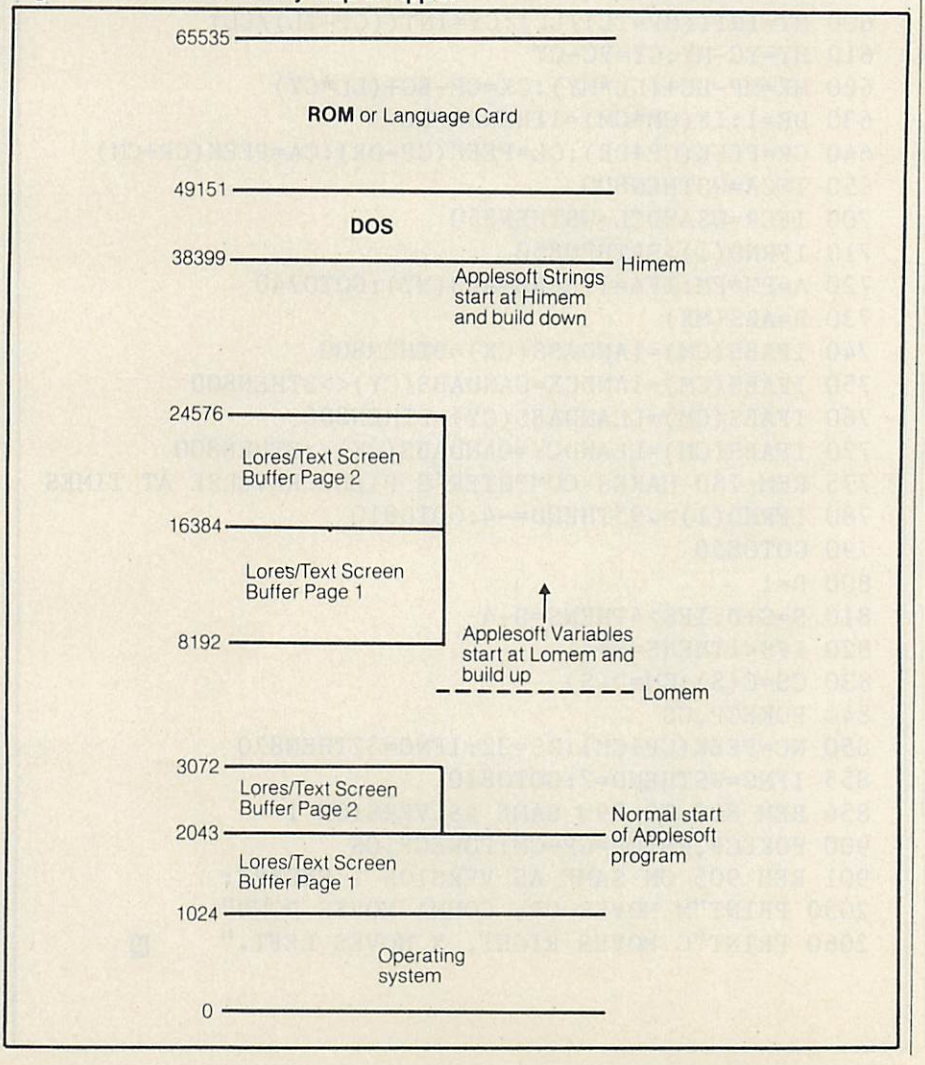
APPLE'S versatile screen display is one of the features which have contributed to its popularity. In addition to text, which is essential for communication in all programs, Apple has two levels of graphics which can be the starting point for the development of games or more serious applications involving pictorial presentation of data.

The programs here have been devised to illustrate as many as possible of Apple's features. Progressing from a simple program which produces a multi-coloured chart in low-resolution Lores graphics, the format is developed to produce a complex program which permits lower- as well as upper-case characters to be typed on the screen in any axial direction — up, down, left or right — and combined with graphical features such as drawing circles or lines between specified co-ordinate positions. By following the development of the algorithms used, the reader should be able to expand the programs.

To understand the programs and some of the apparently strange techniques which are incorporated, it is desirable to have some understanding of Apple's internal organisation. The memory map is set out schematically in figure 1.

The regions which are of interest are the screen buffers which are found at decimal addresses 1024 to 3073 and 8192 to 24575. Text and low-resolution graphics share addresses 1024 to 3073 and,

Figure 1. Schematic memory map of Apple.



as they cannot occupy the locations simultaneously, a choice of which to display has to be exercised. Text is destroyed when graphics are stored, and vice versa.

Each area of memory is divided into two pages, and the screen will display whichever of these is indicated by the setting of a switch whose state can be changed by a Peek or Poke command to a special location.

Apple was designed when memory chips were not as plentiful and cheap as they are now. Consequently, only the screen buffer which is used for working communication with the user is reserved exclusively for the screen display. Apple may use the other screen buffers for storing programs or variables unless precautions are taken to prevent this happening.

If, for example, the second page of text is needed to store instructions for periodic reference, pointers must be set within Apple to ensure that the relevant area of memory is kept clear. This could be achieved by manipulations carried out by the operator, but in the accompanying programs it is performed automatically, because the programs are intended to be run by a user with little or no previous knowledge.

Apple was not designed for ease of use with cassettes. It does, however, possess a superb disc-operating system, DOS-3.3, which has been used for the development of these programs, although with cassettes could be used after appropriate modifications to the system.

The operator can start from scratch, and when he has finished, simply admire the results of his handiwork on the screen, or he can load an existing graphic display from disc, modify it, and save the result for another day.

In this way he can gradually construct a complex chart or picture, hopefully remembering to make back-up copies at intermediate stages to avoid the heartbreak of a clobbered disc right at the end of several evenings' painstaking work.

Each program in this series has the same general format. First, Apple checks that the required screen buffers are clear, and, if they are not, sets appropriate pointers and re-loads and program in a different area of memory. Next, a greeting and brief description of the program are displayed and there is a pause to permit them to be read.

The operator is then presented with a series of options which permit him to load an existing graphic from disc. Next, the screen displays comprehensive instructions for developing or modifying the graphics; these instructions are stored away on the second text page and can be instantly recalled if help is subsequently needed.

Finally, when the work is complete, Apple stores the finished graphic on disc and re-sets the program pointers to free the memory which had been reserved for the screen buffers.

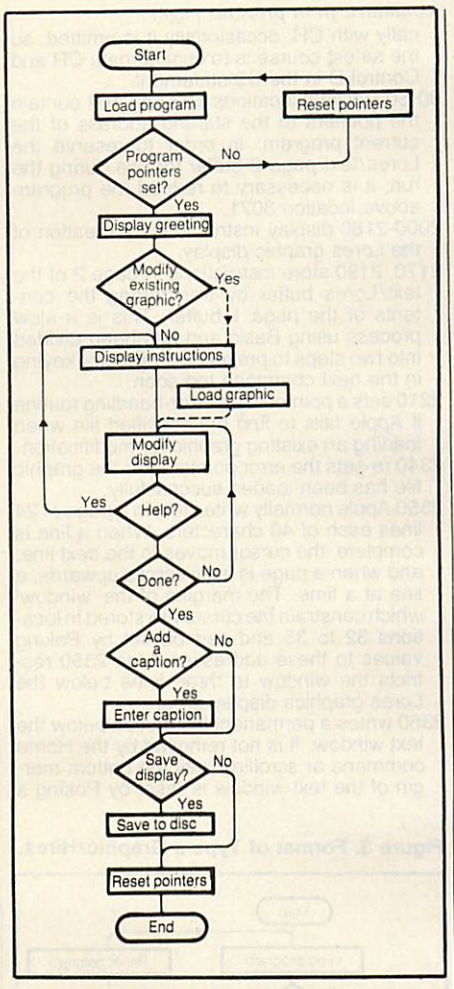


Figure 2. Format of Type-a-Graphic/Lores.

Commands are usually entered by the operator with a single key stroke, but occasionally — for example, to enter a plotting co-ordinate — it is necessary to use more than one key. If this should be required, precise instructions are displayed on the screen.

Mixed text and graphics modes are employed to present the operator with continuously-updated messages to advise him of the current status of the program or position of the plotting cursor, while at any time he can refer back to the instructions to refresh his memory without destroying the graphic display he has already created.

Type-a-Graphic/Lores is the simplest program and enables the operator to produce a simple chart in Lores graphics. The screen is divided into a 40x40 matrix of elementary squares, and each square may be plotted in any one of 16 colours. A block of eight keys is used to control cursor movements and plotting colours are changed with the numerals 0-9 and letters A-F. The general format of the program is set out in figure 2, but some of the program lines require special explanation to permit thorough understanding.

10 It is a DOS requirement that Control D is preceded by a carriage return. Although most Basic statements terminate automati-

(continued on next page)

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(continued from previous page)

cally with CR, occasionally it is omitted, so the safest course is to concatenate CR and Control D in the D$ statement.

30-50 Decimal locations 103 and 104 contain the pointers to the starting address of the current program. In order to reserve the Lores/text page 2 buffer for use during the run, it is necessary to re-load the program above location 3071.

2000-2180 display instructions for creation of the Lores graphic display.

2170, 2190 store instructions in page 2 of the text/Lores buffer by transferring the contents of the page 1 buffer. This is a slow process using Basic and has been divided into two steps to prevent the operator keying in the next command too soon.

2210 sets a pointer to an error-handling routine if Apple fails to find the specified file when loading an existing graphic for modification.

2340 re-sets the error pointer after the graphic file has been loaded successfully.

2350 Apple normally writes text in a page of 24 lines each of 40 characters. When a line is complete, the cursor moves to the next line, and when a page is full it scrolls upwards, a line at a time. The margins of the 'window' which constrain the cursor are stored in locations 32 to 35 and can be set by Poking values to these addresses. Line 2350 restricts the window to three lines below the Lores graphics display area.

2360 writes a permanent instruction below the text window. It is not removed by the Home command or scrolling until the bottom margin of the text window is reset by Poking a new value into location 35 or by the Text command.

2370 displays the current cursor co-ordinates and plotting colour.

2380-2500 call up cursor-movement and colour-changing routines.

2620-2630 washes screen with current colour.

2640-2670 hold the Help routine which switches the display to the instructions stored in the text page 2 buffer. Locations 16304-16297 contain soft switches which control the screen display. The switches are in pairs 16304/16303 for graphics/text; 16302/16301 for all graphics/mixed text and graphics; 16300/16299 for page 1/page 2; and 16298/16297 for Lores/Hires. By referencing the relevant address with a Poke address, 0 command, the switch is set. Thus line 2640 sets the display to text page 2 to reveal the instructions, and line 2660 returns the screen to the page 1 graphics display.

2680-2880 selective colour-change routine.

2860 the command SCRN(X,Y) returns a code (0-15) for the colour of the picture element (pixel) at location X,Y. A+55 for numbers above 9 is the ASCII code for letters A to E.

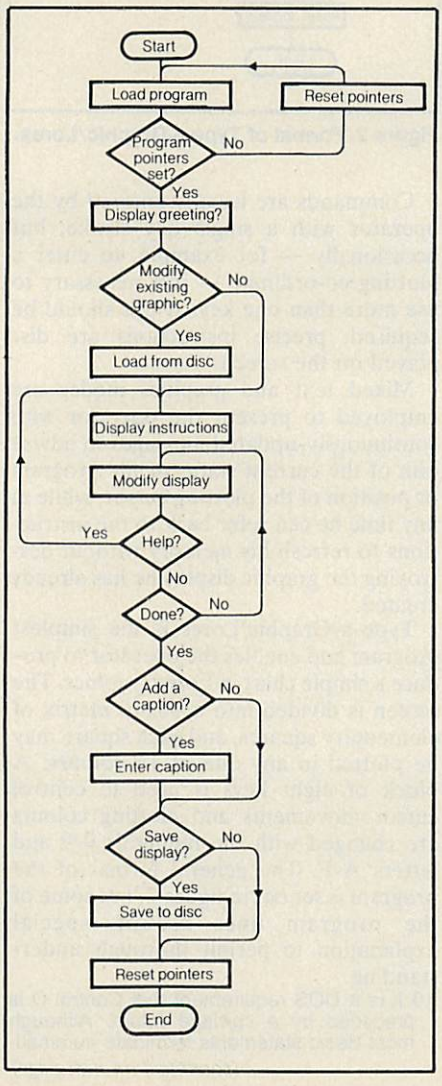
2890-3060 The colour-change routine sets Colour command and a corresponding name string in response to an input character, to change the colour of the pixel at the current location.

8000 re-sets the text window to include the line displaying the Help instruction.

8020 moves the bottom line of the text window to prevent the caption scrolling.

8340-8350 re-set the program pointers and text window to their initial values.

Figure 3. Format of Type-a-Graphic/Hires.



Multicoloured charts constructed using this program could be used for interactive games, for example, using the SCRN() command to obtain the code for the colour at a specified location.

As well as Lores graphics on a 40x40 matrix, Apple has the facility to produce higher resolution displays on a matrix of 160x280 pixels. The trade-off for this improvement in definition is that points can be plotted in eight colours only. Furthermore, of these colours, two are white and two are black, reducing the choice of six different colours, black, white, green, red/orange, pink and blue. The actual hues vary with the television set or monitor used for the display.

Another limitation is that complementary pairs of colours — blue and pink, green and red — are plotted on alternate lines only, reducing the effective definition to 160x140. Within these limitations, however, reasonable graphic displays can be constructed using a program written in a format similar to Type-a-Graphic/Lores. The general construction of Type-a-Graphic/Hires is set out in figure 3. In addition, it includes one or two features which take advantage of the improved definition and these are explained in the commentary below.

5250 The Hires command corresponding to Plot in Lores is HPLOT X,Y which enters a pixel of the most recently specified HCOLOR (default — black).

5280 Numeral keys 0-7 (ASCII codes 48-55) are used to change the plotting colour.

5290-5360 move the cursor. If an attempt were made to plot points outside the screen limits, the program would crash, so the second condition is specified to prevent this happening.

5390 Call 62454 runs a monitor subroutine which switches the whole screen to the most recently plotted HCOLOR.

5400 Hires graphics has a command HPLOT X1, Y1T0X2, Y2 which draws a line between a specified pair of points. A variant of this command is HPLOT TO X2, Y2 which draws a line from the most recently plotted point to the new one.

5460-5680 There are two simple algorithms using Applesoft Basic commands which could be used to draw a circle. The first effectively use polar co-ordinates and HPLOTs R*SIN(Z), R*COS(Z) whilst the second uses rectilinear co-ordinates to HPLOT X,SQR(R*R-X*X). The second algorithm was rejected because it did not plot points evenly round the circumference of the circle, but the first algorithm also suffered from a drawback since the computation of Sin and Cos functions is slow and this makes plotting circles rather tedious. However, advantage can be taken of the symmetry of the circle; the necessary points are calculated for the first 45° and these are then reflected into the other seven octants to complete the circle.

The subroutine takes advantage of the ONERR command to move the program on to the next line to avoid plotting points on a circle which would be outside the Hires screen and thus cause the program to crash. For this reason a pedantic loop structure has been chosen, as the ONERR routine cannot be used in conjunction with a For . . . Next loop.

5690-5740 Separate subroutines must be used to change the X and Y co-ordinates because the Hires screen is not square.

Program 1. Type-a-Graphic/Lores.

```
1  REM  TYPE-A-GRAPHIC (LORES)
2  REM  PROGRAM WRITTEN 23 APRIL 1980 IN APPLESOFT BASIC
3  REM  LAST AMENDED 17 JUN 1981 (VERSION NO.15)
4  REM  COPYRIGHT 1981 - ROGER CULLIS
10 D$ =  CHR$ (13) +  CHR$ (4): REM  CR + CONTROL D
30  IF  PEEK (103) = 1 AND  PEEK (104) = 12 AND  PEEK (3072
    ) = 0 THEN  GOTO 60
40  POKE 103,1: POKE 104,12: POKE 3072,0
50  PRINT D$;"RUN TYPE-A-GRAPHIC (LORES)"
60 C$ = "BLACK":L1$ = "":L2$ = "":L3$ = "": REM  INITIALISE

997  REM  ****************************************
998  REM  INTRODUCTION
999  REM  ****************************************
1000  HOME : PRINT : PRINT
1010  PRINT  TAB( 12)"******************"
1020  PRINT  TAB( 12)"*                *"
1030  PRINT  TAB( 12)"* TYPE-A-GRAPHIC *"
1040  PRINT  TAB( 12)"*                *"
1050  PRINT  TAB( 12)"*    (LORES)     *"
1060  PRINT  TAB( 12)"*                *"
1070  PRINT  TAB( 12)"******************"
1080  VTAB 12: PRINT " A PROGRAM TO PLOT POINTS IN DIFFEREN
    T"
1090  PRINT : PRINT " COLOURS USING LOW RESOLUTION GRAPHICS
    "
1100  PRINT : PRINT " COLOURS ARE CHANGED AND THE PLOTTING"

1110  PRINT : PRINT " POSITION MOVED USING THE KEYBOARD."
1120  FOR I = 0 TO 5000: NEXT : REM  DISPLAY TIME
1130  HOME : VTAB 10: PRINT "DO YOU WISH TO MODIFY AN EXIST
    ING"
1140  PRINT "PICTURE OR DIAGRAM (Y/N?)": PRINT
1150  GET B$: IF B$ = "N" THEN  GOTO 1190
1160  IF B$ <  > "Y" THEN  GOTO 1150
1170  PRINT : PRINT "ENTER ITS FILE NAME,"
1180  PRINT : INPUT "THEN PRESS 'RETURN' - ";NAME$
1997  REM  ****************************************
1998  REM  INSTRUCTIONS AND GRAPHIC CONSTRUCTION
1999  REM  ****************************************
2000  HOME : PRINT  TAB( 14)"INSTRUCTIONS"
2010  PRINT : PRINT "UIO ) MOVE THE CURSOR POSITION (I-UP"
2020  PRINT "J K )"
2030  PRINT "NM, ) J-LEFT,O-UP/RIGHT, ETC. )"
2040  PRINT : PRINT "0-9 ) SELECT THE PLOTTING COLOUR"
2050  PRINT "A-F )"
2060  PRINT : PRINT "X Y ) SELECT THE PLOTTING COORDINATES"

2070  PRINT "Z   ) COVER SCREEN WITH CURRENT COLOUR"
2080  PRINT "R   ) REPLACE A SELECTED COLOUR"
2090  PRINT : PRINT "S   ) STOP PLOTTING, ENTER SAVE ROUTIN
    E"
2100  PRINT : PRINT  TAB( 16)"COLOURS"
2110  PRINT "0-BLACK     1-MAGENTA    2-DARK BLUE"
2120  PRINT "3-PURPLE    4-DARK GREEN 5-GREY"
2130  PRINT "6-MID BLUE  7-LIGHT BLUE 8-BROWN"
2140  PRINT "9-ORANGE    A-GREY       B-PINK"
2150  PRINT "C-GREEN     D-YELLOW     E-AQUA"
2160  PRINT "F-WHITE"
2170  FOR I = 2048 TO 3023: POKE I, PEEK (I - 1024): NEXT :
    REM  TRANSFER TO TEXT P2 BUFFER
2180  VTAB 24: PRINT  TAB( 8)"PRESS 'RETURN' TO CONTINUE"
2190  GET A$: IF A$ <  > CHR$ (13) THEN  GOTO 2190
2200  FOR I = 3024 TO 3071: POKE I, PEEK (I - 1152): NEXT
2210  ONERR  GOTO 2250
2220  GR : IF B$ = "N" THEN  GOTO 2340
2230  PRINT D$;"BLOAD "NAME$", A$400": REM  LOAD EXISTING G
    RAPHIC
2240  GOTO 2340
2247  REM
2248  REM  ERROR ROUTINE
2249  REM
2250  TEXT : HOME : VTAB 10: PRINT "FILE - "NAME$" - NOT AV
    AILABLE"
```

(continued on next page)

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(continued from previous page)

```
2260  PRINT : PRINT "PLEASE CHECK SPELLING AND DISK CATALOG
      "
2270  PRINT : PRINT "DO YOU WISH TO RE-ENTER FILE NAME (Y/N
      ?)"
2280  GET B$: HOME : VTAB 22: IF B$ = "Y" THEN  GOTO 2320
2290  IF B$ <  > "Y" THEN  GOTO 2280
2300  PRINT "ENTER ITS FILE NAME,"
2310  INPUT "THEN PRESS 'RETURN' - ";NAME$: HOME : VTAB 22
2320  PRINT "CONTINUE WITH 'TYPE-A-GRAPHIC' PROGRAM"
2330  FOR I = 0 TO 2000: NEXT : REM  DISPLAY TIME
2340  POKE 216,0: REM  RESET ERROR FLAG
2350  HOME : POKE 34,20: POKE 35,23: REM  SET TEXT WINDOW
2360  VTAB 24: PRINT  TAB( 10)"TYPE 'H' FOR HELP"
2370  HOME : VTAB 22: PRINT  TAB( 5)"X = ";X;"   Y = ";Y";
      COLOUR = "C$
2380  PLOT X,Y
2387  REM
2388  REM  MODIFY GRAPHIC DISPLAY
2389  REM
2390  GET A$
2400  IF  ASC (A$) > 47 AND  ASC (A$) < 71 THEN  GOSUB 2890
      : COLOR= C: GOTO 2370: REM  NEW PLOTTING COLOUR
2410  IF A$ = "I" AND Y > 0 THEN Y = Y - 1: REM  UP
2420  IF A$ = "K" AND X < 39 THEN X = X + 1: REM  RIGHT
2430  IF A$ = "M" AND Y < 39 THEN Y = Y + 1: REM  DOWN
2440  IF A$ = "J" AND X > 0 THEN X = X - 1: REM  LEFT
2450  IF A$ = "U" AND X > 0 AND Y > 0 THEN Y = Y - 1:X = X -
      1: REM  UP/LEFT
2460  IF A$ = "O" AND X < 39 AND Y > 0 THEN Y = Y - 1:X = X
      + 1: REM  UP/RIGHT
2470  IF A$ = "N" AND X > 0 AND Y < 39 THEN Y = Y + 1:X = X
      - 1: REM  DOWN/LEFT
2480  IF A$ = "," AND X < 39 AND Y < 39 THEN Y = Y + 1:X =
      X + 1: REM  DOWN/LEFT
2490  IF A$ = "X" OR A$ = "Y" THEN  GOTO 2550: REM  CHANGE
      COORDINATE
2500  IF A$ = "Z" THEN  GOTO 2620: REM  NEW SCREEN COLOUR
2510  IF A$ = "R" THEN  GOTO 2680: REM  REPLACE A COLOUR
2520  IF A$ = "S" THEN  GOTO 8000: REM  FINISH PLOTTING
2530  IF A$ = "H" THEN  GOSUB 2640
2540  GOTO 2370
2547  REM
2548  REM  CHANGE CURSOR COORDINATE
2549  REM
2550  HOME : VTAB 22: PRINT "ENTER COORDINATE, THEN PRESS '
      RETURN'"
2560  PRINT  TAB( 5)A$;
2570  INPUT " = ";A
2580  IF A < 0 OR A > 39 THEN  GOTO 2550
2590  IF A$ = "Y" THEN Y = A: GOTO 2370
2600 X = A
2610  GOTO 2370
2620 X1 = X: FOR X = 0 TO 39: VLIN 0,39 AT X: NEXT :X = X1
2630  GOTO 2370
2637  REM
2638  REM  DISPLAY TEXT P2
2639  REM
2640  POKE  - 16303,0: POKE  - 16302,0: POKE  - 16299,0: REM
      TEXT,ALL,P2
2650  GET A$: IF A$ <  > CHR$ (13) THEN  GOTO 2640
2660  POKE  - 16304,0: POKE  - 16300,0: POKE  - 16301,0: REM
      GRAPHICS,P1,MIXED
2670  RETURN
2677  REM
2678  REM  SELECTIVE COLOUR CHANGE
2679  REM
2680  HOME : PRINT "ENTER CODE (0-9,A-F) FOR COLOUR TO"
2690  PRINT "BE CHANGED"
2700  GET A$: IF A$ = "H" THEN  GOSUB 2660: GET A$
2710  GOSUB 2890:C1$ = C$:C1 = C
2720  HOME : PRINT "ENTER CODE (0-9,A-F) FOR SUBSTITUTE"
2730  PRINT "COLOUR"
2740  GET A$: IF A$ = "H" THEN  GOSUB 2660: GET A$
2750  GOSUB 2890:C2$ = C$:C2 = C
2760  HOME : PRINT C2$" WILL REPLACE "C1$
2770  PRINT "OK (Y/N?)"
2780  GET A$: IF A$ = "N" THEN  GOTO 2680
2790  IF A$ <  > "Y" THEN  GOTO 2790
2800  COLOR= C2:X1 = X:Y1 = Y
2810  FOR Y = 0 TO 39
2820  FOR X = 0 TO 39
2830  IF  SCRN( X,Y) = C1 THEN  PLOT X,Y
2840  NEXT X
2850  NEXT Y
2860 X = X1:Y = Y1:C =  SCRN( X,Y):A$ =  STR$ (C): IF C > 9
      THEN A$ =  CHR$ (C + 55)
2870  GOSUB 2890
2880  GOTO 2370
2887  REM
2888  REM  NEW COLOUR
2889  REM
2890  IF A$ = "0" THEN C = 0:C$ = "BLACK"
2900  IF A$ = "1" THEN C = 1:C$ = "MAGENTA"
2910  IF A$ = "2" THEN C = 2:C$ = "DARK BLUE"
2920  IF A$ = "3" THEN C = 3:C$ = "PURPLE"
2930  IF A$ = "4" THEN C = 4:C$ = "DARK GREEN"
2940  IF A$ = "5" THEN C = 5:C$ = "GREY"
2950  IF A$ = "6" THEN C = 6:C$ = "MID BLUE"
```

```
2960  IF A$ = "7" THEN C = 7:C$ = "LIGHT BLUE"
2970  IF A$ = "8" THEN C = 8:C$ = "BROWN"
2980  IF A$ = "9" THEN C = 9:C$ = "ORANGE"
2990  IF A$ = "A" THEN C = 10:C$ = "GREY"
3000  IF A$ = "B" THEN C = 11:C$ = "PINK"
3010  IF A$ = "C" THEN C = 12:C$ = "GREEN"
3020  IF A$ = "D" THEN C = 13:C$ = "YELLOW"
3030  IF A$ = "E" THEN C = 14:C$ = "AQUA"
3040  IF A$ = "F" THEN C = 15:C$ = "WHITE"
3050  COLOR= C
3060  RETURN
7997  REM  ****************************************
7998  REM  SAVE ROUTINE
7999  REM  ****************************************
8000  POKE 35,24
8010  HOME : VTAB 22: PRINT "DO YOU WISH TO ADD A CAPTION (
    Y/N?)"
8020  PRINT "(UP TO THREE LINES)"
8030  GET B$: IF B$ = "N" THEN  GOTO 8230
8040  IF B$ <  > "Y" THEN  GOTO 8030
8050  HOME : VTAB 21: PRINT "ENTER FIRST LINE (UP TO 40 CHA
    RACTERS"
8060  PRINT "OR SPACES), THEN PRESS 'RETURN'"
8070  INPUT " ";L1$
8080  PRINT  TAB( 10)"OK (Y/N?)"
8090  GET A$: IF A$ = "N" THEN  GOTO 8050
8100  IF A$ <  > "Y" THEN  GOTO 8080
8110  HOME : VTAB 21: PRINT "ENTER SECOND LINE (UP TO 40 CH
    ARACTERS"
8120  PRINT "OR SPACES), THEN PRESS 'RETURN'"
8130  INPUT " ";L2$
8140  PRINT  TAB( 10)"OK (Y/N?)"
8150  GET A$: IF A$ = "N" THEN  GOTO 8110
8160  IF A$ <  > "Y" THEN  GOTO 8140
8170  HOME : VTAB 21: PRINT "ENTER THIRD LINE (UP TO 40 CHA
    RACTERS"
8180  PRINT "OR SPACES), THEN PRESS 'RETURN'"
8190  INPUT " ";L3$
8200  PRINT  TAB( 10)"OK (Y/N?)"
8210  GET A$: IF A$ = "N" THEN  GOTO 8170
8220  IF A$ <  > "Y" THEN  GOTO 8200
8230  HOME : VTAB 22: PRINT "DO YOU WISH TO SAVE THIS GRAPH
    IC (Y/N?)"
8240  GET A$: IF A$ = "N" THEN  GOTO 8280
8250  IF A$ <  > "Y" THEN  GOTO 8240
8260  PRINT "ENTER FILE NAME, THEN PRESS 'RETURN'"
8270  INPUT "";NAME$
8280  HOME : POKE 35,21
8290  VTAB 22: PRINT  TAB( (40 -  LEN (L1$)) / 2)L1$
8300  VTAB 23: PRINT  TAB( (40 -  LEN (L2$)) / 2)L2$
8310  VTAB 24: PRINT  TAB( (40 -  LEN (L3$)) / 2)L3$
8320  IF A$ = "N" THEN  GOTO 8340
8330  PRINT D$;"BSAVE "NAME$", A$400, L$400"
8340  POKE 103,1: POKE 104,8: POKE 3072,0: REM  RESET PROGR
    AM POINTERS
8350  POKE 34,0: POKE 35,24
```

Program 2. Type-a-Graphic/Hires.

```
1  REM  TYPE-A-GRAPHIC (HIRES)
2  REM  PROGRAM WRITTEN IN APPLESOFT BASIC ON APPLE II (48K
     MEMORY)
3  REM  LAST AMENDED 23 JUN 1981 (VERSION NO.14)
4  REM  COPYRIGHT 1981 - ROGER CULLIS
10 D$ =  CHR$ (13) +  CHR$ (4): REM  CR + CONTROL D
30  IF  PEEK (103) = 1 AND  PEEK (104) = 64 AND  PEEK (1638
    4) = 0 THEN  GOTO 1000
40  POKE 103,1: POKE 104,64: POKE 16384,0
50  PRINT D$;"RUN TYPE-A-GRAPHIC (HIRES)"
997  REM  ****************************************
998  REM  INTRODUCTION
999  REM  ****************************************
1000  HOME : PRINT : PRINT
1010  PRINT  TAB( 12)"******************"
1020  PRINT  TAB( 12)"*                *"
1030  PRINT  TAB( 12)"* TYPE-A-GRAPHIC *"
1040  PRINT  TAB( 12)"*                *"
1050  PRINT  TAB( 12)"*    (HIRES)     *"
1060  PRINT  TAB( 12)"*                *"
1070  PRINT  TAB( 12)"******************"
1080  VTAB 12: PRINT " A PROGRAM TO PLOT POINTS IN DIFFEREN
    T"
1090  PRINT : PRINT "COLOURS USING HIGH RESOLUTION GRAPHICS
    "
1100  PRINT : PRINT "COLOURS ARE CHANGED AND THE PLOTTING"
1110  PRINT : PRINT "POSITION MOVED USING THE KEYBOARD."
1140  FOR I = 0 TO 4000: NEXT : REM  DISPLAY TIME
1340  HOME : VTAB 10: PRINT "DO YOU WISH TO MODIFY AN EXIST
    ING"
1350  PRINT : PRINT "PICTURE OR DIAGRAM (Y/N?)"
1360  GET A$: IF A$ = "N" THEN  HGR : VTAB 21: GOTO 1560
1370  IF A$ <  > "Y" THEN  GOTO 1360
1380  PRINT : PRINT "ENTER ITS FILE NAME,"
1390  PRINT : INPUT "THEN PRESS 'RETURN' - ";NAME$
```


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(continued from previous page)

```
1400  HGR
1410  ONERR  GOTO 1430: REM  IF 'FILE NOT FOUND'
1420  GOTO 1500
1430  TEXT : HOME : VTAB 10: PRINT "FILE - "NAME$" - NOT AV
     AILABLE"
1440  PRINT : PRINT "PLEASE CHECK SPELLING AND DISK CATALOG
     "
1450  PRINT : PRINT "DO YOU WISH TO RE-ENTER FILE NAME (Y/N
     ?)"
1460  GET A$: HOME
1470  IF A$ = "Y" THEN  VTAB 10: GOTO 1380
1480  IF A$ = "N" THEN  VTAB 21: GOTO 1560
1490  GOTO 1460
1500  PRINT D$;"BLOAD "NAME$", A$2000"
1510  ONERR  GOTO 1530: REM  IF 'FILE NOT FOUND'
1520  GOTO 1570
1530  VTAB 22: PRINT "NO CAPTION STORED UNDER THIS FILE NAM
     E"
1540  FOR I = 0 TO 2000: NEXT : REM  DISPLAY TIME
1550  PRINT D$;"BLOAD "NAME$"/C, A$400"
1560  PRINT : PRINT "CONTINUE WITH 'TYPE-A-GRAPHIC PROGRAM"

1570  FOR I = 0 TO 2000: NEXT : REM  DISPLAY TIME
1580  POKE 216,0: REM  RESET ERROR FLAG
1590 C$ = "BLACK"
1600 HG$ = "        TYPE'H' FOR HELP"
4997  REM  ****************************************
4998  REM  GRAPHICS MODE ROUTINES
4999  REM  ****************************************
5000  POKE 34,0: POKE 35,24: REM  SET TEXT WINDOW
5010  POKE  - 16303,0: POKE  - 16302,0: POKE  - 16300,0: HOME
     : REM  TEXT,ALL,P1
5020  PRINT  TAB( 5)"INSTRUCTIONS - GRAPHICS MODE"
5030  PRINT : PRINT "USE CURSOR COMMANDS TO MOVE PLOTTING"
5040  PRINT "POSITION, NUMERALS TO CHANGE COLOUR."
5050  PRINT : PRINT  TAB( 16)"COMMANDS"
5060  PRINT : PRINT "UIO ) MOVE THE CURSOR POSITION (I-UP"
5070  PRINT "J K )"
5080  PRINT "NM, ) J-LEFT,O-UP/RIGHT, ETC. )"
5090  PRINT : PRINT "0-7 ) SELECT THE PLOTTING COLOUR"
5100  PRINT "X Y ) SELECT THE PLOTTING COORDINATES"
5110  PRINT "Z   ) COVER SCREEN WITH CURRENT COLOUR"
5120  PRINT "P   ) PLOT LINE TO NEW CURSOR POSITION"
5130  PRINT "R   ) DRAW A CIRCLE WITH CENTRE X,Y"
5150  PRINT "S   ) SAVE GRAPHIC DISPLAY"
5160  FOR I = 2048 TO 3023: POKE I, PEEK (I - 1024): NEXT :
     REM  TRANSFER TO P2 MEMORY
5170  VTAB 24: PRINT  TAB( 8)"PRESS 'RETURN' TO CONTINUE"
5180  GET A$: IF A$ < > CHR$ (13) THEN  GOTO 5180
5190  FOR I = 3024 TO 3071: POKE I, PEEK (I - 1152): NEXT :
     REM  P2
5200  POKE  - 16297,0: POKE  - 16301,0: POKE  - 16304,0: REM
     HIRES,MIXED,GRAPHICS
5210  HOME : POKE 34,20: POKE 35,23: REM  SET TEXT WINDOW
5220  VTAB 24: PRINT HG$
5230  ONERR  GOTO 5260
5240  GOTO 5260
5250  HPLOT X,Y
5260  HOME : VTAB 22: PRINT  TAB( 5)"X = "X"; Y = "Y"; COLO
     UR  =  "C$
5270  GET A$
5280  IF  ASC (A$) > 47 AND  ASC (A$) < 56 THEN  GOSUB 5750
     : GOTO 5250
5290  IF A$ = "I" AND Y > 0 THEN Y = Y - 1: GOTO 5250: REM
     UP
5300  IF A$ = "K" AND X < 279 THEN X = X + 1: GOTO 5250: REM
     RIGHT
5310  IF A$ = "M" AND Y < 159 THEN Y = Y + 1: GOTO 5250: REM
     DOWN
5320  IF A$ = "J" AND X > 0 THEN X = X - 1: GOTO 5250: REM
     LEFT
5330  IF A$ = "U" AND Y > 0 AND X > 0 THEN Y = Y - 1:X = X -
     1: GOTO 5250: REM  UP/LEFT
5340  IF A$ = "O" AND Y > 0 AND X < 279 THEN Y = Y - 1:X =
     X + 1: GOTO 5250: REM  UP/RIGHT
5350  IF A$ = "N" AND Y < 159 AND X > 0 THEN Y = Y + 1:X =
     X - 1: GOTO 5250: REM  DOWN/LEFT
5360  IF A$ = "," AND Y < 159 AND X < 279 THEN Y = Y + 1:X =
     X + 1: GOTO 5250: REM  DOWN/RIGHT
5370  IF A$ = "X" THEN  GOSUB 5690: GOTO 5250: REM  CHANGE
     X COORDINATE
5380  IF A$ = "Y" THEN  GOSUB 5720: GOTO 5250: REM  CHANGE
     Y COORDINATE
5390  IF A$ = "Z" THEN  CALL 62454: GOTO 5250: REM  NEW SCR
     EEN COLOUR
5400  IF A$ = "P" THEN  GOSUB 5690: GOSUB 5720: HPLOT  TO X
     ,Y: GOTO 5250
5410  IF A$ = "R" THEN  GOSUB 5460: GOTO 5230: REM  DRAW CI
     RCLE CENTRE X,Y
5420  IF A$ = "S" THEN  GOTO 8000: REM  FINISH PLOTTING
5440  IF A$ = "H" THEN  POKE  - 16303,0: POKE  - 16302,0: POKE
      - 16299,0: GOTO 5850: REM  TEXT,ALL,P2
5450  GOTO 5270
```

```
5460  HOME : VTAB 22: PRINT "ENTER RADIUS OF CIRCLE (1-140)
      "
5470  INPUT "THEN PRESS 'RETURN'.  R =  ";R
5480  IF R < 1 OR R > 140 THEN  GOTO 5460
5490 X1 = X:Y1 = Y:Z =  - 1
5500 Z = Z + 1: IF Z = 80 THEN X = X1:Y = Y1: POKE 216,0: RETURN
5510 X2 = R *  SIN (Z / 100):Y2 = R *  COS (Z / 100)
5520  ONERR  GOTO 5540
5530  HPLOT X1 + X2,Y1 + Y2
5540  ONERR  GOTO 5560
5550  HPLOT X1 + X2,Y1 - Y2
5560  ONERR  GOTO 5580
5570  HPLOT X1 - X2,Y1 + Y2
5580  ONERR  GOTO 5600
5590  HPLOT X1 - X2,Y1 - Y2
5600  ONERR  GOTO 5620
5610  HPLOT Y1 + Y2,X1 + X2
5620  ONERR  GOTO 5640
5630  HPLOT Y1 - Y2,X1 + X2
5640  ONERR  GOTO 5660
5650  HPLOT Y1 + Y2,X1 - X2
5660  ONERR  GOTO 5500
5670  HPLOT Y1 - Y2,X1 - X2
5680  GOTO 5500
5690  PRINT "ENTER X COORDINATE, THEN PRESS 'RETURN'"
5700  INPUT "       X = ";X2: IF X2 < 0 OR X2 > 279 THEN  PRINT
      TAB( 5)"X = "X"; Y = "Y"; COLOUR - "C$: GOTO 5720
5710 X = X2: RETURN
5720  PRINT "ENTER Y COORDINATE, THEN PRESS 'RETURN'"
5730  INPUT "       Y = ";Y2: IF Y2 < 0 OR Y2 > 159 THEN  PRINT
      TAB( 5)"X = "X"; Y = "Y"; COLOUR - "C$: GOTO 5720
5740 Y = Y2: RETURN
5750  IF A$ = "0" THEN C = 0:C$ = "BLACK"
5760  IF A$ = "1" THEN C = 1:C$ = "GREEN"
5770  IF A$ = "2" THEN C = 2:C$ = "MAGENTA"
5780  IF A$ = "3" THEN C = 3:C$ = "WHITE"
5790  IF A$ = "4" THEN C = 4:C$ = "BLACK"
5800  IF A$ = "5" THEN C = 5:C$ = "RED"
5810  IF A$ = "6" THEN C = 6:C$ = "BLUE"
5820  IF A$ = "7" THEN C = 7:C$ = "WHITE"
5830  HCOLOR= C
5840  RETURN
5850  GET A$: IF A$ <  > CHR$ (13) THEN  GOTO 5850
5860  POKE  - 16300,0: POKE  - 16297,0: POKE  - 16301,0: POKE
      - 16304,0: REM P1,HIRES,MIXED,GRAPHICS
5870  GOTO 5260
7997  REM  ****************************************
7998  REM  SAVE ROUTINE
7999  REM  ****************************************
8000  POKE 34,20: POKE 35,24: POKE 216,0
8010  HOME : VTAB 22: PRINT "DO YOU WISH TO ADD A CAPTION (
      Y/N?)"
8020  PRINT "(UP TO THREE LINES)"
8030  GET B$: IF B$ = "N" THEN  GOTO 8240
8040  IF B$ <  > "Y" THEN  GOTO 8030
8050  HOME : PRINT "ENTER FIRST LINE (UP TO 40 CHARACTERS"
8060  PRINT "OR SPACES), THEN PRESS 'RETURN'"
8070  INPUT " ";L1$
8080  PRINT  TAB( 10)"OK (Y/N?)"
8090  GET A$: IF A$ = "N" THEN  GOTO 8050
8100  IF A$ = "Y" THEN  GOTO 8120
8110  GOTO 8080
8120  HOME : PRINT "ENTER SECOND LINE (UP TO 40 CHARACTERS"
8130  PRINT "OR SPACES), THEN PRESS 'RETURN'"
8140  INPUT " ";L2$
8150  PRINT  TAB( 10)"OK (Y/N?)"
8160  GET A$: IF A$ = "N" THEN  GOTO 8120
8170  IF A$ <  > "Y" THEN  GOTO 8080
8180  HOME : PRINT "ENTER THIRD LINE (UP TO 40 CHARACTERS"
8190  PRINT "OR SPACES), THEN PRESS 'RETURN'"
8200  INPUT " ";L3$
8210  PRINT  TAB( 10)"OK (Y/N?)"
8220  GET A$: IF A$ = "N" THEN  GOTO 8180
8230  IF A$ <  > "Y" THEN  GOTO 8220
8240  HOME : PRINT "DO YOU WISH TO SAVE THIS GRAPHIC (Y/N?)
      "
8250  GET A$
8260  IF A$ = "Y" THEN  GOTO 8290
8270  IF A$ = "N" THEN  GOTO 8310
8280  GOTO 8250
8290  PRINT "ENTER FILE NAME,"
8300  INPUT "THEN PRESS 'RETURN' - ";NAME$
8310  HOME : POKE 35,21
8320  VTAB 22: PRINT  TAB( (40 -  LEN (L1$)) / 2)L1$
8330  VTAB 23: PRINT  TAB( (40 -  LEN (L2$)) / 2)L2$
8340  VTAB 24: PRINT  TAB( (40 -  LEN (L3$)) / 2)L3$
8350  IF A$ = "N" THEN  GOTO 8380
8360  PRINT D$;"BSAVE"NAME$",A$2000,L$2000"
8370  IF B$ = "Y" THEN  PRINT D$;"BSAVE"NAME$"/C,A$400,L$40
      0"
8380  POKE 103,1: POKE 104,8: POKE 16384,255: REM  RESET PR
      OGRAM POINTERS
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SOFTWARE

Software packages are listed by application, in alphabetical order, with the systems on which each package will run also listed alphabetically. The guide is not exclusively for business applications: if your company is the source or dealer for a package with a more unusual application, send us the details and we will create a new category.

The usual criteria have been applied. The minimum configuration is 32K of RAM, a disc and a printer; the price of the package must lie between £50 and £1,000; the companies listed are the source of the software or the main dealers in the U.K., and the capacity quoted is per disc or drive.

Machine type by application

Combined-Ledger/Stock/Invoicing

Machine Type	Supplier Name	Price	Capacity
Apple II	Vlasak Electronics Ltd	£855	1,500 a/c 5k trans
Apple II	Dataforce (U.K.) Ltd	£855	
Apple II	Microsense Computers Ltd	£340	
Apple II/ITT 2020	Informex London Ltd	£298	500 a/c
Commodore 3000/8	Commodore BM (U.K.) Ltd	£1,100	.2-.6k a/c 2-6k trans
Commodore 3032	Compfer Ltd	£400	varies
Commodore 3032	Analog Electronics	£550	
Commodore 3032	Logma Systems Design	£600	1-6 shops

Commodore 3032	Grama (Winter) Ltd	£475	varies
Commodore 3032	Bristol Software Factory	£300	1k a/c 6k trans
Commodore 3032	Compfer Ltd	£600	500 a/c 1k items
Commodore 3032	HB Computers	£695	500 a/c 2,500 trans
CP/M	Graffcom Systems Ltd	£400	varies
CP/M	Benchmark CS Ltd	£950	varies
CP/M	Computastore Ltd	£1,000	
CP/M	Minicomputer CS Ltd	£1,250	varies
CP/M	Salmon Microcomputers	£750	1,600 items 1k trans
CP/M	Selven Ltd	£1,500	3k a/c 7k trans
CP/M	Map Computer Systems	£1,000	varies
CP/M North Star	Intelligent Artefacts	£510	1,500 a/c 5k trans
CP/M North Star	Instar Business Systems	£999	600-2,900
Ohio Scientific	Microcomputer BM	£656	
Tandy Model 2	Chess Consultancies Ltd	£1,200	
Tandy Model 2	Chess Consultancies Ltd	£995	5k items 1,500 a/c
Tandy TRS-80	Microcomputer Applications	£90	
Tecs	Jar Software Systems	£650	500 a/c 300 nom. a/c

Database Managers

Machine Type	Supplier Name	Price	Capacity
Apple II	ACT Microsoft Ltd	£75	
Apple II	Courtman Micro Systems	£106	100k characters
Apple II/ITT 2020	Systematics International Ltd	£72	
Apple II/ITT 2020	Diskdean Ltd	£120	varies
Apple II/ITT 2020	Systematics International Ltd	£125	1,000 references
Apple II/ITT 2020	Informex London Ltd	£198	500-1,200 records
Apple II/ITT 2020	The Software House	£140	900 records
Commodore 3000/8	Stage One Computers	£45-£250	650-2,400 records
Commodore 3000/8	Commodore BM (U.K.) Ltd	£150-£300	650-1.4-64k records
Commodore 3032	CPS (Data Systems) Ltd	£200	varies
Commodore 3032/8	Compsoft Ltd	£190	600-5,000 records
CP/M	Compsoft Ltd	£400	30k records
CP/M	Great Northern CS Ltd	£110 and £210	varies
CP/M	Microtek Computer Services	£250-£500	
CP/M	Clenlo Computing Services	£90-£325	varies
CP/M	Median-Tec Ltd	£500	
Metrotech System	Metrotech	£200-£1,000	
Ohio Challenger	U-Microcomputers Ltd	£175	
Ohio Scientific	Microcomputer BM	£175	
SWTPC	SWTPC	£100	
Tandy TRS-80	Cleartone ADP	£75	varies
Tandy TRS-80	ACT Microsoft Ltd	£75	
Z-80/8080	Structured Systems Group	£135	varies
Z-80/Cromemco	Xitan Systems Ltd	£850	4,000 records/disc

Engineering Design Systems

Machine Type	Supplier Name	Price	Notes
Apple II	James C Steadman	£200	Erect concrete columns
Apple II	James C Steadman	£250	Multibay frames
Apple II/ITT 2020	Aerco-Gemsoft	£175	Pipeline engineering
Commodore 3032	Micro Computation	£300	Building-conversion specification
Commodore 3032	The Alphabet Co	£75	Time study and analysis
CP/M	Median-Tec	£500	Plastic portal frames
CP/M	Median-Tec	£1,500	Finite element analysis
CP/M	Median-Tec	£500	Slope-stability analysis
CP/M	Median-Tec	£500	Retaining wall design
CP/M	Median-Tec	£1,500	Concrete design
Equinox	Equinox	£500	Civil/structural engineering design
Tandy TRS-80	Chess Consultancies	£450	Production planning
Tecs	Jar Software	£600	Production analysis



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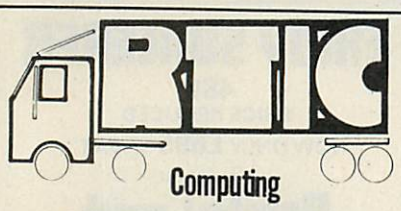
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Estate Agents' Systems

Machine Type	Supplier Name	Price	Notes
Apple II	Microsense	£500	Estate agents' system
Apple II/ITT 2020	Cyderpress	£650	Estate agents' system
Apple II/ITT 2020	Systematics International	£850	Estate agents' system
Commodore 3032	Stage One Computers	£250	Estate agents' package
Compucorp	Verwood systems	£700	Estate sales
Cofnpucorp	Verwood systems	£1,200	Estate managment
CP/M	Selven Ltd	£325	Estate agents' package

Financial Systems

Machine Type	Supplier Name	Price	Notes
Apple II	Microdigital	£200	Sales analysis
Apple II	Microdigital	£130	Credit control
Apple II	Microsense	£194	Cashier retail/whole
Apple II	PK Microsystems	P.O.A.	Solicitors' accounts
Apple II	Dataforce	£80	Cashflow projection
Apple II	Informex	£98	VAT system
Apple II/ITT 2020	Microsense	£125	VisiCalc
Apple II/ITT 2020	Systematics International	£295	Financial planning
Apple II/ITT 2020	Systematics International	£1,000	Financial controller
Apple II/ITT 2020	Microsense	£75	Modelling Desktop plan
Commodore 3000	Stage One Computers	£250	Financial accounts package
Commodore 3000/8	ACT Microsoft	£125	Financial modelling
Commodore 3032	Stage One Computers	£100	Quotation processing
Commodore 3032	CPS	£575	Inventory-costing/ jewellers
Commodore 3032	L & J Computers	£90	Cash book
Commodore 3032	ACT (Petsoft)	£150	Financial planning
Commodore 3032	Stage One Computers	£100	Bank a/c reconcile
Commodore 3032	Logma Systems	£600	Sales/analysis
CP/M	Micromedia	£1,000	Invoice disc factoring
CP/M	Graffcom Systems	£400	Hire-purchase system
CP/M	Map Computers	£550	Financing system
CP/M	Microtek	£500	Accounting
CP/M	Microtek	£750	Budget control
CP/M	Median-Tec	£500	Financial analysis
CP/M	Graffcom Systems	£450	Purchasing system
CP/M Vector	Taylor Microsystems	£390	Cashflow forcasting
Durango F-85	Kesho Systems	£1,000	Time recording/ledger
Tandy TRS-80	Chess Consultancies	£800	Sales statistics
Tandy TRS-80	AJ Harding (Molimerx)	£125	Financial balancing
Z-80/8080	Intereurope	£500	Financial modelling
Z-80/8080	Graham Dorian	£325	Sales analysis retail

General Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II	Computech Systems	£295	500 a/c 1,700 trans
Apple II	Dataforce (U.K.) Ltd	£225	200 a/c 1k trans
Apple II/ITT 2020	Guestel Ltd	£300	200 a/c
Commodore 3032	Bristol Software Factory	£300	1k a/c 6k trans
Commodore 3032	Analog Electronics	£450	
Commodore 8000	Commodore BM (U.K.) Ltd	£300	600 a/c 3k trans
CP/M	PR Daly & Co Ltd	£500	
CP/M	Haywood Associates Ltd	£500	
CP/M	Median-Tec Ltd	£500	500 a/c 5k trans
CP/M	Ludhouse Ltd	£500	200 a/c 5k trans
CP/M	Computastore Ltd	£500	999 a/c 99 centres nine computers
CP/M	Great Northern CS	£345	250 a/c
CP/M	Selven Ltd	£400	1k a/c 3k trans
CP/M	Map Computer Systems	£300	250 a/c 3,500 trans
CP/M	Benchmark CS Ltd	£250	150 a/c 500 trans
Tandy Model 2	Chess Consultancies Ltd	£400	1k a/c
Tandy TRS-80	Tridata Micros Ltd	£225	500 a/c 1,800 trans
Z-80	Liveport Ltd	P.O.A.	

Hotel and Travel Packages

Machine Type	Supplier Name	Price	Notes
Apple II	Dataforce	£525	Hotel management
Apple II	Informex	£298	Travel agents' system
Apple II	Informex	£298	Hotel administration system
Apple II/ITT 2020	Guestel Ltd	£500	Hotel billing
Apple II	Diskwise Ltd	£695	Hotel reservation and guest billing
Commodore 3000	Landsler Software	£350	Hotel guest billing

Incomplete Records

Machine Type	Supplier Name	Price	Capacity
Apple II/ITT 2020	Padmede Computer Services	£450	900 a/c 2k trans/disc
Commodore 3000/8	CSM Ltd	£1,200	250 a/c 3-5k trans
Commodore 3032	Stage One Computers	£750	500 centres 2,300 a/c
Commodore 3032	Micro Computation	£555	120 a/c 5k trans
CP/M	Ludhouse Ltd	£1,000	variable
CP/M	Salmon Microcomputing	£950	5k entries
CP/M	Map Computer Systems	£550	
Durango F-85	Kesho Systems	£1,000	
Exidy Sorcerer	Basic Computing	£350	
Tandy Model 1	AJ Harding (Molimerx)	£150	1,200

Job Costing/Billing

Machine Type	Supplier Name	Price	Capacity
Apple II	Informex London	£498	
Apple II	Deltic Computing Ltd	£250	
Apple II/ITT 2020	Padmede Computer Services	£300	999 clients 99 rates
Apple II/ITT 2020	TABS Ltd	£99	100 jobs 3k trans
Commodore 3032	CSM Ltd	£600	1k jobs 100 people
Commodore 3032	Stage One Computers	£100	300 appointments
CP/M	Map Computer Systems Ltd	£550	400-96k jobs
CP/M	Graffcom Systems Ltd	£400	varies
CP/M	Ludhouse Ltd	£1,000	1k jobs 35 codes
CP/M	Microtek Computer Services	£1,000	
CP/M	Great Northern CS Ltd	£455	300 clients
CP/M	Salmon Microcomputing	£300	225 codes
CP/M Cromemco	Sheffield Micro Information	£1,500	20 operations
CP/M North Star	Intelligent Artefacts	£275	

Mailing Systems

Machine Type	Supplier Name	Price	Capacity
Apple II	Keen Computers Ltd	£300	500 addresses
Apple II	SBD Consultants Ltd	£55	
Apple II	Microsense Computers Ltd	£70	
Apple II	Informex London Ltd	£198	
Apple II/ITT 2020	Systematics International Ltd	£300	500 addresses
Apple II/ITT 2020	The Software House	£57	750 names and addresses
Apple II/ITT 2020	Personal Computers Ltd	£50	400 entries
Commodore 3000/8	Amplicon MS Ltd	£145	1,500-4,000 records
Commodore 3032	MMS Computer Systems	£250	3,000 records
Commodore 3032	Stage One Computers	£100	325 records
Commodore 3032/8	Compsoft Ltd	£190	13k
CP/M	Compsoft Ltd	£400	27k
CP/M	Structured Systems Group	£50	varies
CP/M	Graffcom System Ltd	£250	800-5k records
CP/M	Median-Tec Ltd	£500	
CP/M Horizon	Microtek Computer Services	£250	varies
CP/M North Star	Micromedia Systems	£195	
CP/M Vector	Taylor Microsystems	£375	
Tandy TRS-80	AJ Harding (Molimerx)	£55	600-3,750 records
Tandy TRS-80	Comput-A-Crop	£78	varies
Z-80/8080	Intereurope SD Ltd	£200	30k entries
Z-80/8080	Micro Focus	£90	varies



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NORTH STAR S/Density Disk Controller, DOS/Basic £55; 32K RAM Board £235. CROMEMCO 16K 2708 PROM Board £50. GODBOUT Z80 4MHz CPU Board £95; 8K RAM Board(s) £85. MORROWS 8in S/Density Disk Controller/CP/M £120, 16K RAM Board (kit) £117; D/Density Disk Controller £126. SHUGART SA400 5in Drive(s) £95. TANDON 5in Quad Density Drive £136. Tel: Crawley 515201.

ASTEROIDS FOR SUPERBOARD. 4K. M/C. Available for standard 24x24 and enhanced 32x32 screen (state which). £2.50 on cassette. T. Groves, 23 Broadhurst Gdns, Burnham-on-Sea, Somerset, TA8 1LP. Tel: 0278 785845.

32K SORLERER, 630K twin disks, SIDO expansion, monitor, fans fitted. Many operating systems and software CP/M, M/DOS, word processor on disk and Rompac 5 basics included, E Basic, M Basic, Rompac Basic, Compiled Basics. Many games and spare disks. All manuals, cost over £4,400. Offers at £2,500. Tel: 0222-568286 anytime.

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TUSCAN S100, complete full board, 8K Basic, 2K Monitor, 8K RAM, S100 stereo sound board, hardware, software manuals. Cost over £500, except £400 ono. Tel: 01-902 4738.

COMMODORE printers for sale, as new, 4022 £300. 3022 £250. Telephone 01-622 1279.

WANTED, Rockwell AIM 65 computer, used, working or not but complete. B. Childs, Maidenhead (0628) 39181.

OHIO NORTHWEST — Start computing with an inexpensive SUPERBOARD III and expand later. Technical advice given 6.00pm to 9.00pm Wednesday/Friday. Call in or SAE for details. Compass, 6 Market Street, Standish, Lancs.



ZX80 FOR SALE, both ROMS, 16K RAM, sound unit, PSU, much software. ZX80 equipment £135, software £20. Both £145. Ring 0782 817595 for details.

ZX80 (16K) G.C.E. "O" LEVEL MATHS on cassette. "MATHS 1" teaches differentiation, integration, mutibase arithmetic, matrices plus inverses; and generates questions. "MATHS 2" ranges over whole syllabus with 30 multiple choice questions, 90% of which are generated. "MATHS 3" is in same format as "MATHS 2". Explanations of answers are given in all programs.
Order No. ACOM 3. Price (entire package) £4.50. Cheque with order to: Rose Cassettes, 148 Widney Lane, Solihull, West Midlands B91 3LH.

ITT 2020 48K + 2 disk drives — £700 plus progs. Bourne End 28828 (daytime).

NASCOM 2, 16K RAM B. Veroframe, Easicomp sound generator, graphics ROM, £420. Phone 0493 76329 after 6, (Norfolk).

SUPERBOARD II, 8K, cased, PSU and cassette recorder. Plus Superprint 800 MST, all manuals, £450 the lot. Sheffield (0742) 614003.

DISK DRIVE, ITT 2020 with controller. S/h £250. One new £250. Southend (0702) 230324.

32K PET with Basic 4.0 ROMS, cassette, tapes, toolkit, £530. Tel: 01-449 7812.

RUBIK'S CUBE SOLVER written by TV expert and British champion. Prints out solution and explanation from any random position, Apple disk £10, cassette £10, basic listing £3. N. J. Hammond, 195 Attenborough Lane, Beeston, Nottm.

16K ZX80, PSU, MANUAL, leads. £100. South Shields, 563903 evenings.

ZX18. IK. MOONLANDER. Sensational value for this fast moving graphics game. £2 for listing. Lawtronics, 9 Greenwood Avenue, Bakersfields, Nottingham.

ZX81 BOOK OF TWENTY PROGRAMS, for an amazing £3.95!!! including postage & packing, from, G. Usherwood, 53 Marlborough Rd, Stockton, Cleveland, TS18 4DB.

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TEACHERS — for list of tried and tested PET educational programs send SAE to Des, 36, Westmoreland Street, Darlington, Co. Durham DL3 0NX.

TRS80 4K LEVEL 1 PROGRAMS: Hangman, Sub Hunt, Attack, Cat & Mouse. SAE list. Any 3 £3 inc. P. V. Bamfield 5/24 Windlesham Gardens, Brighton, Sussex BN1 3AJ.

TRS-80 S-100 interface HUH MINI-8100 with four S-100 sockets. New, unused, guaranteed. £50 snip. Telephone: 01-589 5111 Ext 1709.

Order Entry/Invoicing

Machine Type	Supplier Name	Price	Notes
Apple II	Informex	£198	Invoicing system
Commodore 3032	MMS Computers	£250	Order control
CP/M	PR Daly & Co	£200	Invoicing
CP/M	Graffcom Systems	£350	Order entry/invoicing
CP/M	Median-Tec		Invoicing
Tandy TRS-80	Tridata Micros	£75	Invoicing
Z-80/MCZ	Software Architects	£600	Order entry/invoicing

Payroll

Machine Type	Supplier Name	Price	Capacity
Apple II	Dataforce (U.K.) Ltd	£375	
Apple II/ITT 2020	TW Computers Ltd	£145	
Apple II/ITT 2020	Informex London Ltd	£298	
Apple II/ITT 2020	Algobel Computers	£295	500 employees
Apple II/ITT 2020	Vlasak Electronics Ltd	£375	200 employees
Apple II/ITT 2020	Computech Systems	£379	300 employees
Apple II/ITT 2020	Tabs Ltd	£99	50 weekly 100 monthly
Commodore 3000/8	Commodore BM (U.K.) Ltd	£150	200-600 employees
Commodore 3000/8	Landsler Software	£150	200-500 employees
Commodore 3032	Analog Electronics	£90	
Commodore 3032	L & J Computers	£220	
Commodore 3032	Intex Datalog Ltd	£195	200 employees
Commodore 3032	Computastore Ltd	£75	483 employees
Commodore 3032	ACT (Petsoft) Ltd	£195	600 employees
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec	£500	1k employees
CP/M	Salmon Microcomputing	£300	500 employees
CP/M	Map Computer Systems	£350	300-96k employees
CP/M	Daman Computer Services	£900	1k employees/Mbyte
CP/M	Selven Ltd	£500	500 employees
CP/M	PR Daly & Co Ltd	£350	
CP/M	Graffcom Systems Ltd	£500	500 employees
CP/M	PCL Software Ltd	£495	1,200 employees
CP/M	Ludhouse Ltd	£450	300 employees
CP/M	Comput-A-Crop	£495	175 employees
CP/M Horizon	Microtek Computer Services	Lease	varies
CP/M North Star	Micromedia Systems	£495	350 employees
CP/M North Star	Benchmarks CS Ltd	£350	300 employees
CP/M North Star	Intelligent Artefacts	£52	100 employees
CP/M Vector	Taylor Micro Systems	£490	
Durango F-85	Kesho Systems	£500	
Sharp MZ-80K	Tridata Micros Ltd	£250	400 employees
Tandy TRS-80	AJ Harding (Molimerx)	£120	
Tandy TRS-80	Chess Consultancies	£400	400 employees
Tandy TRS-80	Tridata Micros Ltd	£218	400 employees
Tandy TRS-80	3-line Computing	£140	
Tecs	Jar Software Systems	£250	300 employees
Z-80/8080	Liveport Ltd	£250	500 employees

Personnel and Administration

Machine Type	Supplier Name	Price	Application
Apple II	Informex Logic	£198	Personnel records
Apple II	Informex Logic	£298	Staff selection tests
Apple II/ITT 2020	Informex Logic	£298	Employment agency system
Apple II/ITT 2020	Informex Logic	£198	Medical records
Apple II/ITT 2020	Informex Logic	£198	Hospital administration
Commodore 3000	Intex Datalog Ltd	£100	Hospital administration
CP/M	Median-Tec Ltd	£1,500	Employment agency system
CP/M North Star	Micromedia	£595	Personnel records
CP/M Vector	Taylor Microsystems	£390	Piece work
Z-80/8080	Intereurope	£500	Personnel records

Property Management

Machine Type	Supplier Name	Price	Capacity
Apple II/ITT 2020	Cyderpress Ltd	£650	
Apple II/ITT 2020	Informex London Ltd	£298	300 entries
Apple II/ITT 2020	Cyderpress Ltd	£650	500 properties
Appel II/ITT 2020	Algobel Computers Ltd	£650	400 properties
Commodore 3032/8	Compsoft Ltd	£190	13k
CP/M	Compsoft Ltd	£400	27k
CP/M	Algobel Computers Ltd	£650	2k trans
CP/M	Salmon Microcomputing	£900	
Z-80/8080	Graham Dorian Software	£325	varies

Purchase Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II	Dataforce (U.K.) Ltd	£315	200 a/c 1k trans
Apple II	Logic Box Ltd	£490	400 a/c 1k trans
Apple II	Deltic Computing Ltd	£250	1k trans
Apple II	Computech Systems	£295	500 a/c 1,600 trans
Apple II/ITT 2020	Padmede Computer Services	£300	900 a/c 4,500 trans/ disc
Apple II/ITT 2020	Guestel Ltd	£300	200 a/c
Commodore 3000/8	CSM Ltd	£550	1-2k a/c 6-10k trans
Commodore 3000/8	Anagram Systems	£399	.2-2k a/c .8-16k trans
Commodore 3032	ACT (Petsoft) Ltd	£120	200 a/c 700 trans
Commodore 3032	Compfer Ltd	£300	1k trans 7k entries
Commodore 8000	Commodore BM Ltd	£300	600 a/c 4,500 trans
CP/M	Median-Tec Ltd	£500	500 a/c 5k trans
CP/M	Ludhouse Ltd	£500	500 a/c 5k trans
CP/M	Great Northern CS Ltd	£315	500 a/c
CP/M	Structured Systems Ltd	£460	varies
CP/M	Selven Ltd	£600	1k a/c 2k trans
CP/M	Salmon Microcomputing	£350	1k a/c 24k trans
CP/M	Map Computer Systems Ltd	£300	400-96,000 a/c
CP/M	PR Daly & Co Ltd	£350	
CP/M	Computastore Ltd	£400	500 a/c 3,100 trans
CP/M	Haywood Associates	£350	
CP/M North Star	Benchmark CS Ltd	£250	100 a/c 300 trans
Durango F-85	Kesho Systems	£500	
Exidy Sorcerer	Basic Computing	£125	
Tandy Models 1&2	Chess Consultancies Ltd	£250	300-500 a/c
Tandy TRS-80	Tridata Micros Ltd	£225	125 a/c 1k trans

Sales Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II	Computech Systems	£295	500 a/c 1,600 trans
Apple II	Dataforce (U.K.) Ltd	£315	200 a/c 1k trans
Apple II	Logic Box Ltd	£490	300 a/c 1,300 trans
Apple II	Deltic Computing Ltd	£250	1k a/c
Apple II/ITT 2020	Padmede Computer Services	£300	900 a/c 4,500 trans/ disc
Apple II/ITT 2020	Guestel Ltd	£300	200 a/c
Commodore 3000/8	Anagram Systems	£299	.25-2k a/c .5-10k trans
Commodore 3000/8	CSM Ltd	£550 and £650	1-2k a/c 6-10k trans
Commodore 3032	ACT (Petsoft) Ltd	£120	200 a/c 700 trans
Commodore 8000	Commodore BM (U.K.) Ltd	£300	600 a/c 4,500 trans
CP/M	PCL Software Ltd	£475	950 a/c
CP/M	Great Northern CS Ltd	£415	500 a/c
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec Ltd	£500	500 a/c 5,000 trans
CP/M	Ludhouse Ltd	£500	2,000 a/c 8,000 trans
CP/M	Graffcom Systems Ltd	£450	540-7,000
CP/M	Computerstore Ltd	£400	500 a/c 3,500 trans
CP/M	Map Computer Systems Ltd	£300	400-96,000 a/c
CP/M	Daman Computer Services	£900	1.5k a/c 500 trans
CP/M	PR Daly and Co Ltd	£350	
CP/M North Star	Benchmark CS Ltd	£250	200 a/c 500 trans
Durango F-85	Kesho Systems	£500	
Exidy Sorcerer	Basic Computing	£125	



UK101 SOFTWARE. ROAD RACER: acceleration; running score, speed, laps; high score; bonuses; bollards. Eleven play modes, including 1K m/c for speedy play. Sound option! 8K. £4.
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ZX81 16K Software on cassette. Las Vegas, 4 Games, including roulette and fruit machine (with special features) £3.95. Further details and details of other games on request. S. W. Hessel, 15 Lytham Court, Cardwell Cres., Sunninghill, Berkshire.

8K PET; Lg keyboard external cassette, teaching manuals, plus tapes, very good condition, £380. Ring 01-607 3234 (eve).

WANTED HOME COMPUTER any condition working or not. Limited funds. Bristol 665332.

32K PET — New Roms, large keyboard, toolkit. Many utility and games tapes. Excellent condition. £500 ono. Tel: Stourport (029-93) 78460.

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ZX80 16K RAM and power supply. Good condition, £100. Redditch 41647.

MZ-80K TOOLKIT for SP-5025 tape BASIC — only 2.3K of memory used, but offers: auto line numbering; renumbering; line deletion; program appending; hexadecimal conversion; trace and single step; string or variable search; memory dump and program recovery after deletion. £20 for tape and instructions (please specify memory size) to R. Boyle, 132, Broughton Ave, Aylesbury, Bucks.

IBM GOLFBALL TYPEWRITER converted for use as computer printer. Complete with ACULAB and PET interfaces. Allows use of any golfball. With keyboard use as ordinary typewriter. £325 and £100 interfaces. Phone Welwyn Garden City (07073) 31983 day.

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2716's (5v Motorola) £4.40. 4 off £17.20. 2732's to order. 1N4148 50 £1.25. 100 £2. BC107/8/9 plastic 8.5p. VAT is included. P&P 40p under £10 (cash with order). Mail order only at present. Wessex Components, 17 Cripstead Lane, Winchester.

ZX80 (16K ONLY) SOFTWARE. Hands off moving graphic games: Tank Shoot — realistic shell trajectories plotted across screen. Hit the tank and it explodes. Ten Pin Bowling — slow motion ball, steered by you. Realistic ball spin, pin scatter, lane reset, computer scores game including spares and strikes. Each game £2.99 for cassette and instructions to: Second Foundation, 22 Bramber, Belgrave, Tamworth, Staffs B77 2LL.

DISK NASCOM. 64K/4MHz — with twin drive CP/M Gemini disks and software and Anadex DP8000 printer. 2 parallel/2 serial ports, expanded keyboard, graphics and monitor, cassette interface, to 2400 Baud. All as new. Offers. Stroud, Castleton (N. Yorks) 281.

PET GAMES, well tried by critical aquaintances. Cheap. SAE. Earl Dandy, 29 Marina Ave., Redcar, Cleveland.

ZX81 STAR WARS, 16K, full realtime moving graphics, on screen scoring, fire the photon gun and explode the empire ship, written in Basic. £3 for cassette and instructions. K. J. Gouldstone, 79 Bridge Road, Chessington, Surrey.

DRIVE THE EPSON MX80 printer direct from your Nascom 2 PIO. No interface hardware needed, extensions to NASPEN include subscripts, underlining and page numbering. 1200 Baud tape and manual £8, or SAE for information. Colin Pennycuick, 6 Kensington Place, Bristol BS8 3AH.

APPLE GAMES, ten, including Missile Attack disk, £20. 3802 Screen Sketch tape, £5. Hopkins, 117 St John's Road, Exmouth, Devon.

INVISIBLE MAZE — a new game for ZX81 with 16K RAM, infinitely variable complexity levels, send £2 plus blank tape. Chris Bee, 4 Rufford, Tamworth, Staffs.

OLD ROM PET programs: Breakthro, Life, £2 each. Doyle, 38 Hawthorne Avenue, Long Eaton, Notts.

PET 2001-8K, integral cassette, sound, Epson TX-80 printer with interface and cable, paper, programs, whole system £600. Nottingham 284883.

S-100 — Vector Graphic mainframe £300. Shugart 8" drive, cased/PSU £275. North Star 16K D/ram board £108. Morrows 16K S/ram board £108. Cromemco Z80 2/4MHz CPU board (kit) £90. Phone: Crawley 515201.

Tandy TRS-80	Tridata Micros Ltd	£225	175 a/c 1,350 trans
Tandy Models 1&2	Chess Consultancies Ltd	£250	300 a/c
Tecs	Jar Software Systems	£550	500 a/c

Stock Systems

Machine Type	Supplier Name	Price	Capacity
Apple II	Logic Box Ltd	£490	1,200 items
Apple II	Vlasak Electronics Ltd	£150	7,000 items
Apple II	Dataforce (U.K.) Ltd	£200	850 items
Apple II	U-Microcomputers Ltd	£199	
Apple II	Microsense Computers Ltd	£100	
Apple II	Informex London Ltd	£198	
Apple II/ITT 2020	Microdigital Ltd	£225	625 items
Apple II/ITT 2020	Vlasak Electronics Ltd	£285	500 items
Apple II/ITT 2020	Systematics International Ltd	£500	200-2,500 items
Apple II/ITT 2020	Guestel Ltd	£300	
Apple II/ITT 2020	Padmede Computer Services	£300	2,000 postings
Apple II/ITT 2020	The Software House	£80	800 items
Commodore 3000	Intex Datalog Ltd	£195	2.4-3.7k items
Commodore 3000/8	Rockliff Brothers Ltd	£275	3.4-10k records
Commodore 3032	Logma Systems Design	£600	1-6 shops
Commodore 3032	ACT (Petsoft) Ltd	£75	2,400 items 1,000 a/c
Commodore 3032	ACT (Petsoft) Ltd	£75	1,200-5,900 items
Commodore 3032	Anagram System	£320	500-600 items 255 a/c
Commodore 3032	L & J Computers	£60	500 items
Commodore 3032	Bristol Software Factory	£300	2,300 items
Commodore 3032	Stage One Computers	£100 and £250	600-650 items
Commodore 3032	SMG Microcomputers	£395-£495	2,450-7,000 items
Commodore 3032	Compfer Ltd	£350	200 lines 20 bars
Commodore 3032/8	Compsoft Ltd	£190	13k
CP/M	Compsoft Ltd	£400	27k
CP/M	Microtek Computer Services	£750	
CP/M	PR Daly & Co Ltd	£350	
CP/M	Great Northern CS Ltd	£375	1,500
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec Ltd	£500-£800	1,000 items
CP/M	Graffcom Systems Ltd	£350	350 records/disc
CP/M	Salmon Microcomputing	£400	5,000 items
CP/M	Map Computer Systems Ltd	£250	
CP/M	Ludhouse Ltd	£1,000	12,000 parts
CP/M Cromemco	Micromedia Systems	£1,000	
CP/M Horizon	Microtek Computer Services	£500-£1,000	varies
CP/N North Star	Benchmark CS Ltd	£450	30 items 275 trans
CP/M Vector	Taylor Micro Systems	£995	4,000 items/Mbyte
Exidy Sorcerer	Basic Computing	£125	
Tandy TRS-80	Chess Consultancies	£995	
Tandy TRS-80	AJ Harding (Molimerx)	£150	1,000 items
Tandy TRS-80	Cleartone ADP	£325	4,000 items
Tandy TRS-80	Chess Consultancies	£750	500 items six sites
Tandy TRS-80	Micro Gems	£150	1,000 items
Tandy TRS-80	Tridata Micros Ltd	£200-£375	630 items/disc
Tandy TRS-80	Microsense Software	£150	1,000-2,000 items
Tecs	Jar Software Services	£800	10,000 items 5,000 orders
Tecs	Jar Software Services	£850	1,000 items 300 a/c
Z-80/8080	Graham Dorian Software	£325	varies
Z-80/8080	Rogis Systems Ltd	£500	900-3,500 items
Z-80/8080	Software Architects Ltd	£600	varies

Word Processing

Machine Type	Supplier Name	Price	Capacity
Apple II	Dataforce (U.K.) Ltd	£190	
Apple II	SBD Consultants Ltd	£60	
Apple II/ITT 2020	Systematics International Ltd	£75	
Apple II/ITT 2020	Algobel Computers Ltd	£75	800 lines

Apple II/ITT 2020	Personal Computers Ltd	£225-£300	200k characters
Commodore 3000	Stage One Computers Ltd	£125	
Commodore 3032	Dataview Ltd	£159	
Commodore 3032	ACT (Petsoft) Ltd	£325	12Kbytes
CP/M	Median-Tec	£300	
CP/M	Microtek Computer Services	£350	
CP/M North Star	Micromedia Systems	£495	
CP/M Vector	Taylor Micro Systems	£375	
Ohio Scientific	Microcomputer BM	£116	
Tandy TRS-80	Microcomputer Applications	£50-£190	
Z-80/8080	Intereurope SD Ltd	£500	varies
Z-80/8080	Structured Systems Group	£120	varies

Miscellaneous

Machine Type	Supplier Name	Price	Application
Apple II	Vlasak Electronics	£130	Petrol pump losses
Apple II	Humac Ltd	£1,000	Auctioneers' package
Apple II	Humac Ltd	£600	Invoicing sales — timber
Apple II	Humac Ltd	P.O.A.	Microfiche records
Apple II/ITT 2020	Informex Logic	£198	Insurance records
Apple II/ITT 2020	Informex Logic	£198	Time records/solicitors
Apple II/ITT 2020	Diskwise	£198	TV rental management system
Apple II/ITT 2020	Cyderpress	£650	Auction system
Apple II/ITT 2020	Personal Computers	£195	Operational research
Apple II/ITT 2020	Personal Computers	£100	Time/series analysis
Apple II/ITT 2020	Padmede Computers	£500	Insurance brokers' system
Commodore 3000	Anagram Systems	£850	Media control system
Commodore 3000	Anagram Systems	£800	Slot machine monitor
Commodore 3000	The Alphabet Company	£250	Newsagent suite
Commodore 3032	Microland	£175	Printers' quotation system
Commodore 3032	Stage One Computers	£100	Insurance brokers' system
Commodore 3032	Stage One Computers	£200	Printers' job control
Commodore 3032	Commodore BM (U.K.)	£50	Appointments planner
Commodore 3032	CSM Ltd	£500	Window replacement
Commodore 3032	SA Systems	£550	Farming-office systems
Commodore 3032	L & J Computers	£420	Machine hire
CP/M	Microtek	£500	Garage system
CP/M	PR Daly & Co	£450	Time recording
CP/M	Research Resources	£240	Statistical analysis
CP/M	Salmon Microcomputers	£150	Appointments planner
CP/M	Map Computer Systems	£450	Time recording
CP/M	Map Computer Systems	£750	Calor system
CP/M	Map Computer Systems	£425	Newsboy/newsagents' system
CP/M	Haywood	£500	Time recording
CP/M	Comput-A-crop	£1,000	Farm management
CP/M	Microtek	£1,000	Plant hire
CP/M North Star	Micromedia	£195	Vehicle maintenance
CP/M Vector	Taylor Microsystems	£495	Bill of materials
Tandy TRS-80	Chess Consultancies	£995	Haulage administration
Tandy TRS-80	Cleartone ADP	£300	WIP and invoicing system
Tandy TRS-80	Cleartone ADP	£500	Patient and drugs records
Z-80/8080	Intereurope	£500	Conference organiser

Alphabetical list of suppliers

Supplier	Address	Sales contact
3-Line Computing 0482-445496	36 Clough Road Hull HU5 1QL	Tim Hill
ACT Microsoft Ltd 021-455-8585	Radclyffe House 66-68 Hagley Road Edgbaston Birmingham B16 8PF	M Wauchope



VIDEO GENIE with sound, latest model, almost new, boxed, with extra recorder, much software inc Star Trek and Asteroids, Genie and TRS80 manuals, £295 ono. Farnborough (Kent) 0689 50885.

IBM SELECTRIC 735 typewriter terminal, ex-computer, complete with magnets, non-standard keyboard easily converted, £150. Tel: Ipswich (Suffolk) 73468.

LOW COST PRINTERS/TERMINALS — various used printers/terminals etc, serial/parallel, Centronics, Teletypes w/punch (DD390), 11 to 165 CPS, letter quality printing plus keyboard, very low prices, must be cleared for cash. Phone Mike on 0908 565981 (days) or preferably 319262 (evenings).

APPLE SYSTEM for sale complete 2 discs printer, may split, few months old, still under guarantee. Phone for details: evenings/weekends 01-450 5049.

HIGH QUALITY Computer Grade Tape Cassettes (C60), certified error free, £1,25 inc. p&p each in library box, 4 or more £1 each inc. p&p. S. L. J. Gilinsky, 15 Thornhill Park, Sunderland, SR2 7LA.

ITT 2020 . . . 48K colour. Disk drive D/S 232K and Software for sale. Computer, £500. Disk, £375. 01-249 9895.

BREAKING UK101. All components except PSU, £100. Phone: (0332) 841235.

PET-8K. New ROM. Green screen. Soundbox. Nearly 50 games. Most Arcade games. Invaders, Jailbreak, Cosmiads, Microchess. £395 o.n.o. Tel: 01-845 6372.

48K APPLE II DoS 3.2 Single disc drive television monitor. Teletype printer, little used. Highest offer secures. Wimborne 886381.

NASCOM-2 Software. Fantasy games, Extension Basic, Toolkit etc. SAE for catalogue to: Level 9 Computing, 229 Hughenden Road, High Wycombe, Bucks.

PET 32K Model 2001, small keyboard, integral cassette, manual plus some games. Offers. Telephone: 01-866 2532.

ITT 2020 with Apple disc, DOS 3.3, DOS Tool Kit and games paddles. New last December. Mint condition. Original documentation and packing. 10 extra discs. Cost over £1250 sell for £795. Tel: (0432) 58127 evenings or weekends.

ZX80, 16K RAM, 8K ROM, (with NON FLICKER SLOW MODE), keyboard bleeper, PSU, Programs etc. £100. Tel: (0224) 322936.

PET 32K — All Dungeons and Dragons fans! 32K and 8K program together include main tables, also random character generation. Ring 01-940 2254 after 6pm or write to 51 Ashburnham Road, Ham, Richmond, Surrey.

SHARP MZ-80K for sale. Plus Toolkit, Assembler and many games. Tel: 0273-606876.

SHARP M280K New Basic/Machine Code 'Word Processor' program for cassette operation on 48K machines. Simple to use. Tidy screen format. Many features including Insert, Delete, Find, Move Paragraph, Save, Load, append etc. £12.00. Telephone: 0268-26703 for details.

ATARI VCS: 11 Cartridges inc. Space Invaders and Maze Craze. £220 o.n.o. worth £315. Tel: 021-355 5544 evenings.



EAST ANGLIA. Programmer required for system house with specialised application. Must be experienced in Pascal. Apple experience helpful. Suitable for someone wishing to be involved in the total aspect of the business, writing programs, selling systems, support, etc. Salary negotiable from £5,000-£7,500 plus company car. Assistance with accommodation possible. Box No. 606.

SUPERBRAIN DD 350K, Weyfringe enhanced printer, including Wordstar/Mailmerge, M-Basic, C-Basic, CP/M 2.2, 4 months old, as new £2,600, save £1,000. Slough 41536 evening, 27296 day.

TRS80 LEVEL II + expansion interface + disc drive + Teletype 33, £750 ono. 01-749 2489.

1K ZX81-MOONLANDER (Realistic Graphics) + Dodgems + Mastermind, listing and instructions, all 3 — £1. G. P. Smith, Brynllwyd, Capelseion, Aberystwyth.

ZX80 CONVERSION to white on black. Cheque/PO for £2.14 for modification details payable to J. T. Neyland, 1 Bishwell Park, Gowerton, Swansea, W Glamorgan SA4 3AU.

ONE PET 8K 2001 Series upgraded to 32K and fitted with Computhink control board, cables, etc for 800K drive, disc drive not included, available now £790. One Pet 8K as above but complete with 800K Computhink double disc drive, available November £1,580. All units maintained in Petalect service agreement. If both units taken together in November £2,290. Creative Engineering, Berkhamsted 71066.

ACORN ATOM SYNTHESIZER 7K, superb musical instrument, seven octaves, random music, user defined notes, sequences, plus full edit, load, save, and tempo change facilities, incredible entertainment for £8. D. W. Moran, 99-101 St Leonards Road, Windsor, Berks.

ZX81 GAMES. Six Super Games on Cassette, £3.00 (Plus additional free game and other info). or SAE List/Details. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

GAMBYTES 1, 2, 3: Basic Programming Games. In Basic. 1-50p, 3-£1. Peace, 25 Birches Lane, South Wingfield, Derbyshire.

RUBIK CUBE UNSCRAMBLER. Displays step-by-step solution from any start condition. BASIC listing £3, flow charts and description £2. Wray, 32 Church Green, Totternhoe, Dunstable, Beds.

ZX80/81 RE-NUMBER in Basic, Space Attack, Noughts/Crosses, all 1K. £1.50 + SAE. Micro-Aid, 25 Fore St., Praze, Camborne, Cornwall.

EPSON MX80 FT, MX100, Anadex Printers, ADM 3A, ADM 3A, Televideo 912C, 920C, 950 VDU's, PET, Apple, Tandy and Superbrain. Sale and maintenance service at lowest prices. Telephone A. W. Computer Engineering Co. on 01-751 2196.

FOR ZX81 (1K) Two player "arcade", screen scoring and end of game indicator. Cassette £2.50, listing £1.50 plus SAE. F. McCarthy, 1 Sholebroke Terrace, Leeds LS7 3HF.

DRIVE THE EPSON MX-80 printer direct from your Nascom 2 PIO. No interface hardware needed. Extensions to NASPEN includes subscripts, underlining and page numbering. 1200 baud tape and manual £8, or SAE for information. Colin Pennycuick, 6 Kensington Place, Bristol BS8 3AH.

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AJ Harding (Molimerx) 0424-22039	28 Collington Avenue Bexhill-on-Sea East Sussex	John Harding
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Amplicon M S Ltd 0273-608331	Richmond Road Brighton Sussex BN1 6JA	Peter Wood
Anagram Systems 0403-68601	9 Michell Close Horsham West Sussex RH12 1JT	Jon Quigly
Analog Electronics 0203-417761	47 Ridgeway Avenue Coventry	
Basic Computing 0535-65094	Oaksworth Road Keighley West Yorkshire BD22 7LA	Mike Collier
Benchmark CS Ltd 0726-61000	Tremena Manor Tremena Road St Austell Cornwall PL25 5QG	
Bristol Software Factory	St Michael's Hill Bristol BS2 8BS	W J Kyle-Price
Chess Consultancies Ltd 061-832-6792	Progress House 31-33 Mount Street Salford Manchester M3	D G West
Cleartone ADP 0495-244555	Prince of Wales Industrial Estate Abercarn Gwent NP1 5RJ	C J Holbrook
Clenlo Computing Services 01-653-6028	15 South View Court The Woodlands Beulah Hill London SE19	
Commodore BM (U.K.) Ltd	818 Leigh Road Slough Industrial Estate Slough Berkshire	A Gould
Compfer Ltd 0772-57684	Preston Computer Centre 6 Victoria Buildings Fishergate Preston Lancashire	
Compsoft Ltd	Old Manor Lane Chilworth Guildford Surrey	
Comput-A-Crop 01-771-0867	32 Whitworth Road London SE25 6XH	Jenny Wilson
Computech Systems 01-794-0202	168 Finchley Road London NW3	Laurence Payne
Computerstore Ltd	16 John Dalton Street Manchester M2 6HG	
Courtman Micro Systems 0222-495257	48 Melrose Avenue Pen-Y-Lan Cardiff CF3 7AS	KJ Courtman
CPS (Data Systems) Ltd 021-707-3866	Arden House 1102 Warwick Road Acocks Green Birmingham B27 6BH	
CSM Ltd 021-382-4171	Refuge Assurance House Sutton New Road Birmingham	Peter Mart
Cyderpress Ltd 0491-37769	2 Church Lane Wallingford Oxfordshire	C Murphy
Daman Computer Services 061-793-7015	Kennedy House Rutland Street Swinton Manchester M27 2AU	L J Watson
Dataforce (U.K.) Ltd 0272-314496	68 Alma Road Bristol BS8 2DJ	Chris Pym
Dataview	9 Church Street Colchester Essex	
Deltic Computing Ltd Basingstoke 59715	2nd Floor May Place House May Place Basingstoke Hampshire	
Diskdean Ltd 01-242-7394	23 Bedford Row London WC1R 4EB	
Diskwise Ltd 05793-3780	25 Fore Street Callington Cornwall	R Cornforth
Equinox Computer Systems 01-739-2387/9	Kleeman House 16 Anning Street New Inn Yard London EC2	M Kusmirak
G W Computers Ltd 01-636-8210	89 Bedford Court Mansions Bedford Avenue London WC1	
Graffcom Systems Ltd 01-727-5561	102 Portland Road Holland Park London W11 4LX	B Castledine
Graham Dorian Software 01-379-7931	c/o Lifeboat Associates 32 Neal Street London WC2H 9PS	
Grama (Winter) Ltd 636-8310	89 Bedford Court Mansion Bedford Avenue WC1	Tony Winter
Great Northern CS Ltd	116 Low Lane	P Rayner

0532-589-980	Horsforth Leeds LS18 5PX	
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0225-65379	2-4 Henry Street Bath	
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0734-789183	Wokingham Berkshire RG11 2QX	
Intex Datalog Ltd	Eaglescliff Industrial Estate	
	Eaglescliff Cleveland TS16 0PN	
James C Steedman	18 Manor Road Upper Beeding	
0903-814923	Steyning Sussex	
Jar Software Systems	124 Newport Street	J Blackburn
Bolton 26644	Bolton Lancashire	
Keen Computers	5b The Poultry	Bob Ellis
0602-583254	Nottingham	
Kesho Systems	72 Waterloo Street	Angus Nial
041-226-4236	Glasgow G2	
L & J Computers	3 Crundale Avenue	Jack Goodman
01-204-7525	Kingsbury London NW9 9PJ	
Landsler Software	29a Tolworth Park Road	E Landsler
01-399-2476/7	Surbiton Surrey KT6 7RL	
Liveport Ltd	The Ivory Works	
0736-798157	St Ives Cornwall	
Logic Box Ltd	31 Palmer Street	
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Bolton 389854	Bolton Lancashire	
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Map Computer Systems Ltd	Belgrave Industrial Estate	Denis Thomson
01-633-3084/5	Honeywell Lane Oldham OL8 2LY	
Median-Tec	120 Oxford Road	
0734-596842	Reading Berkshire	
Metrotech	Waterloo Road	
0895-58111	Uxbridge Middlesex UB8 2YW	
Micro Computation	8 Station Parade	
01-882-5104	Southgate London N14	
Micro Focus	c/o Lifeboat Associates	
	32 Neal Street London	
Microact Ltd	Radclyffe House	
021-455-8585	66-68 Hagley Road Edgbaston	
	Birmingham	
Microcomputer Applications	11 Riverside Court	
0734-470425	Caversham Reading Berkshire	
Microcomputer BM	4 Morgan Street	
01-981-3993	London E3 5AB	
Microdigital Ltd	25 Brunswick Street	Graham Jones
051-227-2535	Liverpool L2 0BJ	
Microgems Software	32 Buckingham Avenue	
0602-275559	Hucknall Nottinghamshire	
Microland	17 Victoria Road	
0723-70715	Scarborough North Yorkshire	
Micromedia Systems	Seymour House	
Newport 59276/7	14-16 Chepstow Road	
	Newport Gwent	
Micropute	Communique Place	
0625-612818	9 Prestbury Place	
	Macclesfield Cheshire	
Microsense	Finway Road	
0442-41191/48151	Hemel Hempstead Hertfordshire	
Microtek	50 Chislehurst Road	
0689-26803	Orpington Kent	



SUPERBRAIN 64k Quad. Over £1,000 worth of software. Diablo 1500 with tractor feed and stand (needs attention). Private sale, no VAT, bargain at £1,995. Phone 01-989 0430.

NEW 9" MONITOR B & W IKEGAMI Cge paid £85. System software Basic tutor, £5. Arrington music system for Exidy, £8. Z80 books for sale. 0274 45611.

POOLS PROGRAM. Let your ZX80/81 identify unexpected draws, this ingenious program will forecast result of any match. Needs 3k. For ZX80 (either ROM) or ZX81 (state which). Send £1.75 for listing and instructions to R. Waight, 6 Rosemary Court, Bank House Road, Sheffield.

EDIT-A text editor for the ATOM. £9.95. SAE for further details. P. C. Humphry, La Saline, Rue Sauvage, St. Sampsons, Guernsey, Channel Isles.

FOR SALE: Acorn Atom complete with 7k RAM, leads, expansion socket, manuals and Leventhal's 5602 book. £150 ono. Ring 0642 818475 after 6pm.

SUPERBRAIN programs wanted; games, business, programming, anything to assist newcomer. 51 Burgess Road, Southampton.

HEATH H14 printer, RS-232, used with TRS-80. £200 ono. Phone 01-657 1694.

GALACTICA (latest Arcade Craze), For Superboard, CIE, and 101 £3, also Invaders and Superball, £2 per, all three £6, all 4K, Cassette and Listings. D. Webster, 99 Edmondstown Road, Edmondstown, Rhondda, S. Wales.

ATOM DISASSEMBLER £5. Full Symbolic Disassembler + Listing. Runs in under 2½K. Gilton, 44 Bacon Lane, Hayling Island PO11 0DW.

CROMENCO BYTESAVER Eprom — Programmer S-100 Board. As new, with manual £80. Chorlewood 4507 evenings.

TELETYPES — Three Type ASR 33 with Stands. 20 mA Loop Interface, full servicing data. £90 each ono. Tel: 090-722 3042.

TRS-80 L2/PET, Educational; GCE Maths revision course, Basic Acol bidding; also fun-learning CLAWS (number bonds); ON GUARD (decimal game); MASTERCAB (like Mastermind, but improves spelling). Classroom validated from 7 to 15 years. SAE, Bryants Software, 1 The Hollies, Chalcraft Lane, Bognor PO21 5SX. Tel: Bognor 829478.

ZX80 SINCLAIR BUILT PSU, leads, manual, 10 months old. £65. Tel: King's Lynn 671077.

WANTED — CHEAP, used KIM1, preferably with assembler/disassembler, up to £60. Telephone S. Moss, after 9pm (0743) 56445.

TRS80 16K LEVEL 2, monitor, recorder, power supply, leads, cassettes, manuals. £400. Tewin (Herts) 7496.

NASCOM 32K RAM including printer graphics and tons of extras. Value £700, accept £380 ono. Tiverton 257886.

BASE 2, MODEL 800B, printer, Dot matrix, BI-Directional printing, RS232, I EEE-488, centronics parallel, plus tractor. £235. Evenings Westerham (0959) 63157.



8K PET (OLD ROM) with built in cassette + Sound Box + Space Invaders, Cosmic, Jailbreak, Micro-Chess, Basic Basic. Modified to Green Screen £300. Tel: 01-941 1632 or 03447 5485 evenings.

ATOM GAMES, under 4K, £1.50 each with sound: Rat-trap, Air attack, Tank battle, Poker-dice, Squash, Minefield, Missile, Horserace. S. Green, 15 Hazelwells Road, Highley, Bridgnorth, Shropshire WV16 6EA.

PC1211 BRAND NEW, full 12 months warranty, one only. Offers. Tel: Stevenage (0438) 59677.

TANTEL, Prestel adaptor still boxed and unused, under guarantee. £175. Tel: 0949 51126.

PET Duck Shoot. Arcade quality game. Cassette £5. R. Lewsey, 9 Proctors Way, Bishops Stortford, CM23 3HF.

FOR SALE 2 x 80, P.S.U, 16K RAM, 12" portable television, tape recorder, 20 tapes. Mounted in carrying box, 8K ROM ordered. £150. Phone: 0295-57786.

EXIDY SORCEROR W.P. Pac £90. As new. Tel: 01-946 8467.

UK101 SOFTWARE. Games on tape, e.g. golf, life. Send SAE for full prices. Kitsoft, Springfield, Lyneal Lane, Welshampton, Shropshire.

TRS-80 Level II 16K, green screen VDU, c/recorder, dust covers, numerous software, books. £395. 01-302 5052.

SHARP Printer (MZ-80P) for sale with interface unit (MZ-80I/o). New condition. Only £490 complete. Tel: (0384) 237635.

DURA 1041 (I.B.M. Golfball) typewriter/printer, includes paper tape reader and punch, £180. Telephone: Milton Keynes (0908) 605070.

ROYAL WEDDING TRS-80 LII 16K. Fully animated events include crowd scene, arrival coach, bride, wedding ceremony, balcony scene with sound/music on same tape, £9.50, or SAE for details plus educational and games programs (from £3.50); Bryants, 1, The Hollies, Chalcraft Lane, Bognor, PO21 5SX.

NASCOM 2 . . . 32 K RAM/4 MHz No Waits, NAS-SYS 3, ZEAP 2/EPROM, NAS-DIS Debug/tape, Bits & P.C.S. Toolkit/EPROM, Chess & Space Invaders, Castle Int, Port Probe, 3 D/N Vero Rack & Case, Fan, etc. £690 o.n.o. Tel: (0983) 402549.

ZX80/81 Memory/I.O. 16K RAM + 8255 P.I.O. 24 I/O lines. Blank board and case: £11.50 + p & p. Made and tested: £39.95 + p & p. p & p £1.80. Ring 0245 83262 6pm to 8pm.

IJK101 8K, Newman and Cegmon monitors, £200. Tel: 01-595 7061.

SHUGART SA400 5.25 Minifloppy disc drives, £75 each. Also Tektronix Osciloscope Model 551 at £75. Phone: Geoff on Letchworth (04626) 76422.

REBEL ATTACK — Can you penetrate the warlord's defences? Modular constructed real-time space adventure on cassette for Sharp MZ-80K with sound and graphics. Send £7.50 and memory size to White, 22 Sarling Close, Wokingham RG11 2YY.

NASCOM II 16K with graphics in new case. £375 or offer. Chesham (02405) 6043.

Buyers' Guide

Minicomputer CS Ltd 0494-448686	Pilot Trading Estate 163 West Wycombe Road High Wycombe	
MMS Computer Systems 0234-40601	26 Mill Street Bedford	D Nichols
Padmede Computer Services 025-671-2434	112/116 High Street Odiham Basingstoke Hampshire	John Packwood
PCL Software Ltd 021-552-6126	146-150 Birchfield Lane Oldbury Warley West Midlands B69 2AY	P Hemmings
Personal Computers Ltd 01-626-8121/2/3	194-200 Bishopsgate London EC4M 4NR	Mike Hardwick
PK Microsystems Ltd 01-637-2108	146 Oxford Street London W1	
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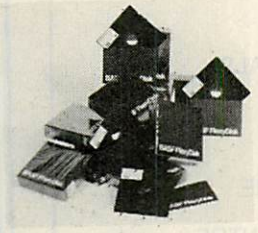
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Son of Hexadecimal Kid

Samson has left Blotto for Earth. On board the star cruiser Green Banana he has a mystical experience while looking at the heavens. But now he is stuck on the moon of a planet of Tau Ceti, 11 light years from his destination. There are no flights to the solar system.

The windows of the transit lounge were misted with condensation. Idly Samson wiped a patch clear with his hand. He gazed out over the cratered moonscape towards the faint yellow star, 11 light years distant, which was rising over the rim of jagged peaks on the horizon. That, he knew, was his own sun.

As he looked, he had an idea. There was a small repair depot next to the space terminal, and at any given time there were three or four space buggies parked outside awaiting collection. They were not really meant for interstellar travel but, on a full tank, might just stretch to a hop of a dozen light years.

Nightfall found Samson, clad in a stolen space suit, creeping over the concrete apron of the launch pad towards the space buggy parked furthest from the workshop. He clambered easily up its side in the low gravity and found the hatch, mercifully, unlocked. In the cabin the electrical systems were energised, and the fuel tanks were nearly full: it was to be collected next day.

"3, 2, 1, zero", he whispered, and pressed Escape on the console.

It took Samson almost as long to reach Earth in the space buggy as the hyperspace cruiser had taken to cover the 70,000 parsec journey from Omega Solaris, but eventually he crash-landed smack on target less than 4 kilometres from Sprocket's Hole. He climbed out on to home soil again and stretched his limbs joyfully.

He left his spacecraft smouldering in a mangled heap and set off at once for his birthplace. When he reached Sprocket's Hole he found it much as he had left it. A thin coil of smoke curled lazily upwards from one of the chimneys. In the vegetable garden a peasant woman was hoeing wearily.

Samson approached her. "I come from afar to bring the knowledge of cosmic oneness to all who will open their hearts to Megabrain", he announced by way of introduction.

She straightened her back and looked up from her exertions. "You sound just like my father", she declared.

"You look just like my mother", he replied.

They both laughed.

It was true. The woman he addressed was his baby half-sister Ada, born of his mother Cleo to Johnny McNull 11 years after his own birth. He could see the telltale scar on her neck — made by his own teeth — that identified her without question. But owing to the time warp caused by his extensive travels through hyperspace his younger sister was now a grown woman while he remained a teenager. Indeed there was no way of knowing his biological age with accuracy, though he reckoned he was 15 or 16.

"So you're Samson then", she said, once he had convinced her of the reality of time dilation. "Folk talk a lot about you. But I never thought we'd see your face again. Come inside and have something to eat".

"You're not angry with me then"?

"Angry"?

"I mean about the er . . ." He tapped his throat with one finger.

"Oh that. I can't remember anything of it. Just as long as you don't try it again".

"I won't do that", he promised. "I've learned my lesson".

From Ada he learned that both McNull and Cleo had died in successive hard winters. She told him other startling news too.

"You're Son of Hex now, you know", she explained. "You have a following. Your ascent to heaven was seen, and many have predicted your return. They await your word. My father came round to that way of thinking before he died, though the Nullards punish anyone who talks about it".

"That's good, for I have returned to overthrow the stultifying Nullard doctrine and open men's eyes to the glory of Megabrain. They will see that all is computation. Everything that is, computes".

"The Nullards certainly won't like the sound of that", she warned him.

"You can be the first", he said. "Look, this is Zapple, the binary tree of knowledge. It has been all round the universe with me. It has seen things you can scarcely imagine. And all the time it has been absorbing information — more than you can ever dream of. Eat of its fruit and you will be wise beyond any wisdom known on Earth".

"Oh, no. Not me, thank you. I've quite enough on my plate being ignorant. I'll feed you if you like — though that could cost me dearly — but you won't get me to byte off more than I can chew".

"Well then, I'll be off". He knew she meant what she said, and realised that his continued presence put her life in danger.

"Where"?

"Into town. I must spread the word".

When he reached the great central plaza of Nada, the holy city of Nullardy, he strode straight up to the immense statue of Tony Bony, climbed on to the plinth at its base, unpacked his bag and started to shout.

"Megabrain is lord of all, and I am his prophet", he proclaimed to all who would hear.

People looked up. Before long a few curious passers-by had formed a straggling audience.

"Who do you think you are"? challenged one of them.

"I am Son of Hex. I have come to welcome you to the wonderful world of computers. I will show you the marvels of the micro-chip".

"And I'll show you the marvels of the bacon-flavoured chip"! quipped the heckler. He held a bag of potato chips in his hand, one of which he popped ostentatiously into his mouth and crunched. There was a ripple of laughter. A small crowd was gathering.

"Come unto me", commanded Samson magisterially.

The heckler stepped forward hesitantly, all eyes suddenly on him.

"Give me what is in your hand".

"That's my lunch"!

"Give it to me".

Reluctantly he proferred his bag. The onlookers pressed forward for a better view. Samson held the food in his left hand, and laid his right on the man's shoulder. Then he returned it to its owner.

"Arise, take up thy chips, and think".

There was a gasp from the crowd.

Samson, at the height of his powers now, had worked a miracle. What he handed back was not a crumpled packet of soggy crisps but a video work-station with EEG interface. The parasitic computing virus that had invaded his cells was beginning to do what its designers had planned long ago.

"Fear not", Samson admonished them. "The computer is just a tool — to lead you to greater knowledge. All life aspires to the condition of computing. Every one of us is part of a distributed system, and if you will open your hearts to Megabrain we shall all be linked in the ever-lasting universal ethernet".

The crowd surged eagerly forward.

"Give to us too, O Son of Hex"! they clamoured.

"You shall have your fill", he called out above the din. "Blessed are they that hunger and thirst after processing power, for they shall control the CPU. Processors for the people! One man, one micro"!

As the crowd pushed and shoved to claim their free gifts two hooded figures detached themselves and made off swiftly. They were spies employed by Brother Bottleneck, one of the seven patriarchs of the Nullard church, on their way to tell him what they had seen.

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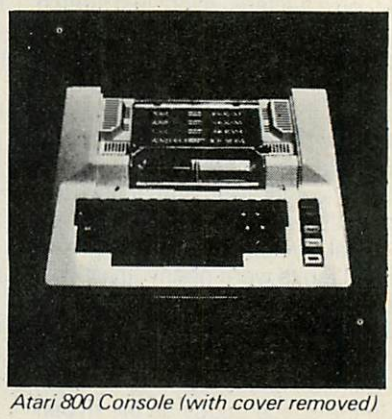
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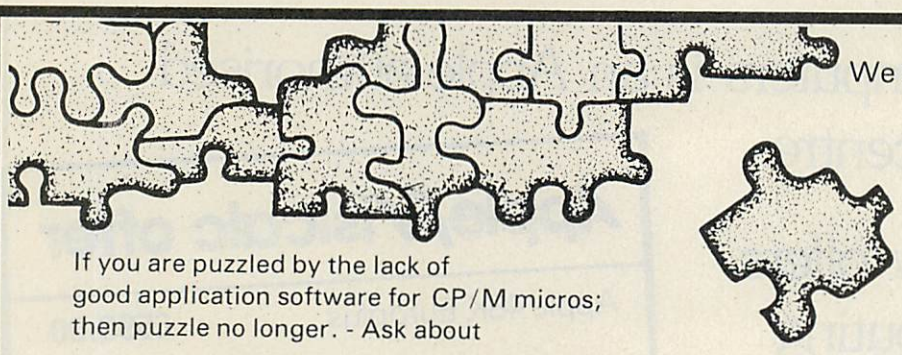
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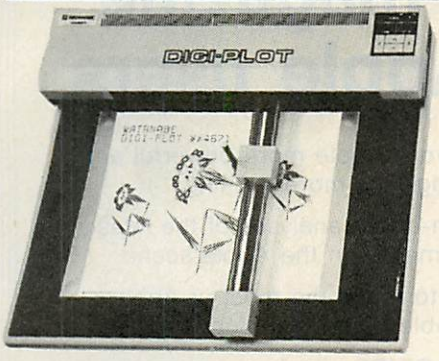
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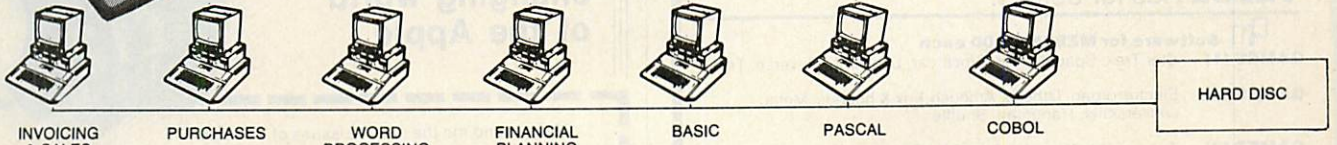
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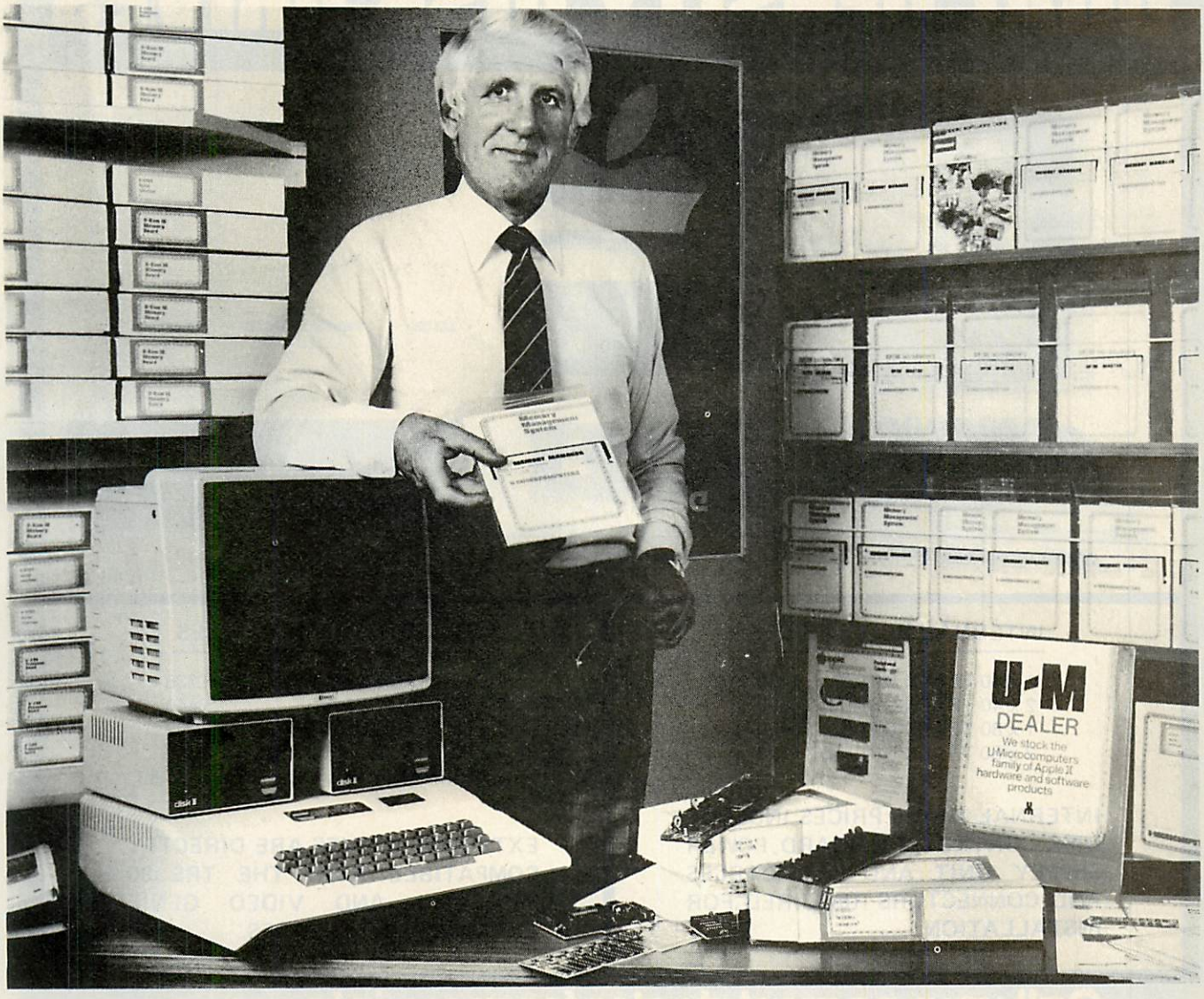
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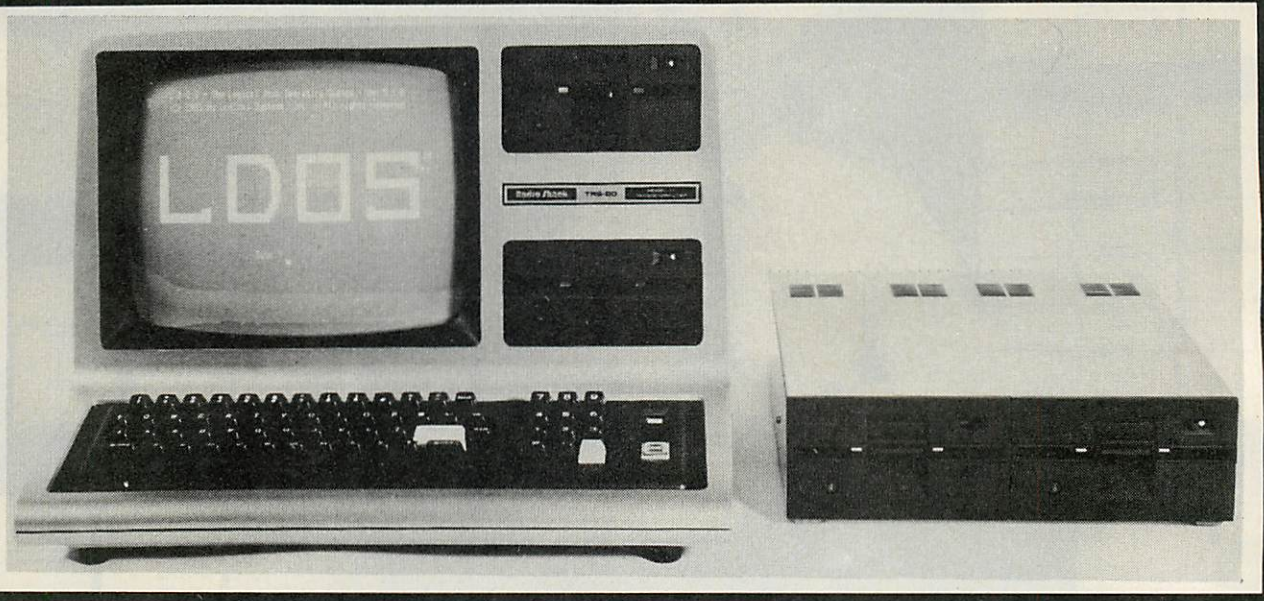
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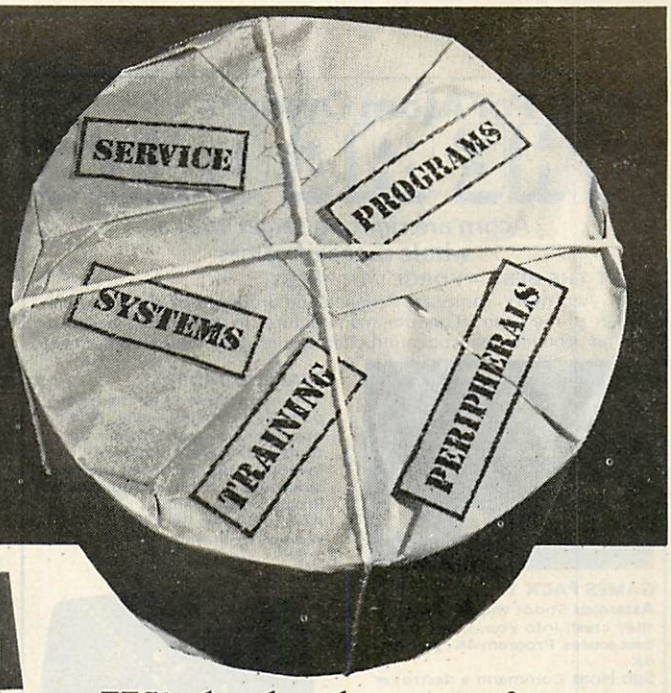
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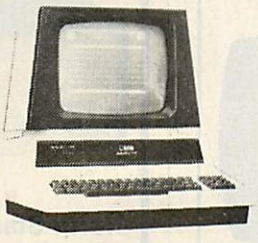
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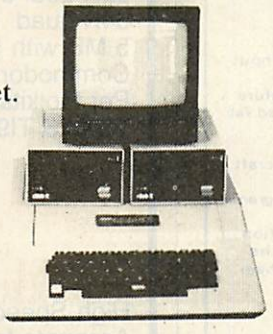
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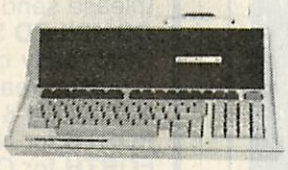
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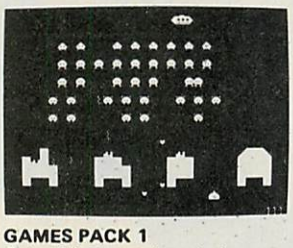
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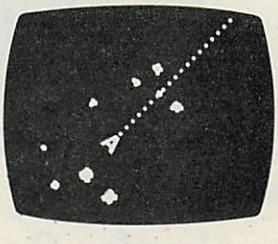
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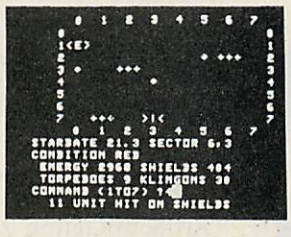
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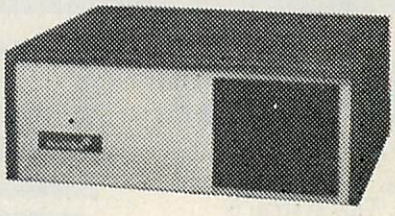
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74LS377	120p
74LS378	100p
74LS390	90p
74LS393	90p
74LS399	200p
74LS445	140p
74LS640	300p
74LS641	450p
74LS642	450p
74LS643	450p
74LS644	450p
74LS668	100p
74LS670	225p

74S SERIES

74S00	60p
74S04	60p
74S05	75p
75S08	75p
74S10	60p
74S20	60p
74S30	60p
74S32	90p
74S37	90p
74S64	60p
74S74	90p
74S85	300p
74S86	180p
74S112	120p
74S114	120p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
74S174	250p
74S175	320p
74S194	350p
74S241	450p
74S260	70p
74S373	400p
74S374	400p

93 SERIES

9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9321	225p
9322	150p
9334	360p
9368	250p
9370	300p
9374	200p

4000 SERIES

4000	15p
4001	18p
4002	20p
4006	70p
4007	20p
4008	70p
4009	40p
4010	40p
4011	16p
4012	25p
4013	35p
4014	75p
4015	70p
4016	35p
4017	50p
4018	70p
4019	45p
4020	65p
4021	75p
4022	70p
4023	20p
4024	40p
4025	20p
4026	130p
4027	40p
4028	60p
4029	75p
4030	40p
4031	170p
4034	200p
4035	110p
4036	295p
4039	295p
4040	60p
4041	80p
4042	65p
4043	75p
4044	70p
4046	80p
4047	75p
4048	55p
4049	30p
4050	30p
4051	65p
4052	80p
4053	65p
4054	130p
4055	125p
4056	120p
4059	500p
4060	90p
4063	100p
4066	35p
4067	400p
4068	15p
4069	20p
4070	30p
4071	25p
4072	25p
4073	25p
4075	25p
4076	60p
4081	22p
4082	27p
4086	72p
4089	150p
4093	45p
4094	200p
4095	95p
4096	95p
4097	340p
4098	90p
4099	120p
40100	220p
40101	132p
40102	180p
40103	180p
40104	99p
40105	120p
40106	50p
40107	60p
40108	470p
40109	100p
40110	300p
40114	250p
4502	70p
4503	50p
4507	45p
4508	200p
4510	70p
4511	80p
4512	80p
4514	200p
4515	200p
4516	75p
4518	70p
4520	80p
4521	210p
4526	90p
4527	150p
4528	80p
4532	110p
4534	500p
4536	300p
4538	120p
4543	140p
4553	320p
4556	60p

4560	180p
4569	180p
4572	30p
4583	100p
4584	50p
4585	100p
4724	150p
40097	90p
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14412	300p
14433	1100p
14599	290p

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6809	1600p
INS8060	1000p
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12v	78L12	30p	79L12	70p
15v	78L15	30p	75L15	70p

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LM317T	200p	78MGT2C	140p
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78H05	550p	RC4195NB	150p
78HGKC	600p	TL497	300p

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DS8836	150p
DS8838	225p
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MC1489	75p
MC3446	325p
MC3480	800p
MC3487	300p
MM58174	1200p
75107	160p
75110	160p
75154	175p
75182	230p
75324	375p
75361	150p
75363	400p
75365	150p
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75491/2	70p
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2.45760MHz	325p
3.276MHz	300p
3.579MHz	175p
4.00MHz	290p
4.194MHz	300p
4.43MHz	125p
5.0MHz	325p
6.0MHz	300p
6.144MHz	300p
7.0MHz	300p
7.168MHz	300p
8.00MHz	300p
8.867MHz	300p
10.00MHz	310p
10.7MHz	300p
12.0MHz	350p
16.00MHz	350p
18.00MHz	300p
18.432	350p
19.968MHz	390p
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55.5MHz	400p
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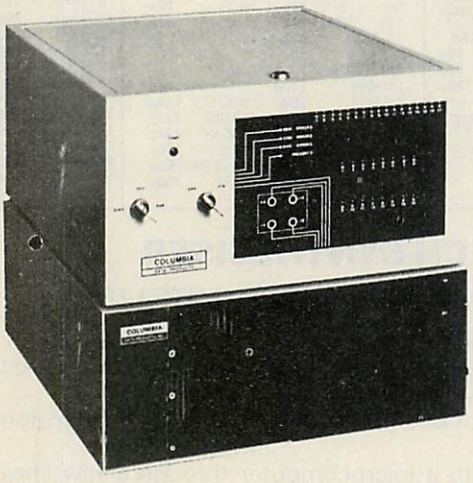
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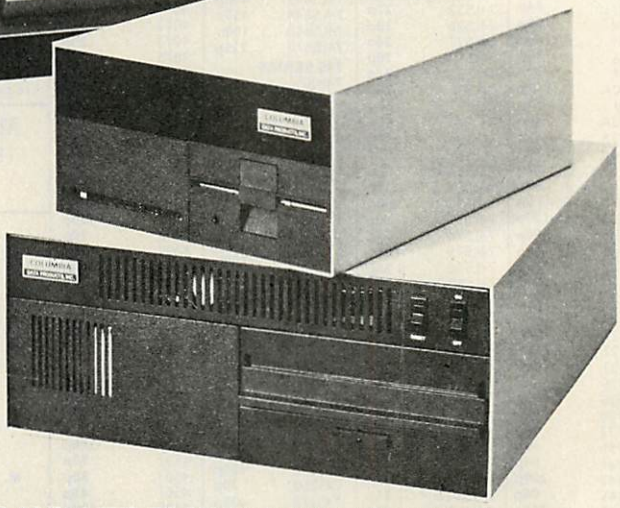
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SYSTEM 4000
EPROM EMULATOR/PROGRAMMERS

EX-STOCK



P4000 PRODUCTION EPROM PROGRAMMER

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MODEL 14 EPROM ERASERS



MODEL UV140 EPROM ERASER

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MODEL UV141 EPROM ERASER

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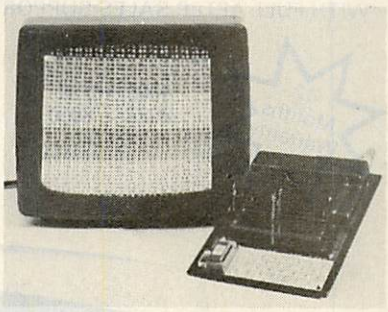
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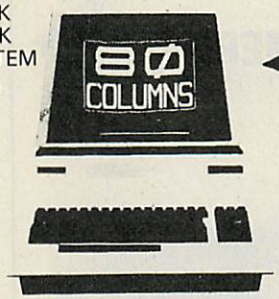
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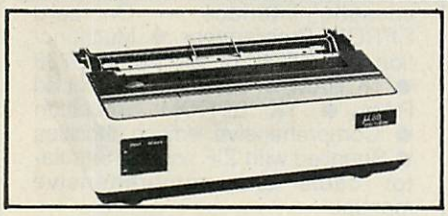
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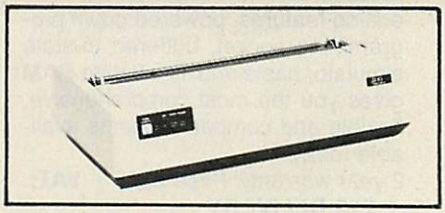
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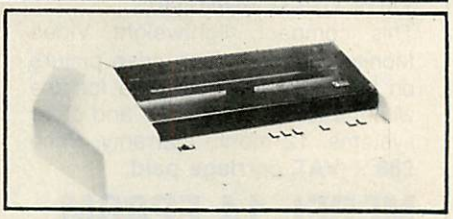
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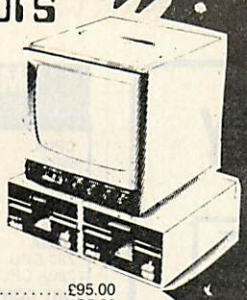
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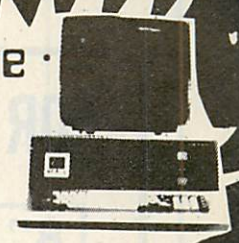
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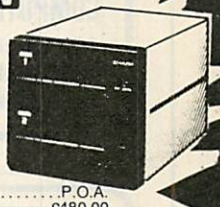
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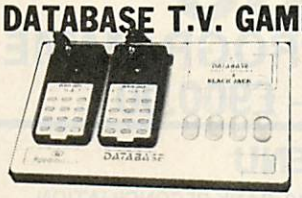
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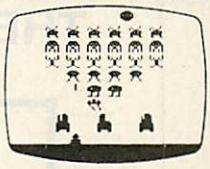
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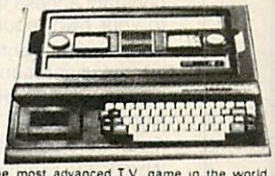
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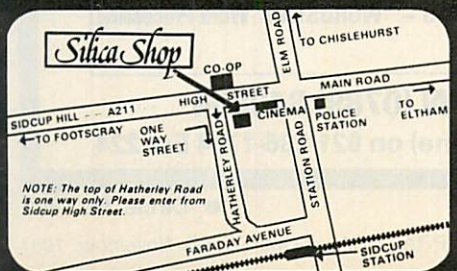


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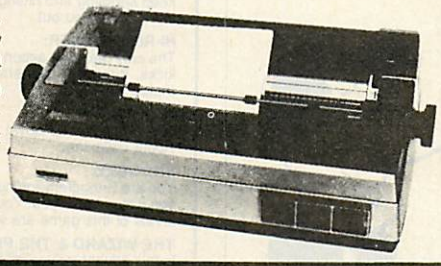
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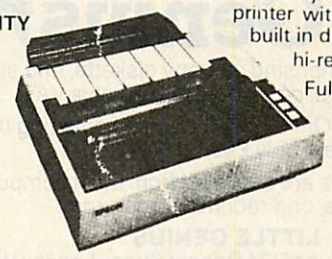
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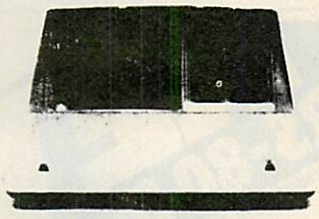
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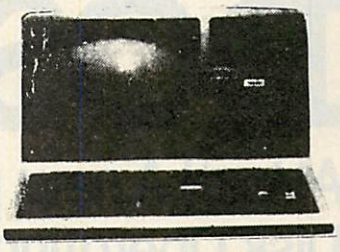
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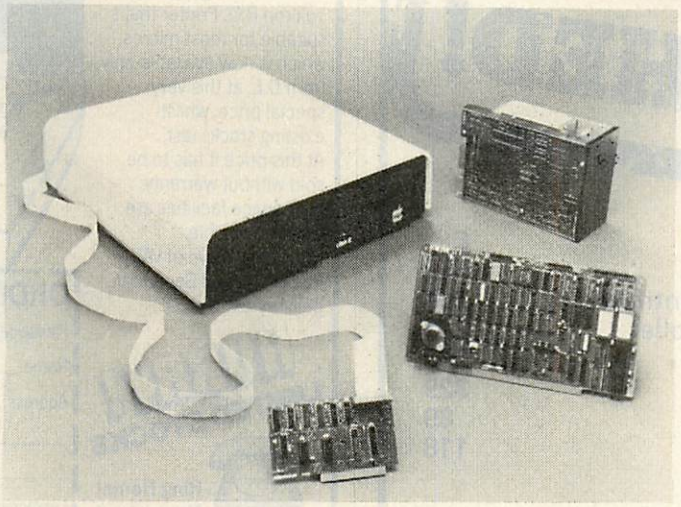
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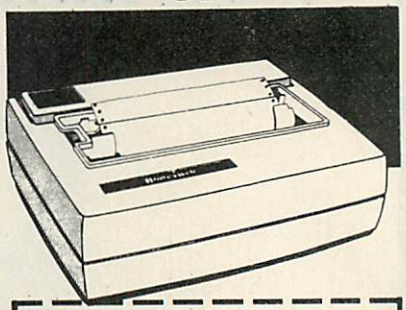
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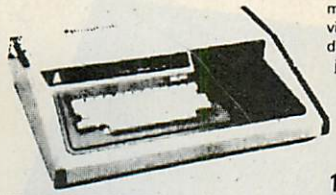
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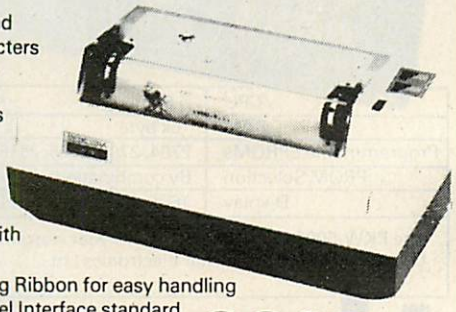


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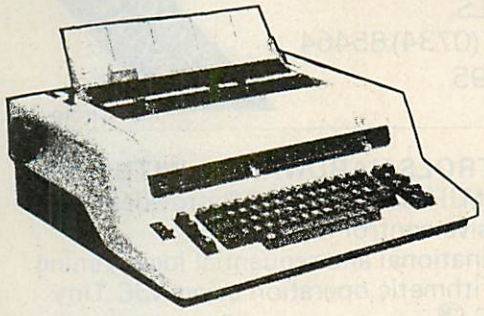
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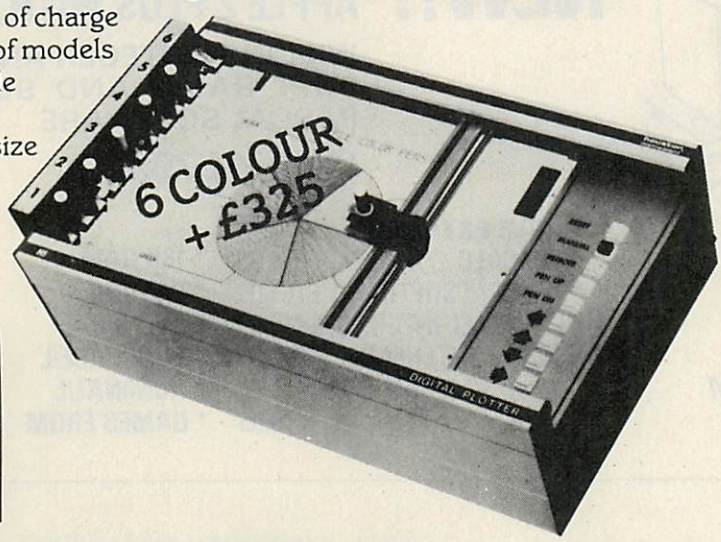
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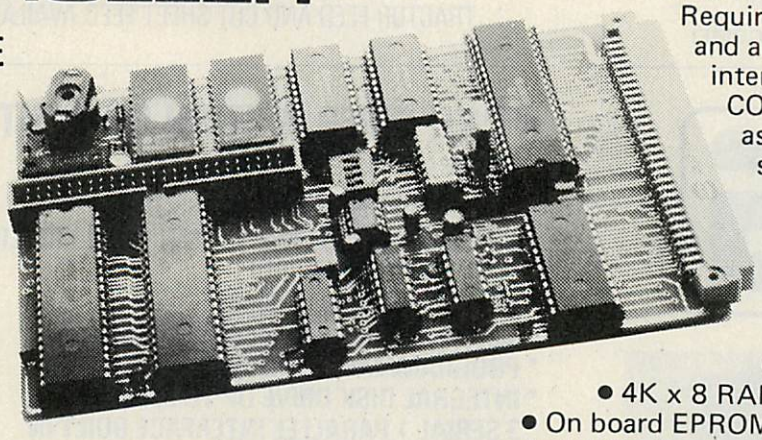
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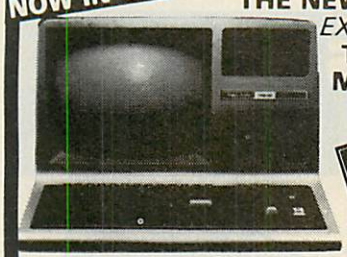
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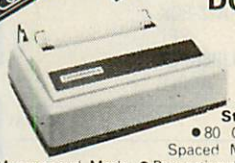
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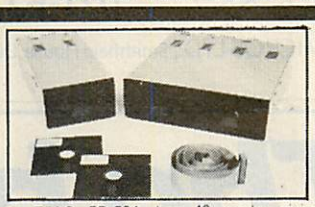
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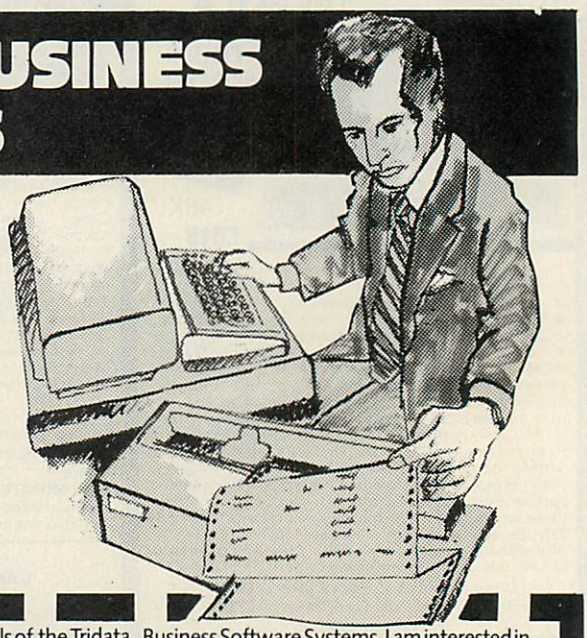
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WHAT YOU NEED

All that is required for you to take advantage of the RAMEX 16 Expansion Board is the following:-

- 48K APPLE II OR APPLE II PLUS
- ONE OR MORE DISK DRIVES
- RAMEX 16

THE MANAGER requires:-

- ONE OR TWO RAMEX 16
- THE MANAGER

METHOD

To get back the 10.5K of memory lost to DOS simply read on.

1. The 48K Apple is configured with the RAMEX 16 in slot Ø and another RAMEX 16 in any other slot. Depending on application this can be any other firmware card.
2. DOS is booted as normal using a DOS 3.3 System Master Diskette or DOS 3.2 Basic Diskette followed by DOS 3.2 System Master Diskette.
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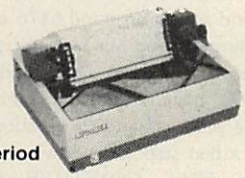




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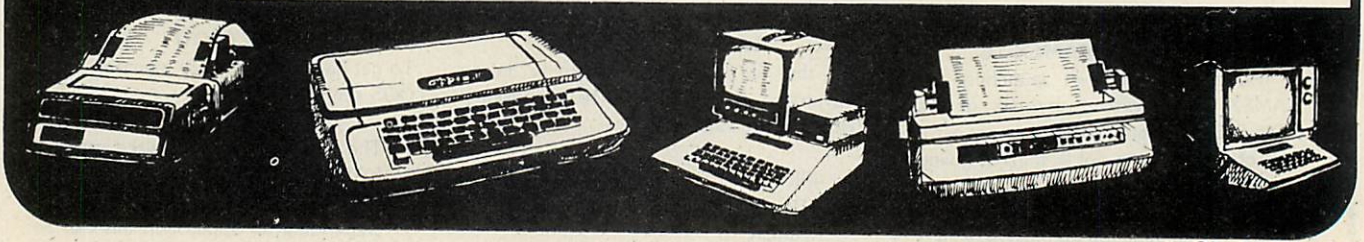


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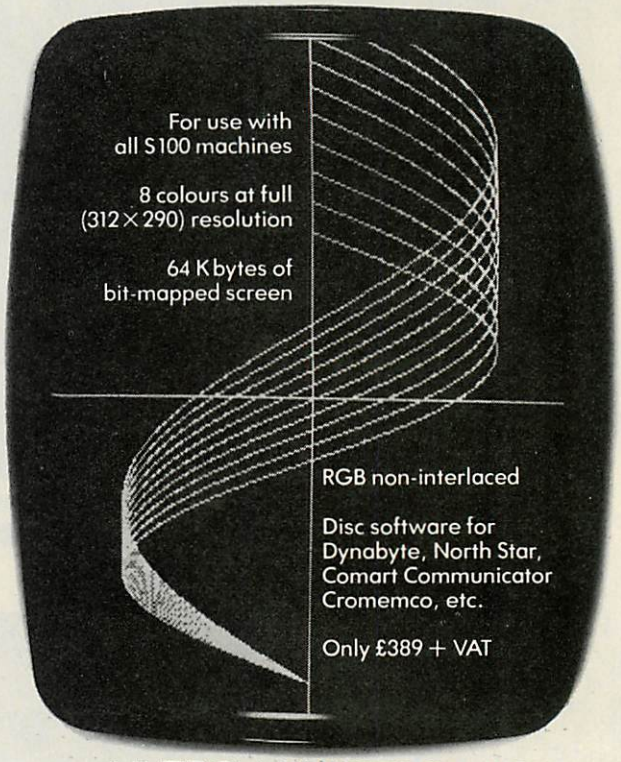
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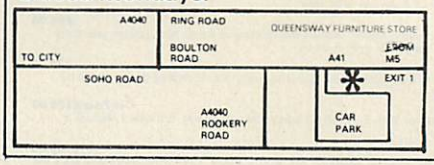
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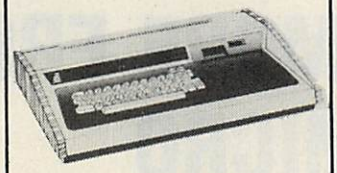
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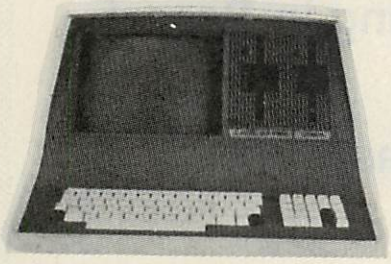
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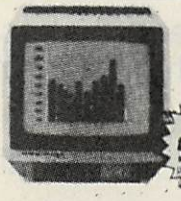
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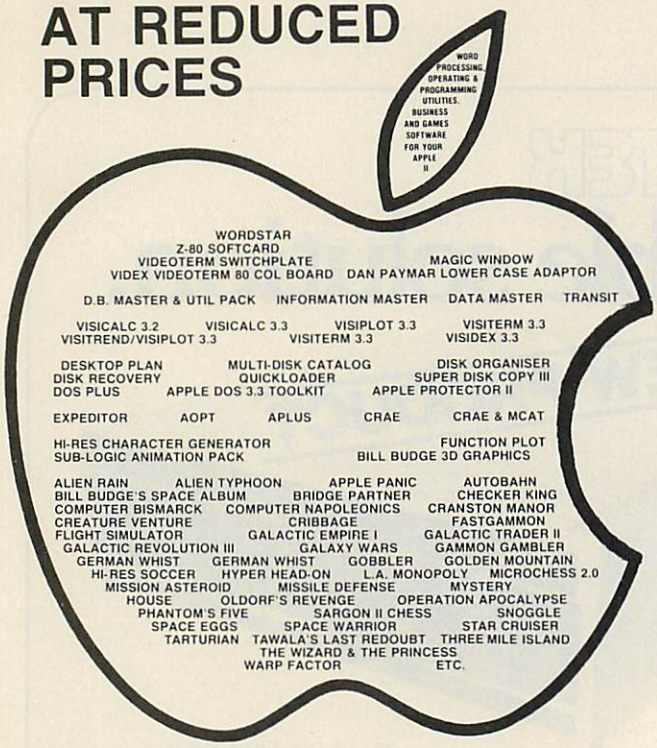
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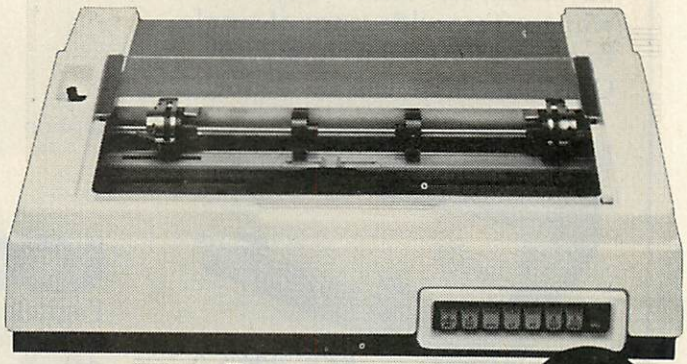
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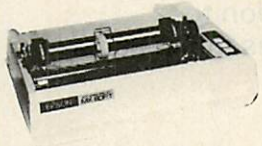
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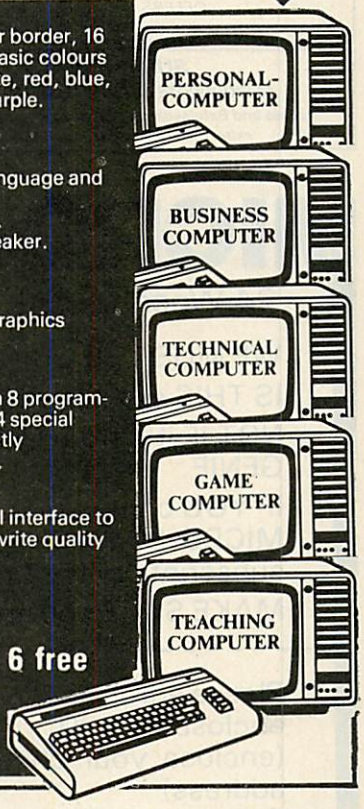
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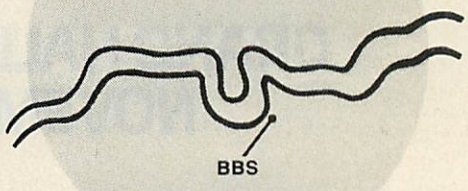
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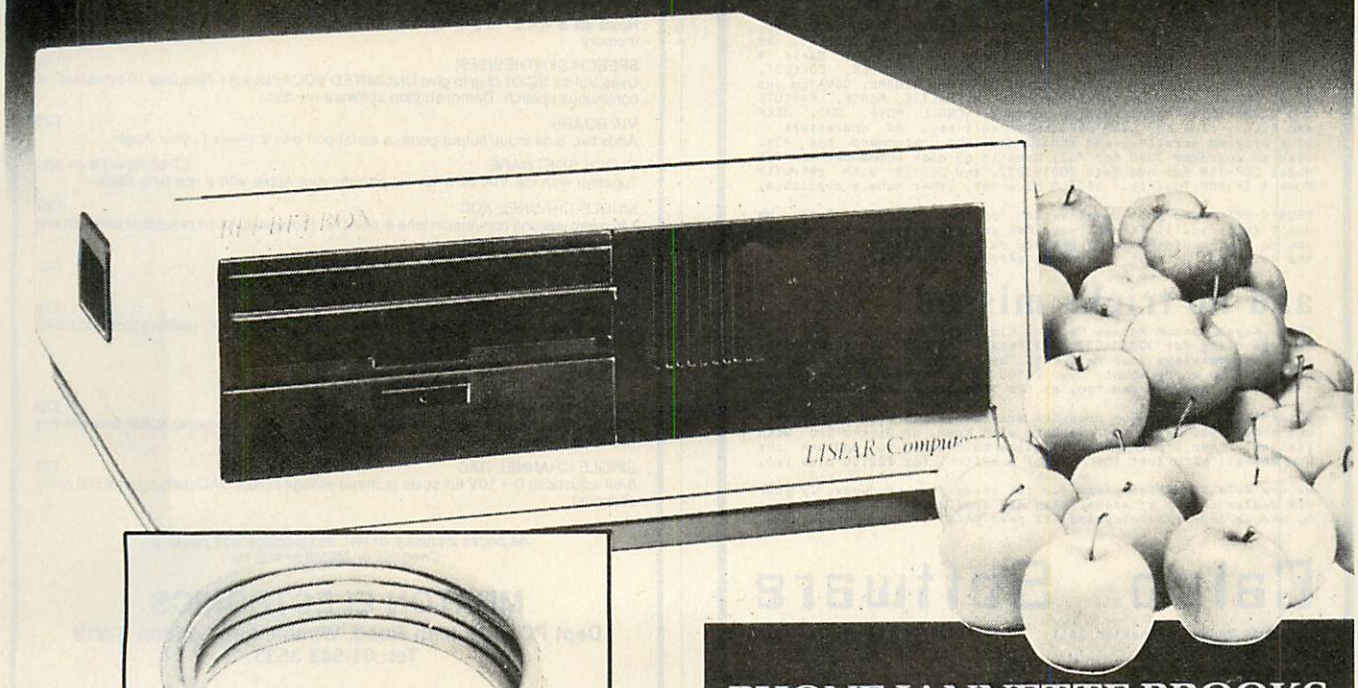
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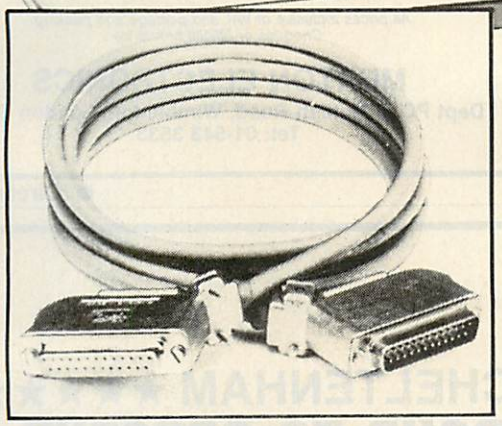
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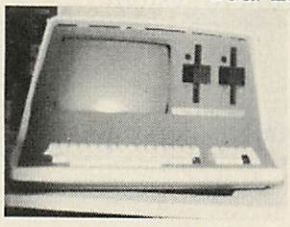
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4027	240
4116	89
	530
4315 CMOS	995
4334-3	325
4864-3	£12
6116-316K	950
6502CPU	495
6503	850
6505	795
6520 PIA	325
6522VIA	495
6530 RRIOT	1350
6532RIOT	795
6545CRTC	1450
6551ACIA	785
6592PC	£26
6800	375
6802	550
6803	1350
6805	670
6808	520
6809	13
6810	175
6821	175
6840	470
6843	1450
6845	12
6850	175
6852	225
6875	550
8080A	450
8085A	550
81LS95	115
81LS96	115
81LS97	115
8212	210
8214	425
8216	200
8251	400
8253	799
8255	399
8257	800
8T26A	135
8T28A	135
8T31A	350
8T95N	135
8T97N	135
AY-3-1015	395
AY-5-1013	350
AY-5-2376	700
CMOS 2114	325
IM6402	420
MC1488	62
MC1489	62
MC14411	695
MC14412	800
RO-3-2513U	600
RO-3-2513L	850
SFF96364E	950
SFC71301	820
TMS2716-3V	875
TMS6011	365
TMS9900J	£36
Z80CPU	390
Z80ACPU4M	550
Z80PIO	400
Z80APIO	440
Z80CTC	400
Z80ACTC	440
Z80SIO-1	£15
Z80A SIO	£23
Z80DART	726
Z80ADART	775
ZN423	195
ZN426	325
ZN427	625
ZN428	478
ZN429	210
ZN1034	200
ZN1040	685

TTL74	
7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	28
7407	28
7408	16
7409	16
7410	14
7411	20
7412	20
7413	24
7414	32
7416	25
7417	25
7420	16
7421	20
7422	20
7423	22
7425	26
7426	30
7427	27
7428	28
7430	16
7432	26
7433	27
7437	27
7438	27
7440	17
7441	68
7442	38
7443	90
7444	90
7445	65
7446	55
7447	50
7448	50
7450	16
7451	16
7453	16
7451	16
7453	16
7454	16
7460	16
7470	35
7472	30
7473	30
7474	25
7475	40
7476	30
7480	48
7481	120
7482	70
7483	50
7484	80
7485	95
7486	26
7489	205
7490	28
7491	45
7492	30
7493	30
7494	34
7495	50
7496	45
7497	120
74100	85
74104	54
74105	55
74107	32
74109	35
74110	40
74111	55
74112	170
74116	88
74118	80
74119	90
74120	75
74121	30
74122	45
74123	50
74125	42
74126	40
74128	42
74132	48
74136	35
74141	70
74142	190
74143	250
74144	250
74145	70
74147	99
74148	75
74150	80
74151	45
74153	45
74154	75
74155	75
74156	75
74157	45
74159	99
74160	60
74161	60
74162	62
74163	64
74164	64
74165	62
74166	65
74167	185
74170	168
74172	290
74173	65
74174	72
74175	72
74176	55
74177	75
74178	95
74179	68
74180	65
74181	140
74182	75
74184	99
74185	99
74188	290
74190	70
74191	70
74192	70
74193	65
74194	75
74195	65
74196	65
74197	65
74198	99
74199	99
74221	80
74246	150
74247	150
74248	150
74249	150
74251	80
74265	65
74273	195
74278	160
74279	90
74283	90
74284	199
74285	199
74290	105
74293	125
74297	236
74298	100
74365	55
74366	55
74367	55
74368	55
74390	99
74393	99
74490	120

74LS	
LS00	12
LS01	13
LS02	14
LS03	14
LS04	15
LS05	15
LS06	15
LS08	15
LS09	15
LS10	15
LS11	15
LS12	15
LS13	30
LS14	48
LS15	15
LS20	15
LS21	15
LS22	15
LS26	18
LS27	15
LS28	20
LS30	18
LS32	15
LS33	16
LS37	16
LS38	16
LS40	16
LS42	35
LS47	40
LS48	80
LS49	60
LS51	15
LS54	15
LS55	30
LS63	150
LS73	25
LS74	25
LS75	28
LS76	20
LS78	24
LS83	50
LS85	80
LS86	38
LS90	35
LS91	80
LS92	36
LS93	36
LS95	45
LS96	120
LS107	43
LS109	30
LS112	30
LS113	40
LS114	35
LS122	44
LS123	55
LS124	105
LS125	30
LS126	30
LS132	45
LS133	35
LS136	28
LS138	35
LS139	38
LS145	75
LS147	199
LS148	99
LS151	39
LS153	39
LS155	39
LS156	39
LS157	35
LS158	36
LS160	41
LS161	41
LS162	41
LS163	41
LS164	48
LS165	145
LS166	85
LS170	170
LS173	72
LS174	72
LS175	59
LS181	130
LS183	275
LS190	58
LS191	58
LS192	58
LS193	65
LS194	40
LS195	40
LS196	58
LS197	85
LS200	345
LS221	60
LS240	96
LS241	96
LS242	85
LS243	85
LS244	80
LS245	118
LS247	40
LS248	65
LS249	68
LS251	40
LS253	40
LS257	48
LS258	40
LS259	85
LS261	195
LS266	25
LS273	90
LS275	290
LS279	88
LS280	250
LS283	45
LS290	57
LS293	46
LS295	215
LS298	130
LS299	420
LS300	175
LS302	175
LS320	270
LS323	270
LS324	200
LS325	320
LS326	330
LS327	315
LS347	150
LS348	190
LS353	185
LS353	185
LS365	37
LS366	37
LS367	37
LS368	90
LS373	75
LS374	75
LS375	48
LS377	90
LS378	69
LS379	65
LS384	250
LS385	378
LS386	28
LS390	62
LS393	60
LS395	199
LS396	190
LS398	275
LS399	220
LS445	140
LS447	195
LS471	620
LS490	245
LS541	135
LS571	620
LS640	225
LS641	225
LS645	210
LS668	175
LS669	150
LS670	175
LS673	550
LS674	750

74L	
74L00	68
74L30	50
74L47	320
74L75	145
74L85	349
74L121	165
74L123	325

74S Series	
74S00	60
74S04	73
74S132	138
74S138	240
74S158	240
74S188	210
74S189	158
74S194	380
74S195	795
74S201	
74S241	540
74S262	850
74S287	325
74S288	210
74S470	325
74S472	1150
74S475	825
74S571	620

75 Series	
75108	350
75150	140
75154	150
75450	95
75451	70
75454	225
75491	89
75492	95

CRYSTALS 100KHz	
	290
200KHz	370
455KHz	370
1.0MHz	295
1.008MHz	290
1.28MHz	392
1.6MHz	323
1.8MHz	323
1.8432MHz	240
2.0MHz	240
2.4576	300
3.2768	240
3.57954M	150
4.0MHz	240
3.6864M	300
4.032MHz	290
4.433619M	120
5.0MHz	240
5.185MHz	300
5.24288M	390
6.0MHz	240
6.144MHz	240
6.5536MHz	290
7.0MHz	290
7.168MHz	290
7.680MHz	300
8.0MHz	240
8.08333M	362
8.867237M	240
9.375MHz	323
10.0MHz	240
10.7MHz	270
12.0MHz	290
14.31818M	320
16.0MHz	275
18.0MHz	290
18.432M	240
19.968MHz	300
20.0MHz	323
26.0MHz	383
26.69MHz	290
27.145MHz	240
27.648MHz	323
38.6667M	290
48.0MHz	270
100.0MHz	323
116.0MHz	300

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	Low profile	Wire wrap
8 pin	8	25
14 pin	10	35
16 pin	10	42
18 pin	16	52
20 pin	22	60
22 pin	25	70
24 pin	25	70
28 pin	35	80
36 pin	—	105
40 pin	30	99

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14pin	**44p**
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12"	**195p**	**215p**	**315p**	**490p**
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8 way	**90p**
10 way	
(SPDT)	
4 way	**190p**

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2x15way	—	**135p**
2x18way	**140p**	**145p**
2x22way	**160p**	**165p**
2x25way	**180p**	**185p**
2x30way	**199p**	—
2x36way	**235p**	—
2x40way	**265p**	—
2x43way	**280p**	—

ZERO Force Insertion DIL Sockets
24way **650p** 28way **820p** 40way **975p**

'D' CONNECTORS (Cannon Type)

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9way	**95p**	**125p**	**145p**
15way	**135p**	**198p**	**150p**
25way	**198p**	**284p**	**170p**
37way	**290p**	**398p**	**185p**

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2716-5V	250p	210p
4116	89p	890p
4334-3	325p	290p

SEIKOSHA GP 80

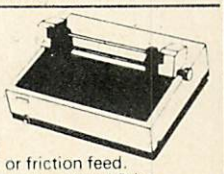


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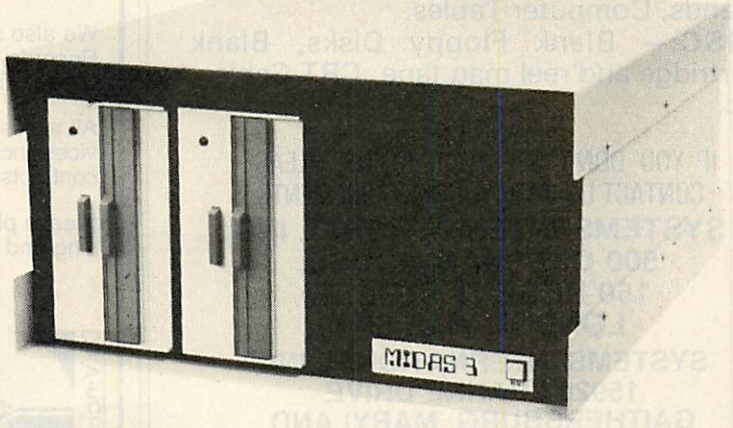
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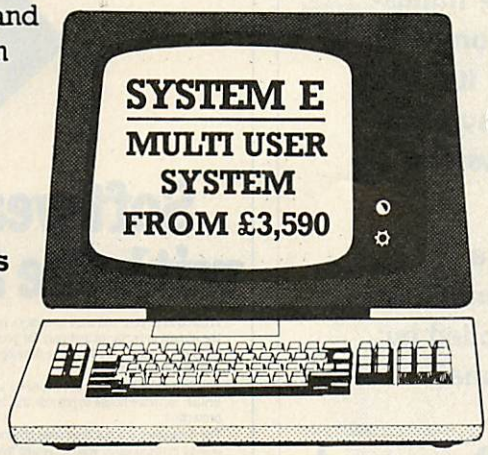
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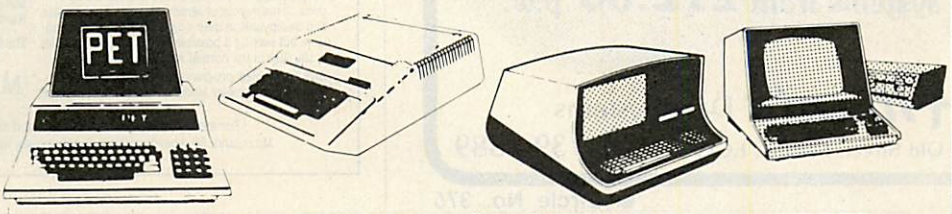
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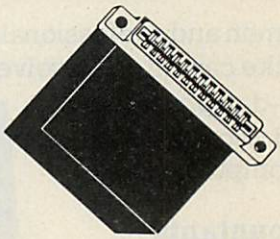
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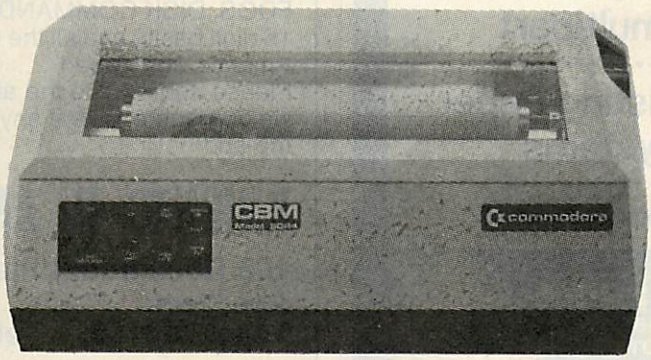
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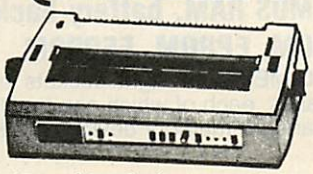
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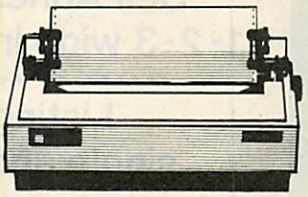
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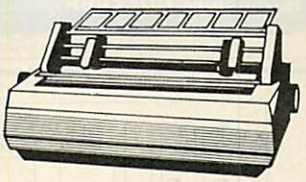
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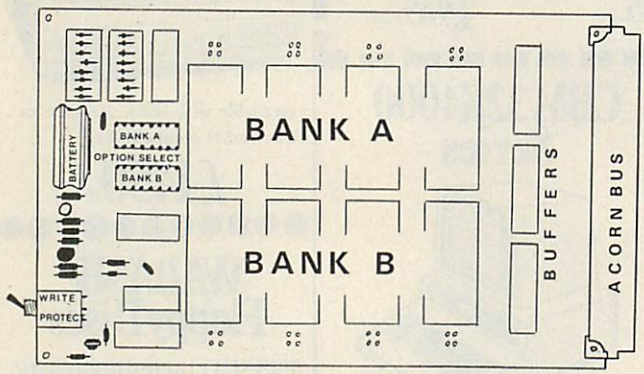
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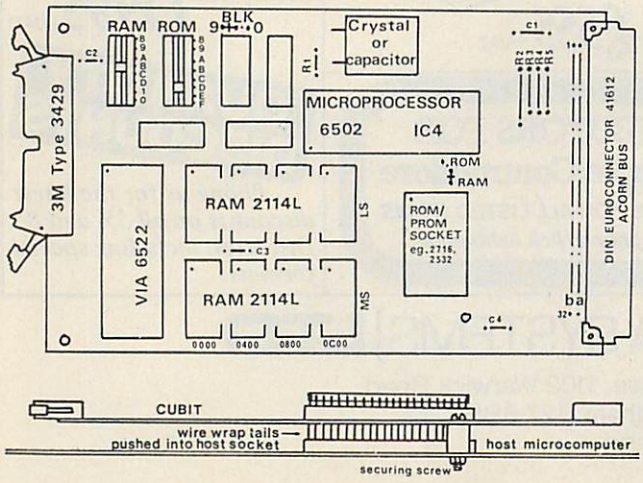
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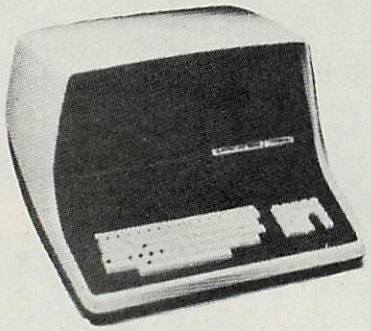


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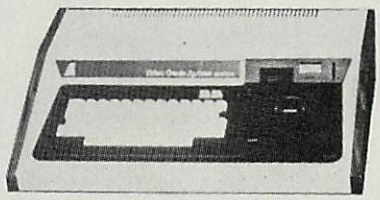
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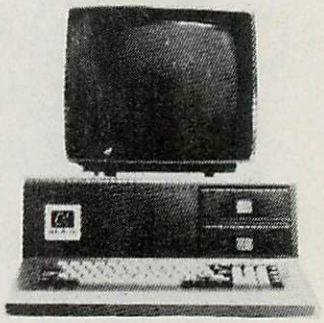
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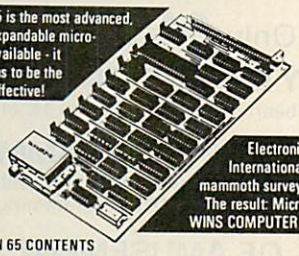
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The MICROTAN 65 kit has won widespread acclaim for its superb presentation. We pay attention to detail!

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MICROTAN 65 assembled and tested.
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Built **£10.00** + VAT

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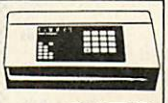
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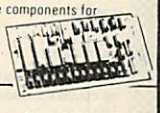
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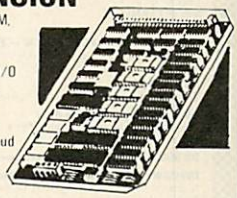
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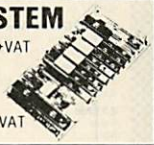
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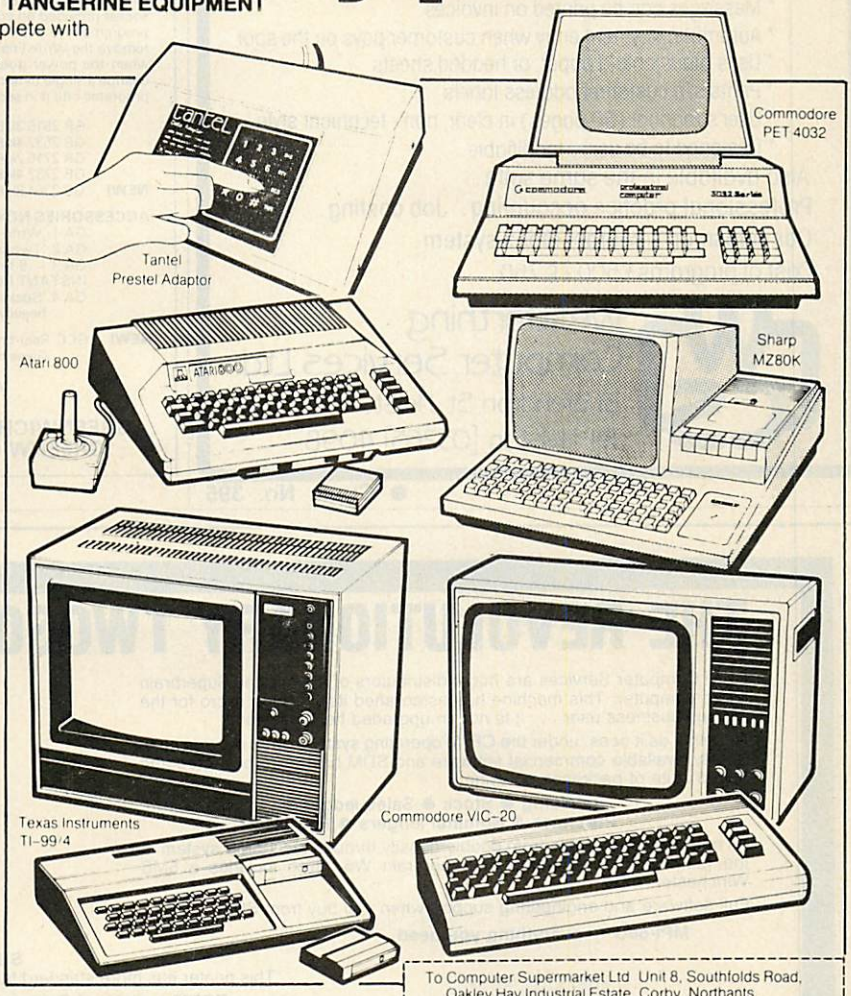
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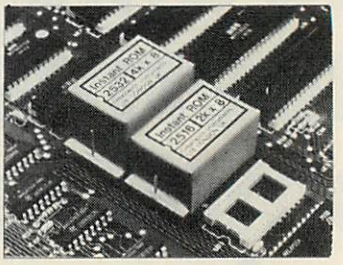
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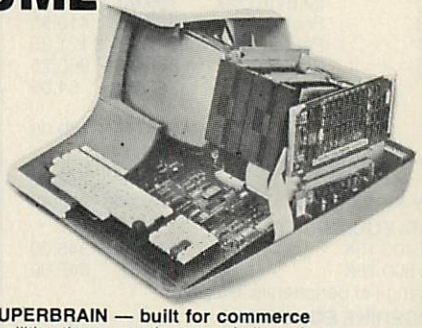
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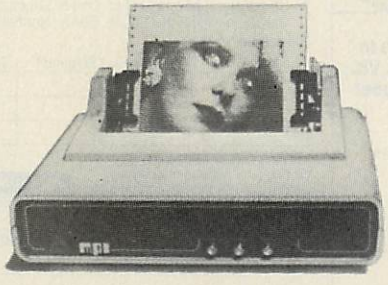
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STOP PRESS

Dear Practical Computing,

We apologise for late copy but this was just too good to miss. The **BRAND NEW** Tokyo Electric's daisy wheel printer, so new in fact we havn't given it a name yet.

Our graphic artist (who's quick) hasn't even had time to knock anything together for we just have to let your readers be the first to hear about it.

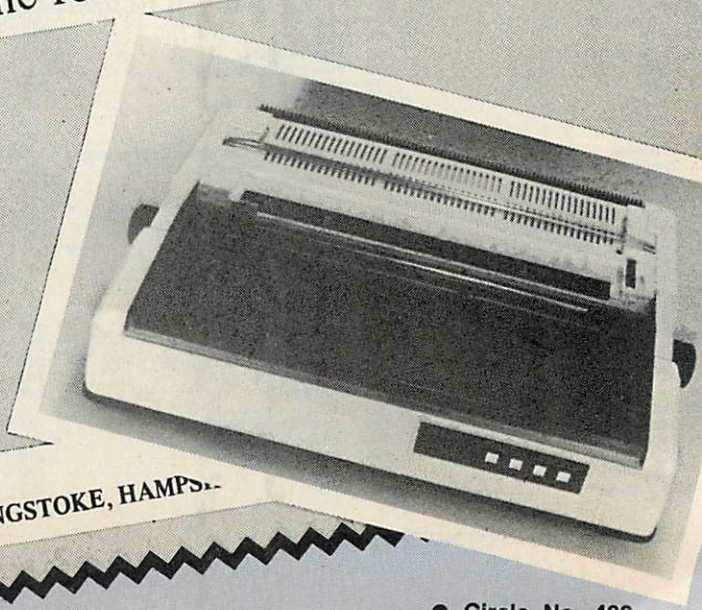
The copy writer also got bogged down trying to find words to describe it, he's ended up with so many wonderfuls, uniques, fantastics, incredibles, that we feel your readers ought to ask us for technical information and make up their own minds.

Anyway, just ask your readers to give **MICRO PERIPHERALS** a ring on **Basingstoke (0256) 56468** and we'll send them all the information they need to know about this brand spanking new daisy wheel printer that's selling for only **£1285 - Standard Model 40 CPS** (min.) or **£1675 - The Executive 55 CPS** (min.) both machines take 15½" paper, have optional friction and tractor feed, parallel or serial RS232 interface and print from a Diablo/Qume font.

Yours,

I. Donaldson.

P.S.
She's a beauty.



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