

80p

Practical Computing

July 1981

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Twinning schools and business

Reviews:

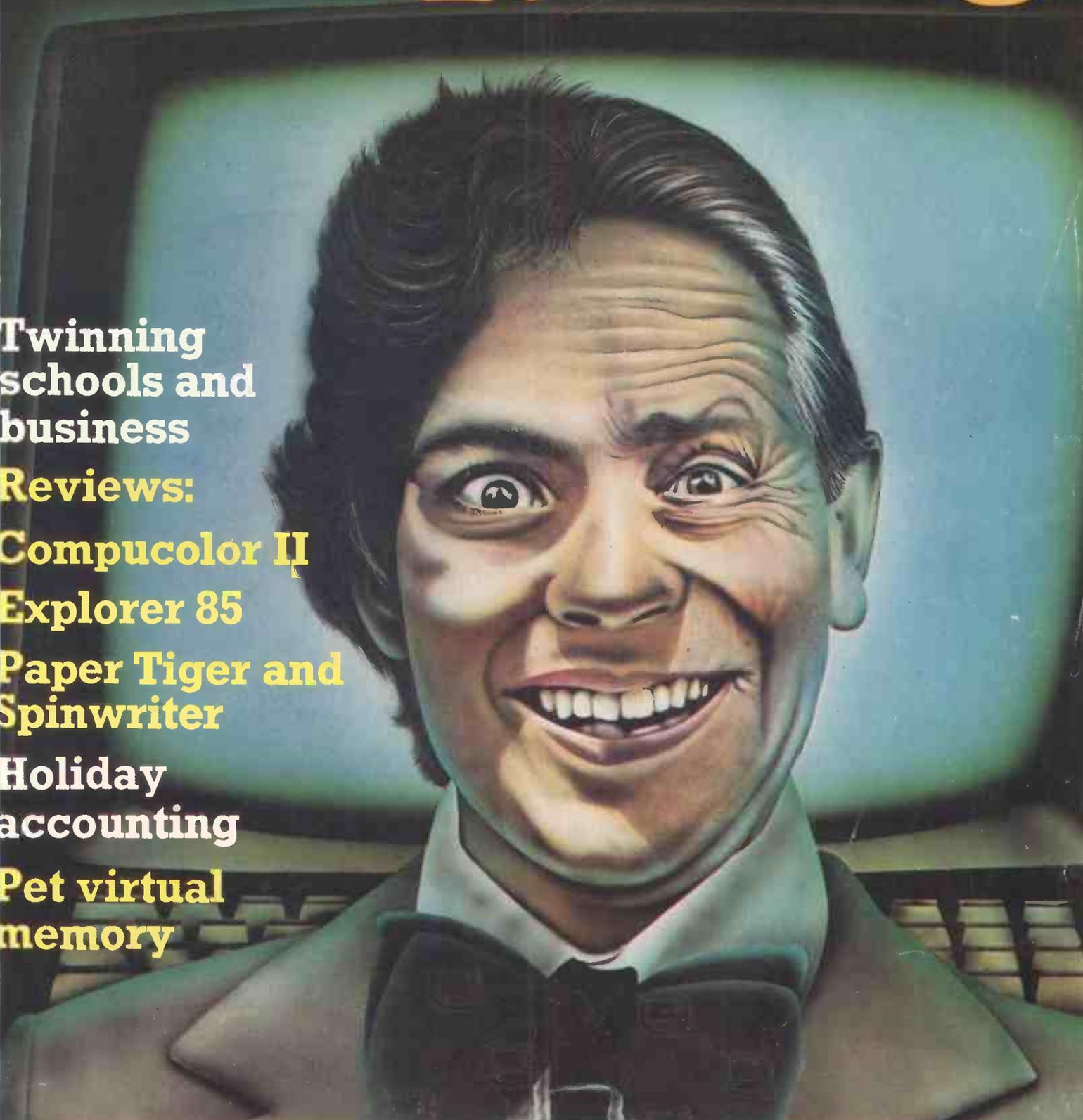
Compucolor II

Explorer 85

Paper Tiger and Spinwriter

Holiday accounting

Pet virtual memory



MicroCentre introduce System Zero

Basic System Zero £587
System Zero/D with DDF £2355

The System Zero is a small computer especially designed for dedicated applications. It is particularly useful in process control situations.

In the basic model you get Cromemco's famous Z-80A single card computer, 1k of RAM, 4k of ROM, Control Basic, and an attractive cabinet. The motherboard provides 3 extra card slots on the S-100 bus, for tailoring the system to particular applications. The basic model is designed for ROM-based programs, but it can be expanded by the addition of memory and I/O cards. It is fully compatible with all Cromemco peripherals, including floppy disks and hard disk systems. Suitably configured the System Zero can run any Cromemco operating system or software package.



New System Zero Computer with quad-capacity DDF disk drive. The system includes built-in diagnostics for a quick system test of memory, controller and disk drives

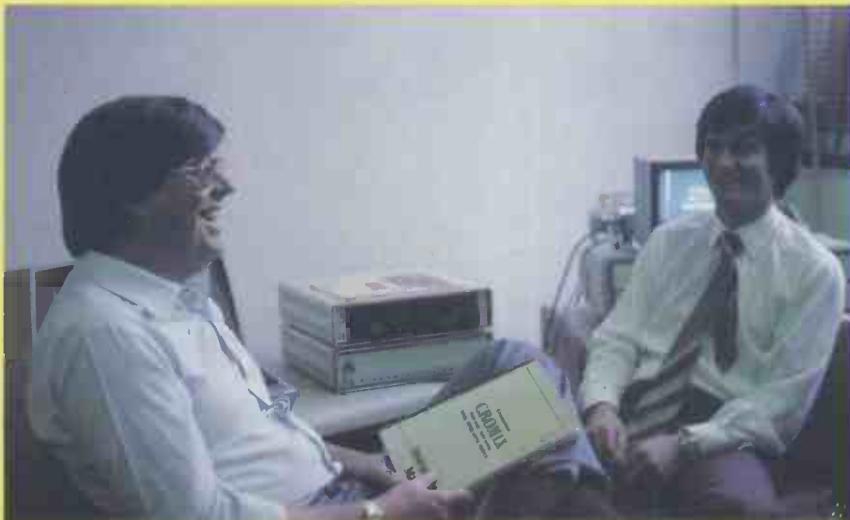
System Zero/D

This special version of the System Zero has 64k of fast RAM, and a model DDF dual disk drive. It includes two double-sided double-density 5 inch disk drives giving a total of 780k bytes storage; and RDOS-2, a new resident disk operating system with terminal and printer drivers, and self-test diagnostics.

The System Zero/D is an exceedingly inexpensive development computer ideal for setting up dedicated applications to run in the basic model. It will support Cobol, Fortran IV, Ratfor, Structured Basic, Lisp, RPG II, Word Processing, DBMS, and the full range of Cromemco's business applications software.

Operating system

The System Zero/D will run any Cromemco operating system provided sufficient memory is available. The minimum configuration of 4k ROM runs control Basic; with 64k RAM the system will run RDOS-2 or CDOS (compatible with CP/M); and with 128k the Zero/D will run the Cromix system (based on Unix).



At the recent UK launch of the System Zero Computer, Cromemco's Technical Director Roger Melen presented a System Zero/D with 128k memory running Cromix. Here he is seen discussing the system with MicroCentre Director Andrew Smith (right).

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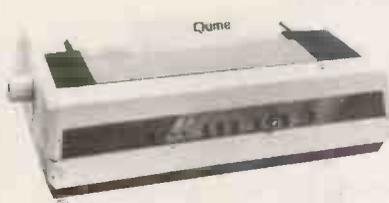
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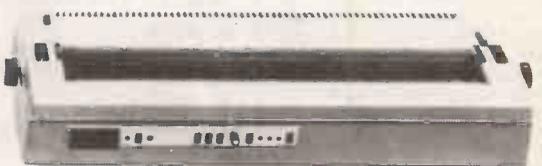
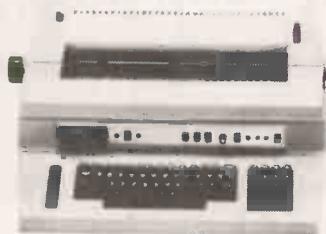
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- CP/M version 2** (not all formats available immediately)£95/£15
- CP/M for Apple 11* Softcard**£250/£15
- MP/M**£195/£25
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- SID** — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values£45/£10
- ZSID** Includes Z80 mnemonics, requires Z80 CPU£50/£10
- TEX** — Text formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer£45/£10
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MICROSOFT

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- FORTRAN 80** — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO 80 (see below)£205/£15
- COBOL 80** — ANSI '74 Relocatable object output. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM. Interactive ACCEPT DISPLAY, COPY, EXTEND£325/£15
- MACRO-80** — 8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included£75/£10

- XMACRO-86** — 8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available£155/£15
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EIDOS SYSTEMS

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- SUPER-SORT III** — As II without SELECT/EXCLUDE£75/£15
- WORD-MASTER Text Editor** — In one mode has super-set of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video-mode, provides full screen editor for users with serial addressable-cursor terminal£75/£15
- WORD-STAR** — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center, underscore and PRINT. Edit facilities include global search and replace, read/write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning£255/£15
- WORD-STAR/MAIL-MERGE** — As above with option for production mailing of personalised documents with mail list from Datastar or NAD£315/£15
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- **PASCAL/Z** — Z80 native code PASCAL compiler. Produces optimised portable reentrant code. All interfacing to CP/M is through the support library. The package includes compiler companion macro assembler and source for the library. Requires 56K and Z80 CPU. Version 3 includes all of Jensen/Virih £205/£15

- **PASCAL/MT** — Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Version 3 includes Sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion. Source for the run time package requires MAC (See under Digital Research). Requires 32K £135/£20

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- **BDS C COMPILER** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie £60/£10

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- **ZDT — Z80 Debugger** to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Facilities similar to DDT £20 when ordered with Z80. Development Package £30/£7

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- **POSTMASTER** — A comprehensive package for mail list maintenance that is completely menu driven. Features included keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Compatible with NAD files. Requires CBASIC-2 £85/£10

- **XASM-68** — Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to intel hex £115/£15

- **XASM-65** — As XASM-68 for MOS Technology MCS-6500 series mnemonics £115/£15

- **XASM-48** — As XASM-68 for Intel MCS-48 and UPI-41 families £115/£15

- **XASM-18** — As XASM-68 for RCA 1802 £115/£15

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- **BSTMS** — Intelligent terminal program for CP/M systems. Permits communication between micros and mainframes. Sends character data files to remote computers under complete control. System can record NEW or data sent from remote computer systems and data banks. Includes programs to EXPAND and COMPRESS binary files for transmission. This software requires a knowledge of assembler language for installation £115/£10

- **PLINK*** — Two pass disk-to-disk linkage editor/loader which can produce re-entrant, ROMable code. Can link programs that are larger than available memory for execution targeted on another machine. Full library capabilities. Input can be PSA Relocatable Binary Module, TDL Object Module or Microsoft REL files. Output can be a COM file, Intel hex file, TDL Object Module or PSA Relocatable file £75/£15

- **RECLAIM*** — A utility to validate media under CP/M. Program tests a diskette or hard diskette for hard disk surface for errors, reserving the imperfections as visible files, and permitting continued usage of the remainder. Essential for any hard disk. Requires CP/M version 2 £40/£5

- **STRING/80** — Character string handling plus routines for direct CP/M BDOS calls from FORTRAN and other compatible Microsoft languages. The utility library contains routines that enable programmes to chain a COM file, retrieve command line parameters, and search file directories with full wildcard facilities. Supplied as linkable modules in Microsoft format £50/£12

- **STRING/80 source code** available separately £185/n.a.

- **VSORT** — Versatile sort/merge system for fixed length records with fixed or variable length fields. VSORT can be used as a stand-alone package or load and called as a subroutine from CBASIC-2. When used as a subroutine VSORT maximizes the use of buffer space by setting the TPA on disk and restoring it on completion of sorting. Records may be up to 255 bytes long with a maximum of 5 fields. Upper/lower case translation and numeric fields supported £105/£15

- **CBS** — Configurable Business System is a comprehensive set of programmes for defining custom data files and application systems without using programming language such as BASIC, FORTRAN, etc. Multiple key fields for each data file are supported. Set-up program customizes system to user's CRT and printer. Provides fast interactive data entry and retrieval with transaction processing. Report generator program does complex calculations with stored and derived data, record selection with multiple criteria, and custom formats. Sample inventory and mailing list system included. No support language required £185/£20

- **MAGIC WAND*** — Word processing system with simple, easy to use full screen text editor and powerful print processor. Editor has all standard editing functions including text insert and delete, global search and replace, block move and library files for boiler plate text. Print processor formatting commands include automatic margins, continuation, heading & footings, centred and justified text. Also prints with true proportional spacing, merges with data files for automatic form letters, and performs run-time conditional testing for varied output. Requires 32K CP/M and CRT terminal with addressable cursor £185/£20

- **T/MAKER** — Powerful new tool for preparing management reports with tabular data. Makes financial modeling projects easy. Do you want a weekly profitability report? Set up the table and compute. Just change the sales figures for next week and compute. You have a new T/MAKER includes a full screen editor for setting up tables which pages left, right, up and down. Compute includes standard arithmetic, percents, exponents, common transcendental functions, averages, maxima, minima, projections, etc. Requires 48K CP/M and CBASIC-2 £155/£15

Orders must specify disk type and format, e.g. North Star-Horizon single density.

Add 15% VAT to orders. Add £1 per item postage and packing

All orders must be prepaid. Make cheques POs etc payable to Lifeboat Associates.

Manual costs are deductible from subsequent software purchase

EFFECTIVE JANUARY 1981

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(M) Modified version available for use with CP M as implemented on Heath and TRS 80 Model 1 computers

(L) User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

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• Circle No. 104

System Specifications

Twin Z80A's with 4MHz Clock Frequency One Z80A (the host processor) performs all processor and screen related functions. The second Z80A is "down-loaded" by the host to execute disk I/O. When not processing disk data, the second Z80 may be programmed by the host for other processor relation functions.

8 bits
10 microseconds register to register
158
All interrupts are vectored

350K (700K on QD model) total bytes formatted on two double density drives. Optional 20.96 megabyte hard disk storage is available directly from Intertec.
250K bits/second
250 milliseconds. 35 milliseconds track-to-track.
4 1/4 inch mini-disk
300 RPM

32K bytes dynamic RAM. Expandable to 64K (socketed). 64K standard on QD model.

256 bytes of static RAM is provided in addition to the main processor RAM. This memory is used for program and/or data storage for the auxiliary processor.

1K bytes standard. Allows ROM "bootstrapping" of system at power-on. ROM storage is 2708 compatible and may be reprogrammed by the user for custom applications.

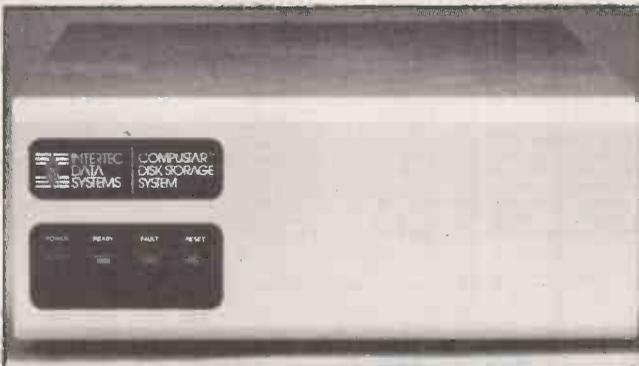
12-inch, specially focused. P4 phosphor, non-glare screen.
25 lines x 80 characters per line.
8 x 8 character matrix on a 8 x 10 character field.
Light characters on a dark background. Blinking or non-blinking.
20 MHz.
Reversed image (block cursor).

Memory-mapped at 38 kilobaud. Serial transmission of data at rates up to 9600 bps.
Simplified RS-232 asynchronous. Parallel interface available.
Universal RS-232 asynchronous. Synchronous interface optional.
Printed circuit edge connector provided for connection of optional S-100 bus adaptor. Adaptor features internally mounted cardguide for up to one S-100 type accessory.
Enables display of all incoming and outgoing control codes.
Choice of even, odd, marking, or spacing.
Half or Full Duplex. One or two stop bits.
Direct positioning by either discrete or absolute addressing.



SuperBrain users get exceptional performance for just a fraction of what they'd expect to pay. Standard SuperBrain features include: two double density mini-floppies with 350K bytes of disk storage, 32K of ram memory (expandable to 64K) to handle even the most sophisticated programs, a CP/M Disk Operating System with a high powered text editor, assembler, debugger and a disk formator. And, with SuperBrain's S-100 bus adaptor, you can add all the programming power you will ever need ... almost any type of S-100 compatible bus accessory. SuperBrain's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application ... General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing, SuperBrain is tops in its class. And the SuperBrain QD boasts the same powerful performance but also features a double-sided drive system to render more than 700K bytes of disk storage and a full 64K of RAM. All standard!

WIDELY USED IN U.K./FRANCE/U.S.A. AND ENGLISH SPEAKING COUNTRIES FOR ITS OVERALL FLEXIBILITY AS A COMPLETE BUSINESS PACKAGE.



Our New CompuStar™ 10 Megabyte Disk Storage System (called a DSS) features an 8 inch Winchester drive packaged in an attractive, compact desktop enclosure. Complete with disk, controller and power supply. Just plug it into the Z80 adaptor of your SuperBrain and turn it on. It's so quiet, you'll hardly know it's there. But, you'll quickly be astounded with its awesome power and amazing speed. The secret behind our CompuStar DSS is its unique controller/multiplexor. It allows many terminals to "share" the resources of a single disk. So, not only can you use the DSS with your SuperBrain, you can configure multiple user stations using our new series of CompuStar™ terminals, called Video Processing Units or VPU's™.

The COMPUSTAR™ Family

VIDEO PROCESSING UNITS

Model 10 VPU

- 64K Internal Memory
- Integral CRT, CPU, & Keyboard
- Download programmable

Model 15 VPU (Universal Processing Unit)

- 64K Internal Memory
- Same features as VPU, less integral CRT and keyboard
- Can be used as a remote printer or a terminal interface device

Model 20 VPU

- 64K Internal Memory
- 350K Dual Disk Capacity
- Integral CPU, Disks, CRT & Keyboard

Model 30 VPU

- 64K Internal Memory
- 750K Dual Disk Capacity
- Integral CPU, Disks, CRT & Keyboard

Model 40 VPU

- 64K Internal Memory
- 1 1/2 MB Dual Disk Capacity
- Integral CPU, Disks, CRT & Keyboard

DISK STORAGE SYSTEMS (All feature our 255 user controller)

10 MB Winchester

- Shugart 8 inch mechanism
- Quiet, table-top operation
- Can be used with CompuStar or SuperBrain Video Terminals

32 MB Control Data CMD

- Cartridge Module Mechanism
- 16 MB fixed/16 MB removable
- Rack-mountable

96 MB Control Data CMD

- Cartridge Module Mechanism
- 80 MB fixed/16MB removable
- Rack-mountable

*** MAIN MENU DISPLAY ***

INCLUDES INVENTORY, DATABASE MANAGEMENT, INVOICING, MAILING ADDRESSES, STATEMENTS, SALES/PURCHASE LEDGER WITH OR WITHOUT AUTO STOCK UPDATE AND DOUBLE ENTRY JOURNALS INCLUDING NOMINAL LEDGER; PLUS A/C RECEIVABLE AND PAYABLE MAKING AUTO BANK ENTRIES.

- | | |
|--------------------------------|--------------------------------|
| 01 = ENTER NAMES AND ADDRESSES | 13 = PRINT CUSTOMER STATEMENTS |
| 02 = SALES INVOICES | 14 = PRINT SUPPLIER STATEMENTS |
| 03 = A/C RECEIVABLES | 15 = PRINT AGENT STATEMENTS |
| 04 = PURCHASE INVOICES | 16 = PRINT TAX STATEMENTS |
| 05 = A/C PAYABLES | 17 = RUN SEPARATE PROGRAMS |
| 06 = STOCK CONTROL | 18 = CHANGE VOCABULARY |
| 07 = ORDER CONTROL | 19 = PRINT YEAR AUDIT |
| 08 = BANK UPDATES | 20 = PRINT PROFIT/LOSS ACCOUNT |
| 09 = SALES LEDGERS | 21 = DISK DIRECTORIES |
| 10 = PURCHASE LEDGER | 22 = CASHFLOW FORECAST |
| 11 = INCOMPLETE RECORDS | 23 = PAYROLL (N/A AVAILABLE) |
| 12 = USER DATABASE AREA | 24 = DISK SWAP/EXIT SYSTEM |

WHICH OPTION

DATABASE FEATURES ARE:

WITHIN THE LIMITS OF TWELVE FIELDS AND 256 CHARACTERS PER RECORD, ANY FILE ARCHITECTURE CAN BE DESIGNED WITH COMPLETE FREEDOM OVER THE LINGUISTIC CONVENTIONS ASSIGNED TO EACH FIELD. THE FILE THEN CAN STORE 32000 RECORDS WHICH CAN BE SEARCHED BY THE RANDOM ACCESS NUMBER (RETRIEVED IN LESS THAN ONE SECOND) OR SEQUENTIALLY COMPARING FOR LEFT FIELD PARTS, FIELD-INKEYS; OR PARTS OF RECORD, AND THEN CHANGED, PRINTED, DELETED, SKIPPED.

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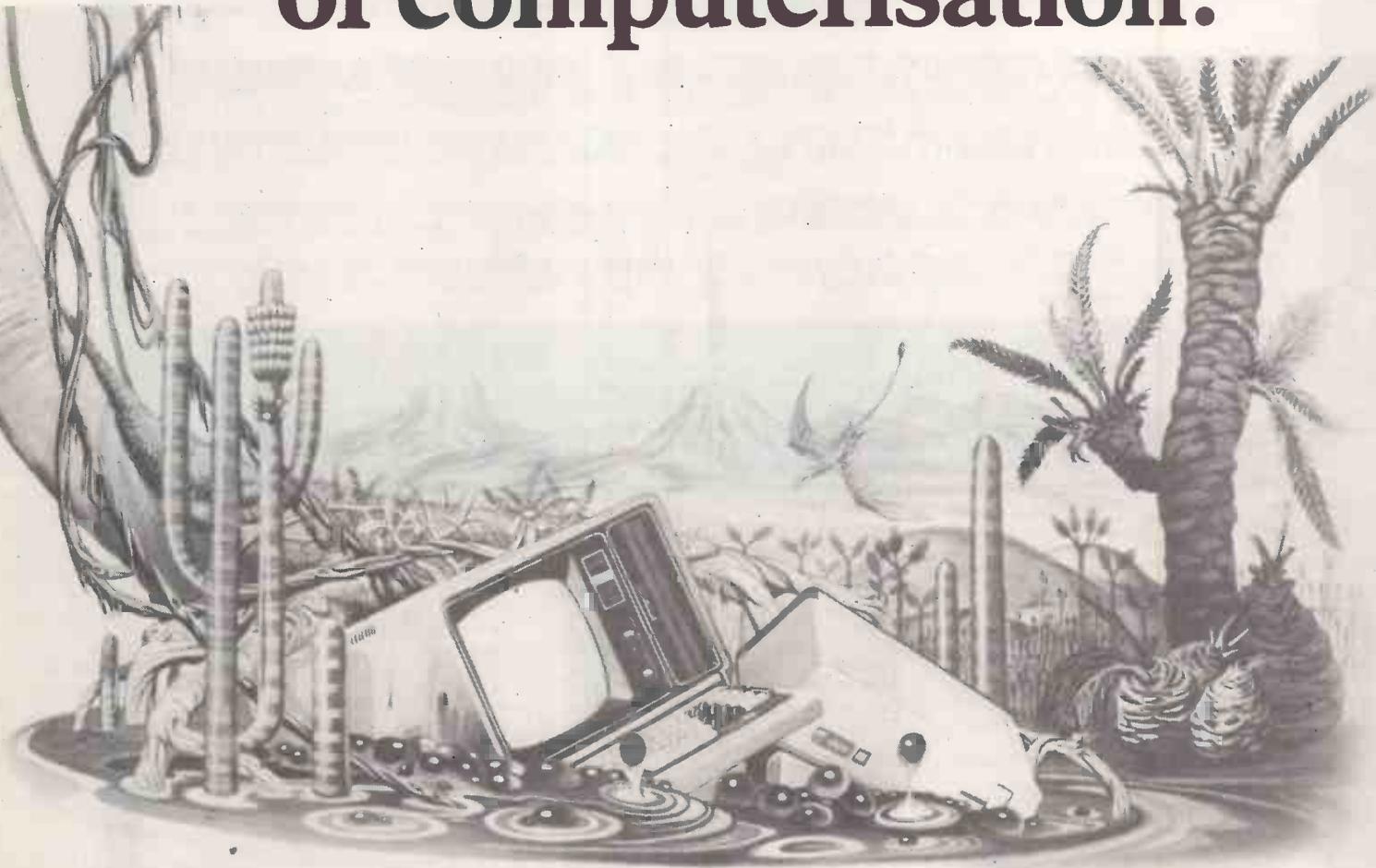
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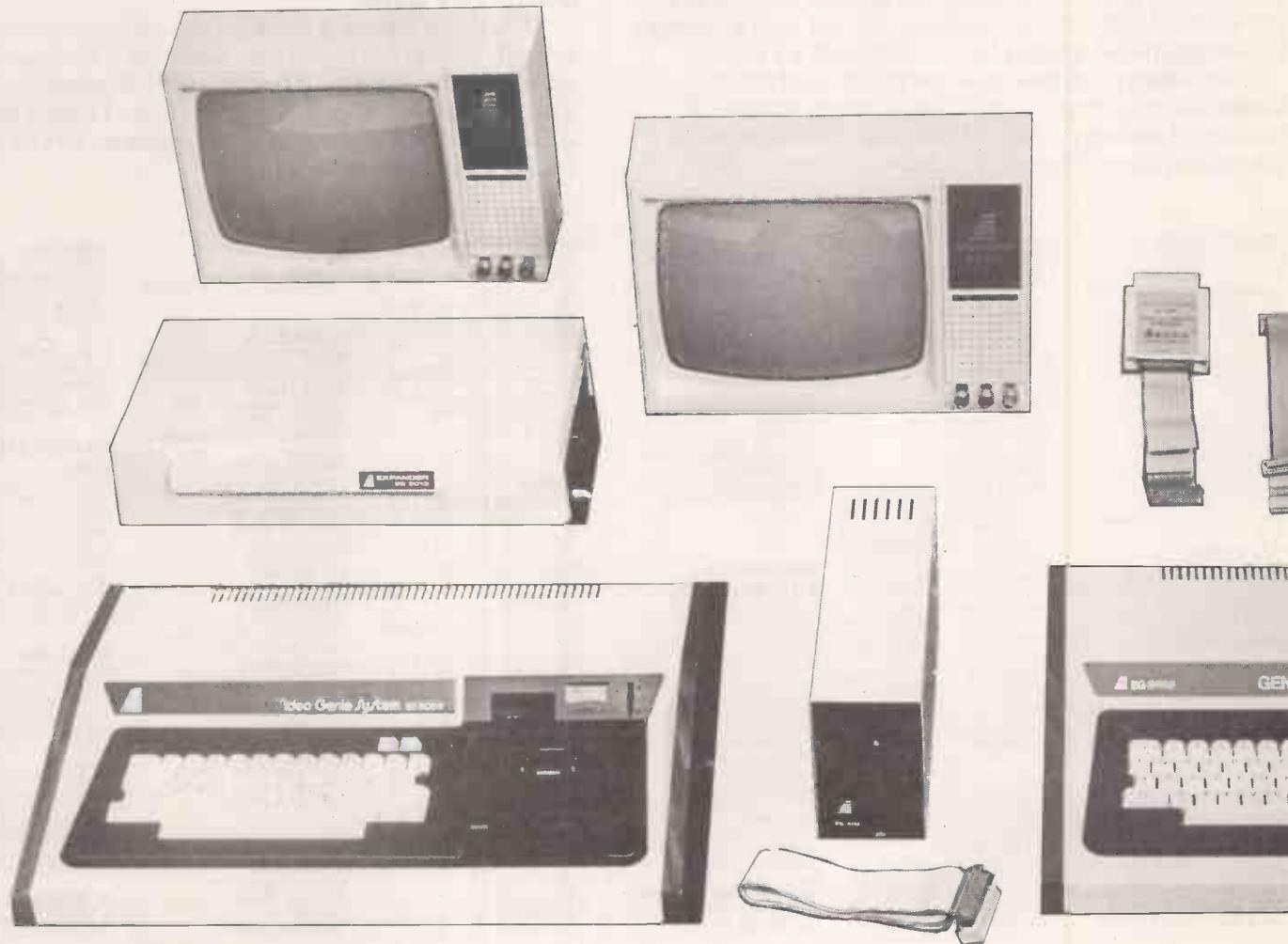
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ILLUSTRATED

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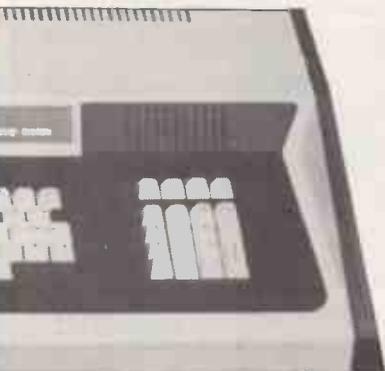
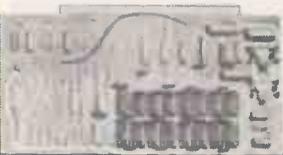
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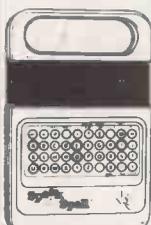
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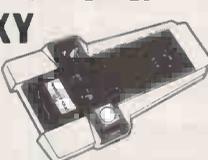


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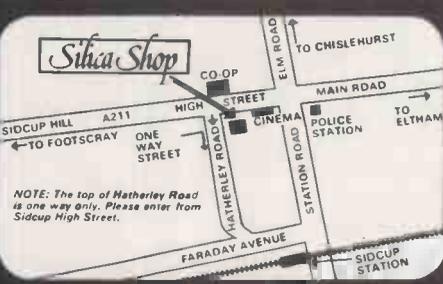
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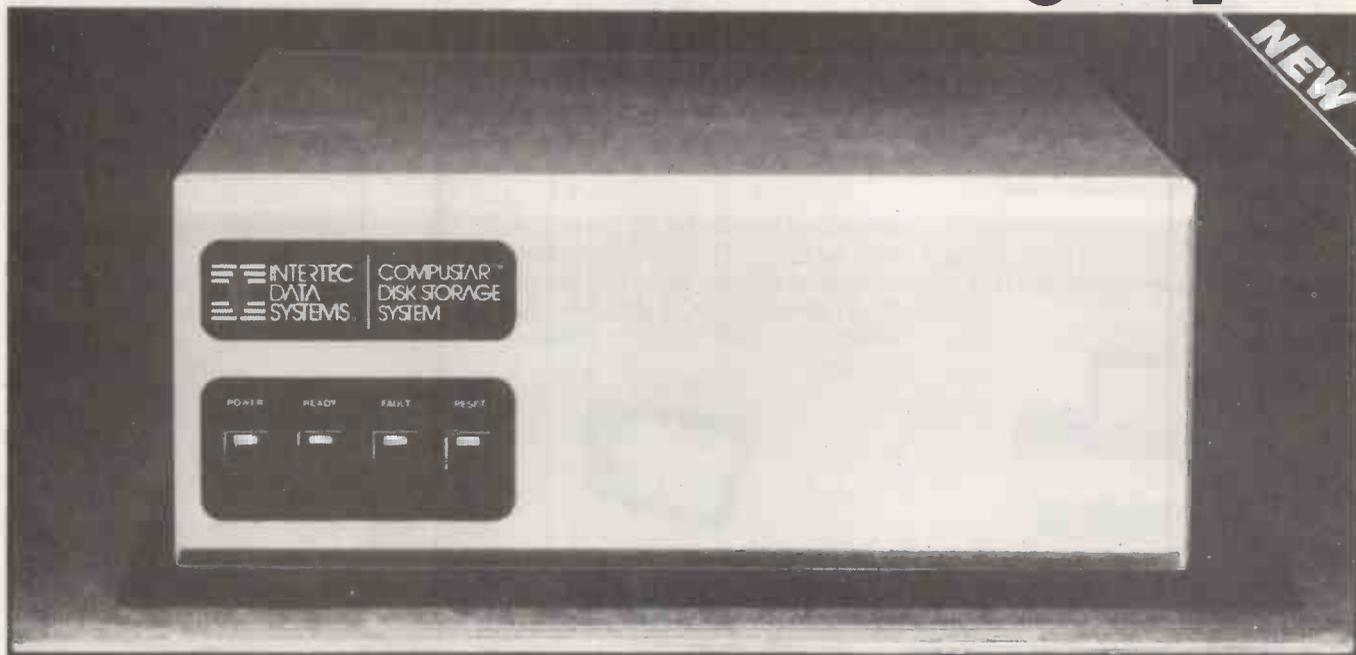
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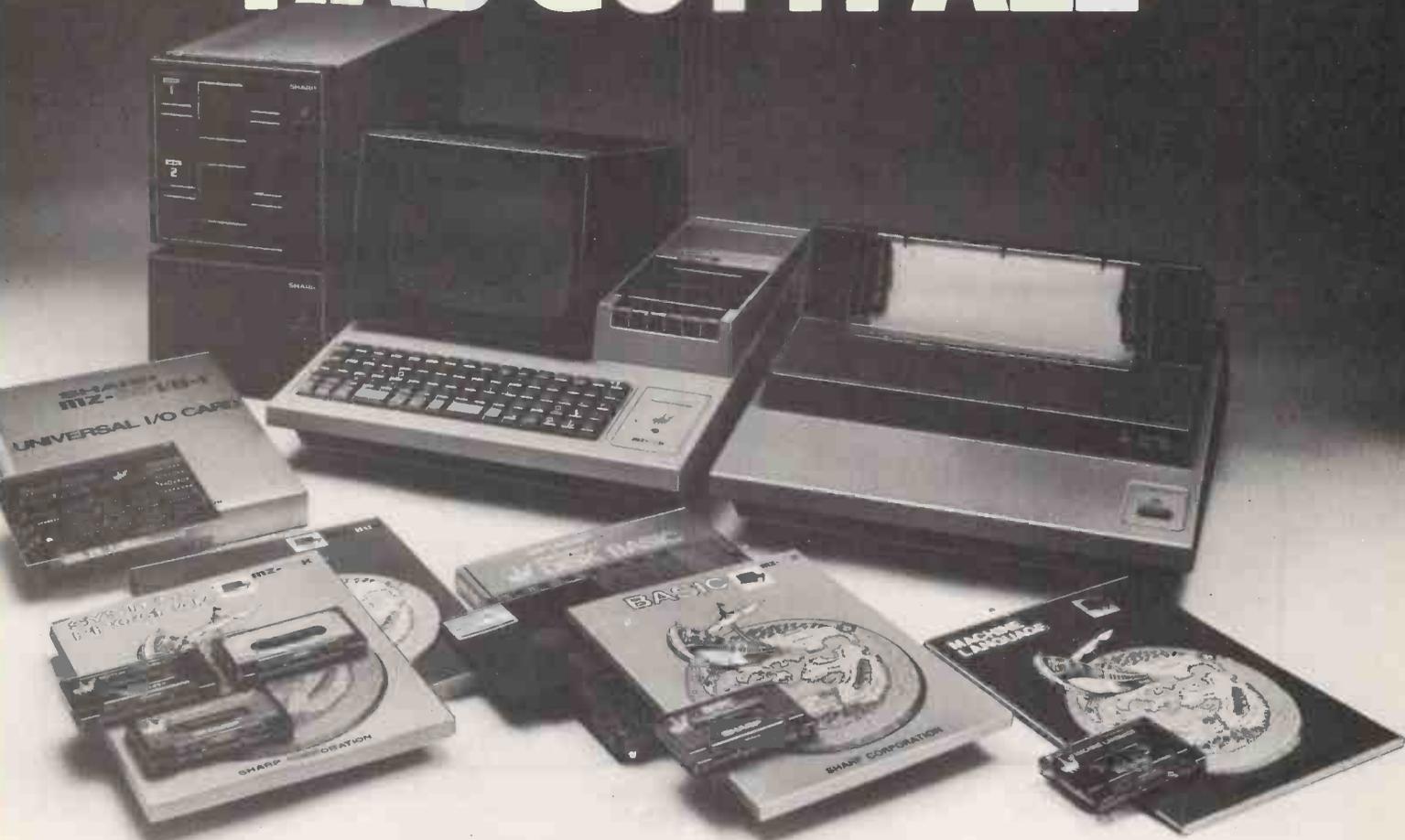
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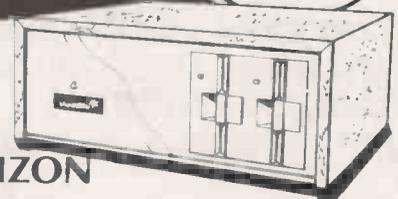
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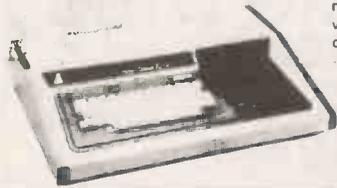
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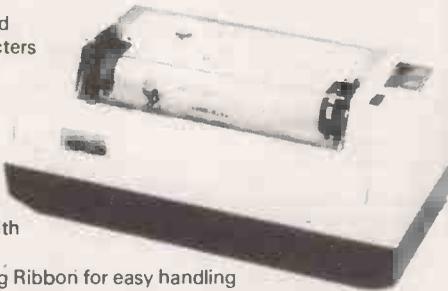
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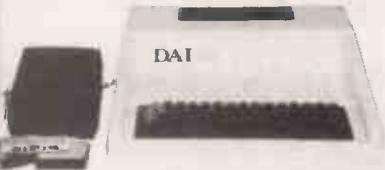
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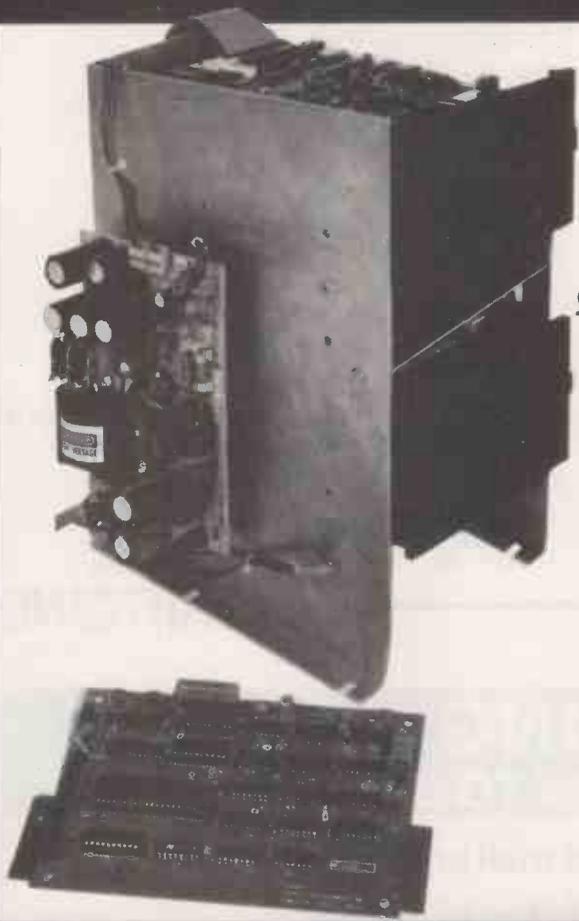
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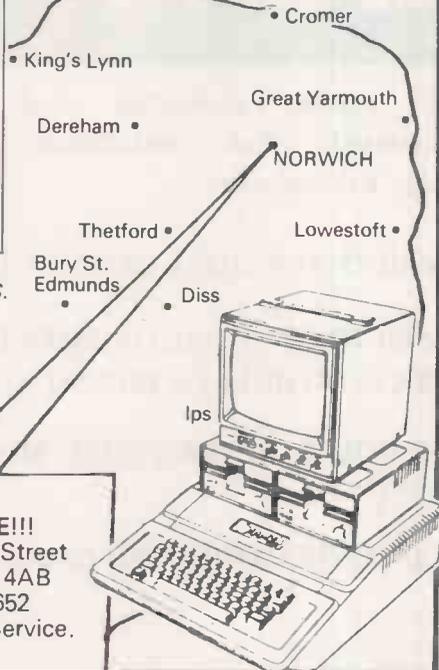
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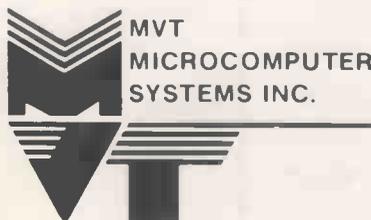
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contemporary cabinete (as in picture) for 8000 series systems add £120.00



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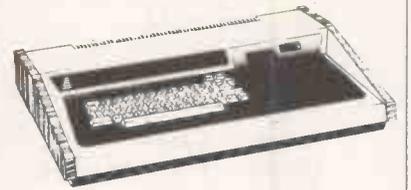
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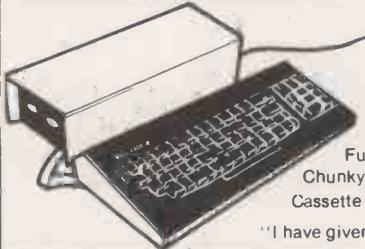
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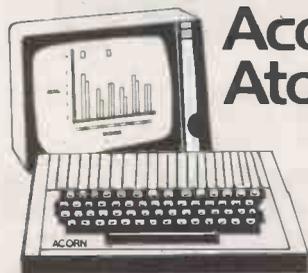
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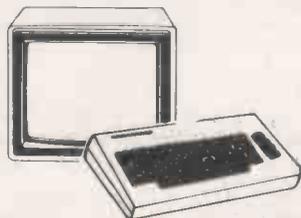


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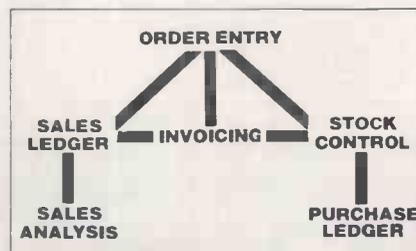
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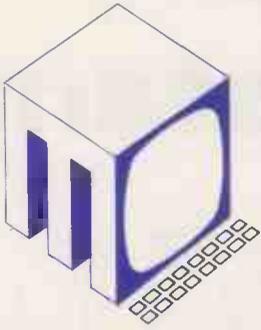
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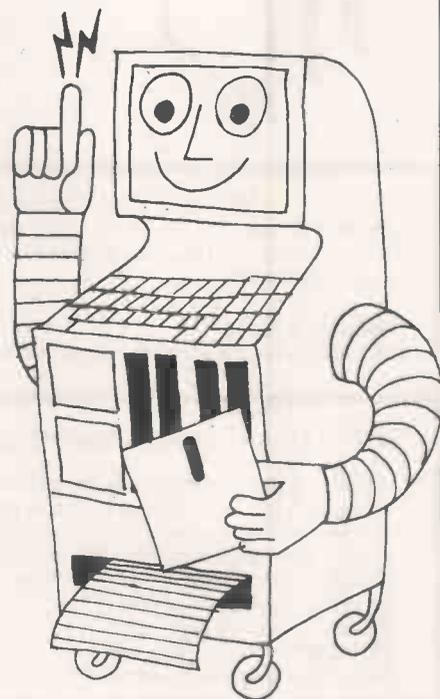
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• Circle No. 153

What price software?

PART OF OUR editorial stock-in-trade is an ingenious comparison between the impact on the software business of the micro and the impact on the book business of the first printing presses. To recap, for the benefit of those readers who have not followed the story so far: before Caxton, books were made very slowly, by hand, in monasteries for very rich men who could not read. That is very like the way software used to be written: very slowly, by hand in applications houses for rich men who knew nothing about computing. The printing press arrives and in the time it takes a scribe to do an illuminated "A", Caxton can run off three or even four whole pages.

Before very long, Caxton has a heap of finished books in the corner of the workroom and is wondering how much to sell them for. Over the centuries, a solution has evolved and now we know how to price a book. Of course, the problem is made easier because a book is a substantial object: the paper, the printing, its storage and transport to the reader all cost large and determinable amounts. What is in question is the return the author and the publisher should receive for their intellectual investment in the book.

With software, the position is rather different: the whole thing is apt to be intellectual investment — the cost of the disc, manual and postage can hardly amount to £10 while the whole package is apt to be offered for £20 — £100 — £1,000. Well, which? That is the problem.

One way to calculate the price is to take the cost of writing the package, add 100 percent for profit and divide the total by the number of copies you expect to sell. This, however, just puts the problem further back. How many do you expect to sell? It is a bold man who will put a figure to that, especially if he is trying to sell a piece of software of general — or so he hopes — appeal. By guessing too low, he might make his price so high it will never sell; by guessing too high he makes his price so low that the few he actually sells do not pay his costs.

Yet, that is probably the wrong approach altogether. The important man here — where is he not? — is the customer. He cares not one fig, jot, iota, or button what it cost the package's perpetrators to write it. He judges it only by its usefulness to him. He might argue: I pay my secretary £2 an hour and this word-processing package will let her type 10 hours less a week so my annual saving is £1,000 so I should expect to pay the capital sum on which £1,000 pa is the interest, viz: £5,000.

Is that how he argues? Of course he does not. Let us return to buying a book. Our customer — or "you" for short — walks into a bookshop and fingers the goods. You look at the cover, the publisher, the lies that he has printed on the back jacket, you flip through the pages, sample a few of the author's well-chosen words and then you part with the trivial amount of money demanded.

The buyer of software is in a rather different position. He can not really obtain any idea of what he is buying by looking at the disc. The manual may be totally misleading. It might be beautifully written, immaculately printed and totally wrong. It may be smudgy, badly laid-out, unindexed but the software it describes is so good you do not need a manual anyway. Yet even if you have the opportunity to run the software in the privacy of your home, you often cannot really tell whether it is going to be worth the month's work growing accustomed to it will entail. If you decide it is — well, here is a blank disc — why not just copy it and save everyone good deal of trouble?

To cope with these uncertainties, the customer tends to apply some very crude rules of thumb. He seems to say things like: "£90? Far too cheap. Not worth bothering about". "£150 — £300 — why not"? "£500 — I'll think about that".

Now, one can sympathise with anyone who does not want to

spend £1,000 on anything, but why reel back in horror from cheap software? Marketing folk-lore tells us that if you halve the price, you sell five times as much. However, the tribulations of low-cost software in our business tell us that this is not necessarily the case.

Even so simple-minded a fellow as our mythical buyer has discovered that an essential, invisible part of any software package is a soothing voice on the end of a telephone which explains why Minnie, your office mouse, made the whole thing crash just by looking at it.

That soothing voice is apt to cost the software perpetrator about £10,000 a year and for some reason emerging folk wisdom has decided packages that cost less than £90 will not make it. Yet VisiCalc originally cost \$70.

The whole problem is confused by the Americans who will insist doing things first, cheapest and loudest. Other things being equal, what relationship should we look for between British prices and U.S. ones? They have about four times the population and that would suggest that their prices ought to be one-quarter of ours to carry the same overheads. Yet if one is to believe the evidence available, people in Britain are twice as likely to be interested in microcomputing as they are in America, so that our real population is only half theirs, and their prices ought to be about half our prices.

Whether by design or accident, that is what we see: with the dollar about half the value of the pound, products often have the same numerical costs in Britain and the U.S. While this is satisfying to the theorist, it makes the entrepreneur's job rather difficult. He cannot confine himself solely to the U.K. market. With America's huge installed base of micros and lavish spending power, he must try to enter that market. It is however, all uphill. Not only does he have to sell 3,000 miles away, he must do it on returns which are only half as great per unit as he would receive in the U.K.

Of course, the volume of the U.S. market ought to work for him just as it does for native producers, but the cost of entering it is that much greater. To make matters still worse, he probably has to contend with the chauvinism of most of Middle America.

To work the American market properly, one almost certainly needs an American base. Keeping and supervising a body several thousand miles from home is an expensive and uncertain business: operating through loose links with American firms is equally risky.

What we need is a concerted national push. Products like Rolls Royces, whisky and tweed get the benefit of national prestige advertising to persuade Americans that of such stuff is heaven made. Something similar ought to be done with British software. Americans ought to have it firmly impressed on them that though they have many fine qualities, they ought to leave the delicate business of programming to their older and subtler cousins. The new computing age is one where the literature, laws, customs, habits of our time have to be transcribed on to silicon. While the thrusting dynamic of the new land may be very good at making hardware, it needs a more civilised spirit to breathe life into it.

The object of the exercise is to flatten out the marketing hill: to persuade the Americans that British software is worth paying a premium for. If we do not somehow manage this — perhaps in the last resort by actually writing better software than they do — our micro industry is going to be swamped in just the same way that our film, aerospace, book publishing, electronics industries have been. It is a great shame in a way that the Americans did not — as they so nearly did in the 1870s — choose German as their national language. If they had, Germany would have all the aggravation of the "special relationship", while we could get on quietly with our own lives. 

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

Censure for Sinclair

I WAS intrigued to read in Feedback, April 1981, that Commodore U.K. is "selling Pet updating ROM sets below cost price" as a gesture to good customer relations. It is good to know that someone in the industry is interested in good customer relations: there must be many customers like me who absolutely loathe Sinclair.

Following strong advertising in the Sunday press, I ordered a Sinclair ZX-80 earlier this year for £100. "We want you to be satisfied beyond doubt", said the advertisement "and there is a 14-day money-back option, of course".

The machine arrived in the second part of February and although it was fun, I had in the meantime discovered your excellent magazine and it did not take long even for a novice like me to realise what the ZX-80 lacked. Imagine my disbelief, however, in reading an advertisement in your April edition for the Sinclair ZX-81, a much-improved machine, at £70.

I immediately asked for my £100 back — so that I could purchase a ZX-81 — but the 14-day period had just expired. "We have every sympathy", said Sinclair and: "We regret we are unable to offer a discounted 8K ROM to existing ZX-80 owners, nor can we offer a part-exchange facility since, as you will appreciate, this would create a precedent".

What kind of business morality is this, to push outdated stock on to unsuspecting customers at nearly 50 percent more than the new model which is about to become available? You can imagine the enthusiasm with which I now view my Sinclair.

If there were more of us, we could have a riot, but as it is, I can only vow never to touch a Sinclair product again and suggest to as many acquaintances as I can that they might be wise to do the same.

**P D Austwick,
Bath.**

In praise of the ZX-81

HAVING drawn attention to the limitations of the Sinclair ZX-80 — Feedback, June 1980 — I feel I must now give due credit for Sinclair's most recent achievement in the computer market.

I refer, of course, to the ZX-81. I have recently bought one of these remarkable units for my own personal use, and also to assess its suitability for schools use. I can state without reservation that the ZX-81 is everything the advertisements claim — and more.

Certain specific points which may be of interest to readers:

- The construction of the casing is considerably more sturdy than the ZX-80, i.e., it does not fold if you squeeze it.
- The touch-sensitive keyboard has a finish far superior to the plastic-sheet finish of the ZX-80 keyboard.
- The manual is exceptionally well written, and very informative.
- I have experienced no problems at all in recording and playing back programs using a moderately-good cassette recorder.
- The moving graphics are very good, and give far more scope for games.
- The screen display is very good and totally flicker-free in slow mode.
- Using a function key, all keywords and functions are input by single-key inputs, plus Shift or Function for some — a great saving of time and storage.

I would have no hesitation in recommending the ZX-81 to any of my pupils, or their parents who are interested in a low-priced computer for personal use. Any comment on suitability for general school use would be a little premature at this stage, beyond saying that without the 16K expansion module, scope for school use would be limited.

Having visited the Acorn laboratories and seen something of developments on the BBC computer, it is clear that — for three times the price — the BBC Proton offers considerably more than the ZX-81 in terms of storage, facilities and expansion potential. It seems to be an excellent unit. For home computing power per pound sterling, though, the Sinclair ZX-81 is going to be hard to beat.

**Graham Blackwell,
South Brent,
Devon.**

Logical languages

I WOULD first like to say that I found Raymond Anderson's article on Pascal, May, 1981, most interesting. On the whole, I believe that it contained some very useful constructive criticism, which could be borne in mind by the software houses. However, I feel that Anderson has put little thought into some of his criticisms.

For example, concerning the case-statement default which he thinks is non-existent. True — there is no simple way out, but then, is it not one of the main intentions of structured languages — especially Wirth's brainchild, Pascal — to promote the logical approach?

The logical answer obviously involves

set instructions: declare all the case alternatives as members of a scalar type, i.e., declare a universal set at the beginning of the program, then just before the case statement, discover if the case operand is not in the universal set, i.e., using IF/NOT(IN/) THEN/ ELSE (Case)). It is longer, but default is not lacking, and in most situations the set version makes more sense.

May I take the opportunity to thank you for a great computing magazine, but please, can we have more articles on languages, like Micro-Pascal and Algol 68? While I am about it, I would dearly like to learn more about Lisp — books are so expensive.

**James Morgan,
Skewen,
West Glamorgan.**

Raising finance

YOUR interesting editorial, *Financing the Future*, May 1981, creates a sour taste in the mouth. The inability to see beyond the end of one's nose is not, I regret, confined to the Government. I am running a virtually-unfunded charity which deals with many hundreds of Vietnam refugees. One of our aims is to establish an efficient charity and thence to create jobs. Our initial dialogue with the Manpower Services Commission suggested that we might be able to obtain money to research unemployment but none to create any solution.

More to the point, in this case micro-computers, I believe that the comparatively small investment of a few £1,000 would provide us with the basis of efficient economic management and the opportunity to find employment for people whose English may not be up to normal employment standards. If and when I can raise some money, I will need to find a secretary; I would prefer a person from Vietnam both because one language barrier would cease to exist and to lower the horrific 90 percent unemployment which exists within this group.

A good word-processing program, for example, would enable our secretary to produce standard letters in reasonable English. The ability to produce and save letters without having to correct reams of paper could provide real help in English improvement.

Financial programs could help to solve the perennial problem of finding capable bookkeepers — a problem so noticeable in small and large charities alike. My experiences in working for commerce and

(continued on page 44)



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• Circle No. 154

(continued from page 42)

in three charities have taught me that even the sometimes inadequate standards of financial management found in commerce are often lacking completely in charities. Already a number of local charitable organisations have expressed interest in the possible use of a microcomputer with multi-user facilities.

Sufficient dynamic and static RAM would provide us with the opportunity to compile the extensive medical statistics which could help solve the many stress-related illnesses that constitute the "Refugee Syndrome". The interest shown by the MSC in research-orientated projects could then produce the cash to staff a medical research and help program.

Finally, we wish to set up a co-operative to provide employment for the many skilled people whom we are trying to assist. The range and number of possible uses is extremely large. The problem arises when one tries to raise the cash to buy such equipment; those with the money to give to such causes tend to regard the micro as a kind of games machine. I can see the means of providing employment, creating wealth for the country, building a self-supporting charity which serves a community of many thousands and rebuilding the self-confidence and esteem of a homeless and lost people.

Roy Tindle,
The Community of Vietnam,
Erith, Kent.

Alternative history

I AM compiling an alternative history of computing. The history will focus on the lighter side of the development of the subject, highlighting the failures, the accidental discoveries, the legend both famous and infamous that have helped to share the present-day state of the art. My address is 996 Warwick Road, Acocks Green, Birmingham.

I would be grateful for any help in the compilation of this work and any contributions in the form of, say, press cuttings, references and personal recollections would be most welcome.

Martin Wakeman,
Acocks Green,
Birmingham.

Protecting software

WITH REFERENCE to the late Lawrence Perry's interesting discussion on the use of patents and copyright in the protection of computer software, April 1981, I would like to add a further possibility.

While it might be harder to implement the following approach in connection with disc-stored programs. I can see no reason why it might not offer immediate protection to program authors in connection with cassette-based material.

The idea is to resort to the protection offered under copyright law to pieces of music. Since a cassette tape — whether containing a program or a piece of Bach

— can be played audibly on a simple machine found in almost every home, and since the definition of music is largely culture-dependent — but still protected, even when the culture is far from the local norm — why not declare each cassette-recorded program to be a piece of music?

Any attempt to copy it, for whatever purpose, would be an infringement of copyright invoking a well-established legal procedure for recovery of compensation.

I would be interested to hear from anyone who has started to take this approach.

Nick Laurie,
Langport,
Somerset.

CP/M documentation

I AM glad to hear that Rose Deakin — *Practical Computing*, April 1981 — is managing to overcome the documentation problems of CP/M. I can, however, assure her that when she progresses to MP/M her earlier problems will seem like the joys of spring.

Having recently taken delivery of an MP/M package, I was surprised to find that documentation on CP/M 2.2 was supplied with it. Then I found that the manual MP/M mainly describes the differences between CP/M and MP/M; in other words, MP/M is just the same as CP/M — except, of course, where it is different.

My favourite quotation is found on page 11, where it says: "See the Digital Research document entitled, CP/M 2.0 Users' Guide for CP/M 1.4 Owners, for a detailed description (of MP/M)", Referring to the CP/M documentation supplied is not all that helpful either. For instance, page 2 of the CP/M 2.2 Users' Guide refers to the reader already being familiar with CP/M 1.4.

I have just one message for Rose Deakin and others who find themselves bewildered or confused — ask. Do not be afraid of appearing foolish, it happens to all of us sometimes. I am not referring to any particular supplier, but to any supplier whose documentation is inadequate.

We are the customers for whom the manuals were written and they should intelligible to us.

Roland Couvela,
Farnham,
Surrey.

Revolutionary storage

BRING personal computing out of the dark age. I have discovered the ultimate storage medium — a medium which can boast unsurpassed reliability, while being highly cost-effective, totally portable, requiring no special handling or storage precautions and easily and compactly stored. This medium can be read and written at different speeds without fear of reliability loss by virtue of a synchronisation signal.

Comparing paper tape to cassettes and floppy discs, you can see that, in price at least, paper tape is the clear winner:

Medium	Storage Capacity	Cost	Cost/Kbyte
Paper-tape	120,000 characters/roll	£1.50	1.28p
Cassette at 300 baud	21,600 characters/tape	£0.55	2.61p
Floppy disc density - single formatted	82,944 characters/disc	£2.90	3.58p

Clearly, from the table, paper tape beats all its competitors in price per memory unit.

I hear the sceptics saying that paper tape is slow, but slow compared to what? A popular machine like the Pet has a tape-transfer rate of 500 baud which is, effectively 250 baud since all data is recorded twice. The Teletype 43 runs at 300 baud.

Yet cost is not paper tape's outstanding asset. Paper tape has almost 100 percent reliability. My last four reels of paper tape have had only three parity errors — an error rate of 0.00625 percent or one part in 160,000.

TTY Knox,
Hull,
Humberside.

Micros in medicine

I WOULD be very pleased to hear from anyone who has any ideas or information about using microcomputers on general hospital wards for teaching or management.

I own a Sinclair ZX-80 with a 16K RAM pack and would like to be able to put it to use when I teach in the ward.

I realise that the Fluid Monitor as packaged by Medicom may soon be leading the field in intensive-care units and I feel that any means of improving nursing care and teaching with the use of microcomputers would be a welcome step forward.

Valerie Garland,
Plymouth.

Course control

I AM interested in locating packages, suitable for running on a microcomputer system, which are designed to control the bookings of places on courses and conferences.

The system would effect control from the first point of contact — an unconfirmed booking — through to the preparation of invoice data following a candidate's attendance on a specific course. Ideally, such software should interface directly with a compatible invoicing/ledger administration package.

If there are no proprietary packages available, perhaps someone could offer me their opinion of the suitability of a tailored hotel reservation, front and back office, system/billing system — such as is offered by Landsler, for example. I can be contacted at 20a Worley Road, St Albans, Hertfordshire AL3 5NS.

N J Williams,
St Albans, Hertfordshire. ☐

INNOVATIVE

TRS-80 SOFTWARE

FROM THE PROFESSIONALS

LDOS

First there were the TRSDOS's, 2.0, 2.1, 2.2 and 2.3. Then came Newdos +, essentially a patched version of the TRSDOS's but with a number of very useful commands and utilities added. Then VTOS 3.0 and VTOS 4.0. These constituted a departure from the earlier DOS's and featured Device Independence so that devices such as the keyboard, printer, VDU and disk drives could interact directly together. Then came Newdos80 which is a rewrite of Newdos +, adding new utilities and new Basic commands, its main features being the ability to mix different capacity drives on the same cable and the ability to use variable length records. Now from LOBO International comes LDOS, the fifth generation disk operating system for the TRS-80 microcomputer. It combines most of the advantages of the preceding disk operating systems and unlike some of them, is accompanied by a complete and readable set of documentation, which includes a Technical Section containing relevant addresses.

It is impossible to describe all of the features of LDOS in an advertisement. For instance it includes no less than 35 library commands as follows:—

APPEND	COPY	DEVICE	DIR	DO	FILTER	KILL
LIB	LINK	LIST	LOAD	MEMORY	RENAME	RESET
ROUTE	RUN	SET	SPOOL	ATRIB	AUTO	BOOT
BUILD	CLOCK	CREATE	DATE	DEBUG	DUMP	FREE
PROT	PURGE	SYSTEM	TIME	TRACE	VERIFY	XFER

All of the useful abbreviations in Newdos are included and the System Commands in Basic (CMD) now number eleven. A program called LBASIC/FIX is included, with which the normal TRSDOS Disk Basic may be patched to include a number of new commands and features. A Job Control Language is included and in fact is one of the most powerful features of LDOS. It allows the user to compile a sequence of commands or key strokes for later execution as a chain, with or without user intervention. There are too many new features to list them herein, but examples are: The ability to provide an audible signal, output through the cassette port. To flash or blink a one line message on the video display. A WAIT feature is included so that the machine can be put into a "sleep" state until such time as the system clock matches the time specified. And so on!

Hard disks in addition to single/double density, single/double sided, 8" and 5¼" floppies are supported although they may, of course, require hardware modifications. Utilities included in the package are:

BACKUP	COMMAND FILE	FORMAT	LCOMM
PATCH	RS232	KEY STROKE/MULTIPLIER	PRINTER FILTER

A Basic Renumber facility is included, as is a Basic Cross Reference function. Both are similar to the ones in Newdos + and Newdos80. Most of the utilities are library commands which were existent in the previous DOS's, have been improved with the addition of new functions or facilities.

The prime development team of LDOS consisted of no less than 8 first rank programmers and they had the support and advice of six other well known programmers. They have done an excellent job to bring to the user what must be the best disk operating system so far produced for a microcomputer, which is destined to become the Standard DOS.

LDOS is totally upward compatible with TRSDOS, that is to say LDOS will be able to copy files and programs from TRSDOS disks onto LDOS formatted disks. As they are competitive disk operating systems, it is not surprising that the manual states that disks created under Newdos are not guaranteed to be compatible with LDOS, but we have not experienced any difficulty. We have done some work on investigating the compatibility of LDOS and the Video Genie and at the time of going to press we have found no incompatibilities. LDOS appears to run on the Video Genie without any problems at all. LDOS is compatible with either the Tandy or Electric Pencil lowercase modifications and Scripsit. LDOS is available for the Model I and Model III. A Model II version will be available shortly.

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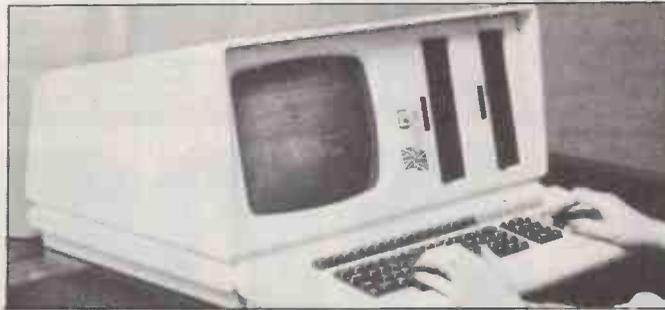
LSI's M-Three aims at professional market

A NEW British microcomputer has been launched, aimed at the top end of the personal-computer market. The M-Three is the latest offering from LSI Computers of Woking in Surrey. The microcomputer cost around £1 million to develop, with one quarter of the money funded by a Government grant.

LSI already manufactures two computers, the M-One and the M-Two at its two factories in Woking. A third factory is under construction and when it is completed, the M-Three will be leaving the production line at the rate of 150 computers a month.

The manufacturer claims that the new machine offers more ability, storage and user-satisfaction per pound cost than any comparable machine available. The machine is Z-80 based, has 64K RAM, two double-density mini-floppy drives, a VDU with 1,920-character green phosphor display and a full-function keyboard. The keyboard has 14 programmable function keys, and a numeric pad making a total of 109 keys.

M-Three is equipped with a



CP/M operating system and is programmable in Basic and Cobol. There is also a range of applications software available from LSI computers. The complete package costs less than £3,000 without software, or £3,500 with one LSI software application included for small-business users.

There is a standard option of two 8in. double-density floppy-disc drives replacing the mini-floppies. With this configuration, the system will cost £4,000 with and £3,500 without software. Printer interfacing is simple and there are two RS232 interfaces available for extra printers or VDUs.

The machine specification and price have been carefully geared to market needs and the manufacturer is confident that

the machine will be a success.

LSI managing director Tom Fitzpatrick has this to say about the company marketing operation: "Our plan is to become one of the major suppliers of high-ability personal computers by 1982. We see the greatest market as the grey area at the top end of the personal market and the very small end of the business market.

"For example, typical customers would be professional people requiring computer power for their own work, small business proprietors, scientists, engineers, schools and colleges".

LSI Computers, Copse Road, St Johns, Woking, Surrey, GU21 1SX. Telephone 04862-23411. □

Second-hand equipment

A BECKENHAM-based concern has launched a microcomputer system to buy and sell new and second-hand micro equipment. Kelly's Computer Market uses two Apples to store details of equipment for sale and wanted.

Buyers and sellers are matched by price, area, machine type or whatever category the subscriber wishes, on a program written by the firm's managing director, Gordon Kelly. Weekly cost of the service is £2.50 plus VAT.

Used equipment attracts a special discount — one month's subscription covers inclusion until the equipment is sold. The service is free to buyers. Contact Kelly's Computer Market, Paragon House, Beckenham, Kent. Tel: 01-659 7997. □

Government outlines strategy for national teletext campaign

MICHAEL Marshall MP, the Parliamentary Under Secretary of State for Industry, has announced that October is to be National Teletext Month. The aim of this will be to promote the sales of TV-based entertainment and the teletext information service. There will be prizes for consumers and the retail trade.

In a speech given to the Scottish Congress of the Radio Industries Club at Gleneagles, Marshall said: "Government is supporting industry to establish rapid consumer acceptance of teletext within the home market, with consequential benefits to prospective imports of software, hardware and know-how.

"While there should be no

Government-led market creation, we can assist by serving as a focal point for industry to initiate increased marketing activity, as well as helping to develop a Teletext promotional campaign, aimed directly at the consumer".

He went on to outline this strategy which would include:

- Provision of consumer material to aid understanding and encourage trials of teletext.
- Public-relations activity.
- Sales-training schemes for shop-floor staff.
- Trade incentives for shop-floor staff.
- Seeking further support from other areas of the teletext industry.

"As a culmination of these

Stars of the Pet Show

THE Commodore Pet Show, West Centre Hotel, Lillie Road, London, June 18-20 features a number of innovative products for the Commodore range of systems. The Commodore Vic-20 has finally made its U.K. public debut.

The Vic-20 is a full-colour computer costing less than £200 and its launch has been eagerly awaited. Commodore, has, however, had problems in producing enough to meet the expected demands from the U.K. market and in adapting the computers for use with British television. Commodore officials are still confident that they will be able to sell 100,000 Vics by the end of the year.

CP/M enthusiasts, or Pet owners who have long been frustrated by their inability to use the vast range of software written under the CP/M operating system, will be heartened to learn that a CP/M adaptor for the Pet, launched at the Pet Show, is now on sale. The CP/M "stunt box" costs £550 and plugs into the IEEE interface on the Pet. An optional RS232 port costs an extra £20.

The software for the device was written by Keith Frewin of Unicorn who then had the "box" developed by Derek Rowe of Small Systems. □

Plessey makes micros

PLESSEY, the U.K. electronics and telecommunications giant, is to manufacture microprocessors. By choosing a licence deal with Mitel, Plessey has made a significant break with its previous policy of in-house process development.

Mitel is a Canadian company which already has similar deals with British Telecom and GEC and was chosen because of its Iso-CMOS process which is among the most advanced available today. □

Programming as a cottage industry

IN HIS book, *The Wired Society*, James Martin predicted the revival of cottage industries. Rather than the traditional weaving, or lace-making activities, however, the cottage industrialist of the future would be a computer programmer. Jeremy Hope, the managing director of Ram Computer Services, hopes to prove James Martin right.

Ram Computer Services' project will, if successful, begin the process of emptying the dp departments of Britain, reversing the trends of the past 200 years. Ram is not looking for just anybody, though — they want experienced, professional programmers to provide business users with first-class custom-designed packages.

The programmers will work in teams, supervised by Ram to ensure that the work meets the high standards required and in part to save programmers from wasting time exploring blind alleys. They will work on machines leased or purchased from Ram, and the scheme will be of special interest to redundant programmers who want to invest their redundancy monies in something which could provide them with a future.

Jeremy Hope, the instigator of the scheme says of the scheme: "We expect the opportunity to have widespread appeal as work can be undertaken at any time of the day or night they choose. Moreover, after a year of working for us, programmers

Four software additions to VisiCalc family

PERSONAL Software, the company responsible for the best-selling VisiCalc program has developed four more packages in the same vein. Like VisiCalc, probably the most-used microcomputer program in the world today, the four new products will be available for most of the popular brands of microcomputer.

The new programs include VisiPlot, a high-resolution

plotting and graphics package; VisiDex, a flexible personal information system; Visi-Trend/VisiPlot, a combination of the VisiPlot program together with a program for time-series manipulation, trend forecasting, and descriptive statistics.

The VisiTerm program allows a personal computer to communicate with a wide variety of other machines ranging from large mainframes down to other personal computers.

There is also a new version of the original VisiCalc program available for the Apple II and the Apple II Plus computers. The enhanced VisiCalc is compatible with Apple's 16-sector disc storage format and includes 17 new commands and operations to make numerical model-building on a personal computer easier still and even more powerful.

The four programs as well as

the new VisiCalc program have the ability to pass data between programs. For example, files created using VisiCalc can be transmitted to another computer via VisiTerm. Files generated by data input using VisiCalc can be used to provide graphical output when transferred to VisiPlot.

There are now a total of seven programs in the Personal Software VisiCalc family, all providing functions vital to the successful management of a business. The software can be used as a suite or the programs used individually by people without any specialised knowledge of computer programming.

The new software is not yet available in the U.K. but for those wishing to buy direct from the U.S., prices are as follows; VisiDex \$199.95; VisiPlot \$179.95; Visi-Trend/VisiPlot \$259.95; VisiTerm \$149.95. Personal Software Inc. 1330 Bordeaux Drive, Sunnyvale, California 94086. □

will be in a position to purchase their own computer, which, who knows, could form the base of an autonomous business operation".

If you are interested in the scheme, contact Jeremy Hope at Ram, 15-17 North Parade, Bradford 1, West Yorkshire. Telephone 0247-391166. □

This neat hand-held terminal from MSI Data International is called a data capturer. Developed by Mektronic Consultants of Manchester, the device known as the TermiPet can be used for the remote entry of data using the keyboard or wand scanning of bar codes. When the Pet is not busy, the data stored in the TermiPet memory is transferred direct to the Pet via a cable connection. From the Pet, the data is transferred to either disc or cassette for immediate or future use. The particular configuration is a MSI-77 with 4K memory, the interface and software either on disc or cassette. The terminal has a double back-up system of batteries to ensure no loss of data. The TermiPet system is available for the 8000, 4000 and 3000 series of Commodore equipment. Prices of the TermiPet system start at £795 plus VAT. For further information contact Catlands Information Systems Ltd, Harrison Building, Green Lane, Wilmslow, Cheshire. Telephone 0625-527166. □



More powerful Aim 65/40

THE enhanced version of the Rockwell Aim 65 single-board microcomputer has been unveiled in London. The Aim 65/40 still uses the evergreen favourite 6502 eight-bit microprocessor from MOS Technology, which means that there will be a degree of compatibility between the two systems.

The Aim 65/40 at about £900 has an on-board thermal printer just like its predecessor, and a full 65-character keyboard. There is a strong resemblance between the two machines but the new model has more integrated circuits as well as a larger display and printer — 40 characters instead of the previous 20.

There is an ample 65K of on-board storage and the configuration of PROM, ROM, and RAM is user-selectable. Portable Microsystems Ltd, Forby House, 18 Market Place, Brackley, Northamptonshire NN13 5SF. Tel: 0280-702017. □

Last year we tested or reviewed 141 PET programs, evaluated 54 peripherals ranging from light pens to printers, and ran 27 major articles on PET programming. Our gossip columnist blew the gaffe on dozens of inside stories, receiving two death threats, five poison pen letters and a dead rat for his pains. We also published 53 letters from PET users, 88

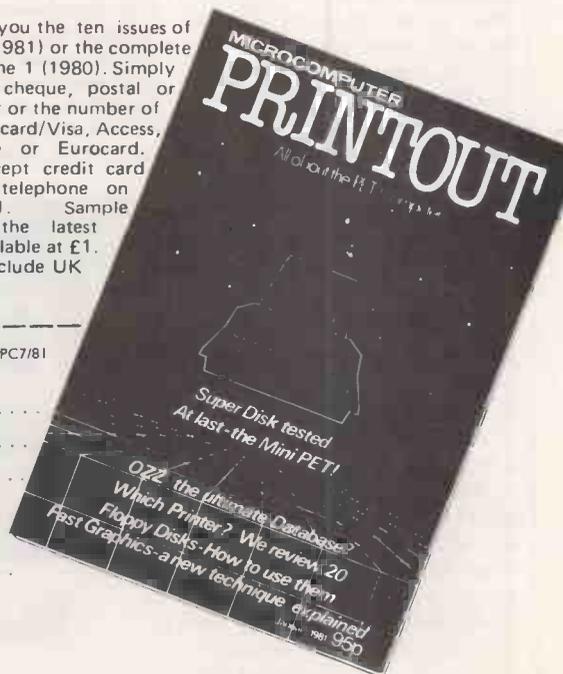
THE TRUTH ABOUT THE PET

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• Circle No. 156

MicroCobol adherents to form user group

MICROCOBOL does not seem to have dominated the pages of *Practical Computing* in the past, but apparently the language seems to set some people's pulses racing. In fact, so keen are some that they have banded together to form a distributors' and users' group.

At the inaugural meeting of the new group, certain resolutions were passed. The first stressed the support and enthusiasm of the group for the Business Operating System and the MicroCobol Development System and all the associated products produced by CAP Microproducts Ltd.

The meeting decided to "encourage further exposure which will result in substantially-increased use of the products". Finally the group proposed to work closely with the CAP organisation "to ensure that this British

software product is grown throughout the world".

Meanwhile CAP has let the MicroCobol division split from the main company. The new company will be known as Microproducts Software Ltd and will be essentially the same company as before but with a different name.

Anyone wishing to apply for membership of the MicroCobol users' group should contact the chairman Bob Muston on 0533 28256. □

The future of Nascom at Lucas Logic

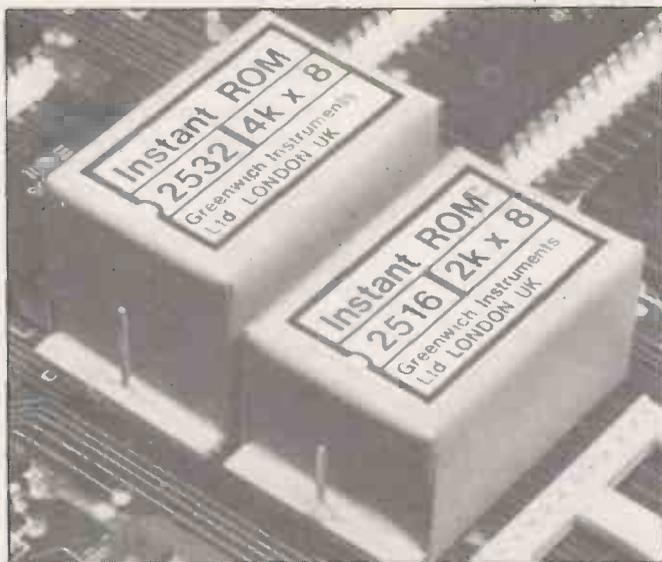
THE PURCHASE of Nascom by a subsidiary of the Midlands engineering giant Lucas Industries ends months of uncertainty regarding the British microcomputer manufacturer's future. The buying company, Lucas Logic, has promised to retain the Nascom name and product range.

Dealers and users of Nascom equipment will no doubt be happy about the deal as it ends for them a period of rumours and false starts. For Lucas, the deal brings them into the small-microcomputer market for the first time.

The new owner of Nascom is a newcomer to the personal-computer scene, but Lucas has been involved in computing since 1977. The management of Lucas Logic see the purchase of Nascom has a natural extension of the company's activities in computer applications for industry.

In addition, it will give the firm a comprehensive and proven range of products, varying from the "starter kits" suitable for educational and hobby users to the high-performance micro and mini-computers for small business and industrial use.

The new address of Nascom is care of the headquarters of Lucas Logic at Welton Road, Wedgnoek Industrial Estate, Warwick. Sales will continue through the existing dealer network. □



Instant ROM is two or four kilobytes of CMOS memory with battery back-up which can be plugged into any standard ROM/EPROM socket, or in the ROM-expansion sockets of the Pet or similar microcomputers. Once inserted it may be used like RAM. The difference is that when the system is turned off, the program stays. Programs can be edited or altered immediately, without erasure problems, yet once entered, the program will remain as if it was stored in ROM. The real advantages of the device are apparent when it is used to write security and utility programs. Since typical battery life is six years, the programs are not likely to disappear very fast. Instant ROM costs £39 for 2K and £56 for 4K inclusive. Contact Greenwich Instruments Ltd, 22 Bardsley Lane, Greenwich, London SE10 9RF. Telephone 01-853 0868. □

Software range will draw HP-1000s into world of graphics

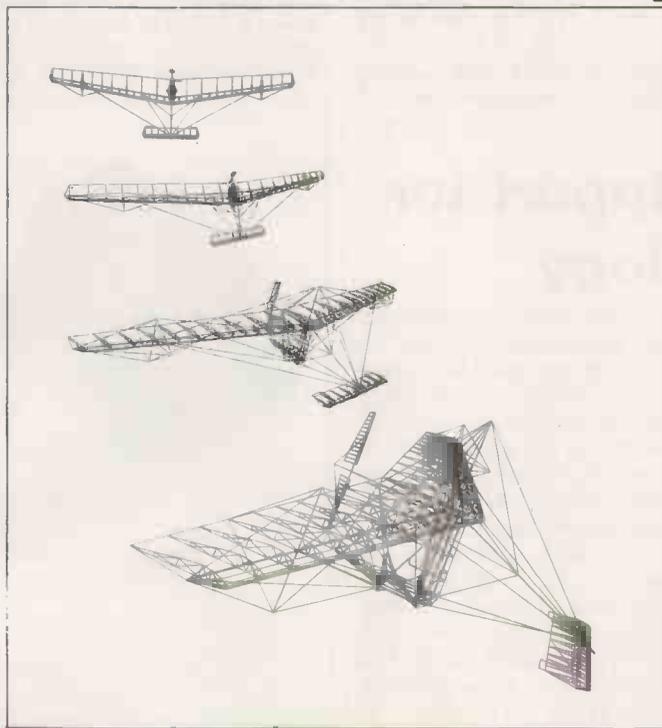
HEWLETT-Packard's new Graphics/1000 II software for use on the HP-1000 range of computers will provide the support required for a wide range of graphics peripherals. Additionally, the resources are now available for more advanced uses such as three-dimensional and interactive graphics which lead to sophisticated computer-aided design applications.

The available software will initially comprise two packages: the device independent graphics library, DGL, and the advanced graphics package — 3D, AGP-3. The DGL package is a collection of programs which will enable the users of different graphics peripherals to use a common set of commands. Alone, the package will support only two-dimensional graphics.

However, the second package will expand the capabilities to support three-dimensional, interactive graphics applications. The software is styled to complement the Hewlett-Packard range of graphics peripherals.

The graphics library weighs in at £1,082, and the three-dimensional package represents a considerable investment at

£2,164. Hewlett-Packard is at King Street Lane, Winnersh, Wokingham, Berkshire. Tel: Reading 61022. □



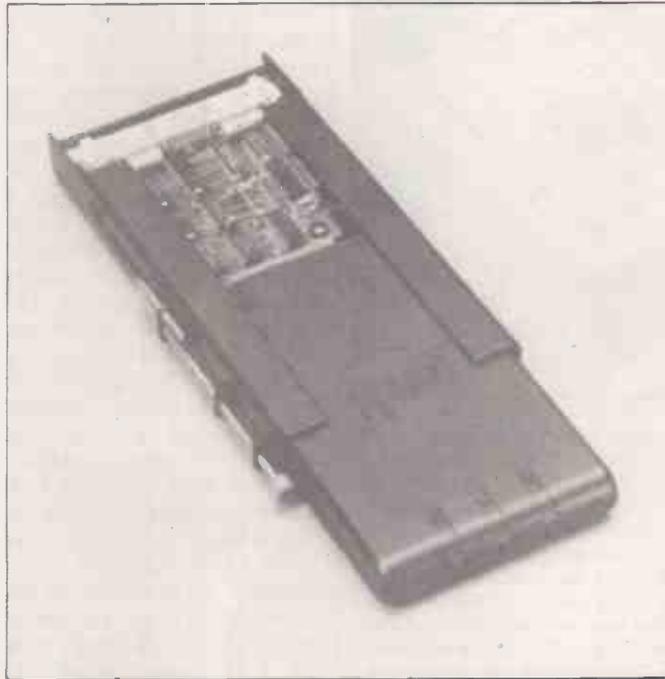
Intel develops removable bubble-memory cassettes

A COMPACT storage medium which can operate in a harsh environment is likely to be of real benefit to microcomputer users who do not have, say, the advantages of air conditioning. Intel has developed a system of removable bubble-memory cassettes which is designed to be a flexible building-block. The Plug-A-Bubble system allows users to configure systems in a variety of ways.

The basic iPAB system consists of a 128Kbyte capacity bubble-memory cassette and holder. There are two optional building-blocks available, a 5¼in. chassis, housing two cassette holders and an iSBX bus interface card with cabling. Individual cassettes are also available.

If 5¼in. sounds familiar, it is because the Plug-A-Bubble system is designed to fit in the same space as a mini-floppy unit. The iPAB cassette is housed in a rugged cast-aluminium cartridge and it contains the Intel 7110 one-megabit bubble-memory, together with the 7220 controller and other support chips. Up to two cassettes can be incorporated in each chassis and can interface with the standard Intel iSBX Multi-module bus.

Each cassette has an average access time of 48 milliseconds and a data transfer rate of 12.5Kbytes per second. The tough case can withstand a shock of 40g. in three axis. The



cassette will operate in the temperature range of 0 to 55° centigrade. The power requirement is a standard +5 and +12 Volts, power consumption eight Watts per cassette.

Typical applications of Plug-A-Bubble include those involving the capture of data such as test instrumentation, telecommunications and data-acquisition terminals and in industrial machine or process control. The system is of particular use in applications where the device needs handling or constant transportation.

To obtain the current

product price reflecting local billing factors and availability, contact Jacques Brunet at Intel Corporation, Rue du Moulin à Papier, 51, Boite 1, B-1160 Brussels, Belgium. Telephone: (322) 660 30 10.

Extra products to suit Apple

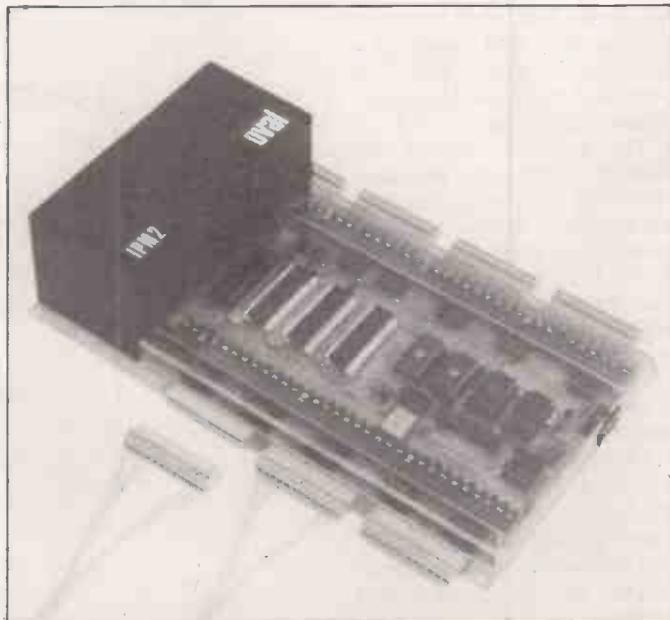
U-MICROCOMPUTERS is a British-based manufacturer of microcomputer accessories based in Warrington, Cheshire. Competing with imported products, mainly from the U.S., the first item in the U-Microcomputer catalogue is a 16K memory card. The U-Ram-16 is compatible with the Apple Language card, but costs less than half the list price of the imported article.

The U-Ram-16 allows Pascal programs to be run, makes 56K — as opposed to 48K — available to CP/M programs, gives VisiCalc 35K rather than 25K to play with, makes the integer Basic ROM card obsolete and can be used with the new Hayden Applesoft Compiler.

The card retails at £130 assembled or £99 as a kit, plus VAT. Discounts are available for volume purchasers. The card is available direct or through the nationwide Apple dealer network and has a one-year warranty against defects.

U-Microcomputers can be found at Winstanley Industrial Estate, Long Lane, Warrington, Cheshire, WA2 8PR. Tel: 0925-54117/8.

This, the new 32-channel Industrial Plant Interface from Oval Automation, is a self-contained, single-board unit and can be connected to the host computer via a serial RS232 link. Although primarily designed for the Apple microcomputer, the IPM-2 can be used with any computer which has a serial port. Alternatively, the unit can be used as a stand-alone device with the instructions contained in EPROMs. The cost of this device is £295 and further details can be obtained from Oval Automation Elm Park, Ferring, Worthing, Sussex, BN12 5RN. Telephone 0903-44831.



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New Technology Finance has a board whose expertise

combines technical, financial and commercial skills and the directors use their knowledge to link clients with potential sources of finance. Another service of the company is to monitor the progress of the client company to the benefit of both client and investor.

Interested companies are invited to contact the managing director of New Technology Finance Ltd, Mervyn E Smith at 27 Old Bond Street, London W1X 3AA. Tel: 01-643 9234.



The Onyx C8000 Series

The C8000 Series is a compatible family of microprocessor-based systems, designed for business and scientific applications.

These powerful general-purpose systems combine processor, memory, fixed 10 Mbyte or 18 Mbyte 8 in. disk (expandable to 76 Mbytes) and cartridge tape driver - all within one low profile enclosure.

The C8001 is an 8 bit Z80A* system with up to 256 Kbytes of memory for 1-5 users. And is easily expandable to the more powerful 16 bit C8002 configuration, with 256 Kbytes to 1 Mbyte of memory handling up to 8 users.

Based on the Z8000* processor, the C8002 may be connected to a high speed local network for further expansion.

Industry compatible versions of COBOL, PASCAL, BASIC, CBASIC2*, FORTRAN and C are available on OASIS*, CP/M*, MP/M* and UNIX* operating systems. Also available are packages for communications, data base management, word processing and business applications.

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*Z80A and Z8000 are trade marks of Zilog Inc. CP/M and MP/M are trade marks of Digital Research Inc. OASIS is a trade mark of Phase One Systems Inc. UNIX is a trade mark of Bell Telephone Laboratories. CBASIC2 is a trade mark of Compiler Systems Inc.

New! Sinclair ZX81 Personal Computer.

Kit: £49.⁹⁵ complete

Reach advanced computer comprehension in a few absorbing hours

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. At £99.95, the ZX80 offered a specification unchallenged at the price.

Over 50,000 were sold, and the ZX80 won virtually universal praise from computer professionals.

Now the Sinclair lead is increased: for just £69.95, the new Sinclair ZX81 offers even more advanced computer facilities at an even lower price. And the ZX81 kit means an even bigger saving. At £49.95 it costs almost 40% less than the ZX80 kit!

Lower price: higher capability

With the ZX81, it's just as 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, or to select a program off a cassette through the keyboard.

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!

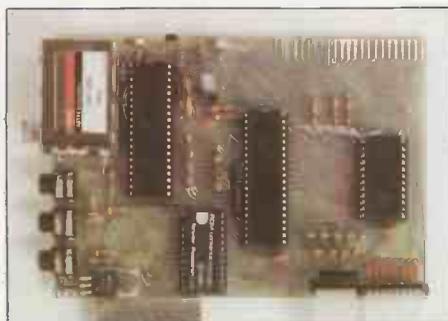
The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

**Built:
£69.⁹⁵
complete**

Kit or built – it's up to you!

The picture shows dramatically 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).

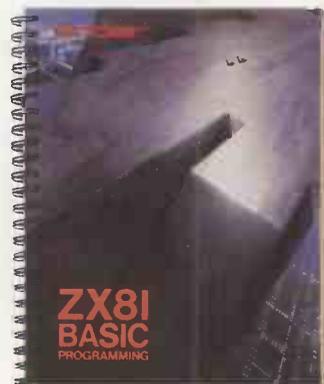
Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



Proven micro-processor, new 8K BASIC ROM, RAM – and unique new master chip.



New BASIC manual



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



If you own a Sinclair ZX80...

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

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

Coming soon – the ZX Printer.

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumeric across 32 columns, and highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981, at around £50 – watch this space!



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.



How to order your ZX81

BY PHONE – Access or Barclaycard holders can call 01-200 0200 for personal attention 24 hours a day, every day. **BY FREEPOST** – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access or Barclaycard. **EITHER WAY** – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

New, improved specification

- Z80 A 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.
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- Randomise function – useful for games as well as serious applications.
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- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet – but coming soon!)
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	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
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	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack(s).	18	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95
				TOTAL £

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Lion Micro Computers Ltd 227 Tottenham Court Road, **London** W1 Tel: 01-636 9613 and 21 Bond St, **Brighton** Tel: 0273 601838

Micromedia Systems, Seymour House, 14-16 Chepstow Road, Newport, **Gwent** Tel: 0633 59276

NSC Computer Shops 29 Hanging Ditch, **Manchester** Tel: 061-832 2269

T & V Johnson (Microcomputers) Johnson House, 75-79 Park St, **Camberley** Tel: 0276 20446 also

148 Cowley Road, **Oxford** Tel: 0865 721461 and 48 Gloucester Road, **Bristol** BS7 8BH Tel: 0272 422061

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Rair Limited, 6-9 Upper St. Martin's Lane, London WC2H 9EQ Tel: 01-836 6921

RAIR

Art for Prestel's sake

COMPUTING may be an art, but can Art be done on a computer? To be specific, on Prestel? It is by no means an obvious application. The Prestel screen is formatted in such a way as to maximise the transmission of "hard" information — and graphics are effectively in a supporting role. The 40-by-24 screen is limited and entering graphics codes to build "pictures" is fiddly.

There are also some restrictions on the use of colours for pictures — we are discussing pictorial art — caused by colour-control characters. Nevertheless, the strong colour saturation and hard

by Martin Hayman

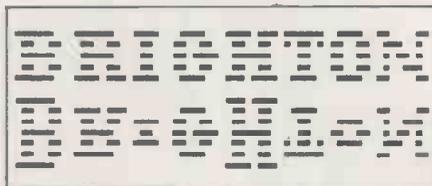
edges represent an obvious challenge to the artist who wishes to make a silk purse out of a sow's ear. Ralph Steadman's *Emotionally-drained squid on holiday* for example is recognisably Steadman but undoubtedly 40 by 28.

Brighton Polytechnic has risen to this challenge and last month presented, in association with Brighton-based Viewpress 444, "the world's first Viewdata art exhibition". Curiously, it was the department of graphic design, under Clive Chizlett, rather than the large and effective computing department, which took most interest in the topic.

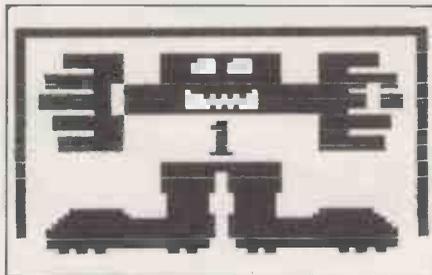
Though Brighton's computing department has taken a lead in videotex and education with its espousal of the schools telesoftware project — see *Practical Computing* Printout, June — this was intended as an exercise in exploring the visual possibilities of the medium.

In the first place, it was intended to run an international competition but this did not make the starting line for shortage of time. In the event, the students in the group had less than two weeks to learn the keyboard and the tricks of the trade, so it was not altogether surprising that several of them found the most interesting avenue

Alphabet by Adam Taylor.



Reflex Brighton by Clive Chizlett.



The goalie by Mark Johnson.

of approach was to design a satisfactory typeface, some of which I reproduce here. These are doubtless a useful contribution to the Prestel repertoire though one doubts their usefulness in a commercial Prestel operation.

Clive Chizlett argues that legibility is demonstrably an aid to comprehension and hence perhaps to saleability; to the idle flicker-through of the Prestel database, this may be so. At the moment, much of Prestel is used for sheer wedges of information but as it becomes more and more part of the well-equipped household, there will be a greater premium on attracting the browser rather than the seeker.

Chizlett also sees room for a Prestel study into the partially-sighted, for whom Prestel offers a means of communication, but he feels it would require resources — intellectual and financial — outside his range. He would not feel qualified, he indicated, to "measure" quality of sight, which would need researchers, qualified in psychology.

As for the exhibits, I must confess to a

Chinese Dragon by Clive Chizlett.



Planet in eclipse by Clive Chizlett.

abcdefghijklmnopqrstuvwxyz
 stuvwxyz
 1234567890

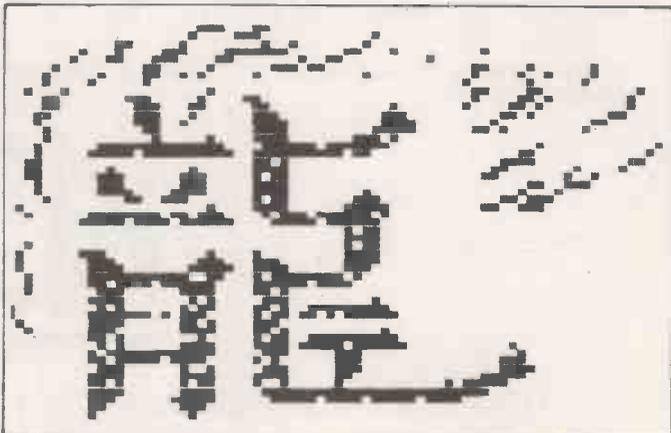
Alphabet by Mark Johnson.

slight disappointment. Much of the best work came from foreign exhibitors, notably the Germans, who have a school dedicated to the exploitation of the medium. I saw no further work from Steadman, who had certainly whetted my appetite for further pictures. One interesting feature of Steadman's *Squid* is the routine developed by IP Mills and Allen to get continuous vertical colours. Unless you can do that, pictures are practically impossible.

The constrictions of blank colour-control characters also make the design of serifed character faces fiddly, though the raster thrown up by the Techs machines which Viewpress 444 uses are an inestimable boon in any kind of Prestel screen design.

Will it catch on? It is certainly an intriguing exercise, but with picture Prestel just around the corner, which will cater for mail-order and other product-type displays, and with the current sophistication of inexpensive, dedicated graphics-orientated machines, I think it may prove something of a blind alley. □

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Twinning schools and business



DAVID FAIRBAIRN, the director of the National Computing Centre and I were discussing the ideal programmer who is — in my view — a 17-year-old who writes code like unrolling a carpet. Developing this theme, we were musing on the fact that most of the people in the U.K. who thoroughly understand micros but have little hardware on which to work are in their teens and in school, while the people who have micros, badly need to understand them but do not are middle-aged and in business.

“Why not”, we said as one, “bring the two together”?

That is what we propose. Schools with a stock of programmers but little hardware should be twinned with businesses which have a stock of hardware and a supply of problems. The twinning will, initially, be arranged through a register kept at the *Practical Computing* offices. As suitable schools and businesses apply, we shall introduce them to each other.

What might happen in practice? We imagine that it could be well worth a firm's while to set aside two afternoons a week when the computer would be used by people from the school. They would expect to help with the business problems that must arise, but at the same time, they would have their own programs to run. “Could you write a little package which re-formats the stock-control file so the word processor can use it”?

“What about a program to calculate whether it's better to buy widgets FOB Rotterdam at the warehouse door in Galashiels”?

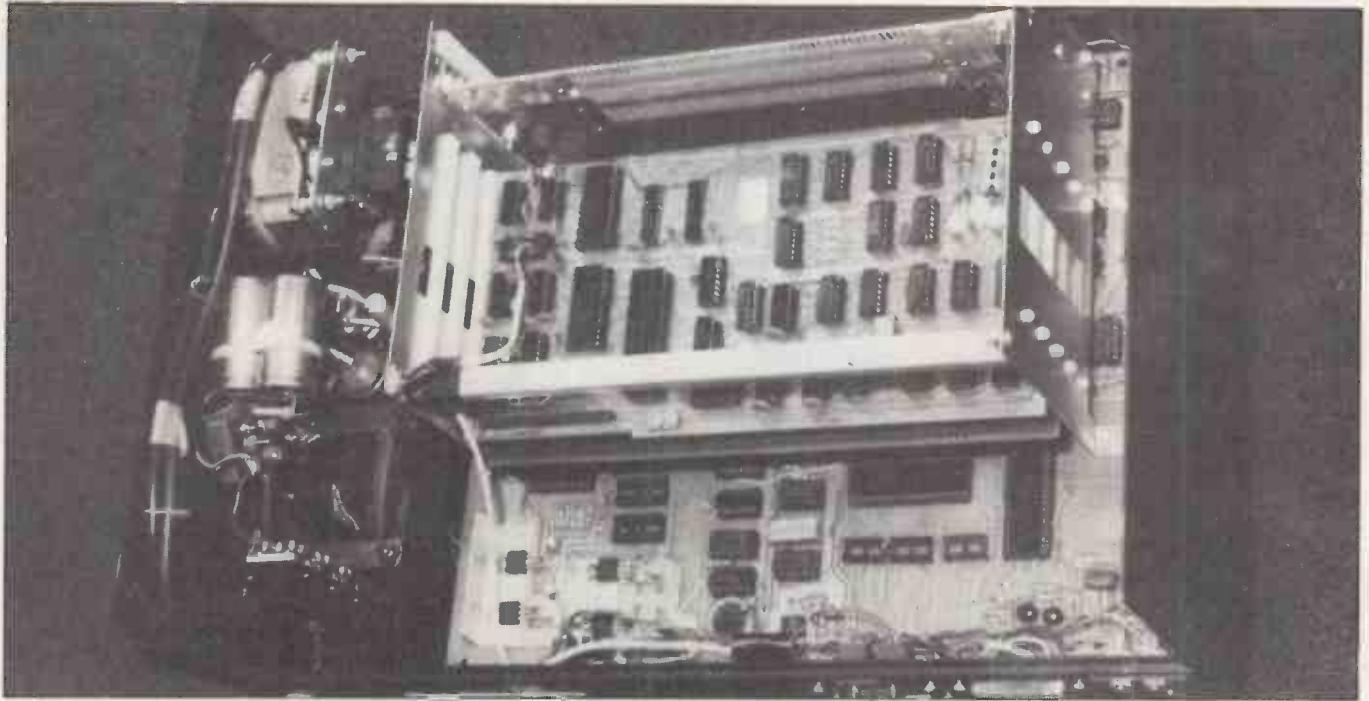
No doubt, as the young helpers make themselves useful around the place, the amiable proprietors will want to reward them suitably. Happily there is not yet an honourable Corporation of Master Programmers to shout “foul” so it is possible that everyone might be able to proceed in a mutually-convenient way. Possibly, the association will lead to the writing of major software packages in the school holidays: if that happens, it can only be to the good.

What, on the other hand might go wrong? Well, the young visitors could be a nuisance. For this reason, we think it is necessary that the link is made officially to the school so that discipline can be applied. A child who makes a pest of himself can be controlled through the school's computing organisation.

If everyone involved is to stay sane, access will have to be controlled. From the school's point of view, it would want to be sure that the youngsters are not being exploited. It would be no part of the project to provide labour for keying in the day's invoices.

The success of a twinning will depend a good deal on the give and take of both sides. If you are interested, let us know. Write to: Twinning, *Practical Computing* Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Peter Laurie



Through the expansion jungle with intrepid Explorer

THE EXPLORER 85 microcomputer system is a low-cost, 8085-based system manufactured in the States by Netronics Research and Development Ltd. The system is designed to be used at a series of levels which provide the user with a logical and well-mapped route through the jungle of system expansion. In its final, fully-developed form, the Explorer is a powerful little machine suitable for a wide range of serious programming tasks.

The powerful 8085 processor from Intel is fully software-compatible with the 8080 and is faster by about 50 percent. That means any program written in 8080 code can be implemented on the Explorer and will execute faster.

The review Explorer system consisted of a series of modules cased in an attractive blue cabinet which lends the system a no-nonsense, business-like air. These sturdy, steel cases are available as an optional extra to those who build the system from scratch and certainly do something to inspire user-confidence.

Compactness

A striking feature of the Explorer system is its compactness; the component parts of the system are a main system cabinet, a rather neat little video monitor, a disc unit, and a ASCII keyboard as well as the CP/M system disc.

The first task, having unpacked all the boxes, is to arrange the component parts on a desk or table and to assemble them. The main system box is the largest component and has three buttons on the front and some switches on the back. The back of the case also has a RS232 port and some jack sockets as well as a number of

terminals, one of which was intriguingly labelled "loudspeaker".

A logical method of constructing and proving the system seemed to involve testing the main part of the system before connecting the floppy disc unit. Verifying the main system soon proved to be simplicity itself — the system components just plugged into each other. All too often when reviewing microcomputers, they fit

by Bill Bennett

together well enough, but when the machine is switched on, nothing happens.

Happily, the fan inside the main cabinet began to hum. When the monitor is turned on, the usual patchwork of a memory dump is displayed on the screen. The next move is to press the re-set button on the front of the main cabinet. The computer will now boot — that is, the memory is cleared and the computer will go to the beginning of the monitor. The Explorer now sits in limbo until an input is received from the keyboard.

The input the Explorer is expecting is a signal to set the baud rate automatically; the machine will operate at any baud rate between 110 and 9,600. The monitor contains a routine which looks for the particular input — in this case, a constant depression of the space bar. The routine then calculates the baud rate accordingly.

Once the rate is set, the signing-on message is displayed on the screen and programming may begin. There was no Basic interpreter in the review Explorer,

so at this level, the programming is entirely in 8085 machine code but to make life easier for the user, some monitor commands are provided.

Connecting the floppy-disc unit did not present any major difficulties. Before connecting the disc unit to the main system, and before inserting a disc, it seemed a good idea to check the disc unit worked. The floppy disc manual recommends that the voltage readings on a certain chip are checked first, and having had bitter experience of wayward disc drives in the past, I followed that advice. The voltages appeared to be correct.

Deceptively simple

Next was the deceptively simple-sounding task of connecting the disc to the main system. To perform this task, you must remove the two screws on the rear of the cabinet, swing the top of the lid forward and lift it out. With the lid off, it is a comparatively easy task to plug in the disc-connector ribbon cable.

I should, however, point out at this stage that once the disc unit is set up it should not be moved too often — the disc controller board sits on a cradle inside the main system cabinet, and every time the disc cable is removed there is a disconcerting flex in the controller card. The manual suggests a blank disc is first loaded to test the head-load and release commands. Not having any blank discs handy at this stage could result in much grief later.



Now the big moment arrives — the loading of the system disc. The Explorer system utilises the 8in. floppy discs which, apart from inspiring confidence in the user with their more business-like appearance, hold far more information than the smaller, 5¼in. version.

Re-set button

The re-set button on the front of the main cabinet is pressed and the reassuring sound of a solenoid clicking informs the user that the disc is being read. After a short wait, which can be nerve-racking if the disc contains expensive software, the system replies by displaying the signing-on message on the video monitor. The machine worked, and gave a good account of itself.

Since the Explorer uses the CP/M disc operating system there is a wide range of applications software available and there is no reason why an Explorer, possibly using two or more disc drives, should not be used in a commercial application. Its compactness and smartness certainly make it a desk-top microcomputer which would not look out of place in the office of any businessman.

One of the best features of the system was the video output — there was very little of that annoying screen flicker which can strain the eyes. The picture always appeared to be sharp and bright. The video monitor supplied with the system can be bought as an optional extra, but considering one is required anyway, the Newtronics monitor at about £80 seems

to be a wise and inexpensive purchase.

If the user is considering using the system as a business or personal computer then the ASCII keyboard is also an essential purchase. A less-expensive alternative for those more interested in control applications is the Hex keypad/display unit.

Unfortunately the Explorer has a shortcoming: it is a little prone to dirty supply current. This is only a small problem and is very simple to remedy but it can be a serious problem because of the consequences of the power supply being interrupted.

When a spike appears on the line — possibly caused by a motor being turned on — it causes the system to crash, which in turn damages any disc which happens to be in the disc drive at the time. To criticise the Explorer on this point might be a little unfair, though, since most microcomputers have the same problem.

The documentation supplied with any computer system provides the potential user with a valuable litmus to hold against the system. Good documentation does not always mean that the hardware is good, however, but if a company goes to a good deal of trouble to make sure that the documentation makes the user's life easy, then this helpfulness may be reflected in the product, and the support the company provides.

The documentation supplied with the Explorer was somewhat unusual but this may be due to the fact that as each level of the Explorer system is bought, the

relevant manual is included with it. As stages are of differing degrees of complexity, the manuals are of vastly differing sizes. One possible solution to the problem would be to provide a ring binder so that each level can be added to the total, providing the user with one volume containing all the relevant information.

The level A manual is a little brief but it contains a parts' list and some reasonable assembly instructions. At first glance, this would appear to be adequate but many constructors would surely welcome a section devoted to trouble-shooting, especially considering the complexity of the project in question. The only help the bewildered constructor can seek is a price list which details factory trouble-shooting fees, and those are all given in dollars.

Machine code

Even so the level A manual contains a rather good section introducing the user to machine-code programming on the Explorer 85. This section is not aimed at the absolute beginner — anyone using it must understand Hexadecimal code, for instance.

I found it to be more than adequate and there is even a sample program fully-documented and talked through, providing anybody with an interest in 8080/8085 machine-code programming a useful introduction. The rest of the manuals, that is for levels B through to E,

(continued on next page)



(continued from previous page)

have a common thread in that they provided relevant parts' lists and good, clear assembly instructions.

There is the slight matter of the different sizes of the manuals, and their differing appearances, but this is a minor complaint. The manuals form a complete set and as such, would be more-conveniently presented in a ring binder. As supplements to these manuals, there are the Microsoft Basic-80 reference manual, assembly instruction sheets for the video board and the ASCII keyboard, cabinet assembly instructions and a Explorer-terminal ROM-user information sheet.

Overall, the documentation is adequate, in terms of information concerning the assembly of the system there are no complaints, but a trouble-shooting guide would be a great help. Some notes concerning the theory of operation of the system would also be desirable. Anyone seriously interested in system architecture would be strongly advised to buy a book on the 8085.

The promotional literature for the Explorer 85 makes great capital of fact that the system is expandable, and to quote the literature: "You're never forced to spend a penny for a component or a feature you don't require". This is the great advantage of the Explorer system.

The design philosophy behind the Explorer is based on the concept of levels. These levels are the backbone of the system and provide the user with a structured method of expanding the system. These units or levels are relatively inexpensive and the system can, therefore, be expanded as the user needs more computing power or as his budget allows.

The lowest level in the scheme is a single-board computer, the level A. The level A kit together with a video monitor,

an ASCII or Hexadecimal keyboard, an RF modulator, and a suitable power supply, would provide the beginner with a useful introduction to programming.

The level B kit provides a S-100 bus expansion; level C is a card cage to accommodate up to six S-100 cards; level D provides the user with 4K of static RAM and level E is an EPROM expansion kit and also available is 8K Microsoft Basic in ROM or on tape.

The Explorer system then is capable of assuming many forms, for instance, a beginners' system, an OEM controller or a fully-fledged microcomputer system with four discs and running under CP/M.

Conclusions

- The Explorer 85 is above all else a flexible little machine, available as a single-board kit or as a fully-fledged system, complete with discs, cases and CP/M.
- The CP/M operating system gives the user access to a very large range of software at reasonable prices.
- Construction of the system may prove to be far too difficult for the novice but should not prove too arduous a task for the more experienced and less faint-hearted constructors.
- The modular approach to expansion allows the user to let his system grow with his finances or requirements.
- The level A kit can be purchased for about £85, a 4K kit £327. Assembled this price would rise to £402 and the cases with cooling fans, etc., take the price up to £502.
- A RAM board is now available containing 16K of pageable memory.
- The Explorer 85 uses the 8085A CPU and is an S-100-based system.
- The Explorer 85 is marketed in kit and assembled forms by Newtronics Ltd, 255 Archway Road, London N6. Telephone 01-348 3325. 

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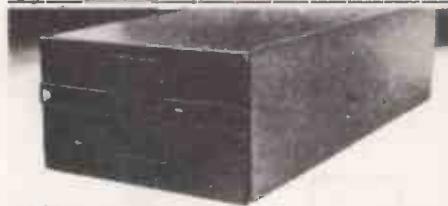
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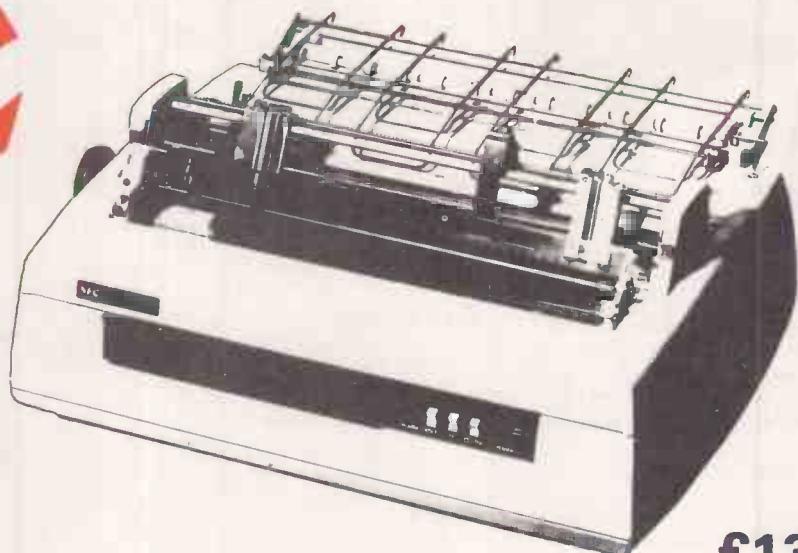
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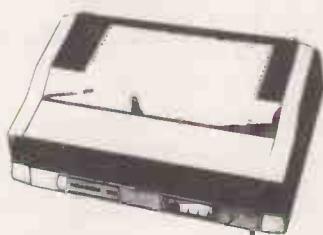


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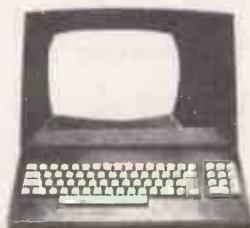


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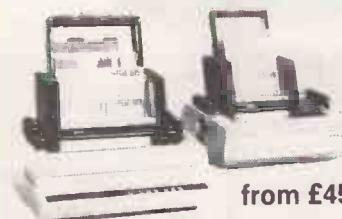


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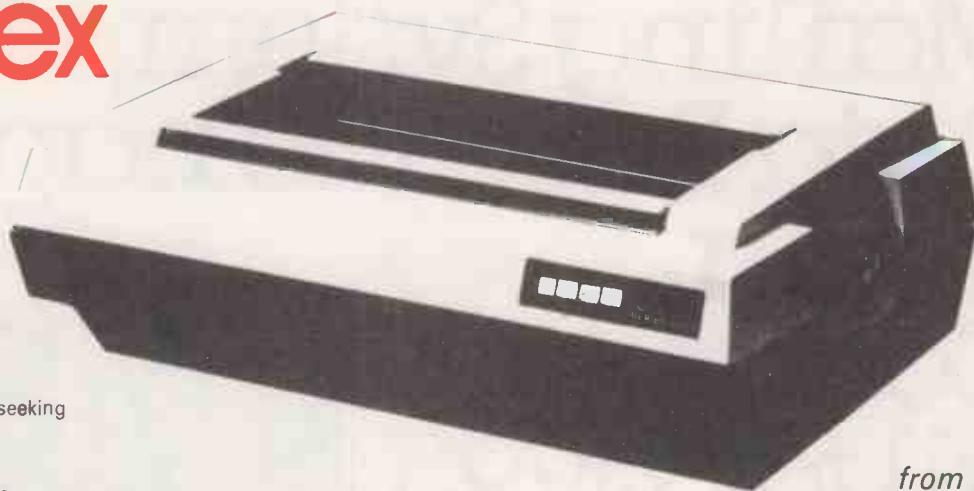
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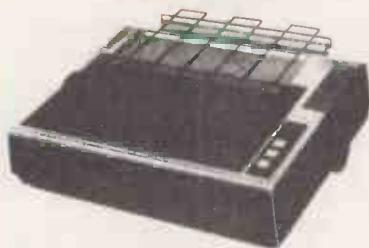


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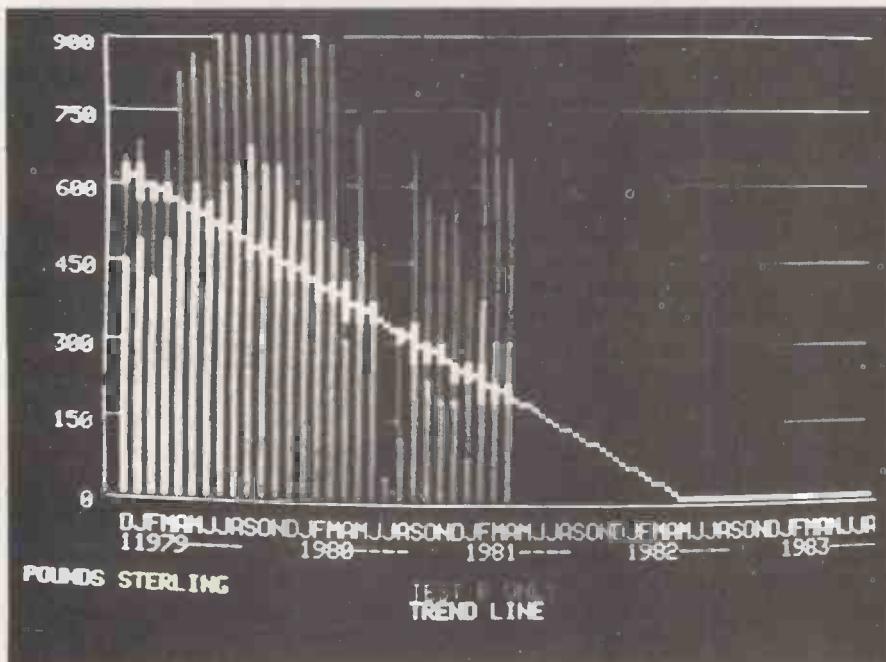
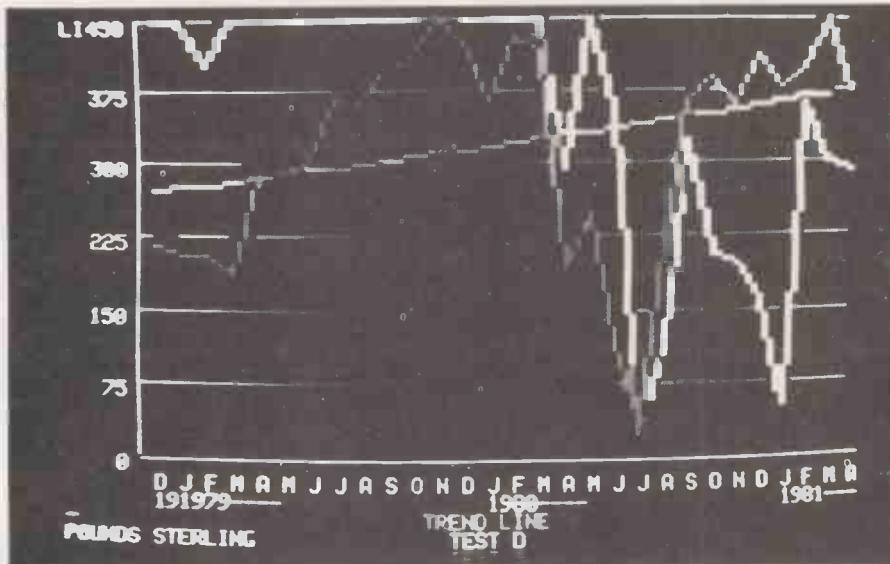
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Putting a new complexion on micro graphics: Compucolor II



THE COMPUCOLOR machine was first launched in the U.S. in 1978 by Intelligent Systems Corporation and has been available in the U.K. since early 1979 from Abacus and now Dyad Developments Ltd of Great Milton, Oxfordshire. Dyad has been handling the Compucolor II in the U.K. for about a year.

The Compucolor II is in its second and third generation of development. The review system supplied to us by Dyad Developments was the Compucolor II with a 'deluxe keyboard and single floppy disc drive and Microline 80 matrix printer.

The Compucolor II is manufactured in the U.S. by Compucolor Corporation which is also linked with Intelligent Systems Corporation. Intelligent Systems Corporation also manufactures a similar machine called the Intecolor 3000 and

by Mike McDonald

8000 and has a long history of manufacturing colour micro-based systems. The Compucolor II population in the U.K. is currently in the low hundreds.

The system is supplied as a set of stand-alone units comprising:

- A 12in. colour monitor which also contains the peripheral controllers, central processor and power supplies.
- A single-density, single-headed floppy disc drive made by Siemens.
- A "floating" keyboard available in three models — standard, extended, and deluxe. The last two are optional and our version had the 117-key deluxe model.
- A Microline 80 serial dot-matrix printer. This was the printer supplied although the RS232C interface would be capable of driving any variety of Teletype printer.

Each unit is connected via ribbon cable to the printed-circuit-board edge connectors on the back of the colour monitor. The monitor and printer are each powered separately from the mains. There are three edge connector outputs on the back of the monitor: a 50-pin bus of no particular standard; an RS232C bi-directional serial output; and a keyboard/peripheral connector.

We found the connection of the disc drive unusual in as much as it had to be piggy-backed via a small printed-circuit card on to the keyboard connection.

The disc drives for the Compucolor machine are all externally connected. The 3000 series has an integral, single floppy disc drive mounted in the colour monitor casing.

Our system was the model 5 with 32Kbytes of RAM, 16K of ROM and the disc drive provides 50Kbytes of on-line user storage. The Compucolor II had been modified with a microswitch to select

(continued on next page)

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upper/lower-case or upper-case/graphics characters from the keyboard.

With the system is supplied a 115-page programming manual, a 120-page maintenance manual, and a short instruction manual. The native language of the machine is a disc Basic 8001 interpreter which is ROM-resident. The Basic offers the following features:

27 statements: clear, data, dim, def, end, file, for, get, gosub, goto, if, input, next, on, out, plot, poke, print, put, read, rem, return, restore, step, then, to and wait.

Five commands: cont, list, load, run and save.

18 mathematical functions: abs, atn, call, cos, exp, fre, int, inp, log, peek, pos, rnd, sgn, sin, spc, sqr, tab, tan. All have arguments, i.e., tan(x).

Nine string-handling functions: asc, chr\$, fre, left\$, right\$, len, mid\$, str\$, and val. each has various arguments, i.e. left\$(a\$, 1).

The disc commands are: copy, delete, device, directory, initialise, load, print, rename, run, save, and write.

There is only a simple line editor function in Basic — re-type lines to replace or update. Erroneous input on a line may be deleted at the time of entry. An optional extra is a Basic text editor which is soft-loaded from floppy disc although we found the routines somewhat unwieldy. Routines included: move and delete — range — re-number, merge, compact — space removal — and repac — rem removal.

On power-up, the machine moves immediately into Basic and allows the user

Dimensions	Width	Height	Depth
Cabinet	18in.	13.6in.	15.8in.
Keyboard	18.7in.	2.8in.	6.9in.
Weight — 37lb. Including keyboard.			
Screen size — 13in. diagonal.			

Table 1.

to specify how many bytes are available for Basic memory. A null entry defaults to the maximum mounted in the particular model.

The full-colour display monitor has 64 characters per line by 32 lines or 32 characters per line by 16 lines in large-character mode. The default on power-up is the large-character mode. The 64 ASCII characters are formed from a five-by-seven dot matrix and there are a further 64 special characters created from a six-by-eight dot matrix.

The screen can also be used in a 128-by-128 pixel graphics mode. We found the colours rich and of good quality but like all colour displays, some resolution is sacrificed when displaying small textual characters. While the upper-case characters were satisfactory, the lower-case characters were poor and hard to read. In graphics mode, the screen displays are of a very high quality but again, smaller-resolution fields become ill-defined.

The keyboard on our machine was most impressive. There is a central-pattern, standard QWERTY lay-out topped by two rows of special function keys, which include 15 user-programmable function keys, and sided by three blocks of separate keys — a numeric pad, a colour-selection pad and an editing-function pad.

Most keys have two or three functions

accessible through either shift, control or escape-sequence selection. All of the Basic reserved words are available as single keystrokes. There are plotting functions for the graphics mode and, of course, most of the control-code functions required for using this machine as a Teletype terminal on-line through the RS232 interface. In addition to this there are the 15 user-programmable function keys.

The programmable-function keys on the demonstration machine had been changed for those supplied with the word-processing package which we look at later. These alternative keys provided a variety of editing functions under the control of the word-processing software.

The colour-selection pad offered cyan, dark blue, black, white, red, magenta, yellow and green. Colours can be selected for use in either foreground or background mode. All colours are selectable under program control as part of the plot command.

There is a re-set key on the keyboard which causes the machine to enter 'CRT Mode'. In this mode, the Compucolor II may be used as a VDU through the communications port to other computers. The output baud rate may be keyboard-selected from any one of seven preset values ranging between 50 and 9,600 baud. There are two methods of re-entering Basic, one destructive to any program held in memory and the other non-destructive.

As well as full cursor control — right, left, up, down, and home — there is also an auto key which causes the first program on disc to be loaded and run — auto-boot function. We found the keyboard construction to be of very good quality and it had a light feel.

Initially, it might be somewhat confusing to the first-time user because of the number of functions available — a small price to pay for such a tremendous range of facilities. Sensible colour coding of batches of the keys helps to avoid confusion. The deluxe keyboard is likely to meet the requirements of any computer user whether a novice or expert.

The disc drive was the simplest type we have yet encountered. It was a Siemens 5.25in. single-sided, single-headed unit. The disc format has 40 tracks and average access time is quoted as 400ms with a transfer rate of 76.8K bps. Total capacity is 51.2Kbytes per side. Compucolor recommends that users use both sides of a floppy disc simply by turning it over.

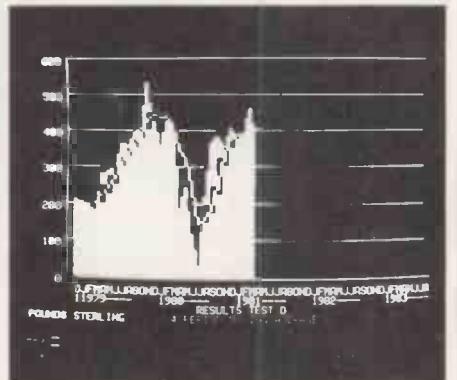
We felt dubious about this where the machine is likely to be used in a commercial environment unless the floppies are certified as double-sided. The drive is a box whose front is a flap which, when lifted, exposes the complete interior of the unit.

There is little to see other than the drive spindle and read/write head. Discs are placed into the mechanism; closing the flap makes it ready for access. The system occasionally had difficulty reading the

disc loaded, but it usually succeeded after a re-try.

Some of the disc commands work from within Basic such as save and load. Others had to be entered under the control of FCS. FCS stands for File Control System and is a mode entered through a keyboard selection which forces an exit from Basic. From it, directories can be displayed and files deleted and handled.

The disc commands provided were adequate but we did not consider this aspect of the system very user-friendly. The disc directory displays comprehensive information but also gives the file sizes in Hexadecimal. Only some 15 pages in the manual were devoted to the disc system and file handling so there is room for



improvement — this is really more applicable from the programming viewpoint.

The disc error messages are unclear and are in the form of four-letter combinations. Basic is equally guilty in providing only two-letter error messages. The screen displays three lines of some amazing random fireworks when a file is deleted either manually or under program control. This was apparently the result of FCS using part of the screen memory as its buffer area.

The printer was a Microline 80 serial dot-matrix printer. There was no documentation for it but it seemed to be a compact and quiet printer with very good print quality. Our version was friction-fed and plugged straight into the RS232 interface port at the back of the monitor.

The Intel 8080 microprocessor acting as CPU has a two micro-second cycle time and the overall effect was that of a fast processor. The physical specifications for the system are given in table 1. The prices for the Compucolor II are listed in table 2.

The first of the two software packages we looked at on the Compucolor II was a data management and display system called Trendspotter. The package is a U.S. product for the Compucolor produced by Friend Information Systems of Boston.

The suite of routines allows users to create files containing relevant data or statistics for subsequent plotting in the form of line graphs, point plots, bar charts and further analysis of such data for trends and patterns. Application of the package is simple and it is intended to assist any operator to display data and

develop a better understanding of the information content.

The package is supplied in the form of a comprehensive manual and two floppy discs — one program disc and one data disc. The software is a single program. Once it has been loaded, the program disc is dismantled and the data disc brought into use. The main menu offers:

1. Update file
2. Create a new file
3. Edit old file
4. Delete a file
5. Hard-copy printout
6. Directory of files
7. Change file name
8. Go to display program

Initially, data must be entered into a file for retrieval by the display program. Data may be periodical or independent — although the package is geared to analysis of data against a time base of months, quarters, or years. The create function prompts the user for a title of the data to be entered, the file name under which it will be stored, whether the data is monthly/quarterly/yearly, the starting date, and a units title.

Having completed this, the system produces a formatted screen and proceeds to prompt the operator for the data values against incrementing dates beginning with the start date. Each value is keyed until a null entry terminates the data input routine and the operator is then prompted for confirmation to write the file away.

Having created a file, it can then be displayed, edited and updated. The edit function displays the data dates and values on the screen and prompts for the entry of the date of the value to be altered and then its new value.

The update function permits additional values to be concatenated on to the end of the file at a later stage. The routines are easy to understand and use. Having entered a few files, the other main function is the display program, option 8.

The display program creates a blank graph format on the screen and awaits input from the operator at a prompt point on the bottom of the screen. Data files may be loaded into one of four work files in memory or into a common work area. Alternatively, files may be called for direct plotting on the screen.

Any file loaded from the disc is placed automatically into work area 0. From there, it may be saved into the other work areas numbered 1 to 4. If we had a file of values called EXPA, it could be plotted as a bar graph by simply entering BAR EXPA or the same result could be achieved by entered Load EXPA followed by BAR 0. In both cases, a copy of file EXPA is left in work area 0. The display is filled in with x and y axis values and descriptions and a bar plot is built across the screen in a suitably different colour from the background.

Trendspotter calculates the axis to fill the graph format and labels the display with the title of the file in the same colour as the plotted information. Further files

may be plotted on to the same chart in different colours providing there is not too significant a change in the scaling factor.

The types of plot are: bar graph, line graph, scatter graph — point plot — area graph line graph with solid colouring of area under the plot, and nBar or multiple bar graph — several bar plots combined. Various types of the same data may be executed on the same display to find the most appropriate display method. The data may be further manipulated in the

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Programming manual	£14
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Oki Microline 80 Matrix Printer	£329
Software	
Compuwriter word-processing package	£146
Trendspotter data-display package	£245
Basic editor	£20
Fortran	£40
Pilot	£30
Statistics pack in three volumes	£55
Other programs are available such as games and utilities and other business applications are due for release soon.	

Table 2.

work files to provide some simple trend analysis. The options include:

Smooth: Calculates an exponential smoothing of the data in the 0 file and plots a line graph with the result. A factor of between .01 and 1 must be entered as the argument.

2Smooth: same as smooth except that it computes and plots a second-order exponential smoothing of the data in work file 0.

3Smooth: third-order smoothing.

Moving: calculates a moving average and plots a line graph. User must enter a value to indicate the number of periods for the calculation.

Trend: computes a linear-least-squares trend line and plots a line graph. An optional date may be entered to indicate the start point for the evaluation.

Etrend: computes an exponential-fit trend line and plots the result.

Ltrend: computes a logarithm-curve fit trend line and plots the output.

There are a further 33 commands for handling data, data files or making cosmetic changes to the display parameters. They can be entered as the first three characters of the command followed by any argument necessary. Many of the commands are useful but we found little occasion to use many of them.

The package does an excellent job of handling and displaying the data in a reasonable format. The user may plot as much information on any one display as can be digested and would appear to be a

welcome aid for anyone whose job requires a considerable amount of forecasting with figures. The package is simple to use and although it lacks a number of other analytical routines such as multiple regression, the methods available should be sufficient for most data analysis.

Trendspotter is well-named. We found that the programs are robust and the displays excellent. Certainly a program like this is a great aid in the pictorial representation of time-based data. From the two example files used, some interesting trend information was gleaned which was far from apparent or even obvious from a close examination of the numerical data. It was unfortunate that the printer would not interact with this program to allow us to obtain a hard-copy listing of the data files. The manual refers to the use of plotters. In general, the documentation was very good and not difficult to read or use. Trendspotter is exceptionally good value for money at the quoted price.

The second application package supplied with the Compucolor II was a program called Comp-U-Writer. It is a word-processing package for the machine written by an U.S. company. To run the package, users are required to have the full 117-key keyboard. Supplied with Comp-U-Writer are about 20 key-tops, which replace most of those on the top row of the keyboard and provide dedicated functions within the package. Comp-U-Writer is supplied in the form of an A4 manual and two program diskettes — one of which is for security only.

When you load the program, the system requests a date entry and the screen is set into a 24-line blank page and a ruled heading for showing tabulator settings and messages. Comp-U-Writer can accept and hold up to 500 lines of typed text based on the Compucolor II 63-character-line format. This storage capacity is divided up into a number of 24-line pages.

The status line at the top of the screen shows the user on which line and which page the cursor is to be found. Comp-U-Writer accepts text entry directly from the keyboard and pre-formats the input on to the screen preventing truncation of words on wrap-around of the text from one line to the next.

Text is displayed as green characters on a black background in both upper- and lower-case. Once some text is entered, the user may move the cursor around the screen and any further text entered at the cursor position is automatically inserted into the line.

The cursor is a solid colour square and does not act as a background character. As it is moved along a line, the characters and line move one space to the right of the cursor which visually produces a most unusual effect. Each page automatically scrolls upwards, line by line, as more text is added and the page indicator is incremented. Four of the function keys

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allow the operator to jump around a document as follows:

- Beg — Place the cursor at the beginning of the document. (page 14).
- End — place the cursor at the end of the document.
- Next — move the cursor on to the next page of text.
- Prev — move the cursor on to the previous page of text.

A tabulator key is provided and there are two fixed — function keys offering set-tabulator and clear-tabulator options. Tabulators are indicated by markers on the status line at the top of the screen. Editing keys are provided to give the following functions: delete character, delete word, delete line and undelete.

The undelete key will restore text which has just been deleted inadvertently. Insertion occurs automatically if text precedes the current cursor position on a line or extra lines can be inserted with carriage returns.

There is the facility to mark blocks of text with a mark-beginning and mark-end function. The cursor is positioned at the start of the text to be marked and "mark beg" is selected which places a special red character at that point on the screen.

Cursor movement to the end of the text to be marked is followed by the "mark-end" key and the interposing information is displayed in red. Once a block of text has been highlighted in this way a number of facilities are available to manipulate the block using more fixed function keys. These are:

- Move block — if the cursor is moved to another part of the screen and move block actioned, the block is inserted at this position and the remaining space closed up.
- Copy block — produces a copy of the marked text at the current cursor position.
- Delete block — removes the marked text from the screen and closes up the display.
- Marked text may be unmarked by deleting the marking characters displayed at the beginning and end of the block. Screen editing is carried out as quickly as we have seen in other microcomputer-based word-processing systems.

Words or phrases may be sought and replaced through three function keys offering define, search and replace. The define key prompts the operator to enter the required word or phrase. Once completed, this is stored for future reference until changed by the entry of something else.

Depression of the search key causes Comp-U-Writer to search through the text held in memory and to place the cursor on any first match it can find. For several occurrences of the same word or phrase, the search may be re-enacted from the new start point. If replace is selected, the operator is prompted for input of text which is to replace any occurrence of the search option.

The replace option will alter every occurrence of the search string if desired.

Cursor movement may be either slow or high-speed. Text may be further formatted on input by selecting either the

indent or centre functions. Centre causes any text entered to be positioned in the middle of the page. As more words are entered, Comp-U-Writer re-justifies the line to re-position it around the centre of the screen line until a carriage return is entered, forcing the cursor down on to a new line. The indent causes the current line of text to be started at a left-margin position which corresponds to a default value set by the user as part of another Comp-U-Writer.

The balance of the dedicated function keys and their facilities within Comp-U-Writer are associated with the disc file handling routines and the setting of options for producing hard-copy print-outs of the text.

Text may be saved and re-loaded from floppy disc through the save and load function keys. When you select the save option, you are prompted for the file name under which the file is to be stored. Comp-U-Writer then concatenates the current system data which was entered on loading the software program — or to the end of the file name and proceeds to store the information on the diskette mounted.

To load a file into Comp-U-Writer, the load option is keyed and a display is produced of the first five directory entries on the disc. Each entry shows the file name, the date of creation and the number of pages contained. Placed beside each file name is an individually-coloured square.

To load the chosen file, the user hits the colour key corresponding to that file. If the required file is not shown in the current display, the next five may be brought on to the screen by hitting the list function key.

Disc functions comprising; initialisation formatting of a new disc — file deletion, and renaming of files are offered through a similar colour-coded menu option selected by depressing the out key.

Printer options are provided for through two functions. The print key will allow for the setting of the following defaults — again through a colour-coded menu: Lines per page — page length; characters per line — page width; left-margin position; M indentation start point; baud rate setting — for printer: and start-page number.

Printing is started by selecting the print function as a command key and the operator is led through two screen menus offering the following option before printing starts:

Double spacing	Continuous forms
Two columns per page	Justified right margin
Marked text only	Auto page numbering
ETX-ACK protocol	Commence printing

While printing is in progress, the user may abort the function by pressing the escape key. The ETX-ACK protocol is a handshake-procedure required by some printer devices. Marked-text-only is a very useful option which allows the operator to print blocks of text highlighted with the mark-beginning and mark-end key options.

The two-column selection forces Comp-U-Writer to print the text in two discrete columns on the page. This would presumably be used in a publishing-industry application.

We found Comp-U-Writer to be a very simple word-processing system but very easy to use by virtue of the colour-coded dedicated function keys. Dyad Developments offers the excellent NEC Spinwriter as the hard-copy printer for use with Compucolor II and Comp-U-Writer and many should find the package more than adequate for the preparation of non-standard letters and reports.

The only convenient way to erase the Comp-U-Writer memory of all text was to re-set the machine and re-enter the program at the opening sequence which meant having to re-key the system date. It was also a pity that the user is not given the opportunity to define which colour is to be used for the background screen or for the display the text characters on the screen.

We found that better character definition was obtained with white on black. Other than this, the package appeared to be robust and should prove to be useful for commercial users of the Compucolor II. Like Trendspotter, the program certainly offers very good value for money at £146.

Conclusions

- For those interested in colour-display microcomputers, the Compucolor II must be a serious contender against systems using a colour television set as their output display device.
- The colours provided are not extensive, but rich and easy to select directly from the keyboard: the display quality is superior to TV output although some lower-case characters become ill-defined when buried in a screen full of text.
- The price of this machine is certainly competitive in the present U.K. market and the Compucolor II represents a good buy for those who would like a colour-based Teletype VDU for on-line working to mainframes.
- A ROM-resident screen editor would be a distinct advantage for the Compucolor II.
- The keyboard is of a high quality and should meet most users' requirements in terms of facilities ad features.
- The Basic interpreter has all of the commands commonly available in other machines and FCS is adequate although error messages from both are not well-defined.
- Trendspotter and Comp-U-Writer are both useful packages which represent good value for money: some of the more traditional commercial functions — payroll, stock, ledgers, etc. — are now needed before this machine becomes generally accepted in the business environment. □

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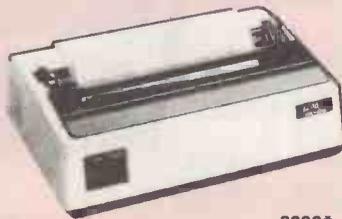
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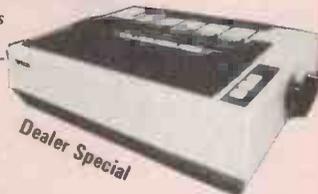


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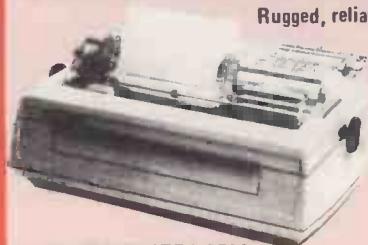


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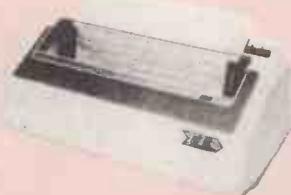
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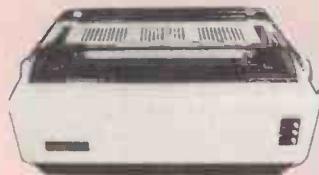
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The Printer Professionals



Prokit's machine-code routines ease data-entry problems

PROKIT 1 is a collection of machine-code subroutines intended to solve data-entry problems for programmers and operators alike. The program is available on tape, disc, and Computhink disc for 32K large-keyboard Pets with the new ROMs, and in identical format for the newer 8000 series SuperPets.

My version of Prokit was supplied by Intex Datalog of Eaglescliffe Industrial Estate, Stockton on Tees, Cleveland, a company which is a local Pet dealer and

by Joe Telford

which produces business software; Prokit is a spin-off from these packages and consists of a CBM disc and a manual.

The manual is of foolscap size, 20 pages in length and uses the front cover as an instant guide to the package. The manual is structured to take you through all the Prokit routines one by one and suggests ways to use Prokit in your programs. Prokit's use with tape, CBM disc and Computhink disc is covered in a section at the end.

The manual is essentially easy reading. In addition to the manual, there are a number of demonstration programs you can load to help you during a section on a particular routine. These programs are full of REM statements and easily understood.

The first program to load is Prokit itself. Once run, it settles in the top 3K of user memory, just below the visible screen. The operator must now set the top-of-memory pointers — unless that is done by any program containing Prokit. Examination of the top 3K of memory showed that no space was left to hold DOS support for CBM discs.

This plus the fact that all routines are called by the Sys command, with parameters amended by Pokes, made me wonder why Prokit had been designed in this way while other programming-aid packages were patched into Basic.

Intex Datalog explains that the lack of DOS support was simply because during the run of the kind of large program you might design with Prokit, the operator would not need DOS support. Indeed, the Prokit package has to work for tape users and Computhink disc users, hence the version must be acceptable to all.

Intex Datalog's reason for not patching Prokit into Basic, via the Chargot memory area, is because there are a number of add-on programs and ROM chips using the patch, and even Computhink uses one. Prokit must be able to run with any of these loaded, in



any order — hence the apparently clumsy Sys/Poke technique.

The manual shows that there are six specific routines, each called by a Sys command, with parameters adjusted by one or more Poke commands.

They include:

1. Date input
2. General input of chosen valid characters.
3. Numeric inputs.
4. Screen-to-printer graphic conversion.
5. Search/match routine.
6. Screen-swap routines.

Once Prokit is settled into memory, the string QS is set to the null string and the

Size	3K memory not including extra screens
Type of program	Machine-code routines
Computer type	CBM 3000,4000,8000 series.
Market	Serious amateur/business programmer.
Cost	£35 plus VAT
Setting up	QS = " ": Poke 59468, 14 : Lower Memory
Routine calls	By Sys commands, adjusted by Poke commands
Special entries	Default entry allowed.
Facilities	1. Date entry. 2. General entry. 3. Numeric entry. 4. Graphic conversion 5. Search/match routine. 6. Screen exchanges.

Figure 2. Prokit package details.

Pet Poked into lower-case. Failure to set QS will cause syntax errors during use. Setting-up must be done in the Basic section of each program to use Prokit. The string QS temporarily holds the input after being formatted by Prokit. For this reason one normally copies the contents of QS into a more permanent variable, so

that data is not overwritten by future input-routine calls.

The date-input routine allows input into QS of a date in the format dd.mm.yy. On calling SYS 29699, a reverse field bar eight spaces long is produced after the last print position. Only valid dates may be entered, e.g., 29.02.80 is treated as valid, though 29.02.81 is not, nor is 31.09.81.

If the reverse-field area is filled by a print statement, the cursor is returned to the start of the field before calling the routine. The reverse field will display a default value which will be accepted by pressing return. The return key can be pressed at any time during date input, but only valid dates will be accepted. When a valid date has been entered, the reverse field clears leaving the entry still on the screen but also in QS for processing.

If, during input, the operator presses the Shift-Clr key combination, the format dd.mm.yy. is superimposed on the reverse field as a memory jogger. A demonstration program "PKD" is included to show the use of the date-routine in a program.

A certain maximum number of particularly-chosen valid characters may be entered into the general-input routine. This routine is set up by creating a string VCS containing all the valid characters allowed in entry and then by Poking the maximum number of characters into location 1. A call of SYS29696 produces a reverse-field bar, the length of which is governed by that Poke to location 1.

Only characters previously loaded into VCS will be accepted and the Return key can be pressed at any point in the line. If the entry is less than the full bar length, QS will be padded with spaces to help future print formatting.

As before, default values can be set for Return key entry. Because they are in the

entry field, the routine assumes they have all passed the entry-validation tests. All characters in the default entry are, therefore, accepted, valid or not. It is up to the programmer to ensure that the program default statements are valid.

This routine does not check for spelling mistakes — the size of a suitable dictionary makes it impossible. Again a program with many REMs is included for demonstration, and a more elaborate version is included as well as suggestions for applications such as telephone-number entry.

Numeric input

The numeric input routine allows the input and formatting of numbers, specifying the number of places before and after the decimal point as well as allowing positive-only numbers to be input or both + and - number entry. Before calling the routine, three locations must be Poked:

910: the number of points before the decimal point

911 : the number of points after the decimal point

912 : a 0 for only positive numbers or a 1 for both negatives and positives.

SYS 29702 calls the routine and the now-familiar reverse-field bar appears as in the other routines. Because numbers are entered from left to right, the number 12 in a four-digit entry field looks like 1200. When the decimal point is pressed, however, the routine re-formats the number to 12 automatically. An unwary operator can press Return at an inappropriate stage and obtain a garbage input a power of 10 higher than expected.

Two remedies are suggested in the documentation. The first alternative is to press the decimal point after your whole-number part has been entered, then the Return key. This is, in fact, what I suggest. The routine has a special extra key, J, which behaves like the return key except that only numbers to the left of the cursor are accepted into Q\$.

The normal Return key enters everything in the field into Q\$. The demonstration program "PKN" shows ways of using the routine, reminding the operator that in accepting both positive and negative numbers, the '-' key can be pressed at any stage to make the number negative, and the '+' key reverses the process.

The previous three routines have an extra key which behaves as a Return key. The RVS key performs the same function as Return, but after it has been pressed, the location 32767 contains a 1 to indicate trouble. The suggestion given with the documentation and demonstrated by the accompanying programs is that an operator may notice an input mistake, such as a spelling error, possibly three inputs after it has occurred.

The operator can press RVS and a Basic routine can step the input back sequentially to the faulty line. This can be corrected and the correct inputs Returned to the position where the error was noticed. The program can then continue as normal.

The Pet, in some printer combinations, prints garbage on a printer when the screen is in upper- and lower-case. The graphics-conversion routine adjusts for that problem. As before, input from the screen goes straight to Q\$. SYS 29711 adjusts Q\$ to print correctly on a printer.

Search match

With the search/match routine, characters in string S2\$ are searched for a substring S1\$. Both strings must be set by the program, then SYS 29708 does the hard work. Location 32767 contains the number of the character in S2\$ where a match starts. If the number 0 is found, no match occurs. The serious programmer will find that sequential searches using the routine are up to 200 times faster than using Basic.

An additional benefit is the reduction of garbage collections when using the routine.

Its suggested uses are given in the manual and a demonstration is included. One which particularly interests me is the implementation of a Match statement in Basic, so that a Pilot-like language can be approximated.

In a Basic program, a number of data-entry forms may be duplicated on the screen. The suggested method is to create them in their entirety and call them to screen when needed by machine-code screen exchange. The routines allow the exchanging to be done, though not the creation of screen forms. This is done by a program called Screens which has 10 suggested input forms, which you may change to suit yourself using the editing facilities provided by the program.

The final results can be protected, the Screens program erased, and the operator's own business/administration program added. The complete combination can then be saved for future use. Once the screens are created, the next step is the use of the routine which calls the screens into view.

The control over screen exchange is as follows:

1. Memory copied to screen.
2. Screen copied to memory
3. Screen and memory swapped.

The type of exchange 1,2,3 is governed by Pokes to locations 32503,32504,32506, 32507 and called by SYS 29705. If more than one hidden screen has been created, additional Pokes to locations 910 and 911 are needed to select the particular screen.

Each screen of information uses up an extra 1,000 bytes below the Prokit routines, so one is advised to use the minimum number of screens necessary for any particular business program. The complete routines are demonstrated in a program 'TDEM', which is very impressive.

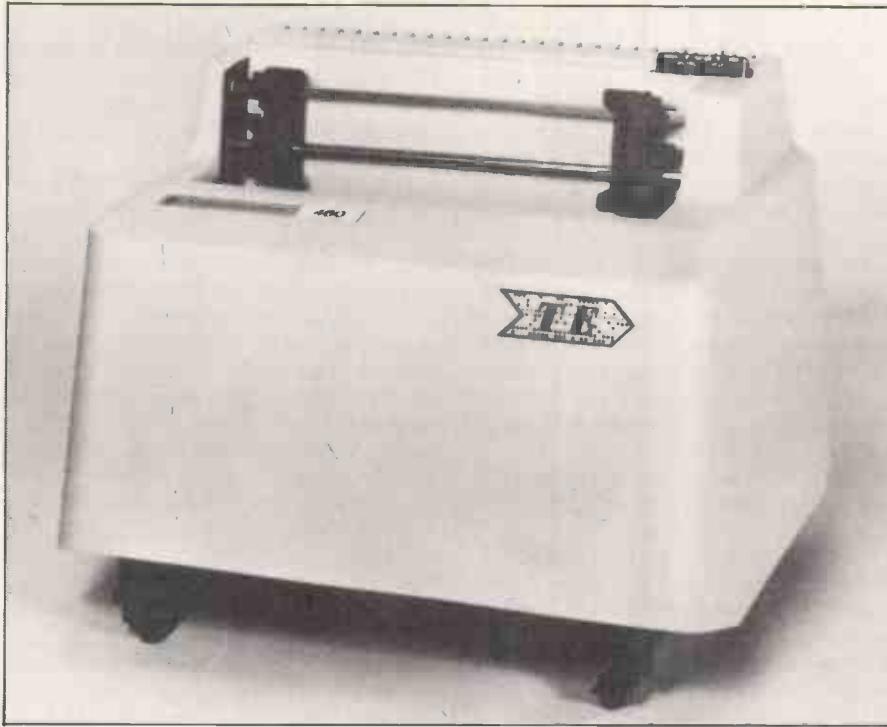
A section of the manual is devoted to an explanation of how to use Prokit in one's own programs, and deals with saving the entire memory on tape, CBM disc and CompuLink disc. Commercial software writers wishing to use Prokit may contact the distributor to reach an agreement over copyright.

Conclusions

- I tried especially hard to create a situation which affected any routine, and in all situations, as long as the correct Pokes, Sys and valid characters were set, Prokit behaved according to documentation.
- My biggest worry now is that any data errors in programs which I write will be caused by poor programming on my part, rather than their poor entry technique.
- It is worth looking after the manual as the Screens program and swapping routines are more difficult to remember than the other routines, most of which I have now committed to memory.
- All in all, a very useful package. □

Figure 1. The Prokit memory map.

Address	Contents	Address	Contents
1	Length of field for general input routine.	29439	Top of spare screens 1K for each screen.
910	Number of spaces before decimal point/low byte of current screen start.	29440	Start of Prokit
911	Number of spaces after decimal point/high byte of current screen start.	29696	Link to general input routine
912	Sign for numerical input.	29699	Link to date input routine.
1025	Start of Basic program area.	29702	Link to numeric inputs
		29705	Link to screen exchange
		29708	Link to search routines
		29711	Link to graphic conversions
		32503	} Directions for type of screen exchange.
		32504	
		32506	
		32507	
		32767	Flag for search/RVS ROUTINES
		32768	Start of visible screen.



The action of the Tiger

THE PAPER TIGER made its first appearance in the U.K. in September 1979 as an eye-catching design — one of the American contenders against the onslaught of the Japanese dot-matrix invasion. Like the majority of dot-matrix machines, that model, the 440, had a seven-wire head, producing a text crippled with truncated descenders which was legible, useful for listing and general computer donkey-work, but a poor second to the Qume/Diablo front when it came to word-processing.

Substantially the same machine is still available as the 445, but the manufacturer, Integral Data Systems, is closing on the heels of the expensive daisy-wheel designs with two new offerings, the 460 and the 560, each of which offers true descenders and a print appearance not far removed from that of a good typewriter.

The improvement is achieved by increasing the number of wires in the head to nine and by staggering them so that the individual dots to some extent blend into a smooth line. High print-speed is maintained at around 150 characters per second, and according to Integral Data Systems, the machine “also offers a bi-directional logic-seeking device to enhance its print optimisation characteristics”.

Teleprinter Equipment, the U.K. distributors, lent us the 460, the version designed for standard 8.5in. tractor-feed stationery, although the adjustable tractors will take all the smaller roll sizes. The 560 is a similar machine

mechanically, but with a maximum carriage width of 14.75in. and a newly-designed case. The 460 retains the upright moulded resin case of the earlier Paper Tiger model.

The industrial design of the machine was, frankly, a disappointment, as if the good ideas and the ingenuity had all been used up on the internal workings. The case in particular, a single resin moulding that slips over the chassis from above, is an ergonomic flop, and for most of our

by Chris Bidmead

trials, we dispensed with it altogether, wedging a piece of rubber into the micro-switch which cuts out the mains when the chassis is exposed.

In everyday use, this cover probably works well enough. The poor design becomes evident only when trying to remove or replace it — to change the ribbon, for example.

The 460 and 560 each use the same ingenious ribbon cartridge — a kind of oblong plastic box into which the mechanism stuffs the ribbon at one end while pulling it out at the other in a continuous Möbius loop. Ribbon life is now claimed to be increased from six million to nine million characters compared to the previous open-ribbon system, although the new cassettes now cost £13 each as opposed to £9. This represents a small saving, until you prematurely damage a ribbon and have to throw it away, because

there seems to be no easy way of repairing the loop.

The machine arrived with tell-tale inky finger marks on the cover, indicating that somebody had had trouble fitting the ribbon. We quickly discovered why — although the ribbon is neatly cartridge, its inked surface has to be handled to loop it round the four guide rollers. Replacing the case afterwards is not an enjoyable business. There are too many points at which the strangely-shaped case can foul the chassis.

The dedicated owner, who has bought the machine for its undoubted versatility — RS232 and parallel interfaces are options, and the electronics offers a choice of font sizes, as well as a proportional-spacing option — will no doubt become adept at handling the case, guiding it back so that its four slots engage simultaneously over the chassis bolts.

Even so, the day will arrive when he, or somebody, picks the machine up to carry it across the room. The case is held on to the chassis by four finger-tightened nuts — or, in transit across the room, *vice versa*. The ease with which the chassis could drop from the bottom of the case hardly bears thinking about.

On power-up, a toggle switch gives the option of self-test, continuously printing out the whole character set. The manual also recommends using this switch “momentarily” for emptying the buffer to abort printing. Your idea of “momentarily” had better correspond with the manufacturer’s, because if this moment is prolonged until the printer begins to self-test and the print-head is not in the home position, the self-test logic insists on printing out a full line, remorselessly jamming the print-head against the right-hand limit of travel with an awful graunching noise.

When this happened, we dived for the mains-off switch, but not before we had fouled the ribbon and blown the print-head motor fuse. To replace the fuse and the ribbon we had to remove the cover.

The 460 appears to offer a choice of four character fonts, though in reality they are all a re-dimensioning of the same basic set. Thus the smallest, 16.5 to the inch, resembles book type, particularly when printed out proportionally; and the largest is the familiar dot-matrix ‘Expanded’. The appearance on the page is close to a good cloth-ribbon typewriter, the slight unevenness giving the text a hand-wrought look.

Occasionally, particularly at the beginning of lines, a character appeared to be squashed sideways, and this might create problems of legibility, especially with figures printed in the smallest size. Apart from this, and a raggedness of the left-hand margin which we managed to cure by tightening the drive belt, the printed output is very elegant. The smallest type size enabled perfectly-legible full assembler listings to be made on 80-column paper.

The 460 on trial was supplied with the full graphics option, which includes a 2K buffer and the capability of addressing each needle individually, so that in theory, the printer will print any pattern for which you have the patience to write the software. If you do not have patience, but have an Apple, a commercial package called Apple Graphics Dump will send screen graphics directly to the Paper Tiger.

We tested the graphics to the extent of printing a series of chequers of various sizes, and everything worked very well and at high speed. Resolution is excellent, comparable with so-called infinite-matrix printers.

We drove the printer at its top speed of 9,600 baud and ran into buffer overflow problems, as our standard printer-driver software is based on ETX/ACK buffer control, and so failed to recognise the DC1/DC3 protocol observed by the Paper Tiger — see table 1. All the other printers we have tested offer both protocols, either simultaneously or as “strappable” options, and we had to spend some time with a hot soldering iron around the sensitive parts of our Bitstreamer II I/O board before solving the problem by implementing the Data Control Ready handshaking line of the RS232 interface.

Although we used the printer only in its RS232 mode, the machine can be re-configured as a parallel Centronics-type printer with some nimble-fingered re-strapping. This is not something one would want to do every day, but the inaccessibility of the relevant jumper board is one more manifestation of the inward-looking design, which seems to tolerate but not welcome human contact.

Another example, common among printer manufacturers, is the misuse of miniature DIL switches. These devices, though robust, are intended on the whole for once-and-for-all setting of options — so that defining the baud rate and parity is a legitimate application.

The Paper Tiger leans on them too heavily for setting and re-setting such variables as auto-line feed, proportional spacing, form length and character density. True, these options can also be adjusted through software, and in a properly-integrated system probably would be. However, by the time you have re-written your operating system, the domestic laser printer will have arrived.

Limited word-processing facilities are built into the machine, so that it is possible to write software to alter margins and execute absolute tabbing both vertically and horizontally. In particular, the right-justification mode offers very clever word-wrap facilities.

Table 1

Speed test comparisons with daisywheel printers are not really relevant because the applications are different, but we ran two of our standard speed tests on the Paper Tiger to see what kind of speed advantage a good dot-matrix machine could give.

Test	Time taken
Standard-text test	1'03"
Formatted-text test	0'26"

Comments

57 cps — half the claimed best speed. Yet the manufacturer does not define the conditions of its own test. The machine was in justify and proportional mode, so had a good deal of thinking to do. Under these conditions it was not much faster than a daisy-wheel printer.

Twice the speed of a good daisywheel printer. The print-head moves very fast, bi-directionally converting strings of spaces into absolute tabulations. Yet direct comparison with daisywheel speeds is unfair — the Paper Tiger did not provide underlining in this test.

Text is sent to the printer without carriage returns — except at the end of paragraphs — and is automatically broken at the correct spaces into lines that are then padded out to be of identical length. There is no easy way, though, of producing underlines and centring text.

Conclusions

- The Paper Tiger is a fast dot-matrix printer with correspondence-quality resolution.
- The machine should be trouble-free and inexpensive to run — but the ribbons are only available from the distributor.
- A good variety of setting-up options means the printer should be able to match virtually any system.
- Poor industrial design mars an otherwise well-conceived machine.
- At £795 for the 460, £995 for the 560, the new Paper Tiger is not exactly given away. With Japanese competition hard on its heels, these prices may well fall soon.

Spinwriter's quality is not just on paper



OUR FIRST impression on unpacking the NEC Spinwriter was one of superb production engineering. The case is the apparently now industry-standard cream colour well-cast in three metal parts which fit together perfectly. The front cover is articulated on long hinges which lift it clear of the tractor feed when fitted and it snaps shut again with reassuring firmness. Even the disposable security bolts which hold the machine during shipping are beautifully tooled.

Not one but two main power switches are provided at the front and rear, ingeniously linked so that the functioning switch is defined as whichever the user switches on first — you do not have to fumble for both of them.

The purpose of this is not entirely clear; perhaps the rear switch is intended for applications where an unqualified user might switch off the machine accidentally.

Optionally, the machine will self-test on power-up, though only in the most rudimentary way by reiterating the familiar holo-alphabetic sentence about the fox and the lazy dog. The built-in diagnostics also appear elementary at first sight. They are based on combinations of

(continued on next page)

(continued from previous page)

a single light and an alarm bell; so that, for example, the light and the bell with printing continuing indicates "Paper out", light and bell with printing arrested means "Cover open", while a repeating bell broadcasts the news that all is not well with the print-head. Until one masters these various cries for help, the teething period can be very noisy, but with practice, it becomes easy to identify the fault quickly.

An obtrusive feature at the back of the machine is a chrome-plated wire cage responsible for monitoring the even feed of continuous stationery to the platen. The equivalent on other machines is a simple grill which ensures that incoming paper does not choke the air intake. The Spinwriter device is hinged, and requires continuous paper to be threaded through it so that a microswitch can detect the paper-out condition.

It adds to the complication of loading continuous stationery and means that if using single sheets, something has to be done to override the switch. Though the arrangement works well, we were left with the feeling of a certain amount of "chrome-wire overkill" in this department.

Access to the internal workings is a simple matter of operating two levers inside the cover, which lifts off cleanly with no trailing wires. The interior is uncluttered and well laid out, with most of the components easily accessible. None of these, incidentally, seems to run at much more than blood heat, even after sustained operation.

The electronics occupies four large, well-mounted boards at the rear, three of which run almost the whole width of the machine. From the size on the boards and the mixture of components, it becomes clear that the very latest technology has not been used, but this seems to be a deliberate design choice — part of the overall conservative philosophy.

One element of the design is obviously innovative — the tulip-shaped print-element, or "thimble". Unlike the Diablo daisywheel, but like more recent wheels such as the Ricoh, each petal carries a pair of characters.

This introduces the need for a vertical shift, with corresponding complications to the print-head design, but the trade-off is a gain in print speed and the ability to offer a total character set of 128 characters compared to the more usual 98. Changing the thimble seemed to be marginally more difficult than the corresponding operation on the Diablo, though this may have been due to our lack of familiarity. On both machines, the ribbon has to be removed first.

Annoyingly, the left edge of single sheet paper sometimes caught the print-head, causing the ribbon to ride up out of position, and the lid had to be lifted to adjust it before printing. We have encountered a similar bug on other

Test	Time Taken	Comments
Standard-text test	1'31"	43 cps — rather less than claimed. The manufacturer does not, however, define the conditions of its own test.
Formatted-text test	0'57"	About the same as a medium-speed printer.
Graphics test	7'40"	Not impressive.
Tabbing test	0'43"	Very good. The Spinwriter seems to handle tabbing cleverly.

- **Formatted-text test.** The 8080 CPU loses a relatively large amount of time in calculating print-head movement, so that the speed of printing heavily formatted text is disproportionately slow.
- **Tabbing test.** The Spinwriter seems to translate a string of spaces into a single continuous carriage movement, resulting in print action which is smoother than the usual judder associated with the LPrint Tab instruction from Basic on ordinary daisy-type printers. The trick with the latter is to translate all Tab instructions into absolute tabulator instructions, using ESC LT «ascii character». This also works on the Spinwriter and results in an improvement in tabbing speed.
- **Graphics test.** The Spinwriter makes the necessary calculations so slowly that in this mode it runs some 50 percent slower than its nominal print speed would suggest. The machine also seemed to be somewhat careless about its print-impression control when running in graphics mode: its full stops almost drilled through the paper.

Table 2.

machines: there is often a position of the paper guides that causes the paper to foul against the print-head in its zero position.

Mechanical single-sheet feeders are sometimes programmed to move the print-head to the centre during paper-change, and it seems a pity that this cannot be arranged to occur during manual paper-change. The remedy is to be careful on setting the paper guides

On one occasion, the ribbon broke — our only carbon ribbon — which gave us the chance to discover that the ribbon cases are so well engineered that it is a simple matter to ease them open, effect the repair, and snap them shut again. In fact, they are so well made they are virtually refillable.

Which they might well need to be. None of the computer-consumable suppliers we talked to knew of any alternative manufacturer of Spinwriter-compatible ribbons and thimbles. There seems to be little difficulty in obtaining supplies from NEC — at least not in London. Yet the absence of "second-sourcing" is something would-be buyers certainly ought to take into account.

The model under test was the 1515, chosen as the version which understands the Diablo escape codes of our word-processing software. Physically-identical machines are available to match a variety of interfaces, notably Centronics, parallel Qume, and Current Loop. The Diablo version seems to correspond closely to the older Diablo escape codes, which are a sub-set of the current protocol used on the Diablo 630 but the Spinwriter does not understand any of the later updates like Remote Re-set and Top Margin. The 1515 is, in fact, described in the Spinwriter maintenance manual as a direct replacement for the Diablo 1610 a machine now two generations old.

Its chip technology seems to belong to much the same era, and it is clear that

assessed alongside newer machines like the Diablo 630, the NEC Spinwriter is a little long in the tooth. Apart from the novel tulip-shaped print-element which may well owe its existence as much to the laws of patent as to design progress, and a major re-think of the printer chassis "borrowed" back by Diablo in its new range, the Japanese device appears to be little more than a collation of beautifully-engineered refinements on the old Diablo 1610/20 range.

The result is a conservatively-styled, beautifully-built printing terminal with a reputation for sustained trouble-free performance. Its philosophy seems to be to accept a slight trade-off of print quality against increased print speed, although this gain is unfortunately lost whenever the somewhat senior 8080 CPU is called on to deliberate on print-head movement optimisation — see table 2.

Within these limitations, the Spinwriter is quiet, fast, and gives the impression of being very assured in operation. Memec, the U.K. distributor to which we are grateful for the loan of the review machine, recommends an end-user price of £1,950, which is not exactly a bargain. Shop around and be prepared to argue: these prices are not carved in stone. Be careful, though, to make sure that the dealer from which you buy can give you support at the price you choose.

Conclusions

- Mechanically fast, the spinwriter still "thinks" slowly.
- There is no second-source yet for Spinwriter ribbons and thimbles.
- The print quality, though very good, is not of the first order.
- Manufacturing quality is superb.
- The Spinwriter is a mature product in the very best sense: bug-free, increasingly well-supported, and as reliable as the best machines available.

Writing your own business software

PERHAPS the best piece of advice in this series will be given in the first sentence — don't. Producing good business software is a job for a software house. Its staff will, ideally, be able to take the time and trouble required, knowing that their investment can be recouped from volume sales of a successful package. Their experience will produce results of a standard you will find hard to match.

If you are still reading this, you probably fall into one of the following categories:

- You have a specialised problem, cannot find a package, and custom-written software would cost you the earth.
- You have plenty of time and are convinced that you can do the work yourself.
- The sales literature for your machine says that programming can be learnt by anyone with a few hours to spare.

The way to avoid the hours of work normally involved in designing, programming and testing your system is to have someone else do most of it for you. Since about 80 percent of all programming is not concerned with the application in question, but relates to input validation, data conversion and other standard routines already in existence, it follows that 80 percent of any typical program has already been written.

This series aims to provide you with the 80 percent and help you write the other 20 percent. I shall assume that you already

by Charles Somerville

have some programming experience, and, as Basic is probably the most commonly-used language, it will be used in all the examples.

All the routines are already incorporated in successful commercial packages, using Microsoft Basic and CP/M. Users of other Basics, and perhaps other languages, should be able to convert the routines easily for their own use.

Imagine that you are watching ITN's *News at Ten*. The newsreader's head appears at the top left-hand side of your television screen. As the program progresses, more of him appears, until you can see a head and shoulders lining the left-hand side of the screen.

At this point, the newsreader's toupe begins to disappear from the top of the screen, while his torso climbs on from the bottom. By 10.30pm you are left with a view of a pair of shoes, three inches of sock and some turn-up.

That would not be the standard of presentation you expect on your television, so why should the average computer user have to tolerate information appearing and disappearing on a VDU in the same manner?

Good screen presentation is an essential part of good software. Not only does it make a system easier to use, it can make it easier to sell, too.

One of the most important aspects of

any software you may write is a standard screen lay-out.

System Title
Menu Selection
Working Area
Error Messages
Help Information

Distinct areas of the screen are reserved for the following purposes:

- System title: Displaying the title of the system is use is especially helpful if several people will use the computer in the course of a day's work.
- Menu selection: The method of programming which this series describes as based on a menu system of selecting processing options. Showing the chosen option is a reminder to the user.
- Working area: This is where your 20 percent fits in. The working area will be used to display application-related data, and to accept information from the user.
- Error messages: All error messages will appear in this area. They will be highlighted in some way to catch the user's eye.
- Help area: This area will be used to display additional guidance to a user who cannot follow instructions given in the working area.

The number of lines allocated to each area depends on the display format of the machine you are using. For the 'standard' 24-by-80 screen used in examples, the screen is divided as follows:

Lines 1 and 2:	System title underlined.
Line 3:	Blank
Line 4:	Menu selection
Line 5:	Blank.
Lines 6 - 21:	Working area.
Line 22:	Error messages
Lines 23 and 24:	Help information

The idea that information should not be allowed to roll-off the screen does not mean that the screen should be cluttered with redundant information. Once a portion of the display is no longer helpful or relevant, it should be erased.

For instance, the user may be presented with a list of 10 choices, followed by the instruction to choose one of them. Once the choice has been made, only the chosen item should be kept on the screen. The rest of the list, and the installation, must be erased.

If we are to use the computer as outlined, the following facilities must be available:

- A method of clearing the whole screen.
- A method of clearing a portion of the screen.
- A method of highlighting certain areas of the screen, e.g., intensified or flashing characters or reverse video.
- A method of positioning the cursor at a certain point on the screen.

The Superbrain and others use Hexadecimal "DC" ASCII form feed to clear the screen, but Vector Graphic uses hexadecimal "04". The information for your machine is probably tucked away in an appendix to the user manual.

Clear screen

Having discovered, say, that the clear-screen character for your machine is Hexadecimal "0C", you could use the statement PRINT CHR\$(12) to clear the screen. To anyone else reading the program though, this could mean cursor left or clear to the end of line if they are used to a different machine. A better idea is to have an initialisation subroutine in your program:

```
30000 REM INITIALISATION SUBROUTINE
30010 CLS$ = CHR$(12) : REM CLEAR SCREEN CHARACTER
30999 RETURN
```

You can then use CLS\$ to clear the screen through the program. Perhaps the best idea of all is to keep the value on disc, and enter it as part of the initialisation subroutine. This means that your program can be transferred between different makes of machine by updating a "configuration" file. The subroutine might look like this:

```
30000 REM INITIALISATION SUBROUTINE
30010 OPEN "I", 1, "CONFIG"
30020 INPUT #1, CLS$, CLES$, CLL$, HIONS$, HIOFFS$, X, Y, FIRST$, LEADING$
30030 CLOSE #1
30999 RETURN
```

Note that besides the value of CLS\$, we have read in several other variables. CLES\$ and CLL\$ are the characters to clear to the end of the screen or to the end of the current line, respectively. HIONS\$ and HIOFFS\$ are used to control the highlighting of error messages.

They switch on and off any flashing characters, highlighting characters or reverse video. Should your VDU have none of these features, set HIONS\$ and HIOFFS\$ = "" when creating the configuration files, and they will have no effect when used. The other four variables are used in positioning the cursor. A typical computer will position the cursor

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by writing a string of characters to the screen in the form:

Cursor lead-in sequence + column number + row number.

The cursor lead-in sequence will be one or more characters which tell the video-driver software/firmware that a cursor positioning operation is required. Once again, lack of agreement between manufacturers means that a Superbrain uses Hexadecimal "1B59" ASCII Escape Y while a Vector Graphics uses Hexadecimal "1B". The same applied to the column and row numbers.

Many manufacturers add a fixed number to the row and column numbers to allow them to be represented by printed characters. Hence to position the cursor to column 30, row 12 on a Superbrain:

```
CURSORS$ = CHR$(27) + "Y" + CHR$(32 + 30) + CHR$(32 + 12)
```

```
PRINT CURSORS$;
```

You will see that this machine adds decimal 32 to both the row and column numbers, and requires the column number to be stated before the row number — unlike our general-purpose examples.

All these differences between machines can be overcome by defining a Basic function to generate cursor-positioning strings. This would be included in the initialisation routine as follows:

```
30040 IF FIRST$ = "X"
```

```
THEN DEF FNTAB$(C,R) = LEADIN$ + CHR$(X+C) + CHR$(Y+R)
```

```
ELSE DEF FNTAB$(C,R) = LEADIN$ + CHR$(Y+R) + CHR$(X+C)
```

FIRST\$ will have been set to "X" on the configuration files if the machine in question expects the column X co-ordinate to be given first. Otherwise FIRST\$ will have been set to "Y". X and Y are the decimal values which have to be added to the column and row numbers respectively. We now have a function which can be used on any machine in either of two ways.

Commonly-used cursor positions should justify creating some cursor positioning strings as part of the initialisation routine:

```
30050 CUR 3012$ = FNTAB$(30,12)
```

would initialise the variable CUR3012\$ so that:

```
PRINT CUR3012$;
```

will always position the cursor at column 30, row 12. At other times, the variable CURSORS\$ could be set to the required value by use of function FNTAB\$ just before it is needed.

You may be wondering why the cursor is positioned with:

```
PRINT CURSORS$;
```

and not just:

```
PRINT CURSORS$
```

This is because, unless you include the semicolon, Basic appends a CR/LF — carriage return and line-feed — sequence to your character string, causing the

cursor to jump to the start of the next, ruining your cursor positioning.

Microsoft Basic has a command, WIDTH 255, which suppresses the insertion of CR/LF, but as this is not found in most other Basics, it will not be used here.

Next month's article will deal with data input and validation and acting on the result. In the meantime, try the following:

- Find the screen-control characters for your machine.
- Create a configuration file. Set all the nine variables to the correct values, open a new sequential output file, and write a single record consisting of the variables. For example:
1000 CLS\$ = CHR\$(4) : CLE\$ = CHR\$(15) : CLL\$ = CHR\$(16)
1010 HION\$ = CHR\$(26) : HIOFF\$ = CHR\$(26)
1020 X = 127 : Y = 127 : LEADIN\$ = CHR\$(27) : FIRST\$ = "X"
1030 OPEN "0", 1, "CONFIG"
1040 WRITE #1, CLS\$, CLE\$, CLL\$, HION\$, HIOFF\$, X, Y, FIRST\$, LEADIN\$, 1050 CLOSE #1
1060 RESET
1070 END
- Write a program which uses an initialisation routine to read the configuration file. Clear the screen. Write a highlighted message to the error-message area. Write "TESTING" to column 36 onwards of the menu-selection area. Clear the error message line. Write information on the first four lines of the working area then erase from the second line of the working area to the end of the screen.

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No holiday for seaside resort's hard-working Apple

ANYONE WHO ventures towards the East Coast from, say, the bustle of London's Old Street Station could be forgiven for thinking that time was playing tricks — that Freddie Laker had never put America within the range of most people's holiday budgets, that the glossy Sunday supplements of most had never brought exotica, squalor and glamour from far-flung corners of the earth into your sitting room, and, in fact, that the late sixties, and early seventies, had never really happened at all.

The Essex coastal villages typically have the air of beleaguered settlements whose inhabitants chose to bypass the stark facts of London life by building a closed world of net curtains, chicken in the basket and holiday camps.

It also has a remarkably flat landscape, which some might find rather on the depressing side. The land beyond the pretty little village of St Osyth is flat. Towards the sea, it is punctuated by rows of small beach huts; at the beach itself there are more than 2,500 holiday letting units. At the height of the season, the place reverberates with the sound of bingo callers, fruit machines and kids.

We went there out of season though, when it is a ghost town of empty chalets and abandoned plastic buckets. Our destination was the Seawick Holiday Lido, largest holiday homes complex at St Osyth Beach and from Whitsun to late September the destination for thousands of visitors — mainly east Londoners bound for one of the 150 chalets or 600 holiday caravans.

Seawick provides more than just accommodation by the sea, though. In fact, the management is quietly proud of the fact that once a holidaymaker has arrived, there is no reason why the family should leave Seawick.

Star performers

For example, Seawick's tenants have the Club El Tora Leisure Complex, two bars, heated swimming pool, restaurant, dance floors and a medieval banqueting hall complete with hogs' heads and shields. There is bingo, a children's playground, an amusement arcade, a shopping centre, and the Seagull pub — where every night in the season you will find Jolly Roger, "the virtuoso of the organ". There is a big-name entertainment programme, too, offering among other attractions Acker Bilk, Marty Wilde, Gary Glitter and Joe Brown and the Bruvvers.

There are "space invaders" games in the amusement arcade, but you feel that not much else has changed at Seawick in the past 20 years — that is, until you visit the nerve centre of this substantial business operation. In the office of Seawick's accountant John Lambert, you will find his Apple II microcomputer.

The Seawick Holiday Lido was established just at the end of the Second World War and now covers some 50 acres of land. John Lambert explains that it presents immensely-varied administrative problems: "Here we sell everything from

by Cathy Lane

a tiny box of matches to a £5,000 caravan — a big range of items at widely-varying prices and in very different volumes. Our turnover is in excess of a million, but, of course, that money is earned in a very short space of the year.

"Every June and July we're suddenly and completely overwhelmed with money, mostly cash, and I'll be spending virtually every morning counting wads of grubby pound notes".

Seawick's staffing levels also vary enormously from about 120 people at the height of the season, including part-time bar staff and chalet cleaners, to a core of just 30 or so for the rest of the year.

What is more, all the money may be taken in the summer, but winter is the busiest time of the year for John Lambert. That is when the sums have to be done and all the prices set for the following season. The bills have to be paid for the 25 or so suppliers; contracts for the caravan owners are renewed; and the Lido must ensure that it remains ahead of its competitors, checking facilities and potential new offerings and the performance of others in the same business.

To help him monitor outgoings, Lambert had been using a bureau in Ipswich for the purchase ledger and some analysis. This certainly helped, but by 1978 it was becoming unsatisfactory: "The bureau's prices were constantly rising and by the end we were paying as much as £150 a month. Combined with the time it took to send data to the bureau and eventually receive the reports and the books back, that system was just not good enough".

Like any sensible accountant in the last two or three years, Lambert had been taking an interest in the development of the small-computer market. He gradually became convinced that Seawick both needed and could afford a system of its own.

His only previous computer experience was with a large IBM machine at his previous job but his young colleague, Steve Gay, had studied computing as a recreational subject at school for a year. So between them, they had some appreciation of the potential for computers.

They had scant knowledge of programming though. That did not stop them being convinced that they needed a system which they could program themselves. That was largely due to the special problems of running Seawick. Their encounters with computing had already led them to the conclusion that no off-the-shelf package would match their requirements well enough: "We're just not a standard kind of business". Also they felt that no brought-in programmer could do a better job of understanding the Seawick operation than they would.

Steve Gay and John Lambert attended a one-day conference-cum-demonstration held by Tandy and were duly impressed. The impact was dissipated, however, when a TRS-80 was demonstrated at Seawick: "For a start, the chap didn't seem to know as much as we did. It was a disaster". This was a disappointment for by this time they had bought the Tandy reference manuals and started to learn programming.

Help from dealer

They had some help from Lambert's brother-in-law, a lecturer in computing at Southampton Polytechnic, and between them they had already worked out how a purchase ledger could be devised for Seawick.

Then in September, a microcomputer dealer called Micro Management opened a shop in nearby Frinton. Lambert found he was talking to people who seemed friendly, helpful, and, above all, easy to talk to. After several visits to Frinton, they elected to buy from Micro Management an Apple II with two floppy disc drives and a matrix printer. On top of this they tested, liked, and bought Micro Management's own off-the-shelf purchase-ledger program on the understanding that they would receive assistance with writing subsequent programs. The total cost was in the order of £2,500.

From the outset, the computer was very much an accounting machine. Most of the other people at Seawick were dubious of its value, but Lambert and Gay had to be committed — for one thing they had no option but to start work on it immediately. They had already stopped dealing

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with the bureau and a large backlog of work had built up.

The main problems at the outset were due to their lack of understanding about how the computer worked. That was compounded by the seemingly-inevitable program faults. "The hardware has always been very reliable; it's us who have proved unreliable".

The purchase-ledger software had to be modified quite substantially; Seawick has nearly 25 suppliers, but needed 1,000 cost-analysis codes. The program allowed only for 100.

Batch processing

Even after Micro Management had adjusted the program, it continued to give problems — the kind of problems that Lambert and Gay could not solve without understanding the computer. Lambert now believes that "it is essential to be able to see what goes on in the computer — you need to see how data are being stored on the discs".

He also had to devise his own operating methods for the system, and one important result of the exercise is that he has effectively adopted those usually more characteristic of large companies: "For instance, when we first went to Micro Management, we were told that you just have to key in your invoices every day or each week or so and leave them. Yet it's

not that simple, because you do have to tally all your figures back. So now we always batch-list everything in a control book before feeding it into the computer".

Despite the hiccups, the purchase ledger was sorted out in two months and Lambert is grateful for the help they received from Micro Management. By then, they had already started on a sales-ledger program — helped interestingly enough by piles of brochures from all types of micro suppliers: "Between them they almost told us how to write the program."

The sales ledger has a file of 500 or so caravan owners who pay ground rent to Seawick, as well as electricity and repair bills. There is evident relief in Lambert's voice at the prospect of computerising this: "At last, we're getting rid of that laborious Kalamazoo system. It may have been all right in its way, and it would certainly be fine for most businesses — but we're unusual. The caravan rents account for about only one-fifth of our total revenue, but they were very complicated to calculate. We're sending out computer-generated statements now, which really do make people better payers, and soon we'll be sending out contract-renewal forms and the invoices automatically".

Once the sales and purchase ledger were completed, Lambert found himself with many other things he wanted to do at

once; a nominal ledger, a cigarette stock-control program, some method for handling bar inventory.

Lambert is pleased enough with the ways things have gone, though: "I was extremely happy that the purchase, sales and nominal ledger were all set up in time to cope with 1980 — good going I think. Whether we could have done it without Micro Management's help is debatable.

"We also have the cigarette program running very much as a test-bed for other stock control. Actually," he confides, "I hate cigarettes. I don't smoke, there's no profit in them and there's so much at risk. Yet we must stock them; and it's just because there isn't much profit that it is essential to keep a close eye on them". This program involves one file of brands and another for the outlets round the Lido, so that the incoming and outgoing stocks can be checked.

Payroll

John Lambert intends to consolidate the work already done on the machine: "We've had to adapt our working methods to suit the computer: I'll change that. We have thought about doing payroll on it — at the moment we still use the Kalamazoo system. I don't think it would be beyond us to write our own program, though whether we could do it for the same price as buying a commercial package is another question".

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Exploration and exploitation of new worlds
are the goals of Bob Merry's two-part game *Star System*.

STAR SYSTEM

STAR SYSTEM is a game of exploration where the program will create a planetary system for you to explore and exploit. Some of the planets may be inhabited and you will have the chance to contact them and, if you are lucky, establish friendly relations which can lead to the exchange of gifts.

In designing the game, I have given the option of stopping it at any point and recording the position so that the game can be played using new data or data saved from a previous game. Because of

the complexity of the game, the playing part fully occupies 8K and the instructions and preparation are put into a separate program.

This first program creates a Star System, consisting of several planets each with its own environment, which is determined by a mixture of luck and logic, e.g., while the atmosphere of a planet is randomly selected, the temperature is determined by its orbital position relative to the star and the other planets. Once the system is created, it is recorded as a data

tape, which is saved for use in the game program.

Because of this and the use of machine code for part of the display, it would be difficult to implement the program on systems other than the Pet for which it is intended — I would be very interested to hear of anyone who does manage to translate the ideas contained in the game on to other systems. The program listings given are written for the old ROMs, but since I have both sets of ROMs available thanks to a Basic Switch, I have developed

Table 1. Machine-code section of program.

033A	A9 00	LDAIM 00	;Stores address 32768	038C	20 9A 03	JSR	BLANK	;Gosub blank-string
033C	85 01	STAZ 01	;in zero-page					printer
			locations	038F	A2 4B	LDXIM 4B		;Load X with the
033E	A9 80	LDAIM 80	;01 and 02					required Offset
0340	85 02	STAZ 02	;	0391	20 AC 03	JSR	INCADD	;Move to the next
0342	A9 48	LDAIM 48	;Loads 72 into the					address
0344	8D F9 03	STA 03F9	;COUNT 1 location	0394	CE F8 03	DEC	COUNT2	;LOOP3 allows for
			(1017)					nine repeats
0347	A9 04	LDAIM 04	;Loads 4 into the	0397	D0 F1	BNE	LOOP3	;of the 5 blank
0349	8D F8 03	STA 03F8	;COUNT 2 location					string
			(1016)	039A	60	RTS		;Return to the Basic
034C	A9 66	LDAIM 66	;CHR\$(166) in A					program
034E	A2 01	LDXIM 01	;Increment in X					
0350 LOOP1	81 00	STAIX 00	;CHR\$(166) to 32768	039A BLANK	8D F9 03	STA 03F9		;Set COUNT 1
0352	20 AC 03	JRS INCADD	;Gosub increment	039D	A9 20	LDAIM 20		;Put CHR\$(32) in A
			address	039F	A2 01	LDXIM 01		;Put increment of 1
0355	CE F9 03	DEC COUNT1	;LOOP1 allows for					in X
			840	03A1 LOOP4	81 00	STAIX 00		;Print blank at
0358	D0 F6	BNE LOOP1	;repeats of					indirect indexed
			CHR\$(166) at					address
035A	CE F8 03	DEC COUNT2	;successive screen	03A3	20 AC 03	JSR INCADD		;Move to the next
			locations					address
035D	D0 F1	BNE LOOP1	;i.e., 21 lines.	03A6	CE F9 03	DEC COUNT1		;LOOP4 counts the
035F	60	RTS	;Return to Basic					number of
			program	03A9	D0 F6	BNE LOOP4		;Blanks passed to it
0360	A9 30	LDAIM 30	;Stores address	03AB	60	RTS		from main program
			32816	03AC INCADD	A8	TAY		;Return
0362	85 01	STAZ 01	;in zero-page					;Save current value
			locations	03AD	18	CLC		of A in Y
0364	A9 80	LDAIM 80	;01 and 02	03AE	8A	TXA		;Set 'Carry' to zero
0366	85 02	STAZ 02	;	03AF	65 01	ADC 01		;Put X in A
0368	A9 0A	LDAIM 0A	;Loads 10 into the					;Add A to zero
036A	8D F8 03	STA 03F8	;COUNT 2 location	03B1	90 02	BCC CLEAR		page 01; store in A
			(1016)					;Check 'Carry' and
036D LOOP2	A9 0C	LDAIM 0C	;Number of blanks	03B3	E6 02	INCZ 02		add 1 to
			in string	03B5 CLEAR	85 01	STAZ 01		;Zero page 02 if set
036F	20 9A 03	JSR BLANK	;Gosub blank-string					;Put new address in
			printer	03B7	98	TYA		zero page 01
0372	A2 44	LDXIM 44	;Load X with the	03B8	60	RTS		;Recover value of A
			required offset					;Return
0374	20 AC 03	JSR INCADD	;Move to the next	03B9	A9 48	LDAIM 48		;Stores address
			address					33608
0377	CE F8 03	DEC COUNT2	;LOOP2 allows for	03BB	85 01	STAZ 01		;in zero-page
			10 repeats					locations
037A	D0 F1	BNE LOOP2	;of the 12 blank	03BD	A9 83	LDAIM 83		;01 and 02
			string	03BF	85 02	STAZ 02		;
037C	60	RTS	;Return to Basic	03C1	A9 02	LDAIM 02		;Puts 2 into the
			program	03C3	8D F8 03	STA 03F8		;COUNT 2 location
								1016
037D	A9 4A	LDAIM 4A	;Stores address	03C6 LOOP5	A9 50	LDAIM 50		;Number (80) of
			32842					blanks required
037F	85 01	STAZ 01	;in zero-page	03C8	20 9A 03	JSR BLANK		;Gosub blank-string
			locations					printer
0381	A9 80	LDAIM 80	;01 and 02	03CB	CE F8 03	DEC COUNT2		;LOOP5 gives two
0383	85 02	STAZ 02	;					times 80 blanks
0385	A9 09	LDAIM 09	;Loads 9 into the	03CE	D0 F6	BNE LOOP5		;i.e., four lines at
0387	8D F8 03	STA 03F8	;COUNT 2					the bottom of the
			locations (1016)	03D0	60	RTS		screen
038A LOOP3	A9 05	LDAIM 05	;Number of blanks					;Return to Basic
			in string					program

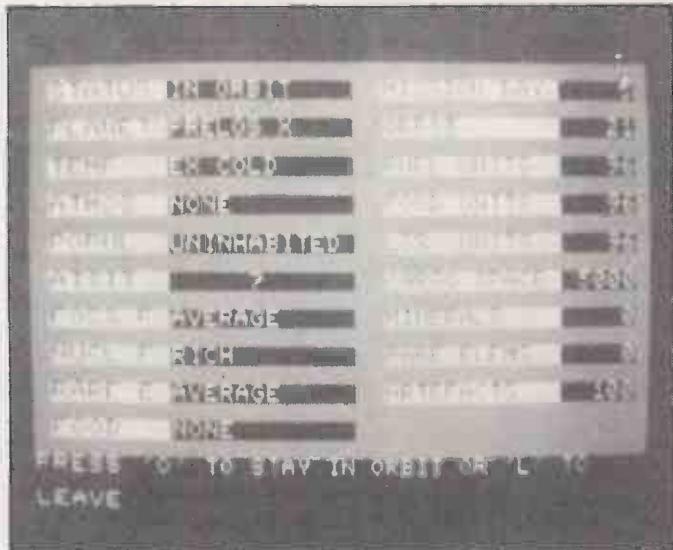


Figure 1.

a version for the new ROM and will give you conversion details.

As you will find out when you run the program, you are presented with a good deal of information about the planet you are orbiting and one of the first things I considered when designing the game was how to present this information. I decided on a display that looks like figure 1 which is a display from early in the game. Initially, I implemented this in Basic and did so by first considering the basic grid, which is shown in figure 2. This can be thought of as being in three sections: firstly, there is the background, which consists of 21 lines of CHR\$(166) — the shifted & graphics character; next, we have 10 windows each consisting of 12 blank spaces and separated by two lines; finally, there are nine other windows of five blanks each.

Basic too slow

Looked at in this way, the display can be described in programming terms by a series of For . . . Next loops, with appropriate movements of the cursor to start the action in the proper place and put the correct gaps between the windows. The two sets of windows need to be thought of separately, as they will carry two different sets of information — those on the left refer to the planet you are orbiting, while those on the right concern your spaceship — and they will be updated at various times in the program.

My first attempt at the program produced the display using Basic. However, it soon became apparent that this was less than satisfactory for two reasons. One was the pressure on memory space to give me sufficient scope for all the variable factors and complexities I wished to introduce. The other was the time it took the program to print the display. This would not have been important had I needed to print it only once, but it is an important part of the program that you use the screen for

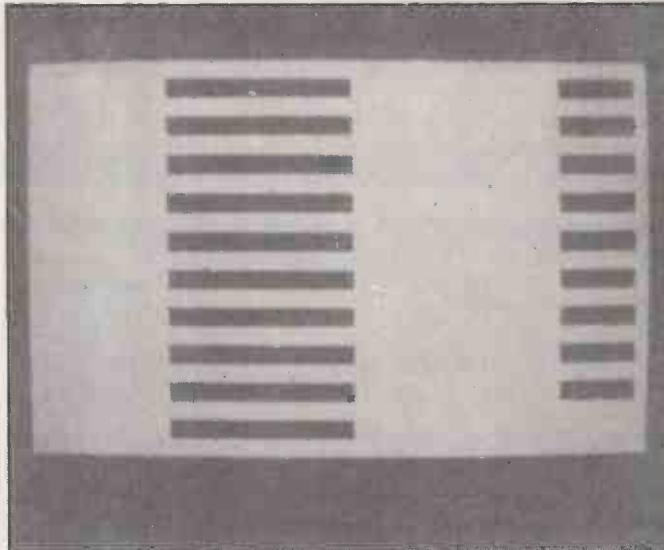


Figure 2.

several other read-outs when you are exploiting a planet.

The display of several seconds while the display was reconstructed was becoming tedious and it soon became obvious that I should try to develop a machine-code routine which would suit my purpose. If I could also lodge this routine in the second cassette buffer — a useful piece of spare memory — I would also free more memory for the game. Up to this point I had not tried any serious machine-code programming, so this was to be a voyage of discovery. The fact that I was successful should encourage other tyros to have a go and improve the speed of their programs.

First, for those who are not familiar with what is meant by machine code, a few words on how your microprocessor receives its instructions. An eight-bit microprocessor, such as the 6502 at the heart of the Pet, 'understands' words consisting of eight binary digits, from 00000000 to 11111111. These words can represent numbers or instructions and will be appropriately interpreted by the microprocessor according to their context.

Although the microprocessor can only deal with numbers in this form, it is an inconvenient form for a human operator to have to work and various high-level languages are available, such as Basic. These need to be interpreted into a series of numbers for the microprocessor and it is this process that makes a program written in Basic run much more slowly than one applied directly to the microprocessor.

Machine-code programs consist, therefore, of a series of eight-bit binary words. Numbers like 01001011, are, however, cumbersome for a human and not easily understood at a glance. Instead, the same numbers can be expressed in two other ways, decimal and Hexadecimal. In decimal notation our range of eight-bit numbers lies between 0 and 255, inclusive, and this is the form in which the machine-

code program appears in the Data statements in the Basic program.

Binary words can also be considered as consisting of two four-bit numbers in the range 0000 to 1111. This range can be represented by 16 symbols, the numbers 0 to 9 and the letters A to F. Thus each eight-bit word is represented by a two-digit Hexadecimal — base 16 — number, in the range 00 to FF. This Hexadecimal notation is extended to higher numbers. For example, the location 826 in memory can also be referred to as 033A, meaning 0 times 16³ plus 3 times 16² plus 3 times 16¹ plus A(10) times 1.

Hex instructions

This Hexadecimal form is used in the listing of the machine-code program given in table 1. Remember, these two-digit words can be instructions, addresses or actual numbers — it is up to the microprocessor to decide which according to the context.

Now let us consider the machine-code itself. Eventually, it will be placed in memory from locations 826 to 976 — 033A to 03D0 — and these memory locations are listed down the left-hand column of table 1. In the next column, at various points in the program, the names and start positions of particular sections of the program are given to which a jump has to be made. These labels are an aid to understanding and are not entered as part of the program. The next three columns are the program itself.

The first of these three columns contains instruction words and these instructions may be followed by 0, 1 or 2 other numbers. Some instructions stand alone and need nothing after them; others refer to a number in the range 0 to 255 and have one number after them, while others refer to a full address needing a four-digit Hexadecimal number. We will see examples of all the types as we study the program.

(continued on page 85)

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Next in table 1, we have another version of the program, using mnemonic symbols which are more easily interpreted by the reader than the Hexadecimal numbers. This form is known as assembly language and can be used when writing machine-code. In this case, I wrote the original program in this form and then translated it into the Hexadecimal and decimal listings later, but it is also possible to use an assembler program which will allow you to compile the machine-code directly into memory by entering the mnemonic symbols into your computer.

The assembly listing is given to allow you to follow the working of the program more easily, and to this end there are a number of remarks included on the right of table 1, explaining what is happening.

Program sections

The program consists of four main sections, each a program in its own right, plus two subroutines. 033A to 035F contain a program for printing a backing of 21 lines of CHR\$(166) and is called by SYS 826. 0360 to 037C print 10 strings of 12 blank spaces — CHR\$(32) — in the appropriate positions on the display and is called by SYS 864. 037D to 0399 prints nine strings of five blank spaces towards the right of the display and is called by SYS 893.

Next in the program are two subroutines: 039A to 03AB is known as Blank and prints blank spaces for the number of times it is told by the program that calls it; 03AC to 03B8 is labelled INCADD and is used to modify the address of the screen location to that needed for the next printing. Finally, 03B9 to 03D0, which was added as an afterthought after the successful development of the other routines, is used to clear the bottom of the screen by printing four rows of blanks on lines 22 to 25.

The significant feature of the Pet that allows machine-code routines like these to be used is the screen appearing to the system as just another area in memory. You will probably be already familiar with this concept if you have ever used Poke and Peek. The screen information is allocated a 1K block of memory, starting at 8000 — 32768 — and we can put a symbol directly on to the screen by finding the number which represents that symbol and then Poking it into the correct memory location.

For example, POKE 32768, 102 puts a shifted & symbol into the top left-hand corner of the screen — try it. Note, however, that this number for Poke is not always the same as the CHR\$ number — the same symbol can be seen using PRINT CHR\$(166) and our machine-code program uses CHR\$(166) and CHR\$(32), a blank space, which correspond to the Hexadecimal —

decimal — numbers of 66(102) and 20(32).

Putting one of these symbols on to the screen would be easy if there were an instruction for the microprocessor which said: "Put N into memory location M". However, such an instruction would contain two unknowns, M and N, and this is not possible. Instead, we have to use intermediate registers to store one of the unknowns. The registers we have available in the 6502 are the A, X and Y registers.

They are eight-bit registers and differ in their intended uses. The A register is the arithmetic register and there are instructions to allow you to modify its contents in ways which are arithmetic operations. The X and Y registers are index registers and can be used in other ways.

To return to the problem of putting N into M, one way to do this is to put N into A — load A immediately with N — and then transfer the contents of A to M — store A at M. There are instructions for this and, in fact, we use such a sequence starting at 0342, where we store the Hexadecimal number 48 in 03F9. As far as storing numbers in screen locations is concerned, we must bear in mind that these locations must be altered after each print action.

Consequently, a more indirect approach is required, using a form such as: "Store the contents of A at a memory location given by the contents of p". This allows us to modify the contents of p so that the next location's position is stored there. This is the approach the program uses and the first consideration is where to have p. We can consider the memory available in terms of blocks — for example, 1K blocks — which might seem a convenient form of subdivision.

There is, however, a smaller subdivision which is also useful. This is the amount of memory which can be defined by one eight-bit number; 00 to FF gives a total of 256 addresses and this is known as a page. The easiest page to define is the one from 0000 to 00FF, known as the zero page and there are several instructions which can be given to the 6502 to direct it to the zero page.

For this reason, much of the zero page is occupied with the operating system of the Pet, but we can borrow two locations which will not be needed. Zero-page locations 01 and 02 are normally used to store a reference address for the USR function. This is not involved in our program so we will store the relevant screen location in these two spaces.

The least-significant part of the address goes in 01 and the most-significant part in 02. This is done initially by the section of a program from 033A to 0341, where we first load 00 directly into the A register and then store the contents of A at zero-page address 01, followed by loading A with 80 and storing the contents of A at zero page 02.

The two numbers we store next are

counters to determine the number of times we print the shifted & symbol. We want to do this for 21 lines of the screen; 21 times 40 = 840. However, a single eight-bit number gives us a count of only 256, so we need to make three counts of 256 — which equals 768 — plus the remainder of 72.

Now we have the first screen location loaded into the zero page and have set our counters, we load A with the symbol to be printed, CHR\$(166) and the X register with the increment in the screen address we want. Since we are printing CHR\$(166) at every location in the first 21 lines, the increment is simply 1.

Now we give the print command using an instruction which will find the address we stored in the zero page. STAIX 00 tells the microprocessor to store the contents of A at an address which will be found in the zero-page location 00 plus the contents of the X register (1).

Having found the address 8000 — 32768 — the contents of A are now stored there. Note, however, that the A register will not be cleared, but will still have 66 — 102 decimal — left in it. The overall result of this process is to print CHR\$(166) in the top left-hand corner of the screen. We now need to increment the address in 01 and 02, before the next print command and this is the purpose of the subroutine INCADD to which the program is now directed.

Arithmetic functions

In INCADD, we will need to carry out an arithmetic operation involving the use of the A register, but we have not finished with the contents of the A register, so the first step is to find a temporary place to store the A register contents. The Y register is not needed for anything else, so we use this as it needs only a single instruction TAY.

The arithmetic function we are to use involves a flag which is set to 1 if the A register contents are increased above FF. Although the A register would go from FF to 00; the carry flag would be set to show that this has occurred.

Now we put the desired increment into A (TXA) and add to it the contents of zero page 01. Eventually, after this subroutine has been visited several times, this would result in A exceeding FF and the carry flag would be set. If this should happen then zero page 02 is incremented by 1, but if it does not, this INCZ instruction is bypassed.

The BCC instruction tells the program to go forward two steps if the carry flag stays clear. The new contents of A are stored at zero page 01, the old contents of A — CHR\$(166) — are transferred back from Y and the main program is rejoined at 0355.

So far, we have printed CHR\$(166) at 32768 and increased the indirect address in

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the zero page to 32769. We will now print at this new address and make another increment in the address and so on. We must also keep track of how many times we do this so that we end after 840 such actions. That is where the two counters enter. We first decrease COUNT 1 by 1, from decimal 72 to 71 and then test to see if this resulted in a zero answer — another flag is used for this.

Obviously, it does not happen this time so the program is told to branch if not equal to zero. This branch instruction is followed by a number, F6. Branch instructions allow for forward and backward branching. We use 00 to 7F to indicate forward branching and FF down to 80 for reverse branches. FF means one step back, FE two steps and so on. Thus F6 means 10 steps and we need to know from where to count.

After the microprocessor has read F6, its program counter will have stepped on to the next position, so one step back takes it back to the F6, two steps to D0, etc. — 10 steps takes it back to 0350, the instruction to print CHR\$(166) at the next screen location. This process continues until COUNT 1 reaches zero when, instead of branching back, the program decreases COUNT 2 from 4 to 3 and since this does not result in zero, branches back 15 steps to continue printing.

The next decrement of COUNT 1 results in its going from 00 to FF and the program will, therefore, go through another 256 cycles of printing before COUNT 1 again reaches 00 and COUNT 2 is decreased to 2. After another two sets of 256 cycles, making a grand total of 72

+ 256 + 256 + 256 = 840, COUNT 2 reaches zero and the RTS instruction is reached which returns control to the Basic program.

The other three programs are all similar in that they print a series of blank spaces. The first two, starting at 0360 and 0370, print out strings of blanks, separated by two lines on the screen. The sum of the length of the string and the increment needed to locate the next string has to be decimal 80.

The first stage is to load the first address that we will need into the zero-page locations 01 and 02. Then we enter the number of times we want the string repeated in COUNT 2. Next, we put the length of the string into the A register and we are ready to call subroutine Blank.

This starts at 039A and firstly stores A in COUNT 1. Then it reloads A with 20 — CHR\$(32) — the number which represents a blank space, and loads X with 1, as this will be the initial increment required. STAIX 00 has the effect of printing a blank at the first memory location indicated by the contents of zero page 01 and 02.

Subroutine INCADD is used to step the screen location on one and this process is repeated for the number of blanks required, as determined by the contents of COUNT 1. Once COUNT 1 reaches zero, we exit the loop and return to the main program at 0372.

Back at 0372, we load X with the increment needed to move from the screen position at the end of the string to the start of the next string, two lines further down the screen. The offset is given by subtracting the length of the string from

80. Then we use INCADD to increment the screen address in the zero page. The loop controlled by COUNT 2 will allow for the string of blanks to be repeated the required number of times. Program 037D operates in an identical manner to this, while 03B9 involves only the use of the BLANK subroutine to print out two strings of 80 blanks.

That then is the machine-code routine to be used in Star System. It is contained in the Data statements in lines 120 to 190 of the Basic program. In this program, they will be put on to the data tape in line 600 and in the next program they will be transferred from the tape into the second cassette buffer. If you wish to check that you have entered these Data statements correctly, first enter the program down to line 190 and save it. Next add the 192 FOR I = 1 TO 22: READ NS: NEXT 194 FOR I = 826 TO 976: READ D: POKE 1,D: NEXT

196 SYS 826: SYS 864: SYS 893: SYS 953
198 WAIT 59410,4,4

This should result, when run, in a display like figure 2, and the program will end to give Ready when Space is pressed. Delete the additional lines and continue entering the program.

For those of you with new ROMs, here are the necessary modifications:

Line 560 Delete the two POKE commands
Delete lines 1110 to 1140
Delete GOSUB 1110 in lines 570, 580, 590, 600, 610, 620

As you may realise, the purpose of these additions for the old ROMs are to give a more reliable Data Tape, with correctly separated blocks of data and a correct header at the start of the tape.

Next month, we will give you the game program itself.

READY.

```

10 REM** *STAR SYSTEM** **
20 REM**
30 REM**A SFACE EXPLORATION GAME **
40 REM** IN TWO PARTS **
50 REM** FOR AN BK PET (OLD ROM) **
60 REM** BY R.C.HERRY. JAN 1981 **
70 REM*****
80 REM**SEE ARTICLE FOR CONVERSION**
90 REM** FOR NEW ROM **
100 DATA VARDOS,LEXOH,HTROS,VEGA,GORSIK,HYLOG,PREL0S,DARIX,REND0R,SIR0LA
110 DATA 1,1111,IV,V,VI,WI,WII,IX,XI,XII
120 DATA 169,0,133,1,169,128,133,2,169,72,141,249,3,169,4,141,248,3,169,102
130 DATA 162,1,129,0,32,172,3,206,249,3,208,246,206,248,3,208,241,96,169,48
140 DATA 133,1,169,128,133,2,169,10,141,248,3,169,12,32,154,3,162,68,32,172,3
150 DATA 206,248,3,208,241,96,169,74,133,1,169,128,133,2,169,9,141,248,3,169,5
160 DATA 32,154,3,162,75,32,172,3,206,248,3,208,241,96,141,249,3,169,32,162
170 DATA 1,129,0,32,172,3,206,249,3,208,246,96,169,24,138,101,1,144,2,230,2
180 DATA 133,1,152,96,169,72,133,1,169,131,133,2,169,2,141,248,3,169,88,32
190 DATA 154,3,206,248,3,208,246,96
200 DATA 100,100,100,5000,0,0,100,1
210 DIMP$(12)
220 PRINT"STAR SYSTEM CREATION
230 PRINT"THIS PROGRAM CREATES THE STAR SYSTEM
240 PRINT"TO BE USED IN YOUR GAME. IF YOU WANT
250 PRINT"THE FULL INSTRUCTIONS, PRESS 'V'; PRESS
260 PRINT"ANY OTHER KEY TO OMIT THESE.
270 R=RND(1):GETR$:IFR$=""THEN270
280 IFR$="V"THENGOSUB690
290 PRINT"PLEASE WAIT WHILE THE SYSTEM IS CREATED
300 R=INT(10*RND(1))+1:FORI=1TOR:READS$:NEXT
310 IFR=10THEN30
320 FORI=R+1TO12:READD$:NEXT
330 N=INT(5*RND(1)+8):FORI=1TON
340 READS$:P$(I)=S$+"*"+P$
350 IFLEN(P$(I))<12THENP$(I)=P$(I)*" ":GOTO350
360 T=INT(1067+1):P$(I)=P$(I)+RIGHT$(STR$(T),1)
370 E=INT(5*RND(1)+1):P$(I)=P$(I)+RIGHT$(STR$(E),1)
380 IFT<20RT=50RE=STHENP$=GOTO410
390 IFRND(1)>2,2THENP$=GOTO410
400 P=INT(7*RND(1)+1)
410 P$(I)=P$(I)+RIGHT$(STR$(P),1)
420 P$(I)=P$(I)*"6"
430 FORJ=1TOD:J=INT(3*RND(1)+1):P$(I)=P$(I)+RIGHT$(STR$(J),1):NEXT
440 IFT<30RT=5)AND(E=30RE=4)THENP$="2":GOTO470
450 IFT=4AND(E=30RE=4)THENP$="3":GOTO470
460 F$="1"
470 P$(I)=P$(I)+F$+"00"
480 O=0+INT(3*RND(1)+1)+O$=STR$(O)
490 IFLEN(O$)>3THENO$=RIGHT$(O$,2):GOTO510
500 O$="0"+RIGHT$(O$,1)
510 P$(I)=P$(I)+O$+NEXT
520 IFN=12THEN540
530 FORI=N+1TO12:READD$:NEXT
540 PRINT"PLEASE LOAD A BLANK DATA TAPE. PRESS
550 PRINT"SPACE WHEN READY."WAIT59410,4,4
560 POKE244,2:POKE243,12:OPEN1,1

```

```

570 PRINT#1,S$:GOSUB1110
580 PRINT#1,N$:GOSUB1110
590 FORI=1TON:PRINT#1,P$(I):GOSUB1110:NEXT
600 FORI=826TO984:READM:PRINT#1,M$:GOSUB1110:NEXT
610 DB=INT(35*RND(1)+5):PRINT#1,DB:GOSUB1110
620 FORI=1TON:PRINT#1,B$:GOSUB1110:NEXT
630 CLOSE1
640 PRINT"THE DATA FOR YOUR GAME IS NOW READY.
650 PRINT"THE STAR SYSTEM IS CALLED "S$" AND
660 PRINT"THE PLANETS IN IT. REWIND YOUR
670 PRINT"DATA TAPE, LOAD AND RUN THE GAME PROGRAM
680 END
690 PRINT"YOU ARE THE COMMANDER OF A DEEP-SPACE
700 PRINT"EXPLORATION STARSHIP. YOUR MISSION IS TO
710 PRINT"EXPLORE THE STAR SYSTEM AT WHICH YOU
720 PRINT"ARRIVE. WHEN YOU COME OUT OF WARP DRIVE
730 PRINT"YOU WILL HAVE LIMITED AMOUNTS OF FUEL,
740 PRINT"FOOD AND LIFE SUPPORT. ONE OF YOUR TASKS
750 PRINT"IS TO COLLECT SUFFICIENT OF THESE ITEMS
760 PRINT"FROM THE PLANETS IN THE SYSTEM TO RETURN
770 PRINT"TO EARTH. YOU NEED AT LEAST 1000 UNITS
780 PRINT"OF EACH. PRESS SPACE AT THE END OF EACH
790 PRINT"PAGE OF INSTRUCTIONS TO CONTINUE."WAIT59410,4,4
800 PRINT"SINCE THIS IS A GAME OF EXPLORATION - A
810 PRINT"ADVENTURE INTO THE UNKNOWN - YOU ARE LEFT
820 PRINT"TO DISCOVER FOR YOURSELF HOW THE VARIOUS
830 PRINT"FACTORS IN THE GAME INTERRELATE (E.G.
840 PRINT"HOW ATMOSPHERE AND TEMPERATURE AFFECT
850 PRINT"MINING CONDITIONS AND EFFICIENCY), YOU
860 PRINT"WILL EARN POINTS FOR ESTABLISHING GOOD
870 PRINT"RELATIONSHIPS WITH CONTACTED RACES, WHO
880 PRINT"WILL RANGE FROM PRIMITIVE TO SUPER-RACE
890 PRINT"ACCORDING TO THE STAR-TRAVEL LEVEL).
900 PRINT"IF THEY LIKE YOU THEY MAY GIVE YOU GIFTS
910 PRINT"AND YOU CAN INFLUENCE THEM WITH GIFTS."WAIT59410,4,4
920 PRINT"ONE OF YOUR TASKS IS TO SURVEY THE STAR
930 PRINT"SYSTEM. A SHORT SURVEY OF A PLANET CAN
940 PRINT"BE DONE BY STAYING IN ORBIT FOR TWO DAYS
950 PRINT"WHILST A COMPLETE SURVEY TAKES OVER TEN
960 PRINT"DAYS. YOU SHOULD DO A SHORT SURVEY ON
970 PRINT"ALL THE PLANETS AND A COMPLETE SURVEY
980 PRINT"WOULD BE DONE OF INHABITED PLANETS.
990 PRINT"THE ON-BOARD COMPUTER WILL AUTOMATICALLY
1000 PRINT"SURVEY THE PLANETS AND SEND THE RESULTS
1010 PRINT"BACK TO EARTH."WAIT59410,4,4
1020 PRINT"WHEN YOU ARE READY TO RETURN TO EARTH,
1030 PRINT"OR IF YOU WISH TO TAKE A REST, YOU CAN
1040 PRINT"ENTER YOUR DESTINATION AS '99'. THIS
1050 PRINT"WILL GIVE YOU THE CHOICE OF SAVING THE
1060 PRINT"CURRENT POSITION ON A DATA TAPE, OR OF
1070 PRINT"ADDING UP YOUR POINTS. THERE IS A LARGE
1080 PRINT"PENALTY FOR ATTEMPTING TO RETURN TO
1090 PRINT"THE EARTH WITH INSUFFICIENT SUPPLIES."WAIT59410,4,4
1100 FORI=1TO10 GETR$:NEXT RETURN
1110 IFPEEK(625)<180THEN RETURN
1120 POKE59411,53:T=1
1130 POKE12THEN1130
1140 IFPEEK(611)=61:RETURN

```

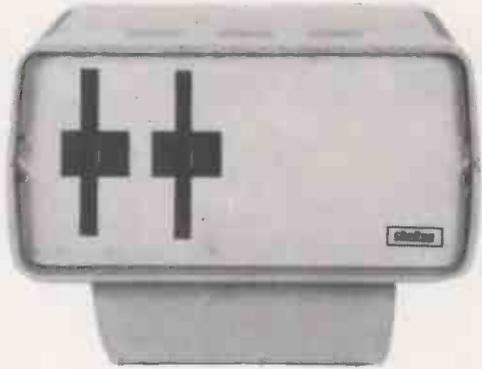
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The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

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

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 - if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

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

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 - including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 and the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 - Games

For ZX81 (and ZX80 with 8K BASIC ROM)

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

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

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

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

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

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

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

For ZX81 with 16K RAM pack

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

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

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

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

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

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

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

Cassette 3 - Business and Household

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

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

NOTE PAD - a powerful, easy-to-run system for storing and



retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

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

Cassette 4 - Games

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

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

TWENTYONE - a dice version of Blackjack.

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

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

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

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

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

For ZX81 (and ZX80 with 8K BASIC ROM)

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

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

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

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

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

TEMP - Volumes, temperatures - and their combinations.

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	24	Cassette 4 - Games	£3.95	
	25	Cassette 5 - Junior Education	£3.95	
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	18	*16K RAM pack for ZX81 and ZX80	£49.95	
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Continuous ribbon 9/16" (14mm) wide, 20 yards (18.3 meters) long
Mobius loop allows printing on upper and lower portion on alternate passes.

OPERATOR CONTROLS

Power on/of
Reset switch — allows disabling of printer without dropping AC

DATA INPUT

7 or 8 bit ASCII parallel, TTL levels with strobe
Acknowledge pulse indicates that data was received.

ELECTRICAL REQUIREMENTS

60 Hz; 115VAC, + 10%/—10% of Nominal
50 Hz; 230VAC, + 10%/—10% of Nominal

PHYSICAL DIMENSIONS

Weight: less than 10 lbs./5 kg
Width: 14.5 inches/37cm
Depth: 11.0 inches/28cm
Height: 4.89 inches/13cm

Dimensions exclusive of roll paper holder.

TEMPERATURE

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Storage: —35° to 140°F (—37.2° to 60°C)



HUMIDITY

Operating: 20% to 90% (No Condensation)
Storage: 5% to 95% (No Condensation)

FORMS HANDLING

Roll Paper: 8.5 in. x 5.0 dia. with 1 in. core
maximum dimension.
3.5 in. wide with .38 in. core minimum
dimension

Fan Fold: 9.0 in./22.9cm wide pin to pin
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NPV AT 12.5 % IS -109.62

NPV AT 10.5 % IS 4.65

P	ICAPITAL	WORKING ICAPITAL	REVENUE	TAXATION	CASH FLOW	NPV	CUM NPV	P	ICAPITAL	WORKING ICAPITAL	REVENUE	TAXATION	CASH FLOW	NPV	CUM NPV
00	- 3000	+ 1000	+ 50		- 1950	- 1950	- 1950	00	- 3000	+ 1000	+ 50		- 1950	- 1950	- 1950
01	- 500		+ 150		- 850	- 801	- 2751	01	- 500		+ 150		- 850	- 809	- 2759
02		- 300	+ 275	+ 1475	+ 1450	+ 1289	- 1462	02		- 300	+ 275	+ 1475	+ 1450	+ 1312	- 1447
03		- 250	+ 350		+ 100	+ 84	- 1378	03		- 250	+ 350		+ 100	+ 86	- 1361
04		- 250	+ 350	- 300	- 200	- 158	- 1536	04		- 250	+ 350	- 300	- 200	- 164	- 1525
05			+ 350		+ 350	+ 261	- 1275	05			+ 350		+ 350	+ 273	- 1252
06			+ 400	- 300	+ 100	+ 70	- 1205	06			+ 400	- 300	+ 100	+ 74	- 1178
07			+ 450		+ 450	+ 298	- 907	07			+ 450		+ 450	+ 317	- 861
08			+ 500	- 400	+ 100	+ 62	- 845	08			+ 500	- 400	+ 100	+ 67	- 794
09	+ 750	+ 300	+ 200		+ 1250	+ 736	- 109	09	+ 750	+ 300	+ 200		+ 1250	+ 798	+ 4
	- 2750		+ 3075	+ 475	+ 800	- 109			- 2750		+ 3075	+ 475	+ 800	+ 4	

This - the True Rate of Return on this project is 10.5%

Making capital out of appraisal methods

Careful financial appraisal of capital expenditure and investment are often thought to be necessary only in very large companies which spend large sums of money. Yet even the smallest business could and should employ adequate appraisal methods — both for examining potential investment opportunities and for comparing alternative investments. EG Acraman reports.

AN EXAMPLE of the application of such appraisal methods might be where a business must choose between two machines, one of which is more expensive than the other but has a greater capacity and longer life. Evaluating the nett present value, NPV, of the additional cost could solve the problem of which to choose.

One method which can give seriously-misleading results is the "payback" method which judges comparative investments on the length of time taken to recover the initial outlay. This method pays no regard to the timing of cash-flows or the total income from the project over its useful life.

The technique currently accepted as most efficient is that of discounted cash-flow, DCF. When a business makes an investment, it pays cash today in the expectation of receiving more in the future. This cash-flow and the timing of it is the basis of the appraisal. All "book" adjustments such as depreciation, profit or loss on the sale of an asset, etc., are ignored, but all cash-flows — even notional ones — should be brought into account.

Thus, if an existing asset — such as a building — is to be utilised in a project being evaluated, the cash value of that asset should be charged to the project. Similarly, requirements for working capital, tax reliefs on purchase of plant, etc., should be included in the calculations.

The discounted-cash-flow method recognises the importance of the timing of cash flow, i.e., at a discount rate of 10 percent, £10 to be received in one year is worth only £9.09 today, and £10 to be received in four years is worth only £6.83 today.

Thus, to evaluate a project by the DCF method, the cash-flows throughout its life are estimated and discounted back to the NPV at the desired rate of return. The discount rate at which the NPV is zero is

the true rate of return on the project.

The program will first ask for the name of the project, the number of periods per annum, i.e., one for annual rests, four for quarterly, 12 for monthly etc., and the total number of years concerned.

The cash-flows for each period — + for income, — for expenditure — are then input under the categories: capital expenditure, working capital, revenue and taxation. Finally, the rate of discount to be applied is entered. The Pet then displays the NPV of the project at the rate of discount given. You then have a choice of:

- Trying another discount rate. This will recalculate the NPV of the cash-flows already entered, using the revised rate of discount.
- Determining the true rate of return. If the total NPV returned was positive, this indicates that the true rate of return is higher than the rate quoted. Conversely, if the NPV was negative, the true rate of return is lower than that quoted. To calculate the true rate of return, i.e., that at which the NPV is zero or as close to zero as possible, the rate already in the variable R is increased/decreased by 0.1 and the calculations repeated in a loop until the total NPV is 5 or less.

This value can be amended — line 470 — to suit particular requirements, but if it is set too low and the figures involved in the project are large, you may be caught up in a perpetual loop. On the other hand, if it is set too high, you could obtain a slightly erroneous answer.

- Changing any entry. To test the value of a project under varying circumstances, or to test the sensitivity of the result to possible changes in specific items, it is often useful to have the answers to "what if?" questions. This facility enables you to revise one particular figure without having to re-enter every single item of data.
- Displaying the table on the screen, or printing it out. The program is written to print out to a Commodore printer, and the printout gives, for each period and the total, the four figures input plus the total cash-flow, the NPV and the cumulative NPV to the period. The cumulative NPV indicates the break-even point, i.e., the period in which the sign changes from negative to positive.

The screen display, due to limitations of size on the 40-column screen, consolidates the first two columns and omits the last one.

```

100 REM**INVESTMENT APPRAISAL**
110 REM**USING DISCOUNTED CASH FLOW**
120 REM**COPYRIGHT(C)-E. G. ACRAMAN**
130 REM**1ST JANUARY 1981**
140 PRINT "DISCOUNTED CASH FLOW"
150 REM**DIM FOR TOTAL NUMBER OF PERIODS**
160 DIM B(60),O(60),R(60),P(60),C(60),T(60),V(60)
170 INPUT "PROJECT NAME";P$
180 INPUT "HOW MANY PERIODS PER ANNUM";A
190 INPUT "HOW MANY YEARS";B:P=R#B
200 FOR X=0 TO F-1:PRINT "PERIOD ";X:INPUT "CAPITAL EXPENDITURE ";B(X)
210 INPUT "WORKING CAPITAL ";P(X):INPUT "REVENUE ";O(X)
220 INPUT "TAXATION ";R(X):NEXT
230 B1=0:P1=0:O1=0:C1=0:R2=0:T1=0:X1=0
240 FOR X=0 TO F-1
250 C(X)=B(X)+P(X)
260 T(X)=O(X)+O(X)+R(X)
270 B1=B1+B(X):P1=P1+P(X):O1=O1+O(X):C1=C1+C(X)
280 R2=R2+R(X):T1=T1+T(X):NEXT
290 INPUT "ANNUAL RATE OF DISCOUNT ";R
300 X1=0
310 R1=(R*.01):GOSUB 460
320 PRINT "N P V AT "R% IS"INT(X1*100+.5)/100
    
```

(continued on next page)

(continued from previous page)

```

330 PRINT"PRESS ANY KEY TO CONTINUE"
340 GETX$:IFX$=""GOTO340
350 PRINT"DO YOU WISH TO -"SPC(67)"1) TRY ANOTHER RATE OF DISCOUNT"
360 PRINT"0 2) KNOW THE RATE OF RETURN"
370 PRINT"0 3) CHANGE ANY ENTRY"
380 PRINT"0 4) DISPLAY ON SCREEN"SPC(59)"5) PRINT OUT THE TABLE"
390 PRINT"0 6) END",,,"ENTER COMMAND BY NUMBER (1-6) ?"
400 GETC$:IFC$<"1"ORC$>"6"GOTO400
410 PRINT"0":ONVAL(C$)GOTO290,420,520,680,760,940
420 R=R+SGN(X1+1)/10
430 R1=(R*.01)
440 X1=0:GOSUB460:GOTO470
450 REM**CALCULATE NPV OF CASH FLOW**
460 FORX=0TOP-1:V(X)=T(X)/((1+R1)(X/A)):X1=X1+V(X):NEXT:RETURN
470 IFABS(X1)>.5GOTO420
480 PRINT"RATE OF RETURN IS "R"%
490 PRINT"PRESS ANY KEY TO CONTINUE"
500 GETX$:IFX$=""GOTO500
510 GOTO350
520 PRINT"CHANGE OF ITEM"
530 PRINT"1) CAPITAL EXPENDITURE",,"2) WORKING CAPITAL "
540 PRINT"3) REVENUE",,,"4) TAXATION"
550 INPUT"ENTER COMMAND BY NUMBER (1-4)":K
560 IFK<1ORK>4GOTO520
570 INPUT"PERIOD NUMBER":L
580 IFL>P-1THENPRINT"PERIOD NUMBER TOO HIGH":GOTO570
590 INPUT"REVISED AMOUNT ":E
600 IFK=1THENB(L)=E
610 IFK=2THENP(L)=E
620 IFK=3THENO(L)=E
630 IFK=4THENR(L)=E
640 PRINT"DO YOU WISH TO CHANGE ANY OTHER ITEM?"
650 GETX$:IFX$<"Y"ANDX$<"N"GOTO650
660 IFX$="Y"GOTO520
670 GOTO230
680 PRINT" P    CAP    REV    TAX    TOTAL    NPV    "
690 FORX=0TOP-1
700 PRINTXTAB(5)C(X)TAB(12)O(X)TAB(19)R(X)TAB(26)T(X):
710 PRINTTAB(33)INT(V(X)+.5):NEXT
720 PRINTTAB(5)C1TAB(12)O1TAB(19)R2TAB(26)T1TAB(33)INT((X1)+.5)
730 PRINT"PRESS ANY KEY TO CONTINUE"
740 GETX$:IFX$=""GOTO740
750 GOTO350
760 A$="991 ZZ 31":D$=" 999999 31"
770 A$=A$+D$+D$+D$+D$+D$+D$+D$
780 FORX=1TO3:OPENX,4,X-1:NEXT:PRINT#3,A$
790 B$="991 "+MID$(A$,7,74)+" 31"
800 PRINT#1," PROJECT - ":P$
810 PRINT#1:PRINT#1," PERIOD IS ":12/A:"MONTHS":PRINT#1
820 PRINT#1," NPV AT "R"% IS"INT(X1*100+.5)/100:PRINT#1
830 PRINT#1," _____":
840 PRINT#1," _____"
850 PRINT#1," | | | | | WORKING | | | | | ";
860 PRINT#1," |"TAB(8)"| CASH |"TAB(8)"| CUM |";
870 PRINT#1," | P |CAPITAL |CAPITAL |REVENUE |TAXATION| FLOW | |";
880 PRINT#1," NPV | NPV |":C$="|-----":GOSUB930:T=0:FORX=0TOP-1
890 N=INT(V(X)+.5):T=T+N:PRINT#2,0,X,B(X),P(X),O(X),R(X),T(X),N,T
900 NEXT:GOSUB930:PRINT#3,B$:PRINT#2,0,B1,P1,O1,R2,T1,X1:C$="|-----"
910 PRINT#1," |-----"C$C$C$C$C$C$C$":PRINT#3,A$
920 CLOSE1:CLOSE2:CLOSE3:GOTO350
930 PRINT#1," |-----"C$C$C$C$C$C$C$":RETURN
940 END

```

READY.

□

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Please return to: Online Conferences Ltd., Argyle House, Northwood Hills, Middx. HA6 1TS. Tel: Northwood (09274) 28211 Telex: 923498	

HAVING presented the programmed multiple-choice test as an educational tool for examination and revision purposes — December 1980 — I realised that it was possible to carry the idea to its logical conclusion and to program the complete cycle of events which comprises the multiple-choice system.

A complete system must have a comprehensive library of questions to be revised and updated when necessary. Each question is allocated a difficulty factor, DF, which is modified after each use of the question within a test. Thus, when questions are selected to form a test, their set of difficulty factors is used to guarantee the fairness of the test — to ensure that an average candidate will have, say, a pass mark of between 50 percent and 60 percent, if this is the required average mark bandwidth.

The complete system must start with the library, proceed with a selection of questions from the library and the make-up of a test paper, which can be checked and given to the candidates who sit the exam. Results can then be gathered and checked for fairness, and for anomalies, the accepted results can be fed back to the library and necessary amendments carried out.

From the start, teachers using the exams must be submitting useful questions to the

by Rex Tingey

library, while revising their own ideas through experience of the system, both in the marking/revising of questions, and in the writing of balanced papers. The library team are the scheme experts and offer advice and help in programming examination make-up and in marking results, as well as being responsible for revision of the library. They will also check and accept new questions, discarding questions which prove to be without merit.

The examination room should have at least two microprocessor units coupled to a single floppy-disc unit and a printer, which will also be used by the library team and examining teachers when not used for tests. The Commodore Pet fills the bill exactly, say, six 16K 3001s, a 3022 printer and a 3040 dual-drive floppy-disc unit making the ideal set-up. All programming work is carried out to and from floppy discs in either program or sequential form.

The library consists of programs on disc which are re-written as sequential data. The question sets can then be read by an outline question-paper program from the floppy disc, and the data inserted into the program as a series of overlays, making up the complete paper, as selected by the examiner.

A test-paper program contains fundamentals to read data, present the exam to the candidate and to record his results in memory, retained after CLR or NEW. In memory, the results can be extracted by another program. The

A complete micro-based examination system

program reads and writes as sequential information to the floppy disc for later detailed analysis and correlation after all the candidates have finished the test. Then, the extracted results can be printed out and examined for anomalies and, if the difficulty factors seem wildly in error, the marks can be re-examined and possibly balanced toward the norm.

Amended results can be issued to the apprehensive candidates and returned to the library team for further analysis and for the updating of the library questions used for both content and DF. The library data program allows for this procedure, as well as the printout of complete or selected sets of answer/questions in a form similar to that screened for a test.

Difficulty factors are used to select a series of questions which can be expected to be answered by the average candidate in such a manner that he will achieve an average result. To this end, DFs are selected so that they can be plotted to approximate a Standard Deviation (Gaussian) Curve in distribution.

In our case, we have a base range, x axis, of 0 to 20, with every candidate correctly answering a question with a DF of 0, and none correctly answering one with a DF of 20. There is unlikely to be a question in data which a candidate will not, sooner or later, misunderstand, and up goes the DF from 0 to 1 or 2.

A DF of 20 usually means that there is something wrong with the question. New questions should enter the field with a pre-judged DF close to the median, and for a difficulty factor to rise to 20 means that it is never correctly answered. For this to happen could be due to one of four possibilities:

- Its source is obscure or from a high information level, beyond the scope of the course.
- The question is ambiguous.
- The "wrong" answer is correct.
- That part of the subject has not been taught.

The use of the question within the scheme will quickly root out any to which the last three apply, but it may take a few more passes through the system to conclude that the first is the reason for the high DF.

It is unlikely, anyway, that many questions will retain difficulty factors above 16 or 17 for long since post-exam inquests bring out sufficient information to pass answers to the difficult questions through the grape vine, which is one of the reasons why a good, growing library system is essential.

It can also be seen that the questions in the library can be for the lowest to the highest levels of examination, with a considerable overlap of difficulty factors.

The values selected for a particular

paper need only an approximate Gaussian curve in distribution, particularly with only 25 questions to a paper. The ends will necessarily be clipped off the very high and very low factors. The factors given in the program listing are for example only, and should be re-started around the median. The last figures of the set should be zeroed.

Additional questions

The example library data program given is written for economics at about O level, but the data can, of course, be changed for 50 questions on any other subject, but following the same rules of entry. Further, the library need not be limited to 50 questions per subject, but additional question/answer sets require that all the relevant numbers in For/To sequences will need changing from either 50 or 350 to the new requirement. Note that there are seven data elements to each set.

Each complete data set contains one element which is multiple data — the sixth of each set — which keeps together the library number, the difficulty factor as a letter and the correct answer as a letter; A, B, C or D. The last element of the seventh group is a figure for the number of times the question has been used, to modify the difficulty factor, moving it to and from the mean.

In the Pet, the use of the Integer feature will always move the DF back, should the most recent figure be only one lower. Should the most recent figure be two or three higher, for a well-used question, the DF will not necessarily shift forward. Line 40050 may need adjustment mathematically if the DFs over-optimistically move backwards every run.

That can obviously be achieved by finding the difference between the complete value and the integer, adding 1 whenever it is above .5. Yet since any modifications are semi-manual, this can be kept in check by the library team.

The first five elements of a data set are the question and four answers — one answer and three distractors. The line numbers are made to correspond, in the manner shown, with the actual question numbers so that finding and entering data is simplified. The question can be up to 72 elements long, including spaces, as can the answer/distractor four; if longer, an error condition will prevail during subsequent extraction of this data.

Each library data program should have at its end the various sequences given here, to operate the data update, extraction, check-through, and sequential data write. The check-through program will operate to either the screen or to the printer, as selected, and the printer

sequence will either print out all the data in proper order, or printout selected data only.

The first purpose of the multiple make-up program is to extract required data sets from the library, now existing as sequential data on the disc. This is achieved by line 0, and then 20000 on. Lines 60000-on are a mean of cancelling this first purpose part after it has completed its task.

Data extraction takes place by reading through the data, in sequence, until the required set is reached when it is screened complete with correct line numbers, "DATA", and the required five commas on each of three lines. It can then be checked, visually, to ensure that it is the required set, and returned over to place it into the data structure of the program now being formed.

Since this procedure clears variable and string memory automatically, it is necessary to Poke the progressing line numbers being created into a more substantial form. In this case, byte 1000 of the second cassette buffer is used. Further use is later made of this unused part of memory for results, candidate number and library numbers. There is no practical need for a second cassette recorder within the scheme.

Line numbers are made to match question set position $\times 10$, so that the next two lines of data can be given +2, +2, and then the elementary number itself is incremented by one, giving up to 256 question numbers if required.

Note that this part of the scheme gives no limit, up to 256, to the number of question sets it is possible to overlay, but the number of read questions is limited in line 20010 to 50 library questions. As the library is expanded, this figure will need to be increased to match.

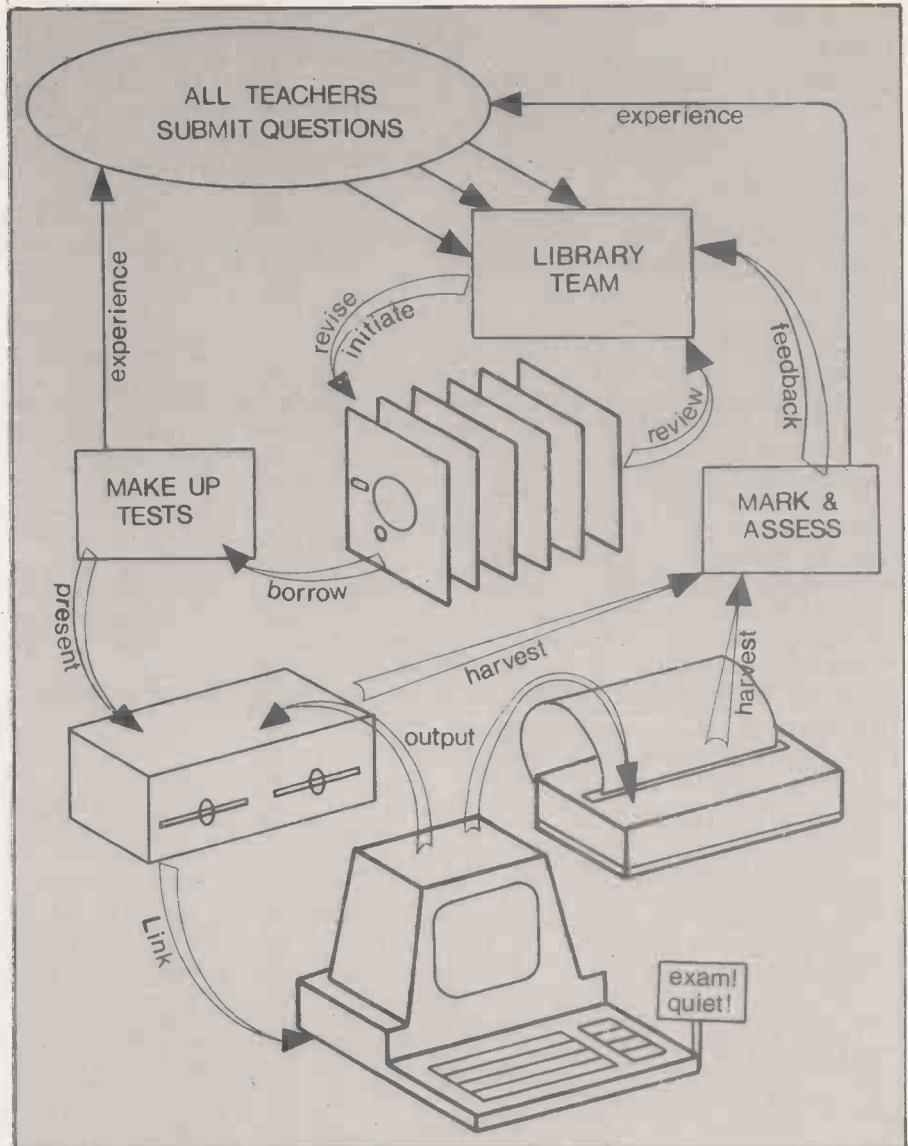
Standard form

The cursor is moved in conjunction with the print lines to be over the first line of data and to proceed downwards with the carriage returns to include the GOTO 20000. On the 25th question, however, the cursor should be shifted down to the lower-screened line which reads GOTO 60000. Returning over this produces a column of numbers, cancelling the now unwanted part of the program from useful memory.

The program now consists of the new data and all requirements to run, present and score the examination. Note that all inputs print three cursor-rights, a diamond, and three cursor-lefts. This produces on error a Re-do from start and a repeat Input request for all numerical inputs only, preventing a run failure and Ready.

However, string inputs will accept the diamond or other symbol and may abort because of this. The way to avoid this error is to follow the input with the line: 5052 IF N1\$ = " \diamond " GOTO 5050

This is not necessary here as the string is



The multiple-choice examination system.

used only in the final score routine. Save the completed test paper to the floppy disc.

The examination is presented in a standard form, but with the questions appearing in a random order which is decided by the initial shuffle of 25 figure pairs. If the test contains more than 25 questions, the figure-pair string will have to be concatenated with the extra numbers required, and the figures on lines 5100 and 5200 will need amending, and the score section will need to be altered to suit the percentage requirement.

As the questions are answered, they score four marks each for a correct response and zero for an incorrect response. The correct answer must still be sought and given or the test will not proceed; further marks cannot be lost or gained on that particular question.

There is no reason why a candidate should not be informed of a correct answer after failing to know it during the test. Line 6060 could be modified to print the correct response. Seeing the correct response after making the error is good revision work.

As each question is answered, a byte in the second cassette buffer corresponding to the question number is Poked with the score, 4 or 0, so that at a later stage a For-To loop can collect scores in a correct sequence of question position. At the same time the value of Q\$ is extracted with the same order and Poked some 50 bytes up from that group, forming another series.

Score reviewed

At the end of the test, a score is displayed, however the candidate should be informed that the score is open to review, and that his result could be subject to alteration, dependent on overall results.

The harvest results program is for the invigilator to go to each computer in the examination room in turn and to load this program into memory and select whichever method of data transfer is required to access the results from the second cassette buffer area.

Results can be printed to the screen, printed out on the printer, both with

(continued on next page)


```

6020 GETZ:IFZ#=""GOTO6020
6030 IFZ#>"D"GOTO6020
6040 IFZ#<"A"GOTO6020
6050 V#:=RIGHT$(Q#,1):IFZ#<V#GOTO7000
6060 PRINTZ#;"IS INCORRECT":K#:=GOTO6020
7000 I:=K:J:=J+1:PRINT"INCORRECT"SPC(1);V#SPC(14);J" SCORE":I:TI#="000000"
7020 K1:=900+A:POKEK1,K:V1:=VAL(Q#):K2:=949+A:POKEK2,V1
7040 IFTI#<"000003"GOTO7040
7050 GOTO5100
7999 END
8000 PRINT"THE ECONOMICS # MULTIPLE CHOICE"RETURN
9000 GOSUB8000
9010 PRINT"THE CANDIDATE "N1#" SCORES":PRINTTAB(15)I""
19999 END
20000 PRINT"ADDING QUESTIONS FROM DATA":I#="DATA":J#="":P1:=PEEK(1000)
20008 PRINT"QUESTION NUMBER "P1
20010 INPUT"ENTER DATA NUMBER";I#;X:OPEN2,8,2,"1:DATA,S,R":FORAI=1TO50
20030 FORA=1TO7:INPUT#2,B#:=A#(A)=A#;NEXT:IFA1#XGOTO20100
20040 NEXTA
20100 P=P1+10:PRINT"NUMBER";I#A#(1):P=P+2:PRINTP:I#A#(2)J#A#(3)J#A#(4)J#A#(5)
20110 P=P+2:PRINTP:I#A#(6)J#A#(7):P1=P1+1:POKE1000,P1:CLOSE2:PRINT"GOTO20000"
20120 PRINT"REMEMBER ONLY ONE ANSWER AT END OF EACH QUESTION OVER DATA
29999 END
50000 PRINT"THE ECONOMICS # MULTIPLE CHOICE"RETURN
50010 PRINT"20100"
60020 PRINT"HOME CURSOR & RETURN OVER!"
READY.

```

Listing 3. Harvest results program.

```

1 REM COPYRIGHT (C) REX L TINSLEY © 1981
10 DIMA(26)
100 FORA=0TO25:B=900+A:C=PEEK(B)Z=A:A(Z)=C:NEXT:A=0
110 FORZ=1TO25:A=A+R(Z):NEXT:Z=B
200 PRINT"EXAMINATION RESULTS"
300 PRINT"SELECT PRESENTATION MODE"
320 PRINT"0=PRESS #A# FOR SCREEN RESULTS."
340 PRINT"1=PRESS #Z# FOR PRINT-OUT"
350 PRINT"2=PRESS #D# FOR DATA TRANSFER TO DISK"
360 PRINT"3=FOR LIST OF LIBRARY QUESTION NUMBERS #F#
900 GETZ:IFZ#=""GOTO800
810 IFZ#="Z"GOTO2000
820 IFZ#="D"GOTO3000
830 IFZ#="P"GOTO4000
1010 PRINT"ENTER CANDIDATE NUMBER "A(0) " SCORE "B
1020 PRINT"1-"A(1),"2-"A(2),"3-"A(3),"4-"A(4)
1030 PRINT"5-"A(5),"6-"A(6),"7-"A(7),"8-"A(8)
1040 PRINT"9-"A(9),"10-"A(10),"11-"A(11),"12-"A(12)
1050 PRINT"13-"A(13),"14-"A(14),"15-"A(15),"16-"A(16)
1060 PRINT"17-"A(17),"18-"A(18),"19-"A(19),"20-"A(20)
1070 PRINT"21-"A(21),"22-"A(22),"23-"A(23),"24-"A(24),"25-"A(25)
1080 PRINT"3=PRESS #Z# TO CLOSE: OTHER TO RE-RUN."
1100 GETZ:IFZ#=""GOTO1100
1110 IFZ#="Z"THENEND
1120 RUN
2000 OPEN4,4:PRINT#4:PRINT#4,"CANDIDATE NUMBER "A(0) " SCORE "B
2010 PRINT#4:PRINT#4
2020 PRINT#4,"1-"A(1),"2-"A(2),"3-"A(3),"4-"A(4),"5-"A(5)
2030 PRINT#4:PRINT#4,"6-"A(6),"7-"A(7),"8-"A(8),"9-"A(9),"10-"A(10)
2040 PRINT#4:PRINT#4,"11-"A(11),"12-"A(12),"13-"A(13),"14-"A(14),"15-"A(15)
2050 PRINT#4:PRINT#4,"16-"A(16),"17-"A(17),"18-"A(18),"19-"A(19),"20-"A(20)
2070 PRINT#4:PRINT#4,"21-"A(21),"22-"A(22),"23-"A(23),"24-"A(24),"25-"A(25)
2080 PRINT#4:CLOSE4:PRINT"MC TO CLOSE: OTHER TO RE-RUN"
2100 GETZ:IFZ#=""GOTO2100
2110 IFZ#="Z"THENEND
2120 RUN
3000 PRINT"TRANSFER RESULTS TO DISK"

```

```

3010 PRINT"REMEMBER ONLY ONE ANSWER AT PRESENT!"
3020 INPUT"ENTER CANDIDATE'S NUMBER";I#;C
3100 OPEN15,8,15:PRINT#15,"11"CHR$(I#):CHR$(I#)
3110 IFC=1THENOPEN2,8,2,"1:1,S,R"
3112 IFC=2THENOPEN2,8,2,"1:2,S,R"
3113 IFC=3THENOPEN2,8,2,"1:3,S,R"
3114 IFC=4THENOPEN2,8,2,"1:4,S,R"
3115 IFC=5THENOPEN2,8,2,"1:5,S,R"
3116 IFC=6THENOPEN2,8,2,"1:6,S,R"
3117 IFC=7THENOPEN2,8,2,"1:7,S,R"
3118 IFC=8THENOPEN2,8,2,"1:8,S,R"
3119 IFC=9THENOPEN2,8,2,"1:9,S,R"
3200 FORZ=0TO25:PRINT#2,B#(Z)CHR$(NEXT_CLOSE2):CLOSE15
3300 PRINT"MC TO CLOSE: OTHER TO RE-RUN"
3310 GETZ:IFZ#=""GOTO3310
3320 IFZ#="Z"THENEND
3330 RUN
4000 OPEN4,4:PRINT#4:PRINT#4,CHR$(1)"ECONOMICS"
4020 FORA=1TO25:B=949+A:C=PEEK(B):PRINT#4,A#="C:NEXT:PRINT#4:CLOSE4
4300 PRINT"MC TO CLOSE: OTHER TO RE-RUN"
4310 GETZ:IFZ#=""GOTO4310
4320 IFZ#="Z"THENEND
4330 RUN
READY.

```

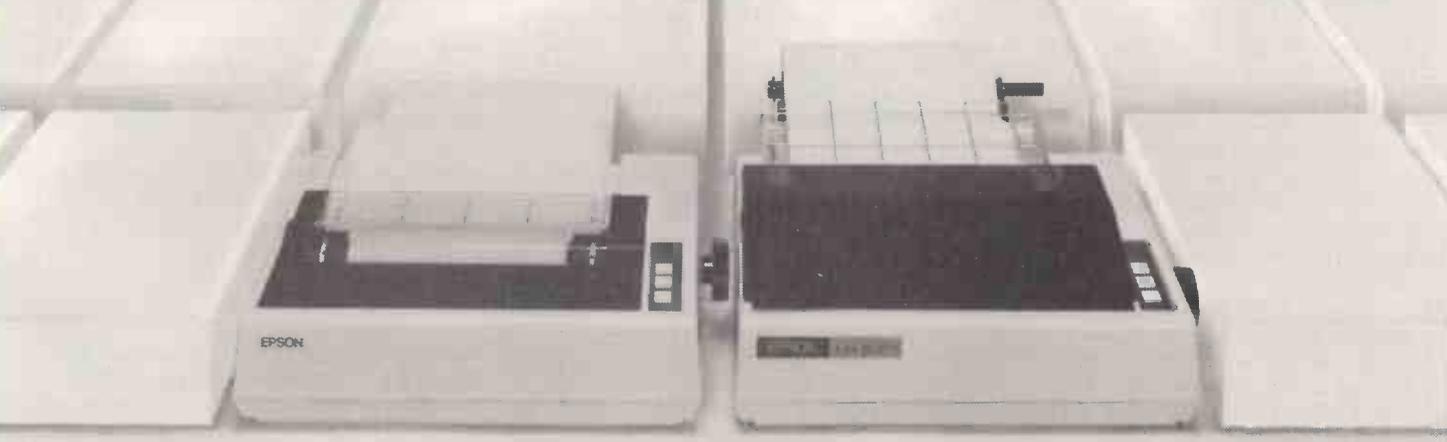
Listing 4. Assess difficulty factor.

```

10 DIMA(26) DIMR(25) DIMC(25) DIMD(25) DIME(25) DIMF(25) DIMG(25)
20 DIMH(25) DIMI(25) DIMJ(25)
100 GOSUB60000:IFN#0THENGOSUB50020
110 IFN#0THENPRINT"NUMBERS ENTERED":GOSUB50000
200 N#:=1:IFN#0THENPRINT"THATS ALL":GOTO10000
210 INPUT"CANDIDATE NUMBER (2 IF ALL)";Z#(N):Z#(N)
220 IFZ#(N)=""Z"THENN#:=1:GOTO10000
230 IFZ#(N)="#GOTO210
240 A:=VAL(Z#(N))
300 IFA=1GOTO1000
310 IFA=2GOTO2000
320 IFA=3GOTO3000
330 IFA=4GOTO4000
340 IFA=5GOTO5000
350 IFA=6GOTO6000
360 IFA=7GOTO7000
370 IFA=8GOTO8000
380 IFA=9GOTO9000
1000 OPEN2,8,2,"1:1,S,R"
1010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):A(B)=VAL(C#):NEXT:CLOSE2:GOTO100
2000 OPEN2,8,2,"1:2,S,R"
2010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):B(B)=VAL(C#):NEXT:CLOSE2:GOTO100
3000 OPEN2,8,2,"1:3,S,R"
3010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):C(B)=VAL(C#):NEXT:CLOSE2:GOTO100
4000 OPEN2,8,2,"1:4,S,R"
4010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):D(B)=VAL(C#):NEXT:CLOSE2:GOTO100
5000 OPEN2,8,2,"1:5,S,R"
5010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):E(B)=VAL(C#):NEXT:CLOSE2:GOTO100
6000 OPEN2,8,2,"1:6,S,R"
6010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):F(B)=VAL(C#):NEXT:CLOSE2:GOTO100
7000 OPEN2,8,2,"1:7,S,R"
7010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):G(B)=VAL(C#):NEXT:CLOSE2:GOTO100
8000 OPEN2,8,2,"1:8,S,R"
8010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):H(B)=VAL(C#):NEXT:CLOSE2:GOTO100
9000 OPEN2,8,2,"1:9,S,R"
9010 FORB=0TO25:INPUT#2,B#:=RIGHT$(B#,2):I(B)=VAL(C#):NEXT:CLOSE2:GOTO100
10000 OPEN4,4:PRINT#4:PRINT#4,CHR$(1)"DIFF. FACTORS"
10050 FORA=1TO25:R(A)=A(A)+B(A)+C(A)+D(A)+E(A)+F(A)+G(A)+H(A)+I(A)+J(A)/N
10100 S(A)=INT(R(A)*5):R(A)=20-S(A):B=949+A:C=PEEK(B)
10200 PRINT#4,A#="R(A)":"C"NEXT
49999 CLOSE4:END
50000 PRINTZ#(1) "Z#(2) "Z#(3) "Z#(4) "
50010 PRINT"TAB(Z#(5)) "Z#(6) "Z#(7) "Z#(8) "Z#(9)
50020 PRINT"OK"
60000 PRINT"ASSESSMENT OF D.F.":RETURN
READY.

```

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Simulating 350K of virtual memory capacity

THE FULL 340K of the Pet disc memory and the 32K of main memory can be used with the appearance of being virtually continuous. Thus a database of some 350K is possible giving a facility normally available only on much larger machines. The method I describe to obtain this has been written with the Pet in mind but, it is readily transferable to other systems.

The term virtual memory was one made much of by IBM during its launch of the facility some years ago but as I said in my article on co-ordinate drilling in the

by J A Forbes

February 1981 issue, there is not much that is new, and, indeed, the facility of virtual memory and its concept first appeared in this country when computing was in its infancy. I believe that in fact it was the Argus range of computers.

Many articles have been written on how, by judicious use of Poke, one can preserve the variables from another program. However, this has the problem that such arrangements are normally valid only for one specific set of circumstances. What this means is that if any of the characters are changed, the linking arrangement must also be changed.

As an introduction to the subject, I would refer you to Nick Hampshire's book *The Pet Revealed* and in particular to pages 68 to 73 where the method and structure of linking Basic lines is discussed. In particular, page 71 gives a line-find routine which will print out the link address contents of a given line while page 72 shows how this information may be used to link programs together.

Let us first examine overlay/main subroutine-linking arrangements. In the Pet, line numbers and the location of program lines and their contents are organised as follows.

The user program starts from memory location 1024 and upwards. The first two bytes of a program line contain the address of the next program line — the link address. The third and fourth bytes contain the user line number in binary format and the remaining bytes are the program line contents up to the address of the next line. The end of a statement is indicated by a zero byte. This can be shown diagrammatically as in figure 1.

The first two bytes of the last line give the address of a location which contains two zeros which is used to indicate the end of the program.

When a program is loaded using a load command contained in a program already in the computer memory, the new pro-

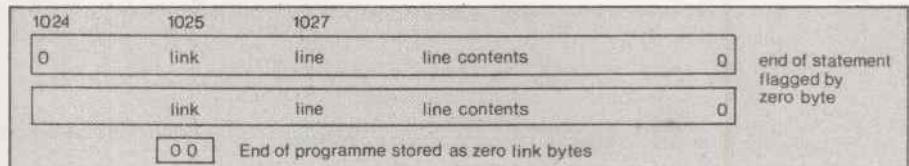


Figure 1.

gram will be loaded from memory location 1024 upwards, as described. Clearly, the new program will overwrite an area of memory equal to its own length. To overcome this problem when loading the various overlay programs, we must ensure that the main program loaded occupies an area of memory greatly exceeding that of any subsequent program and that the parts of the original program which we wish to leave undisturbed have line numbers greater than those used in any subsequent overlay. We must also ensure that a means exists for linking the end of the new program to the beginning of the undisturbed portion of the original program.

This may be more clearly illustrated diagrammatically by figure 2.

From this consideration of how lines are held in memory and how a main program would have to be constructed to allow overlays, let us now look at a typical main-core program which has the following features:

- A menu of selectable overlays each of which can be up to, say, 10K long.
- A set of standard utilities which are called by each overlay.

It is also necessary to determine at the start what other programs you may wish the main program to call into memory. For example, a reverse-field facility may be required which can be used by either the main program or the overlays and which can reverse field lines, blocks or even lines in sequence. This program is written in Hex and located in the cassette 1 buffer and is called Reverse. The listing given here may be entered into memory by the machine-code monitor, then saved and recalled by the main program when it is first run.

To use this program it is necessary to provide it with some basic information prior to calling it during a program. The following Pokes are required

- POKE 714, Number of columns in from edge of screen.
 POKE 715, 128
 POKE 716, Screen line number of start — 1 to 25 from top of screen.
 POKE 717, Number of lines in the block.
 POKE 718, Number of columns in block.

0292 98 48 18 A9 28 65 01 EA
 029A 85 01 EA A9 00 65 02 EA

0292 85 02 EA 68 A8 60 48 98
 029A 48 8A 48 AE 7C 02 20 82
 02A2 02 CA D0 FA AE 7D 02 AC
 02AA 7E 02 B1 01 49 80 91 01
 02B2 88 D0 F7 CA F0 06 20 82
 02BA 02 4C A9 02 68 AA 68 A8
 02C2 68 60 00 00 00 00 00
 02CA 00 00 00 00 00 00 00
 02D2 AD CA 02 85 01 AD CB 02
 02DA 85 02 EA AD CC 02 8D 7C
 02E2 02 AD CD 02 8D 7D 02 AD
 02EA CE 02 8D 7E 02 4C 98 02

This reverse-field function can be called by a SYS (722) command preceded by the necessary Pokes. An example of its use is in alternately flashing the words letter and number in the option legend which appears at the bottom of each displayed overlay page. See subroutine at line 40000 in the main program listing.

The calling line for this and any other utilities must be entered as the very first lines in the main-core program. This will ensure that they are loaded when the main program is first run but, of course, these lines will be later destroyed as they are overwritten by the first overlay called.

Next the filler area is entered up to the point where the filler has occupied an area of memory slightly greater than the maximum size of the largest overlay. In my case I used an area occupying 10K. One can calculate in Hex what the equivalent decimal value is of the filler area required and, when keying in the filler, periodically examine memory.

Memory check

For example, 10K = 2710 in Hex, therefore, when the entered filler reaches 2710 you know that there will be an area of 10K for overlays. The filler area can be filled in by simply entering sequential print statements and typing in anything at all. One method is to load any old 10K program, re-number it using a re-number program and then enter the initial call lines previously mentioned.

It is essential to use low line-number values, and increments, so that high values are preserved for the main program, e.g., make a rule that line numbers from 1 to 1900 are reserved for overlays or filler and line numbers of 20000 upwards for the main program.

Having generated a filler area, it now

remains to complete the main program. The exact format will depend on the application but will probably comprise a menu page which branches on selection to display the first page of the selected overlay and, while this page is being read by the user, the remaining pages are being loaded into the filler area, transparently to the user.

The next requirement would probably be a means of allowing users to progress through the overlay pages at their own reading rate and, therefore, a legend-generating subroutine is incorporated into the main program which, when called by the overlay, will print "PRESS ANY LETTER TO CONTINUE" and "PRESS ANY NUMBER FOR MENU".

In addition, there is a timer incorporated into the subroutine which will return the display to the menu if no key has been depressed for 40 seconds.

The fact that the timer is entered by a Gosub from an overlay but exited by a branch to menu would normally result ultimately in an out-of-memory error as the stack eventually overflows. However Basic performs a Run after each selection and this re-initialises the stack after each menu selection.

A sample program listing is given for both main and overlay programs. While this is only a demonstration program, it will work and should be loaded and run to develop a feel for the system. Only one overlay is given to show the principle.

The main program shows the utility calling lines at lines 2 and 3; the filler area at lines 2110 to 2250; the menu at lines 20000 to 20640; two overlay first pages — the others indicated in the menu are implied but not shown; the timer and key depression check at lines 40000 to 40030 — note the Poke and SYS (722); commands which use the Reverse program to reverse field the words Letter and Number; and finally the legend subroutine at lines 41000 to 41010.

The overlay listing shows the SYS(29808) command which alters the link address for line 18000 to that of line 20000 in the main program. The Gosub at line 10 and 20 print the legend on line 24 and 25 after the overlay has been loaded from disc. Note that the last line before line 18000 returned you to the menu indicating that the last page has

been viewed but there is no reason why one could not offer a choice of either the menu or that overlay's first page at line 25500.

Having created both the overlay and main program, it is now time to examine the method of linking the two. Since this linking program is of general interest, the assembly listing is given in full. First let us consider the method given in *The Pet Revealed*. The problem with that method is the linking commands apply not to a line number value but rather to the location of that line in the overlay when in memory. What this means is that should you change the number of characters before the last line, the link arrangements are no longer valid and have to be re-calculated.

Link address

What is required is a means of finding and changing the link address of a given line number value regardless of its position in memory. A short assembly-language program called Link has been prepared which is loaded by the main program during its initial run and stored in a protected area at top of memory. The reason that it sits some 2K down is to allow for insertion of other utilities such as a soft Toolkit, etc.

When the overlay in question is loaded, line 5 will cause Link to search through memory until it finds line 18000 and then change its link address to that of line 20000 in the main program. It is fast and effective provided that the last line is always 18000 and that the filler area or any other line prior to line 20000 in the main program is not altered in quantity since that would move the location of line 20000.

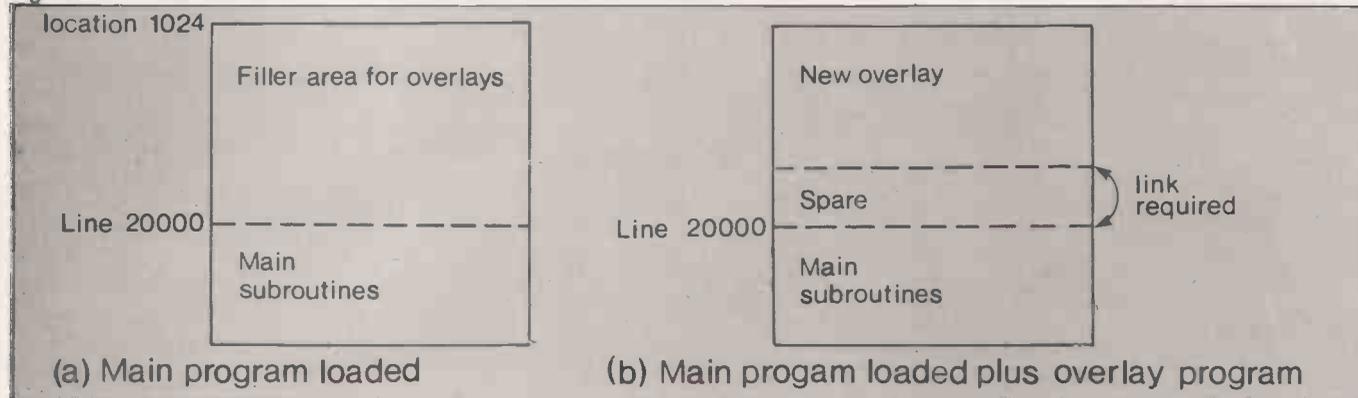
The value of the line which Link is seeking may be changed just as the link address to which it will link that line, may also be changed. The values incorporated in the listing are obviously those for this demonstration but may be changed by Poking new values or changing them permanently, their locations are given here;

HEX LOCATION	CURRENT VALUE	FUNCTION
7490	50	Sought line number LO
74BE	46	Sought line number HI
74D3	43	Main program link

Listing	Address	Instruction	Comment
74DD	06		address LO Main program link address HI
7470	AD 01 04	LDA	Get base address from
7473	85 01	STA	0401 and 0402 and store
7475	AD 02 04	LDA	as address LO in 01
7478	85 02	STA	as address HI in 02
747A	START A501	LDA	Get base address LO
747C	18	CLC	Clear carry
747D	69 02	ADC # 2	Add to base address LO to get
747F	85 01	STA	location of line number LO
7481	85 4B	STA	and store in 01 and 4B
7483	A5 02	LDA	Get base address HI, add carry
7485	69 00	ADC 0	if any.
7487	85 02	STA	Store line address HI
7489	85 4C	STA	in 02 and 4C
748B	A2 00	LDX #0	Set register X to zero.
748D	A1 01	LDA(X)	Load Acc with value of contents
748F	C9 50	CMP #50	at 01 and compare to Hex 50
7491	FO 22	BEQ CHECK HI	Branch if equal the CHECK HI
7493	NEXT 38	SEC	Subtract 2 from line addresses.
7494	A5 01	LDA	to restore link address
7496	E9 02	SBC # 2	and
7498	85 01	STA	store as LO on 01/ 4B
749A	85 4B	STA	HI in 02/4C
749C	A5 02	LDA	
749F	E9 00	SBC # 2	
74A0	85 02	STA	
74A2	85 4C	STA	
74A4	A1 01	LDA(X)	Using current link address
74A6	85 01	STA	get and store next link
74A8	E6 4B	INC	address as LO in 01
74AA	DO 02	BNE	
74AC	E6 4C	INC	
74AE	A1 4B	LDA(X)	
74B0	85 02	STA	HI in 02
74B2	4C 7A 74	JMP	No match found so jump to START
74B5	CHECK HI E64B	INC	Having found LO equal 50
74B7	DO 02	BNE	now check line HI

(continued on next page)

Figure 2.



ANALYTICALLY, if we let C_n be the number of comparisons made in sorting n elements, and let M_n be the number of movements or exchanges made, then considering a randomly-unsorted collection of n items:

Bubble-sort:
 $C_n = (n^2 - n)/2$ $M_n = 3(n^2 - n)/4$
 Insertion:
 $C_n = (n^2 + n - 2)/4$ $M_n = (n^2 - 9n - 10)/4$

To give an example, Bubble-sort will, on average, make no less than 1,248,750 comparisons and exchanges in sorting 1,000 numbers.

From these results, we say that the complexity of computation in both Bubble-sort and Straight Insertion sort is of order n squared. In contrast, that of Shell-sort is approximately of order n to the power (1.2), and though a vast improvement, it is still slow when we

by Mark Walker

appreciate that complexities of order ($n \log n$) are theoretically possible. We therefore illustrate one of the fastest sorting algorithms, Quick-sort — see table 1.

Quick-sort was developed by CAR Hoare and like all the best algorithms, it is fundamentally simple. Given n objects a_1, \dots, a_n to be sorted in an array A , we choose an element x from them and construct a partition of A into A_1 and A_2 where:

$$A_1 = \{a_i : a_i > x\}$$

$$A_2 = \{a_i : a_i \leq x\}$$

and then construct partitions of A_1 and A_2 based on new elements x_1, x_2 chosen from them, and so on. The array A becomes sorted when the partitions are of unit size.

It is usual to choose each x as the middle, median element of the partition considered. This is because if x is the median of the array, both the best and average performance of the algorithm and good, since a random number tends to lie near the median.

The algorithm lends itself very easily to a recursive definition, and a procedure to perform Quick-sort is given in a slightly-altered form of BCPL — with [] replacing ! Conversion to Pascal is easy.

```

LET quicksort (lowup,array) BE (
  LET k,j := lowup
  LET x := array[ (lowup)/2 ]
  WHILE k<=j DO (
    WHILE array[k]<x DO k := k + 1
    WHILE x<array[j] DO j := j - 1
    IF k<=j THEN (
      LET y:=array[k]
      array[k] := array[j]
      array[j] := y
      k := k + 1
      j := j - 1
    )
  )
  IF low<j THEN quicksort(low,j,array)
  IF k<up THEN quicksort(k,up,array)
)
and is called with quicksort(1,n,A)
    
```

Table 1. Time in ms. to sort 512 keys in a CDC6400 Pascal implementation.

	Ordered	Random order	Inverse order
Straight insertion	23	1444	2386
Binary Insertion	125	1027	2090
Bubble-sort with flag	8	4270	6542
Shaker-sort	9	3642	6520
Quick-sort	69	146	79

Essential tools for repetitive sums

The listing in Basic is much less clear, due mainly to Basic's lack of local variables, and is consequently non-recursive. It assumes the data to be sorted is in an array A of N elements. M is a constant for a stack composed of two arrays SL,SR which contain the left and right bounds of the current partition to be further partitioned. S is the point of most recent entry to this stack.

Since the following code is of itself difficult, the routine should merely be copied line for line when required. The recursive version should be studied since it neatly embodies the essentials of the Quick-sort algorithm.

```

5 REM NON-RECURSIVE QUICKSORT ROUTINE
100 M=12 : DIM SL(M),SR(M)
110 S=1 : SL(1)=1 : SR(1)=N
115 REM TAKE TOP REQUEST FROM STACK
120 L=SL(S) : R=SR(S) : S=S-1
125 REM SPLIT A(1) ... A(R)
130 I=L : J=R : X=A( INT((L+R)/2) )
140 IF A(I)<X THEN I=I+1 : GOTO 140
150 IF X<A(J) THEN J=J-1 : GOTO 150
160 IF I>J THEN 190
170 W=A(I) : A(I)=A(J) : A(J)=W
180 I=I+1 : J=J-1
190 IF I<=J THEN 140
200 IF I>=R THEN 220
205 REM STACK REQUEST TO SORT RIGHT PARTITION
210 S=S+1 : SL(S)=I : SR(S)=R
220 R=J
230 IF L<R THEN 130
240 IF S<>0 THEN 120
    
```

Consideration of table 1 shows how great an improvement Quick-sort is over the elementary sorting algorithms.

Numerical analysis is a major area of activity for computers, since it involves large quantities of repetitive computation to solve systems of linear equations, differential equations or partial differential equations. Matrices and determinants are essential tools in this area, so we pause briefly to consider each in turn.

Matrices can be thought of as a shorthand method of writing a grid of numbers, usually equation coefficients. They have no value, and are usually represented as a two-dimensional array. A determinant is also a grid of numbers, but has a single value which may be computed thus:

Set of Equations: $3x - 2y + z = 7$
 $x + 5y - z = 9$
 $x - y + 4z = -2$

Matrix of coefficients: Determinant:

$$\begin{vmatrix} 3 & -2 & 1 \\ 1 & 5 & -1 \\ 1 & -1 & 4 \end{vmatrix} = \begin{vmatrix} 3 & -2 & 1 \\ 1 & 5 & -1 \\ 1 & -1 & 4 \end{vmatrix} = 61$$

Operations on matrices are very simple, the following routine adds matrices A and B — each $N \times N$ elements — to give matrix C , subtracts them to give D , multiplies them to give E and transposes A to give F .

```

100 FOR I=1 TO N
110 FOR J=1 TO N
120 C(I,J) = A(I,J) + B(I,J)
130 D(I,J) = A(I,J) - B(I,J)
140 E(I,J)=0 : FOR K=1 TO N
150 E(I,J) = E(I,J) + A(I,K) * B(K,J)
160 NEXT K
170 F(I,J) = A(J,I)
180 NEXT J,I
    
```

Matrices need not be square. Generally, if a matrix has r rows and c columns then it is a ($r \times c$) matrix. Matrices may be added and subtracted only if they are the same size. Two matrices may be multiplied only if they conform to the rule:

$$(p \times m) \cdot (m \times n) = (p \times n)$$

Any matrix may be transposed.

We now consider the evaluation of determinants, the mathematics is well covered in the references, and the program emulates the process shown in table 2.

Essentially then, we reduce the determinant successively from an $N \times N$ to a 1×1 . The value of the determinant is then this value multiplied by the scaling factors removed. These factors are removed to make the largest element in the column unity, rows are exchanged to ensure that this element is on the diagonal for reasons of numerical stability. Appropriate multiples of this column are added to the others to reduce their upper elements to zero as shown.

In this routine, A is an $N \times N$ array whose determinant is to be evaluated in D . This method uses a form of Gaussian elimination with partial pivoting, a technique explained more fully when considering solution of equations. Note that the routine does not preserve the matrix A .

```

5 REM DETERMINANT EVALUATION ROUTINE
100 D=1
110 FOR I=1 TO N
115 REM PLACE MAX. COEF. OF ROW I ON DIAGONAL
120 R=I : M=A(I,I)
130 FOR K=I+1 TO N
140 IF A(I,K)>M THEN 160
150 M=A(I,K) : R=K
160 NEXT K
165 REM IF ZERO THEN FINISH
170 IF M=0 THEN D=0 : GOTO 330
180 IF R=I THEN 230
185 REM MAX. COEF. NOT ON DIAGONAL SO SWOP ROWS
190 FOR K=1 TO N
200 M=A(K,I) : A(K,I)=A(K,R) : A(K,R)=M
210 NEXT K
215 REM DETERMINANT CHANGES SIGN AS ROWS SWAPPED
220 D=-D
225 REM REMOVE SCALING FACTOR
230 D=D * A(I,I)
240 IF I=N THEN 330
245 REM DIVIDE TO MAKE PIVOTAL ELEMENT UNITY
250 FOR J=N TO I STEP -1
260 A(I,J)=A(I,J) / A(I,I)
270 NEXT J
280 FOR J=I+1 TO N
285 REM SET MULTIPLIER FOR NEXT ROW
290 M = -A(J,I)
300 FOR K=I TO N
310 A(J,K) = A(J,K) + A(I,K) * M
320 NEXT K,J,I
330 PRINT "VALUE OF DETERMINANT IS "D
    
```

(continued on next page)

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String routines

JEFF TOCK'S contribution to the Z-80 Zodiac in the April 1981 issue of *Practical Computing* caught my eye as a very useful subroutine and apart from an error in line 200 was soon in RAM and running, writes John Attfield of Benfleet, Sussex.

However, I felt that it should be possible, using string manipulation, to achieve the same result in less space. The result as you can see confirms this and apart from the statement

```
SCREEN X, Y
```

in line 270, the program should run on almost any machine with string-handling facilities. The program is easily extended using string arrays to display any number of strings following each other in an endless loop.

Variables:

```
A = counter
D = delay speed
L = string length
X & Y screen co-ordinates
AS = main string
BS = right of string
CS = left of string
200 A=0:X=10:Y=7:D=200
210 CLS
220 AS="TICKER TAPE TEST STRING"
230 L=LEN(AS)
240 A=A+1:IFA=L THEN A=1
250 BS=RIGHT$(AS,L-A)
260 CS=LEFT$(AS,A)
270 SCREENX,Y:PRINTBS+CS
280 FOR C=1TOD:NEXTC
290 GOTO240
```

More instructions

IF YOU are a user of the Z-80 microprocessor at assembly level, then you should have been reading David Peckett's series on machine code. Shame on you if you have not, writes Kieron Leech of Warrington, Cheshire.

However, he has missed a very interesting point, namely it has more instructions than Zilog tells you. For example, if you look at the list of rotate and shift instructions you will see:

```
RL Rotate left
RLC Rotate left, copy bit 7 into carry
RR Rotate right
RRC Rotate right, copy bit 0 into carry
SLA Shift left arithmetic
SRA Shift right arithmetic
SRL Shift right logical
```

You should be able to see that there is an odd one out, SLA. It has no "SLL", shift left logical going with it. In fact, one exists. When Zilog wrote the original specifications for the Z-80, a shift left logical was included.

Unfortunately, when the microprocessor was tested, it was found that the "SLL" function did not work. Rather than spending thousands trying to correct it, it was simply omitted from the specifications. The nature of its failure is very simple, however, and easy to correct. If you look at the Shift right logical you will see it does

```
0 → [ 7 0 ] → CY
or so the programming manual tells us. If you try the "SLL" you will see that it does this:
```

```
CY ← [ 7 0 ] ← 1
```

It puts a 1 in bit 0 where it should put a 0. This is easily corrected by a re-set of the affected bit. The codes for our new instruction, "SLL", are in table 1 — a total of 10. They will probably be of use sometimes, if you remember where they go wrong. However, there is more to the Z-80 than this. If you look through the programming manual at the way the IX and IY registers are used, you can see some very interesting happenings. For example:

```
LD A,(HL) 7E
LD A,(IX + IND) DD 7E XX Where
ADD A,(HL) 86 XX = IND
ADD A,(IX + IND) DD 86 XX
etc., the same for IY, DD replaced by FD
```

It appears that normal codes which "drive" the HL register pair, drive the IX register if they are prefixed by "DD", and IY if they are prefixed by "FD".

The reason for this could be as follows. If we assume there are two two-bit address pointers in the Z-80, P1 and P2, behaving something like the IFF1 and IFF2 flip-flops used for interrupts. Normally, P1 decides which register the instructions for "HL" will go to, "DE", "HL", "IX" or "IY".

The reason "DE" is included is that the "EX DE, HL" instruction only takes four clock periods to execute, and since it takes that many clock periods to move the data in one eight-bit register to another I do not think it has enough time to swap two 16-bit registers around. All it probably has time for is to change that pointer so that instructions for "DE" are now routed to "HL", and *vice versa*.

Now "DD" seems to save P1 in P2 so it can be recalled when the instruction concerning IX has finished, and then it forces its own code into P1 so that the next "HL" instruction operates on "IX". "FD" will do a similar thing, but for "IY" instead of "IX".

If you look in the Zilog programming manual, however, not all the "HL" codes seem to have equivalent "IX" and "IY" codes. It seems worthwhile, therefore, to put "DD" and "FD" in front of these "HL" only instructions and see what happens.

In fact, it gives you an extra 88 instructions. Most of these seem to operate on the low- and high-order bytes of "IX" and "IY" individually, treating them exactly the same as "HL", i.e., splittable into two eight-bit registers. See table 2 for all the new codes.

Not all the codes we might expect to work, however, do. In particular, the prefix "ED" seems to re-set P1 so that the following instruction is not transferred to "IX" or "IY". I cannot make the rotate and shift instructions work either — they do nothing. It should also be obvious that you cannot say anything like "EX DE, IX", since the exchange instruction changes P1.

Table 1.

Shift Left Logical — SLL. This is the instruction Zilog wrote out of the Z-80 specifications because it did not work

properly. It was supposed to place bit 7 of the byte operated on into the carry flag, shift the byte left then place a 0 in bit 0 but instead it places a 1 there.

SLL (HL)	CB 36	
SLL (IX + IND)	DD CB XX 36	Where XX
SLL (IY + IND)	FD CB XX 36	= IND
SLL A	CB 37	
SLL B	CB 30	
SLL C	CB 31	
SLL D	CB 32	
SLL E	CB 33	
SLL H	CB 34	
SLL L	CB 35	

Condition bits affected

S: Set if result is negative, re-set otherwise
 Z: Set if result is zero, re-set otherwise
 H: Re-set
 P/V: Set if parity even, re-set if parity odd
 N: Re-set
 C: Data from bit 7 of source

Table 2 is a list of the 'new' op-codes operating on the IX and IY registers.

The list is in numerical order.

DD 24	FD24	INC IXH	INC IYH
DD 25	FD 25	DEC IXH	DEC IYH
DD 26 nn	FD26nn	LD IXH,n	LD IYH,n
DD 2C	FD2C	INC IXL	INC IYL
DD 2D	FD 2D	DEC IXL	DEC IYL
DD 2E nn	FD2E nn	LD IXL,n	LD IYL,n
DD 44	FD 44	LD B,IXH	LD B,IYH
DD 45	FD 45	LD B,IXL	LD B,IYL
DD 4C	FD 4C	LD C,IXH	LD C,IYH
DD 4D	FD 4D	LD C,IXL	LD C,IYL
DD 54	FD 54	LD D,IXH	LD D,IYH
DD 55	FD 55	LD D,IXL	LD D,IYL
DD 5C	FD 5C	LD E,IXH	LD E,IYH
DD 5D	FD 5D	LD E,IXL	LD E,IYL
DD 60	FD 60	LD IXH,B	LD IYH,B
DD 61	FD 61	LD IXH,C	LD IYH,C
DD 62	FD 62	LD IXH,D	LD IYH,D
DD 63	FD 63	LD IXH,E	LD IYH,E
DD 65	FD 65	LD IXH,IXL	LD IYH,IYL
DD 67	FD 67	LD IXH,A	LD IYH,A
DD 68	FD 68	LD IXL,B	LD IYL,B
DD 69	FD 69	LD IXL,C	LD IYL,C
DD 6A	FD 6A	LD IXL,D	LD IYL,D
DD 6B	FD 6B	LD IXL,E	LD IYL,E
DD 6C	FD 6C	LD IXL,IXHL	LD IYL,IYHL
DD 6F	FD 6F	LD IXL,A	LD IYL,A
DD 7C	FD 7C	LD A,IXH	LD A,IYH
DD 7D	FD 7D	LD A,IXL	LD A,IYL
DD 84	FD 84	ADD A,IXH	ADD A,IYH
DD 85	FD 85	ADD A,IXL	ADD A,IYL
DD 8C	FD 8C	ADCA,IXH	ADCA,IYH
DD 8D	FD 8D	ADCA,IXL	ADCA,IYL
DD 94	FD 94	SUBA,IXH	SUBA,IYH
DD 95	FD 95	SUBA,IXL	SUBA,IYL
DD 9C	FD 9C	SBCA,IXH	SBCA,IYH
DD 9D	FD 9D	SBCA,IXL	SBCA,IYL
DD A4	FD A4	ANDA,IXH	ANDA,IYH
DD A5	FD A5	ANDA,IXL	ANDA,IYL
DD AC	FD AC	XORA,IXH	XORA,IYH
DD AD	FD AD	XORA,IXL	XORA,IYL
DD B4	FD B4	ORA,IXH	ORA,IYH
DD B5	FD B5	ORA,IXL	ORA,IYL
DD BC	FD BC	CPA,IXH	CPA,IYH
DD BD	FD BD	CPA,IXL	CPA,IYL

IXH is the highest bits of IX, i.e., bits 8 to 15 IXL if the lowest eight bits of IX, i.e., bits 0 to 7.

The instructions change the flags in the same way the "HL" equivalent instructions do. □

Long division

THE SEVERE arithmetic limitations of the ZX-80 present a challenge to one's ingenuity, particularly the inability of the computer to handle any number greater than 32767 and the rounding down to nought in using the computer for division, writes Robin Allott of Seaford, Sussex.

However, by a combination of the use of arrays and loops, these arithmetic limitations can be overcome as the following program for very long division shows; it allows the division of a number of any size by a number of any size, e.g., a 40-figure number by a 20-figure number or by a single-figure number. If one wants to use the program for large numbers it is better run on the ZX-80 with the 16K add-on memory.

The program is very simple to run. After Run, it first calls for ND — the number of digits in the number to be divided — and then for DD — the number of digits in the divisor.

It then calls for X — the number to be divided — input each figure separately — and then for Y — the divisor — input each figure separately. It prints out the answer without initial noughts; the program can be adapted very simply to produce as many decimal places as required.

Telephone pad

HERE IS a program for storing a telephone directory on the ZX-80 using the program listing to store the data, writes MG Ormerod of Reigate, Surrey. This has the advantage over other methods of storing data in that the data is not lost by inadvertently using the Run command. The basic program consists of three lines.

```
10 PRINT "GIVE REQUIRED NAME"
20 INPUT US
30 GO TO (CODE(US)-37)*100 + (CODE
(TL$(US))-37)*2
```

Each entry of the directory consists of a line number, print instruction and a string giving name and telephone number. When

making an entry to the directory, a new line is added to the program. The line number is calculated by taking the first letter of the name and putting A=1 or B=2, etc., and then multiplying by 100 and adding the value of the second letter × 2, e.g.,

```
1030 PRINT "JONES", "ALAN", "01-644-9821"
```

```
1031 GO TO 20
```

```
3826 PRINT "SMITH", "JOHN", "063-8948", "SMITH", "PETER", "278-4539"
```

```
3827 GO TO 20
```

The line number + 1 is used to return control to line 20.

Die cast

IN FEEDBACK, January 1981, Neville Falkiner lists a Double Dice Throwing program, writes Brian Horsfield of Middlesbrough.

Here is a shorter Double Dice Display which fits the basic ZX-80 and allows either die to assume the higher value.

```
1 REM B. HORSFIELD
10 LET A$="*. *"
20 LET B$="* *"
30 LET C$="* *"
40 LET D$="* *"
45 CLS
50 LET X=RND (6)
60 LET Y=RND (6)
70 IF X=1 THEN PRINT "....C$"
80 IF X=2 THEN PRINT "B$.....D$"
90 IF X=3 THEN PRINT "B$.....C$.....D$"
100 IF X=4 THEN PRINT "A$.....C$.....A$"
110 IF X=5 THEN PRINT "A$.....C$.....A$"
120 IF X=6 THEN PRINT "A$.....A$.....A$"
130 IF Y=1 THEN PRINT ".....C$"
140 IF Y=2 THEN PRINT ".....D$"
150 IF Y=3 THEN PRINT "B$.....C$.....D$"
160 IF Y=4 THEN PRINT "A$.....C$.....A$"
170 IF Y=5 THEN PRINT "A$.....C$.....A$"
180 IF Y=6 THEN PRINT "A$.....A$.....A$"
190 INPUT N$
200 IF N$=" " THEN GO TO 45
210 STOP
```

Copyrights

WE HAVE all seen program listings with the first line showing who wrote the program or who holds the copyright and, perhaps, wondered how to do it effectively, writes David Bailey of Leeds, West Yorkshire. It is easy enough to make the first line of a

program a Rem statement with the appropriate message, but this is far too easy to erase.

So, how about making the message line 0? Try entering line 0. As you cannot do it by normal means — the computer treats it as a direct command — try this: make the first line of your program a Rem statement containing your message less its first character. If the message were going to be Acme Programs, the first line would be 1 REM CME PROGRAMS

Now, as direct commands enter the following:

```
POKE 16425,0
then
POKE 16426,38.
```

When the listing is returned to the screen the first line of the program reads 0 ACME PROGRAMS

Now try to erase line 0 in the normal way. If that does not work try to edit it. You cannot do either. Line 0 has no effect on a program providing it does not have a command after the line number, it will form part of the program and the computer will carry it out.

How was it done? Well, location 16425 in RAM is the first line number so POKEing that with 0 makes the first line number 0. Location 16426 is the command in the first line, so POKEing that location with 38 makes A the first character after the line number.

Super docker

THIS PROGRAM is called Super Docker, writes S Farr of Fareham, Hampshire. It runs on a 1K machine, and has some new features; the cursor controls act as movement indicators, e.g., if you want to go left, you enter 5.

This program has also magnitude, e.g., if you want to go up three lines, you enter 7 — to go up — n/1 then 3 n/1 and the ship moves three lines. If you continue to press n/1, the ship continues to move up

Long division

```
1 GOTO 350
10 FOR A=1 TO ND
20 LET C=0
30 FOR J=1 TO DD
40 LET E(J)=A(A+DD-J)
50 NEXT J
60 FOR B=1 TO DD
70 LET E(B)=E(B)-B(DD+1-B)
80 IF B=DD THEN GOTO 150
90 FOR F=1 TO DD-B
100 IF E(B-1+F)<0 THEN LET E(B+F)=E(B+F)-1
110 NEXT F
120 FOR F=1 TO DD-B
130 IF E(B-1+F)<0 THEN LET E(B-1+F)=E(B-1+F)+10
140 NEXT F
150 NEXT B
155 IF DD=1 AND E(DD)>-1 THEN GOTO 170
160 IF E(DD)<0 THEN GOTO 200
170 LET C=C+1
175 IF DD=1 AND E(DD)=0 THEN GOTO 250
180 IF E(DD)>0 THEN GOTO 60
200 IF A=ND THEN GOTO 250
210 FOR J=1 TO DD
220 LET A(A+DD-J)=A(A+DD-J)-C*B(DD+1-J)
221 IF A(A+DD-J)<0 THEN LET A(A+DD-J-1)=A(A+DD-J-1)-1
222 IF A(A+DD-J)>0 THEN LET A(A+DD-J)=A(A+DD-J)+10
230 NEXT J
240 LET A(A+1)=A(A+1)+10*A(A)
250 LET D=D+1
260 LET C(D)=C
270 NEXT A
280 FOR D=1 TO ND
285 LET L=C(D)+L
286 IF L=0 THEN GOTO 300
290 PRINT C(D);
300 NEXT D
310 STOP
350 INPUT ND
360 INPUT DD
370 LET D=0
371 LET L=0
400 DIM A(ND+DD-1)
410 DIM B(DD)
420 DIM C(ND)
430 DIM E(DD)
440 PRINT "X ";
450 FOR J=1 TO ND+DD-1
460 IF J<DD THEN LET X=0
470 IF NOT J<DD THEN INPUT X
480 IF NOT J<DD THEN PRINT X;
490 LET A(J)=X
500 NEXT J
510 PRINT " DIVIDED BY Y ";
520 FOR K=1 TO DD
530 INPUT Y;
540 PRINT Y;
550 LET B(K)=Y
560 NEXT K
570 PRINT "=";
600 GOTO 10
```

```

2  RANDOMISE Criss-cross
4  DIM A(8)
6  LET B=0
8  PRINT "NL FOR MY GO"
10 INPUT A $
12 LET D=0
14 GOSUB 96
16 FOR C=0TO7
18 IF A(X)+A(Y)+A(Z)=122 THEN GOTO 38
20 IF A(X)+A(Y)+A(Z)=104 THEN IF D=1 THEN GOTO 38
22 IF A(X)+A(Y)+A(Z)=104 THEN LET D=1
24 GOSUB 98
26 NEXT C
28 IF D=1 THEN GOTO 14
30 LET E=RND(9)-1
32 IF NOT A(E)=0 THEN GOTO 30
34 LET A(E)=61
36 GOTO 44
38 IF A(X)=0 THEN LET A(X)=61
40 IF A(Y)=0 THEN LET A(Y)=61
42 IF A(Z)=0 THEN LET A(Z)=61
44 CLS
46 LET B=B+1
48 FOR F=0 TO 8
50 PRINT CHR$(A(F));
52 IF F=8 THEN GOTO 66
54 IF F=2 OR F=5 THEN GOTO 60
56 PRINT "a";
58 NEXT F
60 PRINT
62 PRINT "aaaaa"
64 NEXT F
66 PRINT

68 PRINT
70 GOSUB 96
72 FOR G=0 TO 7
74 IF A(X)=A(Y) AND A(X)=A(Z) AND NOT A(X)=0 THEN GOTO 110
76 GOSUB 98
78 NEXT G
80 IF B=9 THEN GOTO 122
82 IF (B/2)*2=B THEN GOTO 8
84 PRINT "ENTER YOUR GO 0-8"
86 INPUT G
88 IF G>8 THEN GOTO 84
90 IF NOT A(G)=0 THEN GOTO 84
92 LET A(G)=52
94 GOTO 44
96 LET B$="02147685264536048"
98 LET X=CODE(B$)-28
100 LET B$=TL$(B$)
102 LET Y=CODE(B$)-28
104 LET B$=TL$(B$)
106 LET Z=CODE(B$)-28
108 RETURN
110 IF (B/2)*2=B THEN GOTO 116
112 PRINT "I";
114 GOTO 118
116 PRINT "YOU";
118 PRINT " WIN"
120 GOTO 124
122 PRINT "DRAW"
124 PRINT "NL TO PLAY AGAIN"
126 INPUT C$
128 CLS
130 IFC$= "" THEN RUN
    
```

three lines. If you are one line away from the place marked

DDOCK * DOCK
and you are still going three lines up, the ship will crash. To stop it doing that, you have to counteract the three lines up, so you enter: 8 — to go down — n/1 and 2 n/1, you are now travelling one line upwards, because three up — two down = one line up.

At the start of the program, you will be moving at a random velocity so this has to be counteracted. The program is also equipped with fuel. If you go down four lines you lose four fuel units. It also tells you when you have run out of fuel.

Here are some warnings: the ship may not touch the sides of the screen, the bottom of the screen or the top dotted part of the screen.

Criss-cross

THE PROGRAM enables you to play noughts and crosses against a ZX-80 with 1K of RAM, writes Robert Wray of Cottingham, North Humberside. The program does not think more than one move ahead, so if it is not able to block an opponent's line or complete one of its own — the preference is to block the opponent's line — it takes a random move into an unoccupied space.

The computer is always given the first move, by responding to the printout "NL FOR MY GO" by pressing newline, which gives it a reasonable chance of winning. You are then requested to enter the space you wish to take — illegal co-ordinates are rejected — which range from 0, the top-left position, to 8 — at the bottom right.

Thus, if you wish to place your nought — the computer always plays crosses — in the centre, input 4 followed by newline. The program detects the end of the game, and states the winning side or draw and also offers another game obtained by pressing newline.

In the computer, the board positions

are stored as the nine elements in the array A. Lines 10 to 42 generate the computer's move using the subroutine at lines 96 to 108 which scan all the lines on the board. Lines 44 to 68 display the board, 70 to 80 watch for the end of the game. Line 82 tests to see if it is the computer's turn — when B is even — otherwise, it continues to lines 86 to 94 which process the player's move. Lines 110 to 130 print out the result of the game and offer another. The lower-case 'a' in lines 56 and 62 represents the graphic character obtained by keying shift A.

Print statements

I CANNOT recall having seen any comment about the ZX-80 Basic structure Print x, where x is a decimal integer, writes Eric Deeson of Highgate, Birmingham. When the instruction is executed, x is printed.

Thus

```

10 PRINT 3
20 PRINT 2
30 PRINT 1
40 PRINT 0
    
```

When Run gives

```

3
2
1
0
    
```

I find the facility of great value during program development, when wishing to do a check Run of an unfinished program. If we use X PRINT X where X is the line number addressed by a Goto or Gosub statement, it is easy to see if the Run is correct. Here is an example.

```

10 PRINT "TYPE 1,2 OR 3"
20 INPUT A
30 IF A < 1 OR A > 3 THEN GO TO 50
40 GO SUB A * 100
50 PRINT 50
60 STOP
100 PRINT 100
110 STOP
190 RETURN
200 PRINT 200
210 STOP
290 RETURN
300 PRINT 300
310 STOP
    
```

390 RETURN

When Run, this far-from-complete program will show that intended jumps are executed correctly. In the program, by the way, OR can be typed with a single key-stroke, and stored in a single byte, rather than four. It is worth noting that all the shift keywords — AND, OR, NOT, THEN, TO — can be used in Print statements.

Super dockér

```

10 RANDOMISE
20 LET Z=70
30 LET F=10
40 LET W=RND(4) -2
50 LET M=0
50 LET I=RND(4) -2
70 LET V=RND(10)+5
80 LET H=RND(25) +2
90 IF W<-1 OR W<1 OR I>1 THEN GOTO 120
100 IF V=-1 AND H=14 THEN PRINT "DOCKED"
... "SCORE="; Z+(3*F)
110 IF V=-1 AND H=14 THEN STOP
120 IF W<0 OR W>17 OR H<0 OR H>29 THEN PRINT "CRASHED";
130 IF H=14 AND V<0 THEN PRINT ">TOOFAST>"
140 IF W<0 OR W>17 OR H<0 OR H>29 THEN STOP
150 LET Z=Z-2
160 PRINT "(Shift d's) DOCK (Shift r)>>*C (Shift e) DOCK (Shift f)"
170 IF V<1 THEN GOTO 210
180 FOR V=1 TO V
190 PRINT
200 NEXT V
210 IF W<1 THEN GOTO 250
220 FOR X=1 TO H
230 PRINT "STAR";
240 NEXT X
250 PRINT "C00"
260 IF F<1 THEN GOTO 500
270 PRINT "FUEL =";F;"KG."
280 PRINT "DIRECTION=";
290 INPUT G$
300 PRINT G$
310 IF G$="" THEN GOTO 350
320 PRINT "MAGNITUDE=";
330 INPUT M
340 IF M<0 THEN GOTO 330 -
350 CLS
360 IF M>F THEN LET M=F
370 LET V=V+M
380 LET H=H+I
390 IF G$="" THEN LET M=0
400 LET F=F-M
410 IF G$="5" THEN LET H=H-M
420 IF G$="5" THEN LET I=I-M
430 IF G$="6" THEN LET V=V+M
440 IF G$="6" THEN LET W=W+M
450 IF G$="7" THEN LET V=V-M
460 IF G$="7" THEN LET W=W-M
470 IF G$="8" THEN LET H=H+M
480 IF G$="8" THEN LET I=I+M
490 GOTO 90
500 PRINT "NO FUEL",,,, "YOU ONLY HAVE N/L"
510 INPUT G$
520 GOTO 350
    
```

Space saving

THE INSTR\$-Function is a fine space saver, writes Rolf-Fr. Matthaei of Hamburg, West Germany. I am updating my programs from a two-line version of

```
20 AS=""
30 AS=INKEYS:IF AS="" THEN 30
```

to a one-line version which saves about 18 bytes:

```
20 AS=INSTR$(1)
```

I found that INSTR\$ also works very well inside expressions:

```
old: 20 AS=INKEYS:IF AS="" THEN 20
      ELSE BX=ASC(AS)
new: 20 BX=ASC(INSTR$(1))
```

The space-saving hint in Tandy Forum, April 1981, is also valid for the TRS-80 Model I.

Pascal roots

TANDY'S cassette-based Tiny Pascal is an inexpensive but effective way of getting to grips with the Pascal language, but there is an error in the Tiny Pascal manual which can have disconcerting results, writes JE Swann of Henley on Thames, Oxfordshire.

If you run the following program:

```
BEGIN
  WRITE(SQR(4) # )
END.
```

you will obtain the answer 16.

In other words, the SQR(exp) function squares — and does not find square-roots as described in the manual. Of course, Tiny Pascal handles only integer data types so a square-root function has limited application. Here is a Tiny Pascal program which produces integer answers

to square-root problems:

```
(*SQUAREROOTS*)
VAR NUMBER,ROOT:INTEGER;
BEGIN
  REPEAT
    READ (NUMBER #.);
    BEGIN
      ROOT:=1
      REPEAT
        ROOT:=(NUMBER DIV ROOT + ROOT
          DIV 2
          UNTIL ABS (NUMBER DIV SQR(ROOT)-
            1) < 1;
        WRITE (ROOT #., 13)
      END
    UNTIL NUMBER = 1
  END.
```

Little and large

OWNERS of TRS-80s who have recently bought a Radio Shack TRS-80 Line Printer II may be interested to know that the printer, I have found, will produce four character faces, writes David Bishop of Doncaster, South Yorkshire. That is two additional ones to the two mentioned in the printer manual. The two mentioned are normal-size and double-size letters. The other two I have discovered are half-size and bold letters. For a demonstration of the four faces try the following short program:

```
1 LPRINTCHR$(27);CHR$(14);"Double size letters"
2 LPRINTCHR$(27);CHR$(20);"Half size letters"
3 LPRINTCHR$(27);CHR$(14);"Bold letters"
4 LPRINTCHR$(27);CHR$(19);"Normal size letters"
Double size letters
Half size letters
Bold letters
Normal size letters
```

You will notice that each instruction has to have CHR\$(27) followed by

CHR\$(X), where X is the code number for the face you require. Sadly, however, it is not as simple as this.

What CHR\$(X) prints depends on what face was printed last. A normal-size face (CHR\$(19)) followed by the instruction CHR\$(14) will produce double-size face. However, if the instruction CHR\$(14) follows half-size face (CHR\$(20)) has been used, bold letters are produced.

If a plain LPRINT or LLIST instruction is executed after double-size face has been used, the printer reverts to normal-size face. If bold face has been used, the printer reverts to half-size face. If normal or half-size faces have been used, the face remains the same.

Finally, printing in double-size or bold face lasts only one line and if your line is too long, some is liable to be lost. Normal and half-size faces wrap around to the next line with no problems — it is possible to LLIST in half-size face, which produces an interesting listing.

Screen draw

THIS program enables the user to draw on the screen using the keypad, writes James Hallows of Solihull, West Midlands. First of all, type the program and after you have successfully used the program to draw graphs, diagrams, etc., start experimenting with it. For example, try adding the following to the program:

```
68 PRINT CHR$(23)
```

Then type the following which enables the computer to draw a diagram at random. It is best to leave out line 68 if the computer is to draw at random.

```
25 GOTO 325
325 L=INT(RND(1024)):B=L+15360:F=1
330 POKE B,191
332 G=INT(RND(10)):F=F+1
335 IF F=1000 THEN END ELSE 345
345 IF G="1" THEN 200
350 IF G="2" THEN 210
360 IF G="3" THEN 220
370 IF G="4" THEN 230
380 IF G="5" THEN 332
390 IF G="6" THEN 240
400 IF G="7" THEN 250
410 IF G="8" THEN 260
420 IF G="9" THEN 270
430 GOTO 332
10 CLS:PRINT 507,"SKETCHING"
20 FOR N=1 TO 1000:NEXT:CLS
30 PRINT"INSTRUCTIONS (Y/N)?":INPUT A
40 IF A="Y" THEN 280
50 CLS:PRINT"ENTER STARTING POINT (1
  TO 1024)":INPUT B
60 X=B+15359:IFX<15360 OR > 16383
  THEN 50 :CLS
70 POKE X,191
80 R#=INKEY$:IF R#=""THEN 80
90 IF R#="E" THEN 320 ELSE 100
100 IF R#="C" THEN 50 ELSE 110
110 IF R#="1" THEN 200 ELSE 120
120 IF R#="2" THEN 210 ELSE 130
130 IF R#="3" THEN 220 ELSE 140
140 IF R#="4" THEN 230 ELSE 150
150 IF R#="5" THEN 80 ELSE 160
160 IF R#="6" THEN 240 ELSE 170
170 IF R#="7" THEN 250 ELSE 180
180 IF R#="8" THEN 260 ELSE 190
190 IF R#="9" THEN 270 ELSE 195
195 PRINT R#;GOTO 80
200 X=X+63:POKE X,191:GOTO 80
210 X=X+64:POKE X,191:GOTO 80
220 X=X+65:POKE X,191:GOTO 80
230 X=X-1:POKE X,191:GOTO 80
240 X=X+1:POKE X,191:GOTO 80
250 X=X-65:POKE X,191:GOTO 80
260 X=X-64:POKE X,191:GOTO 80
270 X=X-63:POKE X,191:GOTO 80
280 CLS:PRINT:PRINT"USE THE KEYPAD
  TO DRAW ON THE SCREEN"
290 PRINT "8=UP,2=DOWN,6=RIGHT,
  4=LEFT,7=NORTH WEST,9=NORTH EAST,"
300 PRINT "1=SOUTH WEST,3=SOUTH EAST,
  PRESS E WHEN YOU HAVE"
303 PRINT "FINISHED DRAWING AND C IF
  YOU WANT TO CLEAR THE "
305 PRINT"SCREEN. IF ANY OTHER KEY
  IS PRESSED, THEN THE"
307 PRINT"CHARACTER ON THAT KEY WILL
  BE PRINTED. KEEP TO"
309 PRINT"THE MIDDLE OF THE SCREEN.
  DO NOT TRY TO GO BEYOND"
310 PRINT"THE EDGES OF THE SCREEN.
  ENJOY YOURSELF.":GOTO 500
320 CLS:PRINT"ANOHTER GO?":INPUT G:
  IF G="Y" THEN 30 ELSE END.
500 PRINT:PRINT:PRINT"PRESS ANY KEY."
510 I#=INKEY $:IF I#="" THEN 510
  ELSE 50
```

UK101 FRE(X)

ROGER CUTHBERT's excellent discussion of the FRE(X) problem on the UK 101 6502 Special, January 1981, is much appreciated, writes J Ryson of Hyde, Cheshire. I have implemented the suggested change to BAS 3 in the form of a 5V 2716. The modification appears to work perfectly; my general-purpose file program which hung up when sorting large files, now runs correctly thanks to the garbage-clearance routine, and no problem has arisen during two weeks regular use.

I am writing to encourage other UK 101 users to adopt the method. The rest of the article suggested that EPROM implementation was difficult; I believe that this solution is easier than the alternatives suggested and certainly more effective.

The single-voltage 2716 is very easy to program requiring a single 50 millisecond pulse at TTL level for each memory location. If you switch the top three address lines manually, data and other address lines can be controlled by a single PIA device and one of the control lines to provide the program pulse.

I used the extended monitor to move the BAS 3 into RAM, where the necessary bytes were modified and then programmed the EPROM under Basic control through a 6521 PIA.

The method of plugging the EPROM into the BAS 3 socket may be crude, but has two overwhelming advantages: It is easy and it works. Low-profile Texas dil. dockets will plug into a socket. Take a 24-pin socket and bend pins 18, 20 and 21 out horizontally, solder a wire to pin 24 as close under the socket as possible and solder the other end to pin 21 which is Vpp and is thus connected to +5V as is required for read and standby.

Solder a flying lead between pin 18 (CE) of the socket and pin 11 of IC 16. Solder another flying lead between pin 20 (OE) of the socket and the rear left hand connection of W6 which is situated to the left of IC 17.

Plug this socket — except pins 18, 20 and 21 — into the socket for BAS 3 (IC 11) and then insert the programmed EPROM. To revert to the masked ROM, remove the EPROM and socket and plug in the ROM. No changes have been made to the board.

Same socket

AS A relative newcomer to computing, I found the January 1891 issue extremely enlightening about the use of interrupts as well as useful in eliminating the UK101 Basic3 string, writes R L Curd of Farnborough, Hampshire.

Others interested in Roger Cuthbert's 2716 EPROM replacement may be interested to know the following hardware changes. This will enable the use of the original socket on the board.

PIN 21 goes to plus 5V

THE 6502 SPECIAL is dedicated exclusively to the exchange of information between 6502 users. It is up to you, the reader, to help establish this page with your ideas, problems and guidance for other 6502 users. Please mark your letters 6502 Special. We pay £5 for each contribution published.

PIN 18 goes to ICI6e pin 11 as suggested

PIN 20 goes to IC21b pin 4

I have carried out this modification and it works exceptionally well. Roger Cuthbert is to be congratulated on the clarity of his article.

ASCII characters

FOR HARD-UP Microtan 65 users, this program will type any character by inputting its ASCII code on the Hex keypad writes Bill Crasnell of Churchdown, Gloucestershire.

```
0400 20 FA FD
      3 A501
      5 E930
      7 0A
      8 0A
      9 0A
      A 0A
      B 8550
      D 20 FA FD
0410 A501
      2 E940
      4 100D
      6 A501
      8 E92F
      A 18
      B 6550
      D 2075 FE
0420 4C00 04
      3 18
      5 6909
      7 4C 1A 04
```

Type in Hex ASCII Code

New restore

WHEN THE command New is used on the UK101 one of the many things to happen is that the first link bytes held in memory locations 0301 & 0302 Hex are set to zero, writes Alan Brown of Newbridge, Midlothian. The program is still in memory — it just cannot be listed or run.

If you accidentally New a program, it can be saved as follows:-

```
FOR J= 800 TO 769 STEP -1: IF PEEK
(J)<>3 AND PEEK (J+2)<>0 THEN NEXT
```

This should be typed as one line without a line number. When OK is printed J will be the value of the memory location that holds the end (00) of the first program line. If you now type:

```
POKE769,J- 769:POKE770,3
```

This will restore the first link bytes. The program can now be listed and should be saved immediately since other program pointers will have been re-set and the system is in danger of crashing. On no account should you try to erase any spurious line numbers which appear — the result can be quite spectacular. The memory locations mentioned are for the new-monitor EPROM and may have to be altered for other monitors.

Screen dump

THIS following machine-language program provides a very convenient means of obtaining a screen dump to printer. It can be used when the machine is in either Basic mode or DOS mode writes LM Goddard.

```
                                ORG F000H
F000 21 20 F0.                LD    HL,F020H
F003 16 4F                    LD    D,4FH
F005 1E 00                    LD    E,00H
F007 3E 0B                    LD    A,0BH
F009 43                        LD    B,E
F00A 0E 00                    LD    C,00H
F00C CF                        RST   8
F00D 3E 13                    LD    A,13H
F00F 06 4F                    LD    B,4FH
F011 0E 0D                    LD    C,0DH
F013 CF                        RST   8
F014 1C                        INC   E
F015 7B                        LD    A,E
F016 D6 18                    SUB   18H
F018 C2 07 F0                JP    NZ,LOOP
F018 C9                        RET
```

The program is entered most easily using DEBUG, but can, of course, be entered in assembly code and assembled. If using DEBUG to enter the program, use DUMP to store it on disc with start = F000 and END = F01B — Program name, SCRDMP/CMD.

Enter this following program in Basic.

```
100 SYSTEM "LOAD SCRDMP/CMD"
110 DEFUSR = HF000
120 X = USR (0)
130 END
```

Save program with the name SCRDMP/BAS. The utility can be used at any time, as follows:

- Basic mode: enter RUN "SCRDMP/BAS".
- DOS mode: enter SCRDMP/CMD.

Non-printing input

IN THE August 6502 1980 Special, Michael Taylor of Peterborough wrote that the UK 101 or its Ohio Scientific Equivalent could be made to produce a non-printing input instruction, writes M J Murphy of Smallfield, Near Horley, Surrey.

The locations 538 and 539 decimal contain the original UK101 and Ohio Scientific Synmon monitors pointed to FF 69 Hex.

Poking 138 into location 538 caused the vector to point to an RTS machine-code instruction in the monitor. Thus, any output after the Poke was not directed to the screen or printer. I have a CIE which on conversion to 48-by-32 video format required a new monitor. I bought the Mutek Cegmon but was not pleased to find that the machine-code "fix" no longer worked.

The Cegmon output routine is located
(continued on next page)

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at FF9B not FF69 so that the output vector now points to FF9B, and must be altered from this value to point to an RTS instruction. The nearest RTS to FF9B is at FFBC, so by altering location 538 to contain the decimal equivalent of BC, no output is made to the screen of ACIA.

The original value of location 538 is 9B (Hex), 155 decimal, 188 must be poked in to produce the non-printable input. The routine at FF9B is general-purpose and can be omitted from both keyboard and serial-input routines so that programs may be loaded without being printed on to the screen by preceding the load with a POKE 538, 188. To return to normal printing input POKE 538, 155.

Scroll stopper

MANY UK101 users probably have trouble examining a program while it lists on the screen due to the speed at which it scrolls writes Alan Saul of the Isle of Wight.

Rather than slow all printing with POKE 518, the following routine allows the user to stop scrolling with the space bar and to re-start by pressing any key. That enables a program, or any other listing, to be stopped, or slowed to be viewed at leisure.

To enable the program after RESET/W, re-execute line 70. To disable the routine — it may be necessary for example, if a Basic program polls the keyboard — execute;

```
POKE 538, 105:POKE 539,255
10 FOR I = 546 TO 569
20 READ P:POKE I,P
30 NEXT
40 DATA 201,13,208,17,169,253,141,0
50 DATA 223,173,0,223,201,239,208,3
60 DATA 32,0,253,169,13,76,105,255
70 POKE 538,34:POKE 539,2
80 NEW
```

Cassette data

THIS ROUTINE will generate its own Data statements and output them to a cassette recorder, writes Tim Allen of Ash Vale, Hampshire. The format of the statement is exactly the same as that normally typed by the user, i.e., 100 DATA a,b,c,d,e etc.

It is very important that semicolons are used wherever shown. Data in an array D(A) will need to be changed to PEEK(A) commas. PEEK(512) checks that a line has not been filled.

The main use for the routine is to change lengthy machine-code routines into Basic Data statements, in which case D(A) will need to be changed to PEEK(A) etc. The L in line 70 is used to detect the final piece of data and has the value of the dimension of array D(A) i.e., DIM D(L).

The listing is short and self-explanatory so it can be modified easily to suit individual needs. Do not forget that the Data statements become valid program lines only when the tape is re-loaded and works because of the way in which the UK 101 — and Superboard — save programs.

```
10 REM UK 101 DATA SAVER
20 REM
30 A=L:Z=10 INPUT A:Z
40 POKE 517,1 PEEK
50 PRINT Z,"DATA";
60 PRINT D(A);IF PEEK(512)>=240
THEN 90
70 IFA=L-1 THEN PRINT "," D(A+1):
POKE 517,0:END
80 PRINT ",";A=A+1:GOTO 60
90 A=A+1:PRINT "," D(A):Z=Z+5:
A=A+1:GOTO 50
```

Pay tax

MICHAEL Whittle presents a program which is designed to calculate the pay and tax of monthly-paid staff, and is able to cope with changes in tax code and salary,

including calculating back-dated pay rises.

I am not offering it as a business program since it calculates the tax exactly, he writes, whereas the Inland Revenue uses tax tables which undercharge slightly by rounding down the tax due.

The program is written for the UK101, and will run on the Ohio Superboard without modification. It will run on most other micros if lines 120, 130 and 330 and 340 are modified to invite an INPUT at the end of each month's printout.

Line 180 contains the pensions' calculations for the universities superannuations scheme — that would have to be modified for the individuals own pension scheme.

```
10 REM PAYE CALCULATOR by Mike Whittle
20 AP=****:REM ANNUAL SALARY
30 TC=597:REM TAX CODE
40 NI=32.88:REM NATIONAL INSURANCE
50 DEFFNA(X)=INT(X*100+.5)/100
60 DATA APRIL,MAY,JUNE,JULY,AUGUST,SEPTEMBER
70 DATA OCTOBER,NOVEMBER,DECEMBER,JANUARY
80 DATA FEBRUARY,MARCH,11250,.3,2000,.4,3500
90 DATA .45,5500,.5,5500,.55:REM TAX BANDS
100 DIM M$(12):FOR I=1 TO 12:READ M$(I):NEXT I:PRINT
110 FOR I=1 TO 5:READ BD(I),RT(I):REM BAND & RATE
120 NEXT I:PRINT "PRESS 'SHIFT' TO CONTINUE -"
130 PRINT "CONTROL' TO CHANGE VALUES":PRINT
140 FORM=1 TO 12:PRINT M$(M);": ";
150 MF=FNA(AP/12)+BF:REM MONTH'S GROSS PAY
160 CG=CG+MF:REM CUMULATIVE GROSS PAY
170 PRINT TAB(12);"GROSS PAY";MF
180 FM=FNA(.0625*(CG-100/12*M)):REM PENSION
190 FX=FM-FP:FP=FM:PRINT "PENS";FX;
200 CF=CG-FM:REM CUMULATIVE TAXABLE PAY
210 TF=(TC*10+9)*M/12:REM TAX FREE ALLOWANCE
220 NT=CF-TF:REM NETT TAXABLE PAY
230 FOR I=1 TO 5:IF NT<=0 THEN 290
240 TR=BD(I)*M/12:REM TAXABLE AT THIS RATE
250 IF NT<TR THEN TR=NT
260 TT=TR*RT(I):REM TAX AT THIS RATE
270 HI=RT(I):TM=TM+TT:NT=NT-TR:NEXT I
280 TX=FNA(TM-TF):PRINT TAB(15);"TAX";TX;
290 TF=TM:TM=0:PRINT TAB(30);"NAT INS";NI
300 NF=MF-FX-TX-NI
310 PRINT TAB(12);"NETT PAY";NF:BF=0
320 IFM=12 THEN 470
330 A=PEEK(57088):IFA=255 THEN 360
340 IFA=250 AND IFA<252 THEN 330
350 PRINT:NEXT M:END
360 PRINT:INPUT "REVISE SALARY Y/N";Y$
370 IF LEFT$(Y$,1)="" THEN 420
380 INPUT "NEW SALARY";AN
390 INPUT "STARTING MONTH";MN$:FOR I=1 TO M
400 IF LEFT$(MN$,3)=LEFT$(M$(I),3) THEN 450
410 NEXT I:GOTO 390
420 INPUT "REVISE TAX CODE Y/N";Y$
430 IF LEFT$(Y$,1)="" THEN 350
440 INPUT "NEW CODE";TC:GOTO 350
450 BF=(AN-AP)/12*(M-I+1):REM BACKPAY
460 AF=AN:GOTO 420
470 PRINT:PRINT "ANNUAL SUMMARY":PRINT
480 PRINT "GROSS PAY";CG:PRINT "TAXABLE PAY";CF
490 PRINT "HIGHEST TAX RATE";HI*100:"%"
500 PRINT "TOTAL TAX";TF:PRINT "PENSION";FM:FND
```

Memory dump

DATA statement writer, which I have written for the new-ROM Pet will dump any part of memory into data statements as explained in the remark statements, writes SP Folmer of Grantham, Lincolnshire.

When run, the program will ask for the start and end addresses and will then proceed to create the data statements relating to the point of memory selected if insufficient memory has been reserved for the data statements, the error is trapped and a warning message is displayed. There will be data statements present but they will be incomplete.

The Stop key is disabled during execution. The program self-deletes on completion. The logic involved is similar to my Blank Suppression program published in the August 1980 edition of *Practical Computing*.

As not all Pet owners have an assembler, it is desirable to accompany an assembly listing with the correspondence data statements which can be Poked into memory.

Normally, for small programs, this is no great problem. For large programs, however, it is not only extremely tedious but also very error-prone.

This program will do in seconds what would otherwise take hours and might have hidden errors. Another use could be to copy part of the operating system and play with it.

Graphic print

I HAVE a 16K Pet and use it with a standard Teletype or another fast printer, neither of which permit Pet graphics, writes A Walker of St Ives, Huntingdon, Cambridgeshire. However, even with the standard 96-character ASCII set, there are a large number of graphical projects which can be carried out.

To do this it is often necessary, due to the format of the data or the structure of the graphics, to produce the display by Poking characters directly to the screen.

It will operate only with the first 64 screen characters and can be used once a graphics display has been drawn to the screen. It is very simple and merely Peeks at the screen locations and converts the values to ASCII for the printer.

```
1000 REM *** READ & PLOT FROM
      SCREEN TO PRINTER ***
1010 OPEN 1,5,0
1020 P=32768 : X=0
1030 FOR I=0 TO 999
1040 X=X+1
1050 IF X=41 THEN X=1: PRINT #1
1060 C=PEEK(P+1)
1070 IF C > 0 AND C < 32 THEN C=C+
      64
1080 PRINT #1, CHR$(C);
1090 NEXT
1100 PRINT #1:CLOSE 1:RETURN
```

It should be noted that this program as it stands makes no allowance for screen characters with values greater than 63, but inclusions of further conditional statements could be inserted to allow for this.

Zero bugs

WHILE developing a statistical program on the Commodore 8000 series business system, we encountered an interesting problem, write RP Hope and I Powis of the University of Bradford Management Centre. At one point in the program a t-test is calculated on a correlation coefficient. This involves dividing by $SRQ(1-Z*Z)$ where Z is a correlation coefficient. The program was occasionally attempting to divide by zero at this point.

Since the program included a test on Z to bypass the calculation when appropriate — i.e., to avoid the error encountered — considerable head-scratching took place.

Eventually we produced the following short example which illustrates the problem and is self-explanatory. The data used are not invented — they are from our original test data. Also, the occurrence of a nine-digit number subject to the SQR function is not an acceptable explanation of the problem apparent from the con-

tradictory results of statements 20 and 30. The program is consistent over a number of Pets, not just the 8000.

```
10 Z=248.11/SQR(61558.5721)
20 IF Z=1 THEN 50
30 PRINT "Z IS NOT 1...IT IS" Z
40 GO TO 60
50 PRINT "Z IS 1"
60 END
RUN
Z IS NOT 1...IT IS 1
READY
```

Stop-key disable

IT IS often desirable to disable the Stop key, particularly when a program is fully working and the resultant Break and Ready messages interfere with one's screen formats and cursor position, writes AR Browne of Moberley, Cheshire.

It is quite well known that the statement `POKE 144,49` new-ROM Pets does indeed disable the Stop key, but has the disadvantage that it also stops the timer.

The following subroutines combine to
(continued on next page)

```
10 REM#PRODUCED BY 'DATA STMT WRITER' (C) S.P.FOLMER, FEB 81*
11 REM
12 REM INTRODUCTION:
13 REM THIS PROGRAM WILL DUMP ANY PART OF MEMORY INTO DATA STATEMENTS.
14 REM THESE DATA STATEMENTS CAN THEN BE SAVED OR APPENDED TO A PROGRAM.
15 REM USING THIS PROGRAM YOU CAN DUMP AN ASSEMBLER PROGRAM AND RELOAD IT
16 REM BY POKING THE DATA BACK INTO MEMORY.
17 REM IT CAN ALSO PROVE A GREAT TIME SAVER FOR ASSEMBLER PROGRAMMERS WHO
18 REM WISH TO PRODUCE LISTINGS OF THEIR PROGRAMS FOR PEOPLE WITHOUT
19 REM ASSEMBLERS.
20 REM
21 REM TO USE:
22 REM THE DATA STATEMENTS WILL APPEAR IN THE MEMORY AVAILABLE BEFORE LINE
23 REM 63000. THEREFORE YOU SHOULD FILL AS MUCH MEMORY SPACE BEFORE LINE 63000
24 REM AS YOU THINK THE DATA STATEMENTS WILL REQUIRE.
25 REM YOU CAN DO THIS SIMPLY BY PRECEDING LINE 63000 WITH LONG REM STATEMENTS
26 REM UNDER NORMAL CIRCUMSTANCES THE REM STATEMENTS YOU ARE NOW READING
27 REM SHOULD BE MORE THAN SUFFICIENT, HOWEVER YOU CAN ALWAYS ADD MORE.
28 REM PLEASE NOTE: IT IS IMPORTANT THAT THE FIRST LINE OF THE PROGRAM SHOULD
29 REM BE 63000. CHANGE THIS AT YOUR PERIL!
30 REM THIS PROGRAM WILL SELF-DELETE AFTER COMPLETION, SO ALL THAT WILL REMAIN
31 REM ARE YOUR DATA STATEMENTS.
32 REM
33 REM
63000 REM DATA STATEMENT WRITER (C) *S.P.FOLMER*FEB 80*
63001 DEFFNAC(X)=PEEK(X):DEFFNB(X)=PEEK(X+1):DEFFNC(X)=FNC(X)+256*FNB(X):FI=-1
63002 LP=40
63003 LP=FNC(LP):IF FNC(LP+2)<63000 GOTO 63003
63004 POKE 41,INT(LP/256)
63005 POKE 40,LP-PEEK(41)*256
63006 PRINT"DATA STATEMENT WRITER (C) SPF FEB 81"
63007 INPUT"START ADDRESS (DEC) ":SR
63008 INPUT"END ADDRESS (DEC) ":EN
63009 POKE 144,49:LN=100
63010 C1=FNC(1025)
63011 OFS=C1+2
63012 FOR I=SR TO EN
63013 IF DSC<0 GOTO 63019
63014 POKE OFS+1,INT(LN/256)
63015 POKE OFS,LN-PEEK(OFS+1)*256
63016 LN=LN+10
63017 OFS=OFS+2
63018 POKE OFS,131:OFS=OFS+1
63019 A$=STR$(PEEK(I)):A$=RIGHT$(A$,LEN(A$)-1)
63020 FOR J=OFS TO OFS+LEN(A$)-1
63021 POKE J,ASC(MID$(A$,J+1-OFS,1))
63022 NEXT J
63023 OFS=J:DS=DS+1
63024 IF OFS>LP-10 THEN PRINT"*INSUFFICIENT SPACE*":I=EN
63025 IF DSC<20 AND I<EN THEN POKE OFS,ASC(","):OFS=OFS+1:GOTO 63023
63026 DS=0
63027 POKE OFS,0
63028 OFS=OFS+1
63029 POKE C1+1,INT(OFS/256)
63030 POKE C1,OFS-PEEK(C1+1)*256
63031 C1=OFS
63032 OFS=OFS+2
63033 NEXT I
63034 POKE C1,0:POKE C1+1,0
63035 OFS=C1+2
63036 POKE 41,4:POKE 40,1
63037 POKE 623,INT(OFS/256)
63038 POKE 42,OFS-PEEK(623)*256
63039 POKE 43,PEEK(623):POKE 144,46
63040 CLR
63041 END
READY.
```

(continued from previous page)

disable the Stop key without stopping the timer and also to re-enable the Stop key if required. The key to the method is Subroutine D, which forms an extension to the Pet clock-interrupt service routine.

It sets the working storage variable at location 155 to indicate that the Stop key has not been pressed — even if it actually has. Subroutine C modifies the stack to force Subroutine D to be executed immediately on exit from the Pet interrupt routine.

Subroutines A and B serve to bring the method into and out of play. To disable the Stop key, invoke Subroutine A, e.g., by Sys (832). To re-enable it invoke Subroutine B, e.g., by Sys (844). Note that it is not the Stop key itself that is disabled/enabled but the break action associated with it.

The subroutines are here shown to reside as usual in the second cassette buffer and may be deposited there by any of the usual means. With suitable modification of address values the subroutines may of course reside elsewhere.

Subroutine A

```
0340 78 SEI
0341 A9 58 LDA #858
0343 85 90 STA 144
0345 A9 03 LDA #803
0347 85 91 STA 145
0349 58 CLI
034A 60 RTS
034B EA NOP
```

Subroutine B

```
034C 78 SEI
034D A9 2E LDA #82E
034F 85 90 STA 144
0351 A9 E6 LDA #8E6
0353 85 91 STA 145
0355 58 CLI
0356 60 RTS
0357 EA NOP
```

Subroutine C

```
0358 A2 04 LDX #4
035A 68 PLA
035B 48 PHA
035C 48 PHA
035D 48 PHA
035E 68 PLA
035F 68 PLA
0360 68 PLA
0361 CA DEX
0362 D0 F6 BNE -10
0364 A9 03 LDA #803
0366 48 PHA
0367 A9 74 LDA #874
0369 48 PHA
036A BA TSX
036B CA DEX
036C CA DEX
036D CA DEX
036E CA DEX
036F 9A TSX
0370 4C 2E E6 JMP ISR
0373 EA NOP
```

Subroutine D

```
0374 08 PHP
0375 48 PHA
0376 A5 9B LDA 155
0378 09 10 ORA #810
037A 85 9B STA 155
037C 68 PLA
037D 40 RTI
```

```
BYTSVE = $00
BRKPNT = $01
TMP0 = $FB
RDOC = $E7EB
RDOA = $E7A7
ERROPR = $E7F7
USRCMD = $3FA
WARM = $FD56
* = $33A
```

```
033A A9 4F LDA #<BREAKP
033C 8D FA 03 STA USRCMD ; STORE START LO
033F A9 03 LDA #>BREAKP
0341 8D FB 03 STA USRCMD+1 ; STORE START HI
0344 A9 00 LDA #00
0346 85 00 STA BYTSVE ; CLEAR SAVE BYTE
0348 85 01 STA BYTSVE+1 ; AND
034A 85 02 STA BYTSVE+2 ; BREAK ADDRESS
034C 4C 56 FD JMP WARM ; ENTER MONITOR
034F C9 42 BREAKP CMP #'B'
0351 F0 03 BEQ BRKSRV ; HANDLE BREAK?
0353 6C 7B 03 JMP(EXTCMD) ; IF NO, THEN GO
0356 A0 00 BRKSRV LDY #00
0358 A5 00 LDA BYTSVE ; FETCH LAST BYTE
035A 91 01 STA(BRKPNT),Y ; REPLACE IT
035C 20 EB E7 JSR RDOC ; SKIP DELIMETER
035F 20 A7 E7 JSR RDOA ; GET ADDRESS
0362 B0 03 BCS ADDR0K
0364 4C F7 E7 JMP ERROPR ; ERROR IF NONE
0367 A0 00 ADDR0K LDY #00
0369 B1 FB LDA(TMP0),Y ; FETCH TARGET BYTE
036B 85 00 STA BYTSVE ; SAVE IT
036D A5 FB LDA TMP0
036F 85 01 STA BRKPNT ; SAVE ADDRESS LO
0371 A5 FC LDA TMP0+1 ; AND
0373 85 02 STA BRKPNT+1 ; REPEAT FOR HI
0375 98 TYA ; CLEAR 'A'
0376 91 01 STA (BRKPNT),Y ; PUT BREAKPOINT
0378 4C 56 FD JMP WARM ; ENTER MONITOR
037B F7 E7 EXTCMD .WORD ERROPR
```

Machine-code debug

THIS CONCISE program was developed to simplify the debugging of machine-code routines when using the monitor program Tim, writes N Darlow of Pavenham, Bedfordshire. It allows the placement of a Break instruction, after an instruction of interest, in the program under test. In this manner, the tested program may be executed under user-control and the registers examined or modified after the breakpoint is executed.

The routine also saves and restores the byte overwritten by the break instruction so allowing systematic debugging to be achieved with the minimum of effort. The uncomplicated listing is self-explanatory. Re-location may be accomplished by altering the memory pointers at \$033B, \$0340, \$0354 and \$0355 to the appropriate values for a particular memory location area.

After entering the program with either Tim or an assembler, the link to Tim is made with the command .G 033A. This initialises the Tim user-command

extension locations and clears variable storage in page zero. The link to Tim should be made after the machine-code load routine has been used, if at all.

The routine is now ready for use and acts as an extension to the monitor command set. For example a typical debugging session may be as follows:

```
SYS(64785)
*B PC IRQ ...
C6FB E62E Entry from Basic to machine-code monitor
.G 033A Establish link to Tim, program already loaded
.B 0415 Set a breakpoint at $0415
.G 0400 Execute code up to break-point
*B PC IRQ ...
0416 E62E Break entry at $0415 with registers displayed
.B 0430 Set next break-point at $0430, replace last one
.G 0415 Execute from previous break-point to next
*B PC IRQ ...
0431 E62E Break entry at $0430 registers available for examination, etc.
```

As can be seen the routine is very easy to use and saves the need for monotonous cursor manipulation and remembering to replace bytes after inserting break instructions in a program.

Planet path plot

THIS PROGRAM is designed to draw on the screen the paths followed by a number of planets among a number of stars placed on the screen by the user, writes Gareth Ingram of Drayton near Abingdon, Oxfordshire. The starting positions, mass and the velocities of the planets are typed by the user and then the computer moves them step by step across the screen.

This version runs on an Apple II Plus with high-resolution graphics, but because I have no colour, the program plots only in white on black. The insertion of a few colour commands would be simple.

Input routine: The program asks for the number of stars and planets, then a page of instructions follows to show the user the format of input. If you are short of memory, this can be omitted. The user is prompted for the data at the bottom of the screen and then draws up the stars as the co-ordinates are inputted.

However, to save space, no extensive checks are made on this data. There is no means of correcting it so the program must be re-run if an error is made by the user when entering the data. After entering the necessary data, the program returns to the main routine and starts processing.

Three arrays are used to hold all the data; one holds the masses of the objects and the other two hold the co-ordinates and velocities. The velocities are in pairs, one in the horizontal direction and one vertical together giving magnitude and direction.

Now, velocity is change in distance, so the velocities are added constantly to their respective co-ordinates, and the planet appears to move along a straight line as the co-ordinates are incremented constantly by this value.

Computational routine: In the main loop, the effect of gravitational forces between the planets and stars on the planets velocities must be calculated. So that the paths bend under this influence, and the planets do not continue off in a straight line, a change in their velocities is needed.

Change in velocity is acceleration, and the acceleration is then added to the velocities to affect this change. The necessary acceleration can be calculated from Newton's laws of gravitation and motion. Now from Newton's law of gravitation the force, (F), on the planet by a star is given by:

$$F = \frac{\text{Mass of planet} \times \text{Mass of star}}{\text{separating distance squared}}$$

From this we can calculate the acceleration of the planet, (A), from:

$$A = \frac{\text{Force on planet}}{\text{Mass of planet}}$$

Yet because there are no units, the computational routine does not follow exactly these equations. If it did large jumps off the screen would occur when a

planet passes near to a large star. This is not that time-consuming, but there is a force exerted on each planet by every other body and these must all be "averaged" to find the resultant force, and so many calculations are done for each planet in turn. After all of the new velocities have been found in this way, the processing passes on to the next routine.

Plot Routine: The reason why the co-ordinates are updated now and not before is because to plot a line from the old position to the new position, both are needed. So first the old co-ordinates are retrieved and plotted, next the new value is calculated and a line drawn between them thus ensuring that the old co-ordinate is not lost first.

This is done for all of the planets in succession unless a planet is moved out of the screen range. When this happens, the planet is marked "dead" by changing its mass to zero and in future, the two main routines reject and by-pass all zero-mass planets.

Eventually, a point will be reached when all of the planets have exceeded the screen limits or been pulled into endless orbits. So, to stop the program a manual break is needed, since no integral checks are made.

Speed is a prime concern in the program, because of the long slow loops. To keep processing time to a minimum I have made two time-saving measures. Firstly, I replaced all of the constants in the main loops by variables since it takes more time to interpret an ASCII number than to simply retrieve a numerical value.

However, I have still used double-letter named variables which take marginally longer to recognise than single letter names, but the clarity gained in using multi-letter names outweighs any speed advantages. Secondly, I placed the main routines at the head of the program. This is because any GOTOs take less time because the computer looks down the line numbers until it finds the one specified.

As it stands, the program takes into account all the gravitational forces between planets. This can be useful because it makes it possible to examine the movements of large masses moving under each other's gravitational influence. Like the search-moon system and binary systems.

The next step with this program is to enable it to work in three-dimensions even though it only plots a two-dimensional view. It is not difficult, and perhaps the stars as well could be made to move.

Variables:

- NO The number of objects
- NP Number of planets
- NS Number of stars
- D(NO, I) The co-ordinates of objects
- V(NP, I) Velocities of planets
- M(NO) Masses of objects
- DX Difference in X co-ordinate
- DY Difference in Y co-ordinate
- X, Y The maximum screen limits
- L, N Set to one and nought
- AX, AY Accelerations
- I, K Indexing variables in loops

NA
R

Intermediate acceleration
Power needed in main
Computational routine, 1.5

```

100 REM -----
101 REM TRAJECTORY PLOTTER
102 REM -----
200 REM -----
201 REM BY GARETH INGRAM ON APPLE II
202 REM -----
400 REM -----
401 REM --TO SAVE TIME ALL CONSTANTS HAVE
402 REM --BEEN REPLACED BY VARIABLES --
403 REM --AND THE MAIN ROUTINE PLACED AT
404 REM --THE HEAD OF THE PROGRAM --
800 GOTO 300
900 REM -----
1000 REM COMPUTATIONAL ROUTINE
1001 REM -----
1010 FOR I = 1 TO NP
1020 IF M(I) = 0 THEN 200
1030 AX = N:AY = N
1040 FOR K = 1 TO NO
1050 IF K = I OR M(K) = 0 THEN 200
1060 DX = D(K,N) - D(I,N)
1070 DY = D(K,L) - D(I,L)
1080 IF DX = 0 AND DY = 0 THEN 200
1090 NA = M(K) / (DX * DX + DY * DY) R
1100 AX = AX + DX * NA:AY = AY + DY * NA
1110 NEXT K
1120 D(I,N) = D(I,N) + AX:D(I,L) = D(I,L) +
1130 AY
1140 NEXT I
2300 REM -----
2301 REM PLOT PROJECTILES
2302 REM -----
2400 FOR I = 1 TO NP
2410 IF M(I) = 0 THEN 300
2420 H$ = D(I,N),D(I,L)
2430 D(I,N) = D(I,N) + V(I,N)
2440 D(I,L) = D(I,L) + V(I,L)
2450 IF D(I,N) < L OR D(I,L) < L THEN M(I) =
2460 0
2470 IF D(I,N) > X OR D(I,L) > Y THEN M(I) =
2480 0
2490 GOTO 300
2500 H$ = D(I,N),D(I,L)
2510 NEXT I
3000 REM ----- END -----
3001 REM -----
3002 REM INITIALISE VARIABLES
3003 REM -----
3010 LOWMEM = 16384
3020 N = 0:L = 1:I = 0:K = 0
3030 AY = 0:AX = 0:NA = 0:NS = 1
3040 NO = 1:X = 279:Y = 160
3050 DX = 1:DY = 1:NP = 1:R = 1.5
3060 REM -----
3070 REM -----
3080 REM DISPLAY INSTRUCTIONS
3081 REM -----
4100 TEXT:HOME:PRINT "-----"
4110 PRINT "THE NUMBER OF PROJECTILES IS ";
4120 NP
4130 PRINT:PRINT:INPUT "THE NUMBER OF STARS
4140 IS ";NS
4150 NO = NS + NP
4160 DIM V(NP,L),D(NO,L),M(NO)
4170 HOME:PRINT "YOU WILL BE ASKED TO ENTER
4180 FIVE PARAMETERS"
4190 PRINT:PRINT"FIRST THE MASS OF THE OB
4200 JECT"
4210 PRINT:PRINT"SECOND AND THIRD THE COO
4220 RDINATES OF THE OBJECT"
4230 PRINT "THESE START AS (5,5) IN THE TOP"
4240 PRINT "LEFT HAND CORNER AND GO TO (275,
4250 155)"
4260 PRINT:PRINT "FOURTH AND FIFTH FOR THE
4270 PLANETS IS THE VELOCITY IN EACH DIREC
4280 TION"
4290 PRINT:PRINT "FIRST YOU WILL ENTER THE
4300 DATA FOR THE STARS"
4310 PRINT:PRINT "PRESS ANY KEY TO CONTIN
4320 UE" :GET WS
4330 REM -----
4340 REM INPUT ROUTINE
4341 REM -----
4350 HGR:IF NS = 0 THEN 600
4360 FOR I = NP + 1 TO NO
4370 HOME:VTAB 21:PRINT "M "; I - NP; " ";
4380 INPUT "MASS , X , Y"; M(I),DX,DY
4390 IF DX < 4 OR DY < 4 OR DX > 276 OR DY >
4400 160 THEN PRINT "X,Y OUT OF RANGE":
4410 GOTO 600
4420 REM -----
4430 REM PLOT THE STAR
4431 REM -----
4440 H$ = D(I,N),D(I,L)
4450 H$ = D(I,N),D(I,L)
4460 H$ = D(I,N),D(I,L)
4470 H$ = D(I,N),D(I,L)
4480 H$ = D(I,N),D(I,L)
4490 H$ = D(I,N),D(I,L)
4500 H$ = D(I,N),D(I,L)
4510 H$ = D(I,N),D(I,L)
4520 H$ = D(I,N),D(I,L)
4530 H$ = D(I,N),D(I,L)
4540 H$ = D(I,N),D(I,L)
4550 H$ = D(I,N),D(I,L)
4560 H$ = D(I,N),D(I,L)
4570 H$ = D(I,N),D(I,L)
4580 H$ = D(I,N),D(I,L)
4590 H$ = D(I,N),D(I,L)
4600 H$ = D(I,N),D(I,L)
4610 H$ = D(I,N),D(I,L)
4620 H$ = D(I,N),D(I,L)
4630 H$ = D(I,N),D(I,L)
4640 H$ = D(I,N),D(I,L)
4650 H$ = D(I,N),D(I,L)
4660 H$ = D(I,N),D(I,L)
4670 H$ = D(I,N),D(I,L)
4680 H$ = D(I,N),D(I,L)
4690 H$ = D(I,N),D(I,L)
4700 H$ = D(I,N),D(I,L)
4710 H$ = D(I,N),D(I,L)
4720 H$ = D(I,N),D(I,L)
4730 H$ = D(I,N),D(I,L)
4740 H$ = D(I,N),D(I,L)
4750 H$ = D(I,N),D(I,L)
4760 H$ = D(I,N),D(I,L)
4770 H$ = D(I,N),D(I,L)
4780 H$ = D(I,N),D(I,L)
4790 H$ = D(I,N),D(I,L)
4800 H$ = D(I,N),D(I,L)
4810 H$ = D(I,N),D(I,L)
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ICL workshops

EASTER SUNDAY, people from all the U.K. homed in on Stoke-on-Trent. The reason was the ICL Mouse Workshop. Eddie George of ICL Kidgrove organised two mazes, oscilloscopes, EPROM programmers, various components and technical and practical advice. About 40 people and 10 mice, in various states of disarray, attended. Everyone I spoke to enjoyed the day.

One group I was particularly pleased to see was from Hayes Manor School, Middlesex. They all live about five miles from me and I had never heard of them. Later on, I noticed them writing LB Electronics on the cover of their mouse and I asked them if they were being sponsored. They said they went into the LB Electronics shop in Hillingdon and talked to the owner about sponsorship. Apparently, he became enthusiastic and has helped them with money and

by Nick Smith

components. The owner apparently said: "Someone came in last year asking for sponsorship and I turned him down. Then he went and won". That was me. I was trying to talk him into giving me stepper motors.

Vernon Gifford — the club co-ordinator of the Amateur Computer Club — was there as an observer. He is trying to organise a one-day seminar on mice/robotics probably at Imperial College in the autumn, and he has also asked me to give a talk to the Croydon ACC on July 7.

Phil Yeardeley and I were furiously working on Brainy Bricks and Sterling Mouse respectively. We both went to compete, at the invitation of the organisers, in the first Paris heat at the Sybex exhibition. We suspected that the reason why there were so few working mice in France was because it was so early in the year.

This was largely confirmed by a M. Marquis and his partner who turned up on my doorstep recently. He came to England from France to buy some spare parts for his E-type Jaguar and to see what a real mouse looked like.

Dumb animal

Pete Boyce was there with his "brainless", i.e., microless-mouse. He displayed it going up and down a straight passage. It looks rather like a flying saucer. Round the outside of the mouse are spring-loaded vertical axles, each one pivoted at the top with a wheel which sticks out on the bottom. When the mouse strays, one or more of the wheels hits a wall and is pushed in. A magnet on the axle then operates a reed switch.

One of the ICL mice was gliding up and down in a straight line, too. Apparently it can either solve mazes or move. Both lots of software were written independently

and will not work together. This has been made worse by the departure of the main programmer.

Other points noticed was a wheel that looked as if it had been pinched from last year's Swiss mouse, Lami, and a chassis with wheels that could be turned through 90°. Both ideas enable a mouse to go up, down, left and right without turning the chassis.

If you have not yet started building your mouse, you would probably have left with mixed feelings. None of the mice on display showed the slightest indication of rushing off to the centre of the maze in double quick time. So you are not far behind. On the other hand several \$10,000 man-hours say it cannot be done without some luck and the occasional prod. Time is beginning to grow short, though to give you some idea, last July I had a chassis with the motors and wheels assembled and it was connected to an output port on my micro. I had also invented my maze-solving algorithm.

Geoff Pike — my partner and mechanic — put the finishing touches to the sensors only three days before the final. I am still trying to improve the sensors. The message is that it is not the building that takes time, it is making it work.

Absolutely everyone has a problem with sensors. Seeing one couple huddled over a pair of Ultra Sonic transducers brought back memories. Another group huddled around an array of eight infra-red detectors. Someone fired a flashgun and all eight sensors detected a wall simultaneously. "They will have to go", said their leader. There really is not a best method which is universally agreed for detecting walls. The only fatal feature in sensors is hysteresis. This effectively eliminates the use of most micro switches.

Do not forget the first British heat at the On-Line Exhibition, Wembley Conference Centre, London, on July 28/31. It is a sad but true fact that the

Nick Smith with Sterling Mouse.



worse the mice the funnier they are so it should be plenty of fun.

Free stepper motors

IMPEX ELECTRICAL — a member of the giant Philips group — has written to me pointing out they it can supply a wide range of new stepper motors from about £13. It can also supply the SAA 1027 stepper motor drive integrated circuit.

Impex would be pleased to hear from anyone interested in stepper-motor applications and is happy to give practical and technical advice if required. In a generous gesture, Impex is prepared to supply a limited number of people building mice, or other novel applications, with free stepper motors. Readers should write, giving details of their application and mentioning the Micro-mouse page to: DS King General Manager, Impex Electrical, Market Road, Richmond, Surrey TW9 4ND.

Les mice à Paris

THE RESULTS of the Micromouse Competition held at the Micro Expo Exhibition in the Palais des Congrès, Paris, were as follows:

First, Nick Smith with Sterling Mouse, reaching the centre in less than 3½ minutes for which he won a Sharp Computer.

Second, Phil Yeardeley with Brainy Bricks. He did not reach the centre but made a splendid effort for which he won a pocket calculator.

In the French Competition: First Kim Mouse which did not reach the centre but made the best effort for which he won an Apple Computer. Second, Carré d'as which only went in a straight line but for its efforts won a Honeywell printer, and third Ariane who, for not much at all won a pocket calculator.

The next contest will be at the Microcomputer Show in the Wembley Conference Centre on July 30 and 31. □

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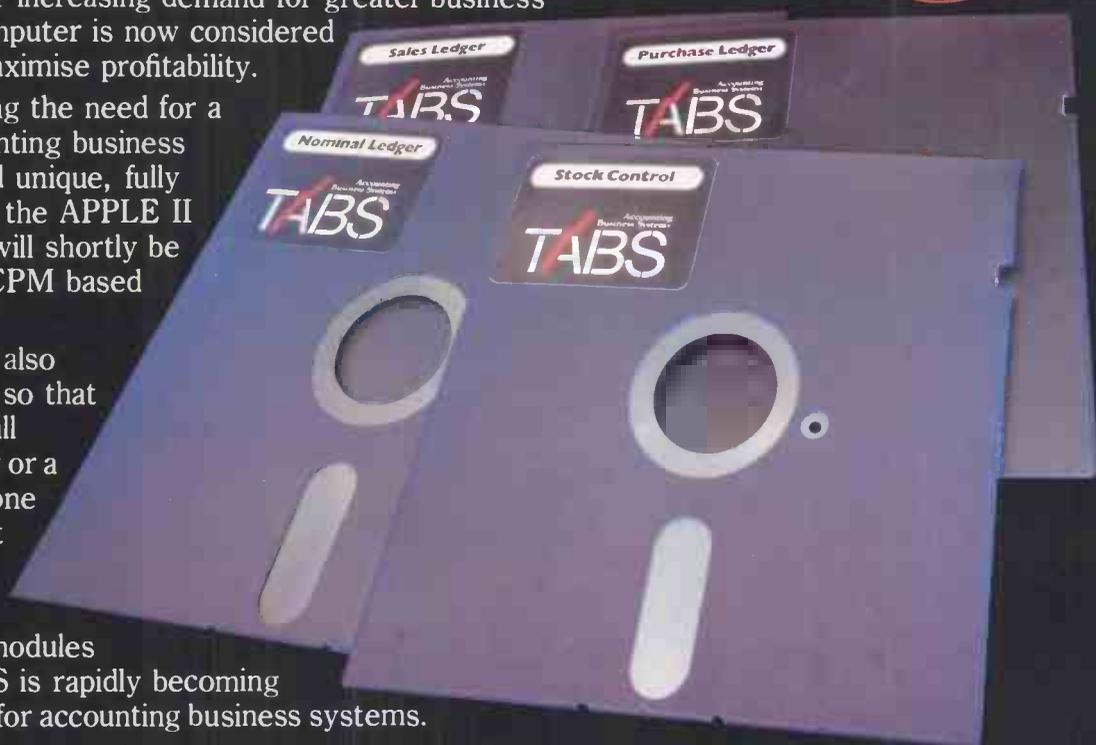
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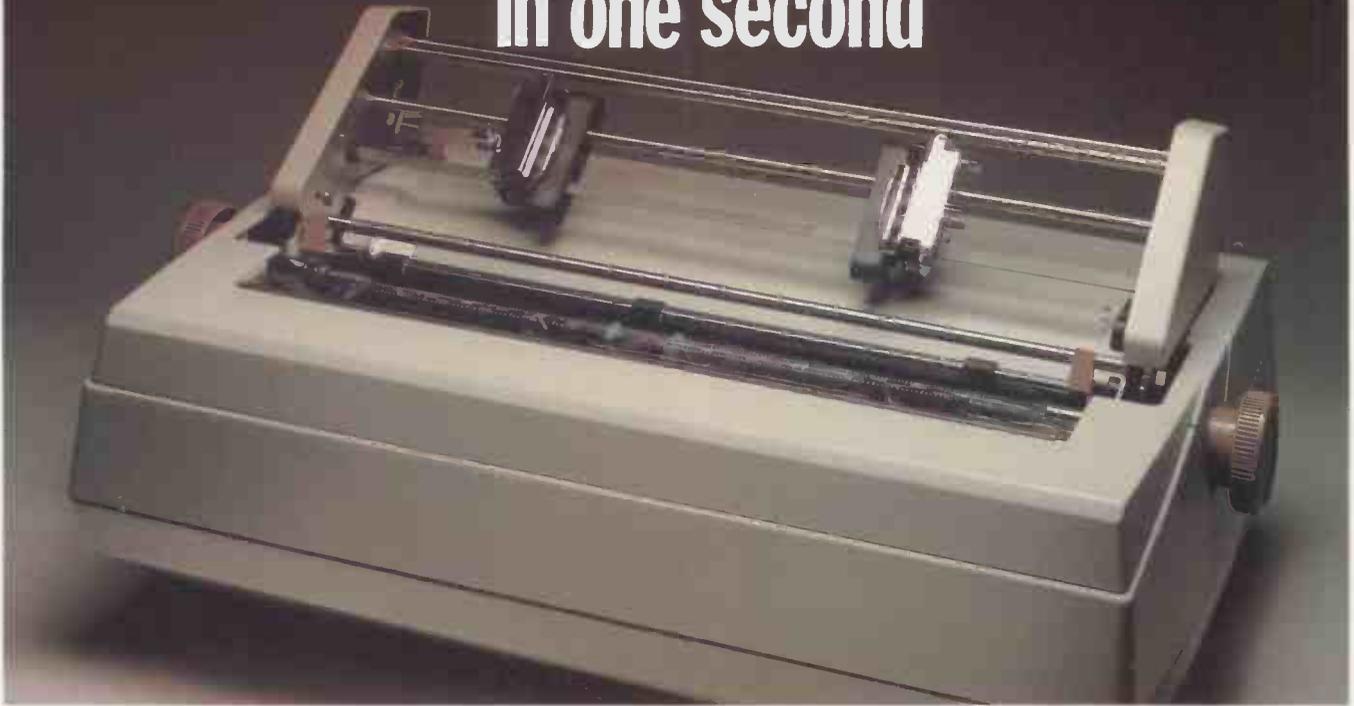
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Programming standard Pascal

By R C Holt and J N P Hume. Published by Prentice Hall International, 380 pages, paperback. Price £7.75; ISBN 0-8359-5690-3. Available from any bookshop.

PASCAL is a high-level programming language which is gaining widespread popularity — especially among micro-computer users and in universities and polytechnics. As an Algol-like language, powerful enough to support most programming applications, yet simple enough that compilers can be implemented for all but the smallest machines, it is deservedly replacing Basic and machine-level languages for more and more tasks.

There is no accepted standard for Pascal. The most widely-quoted standard is the Pascal User Manual and Report by Jensen and Wirth, but that is known to contain defects and ambiguities.

The British Standard Institute proposal to ISO for a new international standard has not yet been agreed. Meanwhile, the UCSD Pascal implementation has become used very widely, and many people regard UCSD as the effective industry standard.

Many universities have decided to teach Pascal because it is easy to teach and to learn, and because it supports the structured programming approach to good programming style.

Excellent example

This new book from Holt and Hume has developed from courses in the computer science department of the university of Toronto — it is an excellent example of a modern, introductory programming language course.

After a brief introduction to computers, the features of Pascal are described in eight chapters, each of which provides a richer, self-contained subset of the full language. Pascal subset one, PS1, is sufficient to write complete programs which print out the results of simple calculations, and each of the subsets which follow, PS2 to PS8, introduces new features, enriching the language and

expanding the range of problems which can be solved.

The chapters which describe each language subset are well-illustrated with plentiful examples of complete programs. Each chapter concludes with a detailed summary of the new material and with a number of very good exercises.

The whole approach is designed to start the reader programming in Pascal as early as possible and as much as possible, so that good habits can be formed and reinforced from the beginning.

Between the chapters which introduce new language features are others which contain advice on program design. They teach the techniques which lead to correct programs and which consolidate earlier material. Many examples are concerned with sorting and searching, with manipulation of text and with data structures.

The authors have avoided the trap of regarding Pascal as primarily a language for numerical programming, while providing a valuable short chapter on numerical methods for those who want it.

The final chapters of the book go beyond just teaching programming and Pascal, to provide comparison with PL/1, Fortran 77, Cobol and Algol W, to introduce assembly language programming and machine simulators and to demonstrate the design of a simple compiler. Appendices contain summaries and syntax charts.

The final Pascal subset described, PS8, is less than full Pascal as defined by Jensen and Wirth. The authors have deliberately omitted GOTO statements, sets, variant records, and subprograms as parameters. That is unfortunate — although the ease with which the authors have avoided the need for GOTO should impress many less-disciplined programmers — but the omission is a minor one.

The care which has gone into the order of presentation of Pascal features, the meticulous proof reading, the excellent examples and index all make this a book far above average.

Conclusions

● It is an excellent introduction to programming and to Pascal, strongly recom-

mended both for newcomers to programming and to experienced programmers who wish to learn Pascal.

Martyn Thomas

Musical applications of microprocessors

By Hal Chamberlain Hardback 660 pages. £15.80. John Wiley and sons.

THIS substantial volume purports to be a comprehensive guide to one of the more exciting applications of micro-computers, musical synthesis. The book is very much a product of the age in which we live — it seems that everywhere we go that our lives are dominated by both computers and music. In the supermarket, constant musak and micro-processor-controlled tills are the order of the day; pop music plays constantly on the radio where program controllers use desk-top computers to select their playlists — music and computers are everywhere.

Many people do not realise the impact that microprocessors and the new technology have already made on the music we hear. An increasing amount of our music diet is already performed on instruments which employ the latest silicon-chip technology. A large percentage of modern music will have been recorded in studios that employ microprocessors. The latest development is the introduction of digital recording techniques.

Wide subject

The subject is rather a wide one and so to simplify the matter, the book has been split into three sections. The first of the three sections covers the necessary background material, and also provides the reader with an overview of the subject. Chamberlain states that this is a subject which "encompasses the disciplines of physics, mathematics and computer programming", and everything in between.

Chapters included in this section cover such topics as: basic principles, voltage-control methods, and micro-processors. A particularly-interesting part of the first chapter covers the history of electronic sound synthesis.

The first section would stand up as a work in its own right but the real meat of the book is included in the second two

sections. Devoted to the twin subjects of computer control of analogue synthesisers and purely digital synthesising techniques, these two sections are a complete course in the subject. The first section must be read or at least glanced at first before proceeding to the next two otherwise an inexperienced reader may find himself in deep water. This is not because of any failing in Hal Chamberlain's excellent book, but has much to do with the fact that there is no point buying expensive hardware if you do not yet know what you want to do with it.

Computer-controlled analogue synthesis is the title of the second section and should be fairly self-explanatory. The section deals with the micro-computer as a controlling device. Since control is the primary use for which micro-processors were developed, it is a relatively-simple section — relative, that is, to the third and final section. This section opens with an evaluation of the elements of analogue synthesis, describing the various elements such as the voltage-controlled oscillator and filters, etc.

Digital synthesis

There is a chapter on digital-to-analogue and analogue-to-digital conversion, another on signal routing. Again, as in the rest of the book, these chapters are useful in their own right. The rest of this section is devoted to interfacing.

The last section is bigger than the two — almost half the book in fact — and it deals with the digital synthesis of music. Chapters included discuss digital tone — generation techniques, digital filtering techniques, generating percussion sounds, hardware and software. The chapter on software introduces a custom-written language for the generation of music called Notran.

Conclusions

- This work is an excellent reference book dealing with an interesting microprocessor application.
- Each chapter forms a reference work in its own right.
- At slightly less than £16 this book is excellent value as it contains information which could only otherwise be found in a number of other works.

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Routines to improve your Pet's display

IN LAST month's article we examined some simple machine-code programs designed to improve the graphics display capability of the Pet. The functions included cursor control which allows the cursor to be moved to specific co-ordinates on the screen where a Print statement will be used to display text or graphics on the line following the cursor position.

The calculation of a screen-memory address from co-ordinate values is essential to any machine-code graphics routine. This is done by a routine common to most of the program in these articles and for this reason is repeated again in listing 1.

This month we look at three more routines, filling a block of the screen with a specified character, reverse-fielding a block of the screen and drawing borders around a specified part of the screen. The program in listing 5 is a Basic loader for all the machine-code routines looked at so far in this series.

Block is a routine which fills a designated block of the screen with a previously-defined character. This is done by a process of repeatedly drawing horizontal lines. The number of lines is equal to the block height and the line length equals block width. The position of

Example 1.

```
10 POKE 86,10 : REM START AT COLUMN # 10
20 POKE 87,10 : REM ON LINE # 10
30 POKE 88,8 : REM BLOCK WIDTH 8 CHARACTERS
40 POKE 89,5 : REM BLOCK HEIGHT 5 CHARACTERS
50 POKE 0,42 : REM USE STAR CHARACTERS FOR BLOCK
60 SYS(30470) : REM CALL SUBROUTINE
```

Example 2.

```
10 POKE 86,10 : REM START AT COLUMN # 10
20 POKE 87,10 : REM ON LINE # 10
30 POKE 88,8 : REM BLOCK WIDTH 8 CHARACTERS
40 POKE 89,5 : REM BLOCK HEIGHT 5 CHARACTERS
50 SYS(30510) : REM CALL SUBROUTINE
```

Example 3.

```
10 POKE 86,10 : REM TOP LEFT CORNER AT COLUMN # 10
20 POKE 87,5 : REM ON LINE # 5
30 POKE 88,20 : REM BORDER WIDTH 20 CHARACTERS
40 POKE 89,15 : REM BORDER HEIGHT 15 CHARACTERS
50 SYS(30090) : REM CALL SUBROUTINE
```

the top-left corner of the block is determined by two variables — column number and line number.

The width of the block can be any integer value with a minimum of 1 and a maximum of 255 character spaces. The height of the block can be any integer value with a minimum of 1 and a maximum of 255. In practice, of course, the maximum block size will be the whole screen. A variable allows the character used to fill the block to be defined in the Basic calling program. The variable locations required by the routine are as follows:

- 86. column number of block start — top left-hand corner.
- 87. screen line number of block start — top-left corner.
- 88. width of block
- 89. height of block.
- 00. ASCII code value of character used in block.

The routine is called from a Basic program with the command:

SYS(30470)

Some example applications for this function:

- To give background characters in graphics
- To highlight data displayed in block area.
- If the character used is a space, this function can be used to erase blocks of the screen.

Example 1 shows a Basic program

by Nick Hampshire

which uses this routine. Listing 3 is the reverse field block of screen.

INVT will reverse the field of all characters within a given block of screen area. This routine is very similar to the routine for filling a block of the screen with a specified character. Instead of putting a character into each memory location in the block, the current contents are read, an exclusive "or" operation performed on it and the result stored in the same location.

The position of the top-left of the block is determined by two variables — column number and line number. The width of the block can be any integer value with a minimum of 1 and a maximum of 255 character spaces. The height of the block can be any integer value with a minimum of 1 and a maximum of 255, though in practice, the maximum size of the reverse-field area is the whole screen. The variable locations required by the routine are as follows:

- 86. column number of reverse block start top-left corner.
 - 87. screen line number of reverse block start.
 - 88. width of reverse block area.
 - 89. height of reverse block area.
- The routine is called from a Basic program with the command:

SYS (30510)

Some example applications for this function:

- To highlight specific sets of data.
- By repeating calling this function with a program loop on the same text area a flashing message can be generated, ideal for error and warning signs.

Example 2 shows a Basic program which uses this routine.

BORD will draw a thin line border around a specified area of the screen. The position of the top-left corner of the border can be any integer value with a minimum of 1 and a maximum of 255 character spaces.

The height of the border can be any integer value with a minimum of 1 and a



maximum of 255. In practice, the maximum size of the border is around the outside edge of the screen. The variable locations required by the small routine are as follows:

- 86..... column number of border start top-left corner.
- 87..... screen line number of border start.
- 88..... width of border.
- 89..... height of border.

The routine is called from a Basic program with the command:
SYS (30090)

Some example applications for this function:

- Enhance the screen appearance by putting a border around the screen edge.
- To identify associated data items by dividing the screen into sub-screen areas using borders to isolate each area.
- To isolate graphical displays from text, etc.

Example 3 is a Basic program which uses routine. All the programs in this series of articles are taken from *Pet graphics* by Nick Hampshire. This book is published by Computabits Ltd price £10.

Listing 1.

```

0066 7400 ;*****
0067 7400 ;* ROUTINE TO CALCULATE SCREEN ADDRESS
0068 7400 ;* FROM VALUES FOR COLUMN AND LINE
0069 7400 ;* COLUMN IN $56, LINE IN $57
0070 7400 ;* ADDRESS RETURNED IN $54 AND $55.
0071 7400 ;* THIS ROUTINE IS ONLY CALLED BY OTHER
0072 7400 ;* ROUTINES IN THE PACKAGE, DO NOT
0073 7400 ;* USE BY ITSELF IT WILL CAUSE PET
0074 7400 ;* TO CRASH SINCE REGISTERS ARE NOT
0075 7400 ;* SAVED ON STACK.
0076 7400 ;* ERROR FLAG IN LOCATION $01
0077 7400 ;*****
0078 7400 ;
0079 7400 A9 00 ADR1 LDA #$00
0080 7402 85 01 STA T9
0081 7404 A5 56 LDA T3
0082 7406 30 33 ADR2 BMI ERROR1 ;COLUMN < 0 ?
0083 7408 C9 28 CMP #$28
0084 740A B0 3A BCS ERROR2 ;COLUMN > 40 ?
0085 740C A5 57 LDA T4
0086 740E 30 41 BMI ERROR3 ;LINE < 0 ?
0087 7410 C9 19 CMP #$19
0088 7412 B0 48 BCS ERROR4 ;LINE > 25 ?
0089 7414 A9 00 LDA #$00
0090 7416 85 54 STA T1
0091 7418 85 55 STA T2
0092 741A A5 57 LDA T4
0093 741C F0 0F BEQ COLUMN ;LINE = 0
0094 741E AA TAX
0095 741F 18 LINE CLC
0096 7420 A5 54 LDA T1
0097 7422 69 28 ADC #$28 ;ADD 40 TO ADDRESS
0098 7424 85 54 STA T1
0099 7426 90 02 BCC LINE2
0100 7428 E6 55 INC T2
0101 742A CA LINE2 DEX
0102 742B D0 F2 BNE LINE ;ANOTHER LINE ? DO AGAIN
0103 742D 18 COLUMN CLC
0104 742E A5 54 LDA T1
0105 7430 65 56 ADC T3 ;ADD COLUMN # TO ADDRESS
0106 7432 85 54 STA T1
0107 7434 A5 55 LDA T2
0108 7436 69 80 ADC #$80 ;ADD SCREEN STARTING ADDRESS
0109 7438 85 55 STA T2
0110 743A 60 RTS
0111 743B ;
0112 743B ;
0113 743B ;
0114 743B A9 01 ERROR1 LDA #$01 ;SET ERROR FLAG
0115 743D 85 01 STA T9 ;STORE IN 01
0116 743F A9 00 LDA #$00
0117 7441 85 56 STA T3 ;SET COLUMN TO 0
0118 7443 4C 06 74 JMP ADR2 ;CALCULATE ADDRESS
0119 7446 A9 02 ERROR2 LDA #$02
0120 7448 85 01 STA T9
0121 744A A9 27 LDA #$27 ;SET COLUMN TO 40
0122 744C 85 56 STA T3
0123 744E 4C 06 74 JMP ADR2
0124 7451 A9 03 ERROR3 LDA #$03
0125 7453 85 01 STA T9
0126 7455 A9 00 LDA #$00 ;SET LINE TO 0
0127 7457 85 57 STA T4
0128 7459 4C 06 74 JMP ADR2
0129 745C A9 04 ERROR4 LDA #$04
0130 745E 85 01 STA T9
0131 7460 A9 18 LDA #$18 ;SET LINE TO 25
0132 7462 85 57 STA T4
0133 7464 4C 06 74 JMP ADR2
0134 7467 ;
0135 7467 ;

```

Listing 2.

```

0644 7706 ;*****
0645 7706 ;* FILL A BLOCK OF THE SCREEN WITH A
0646 7706 ;* SPECIFIED CHARACTER. CHARACTER

```

(continued on next page)

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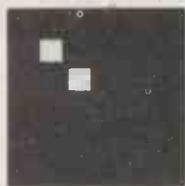


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(continued from previous page)

```

0647 7706 ; * STORED IN $00, TOP LEFT COORDINATES
0648 7706 ; * IN $56 (COL) AND $57 (LINE), HEIGHT
0649 7706 ; * OF BLOCK IN $59, WIDTH IN $58
0650 7706 ; * ROUTINE CALLED BY - SYS(30470)
0651 7706 ; *****
0652 7706 ;
0653 7706 ;
0654 7706 48 BLOCK PHA
0655 7707 98 TYA
0656 7708 48 PHA
0657 7709 8A TXA
0658 770A 48 PHA
0659 770B 20 00 74 JSR ADR1
0660 770E A6 59 LDX T6
0661 7710 A4 58 BLOCK1 LDY T5 ; FILL LINE WITH
0662 7712 89 DEY ; CHARACTER
0663 7713 A5 00 BLOCK2 LDA T8
0664 7715 91 54 STA (T1),Y
0665 7717 88 DEY
0666 7718 10 F9 BPL BLOCK2
0667 771A 18 CLC
0668 771B A5 54 LDA T1 ; CALCULATE START OF
0669 771D 69 28 ADC #$28 ; NEXT LINE
0670 771F 85 54 STA T1
0671 7721 90 02 BCC BLOCK3
0672 7723 E6 55 INC T2
0673 7725 CA BLOCK3 DEX
0674 7726 D0 E8 BNE BLOCK1
0675 7728 68 PLA
0676 7729 AA TAX
0677 772A 68 PLA
0678 772B A8 TAY
0679 772C 68 PLA
0680 772D 60 RTS
0681 772E

```

Listing 3.

```

0683 772E *****
0684 772E ; * INVERT A BLOCK OF THE SCREEN
0685 772E ; * TOP LEFT COORDINATES IN $56 (COL)
0686 772E ; * AND $57 (LINE), HEIGHT OF BLOCK
0687 772E ; * IN $59, WIDTH IN $58
0688 772E ; * ROUTINE CALLED BY - SYS(30510)
0689 772E ; *****
0690 772E ;
0691 772E ;
0692 772E 48 INVT PHA
0693 772F 98 TYA
0694 7730 48 PHA
0695 7731 8A TXA
0696 7732 48 PHA
0697 7733 20 00 74 JSR ADR1
0698 7736 A6 59 LDX T6
0699 7738 A4 58 INVT1 LDY T5
0700 773A 88 DEY
0701 773B B1 54 INVT2 LDA (T1),Y ; READ SCREEN CHARACTER
0702 773D 49 80 EOR #$80 ; INVERT IT
0703 773F 91 54 STA (T1),Y ; AND REPLACE ON SCREEN
0704 7741 88 DEY
0705 7742 10 F7 BPL INVT2
0706 7744 18 CLC
0707 7745 A5 54 LDA T1
0708 7747 69 28 ADC #$28
0709 7749 85 54 STA T1
0710 774B 90 02 BCC INVT3
0711 774D E6 55 INC T2
0712 774F CA INVT3 DEX
0713 7750 D0 E6 BNE INVT1
0714 7752 68 PLA
0715 7753 AA TAX
0716 7754 68 PLA
0717 7755 A8 TAY
0718 7756 68 PLA
0719 7757 60 RTS
0720 7758

```

Listing 4.

```

0373 758A *****
0374 758A ; * DRAW A BORDER OF ANY SIZE AND ANY
0375 758A ; * LOCATION. TOP LEFT COORDINATES ARE
0376 758A ; * COLUMN IN $56, AND LINE IN $57
0377 758A ; * WIDTH IN $58 AND HEIGHT IN $59
0378 758A ; * ROUTINE CALLED BY - SYS(30090)
0379 758A ; *****
0380 758A ;
0381 758A ;

```



```

0382 758A 48          BORD PHA
0383 758B 98          TYA
0384 758C 48          PHA
0385 758D 8A          TXA
0386 758E 48          PHA
0387 758F 20 00 74   JSR ADR1      ;TOP LEFT ADDRESS
0388 7592 A5 54      LDA T1        ;SAVE TOP LEFT ADDRESS
0389 7594 85 56      STA T3        ;IN $56 AND $57
0390 7596 A5 55      LDA T2
0391 7598 85 57      STA T4
0392 759A A9 64      LDA #$64
0393 759C 85 00      STA T8
0394 759E 20 FA 75   JSR HBORD    ;DRAW TOP HORIZONTAL
0395 75A1 18          CLC
0396 75A2 A5 54      LDA T1        ;FOR VERTICAL LINES
0397 75A4 69 29      ADC #$29     ;TOP ADDRESS = TOP
0398 75A6 85 54      STA T1        ;ADDRESS + 40.
0399 75A8 85 56      STA T3
0400 75AA A5 55      LDA T2
0401 75AC 69 00      ADC #$00
0402 75AE 85 55      STA T2
0403 75B0 85 57      STA T4
0404 75B2 A9 65      LDA #$65
0405 75B4 85 00      STA T8
0406 75B6 20 04 76   JSR VBORD    ;DRAW LEFT VERTICAL
0407 75B9 18          CLC
0408 75BA A5 56      LDA T3        ;TOP VERTICAL ADDRESS
0409 75BC 65 58      ADC T5       ;= TOP VERTICAL + WIDTH
0410 75BE 85 54      STA T1
0411 75C0 C6 54      DEC T1
0412 75C2 A5 57      LDA T4
0413 75C4 69 00      ADC #$00
0414 75C6 85 55      STA T2
0415 75C8 A9 67      LDA #$67
0416 75CA 85 00      STA T8
0417 75CC 20 04 76   JSR VBORD    ;DRAW RIGHT VERTICAL
0418 75CF A5 56      LDA T3
0419 75D1 85 54      STA T1
0420 75D3 A5 57      LDA T4
0421 75D5 85 55      STA T2
0422 75D7 A6 59      LDX T6       ;BOTTOM LEFT ADDRESS
0423 75D9 C6 54      DEC T1
0424 75DB CA          DEX
0425 75DC CA          DEX
0426 75DD 18          CLC          ;CALCULATED
0427 75DE A5 54      LDA T1
0428 75E0 69 28      ADC #$28     ;ADD 40 TO ADDRESS
0429 75E2 85 54      STA T1       ;EQUAL TO BOTTOM LEFT
0430 75E4 A5 55      LDA T2
0431 75E6 69 00      ADC #$00
0432 75E8 85 55      STA T2
0433 75EA CA          DEX          ;DO AGAIN UNTIL HEIGHT
0434 75EB D0 F0      BNE BORD1    ;IN X REG =0
0435 75ED A9 63      LDA #$63
0436 75EF 85 00      STA T8
0437 75F1 20 FA 75   JSR HBORD    ;DRAW BOTTOM HORIZONTAL
0438 75F4 68          PLA
0439 75F5 AA          TAX
0440 75F6 68          PLA
0441 75F7 A8          TAY
0442 75F8 68          PLA
0443 75F9 60          RTS
0444 75FA A4 58      HBORD LDY T5   ;LINE LENGTH
0445 75FC A5 00      HBORD1 LDA T8  ;CHARACTER FOR LINE
0446 75FE 91 54      STA (T1),Y   ;DISPLAY AT ADDRESS,Y
0447 7600 88          DEY
0448 7601 D0 F9      BNE HBORD1   ;END OF LINE?
0449 7603 60          RTS
0450 7604 A0 00      VBORD LDY #$00
0451 7606 A6 59      LDX T6
0452 7608 CA          DEX
0453 7609 CA          DEX
0454 760A A5 00      VBORD1 LDA T8
0455 760C 91 54      STA (T1),Y
0456 760E 18          CLC
0457 760F A5 54      LDA T1       ;LOCATION FOR NEXT
0458 7611 69 28      ADC #$28     ;CHARACTER
0459 7613 85 54      STA T1
0460 7615 A5 55      LDA T2
0461 7617 69 00      ADC #$00
0462 7619 85 55      STA T2
0463 761B CA          DEX
0464 761C D0 EC      BNE VBORD1   ;END OF LINE?
0465 761E 60          RTS
0466 761F

```

Listing 5.

10 REM *****

20 REM *BASIC LOADER FOR MACHINE CODE

30 REM *GRAPHICS ROUTINES

(continued on next page)

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```

40 REM *****
100 DATA 31243 : REM CURSOR CONTROL
110 DATA 48,98,48,8A,48
120 DATA A9,13,20,D8,E3,A5,54,F0,09
130 DATA A9,11,20,D8,E3,C6,54,D0,F7
140 DATA A5,55,F0,09,A9,1D,20,D8,E3,C6,55,D0,F7
150 DATA 68,AA,68,A8,68,60
200 DATA 29696
210 DATA A9,00,85,01,A5,56,30,33,C9,28,B0,3A
220 DATA A5,57,30,41,C9,19,B0,48,A9,00,85,54
230 DATA 85,55,A5,57,F0,0F,AA,18,A5,54,69,28
240 DATA 85,54,90,02,E6,55,CA,D0,F2,18,A5,54
250 DATA 65,56,85,54,A5,55,69,80,85,55,60
260 DATA A9,01,85,01,A9,00,85,56,4C,06,74
270 DATA A9,02,85,01,A9,27,85,56,4C,06,74
280 DATA A9,03,85,01,A9,00,85,57,4C,06,74
290 DATA A9,04,85,01,A9,18,85,57,4C,06,74
300 DATA 30029
310 DATA 48,98,58,8A,48,20,00,74,A4,58,A5,00
320 DATA 91,54,88,D0,F9,68,AA,68,A8,68,60
400 DATA 30052
410 DATA 48,98,48,8A,48,20,00,74,A0,00,A6,58
420 DATA A5,00,91,54,88,10,F9,18,A5,54,69,28,85,54
430 DATA A5,55,69,00,85,55,CA,D0,EC,68,AA,68
440 DATA A8,68,60
500 DATA 30470
510 DATA 48,98,48,8A,48,20,00,74,A6,59,A4,58,88
520 DATA A5,00,91,54,88,10,F9,18,A5,54,69,28
530 DATA 85,54,90,02,E6,55,CA,D0,E8,68,AA,68
540 DATA A8,68,60
600 DATA 30510
610 DATA 48,98,48,8A,48,20,00,74,A6,59,A4,58,88
620 DATA B1,54,49,80,91,54,88,10,F7,18,A5,54,69,28
630 DATA 85,54,90,02,E6,55,CA,D0,E6,68,AA,68
640 DATA A8,68,60
700 DATA 30090
710 DATA 48,98,48,8A,48,20,00,74,A5,54,85,56
720 DATA A5,55,85,57,A9,64,85,00,20,FA,75,18
730 DATA A5,54,69,29,85,54,85,56,A5,55,69,00
740 DATA 85,55,85,57,A9,65,85,00,20,04,76
750 DATA 18,A5,56,65,58,85,54,C6,54,A5,57,69,00
760 DATA 85,55,A9,67,85,00,20,04,76,A5,56,85,54
770 DATA A5,57,85,55,A6,59,C6,54,CA,18,A5,54
780 DATA 69,28,85,54,A5,55,69,00,85,55,CA,D0,F0
790 DATA A9,63,85,00,20,FA,75,68,AA,68,A8,68,60
800 DATA A4,58,A5,00,91,54,88,D0,F9,60
810 DATA A0,00,A6,59,CA,CA,A5,00,91,54,18,A5,54
820 DATA 69,28,85,54,A5,55,69,00,85,55,CA,D0,EC,68
5000 POKE 48,0:POKE49,112
5010 POKE 52,0:POKE53,112:CLR
9000 DATA*
9010 READL
9020 READA$
9030 C=LEN(A$)
9040 IFA$="*"THEN9140
9050 IFC<10RC>2THEN9130
9060 A=ASC(A$)-48
9070 B=ASC(RIGHT$(A$,1))-48
9080 N=B+7*(B>9)-(C=2)*(16*(A+7*(A>9)))
9090 IFC<00RN>255THEN9130
9100 POKEL,N
9110 L=L+1
9120 GOTO9020
9130 IFC=5THENL=VAL(A$):GOTO9020
9140 END

```

How a bubble-sort can test code efficiency

WE HAVE recently been involved at Teesside Polytechnic in software development for a character-recognition project involving the use of a hand-print terminal — see Barker 1981. This device acts as an intelligent peripheral which can be attached to a host mainframe, mini- or microcomputer system. Its mode of operation is such that characters may be printed on a flat, pressure-sensitive writing surface to which an appropriately-designed data-capture document has been attached.

Each character written on the document is recognised and its position deduced. This information is transmitted as a three-byte code to the host computer. The code consists of notional row and column numbers, which reflect the position of the

As both Pascal and assembler programming facilities are available for the Pet, we felt it worthwhile to investigate the relative improvements likely to be gained by re-writing the applications code in one or other of these languages.

To make a comparison of the language systems, we wrote a series of three programs. Each was designed to sort an array of positive integer numbers into

by Philip Barker

order using a bubble-sort technique similar to that described by Knuth. The overall strategy embodied in each program was as follows:

1. Generate 200 random numbers.
2. Initialise a timer.
3. Sort numbers using the bubble-sort.
4. Deactivate the timer.
5. Print out the sort time.

The exact details of program implementation depend on the particular language system employed which will be described later. Fundamental to the comparison is the bubble-sort embedded in the third step of the sequence of operations. For each of the languages used, this was coded directly from Knuth's algorithm which is reproduced in table 1.

For our applications, the records R_1 through R_n correspond to the element positions of the array to be sorted. Similarly, the keys — K_1 through K_n — correspond to the values stored at the different array positions.

The bubble-sort algorithm was implemented in both Basic and Pascal. Listings of the programs are shown in figures 2 and 3. In each case, an array of randomly-selected positive integers is generated by invoking an appropriate function procedure — RND in Basic and Random in Pascal.

Once the array of test values has been generated, the code responsible for performing the sort is timed. Timing is achieved by means of the internal real-time clock of the microcomputer. From Basic, this may be interrogated by

(continued on next page)

Algorithm BubbleSort	
Records R_1, \dots, R_n are rearranged in place; after sorting is complete their keys will be in order $K_1 \leq \dots \leq K_n$	
B1.	Initialise BOUND Set BOUND \leftarrow N. BOUND is the highest index for which the record is not known to be in its final position
B2.	Loop on j Set $t \leftarrow 0$. Perform step B3 for $j = 1, 2, \dots, \text{BOUND}-1$, and then go to Step B4.
B3.	Compare/Exchange $R_j : R_{j+1}$ If $K_j > K_{j+1}$ interchange $R_j \leftarrow R_{j+1}$ and set $t \leftarrow j$.
B4.	Any exchanges? If $t = 0$, the algorithm terminates. Otherwise set BOUND $\leftarrow t$ and return to Step B2.

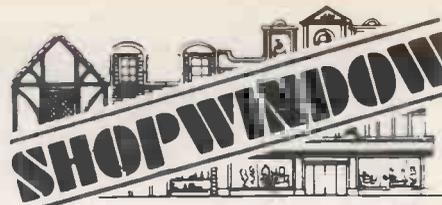
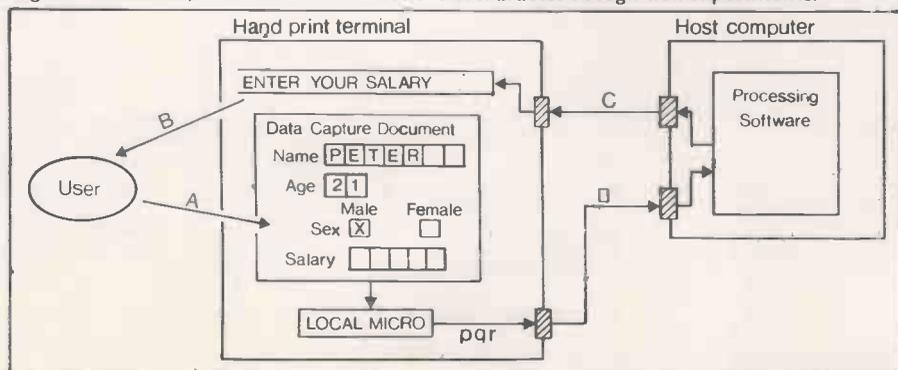
Table 1.

character, and the ASCII value of the character itself.

Software in the host computer can be used to validate this data and process it in various ways appropriate to the application. The arrangement of terminal and host computer is shown schematically in figure 1.

Developing applications software in Basic for use in the host computer is straightforward. However, with Basic, the speed with which the user is able to enter data is severely constrained by software. In view of this, we thought it important to be able to develop programs capable of supporting faster real-time response than could be achieved via the Basic interpreter provided with the microcomputer being used, a Commodore Pet — see Commodore 1979.

Figure 1. Terminal, host and user interactions in character-recognition experiments.



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```

10 DIM X%(200)
20 FOR I = 1 TO 200
30 X%(I) = RND(1)*200
40 NEXT I
50 B = 200 : KS = TI
60 T = 0
70 FOR J = 1 TO B-1
80 IF X%(J) > X%(J+1) THEN 110
90 Z% = X%(J) : X%(J) = X%(J+1) : X%(J+1) = Z%
100 T = J
110 NEXT J
120 IF T = 0 THEN 140
130 B = T : GOTO 60
140 PRINT "TIME";INT((TI-KS)/60); "SECONDS"

```

Figure 2. Bubble-sort in Basic.

(continued from previous page)

references to the system variable TI. The difference between the values of this variable before and after the sort enables the sorting time to be calculated.

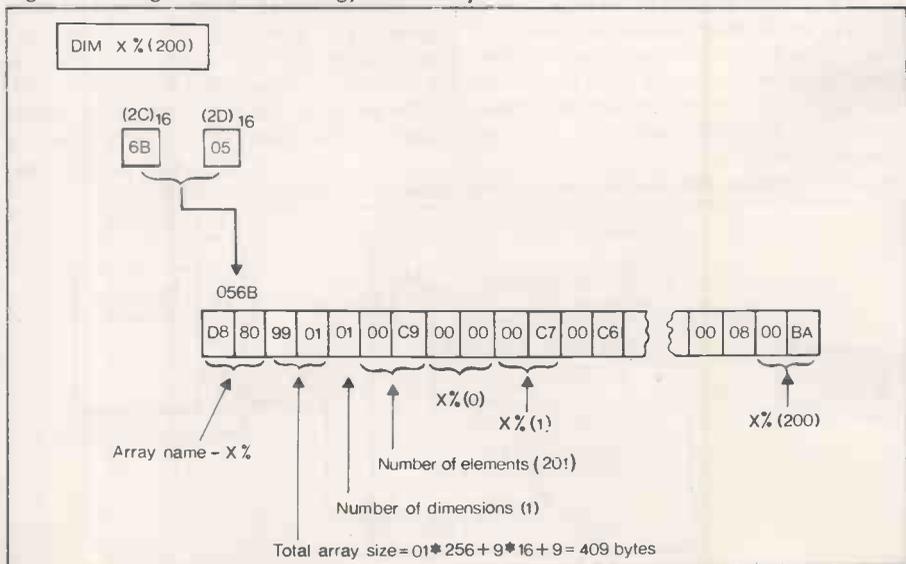
A similar approach is used in the Pascal program: the procedure Settime is used to initialise the real time clock to zero; subsequently, the routines Minutes and Seconds are used to obtain the elapsed time for the sort. Each of the programs was run with sample sizes of 10, 20, 30, 50, 100, 150, and 200 integers. In all cases, the Pascal programs executed far more rapidly than the Basic version. The sort times are presented in figure 8.

To assess the likely improvements gained by using an assembler sort routine, we used a Basic program similar to that shown in figure 4. It acts as a main routine which, after setting up the array to be sorted, invokes an assembly language subroutine whose code is stored at memory locations 6144, decimal address, through 6339. On terminating, the sort routine passes control back to the Basic program which prints out the time required for sorting.

The results of running the program under conditions similar to those used for the high-level languages are presented in figure 8. The substantial improvement in sorting times which results from the use of assembled code is immediately apparent.

To design and implement the assembler

Figure 5. Storage-allocation strategy for an array.



version of the routine, you need to understand:

- The way in which the Basic interpreter stores a source program.
- The storage allocation strategy for integer-array variables.
- The hardware architecture of the Pet microcomputer — in particular, its memory structure and the register arrangement of the MCS6502 processor chip.

Details of the first two points are contained in the Pet Users' Manual while the third point is covered in the MOS Microcomputer Family Hardware Manual and other related microcomputer text books.

Within a Basic program, integer arrays are stored in this general format: array header element 1 element 2 element 3 element n in a contiguous section of memory. Each

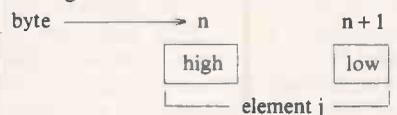
```

10 VAR I,J,B,T,Z : INTEGER;
20 X : ARRAY[1..200] OF INTEGER;
30 BEGIN
40 FOR I := 1 TO 200 DO X[I] := RANDOM;
50 B := 200; SETTIME := (0,0,0);
60 REPEAT
70 T := 0;
80 FOR J := 1 TO B-1 DO
90 IF X[J] < X[J+1]
100 THEN BEGIN
110 Z := X[J]; X[J] := X[J+1];
120 X[J+1] := Z;
130 T := J
140 END;
150 B := T
160 UNTIL T = 0;
170 WRITE('TIME');
180 I := MINUTES*60 + SECONDS;
190 WRITE(I);
200 Writeln('SECONDS');
210 FOR I := 1 TO 200 DO WRITE(X[I])
220 END.

```

Figure 3. Bubble-sort in Pascal.

array element, in turn is represented by two adjacent bytes according to the arrangement:



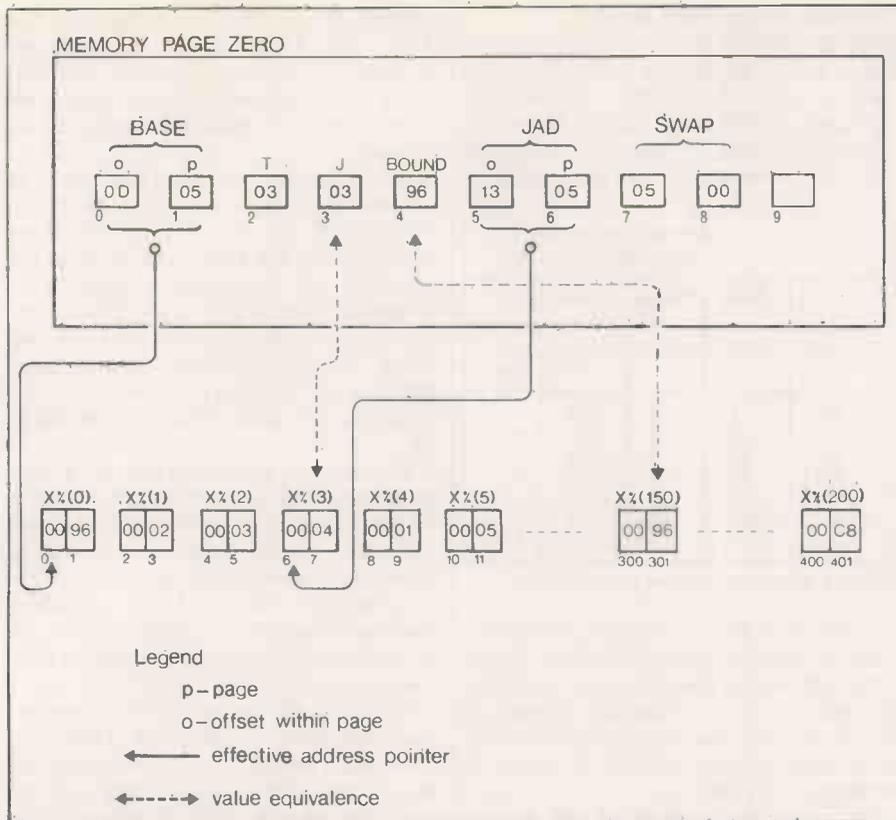


Figure 6. Data structures for the assembler sort routine.

Thus, a value of 1025 decimal would be stored as **04 01** and a value of 199 would be held in the form **00 C7**. The left-most bit of byte *n* is used to reflect the sign of the number positive or negative, so that a value such as -522 would be stored as **FD F6**. The position at which arrays are stored within the source text of the program is given by the address contained in zero page locations (45)₁₀ and (44)₁₀.

The former specifies the memory page and the latter the off-set within the page at which the storage for arrays commences. Similarly, zero-page locations (47)₁₀ and (46)₁₀ point to the section of memory at which array storage ends and unallocated storage commences. These values are useful in helping to decide where to site an assembler routine and the location of the array to be sorted.

The exact details contained in the array header that precedes the elements will depend on its dimension specification. For a one-dimensional array of the type being used for the bubble-sort — see figure 4 — the arrangement is similar to that shown in figure 5. Notice that the array contains a zeroth element which in this program is not used for storing a value to be sorted. Instead, this location functions as a global variable used by the calling routine to pass across to the assembler subroutine the value of the number of elements it is required to sort.

The overall strategy for the machine code sort is:

1. Set up working storage areas.
2. Perform initialisation operations
 - 2.1 Save zero-page environment of Basic

- 2.2 Set base address of array to be sorted
- 2.3 Initialise Bound, J and T.
3. Perform the sort
 - 3.1 Generate the address of array element J
 - 3.2 Compare elements J and J + 1
 - (a) high bytes
 - (b) low bytes, if necessary
 - 3.3 Swap elements J and J + 1, if necessary
 - (a) high bytes
 - (b) low bytes.
4. Restore the zero-page environment of Basic.
5. Return control to the Basic program.

The working storage areas are locations of memory used by the assembler routine while it is performing the sort. For efficiency, they are located in the first 10 bytes of memory page zero. However, because these locations may have some significance to the Basic interpreter, their contents are transferred to a save area local to the assembler routine. At the end

```

10 DIM X%(200)
20 FOR I = 1 TO 200
30 X%(I) = RND(1)*200
40 NEXT I
50 FOR I = 1 TO 200 : PRINT X%(I) : NEXT I
60 PRINT " "
70 PRINT PEEK(45) + 256*PEEK(44) + 7
80 PRINT PEEK(47) + 256*PEEK(46)
90 X%(0) = 150 : KS = TI
100 SYS(6144) : REM INVOKE SORT ROUTINE
110 PRINT "TIME": (TI-KS)/60; " SECONDS"
120 FOR I = 1 TO 200 : PRINT X%(I) : NEXT I
    
```

Figure 4.

of the sorting operation, these 10 zero-page locations are restored to their original values before passing control to the Basic program. Two subroutines, Save and Restor, are used to handle these operations.

The significance of the zero-page
(continued on next page)

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(continued from previous page)

locations used in the sort are as follows:
Swap is the swap area used when the
values contained in two consecutive
elements of the array are to be inter-
changed; Bound, T and J perform the
same functions as indicated in the bubble-

Sample Size (N)	Basic	Pascal	Assembler	
	random	random	random	worst case
10	1	<1	0.03	0.03
20	4	1	0.07	0.07
30	10	2	0.08	0.12
50	32	7	0.22	0.27
100	124	29	0.78	1.02
150	286	68	1.58	2.25
200	548	116	2.87	4.00

Figure 8. Results of sorting experiments.

sort algorithm described earlier; JAD is the
memory address of the Jth element of the
array and Base is the address of its zeroth
element — both in off-set/page format. A
sketch showing the relationship between
these items and the array to be sorted is
presented in figure 6.

To obtain the address of the zeroth
element of the array, the address of the
array header — see figure 5 — has to be
incremented by 7. However, since the
array header may be split over a page
boundary this condition has to be checked
and the page number incremented
accordingly. This situation is illustrated in
figure 9.

Once the address of the base location of
the array has been computed, it is an easy
matter to calculate the address of the first
byte allocated to any given element of the
array. This is obtained by multiplying the
value of J by 2 using an arithmetic shift-
level instruction and adding the address of
the zeroth element, Base. As usual, care
must be taken to check for page-boundary
crossings when this addition is performed.

The strategy for performing the
comparison is reasonably straightforward
once the address of the Jth element —

address N — has been computed. The
high-value bytes of the numbers are
compared — byte N : byte N+2. If byte
N+2 is less than byte N, the numbers are
in order and the remaining operations are
skipped.

Otherwise, the low-value bytes must be
compared — byte N+1 : byte N+3.
Depending on the results of these
comparisons, the swap code is or is not
executed. If the elements need to be
swapped, bytes N and N+2 are
interchanged along with bytes N+1 and
N+3. To achieve this, the zero-page swap
area is used. The data flow involved in the
swapping operation is illustrated in figure
10.

The numbers associated with the arrows
in figure 10 indicate the order in which
data bytes are moved between the registers
and other storage locations. This data
flow is not intended to be optimal.

A detailed listing of the assembly-
language program is shown in figure 7. To
produce the machine-code routine, a dis-
cussed, two-pass assembler was used.
Given a disc file containing the assembly-
language source code, the assembler
produced a second disc file containing the
object code produced as a result of the
assembly process. This object-code file

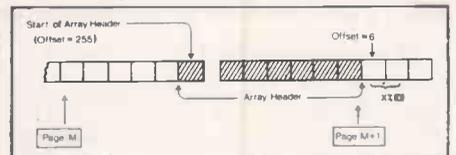


Figure 9.

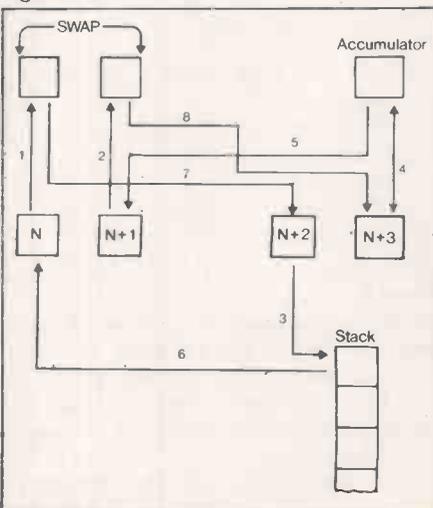
could be loaded into the Pet memory
using the loader program provided with
the assembler-development package.
Once loaded, the relevant section of
memory — (1800)₁₆ through (18C4)₁₆ —
could be dumped on to a cassette tape for
subsequent use by means of the Pet
terminal interface monitor.

The sorting times observed when
different sample sizes are sorted into
descending order by programs written in
Basic, Pascal and assembler are shown in
figure 8. The "random" qualifier
indicates that the sort times refer to
randomly-generated array elements. For
the assembler results, the "worst case"
qualifier refers to measurements made
using an array of positive consecutive
integers — 1 through N — so that the sort
routine has to perform the maximum
possible number of comparisons and
interchanges. The results indicate that
Pascal is about four times faster than
Basic. Similarly, assembler is between 30
and 200 times faster depending on the
sample size.

Although the results in figure 8 indicate
the substantially-greater efficiency of the
machine-code routine, I must emphasise
the limitations of the comparison. In
several ways, the conditions under which
the experiments were performed favour
the machine-code program. In particular:

- The use of positive integers for the tests
limits the applicability of the assembler routine.

Figure 10.





It assumes positive values for the array elements and hence does not test the sign bits of the numbers when the high-value bytes of array elements are compared.

- As it is written, the assembler routine could not be used to sort arrays having more than 256 elements.

Neither the Basic nor the Pascal programs suffer from these limitations. However, one of the major attractions of writing programs in assembler language stems from the facilities it provides for taking advantage of special features that cannot be handled in a high-level language — in this case, pre-knowledge of the size and nature of the data set to be sorted. Should the need ever arise, it would be an easy matter to extend the assembler routine to accommodate the limitations outlined — with a consequent increase in sort time.

Additional instructions could be inserted to test the sign bits of the elements compared, with a skip to Noswap if the sign bit of byte N is set and that of byte N+2 is unset. Alternatively, since negative integers would always sort high in the routine — that is, towards low index values — the routine could be used as it stands with additional code being added to locate any transition between negative and positive element values and, if necessary, implement appropriate block data moves to order the values.

The best strategy would obviously depend on a more detailed analysis of the relevant optimisation calculations. The array size limitation could be overcome by partitioning the array to be sorted into P sub-arrays — each having less than 256 elements — sorting each into order and

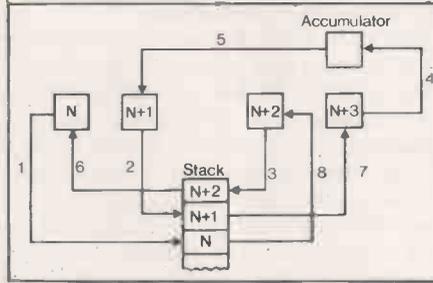


Figure 11.

then performing a P-way merge to produce the final sorted array. Depending on the way in which such extensions are implemented, there would be only minimal departure from the values in figure 8.

It is worth making one final point about the assembler program listed in figure 7. The data flow involved in swapping array elements was not optimised in any way to make the element-interchange highly efficient. Greater use of the stack could have been made, thereby removing the need to use two bytes of zero page memory — Swap and Swap + 1. However, it is unlikely that any major improvement in execution time would be observed.

Indeed, the swap code listed in figure 7 — memory locations 1869 through 1888 — requires only 72 machine cycles compared with 76 cycles for equivalent code based on the use of the stack. These observations are confirmed by measurement of the sort times — figures 11 and 12.

Sorting based upon the use of the stack alone — using 200 numbers under worse case conditions — requires 4.08 seconds.

(continued on next page)

Figure 12.

Number of Machine Cycles	Assembler Code
	SWAPUM NOP
	LDY #0
3	LDA (JAD),Y ; LOAD N
2	PHA ; PUSH ON STACK
5	INY ; INCREMENT Y REGISTER
3	LDA (JAD),Y ; LOAD N+1
2	PHA ; PUSH ON STACK
5	INY ; INCREMENT Y REGISTER
3	LDA (JAD),Y ; LOAD N+2
2	PHA ; PUSH ON STACK
5	INY ; INCREMENT Y REGISTER
2	LDA (JAD),Y ; LOAD N+3
2	DEY ; DECREMENT Y REGISTER
5	DEY ; DECREMENT Y REGISTER
2	STA (JAD),Y ; STORE IN N+1
2	DEY ; DECREMENT Y REGISTER
4	PLA ; PULL OFF STACK
5	STA (JAD),Y ; STORE IN N
2	INY ; INCREMENT Y REGISTER
2	INY ; INCREMENT Y REGISTER
2	INY ; INCREMENT Y REGISTER
4	PLA ; PULL OFF STACK
5	STA (JAD),Y ; STORE IN N+3
2	DEY ; DECREMENT Y REGISTER
4	PLA ; PULL OFF STACK
5	STA (JAD),Y ; STORE IN N+2
	LDA J ; LOAD J VALUE
	STA T ; STORE IN T
	NOP
	INC J ; INCREMENT J VALUE
	NOSWAP

76 cycles

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(continued from previous page)

This value is the average of six measurements for which the standard deviation was 0.005. The corresponding average sorting time based on the use of zero-page memory for swapping was 3.99 seconds with a standard deviation of 0.01. In view of these findings, we conclude that the sort times for the assembler version of the sort routine would be difficult to improve without further detailed analysis based on further optimisation studies.

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Figure 7. Sort routine in assembler.

```

0001 0000                                .OPT MEM
0002 0000 00 00                          BASE .DBYTE $0
0003 0002 00                               T     .BYTE $0
0004 0003 00                               J     .BYTE $0
0005 0004 00                               BOUND .BYTE $0
0006 0005 00 00                          JAD   .DBYTE $0           ; SET UP BASE ADDRESS
0007 0007 00 00                          SWAP .DBYTE $0           ; OF ARRAY
0008 0009                                *=$1800                   ; SKIP AROUND DATA
0009 1800 EA                               INIT  NOP
0010 1801 EA                               NOP
0011 1802 4C OF 18                         JMP GO
0012 1805                                SAVE  *=$+10
0013 180F                                XPTR  = $2C
0014 180F 20 AC 18                         GO    JSR SAVEUM        ; SAVE ZERO PAGE
0015 1812 A5 2C                          LDA $2C
0016 1814 85 00                          STA BASE                ; STORE OFFSET
0017 1816 A5 2D                          LDA $2D
0018 1818 89 01                          STA BASE+1              ; STORE PAGE
0019 181A A5 00                          LDA BASE                ; CHANGE BASE OF
0020 181C 18                              CLC                     ; ARRAY TO POINT
0021 181D 69 07                          ADC # $7                 ; TO, X%(0)
0022 181F 85 00                          STA BASE
0023 1821 90 02                          BCC NEXT                ; SEE IF NEW PAGE
0024 1823 E6 01                          INC BASE+1              ; INCREASE PAGE NO
0025 1825 EA                               NEXT  NOP
0026 1826 A0 08                          B1   LDY # $8           ; LOAD OFFSET
0027 1828 B1 2C                          LDA (XPTR),Y           ; LOOK IN X%(0)
0028 182A EA                               NOP                     ; FOR NUMBER OF ELEMENTS
0029 182B EA                               NOP                     ; TO BE SORTED
0030 182C 85 04                          STX BOUND              ; INITIALISE BOUND
0031 182E A9 01                          B2   LDA # $1           ; INITIALISE J
0032 1830 85 03                          STA J
0033 1832 A9 00                          LDA # $0                ; INITIALISE T
0034 1834 85 02                          STA T
0035 1836 EA                               B3   NOP
0036 1837 A5 03                          LDA J                   ; LOAD J VALUE
0037 1839 A4 01                          LDY BASE+1              ; GET PAGE
0038 183B 18                              CLC
0039 183C 0A                              ASL A                   ; MULTIPLY BY 2
0040 183D 90 01                          BCC SKIP                ; PAGE BOUNDARY?
0041 183F C8                              INY                     ; INCREMENT PAGE NUM
0042 1840 18                              SKIP  CLC
0043 1841 65 00                          ADC BASE                ; ADD IN BASE ADDRESS
0044 1843 90 01                          BCC SKIP2              ; PAGE BOUNDARY?
0045 1845 C8                              INY
0046 1846 84 06                          SKIP2 STY JAD+1
0047 1848 85 05                          STA JAD
; JAD NOW CONTAINS THE ADDRESS
; OF THE REQUIRED ELEMENT
;
; NOW COMPARE ELEMENT J WITH
; ELEMENT J+1
0053 184A EA                               NOP
0054 184B A0 00                          LDY #0
0055 184D B1 05                          LDA (JAD),Y            ; TEST FIRST BYTE
0056 184F C8                              INY
0057 1850 C8                              INY
0058 1851 D1 05                          CMP (JAD),Y            ; COMPARE
0059 1853 90 0F                          BCC SWAPUM
0060 1855 F0 02                          BEQ EQUAL
0061 1857 80 36                          BCS NOSWAP
0062 1859 88                              EQUAL  DEY
0063 185A B1 05                          LDA (JAD),Y            ; TEST SECOND BYTE
0064 185D C8                              INY
0065 185D C8                              INY
0066 185E D1 05                          CMP (JAD),Y            ; COMPARE
0067 1860 F0 2D                          BEQ NOSWAP
0068 1862 B0 2B                          BCS NOSWAP
;
; NOW PERFORM THE SWAP
0070 1864
0071 1864

```



```

0072 1864 EA          SWAPUM NOP
0073 1865 A0 00      LDY #0
0074 1867 B1 05      LDA (JAD),Y
0075 1869 85 07      STA SWAP
0076 186B C8          INY
0077 186C B1 05      LDA (JAD),Y
0078 186E 85 08      STA SWAP+1
0079 1870 C8          INY
0080 1871 B1 05      LDA (JAD),Y
0081 1873 48          PHA          ; PUSH ONTO STACK
0082 1874 C8          INY
0083 1875 B1 05      LDA (JAD),Y
0084 1877 88          DEY
0085 1878 88          DEY
0086 1879 91 05      STA (JAD),Y
0087 187B 88          DEY
0088 187C 68          PLA          ; PULL FROM STACK
0089 187D 91 05      STA (JAD),Y
0090 187F C8          INY
0091 1880 C8          INY
0092 1881 A5 07      LDA SWAP
0093 1883 91 05      STA (JAD),Y
0094 1885 C8          INY
0095 1886 A5 08      LDA SWAP+1
0096 1888 91 05      STA (JAD),Y
0097 188A A5 03      LDA J          ; LOAD J VALUE
0098 188C 85 02      STA T          ; STORE IN T
0099 188E EA          NOP
0100 188F E6 03      NOSWAP INC J
0101 1891 EA          NOP
0102 1892 A5 03      LDA J
0103 1894 C5 04      CMP BOUND
0104 1896 90 9E      BCC B3
0105 1898 F0 03      BEQ B4
0106 189A 4C A7 18    JMP FINISH
0107 189D A5 02      B4 LDA T
0108 189F F0 06      BEQ FINISH    ; RETURN IF ZERO
0109 18A1 85 04      STA BOUND
0110 18A3 EA          NOP
0111 18A4 4C 2E 18    JMP B2
0112 18A7 20 B8 18    FINISH JSR RESTOR ; RESTORE 0 PAGE
0113 18AA EA          NOP
0114 18AB 60          RTS          ; BACK TO CALLER
0115 18AC          ;
0116 18AC          ; SUBROUTINE TO SAVE FIRST TEN
0117 18AC          ; ZERO PAGE LOCATIONS
0118 18AC EA          SAVEUM NOP
0119 18AD A2 09      LDX #9
0120 18AF B5 00      SAV01 LDA $0,X
0121 18B1 9D 05 18    STA SAVE,X
0122 18B4 CA          DEX
0123 18B5 10 F8      BPL SAV01
0124 18B7 60          RTS
0125 18B8          ;
0126 18B8          ; SUBROUTINE TO RESTORE FIRST TEN
0127 18B8          ; ZERO PAGE LOCATIONS
0128 18B8 EA          RESTOR NOP
0129 18B9 A2 09      LDX #9
0130 18BB BD 05 18    RES01 LDA SAVE,X
0131 18BE 95 00      STA $0,X
0132 18C0 CA          DEX
0133 18C1 10 FB      BPL RES01
0134 18C3 60          RTS
0135 18C4          .END
    
```

ERRORS = 0000

SYMBOL TABLE

SYMBOL	VALUE	SYMBOL	VALUE	SYMBOL	VALUE	SYMBOL	VALUE
B1	1826	B2	182E	B3	1836	BA	189D
BASE	0000	BOUND	0C04	EQUAL	1859	FINISH	19A7
GO	180F	INIT	1800	J	0003	JAD	0005
NEXT	1825	NOSWAP	188F	RES01	18BB	RESTOR	1888
SAV01	18AF	SAVE	1805	SAVEUM	18AC	SKIP	1840
SKIP2	1846	SWAP	0007	SWAPUM	1864	T	0002
XPTR	002C						

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UK101: 6502, 4-8K RAM, TV interface, RS232, full keyboard, single-board, personal use, similar to Ohio Superboard. Compshop, 14 Station Road, New Barnet, Hertfordshire EN5 1QW. (01) 441 2922. Reviewed May 1980. *From £199 for kit*

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Horizon: Z-80A, 16-56K RAM, 5¼in. twin drives, S-100 bus, own OS, business, educational or scientific use. Comart, PO Box 2, St Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. Equinox, Kleeman House 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 729 4460. Reviewed April 1979. *From £995 to £2,500*

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Ohio Superboard and Challenger I: 6502, 8K Basic in ROM, 2K monitor, 4K RAM, full keyboard and VDU interface. Hobbyist use. Reviewed June 1979. *From £160*

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Panasonic: 8085, 56K RAM, full keyboard, integral 24 by 80 VDU, integral twin 5¼ or 8in. floppy drives. Three RS232, business use. Panasonic Business Systems, 9 Connaught Street, London W2. (01) 261 3121. Reviewed June 1979. *From £4,150*

PROCESSOR TECHNOLOGY

Sol: 8080, 16K RAM, S-100 bus, 5¼in. drives, VDU integral, business system. Comart, PO Box 2, St Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. Reviewed July 1979. *From £1,750*

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Black Box: 8085, 32-256K RAM, dual mini-floppy discs, eight programmable serial ports, RS232, CP/M, hard discs to 10MB, general and business use. Rair, 30-32 Neal Street, London WC2H 9PS. (01) 836 4663. Reviewed November 1979 and August 1980. *From £2,300*



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Cosmac: 1802 micro with Hex pad and TV interface. Machine-code programming with Tiny Basic option. **HL Audio**, 255 Archway Road, London N6 5BS. (01) 348 3325. *From £79 for kit*

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380-Z: Z-80, 4-56K RAM, RS232, CP/M, twin 5¼ or 8in. discs, high-resolution graphics. Sold principally to higher and secondary education. Reviewed December 1978. *From £830 to £3,500*

280-Z: Board version of 380-Z. Research Machines, PO Box 75, Mill Street, Oxford. (0865) 49791. *From £722 for 4K version*

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Aim-65: 6502, 1-4K RAM, full keyboard, RS232, discs, hobby use, Portable Microsystems, Forby House, 18 Market Place, Brackley, Northamptonshire NN13 5SF. (0280) 702017. Reviewed July 1979. *From £250*

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Archives: Z-80 at 4MHz, CP/M, S-100, serial and parallel I/O, 12in. display, 5¼in., 8in. or 19MB hard disc or 8in. Winchester, 104 keys including 23 configured for Wordstar. Salmon Electronics, PO Box 26, Croft-on-Tees, Darlington (0325) 721368. *£3,400*

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SD SYSTEMS INC

SBC-100: Z-80, 1-48K, S-100 bus, Basic in 8K ROM, four ROM sockets, optional 5¼in. drives, RS232 serial and parallel, single-board. Reviewed January 1981. *From £155*

SD-100/200: Z-80, 64-256K RAM, 8K PROM, S-100 bus, RS232, CP/M, 12in. VDU, twin 8in. drives, business, industrial and general use. Airamco, Unit A2, 9 Longford Avenue, Kilwinning Industrial Estate, Kilwinning, Ayrshire KA13 6EX. (0294) 65533. Barcellos, Kimberley House, Vaughan Way, Leicester. (0533) 26584. *From £3,750*

SEN ELECTRONICS

Organiser: Intel 8085, 64K RAM, multi-user Basic, 8in. drives or 20MB hard discs, three RS232, business use. SEN, 5 London Street, Chertsey, Surrey KT16 8AP. (09328) 66744. *From £7,500*

SGS-ATES

Nanocomputer: Z-80, 6-64K RAM, Gamma bus, 2K NC-2 monitor in ROM, Basic as option, RS232, cassette interface, Hex keypad. Midwich, Hewitt House, Northgate Street, Bury St Edmonds, Suffolk, IP33 1HQ. Reviewed October 1979. *From £350*

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ZX-80: Z-80A, 1-16K RAM, 4K Basic in ROM, cassette and TV interface, touch-sensitive keyboard, educational use. 22 graphics. Sinclair Research, 6 Kings Parade, Cambridge CB2 1SN. (0223) 311488/312919. Reviewed July 1980. *From £79 for kit*

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Chieftain 511-821: 6800/6809, 32-64K RAM, S-50 bus, Flex DOS68/68d/69 dual 5¼in., 8in., dual RS232, video board, wide range of options, general use. Windrush Micro Designs, Gaymers Way, North Walsham, Norfolk. (069) 245189. *From £1,807*

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TI-99/4: 990 16-bit, 16K RAM, Basic in 26K ROM, high-resolution, colour graphics, up to three 5¼in. discs, joystick, cassette and other ports, RS232, personal use. Texas Instruments Ltd., Manton Lane, Bedford, MK41 7PU. (0234) 67466. Reviewed August 1980.

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Tuscan: Z-80, 8-64K RAM, S-100 bus, CP/M, RS232, TV and cassette interface, from single-board, personal use to full business system. Transam, 59 Theobalds Road, London WC1. (01) 405 5240.

ULBRICH AUTOMATION

Powerhouse II: Z-80, 16-32K RAM, RS232, 5in. internal VDU, integral mini-cassette, 2K monitor, IEEE, 14K Basic DOS, OEM users. Powerhouse Microprocessors, 5 Alexander Road, Hemel Hempstead, Hertfordshire HP2 5BS. (0442) 42002.

VECTOR GRAPHIC

MZ: Z-80, 48K-64K RAM, CP/M, 5¼in. discs, optional graphics, serial and parallel ports. Business and general use. Almarc Data Systems, 906 Woodborough Road, Nottingham (0602) 625035. Reviewed October 1980.

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Pascal Microengine: MCP1600, executes P-code directly, 64K RAM, own bus, 5¼in., 8in. or hard discs up to 18MB, two RS232, two parallel ports. Pronto Electronics Systems, 466-478 Cranbrook Road, Gants Hill, Ilford, Essex IG2 6LE. (01) 554 6222.

ZENTEC

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"Right", said Samson with the ship safely locked on auto-pilot, "all that excitement has given me an appetite. I could eat a horse".

"Horse"? queried Rom. "Please explain".

"It means I'm hungry. I want some food".

"Please explain food".

Samson suspected his leg was being pulled, but he could not detect sarcasm in the cybernoid's even voice. "Food is what gives you energy", he began warily.

"Ah", said Rom, "electricity". He plugged an extension flex into a wall socket and started unrolling it.

"No. No. I mean something to eat, something I can chew, ingest, digest".

"I think he refers to a biochemical process", suggested Ram. "Beings of his type derive their motive power from the breakdown of organic hydrocarbons".

A horrible thought dawned on Samson; "Haven't you got anything edible on the whole ship"?

"Well, Prestel has an Arcturan cuttlefish bone to sharpen his beak", offered Rom.

"And there's a Chinese Takeaway near Delta Parvonis, but we've already passed that", added Ram.

"I'm going to starve", wailed Samson piteously.

"Leave it to me", cut in Prestel. He hopped into his cage and began turning the exercise wheel back and forth, like a thief testing a combination lock. A holographic image of strange shapes and hieroglyphics surrounded him as he did so. He twiddled his wheel some more, working his way through the index pages to the classified refreshment frames. Moments later a red-and-white cardboard box somewhat battered in transmission, plopped on to the floor of the cage.

"There you are", he said with pride, "Kentucky Fried Klingon. Any subscriber can dial some up, if they know the right number".

"Mm good", said Samson when he finished, licking his fingers appreciatively.

They landed on Blotto, seventh planet of the giant red sun Omega Solaris, three temporal units early amid a hubbub of mutual congratulation. The crew stayed on board to supervise the unloading as the half-baked ideas were pumped out to replenish the dangerously-depleted supply of the Intergalactic Think Tank which had its headquarters on this planet.

That left Samson at a loose end. He had been paid well for his efforts and was now the possessor of a huge wad of Blottonian Gigaflops, but he had no real idea how to spend them. With time hanging on his hands he wandered around the amusement arcades,

notching up phenomenal scores at Astro-Pinball and raising a few eyebrows by his performance at N-dimensional Hyperchess. He even paid a visit to Blotto's notorious infra-red-light district, but was too timid to sample any of the wares on display, which for a boy of 12 was just as well.

Eventually he mooched back to the ship. "Bored, eh"? was Ram's reaction. "You're set loose in the entertainment centre of the entire galaxy with a fistful of Blottonian Gigaflops and you complain of boredom. I can see I'm going to have to teach you how to enjoy yourself. Just you wait: our unloading will be finished in a few hours. Then we'll really hit the town in style. By the way, where have you been staying"?

"At the YMCA".

"No wonder you're depressed. That crowd of dossers and space hoboos would give anyone the creeps. Listen. I'll tell you what we'll do. First we clean up — then we head straight for the bar at the Intergalactic Hotel. When we've warmed up with a little jungle juice under our belts, we'll take us along to watch the tournament. I bet you don't even know what day it is tomorrow".

Samson confessed his ignorance.

Well, tomorrow's the Vernal Equinox here on Blotto, and tonight's a bit special. Since it takes about 19 of your Earth-years to come round, they grow quite excited about it — kind of carnival atmosphere. At midnight they'll hold the head-butting ceremony. All the young studs in town will climb into the ring and run at each other head-to-head. The winner is the last one left standing. He'll be crowned Spring King".

Samson looked shocked. Ram waved an antenna dismissively.

"It's a vestige of a primitive ritual they had before computerisation. I did it myself one year — got to the semi-final. They called me "battering" Ram. Normally we bring the disposable diapers on the Green Tangerine which they use as padding round their heads, so I guess this time it could get a mite noisy. So long as we arrive in time to catch the quarter-final round we shouldn't miss much of the fun. When it's over things really go wild".

Samson almost imagined a wink on Ram's impassive front panel.

So it was that Samson found himself, only a few hours, standing in a packed crowd of assorted life-forms on the steeply-raked terracing of the Stadium of Light with a half-drunk can of Solarian Punch in one hand shouting enthusiastically at the barbaric spectacle beneath.

Prostrate bodies, felled in earlier rounds, lay littered across the floor of the arena. Two of the survivors were lined up like sprinters at either end of the stadium ready to dash full tilt at one another. This was the needle match. These two were the favourites. At the near end was the local lad, an inhabitant of the neighbouring star system of Altair, who sported a fine pair of antlers and rejoiced in the name of Mighty Micro.

Even at this distance Samson could see that his face was streaked with gashes from earlier bouts. At the far end, built like a tank, was a 40-tonne military cybernoid of the Behemoth class hailing from a planet called Poughkeepsie in the Greater Magellanic Cloud.

The crowd were right behind their own man. Every time the Behemoth moved they hissed, and a great cheer of support erupted into the night when the game Altairan, though dwarfed by his opponent, took off his tracksuit and waved.

A gunshot sounded and the words "They're off" flashed up on the electronic scoreboard. The two gladiators rushed headlong at each other. There was a jarring crunch as skull met steel, distinctly audible above the breathless hush of the spectators. A moment later its echo was drowned by a great roar. Amazingly the skinny Altairan had triumphed: the metal monster keeled over sideways and thudded unconscious to the ground. Samson, carried away by the spring fever, cheered himself hoarse.

The final bout resulted, as expected, in victory for the local hero. He thus won the contest outright and was led to the champion's pedestal from where, dazed and groggy but triumphant, he raised his arms in salute to the crowd — before being borne off shoulder-high into the streets.

Then the festivities really began. In true Blottonian style the frenetic revelry continued unabated till dawn. The roadways were full of dancers and there were wild goings-on as an incredible variety of different beings drowned their inhibitions in the fire-water for which Blotto was justly famous.

Samson's recollection of the subsequent events of that night was very hazy. Suffice it to say that he woke up with a very thick head in a sidestreet of the Blottonian capital. His money was all gone. He never found out whether he had lost it, spent it or simply had his pocket picked. Next to him in the gutter lay his Binary Tree. Its pot was smashed but some soil still clung to its roots.

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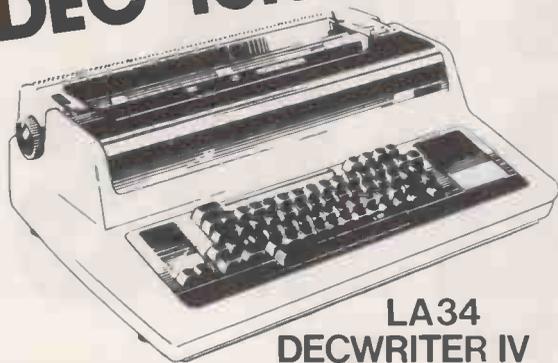
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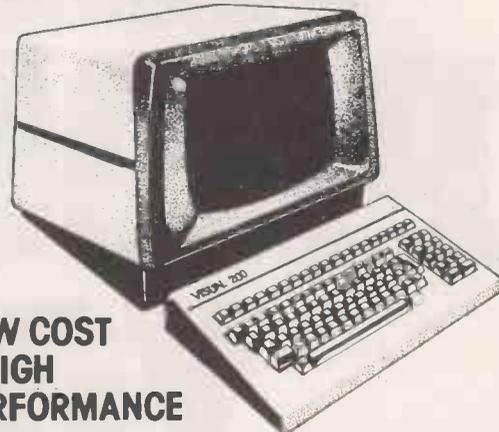
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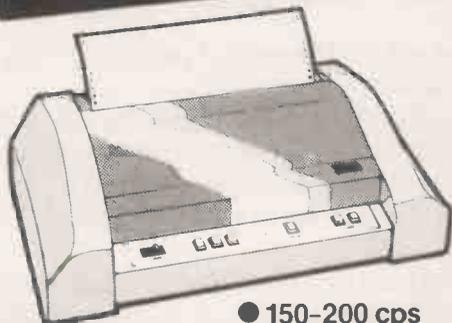
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IF MICROMODELLER were a wine you might be forgiven for describing it as presumptuous and definitely non-vintage. As it is a software package, these may be seen as positive advantages.

Micromodeller comes to the market with the claim that it is the software program that will enable non-computer trained managers to do sophisticated financial modelling on a mere Apple microcomputer. It will cost a fraction of using an expensive program on a mini-computer let alone time sharing on a mainframe.

The Micromodeller software program costs just £425. A complete Apple II computer system, complete with video display, floppy disc drives for memory and a printer costs £4,000. By comparison the program for a mini-computer which rivals Micromodeller would cost around £10,000 according to Applied Computer Techniques the publicly quoted company, which is marketing the new program.

ACT believes that Micromodeller will rival Visicalc, the highly successful American software program which can be used on most micro-computers. Visicalc, which enables micro-computers to be used as sophisticated calculators, has itself been a significant driving force behind the success of mini-computers.

Micromodeller, which is considerably more sophisticated, is expected to encourage sales of micro-computers among business users. In the first 12 months, and it was only launched last week, ACT anticipates sales of over 2,500 programs. Many large companies with high financial modelling costs are expected to adopt Micromodeller on Apple computers.

Intelligence (UK) Limited, which wrote Micromodeller, says it has 95 per cent of the facilities offered by other financial modelling packages—including those costing around £10,000. It says the few features it does not offer are those like declining balance depreciation under French law, and third order polynomial regressions which are very seldom used.

The program has colour graphics and it can present information as line graphs, bar charts or pie charts. Instructions are given in English—the program is designed to be used by businessmen rather than by computer programmers.

ACT is claiming that it only takes a couple of hours to learn how to use—with the help of a tutorial guide. At its launch even some of the most jaundiced observers of the computer industry were making some highly favourable predictions for Micromodeller's future.

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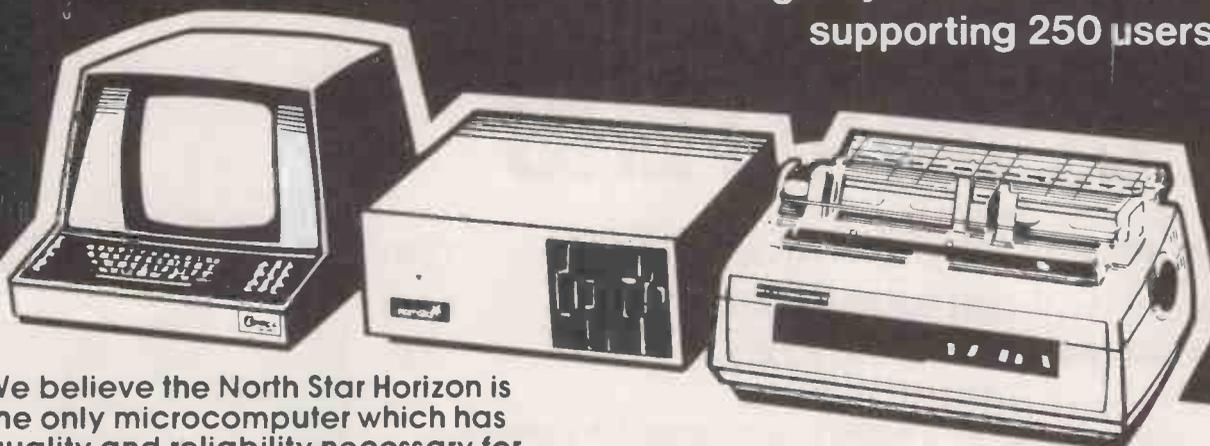
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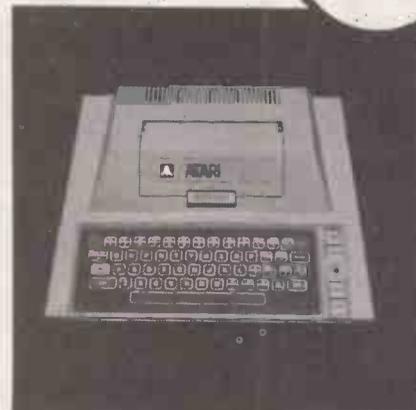
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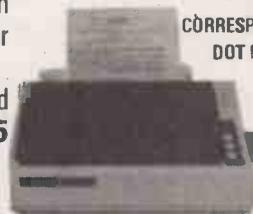
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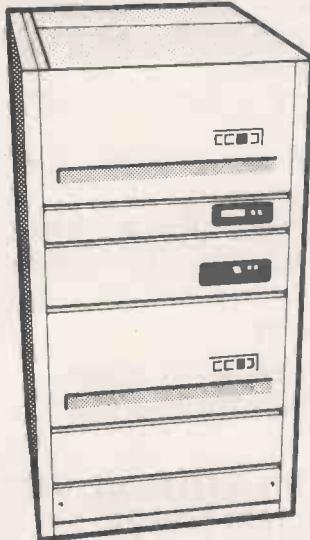
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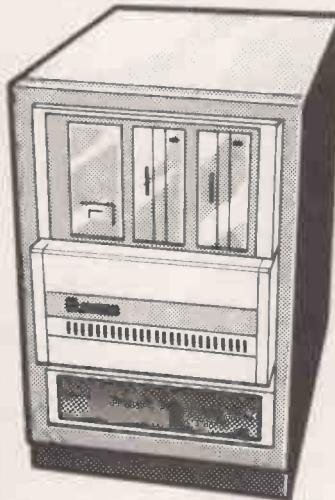
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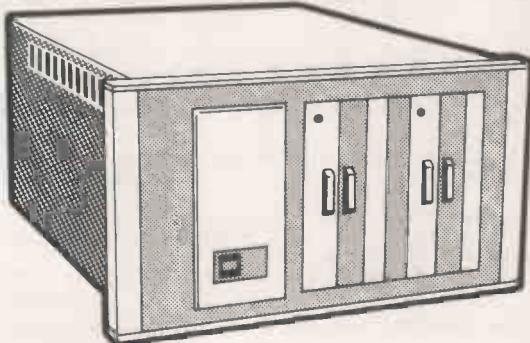


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Memory:

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SOFTWARE

Operating System:

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Languages:

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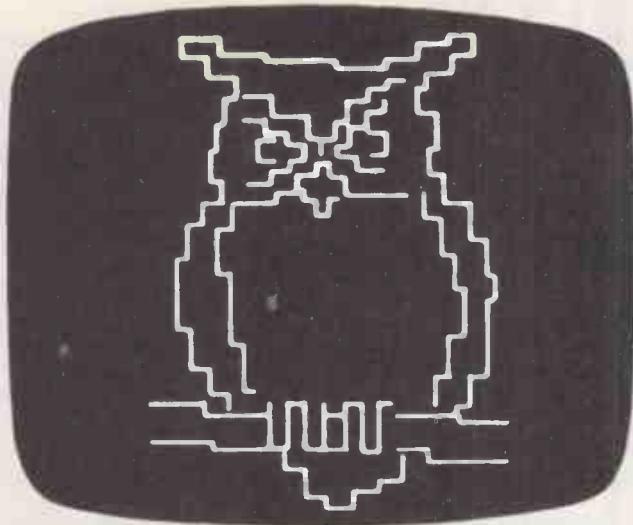
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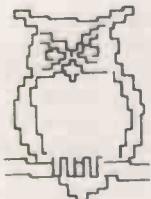


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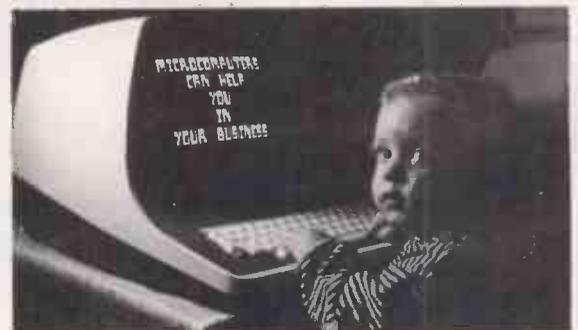
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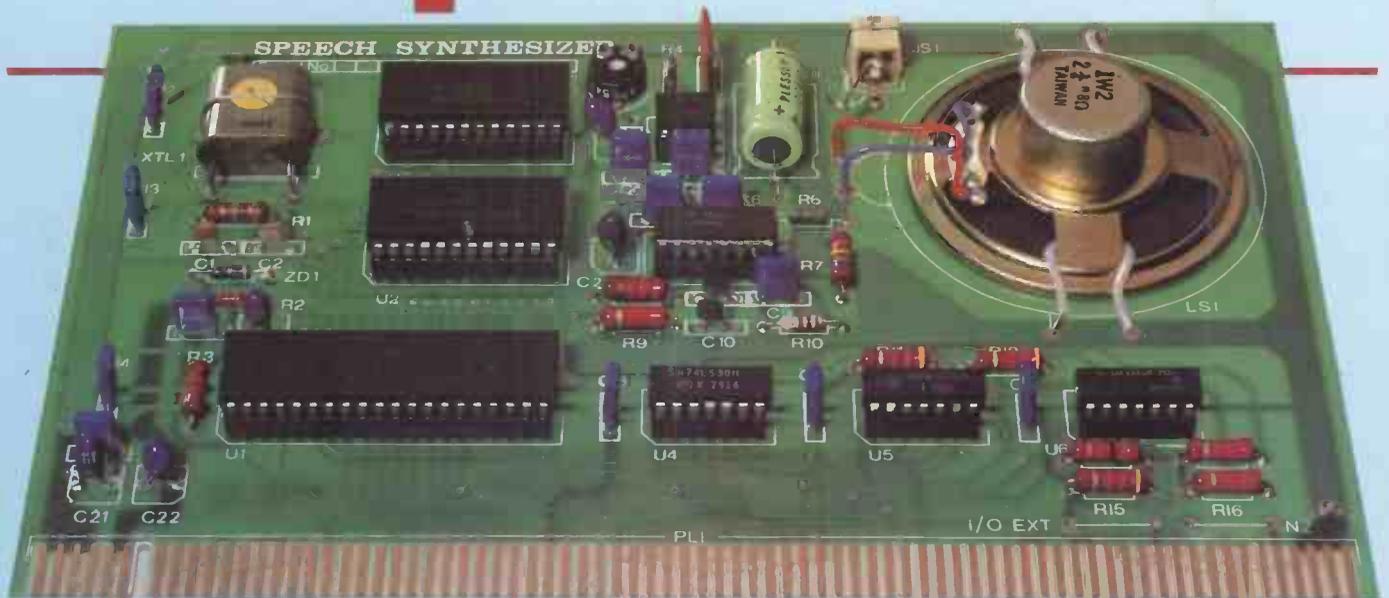
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COMSTAR - North Star BASIC Compiler. Consists of a full compiler which translates a North Star BASIC program into an assembly language source file, a disk-based macro assembler which further translates the source assembly language program into a relocatable machine equivalent, and a linking loader which combines the relocatable machine program with the requisite support routines to form an executable program. There is also a console command processor which reads a sequence of console commands from a disk file to automate the compilation process plus a character-oriented text editor to create console command files or modify assembly language programs. A **COMSTAR/CPM** interface is also available to enable compiled BASIC programs to run under CP/M.

KDS and **KDS-EXT** - A suite of menu driven utility programs written in assembler for fast operation. Developed as a debugging aid for long and complex programs, it includes a patch program to allow the **KDS** machine language routines to be hybridised to North Star BASIC. Consists of a compaction program which improves run time by up to 33%, a cross-reference program which creates and sorts a list of cross-reference items, a program to change the name of a variable globally within a line number range, a search program to locate a given syntax combination or byte value, and a program which compares two programs listing the differences between them. **KDS-EXT** is an extension package to **KDS** with many useful utilities. These include a protect program which also speeds up run times, a directory sort utility, a global editor for the search/replace of syntax combinations, a utility which enables transfer of programs to and from a disk file and then allows editing with a text editor. In addition there are programs to perform multiple variable exchanges, high speed disk dumps/searches, file dumps, and to find a list files of a given type. Highly recommended for North Star BASIC users.

Prices and specifications subject to change without prior notice.

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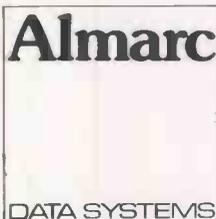
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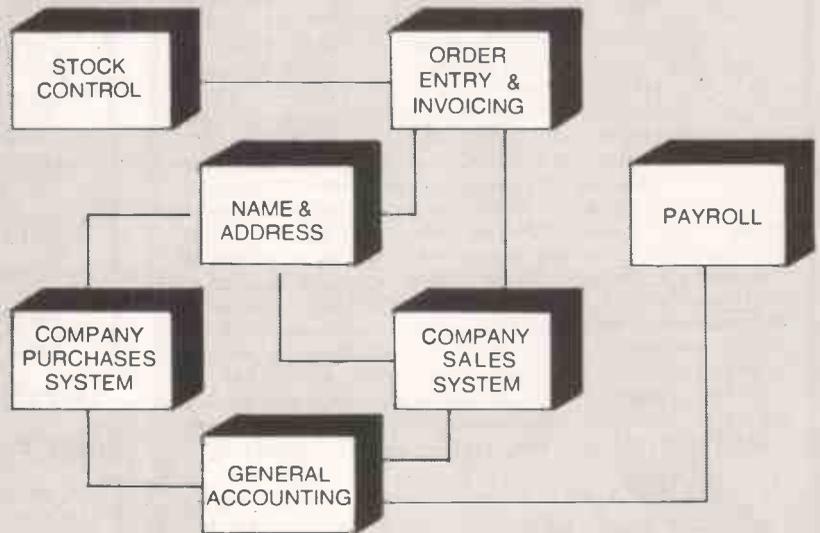
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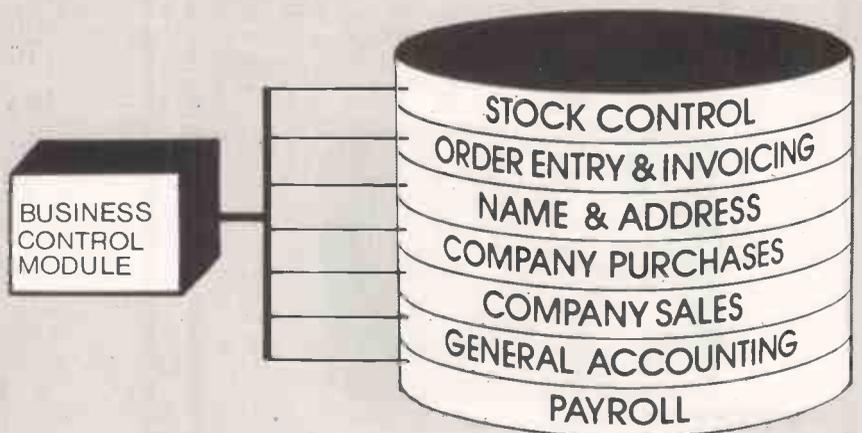
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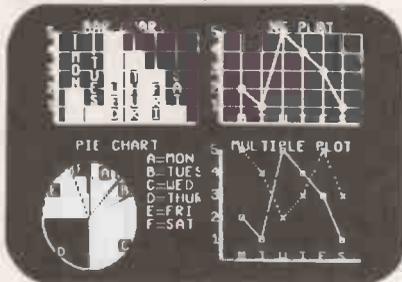
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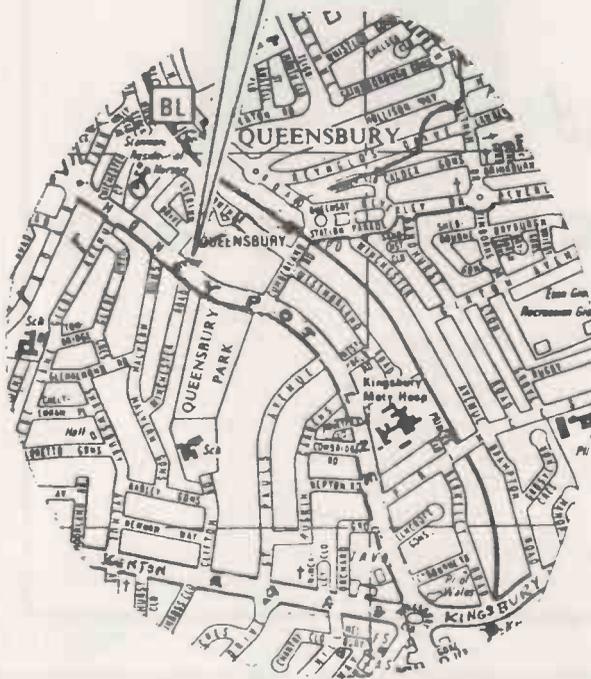
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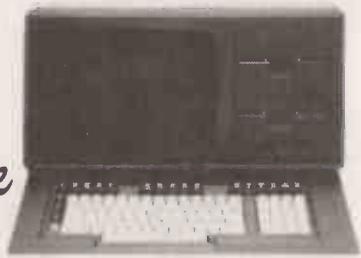
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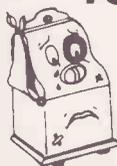


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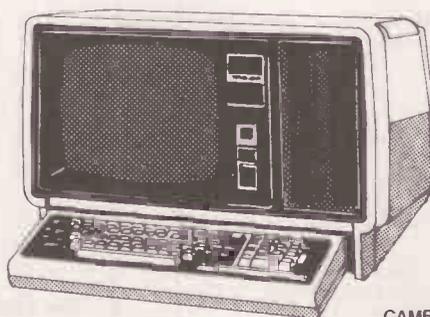
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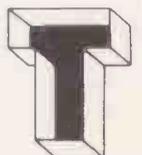
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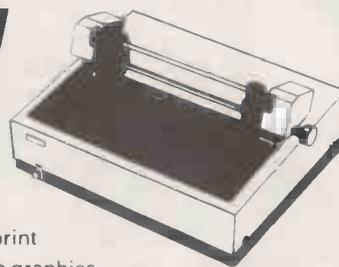
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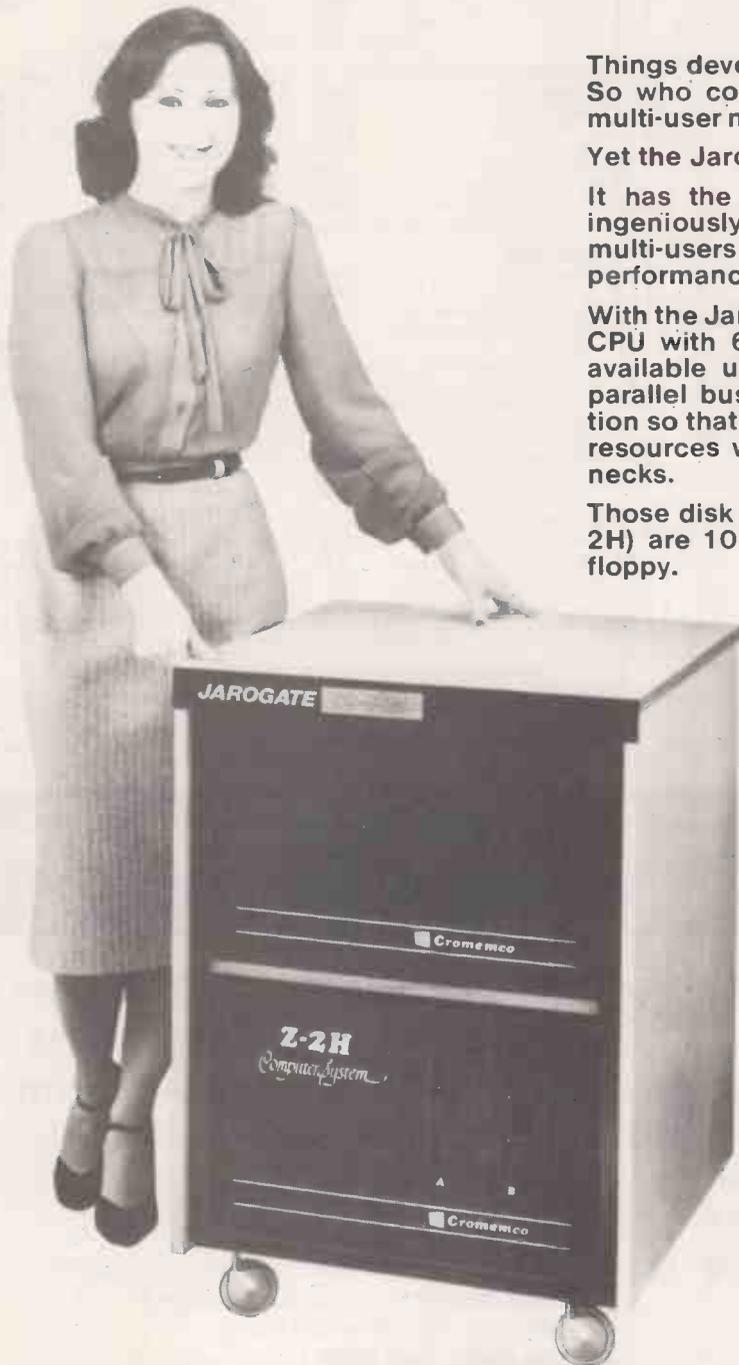
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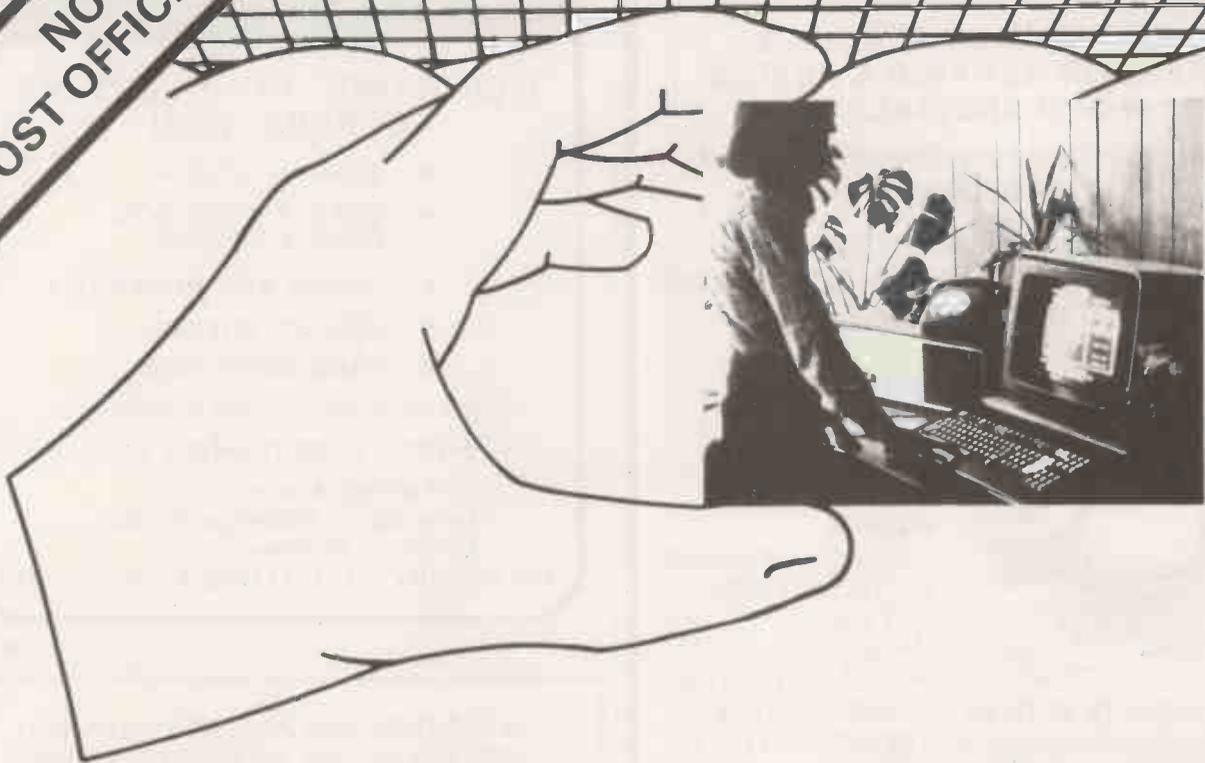
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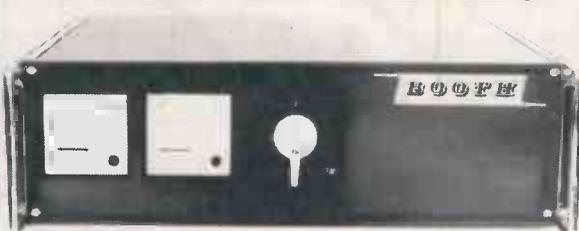
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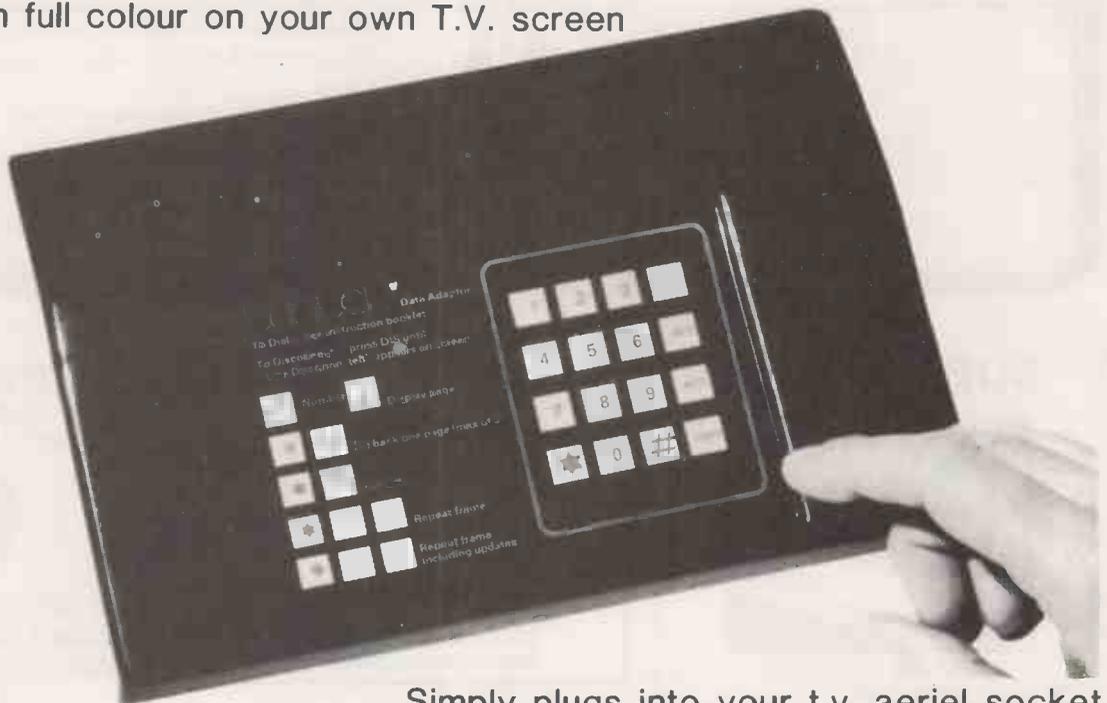
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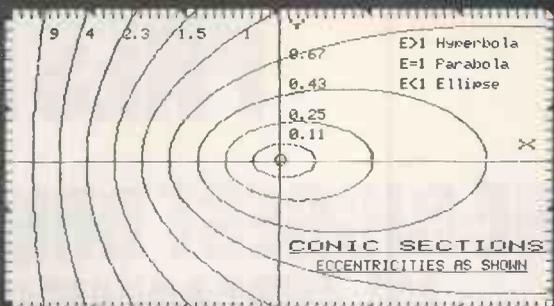
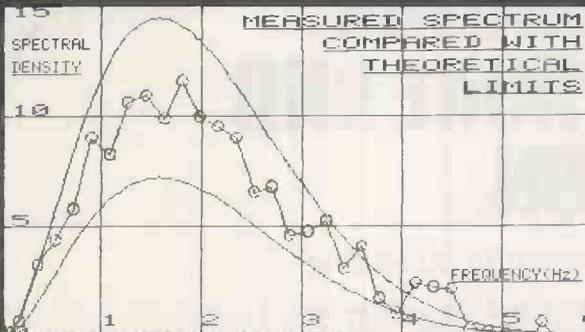
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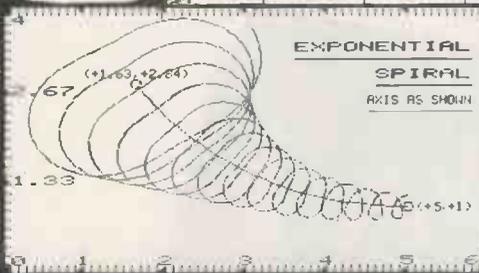
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A NASCOM-2 BASED SYSTEM FOR £1549 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system from £1549 + VAT. For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame, Centronics 737 printer, 10 inch monitor, and the

Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built - the additional cost is available on application.



GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M.

CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5¼" drives (FD250 double sided, single density) giving 160K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives, CP/M 1.4 on diskette plus manual, a BIOS EPROM and new N2MD PROM. All in a stylish enclosure.

Nascom-2 Single drive system. **£450 + VAT**
 Nascom-2 Double drive system **£640 + VAT**
 Nascom-1 Single drive system. **£460 + VAT**
 Nascom-1 Double drive system **£650 + VAT**
 Additional FD250 drives **£205 + VAT**

D-DOS SYSTEM. The disk unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO.

Single drive system **£395 + VAT**
 (please state which Nascom the unit is for)
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 Details available on request.

KENILWORTH CASE FOR NASCOM-2

The Kenilworth case is a professional case designed specifically for the Nascom-2 and up to four additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion.

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 2-card support kit **£7.50 + VAT**
 5-card support kit **£19.50 + VAT**

GEMINI EPROM BOARD

This Nasbus compatible EPROM board accepts up to 16, 2716 or 2708 EPROMs. It has a separate socket for the MK36271 8K BASIC ROM for the benefit of Nascom-1 users. And for Nascom-2 users, a wait state for slower EPROMs. The board also supports the Nascom Page Mode Scheme.

EPROM Board (kit) **£55 + VAT**
 EPROM Board (built & tested) **£70 + VAT**

CASSETTE ENHANCING UNIT

The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshake.

Castle Interface Unit **£17.50 + VAT**

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For really interesting and useful interactions with the 'outside world' the Milham analogue to digital converter is a must. This 8-bit converter is multiplexed between four channels - all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO.

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PROGRAMMER'S AID

For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering; program appending; line deletion; hexadecimal conversion; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to be used with Nas-Sys 1 or 3. **Price £28 + VAT.**

DUAL MONITOR BOARD

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. **Price (kit) £6.50 + VAT.**

NASCOM-2 Microcomputer Kit **£225 + VAT**
 NASCOM-1 Microcomputer Kit **£125 + VAT**
 Built & tested **£140 + VAT**
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CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer that runs at 80cps (proportional) and 50cps (monospaced). This new printer gives text processing quality print. And can print subscripts and superscripts. It has 3-way paper handling and parallel interface as standard. Serial interface is optional. **Price £425 + VAT.** Fanfold paper (2000 sheets) **£18 + VAT.**

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GEMINI 64K RAM BOARD

Newly developed Nasbus compatible board that can accommodate up to 64K of RAM including Page Mode facility. **Kit Prices: £110 (16K), £130 (32K), £150 (48K), £170 (64K). Add VAT to all prices.**

All prices are correct at time of going to press and are effective 1st June 1981.

DISKPEN

The powerful text editor written for the Nascom is now available on a 5¼ inch floppy disk with a number of new features. **Price £43.25 + VAT.**

PORT PROBE

Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. **Price (kit) £17.50 + VAT.**

HEX & CONTROL KEYPADS

Hexadecimal scratchpad keyboard kit for N1/2. **Price £34 + VAT.**
 As above but including (on the same board) a control keypad kit to add N2 control keys to N1. **Price £40.50 + VAT.**

BASIC PROGRAMMER'S AID

Supplied on tape for N1/2 running Nas-Sys and Nascom ROM BASIC. Features include auto line number, full cross-reference listing, delete lines, find, compacting command, plus a comprehensive line re-numbering facility. **Price £13 + VAT.**

GEMINI EPROM-PROG.

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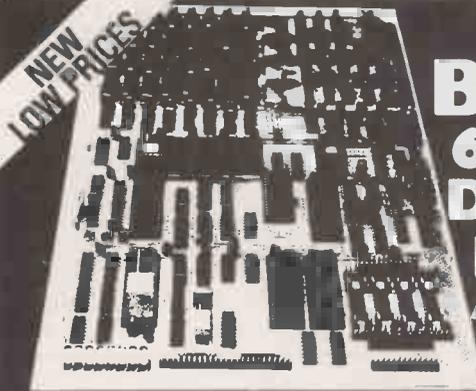
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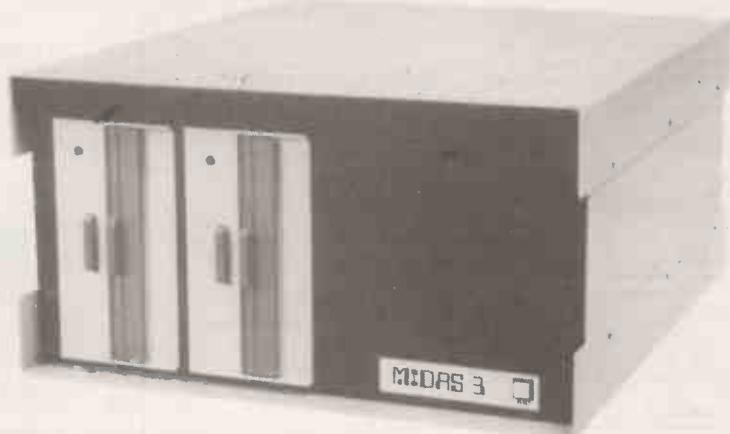
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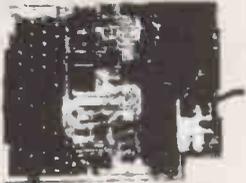
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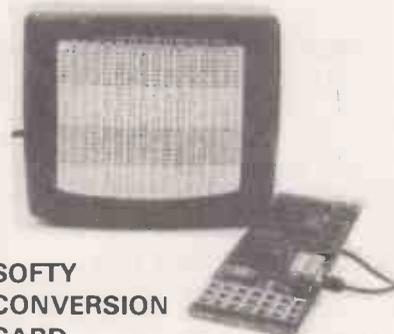
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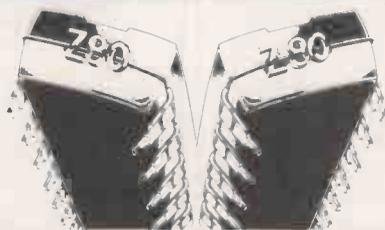
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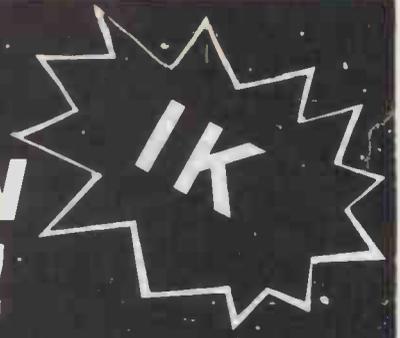
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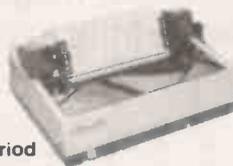
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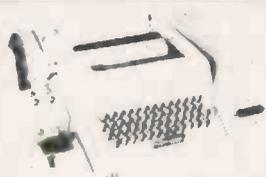
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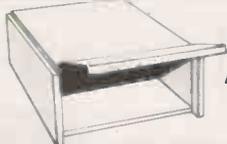
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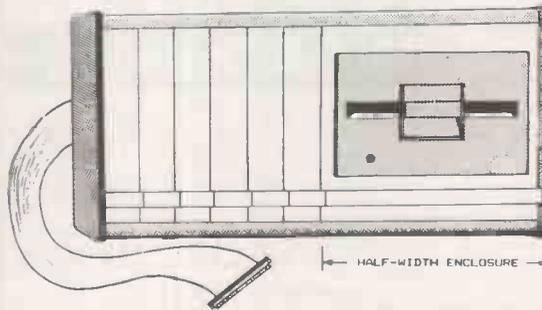
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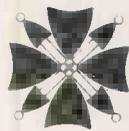
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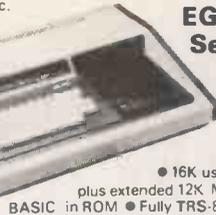
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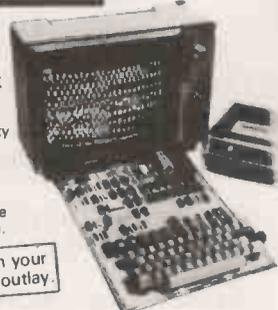
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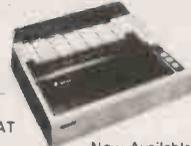
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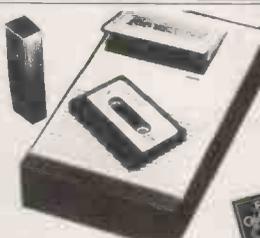
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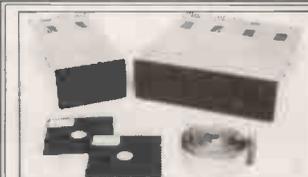
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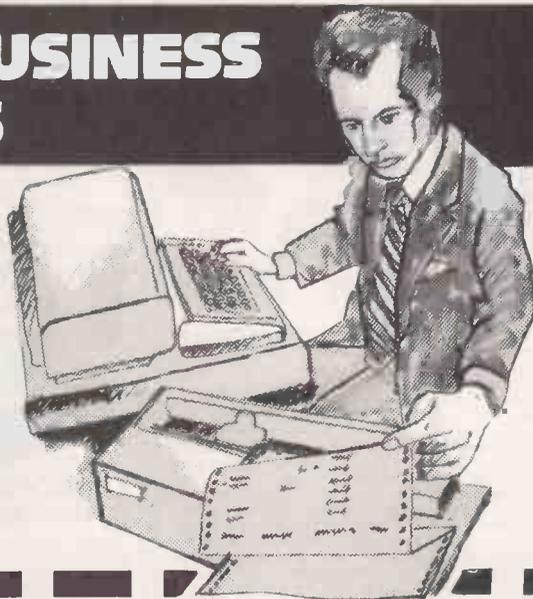
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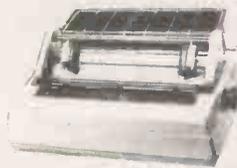
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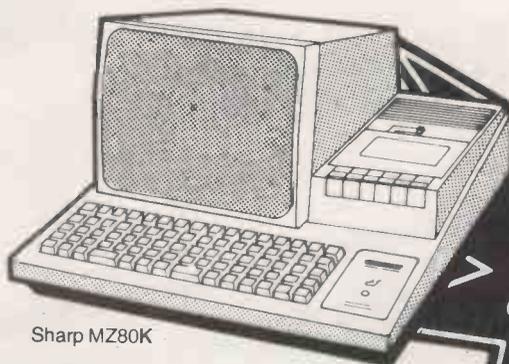
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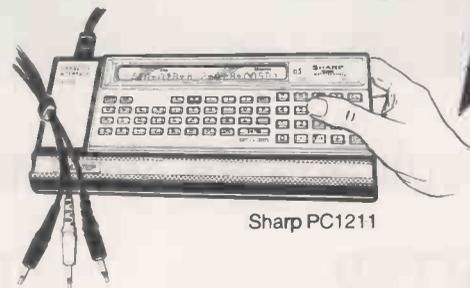


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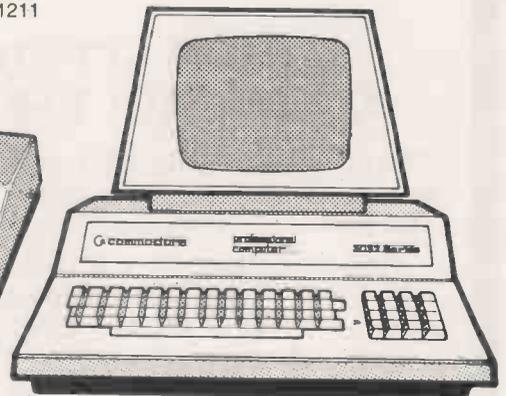
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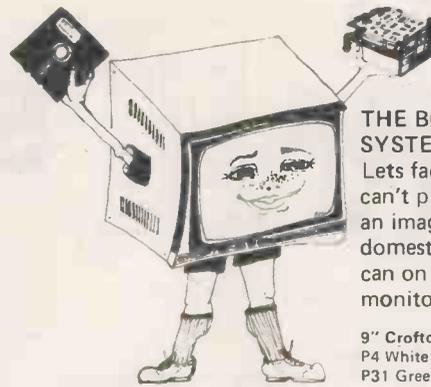


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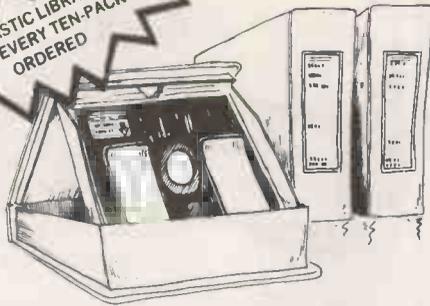
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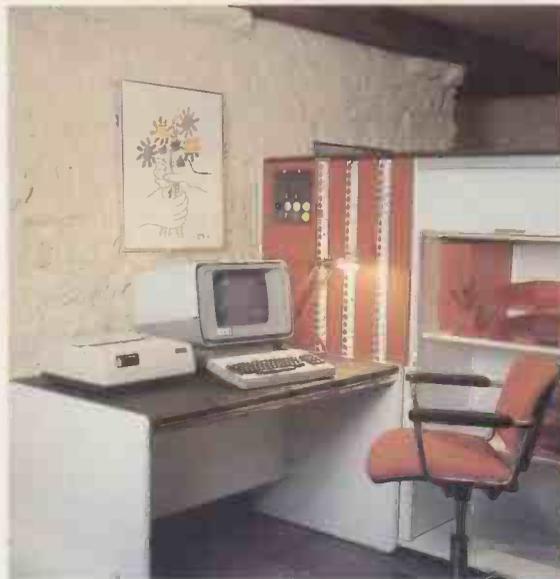
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