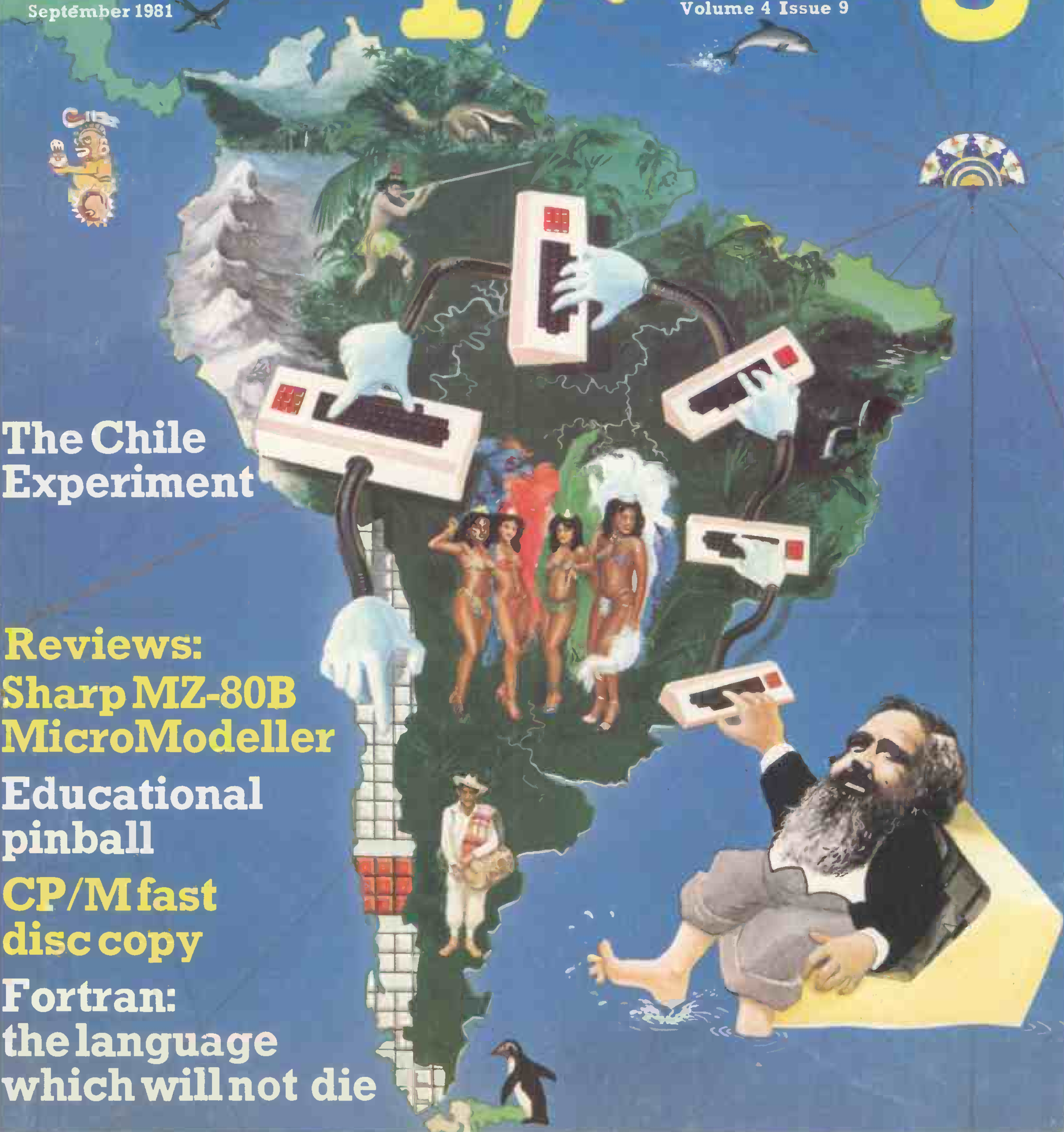
80p

Practical Computing

September 1981

Volume 4 Issue 9



The Chile Experiment

Reviews:
Sharp MZ-80B
MicroModeller

Educational pinball

CP/M fast disc copy

Fortran: the language which will not die

• Circle No. 101

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Editorial: 01-661 3500
Advertisement Manager
David Lake 01-661 3021
Advertisement Executives
Philip Kirby 01-661 3127
Ken Walford 01-661 3139
Midlands office:
David Harvett 021-356 4838
Northern office:
Geoff Aikin 061-872 8861
Advertisement Secretary
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Publishing Director
Chris Hipwell

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Prestel page number 357

ALL SMALL BUSINESS COMPUTERS HAVE THEIR FAULTS. AT PANASONIC WE AVERAGE ONE A YEAR.

True, most small business computers have the capacity to transform your business overnight.

But how many can you rely on to be working efficiently a year from now?

It's an unpleasant little detail most manufacturers tend to gloss over.

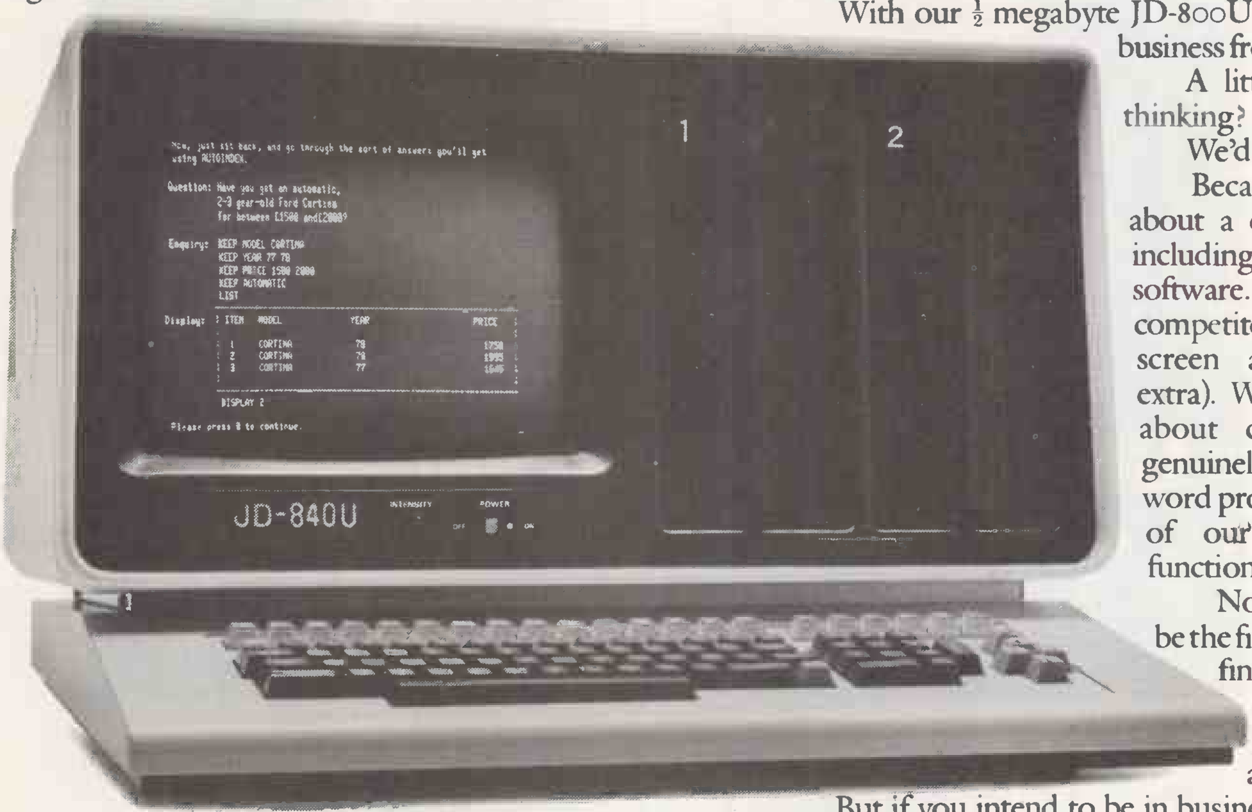
Not Panasonic, however.

Because reliability is the first principle we build into all our computers.

One fault a year per computer is our mean average (including minor faults like a blown fuse).

That's almost unheard of in the computer industry.

Mind you, it does explain why we offer you a year's guarantee instead of the usual three or six months.



WE MEAN BUSINESS

Another key difference about our computers is that we developed them specifically for business use.

From the outset we designed them to be self-contained desktop units rather than a collection of boxes. Mind you, they're quite prepared to adapt to your particular needs.

Both our current models have three input/output ports for linking up with printers and telephones.

(Essential if you're thinking of running them as intelligent terminals off a mainframe computer).

We also make sure they speak your language.

All our computers are supplied with BASIC, the most common of all microcomputer languages.

Plus a CP/M* operating system giving you access to a wide range of software.

And, to show you we really mean business, all our computers support Microcobol.

Specifically developed for commercial use, it's generally regarded as the most comprehensive software available for small business computers.

Finally, we build in all the brainpower you're likely to need.

You've got 64k bytes at your disposal and the capacity to store up to 2 million characters on twin floppy discs.

MORE FOR YOUR MONEY

By now you're probably wondering what it's all going to cost you.

With our ½ megabyte JD-800U you could be in business from about £6,000.

A little pricey, you're thinking?

We'd say realistic.

Because we're talking about a complete set-up, including a printer and software. (Some of our competitors even regard a screen as an optional extra). We're also talking about computers that genuinely double up as word processors, courtesy of our programmable function keys.

Nonetheless, we'd be the first to admit you'll find several cheaper systems if you're prepared to shop around.

But if you intend to be in business this time next year, better buy a Panasonic.

*CP/M is a registered trade mark of Digital Research.

To: Panasonic Business Equipment (UK) Ltd., 107/109 Whitby Road, Slough, Berks SL1 3DR. Tel: 0753 75841. Telex: 847811.

Please send me details of your JD Series microcomputers.

Name ________________ Position ________________

Company ________________

Address ________________

________________ Tel: ________________

Panasonic
Small Business Computers

● Circle No. 104

P

software

mmodore PET.....

LYST (Structured Systems Group) £130/£12
stomised data entry and reporting system in which the specifies up to 75 data items per record, and can use in-tive data entry, retrieval and update facilities to make mation management easy.

£365/£20
nancial Planning program so advanced that it's like hav-a mainframe computer on your desk FPL creates, ifies, displays and prints financial forecasts and analyses inutes.

SIMP/muMATH £135/£20
ckage of programs including muSIMP, a high level pro-mming language for symbolic and semi-numeric process- and muMATH, an interractive symbolic mathematics em written in muSIMP.

ATPAK £260/£20
ofessional statistics and probablity package which can dly handle large files of data.

TEBOOK £185/£20
program allows you to manage your own time (and rs') efficently, just like an office appointment book but the speed and memory of a computer.

ATA MANAGEMENT STEMS

NDOR £365/£20
es 20/DBMS Data Base Management System simplifies rmation processing for inventory control, accounting, onnel records etc. CONDOR uses the relational data- concept allowing the inter-relationship of data elements in files to be user-defined.

£210/£25
figurable Business System is an easy to use, interactive management system with the capacity to define and ement custom accounting applications without recourse ogramming languages such as BASIC and FORTRAN.

ECTOR III-C2 £185/£20
data base processor creates and maintains multi-key bases. It prints formatted, sorted reports with numerical maries or mailing labels.

BS £160/£20
ODASYL-like Hierarcical Data Base System with user-ned SETs, RECORDs and ITEMs, bringing mainframe -base management capabilities to your systems.

BS £475/£20
o Data Base System is a full network data base with all features of HDBS, with fixed or variable record length, /write protection at the ITEM, RECORD, SET and FILE s, and one-to one, one-to-many, many-to-one or many-many relationships between sets.

BS.DRS £160/NA
amic Restructuring System option for MDBS. This is a d-alone program allowing data-bases already containing to be re-designed without affecting the data.

BS.QRS £160/£NA
ry/Report Writing System for DBMS is a stand-alone gram which provides and English-like query language, wing non-programmers to interrogate the data base.

BS.RTL £160/NA
overy/Transaction Logging module for MDBS, which ords any data base changes in a transaction log file which be used by the recovery processor to update a back-up y of the data base.

CCOUNTING PACKAGES (GRAFFCOM)

YROLL	£475/£35
MPANY SALES	£425/£35
MPANY PURCHASES	£425/£35
NERAL ACCOUNTING	£375/£35
OCK CONTROL	£325/£35
DER ENTRY AND INVOICING	£325/£35
D	£255/£35
E RECORDING SYSTEM	£375/£35
ASE RENTAL AND HP SYSTEM	£375/£35

LANGUAGE APPLICATION TOOLS

BASIC UTILITY DISK £40/NA
This disk consists of the CRUNCH-14 compacting utility to reduce the size of and increase the speed or programs written in Microsoft BASIC-80. Also included is DPFUN, a set of double precision routines including square root, natural log, sinh, arcsing etc.

DATASTAR (MicroPro) £195/£35
A powerful, comprehensive forms contol and display system for key-to-disk data entry. DATASTAR is menu driven with built-in learning aids such as help messages on the screen, and input fields may be verified by length, mask, or type (upper or lower case, numeric).

FORMS 2 FOR CIS-COBOL (Microfocus) £110/£12
A screen editor which automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats.

FABS £105/£15
FABS gives you rapid access to large data files by using balanced tree structres containing up to 65,000 records. Instructions are included for use with CBASIC2, S-BASIC, BASIC-80, BASIC compiler, PL/I-80, Pascal/MT + and FORTRAN-80.

MAGSAM III £75/£15
A sophisticated, versatile ISAM file management support system for use with CBASIC-2 and BASIC-80 business applications, allowing real-time enquiries, updates, additions and deletions

MAGSAM IV £185/£15
A high-speed machine code version of MAGSAM III for CBASIC-2 only. It has a 75 percent faster execution time.

M/SORT FOR COBOL-80 £130/£12
A record-sorting utility for COBOL-80 conforming fully to the ANSI '74 level 2 sort/merge standard (except for alphabet name collating sequence).

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

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

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

STRING/80 SOURCE CODE available separately £185

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

SUPERSORT (MicroPro) £125/£25
A superior sort, merge and extract utility supplied both as a complete program and as a relocatble module in Microsoft format. SUPERSORT sorts up to 500 records per minute.

ULTRASORT II £105/15
This high speed sort utility, equipped with select and exclude capabilities, will sort, merge and select data files either in stand-alone mode or called via CBASIC-2 subroutines. It sorts on five keys, each independently ascending or descending, with fixed or variable length field lengths.

SYSTEM TOOLS

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

SID (Digital Research) £65/£10
An 8080 symbolic debugger with full trace, pass count, and breakpoint facilities plus back-trace and histogram utilities. SID works uses symbol files produced by MAC or the Microsoft linker to give a full symbolic display of user labels.

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

XMACRO-86 (Microsoft) £156/£15
An 8086 cross assembler which uses mnemonics slightly modified from the Intel ASM86 assembler. All the macro features and utilities of MACRO-80 are included.

XASM 05, 09, 18,0 48, 68, F8, 65, 400 and 51 (Avocet) £95/£10
Cross assemblers for the Motorola 6805, Motorola 6809, RCA 1802, Intel 8048, Motorola 6800, Fairchild F8, MOS Technology 6502, National Computer 400 and Intel 8051 families.

PASM (Phoenix Software Associates) £70/£15
A Z80 macro assembler using Intel/TDL mnemonics, which will generate output in either Intel hex format or TDL object format or PSA relocatable binary format.

PLINK II (Phoenix Software Associates) £185/NA
A two-pass disk-to-disk linkage editor capable of producing ROMable code. It has full library facilities, and input can be PSA relocatable, TDL object or Microsoft REL files.

PMATE £100/NA
This new-generation screen editor is bristling with special features including full side scrolling, and two visible cursors, one in the text area and another in the command linel.

BUG and uBUG (Phoenix Software Associates) £70/£15
A Z80 interactive machine language debugging tool with full mnemonic trace and interactive assembly, using PASM-compatible mnemonics.

DISTEL £60/NA
Disassembles 8080/Z80 machine code file to Intel 8080 or PASM/TDL mnemonics.

DISILOG £60/NA
A version of DISTEL for Zilog Z80 mnemonics.

ZDT £30/NA
A Z80 debugging tool to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Useful features include the ability to directly access input/output ports, search for hex or ASCII strings, and compare memory areas byte by byte.

Z80 DEVELOPMENT PACKAGE £70/NA
This package consists of a line editor, a relocating Z80 assembler using Zilog/Mostek mnemonics with conditional assembly and cross reference table facilities, and a linking loader producing in Intel format hex file.

WORDMASTER (MicroPro) £75/25
In one mode this text editor has a superset of CP/M's ED commands including global search and replace, both forwards and backwards in the file.

RAID £130/£15
Real-time Assembler Interactive Debugger, for 8080 software emulation and real-time debugging.

RECLAIM £40/NA
A utility to validate disk media under CP/M. It checks a diskette or hard disk surface for errors, collecting any bad sectors into invisible files so that they cannot be accessed. The remainder of the disk can then be used as normal.

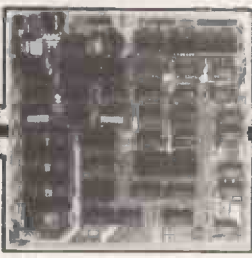
DESPOOL (Digital Research) £45/NA
A utility to permit the simultaneous background printing of a data from a disk file while the user executes another program from the console. DESPOOL occupies 3K of memory.

Please note - the prices in this catalogue are subject to change. Certain packages may require a software license agreement to be complete and returned before shipment can be made.

● Circle No. 106

MicroValue

New British Microsystem. Gemini MultiBoard

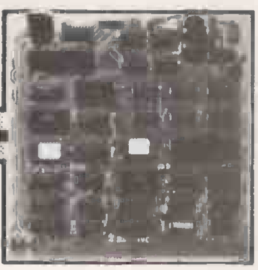


● Eight boards available NOW ● 8" x 8" board modules ● Z80A CPU board ● Z80A Video board ● 64K RAM ● Built and tested

Developed by one of the most experienced micro board design teams in the UK, Gemini MultiBoard* is the ultimate modular board system. Unlike most systems of its kind, virtually nothing is made redundant when you expand it. And for those who want expansion this can be immediate, for we are launching eight boards simultaneously. No other system has offered so much so soon.

All MultiBoard modules are Nasbus† and Gemini 80-BUS* compatible and can be used in a wide spectrum of application, e.g. educational, personal, business, system development and process/production control.

MultiBoard modules are built and tested to the highest standards. And offer enormous computing power and potential at astonishingly low cost.



MultiBoard Modules available now

Z80A CPU

Processor: Z80A CPU at 4MHz. Optional wait-states. Reset jump to any 4K boundary.

Parallel I/O: 8 bit ASCII keyboard socket. Uncommitted Z80A PIO giving two 8 bit bi-directional ports with handshake.

Serial I/O: 8250 UART with programmable baud rates and software selectable between RS232 or 1200 baud CUTS cassette interfaces.

Memory: 4 'Bytewyde' sockets to accept EPROM/ROM/RAM. Memory switched in/out of memory map under software control.

Software: Comprehensive monitor. Optional 12K Microsoft BASIC (ROM). Standard configuration PROM provides decodes for 4 x 2732 (4K x 8) EPROMs.

The CPU Board is fully buffered to the Gemini 80-BUS standard.

INTELLIGENT VIDEO

- Z80A microprocessor controlled.
- 80 x 25 display controlled by 6845 CRTC chip.
- Adjustable dot clock for alternative screen formats.
- Character set: 128 in EPROM + 128 in RAM which can be defined as the video inverse of the main set or as block graphics with 160 x 75 resolution.
- I/O port communication with host computer.
- Light pen socket.
- 8-bit input port allowing several video boards (each with its own keyboard) to be connected to a single CPU board.

FLOPPY DISK CONTROLLER

- Controls: Pertec FD250 5.25in 48 TPI, Micropolis 1015 5.25in 96 TPI, Pertec FD514 8in.
- Controls up to 4 drives of same type.
- Single/double density software selectable.
- Single or double sided.
- Western Digital FD1797 controller.
- Up to 8 drives (2 boards) can be used in the same system.

64K RAM

- Runs at 4MHz with no wait-states.
- 4 banks of 16K dynamic RAM, each bank locatable on any 4K address boundary.
- Page Mode supplied as standard allowing up to 4 memory boards to be addressed.
- All the memory can be used by switching out on-board CPU memory, e.g. in disk environment.

EPROM/ROM BOARD

- Accepts up to 40K of firmware.
- 4 banks of 4 sockets.
- Banks can be mixed between 2708 or 2716.
- 24-pin ROM socket.
- Wait-state generator.
- Supports Page Mode scheme.

EPROM PROGRAMMER

- Programs multi-rail 2708 or single rail 2716.
- Connects to PIO on CPU board.
- Software provided on tape.

3A PSU

- Supplies 4/5 boards.
- LED on each output.
- +5V at 3A; +12 at 1A; 5V at 1A; –12V at 80mA.

KEYBOARD

● Full alpha-numeric ● 59-keys ASCII encoded ● Exclusively designed for Gemini ● Auto repeat ● Cursor control keys

MULTIBOARD PRICES
(excl VAT)
(All built and tested except where marked)

CPU (G811)	**£125.00**
Video (G812)	**£140.00**
64K RAM (G802)	**£140.00**
FDC (G809)	**£140.00**
EPROM/ROM (G803)	**£ 70.00**
EPROM PROG. (G808) Kit	**£ 29.50**
3A PSU (G807)	**£ 40.00**
Keyboard (G613)	**£ 57.50**

FLOPPY DISK UNIT

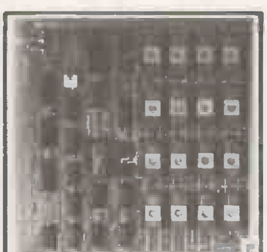
Gemini unit suitable for MultiBoard. Holds one or two 5¼in double sided, double density Pertec drives. Intergral power supply. Price £375 plus VAT for one drive, £575 plus VAT for two drives. CP/M2.2 and documentation £90 plus VAT.

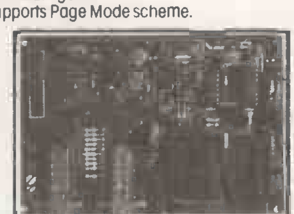
KENILWORTH CASE for MultiBoard	**£49.50 + VAT**
5-Card Support Kit	**£19.50 + VAT**
VERO Frame (also suitable for Nascom)	**£32.50 + VAT**
PSU Enclosure Kit	**£24.50 + VAT**

KEYBOARD enclosures available soon.

MultiBoard Modules are available from the MicroValue dealers listed on facing page.

* Trademarks of Gemini Microcomputers Limited
† Trademarks of Nascom Microcomputers Division of Lucas Logic
†† Trademarks of Digital Research Inc.





MicroValue

COMPATIBLE Nasbus products from your MicroValue Dealers

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 a new N2MD PROM. All in a stylish enclosure.

Single drive system .... **£450 + VAT**
Double drive system .... **£640 + 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**

DCS-DOS A greatly enhanced version of D-DOS, running under Nas-Sys. Gives named files in BASIC, ZEAP, NAS-PEN and machine code programs .... **£50 + VAT**

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.**

NASCOM COMPUTERS

NASCOM-2 Microcomputer Kit **£225 + VAT**
NASCOM-1 Microcomputer Kit **£125 + VAT**
Built and tested **£140 + VAT**

16K RAM KIT .... £100 + VAT
3A PSU KIT .... £32.50 + VAT

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.

Kenilworth case .... **£49.50 + VAT**
2-card support kit .... **£7.50 + VAT**
5-card support kit .... **£19.50 + 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**

A NASCOM-2 BASED SYSTEM FOR LESS THAN £1500 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system from under £1500 + 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.

A-D CONVERTER

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.

Milham A-D Converter (built and tested) .... **£49.50 + VAT**

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 used with Nas-Sys 1 or 3. **Price £28 + VAT.**

GEMINI 'SUPERMUM'

12 x 8 piggy-back board for Nascom-1 offering five-slot motherboard, quality 5A power supply and reliable buffering with reset jump facility. Kit **Price £85 + VAT.**

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 £375 + VAT.** Fanfold paper (2000 sheets) **£18 + VAT.**

BITS & PC's PCG

5 x 4 board which plugs straight into Nascom-2. Operates an cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 98304. Many other features including intermixing of alpha-numeric characters and pixels. **Price (kit) £60 + 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.**

All prices are correct at time of going to press and are effective 1st July 1981.

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.**

'SCREENPLUS'

Screenplus enables a programmer to blank or display in reverse video, selected words, letters or areas of the screen under program control. Suitable for use with either Nascom 1 or 2. 'Screenplus' (built and tested) .... **£40.00 + 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.**

YOUR LOCAL MICROVALUE DEALER

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

BARCLAYCARD VISA

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

BUSINESS & LEISURE MICROCOMPUTERS
16 The Square, Kenilworth, Warks.
Tel: (0926) 512127.

ELECTROVALUE LTD.
680 Burnage Lane, Burnage, Manchester M19 1NA.
Tel: (061) 432 4945.
28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
Tel: (0784) 33603. Tlx: 264475.

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

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

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

● Circle No. 107

PROFESSIONAL
SUPERBRAIN
SOFTWARE

COMPILERS & UTILITIES

Microfocus CIS COBOL:
- Standard compiler.................... £425
- Forms-2 utility £100

NB We are the sole UK distributors of Microfocus products on the SUPERBRAIN.

Microsoft:
- MBASIC interpreter £155
- BASIC 80 compiler £200
- COBOL 80 compiler £390
- FORTRAN 80 compiler £260
- MACRO 80 assembler .... £ 85

Micropro:
- WORDSTAR (word-processing) ... £230
- Mailing list merge for above .... £ 65
- DATASTAR (data management) .. £160
- SUPERSORT £130

The Micro Solution Ltd:
- REPORT GENERATOR £100

(this superb data management tool allows you to produce interactively a COBOL program to select records from a file and print them in your layout)

- BSTAM (inter machine transfer) .... £ 75

APPLICATIONS SOFTWARE

The Micro Solution Ltd:
- Integrated Accounting System . . . £1000
- Stock Control System £400
- Bill of Materials System £400
- Payroll Systems £500

These four modules interlock as required to make a superb total business system.
Half day free training is included in the above price for each module.

The Accounting system includes:
- Sales/Purchase/Nominal Ledgers + VAT
- Final Accounts/Profit & Loss/Bal sheet
- Invoicing
- Open Item or Balance Forward

The Stock Control system includes:
- Order processing/Auto. Reordering
- Picking List production

Others:
- Television Rental system £800
- Estate Agents' system £475
- MICRO MODELLER (Fin Planing) .£645
- SPELLBINDER (word-processing) . £250
- SUPERBIOS(CP/M enhancements) £100
- SUPERVID (video enhancements) . £285

SUPERBRAINS AVAILABLE FROM STOCK,

FROM **£1700** Subject to exchange rate fluctuation

ADD VAT AT STD. RATE TO ALL ABOVE PRICES
POSTAGE AND PACKING WILL BE ADDED
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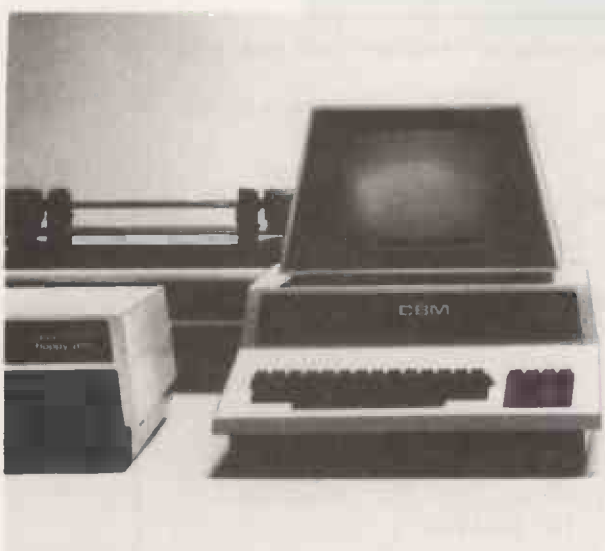
● **Circle No. 108**

Would you interview only one applicant for an important job?



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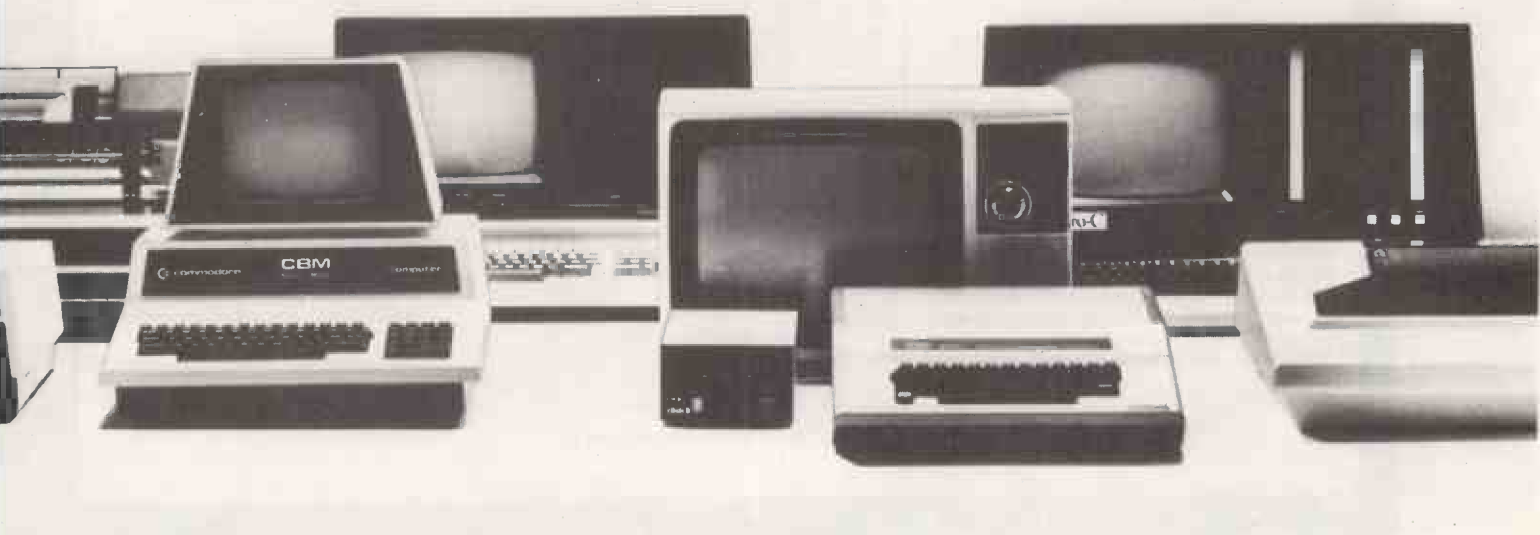

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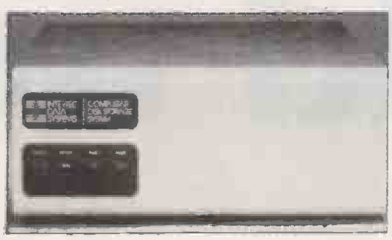

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☐ **CP/M** version 2 (not all formats available immediately) .... £95/£15

☐ **CP/M** for Apple 11* Softcard — Z80 Microsoft BASIC - 80 with high resolution graphics **NEW** .... £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

☐ **DESPOOL** — Program to permit simultaneous printing of data from disk while user executes another program from the console .... £30/£1

MICROSOFT

☐ Ⓛ Ⓜ **BASIC-80** — Disk Extended BASIC Interpreter Version 5, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records .... £155/£15

☐ Ⓛ Ⓜ **BASIC Compiler** — Language compatible with Version 5 Microsoft interpreter and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes Macro-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... £195/£15

☐ Ⓛ Ⓜ **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

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☐ Ⓛ **EDIT-80** — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included .... £45/£10

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☐ Ⓛ **KBASIC** — Microsoft Disk Extended BASIC version 4.51 integrated with KISS Multi-Keyed Index Sequential and Direct Access file management as 9 additional BASIC commands. KISS included as relocatable modules linkable to FORTRAN-80, COBOL 80, and BASIC COMPILER. Specify CP/M version 1.4 or 2.x when ordering. Requires 48K CP/M £295/25
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☐ Ⓛ **SUPER-SORT II** — Above available as absolute program only .... £105/£15

☐ Ⓛ **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

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☐ Ⓛ Ⓜ **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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☐ **TINY C** — interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... £45/£30

☐ Ⓜ **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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☐ Ⓛ **ALGOL 60 Compiler** — Powerful block-structured language featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling, direct disk address I/O etc. Requires Z80 CPU .... £110/£12

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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

☐ **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL Xitan pseudo ops optional. Runs on 8080 .... £35/£7

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☐ **DATEBOOK** — NEW — Program to manage time just like an office appointment book but using the speed and memory of a computer. Keeps track of three appointment schedules (three dental chairs, three attorneys, etc.) at once. Appointments consist of name, reason for the appointment, the date and time, and the length of the appointment. System can be quickly customized for the individual user. Many helpful features for making, changing, finding, and reporting appointments. Requires 48K CP/M and 180K bytes diskette storage. Not available for Apple CP/M .... £185/£15

☐ Ⓜ **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

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☐ **IBM/CPM Utility Package** — has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... £125/£7

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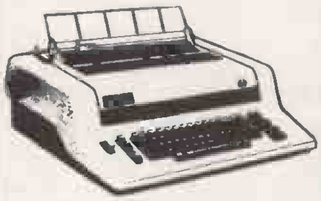

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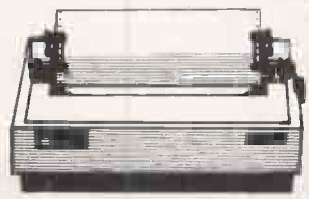

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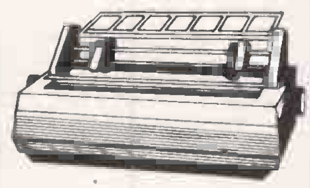

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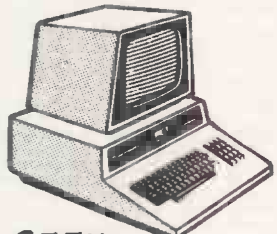

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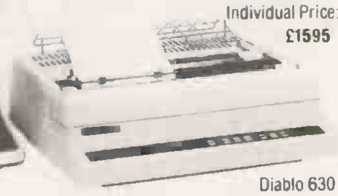

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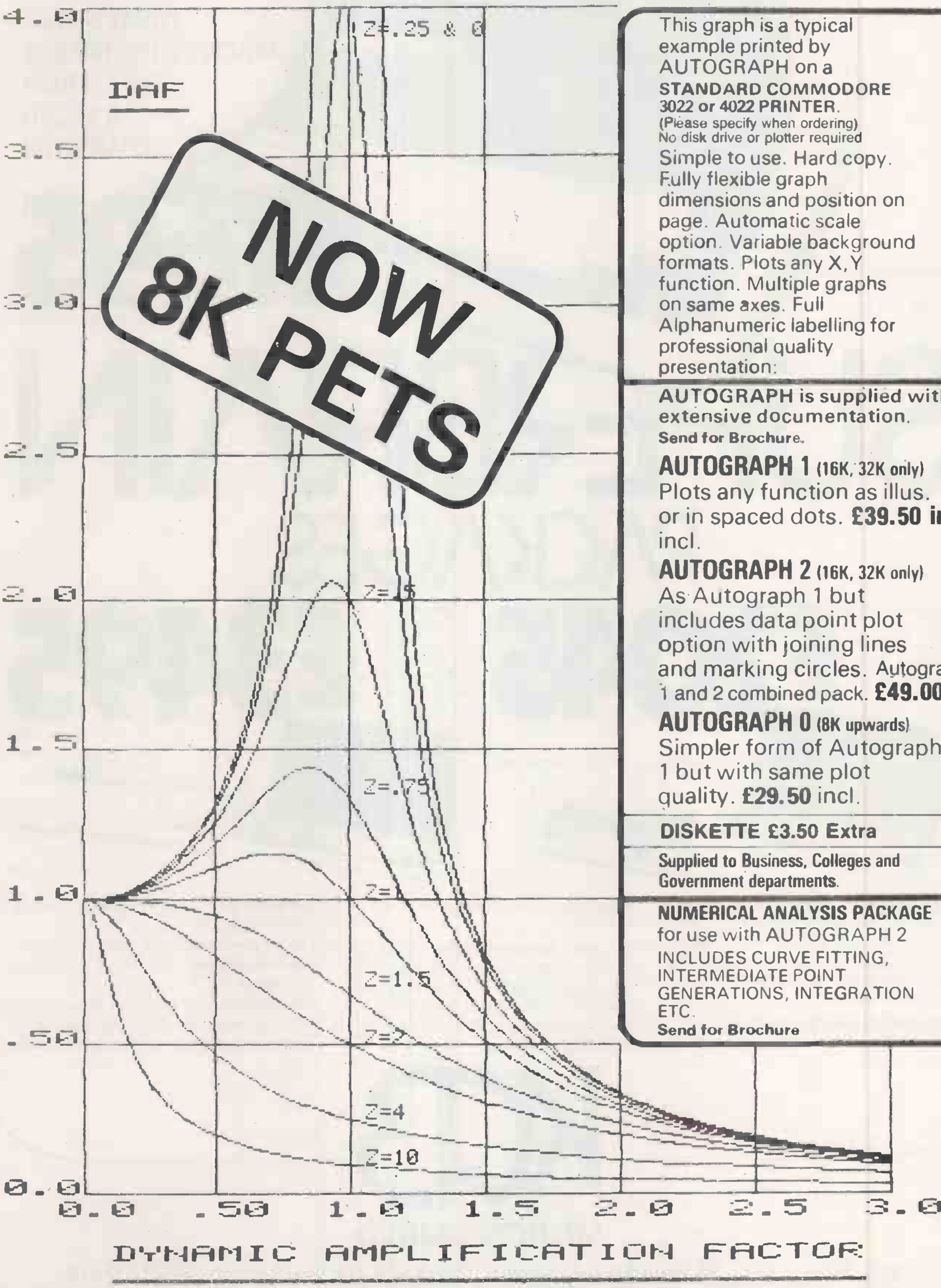

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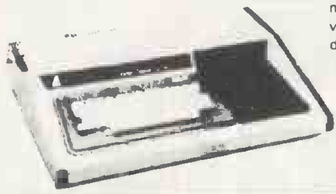

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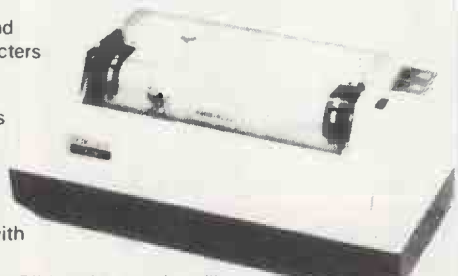

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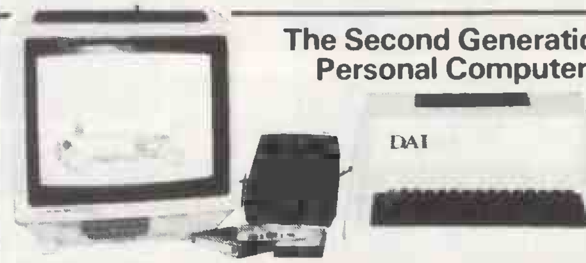

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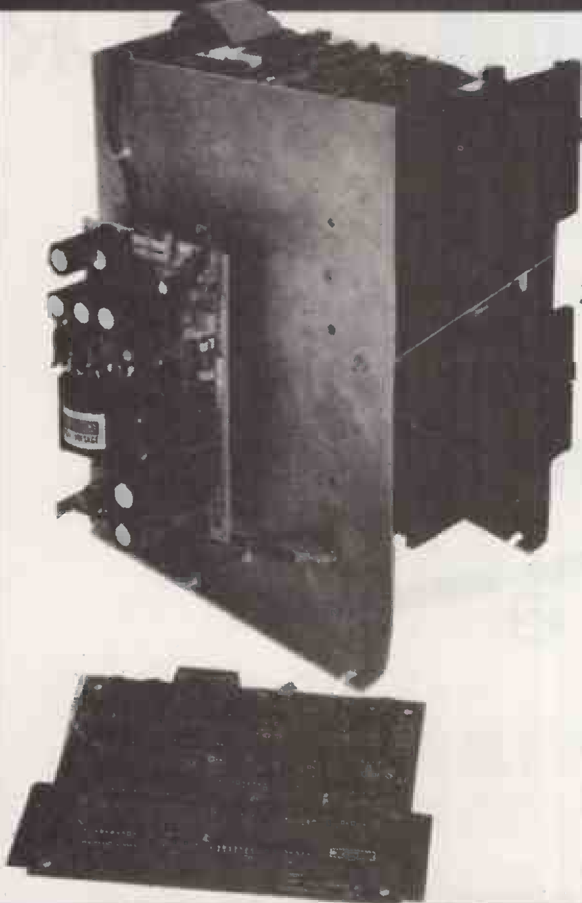

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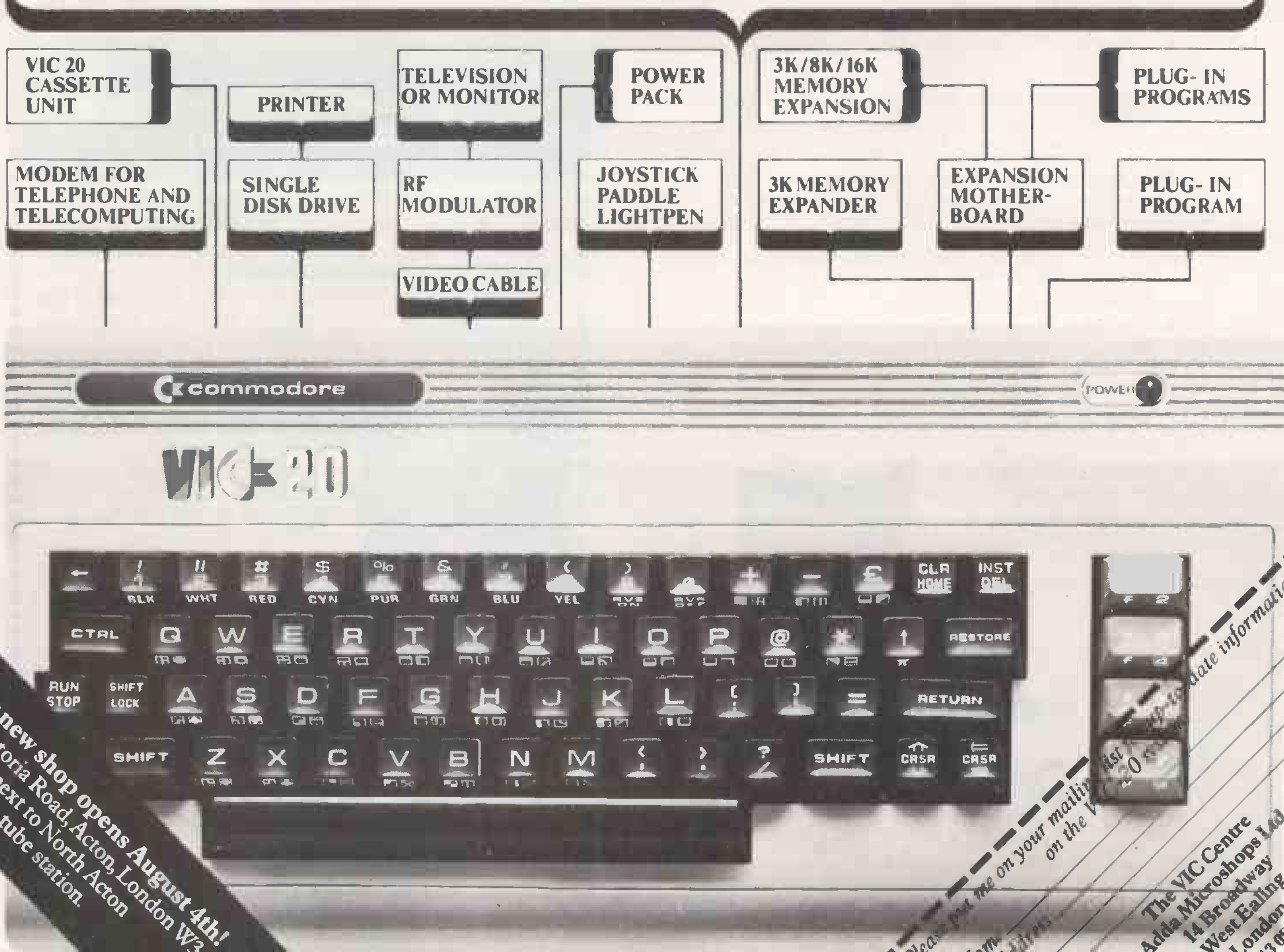

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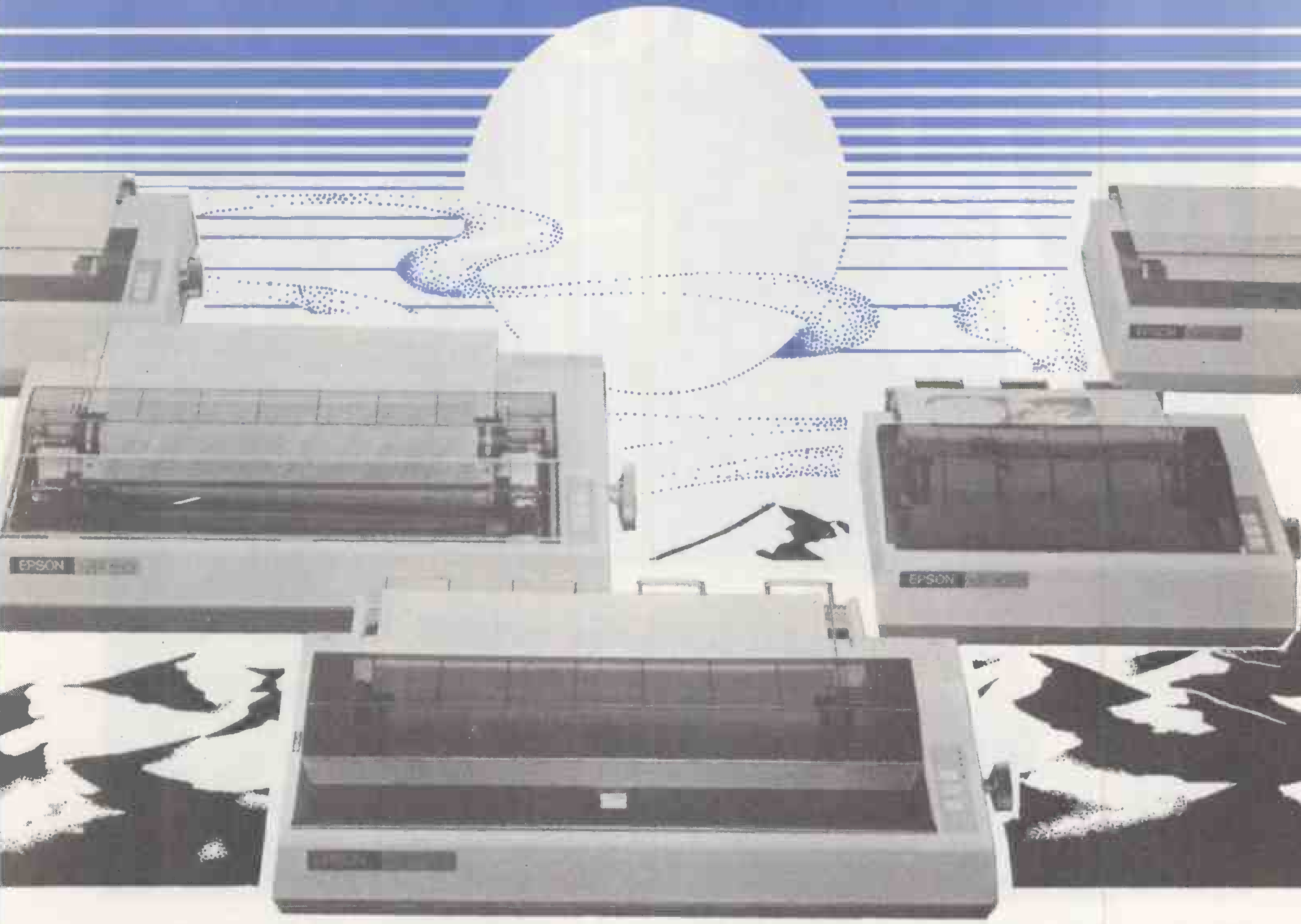

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Prestel on the line

THE FIRST few programs on the *Practical Computing* telesoftware pages — Prestel page 357 — represent, we hope, the start of a completely new direction for personal computing and eventually for the whole way information is handled in this country. What are the aims of the *Practical Computing* telesoftware pages?

The idea was originally British Telecom's, devised as a possible solution to the problem of how to interest people in Prestel. On paper, as it were, Prestel is a wonderful idea. Instead of putting sticky black marks on paper and then trucking thousands of tons of re-processed forest round the country to supply people with information, you put the marks at the end of a telephone and show them on the television set.

In practice, as we have seen, it does not work quite like that. The cost of the sets, the difficulty of finding the information you want, the crude quality of the images all contribute to deter potential users. Although Prestel would be good for them, they will not use it.

"Very well", said British Telecom, showing a resourcefulness not often found in public bodies, "if the public at large will not play, who can we find that will"? Some unsung genius deep in the bowels of the corporation suggested that they capture the microcomputer enthusiasts' interest. Well, he is not at all unsung, really. It was Tony Stillwell and quite predictably, the Americans have just made him an offer he could not refuse, so he is lost to us — for a while at least.

Dramatic effect

Why the microcomputing community? What do we want with boring old Prestel? From the British Telecom point of view, we have a good deal going for us. First, size: there are now more than 100,000 micros in the U.K. and the number is growing all the time. That is about 10 times Prestel's user base, so that if only a small percentage of micro users took to Prestel, the effect would be dramatic. Secondly, micro users obviously like technology and are willing to spend some money on it. If only a few bought Prestel adaptors for their computers, the cost of these expensive little electronic delights would fall in a most satisfactory way.

There was, however, more to the suggestion than the identification of a possible user group. The difficulty with Prestel is really that it is so hard to work and so boring to watch. No doubt you can use it to find the times and fares of planes, trains, buses and ships to Aberdeen, but it would be easier on the eyes and fingers to walk.

Tony Stillwell's thought was subtler than that: "If we can get the micro users interested, they will start making Prestel do all kinds of tricks. Before you can turn round, someone will have written a program to search the database for travel to Aberdeen — or, indeed, many other places. Prestel, interrogated by a micro running intelligent software, is a very different beast from Prestel gaunt, stark and silent on its own".

The final, and perhaps the cleverest, link in the argument was the answer to the question "How?" — by giving *Practical Computing* a 1,000 pages as a playground for its readers. Of course, it was brilliant to choose us, but even cleverer to realise that more would be achieved by letting anyone play who wants to than by forming committees to deliberate in private and then to publish unread and unreadable reports. For the first time, perhaps, an Establishment body has grasped the idea — and acted on it effectively — that the best way to organise things for a mass market is to let the market shape them to suit itself.

How will *Practical Computing* telesoftware pages work? We hope soon that readers will start sending us software through the Prestel message pages: we will both transfer them to the visible telesoftware pages and take hard copy for possible publication in the magazine, where they will earn the usual fee.

Financially, the whole project is free. British Telecom has given us £10,000's worth of pages for a year; we are charging nothing for access to them and we expect to make no money at all from the project.

Darwinian selection

Readers of Peter Blower's article in the August 1981 issue will realise that there are problems in putting software on Prestel. There are several ways of doing it and we do not intend to impose any particular one of them on the users of the *Practical Computing* telesoftware pages. The whole point of the project is to experiment to find the best methods — and the only way to do that is to let all the dogs see the rabbit. No doubt Darwinian selection will set to work to produce the best one.

We do think, though, that whatever style is chosen for presenting software on Prestel, it should be readable both by eye and by machine. This is because, to begin with at least, there will be very few people with adaptors for their micros: listings will have to be entered by hand from the screen, just as they are from the pages of the magazine. Blank space on the screen is expensive, so program lines ought to run on to make the best use of the available space.

In due course, when our 1,000 pages are full, we shall have to weed out old material to make space for new. No doubt the efficient use of space will be a factor in choosing what will stay. Naturally, the very first programs which ought to go up in any style for automatic down-loading should be the software to capture and transmit other programs.

Where do we see it all going?

In the near future, we hope that there will be enough people with Prestel adaptors for their micros to make it worthwhile going commercial. We shall have to pay British Telecom for our pages; we may charge readers to access them; we shall sell advertising space — we will do the things that we do now on paper. One hopes the application of micros to Prestel will unlock huge new markets.

People will be using Prestel to sell software perhaps, but even more interesting, they may be using it to sell information which their software needs. For instance, instead of putting up lists of commodity prices, a broker might give away software which accesses machine-readable prices on his pages. Every time you run that program to see how your pork belly futures are doing, your micro calls Prestel, accesses those pages and earns the broker a fee.

The whole thing could suddenly start to work. So, my children, go forth, be fruitful and multiply — and divide.

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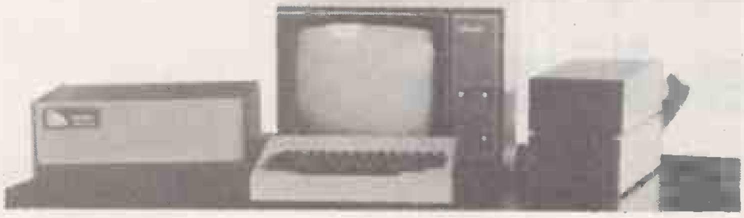

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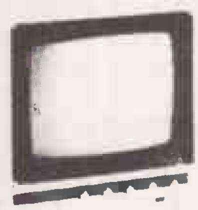

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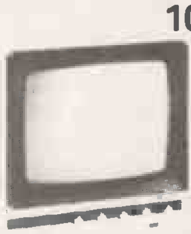

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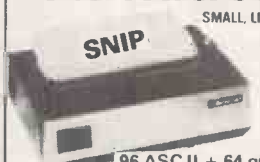

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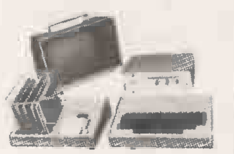

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Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it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

Benchmark performance

I FOUND the article "The true value of benchmarks" in the June 1981 issue very interesting and informative, supporting the view that I have long held: benchmarks commonly used to compare different microcomputers are worthless and that the processing speed of a machine should not, in isolation, be taken as an indication of performance. While hesitating to criticise such a well-researched and presented feature by Boris Allan, I feel I should comment on some of the points raised.

Concerning the storage of large numbers, the comments on page 77 about the inability of certain machines to store the elements for matrix larger than six by six should not include the TRS-80 L2 machine. This system has the facility of storing and displaying numbers in double-precision mode. In this mode, if a number consisting of eight or more digits is entered or if D is used in place of E as the exponent, e.g., 3.48D+12, the number will be stored as a 17-digit number.

The remark by Allan that he was unable to Define functions on the TRS-80 is true of the standard cassette-based machine. User-Defined functions are provided on the disc-based machine, which loads an extra 5K of Basic on top of the resident ROM-based interpreter.

Owners of cassette-based machines can have the same facilities if they use the G2 Level III Basic on cassette, available from dealers for about £34.

My final comment concerns the result of the various results given in MT3F. My disc-based, 48K RAM, TRS-80 Model 1, running the MT2F and MT3F programs exactly as written — including Def functions — gives slightly different results than those published in the article.

Perhaps the most interesting one is the result for the PI - PI value — labelled ABS (PI-PO) in table 3. This produces a value of 8.7422990414493D-08 in double-precision and zero in single-precision mode.

When I first ran this program on the VDU I was mystified by the apparently greater accuracy of the single-precision mode. I then made a small alteration to the program to print out the actual values of PI and PO (P1) and I found that in double-precision, PI was stored as 3.1415926535897932 — 17 digits — and displayed as 16 digits, while P1, or PO in the table, was stored as 17 digits and displayed as 3.141592741012573 — 16 digits.

However, in single-precision mode, both these values are stored and displayed in six digits: the value for each is 3.14159, thus giving a zero-difference result. This last discovery has made me suspect that perhaps the results for some of the other machines that show many zero errors in the tables do not tell the true story.

Perhaps some of these machines only store eight or nine digits and therefore the entry of a longer number such as the value of PI in MT3F results in truncation of the stored number. This would have the same effect as that witnessed in the single precision result, thus rendering the test invalid.

**T A F Drake,
Ickenham,
Middlesex.**

Thoughtful types

BOB SNELL'S and Barbara Colley's Backgammon Program published in the May 1981 issue of *Practical Computing* was excellent, and has already provided many quiet hours of enjoyment. It certainly appeals to the more thoughtful types, who prefer a game with more intellectual skill to the more visual appeal of Space Invaders and the like.

The major criticism from non-computer types is that they are suspicious of the internal random-number generator, and find the program slow when playing at higher levels. The first fear can be allayed by providing an input for dice thrown: the second problem would presumably be solved by moving into machine code — which is beyond my capability at the moment.

Incidentally, the logic in line 248 as printed, is at fault: A$ cannot simultaneously not be "r" nor "a" so a return is never effected. A simple cure is:

```
248 IF A$ = "A" OR A$ = "R" THEN RETURN
249 PRINT "(cursor up)";: GOTO247
```

**J F G Wort,
London W11.**

Tape reliability

AS DEALERS in Nascom and Sharp Microcomputers, we frequently encounter customers with a low opinion of cassette tape as a storage medium. Such customers invariably ignore what we now believe to be the true cause — sub-standard cassette tapes.

In common with other dealers, we sell blank C10 or C12 cassette tapes and believe them to be "screened against drop-outs" — suitable therefore, for the recording of digital data. After trying many suppliers' "screened" tapes which include a number of well-known brand products — we have now reached the conclusion that if they are tested for drop-outs, then the test criteria are totally inadequate.

Among problems that we have so far encountered are:

- Errors because the tape becomes creased by most normal cassette recorders.
- Errors because over-recording does not erase the old data.
- Errors because a tape is read frequently and wears out very quickly.
- No oxide layer on the tape; it took a long time to decide if this was a Read error or a Write one.

When asked, suppliers invariably say that since no other customers have problems, "it must be you". Does this mean all other customers are using low baud rates such as those used by the TRS-80 for example, and can therefore be supplied with low-quality tapes without repercussion?

In view of this widespread problem, has anyone found a source of supply which is always reliable?

**Richard Marshall,
Business and Leisure
Microcomputers,
Kenilworth,
Warwickshire.**

Sharp reproof

I READ with interest the review of the Sharp MZ-80K in the May 1981 issue. I feel, however, that it would have been better to review the Sharp components separately from the Xtal software. In particular, no mention was made of two of the defects in the Sharp SP5025 Basic; lack of string comparison and a limit of 255 on the size of an array dimension which should be considered by anyone thinking of buying the system.

While these shortcomings can be resolved, they make Basic programming unnecessarily complex, particularly for business purposes where numbers of items in excess of 256 are not uncommon.

The main complaint I have is not with my hardware, which I feel is excellent, but with what seems to be another example of Sharp's jealous attitude: the extreme difficulty I have found in obtaining information.

I feel that the manual supplied with the system is a good introduction to Basic and simple programming on the machine — although it does not mention any of the

(continued on page 45)

(continued from page 43)
software limitations. However, after having written to many suppliers and Sharp U.K., I find it almost impossible to obtain any further information. The kind of facts I am looking for are, for example, description of the monitor — acceptable commands, useful routines — or, program pointers for the Basic.

Sharp refuses to sell without its tapes the assembly or machine-language manuals, which might contain some of this information. I understand that Newbear offers annotated listings of the monitor and Basic at £15 and £30 respectively. I feel that this is far too much to pay for this information which is as part of a £6 manual with the Apple.

As well as being frustrating, I feel that this attitude is short-sighted. An examination of the present market surely shows that those manufacturers now selling successfully are those who have been most open with their information.

Philip Bolt,
Kirriemuir,
Angus.

Poking ZX-81

TO CLAIM, as does Mike Hughes in his review of the ZX-81 in the June 1981 issue, that it is almost impossible to Peek and Poke the display is patently an exaggeration. The general case is to Print spaces over the whole area to be used for display at the beginning of the program. Using the knowledge that the start of display-file address is contained in bytes 16396, 16397 Poking becomes relatively simple. Incidentally, 16396 is misprinted as 166396 in the manual. This information and other useful addresses are, of course, in the manual in the system variables' table.

To leave Input, the Stop — shift A — key will work for a numerical input. In the case of string input, Rubout the quotes on the Input prompt, then use Stop.

With regard to the use of a non-standard set of character codes, I cannot imagine the average purchaser of a ZX-81 knowing the ASCII codes.

I fear that ZX-81 owners may become like those who have owned and loved Citroen cars, regarding their idiosyncrasies as that little extra *Je ne sais quoi* rather than a disadvantage.

Guy Morgan,
Pontyclun,
Mid Glamorgan.

Ada advantages

WHILE I AGREE with a number of the criticisms of Pascal made by Raymond Anderson in May 1981, there are a number of errors which should be noted. These mainly arise because Pascal implementations do not yet conform to the ISO draft standard. The validation suite, currently available from NPL, is now being updated to the new standard so that it will be possible to check compilers for conformance with the standard.

The specific points to be considered are:

- An array parameter can have a variable size in Level 1 ISO Pascal. This is the conformant-array parameter facility. It will allow Pascal programs to call NAG routines in many implementations.
- The mark-and-release storage mechanism is not part of the standard because of its inherent insecurity.
- ISO Pascal requires that procedure parameters have their own parameters specified so that this is no longer an insecure feature.

As a final point, all of Anderson's objections to Pascal are overcome in Ada. Until Ada compilers are widely available, Pascal is the obvious choice in many circumstances for both micros and mainframes.

Brian Winchman,
National Physical Laboratory,
Teddington,
Middlesex.

Flashing mystery

INCLUDED in the Tandy Forum column of the June 1981 issue of *Practical Computing* was a short program listing to provide the TRS-80 with a flashing cursor. I was very eager to read this because, although a simple aid, a flashing cursor enables one to see the cursor position much more easily.

Unfortunately, to my dismay, after entering first the Basic program and later the assembly language listing with the aid of an editor assembler, I found that with both programs, my machine jumped immediately to the "Mem Size?" question.

I would be very pleased if anyone could possibly help me with the problem as I cannot see why this should occur. The only solution I thought may lie in the fact that my machine is equipped with the new ROM and possibly the ROM-keyboard driver address may lie in a different address than that stated in the listing.

Graham Nichols,
Cheadle,
Cheshire.

Controlling Pascal

I BELIEVE there may be a very nasty bug hiding somewhere in the system software provided by Sorrento Valley Associates with the Disc 2+2 Auto-Boot Controller Card for 8in. disc drives, when working in conjunction with the Apple version of Pascal.

I used an Apple micro with an SVA card, 8in. discs — they were un-named but I believe they were of DRG manufacture — running under Apple Pascal Version 1.0, on a relatively large, stock-control system. The problem manifests itself as an infrequent but repetitive and potentially fatal loss of volume directory, although not necessarily on the same volume.

The program is well-proven on the Apple mini-disc system, and over the past 12-14 months of operating on a "pure" Apple system, the problem has never been encountered. However, this particular problem first occurred within hours of using Apple Pascal on the 8in. SVA system.

During program operation, there are several areas where data is read permanently to the disc, with a Close (File, Lock) and Re-set (File) operation it would appear that the fault occurs after the Lock, or at the Re-set operation. This is borne out by the fact that there is no loss of data after the volume directory has been restored. The problem announces itself with a

```
10 Error#10
'File Lost In Directory'
```

Thereafter, an examination of the volumes will show one or other has lost its directory, with

```
'No directory on volume'
```

Until now, we have been able to rescue the files, since we have kept a listing of the directory, and use of the Pascal Filer Zero and Make commands have helped us to restore a working directory.

The fact that we have been able to recover the data is in itself interesting, since it implies that the directory blocks and tracks have not been damaged, and moreover, that the format of the discs has not been upset. We have been in touch with Microsense, whose only comment was that we should not use non-Apple accessories, and, apart from that, was unable to offer any advice.

The supplier of the SVA card and the disc drives, has been far more helpful, but as yet unsuccessful in finding the cause, let alone a solution. Our conclusions are:

- Since we have not run the program on any systems other than a "pure" Apple and this particular make of drive, we cannot be certain that it is not the drives themselves.
- That the tracks on the discs are undamaged suggests that the read-heads are not touching the discs, and in any case, the problem is occurring on more than one volume.
- The drives have been changed, as has the SVA card and connectors, eliminating the possibility of a rogue set.
- The disc media have been changed, as has the make of disc.
- To the best of our knowledge, the problem has not yet occurred in any form on a Basic disc, and we conclude, therefore, the problem is Pascal-based.
- We do not completely eliminate our software, but since we are experienced in Pascal programming and have several versions of this one running on standard 5.25in diskettes without problems, the program being the cause seems improbable.

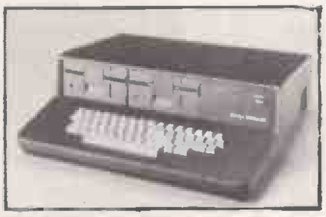
I shall be pleased to hear from anyone who has experience of these drives.

K D Howton,
Southport,
Merseyside.

The British answer to imported best-sellers

A NEW venture has been set up to manufacture and sell a British microcomputer, designed to compete with international best-sellers like the Apple and the Pet. The machine is the Z-80-based Gemini 801 which was originally launched at Compec 80, and has since been modified.

British Micros is the new name behind the Gemini microcomputer and was formed when John Marshall, managing director of Gemini joined forces with Manus Heghoyan of Hegatron (EC) Ltd of Watford. The new company will be based in Watford, Hertfordshire. John Marshall told *Practical Computing*: "When we launched the Gemini at Compec, we anticipated total orders of about 20 per month which was well within our capacity. I was soon disabused of this idea when advanced orders exceeded 200 a month.



The Gemini 801.

"In-house production plans were shelved while I investigated potential backers. This was a fortuitous respite because we discovered that the computer-drawn artwork for the main board was full of bugs. It has now been manually artworked and is perfect.

"About three months ago I met Manus, following the setback of his plans to buy my old company, Nascom Microcomputers — now owned by Lucas. Fortunately, he was still interested in acquiring an interest in microcomputers and our discussions have led to the official launch of British Microcomputers".

The Gemini microcomputer is competitively priced at £1,195 plus VAT, which is for a complete system less the video monitor. Software is at present being developed for the system, although the machine is supplied complete with CP/M and a 24K Microsoft Basic, Microsoft Cobol, Fortran and a special APL will all be available as well.

Contact British Micros, Unit 2, Penfold Works, Imperial Way, Watford, Hertfordshire. Telephone: 92-48222.

Reading that matters

ZILOG, the manufacturer of a wide range of microprocessor hardware products, has produced the 1981 edition of the Zilog Data Book. This volume will form an essential part of any professional's library — especially those involved in the hardware aspects of microcomputing.

More than 500 pages, and nearly 1in. thick, this substantial tome contains complete data sheets for Zilog's popular eight- and 16-bit micro families. The Z-8, Z-80 and Z-8000 ranges are all represented, together with development systems, industrial microcomputer boards, memory and additional relevant information.

At £2, this book represents one of the best buys possible in microcomputing. For a copy, contact Zilog, at Babbage House, King Street, Maidenhead, Berkshire, SL6 1DU. Telephone: (0628) 36131.

Typesetting standards

ANYONE in microcomputing whose business calls for typesetting must have wished that the text files produced by a word processor could be transferred straight into a photo-typesetting machine by telephone or from discs sent by post.

Although there is no great problem in principle — all you need is two MODEMs or audio couplers — in practice, it is hard to find a printer of the human kind who has fought his way through the jungle of incompatible formats and codes to make the whole operation work.

Worse still, even if someone could do it, dire trouble was to be expected from the print unions who tend to look askance at any new technology which reduces work for their members.

However, a printer has now emerged from this jungle — sweating slightly — equipped with an extremely fast Linotype-Paul photosetter and a genuine NGA badge. The man to talk to is Tom Graves at Wordsmiths, West End, Street, Somerset. Telephone 0458-45359. He is prepared to accept copy on certain formats of floppy and by telephone.

Inexpensive channel to micro communications

COMMUNICATION between computers is destined to become one of the major growth areas in the near future. The least expensive official way of doing this is to use a MODEM and the public telephone network. Peripheral Hardware Ltd has pre-empted the boom and now provides two acoustically-coupled telephone MODEMs.

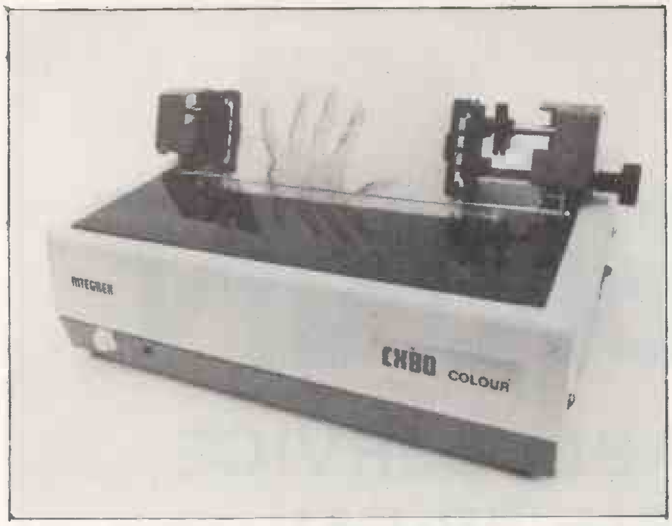
The Sendata Model 700 is the smallest and lowest-cost acoustically-coupled telephone MODEM on the market. Weighing a mere 0.5kg. and measuring 24x6x10cm., the Sendata 700 costs only £169. It features two independent cups which connect on to the telephone handset. Power is received directly from the interface output voltages of the terminal and it will operate at a maximum data rate of 1,200bps. It is CCIT V24/RS232-compatible.

The Sendata model 1080 is an acoustically-coupled telephone MODEM which has a data transmit/receive channel at a speed of up to 1,200 baud, and an independent transmit/receive channel of up to 75 baud per second. The 1080 is portable and weighs only 2kg. It is enclosed in a 280x110x200mm. box to ensure high-noise immunity. It is CCITT V24/RS232-compatible.

Various other configurations are available. 1,200bps transmit only, 75bps receive only and 1,200bps receive only, 75bps transmit only.

Peripheral Hardware Ltd can be contacted at Armfield Close, West Molesey, Surrey KT8 0EA. Telephone: 01-941 4806.

Sendata 700, the lowest-cost MODEM available.



The CX-80 printer is an 80-column, dot-matrix printer which prints in six colours plus black. Working at speeds of 125 characters per second, the CX-80 contains 96 ASCII and 64 Pet graphics characters in ROM. Dot-addressable graphics control is possible, together with double-width and reverse characters, and 15 user-programmable characters. All these features can be accessed via Basic or machine-code programming. The characters are printed uni-directionally using a five-by-seven dot-matrix — six-by-seven for graphics — and a two-line buffer is provided. The IEEE 488 interface enables the printer to be used in the normal manner. The printer is expected to find many applications, especially in the commercial, educational, medical and scientific areas. The printer costs £895 plus VAT, and is available from Davidson-Richards Ltd, 14 Duffield Road, Derby DE1 3RB. Tel: (0332) 366803.

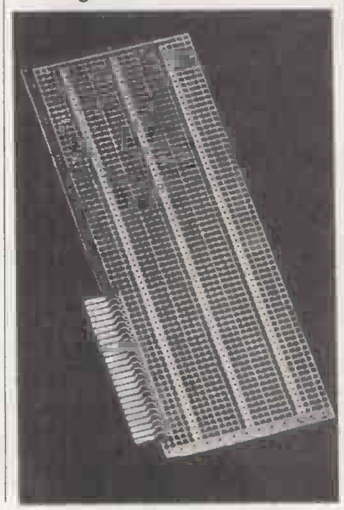
Industrial kit suits systems engineer

ONE OF the most important applications of microcomputers is in the field of industrial automation. Process control, process monitoring and data logging are typical industrial uses. A complete system, however, requires many items of hardware in addition to the main processor.

Interface 80 is a comprehensive range of low-cost, standard products for the do-it-yourself systems engineer in industrial, research or academic institutions. The total package includes a users' manual and specially-written software. It is designed to meet the needs of the engineer who has a working knowledge of computers.

The basic module of the Interface 80 is the Mini-Rack unit. It is a robust frame containing an IEEE decoder, power supply and five pre-wired slots to accept the Machsize circuit boards. The rack will be suitable for use with those computers equipped with an IEEE 488 port.

The Mini-Rack is suitable for use in the harsher industrial environment. Made of sturdy aluminium, the overall dimensions are 8x6½x9in. The rack can either be free-standing or it may be put together with the processor. The price of the Mini-Rack complete with the IEEE decoder and power supply is £350. Machsize Ltd are at York House, Clarendon Avenue, Leamington Spa CV32 5PP. Telephone: (0926) 312542.



Apple users interested in experimenting will be interested to hear of an Apple-compatible prototyping board which is now available from Vero Electronics Ltd. Developed from the successful Vero Microboard pattern, the board is made from copper-clad Epoxy fibre-glass material. Vero claims the new board will sell for half the cost of rival boards. The board has been specifically designed for hard wiring and includes an unusual colander ground plane for maximum screening, a gold tongue, and complete solder-mask protection. Contact Vero on (04215) 2956.

Structured language for Open University

THE OPEN University is to develop a structured language for teaching programming. The new language, OUSBasic will be implemented on the Open University DEC-20 system, and will become available in 1983. Specified by the mathematics department, the language is being developed by SPL, a software house from Abingdon.

OUSBasic is designed to "give students new to computing, and who have to learn by distance-teaching techniques or with little face-to-face tuition, an understanding of programming language fundamentals". The language is not, however, intended for use just by beginners. Eventually, courses aimed at a much higher level will use it.

The need for a new language arose because the university "did not consider the Basic language adequate". The main problem encountered with Basic was its unstructured nature. As with most structured languages, control is by loops such as While/Until rather than Goto, and conditionals such as If-Then-Else-Ifend and so on.

A day to be remembered by ZX-80/81 enthusiasts

SATURDAY, September 26 will be a red-letter day for ZX-80/81 fans. On that day the world's first ever ZX Micro Fair will be held at the Central Hall, Westminster, London.

Because the fair is not a commercial enterprise — it is run by an enthusiast for enthusiasts — it will not make a profit. The most obvious advantage of this will be the absence of an admission charge. The cost of the hall will be met by individuals or groups hiring tables at the fair at a cost of only £15. The idea is, because of the large concentration of ZX users in a small area at one time, people trading at the tables will soon be able to recover the small outlay.

There will also be a bring-and-buy-sale, which is designed to attract people who wish to sell ZX-80s or 81s. Those wishing to buy, but who are not able or willing to wait for their machines will therefore be catered for.

Other attractions will include various club and user-group stands and a bewildering array of products available for use with the ZX-80 and 81 computers. These include; floppy discs, Macronics high-resolution graphics, the Quicksilver character ROM. There will also be plenty of people on hand to answer your questions.

The show will be held at Central Halls, Westminster, London W1. The organiser is Mike Johnston who can be contacted to book tables, etc., on 01-801 9172.

Servicing agreements are ABC micros' strong point

THE LATEST Japanese import to reach our shores takes the shape of the ABC micro. In effect two machines, the ABC-24 and the ABC-26, with the only difference that the 24 has 5.25in. discs and the 26 8in. discs. The specification is standard; Z-80A CPU, 4MHz operation, 64K of RAM and so on.

The feature which makes this machine stand out from the crowd has nothing to do with the software or the hardware. It is the servicing agreements: after the initial six months' free warranty, a comprehensive service contract can be bought for around 10 percent of the original cost of the machine. This on its own would mean little, but Ai Microcomputers has a trained network of 40 engineers who will turn out within four hours of a service call.

Ai's ABC-26 micro.

Ai has managed to arrange this service engineering force by an understanding with another Japanese subsidiary TEC which is one of the largest importers of cash registers. The TEC support and servicing facilities, already well established throughout the U.K., will, therefore, provide this high level of servicing.

The ABC-24 costs £3,195, the ABC-26 £4,250. As usual, memory expansion is available either in steps of 64K of RAM, or by an add-on Winchester hard disc. Communications are another strong point of the Ai computers. Twin RS232C serial ports, with sdlc/hdlc capabilities, CCITT V24 standards and twin parallel ports together with the IEEE 488 bus, should ensure that the computer will interface to anything.

Ai Microcomputers can be found at the Thames Industrial Estate, Marlow in Buckinghamshire.

Apple helps chemists swallow stock control's bitter pill

A COMPUTER system is now available for chemists. The system is designed to run on the Apple computer and was developed in response to a need for a reliable stock-control method. In addition to the stock-control function, the package is capable of printing clearly all medicine labels.

The system has been developed by Micro Management of Ipswich and a package has already been supplied to a local pharmacist. The functions performed by the system are: a printout of the medicine label giving name, strength, and reference number; a manufacturer's reference number and drug reference number; the ability to print drug sales after a specific period, either by manufacturer or drug name; an infallible memory, ensuring that low-quantity drugs, the rarely-needed lifesavers, are not overlooked.

Apple as chemist's aid.

The system, including the Apple computer, a printout and program tailor-made to the customer's requirements, costs around £2,500 plus VAT. Some of the additional benefits of installing such a system were outlined by the director of Micro Management, Brian Cook: "The chemist can avoid being overstocked. A recent report showed that the average chemist is overstocked by some £10-15,000 a year, so that at current interest rates the package will pay for itself, irrespective of everything else".

Micro Management is at 32 Princes Street, Ipswich, Suffolk. Telephone: Ipswich (0473) 57871.

Touch-screen VDU

THE TT-100 touch-screen VDU from Interaction Systems requires no keyboard or light-pen to operate it. Commands are received by the operator touching any of the 32 zones on the face of the VDU.

An overlay attaches to the front of the VDU screen, embedded wires form a matrix of 32 touch zones. When a zone is interrupted by the touch of a finger, a signal is decoded and sent to the CPU. The product will be of most use in those applications which require the interaction of the general public and microcomputers, for example at a library.

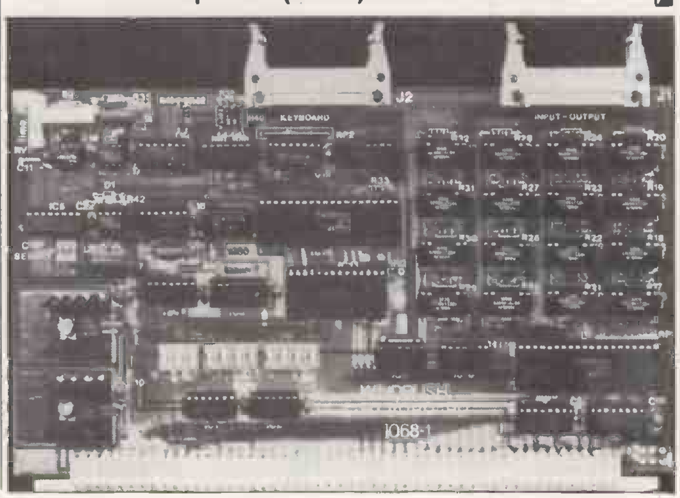
The U.K. distributor for the touch-screen VDU is Keating Computer, 42 Koll-Beck Avenue, Brampton, Barnsley, South Yorkshire.

Hi-Tek and Z-80B

HI-TEK has announced the introduction of the Z-80B, a high-speed version of the industry-standard Z-80 microprocessor. The new version runs at 6MHz as opposed to the usual 2.5MHz. In all other respects the two devices are identical, and the device is compatible with the Z-80 family of peripherals.

The device is available from Hi-Tek Distribution Ltd, Trafalgar Way, Bar Hill, Cambridge CB3 8SQ. Telephone: 0954 81996.

This is the Real World Interface from Windrush Micro Designs Ltd. Designed for use in S-50 based 6800 and 6809 microcomputer systems, the board will interface a microcomputer with industrial-control systems. Designed and manufactured in the U.K., the interface board has eight channels of relay or optically-isolated input and output. There is an eight-by-eight software-driven keyboard matrix encoder. A three-channel programmable timer completes the board. Windrush Micro Designs Ltd is at Gaymers Way Industrial Estate, North Walsham, Norfolk NR28 0AN. Telephone: (06924) 5189.



New range accompanies new name to micro field

KONTRON is a new name in microcomputing, even though those readers involved in electronics will find it familiar. The launch of the company coincided with the launch of an entire range of microcomputer equipment.

The flagship of the Kontron range is the Kontron PSI-80 microcomputer. It is a compact desk-top system and will find applications in business, scientific and engineering environments. The system is a CP/M-compatible machine, which supports a plethora of languages including both the compiled and interactive forms of Basic, Fortran, Cobol, Pascal and assembler. This means that there is a wide base of available software ready for the machine.

Systems are available with single or dual floppy discs, either single- or double-density and if required, add-on Winchester hard discs with a capacity of 10Mbytes and a wide range of plug-in boards. Users who require a large on-line database will find the integral 5Mbyte Winchester an attractive option.

Another Kontron product is the Micronet which will connect several PSI-80s together. Networking and time-sharing systems are an exciting and useful way of increasing computing power for a small outlay — a possible alternative is to link the Kontron to a mainframe.

The KAP 1000/2000 data acquisition system is an industrially-orientated computer system similar to the PSI-80 desk-top computer. It is packaged for the industrial standard 19in. rack mounting. There is capacity for up to 80 analogue inputs, 20 analogue outputs and 160 digital input/outputs.

A range of more than 40 units, supplied in the Eurocard format is being introduced at the same time as the other products. Based on the Z-80A microprocessor, the boards are for high-performance, applications-orientated systems. The boards also add flexibility and expandibility to the PSI-80 and the KAP microcomputers.

Processors, memory-extension boards, various interfaces are just some of the range now ready. For information and further details contact Rodney Howlett, marketing manager, Kontron Electronics PO Box 183, 11 Greenhill Crescent, Holywell Industrial Estate, Watford, Hertfordshire WD1 8XQ. Telephone: Watford 45991.

CP/M users' groupings

AT ITS annual general meeting, the CP/M users' group resolved that membership be split into three classes as follows:

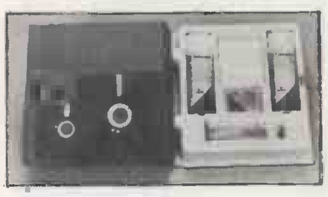
	U.K.	Overseas
Individual	£6	£10
Corporate	£15	£19
Vendor	£50	£54

The group can be contacted on 01-247 0691.

The Altos ACS 8000-10 is available in two versions. Both incorporate a new design of circuit board together with separate controller boards for 8in. Winchester hard disc and mag-tape back-up unit. The version designated 8000-10 is immediately available. It comprises a double-density 8in. floppy disc drive and a 10Mbyte 8in. Winchester hard disc in the one box. A substantial 208K of RAM is included so that four users may run jobs simultaneously under the MP/M operating system. One parallel and six serial ports are included for input and output together with a RS422 network port for future use. The other version is the 8000-10 MTU and is similar to the 8000-10, except that the 8in. floppy disc unit is replaced by a mag-tape cartridge back-up device. The operating system is booted from the Winchester. Logitek is available on 025-72 67615.

Cleaning package

AUTOMATION Facilities provides a selection of cleaning products for computer and word-processor users in a handy bookshelf kit. The kit includes: Safeclene tape-drive



cleaning fluid, Safebuds cotton bud sticks, Safewipes lint-free cotton squares, Foamclene anti-static foam cleanser to remove grease, dust and dirt from keyboards, plastic covers and case; spun-bonded Safecloths and Safeclens anti-static VDU screen wipes. Also is the Floppiclene Flexible disc/diskette head-cleaning system for 8in. or 5.25in. drives.

For further information and a list of distributors, contact, Mrs P Kingsbury, Automation Facilities Ltd, Blakes Road, Wargrave, Berkshire. Telephone Wargrave (073 522) 3012.

Publicans make moves to put computers behind bars

MANAGING a public house or a club is no easy matter. Not only does the landlord have to keep track of a multiplicity of drinks dispensed, via a host of tills and a variety of staff, but he also has the worry of a phenomenon euphemistically known as slippage. As a remedy, the MKR group of Worcester Park has developed a computerised bar-management system.

The Microptic bar-management system is envisaged as a major development in bar-management techniques. Designed to control losses and provide detailed management information from an analysis of accurately-recorded sales transaction data. In plain English, the system notes each drink that is sold as it is sold.

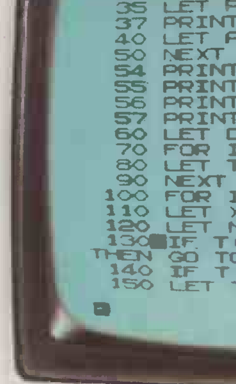
The entire system is centred on a dedicated microprocessor which is sold complete with keyboard, monitor, printer and a real-time clock. A floppy-disc unit can provide a facility for the collection and storage of data. The other important component of the system is the measuring device.

There are two types of measuring device, an optic with a passive-sensing device attached, and a flowmeter for measuring the amount of beer dispensed. While bar staff may resent what the existence of such a system implies, MKR justifies the concept because of the huge losses of revenue the industry suffers each year. Furthermore, breweries and landlords introducing the system have negotiated new rates of pay with the staff involved.

MKR Holdings Ltd, 6 Park Terrace, Worcester Park, Surrey. 01-337 4444.

● Circle No. 141 ▶

New! Sinclair ZX81 Personal Computer.



Kit: £49.95 complete

Built: £69.95 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.

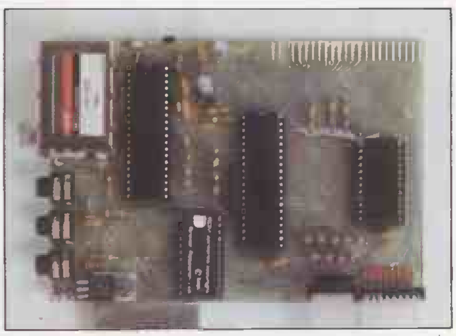
Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

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!

Kit or built – it's up to you!

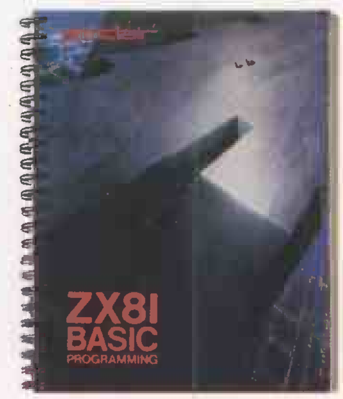
The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with 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.

Vlasak Computer Systems

VLASAK COMPUTER SYSTEMS
Vlasak House, Stuart Road, High Wycombe, Bucks HP13 6AG
Telephone: High Wycombe (0494) 448633

COMPUTER RETAILERS ASSOCIATION MEMBER CRA

● Circle No. 143

Few pieces of software in the history of computing can have aroused as much interest as The Last One, the program which is said to make it possible for anyone with a smattering of programming experience to write sophisticated applications packages. We delve behind the publicity campaign and assess the development version.

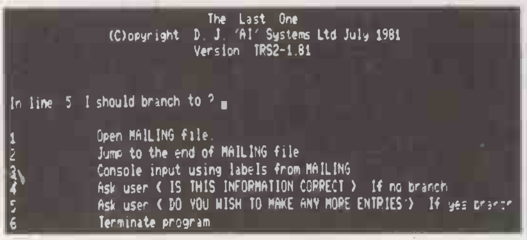
The Last One

by Peter Laurie

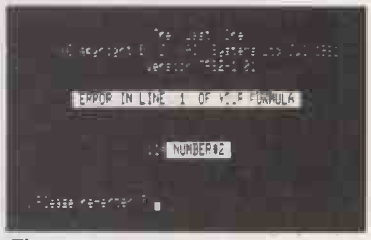
SO FAR The Last One has proved to be something of a mystery. A few people have even suggested that it does not exist; that it is a joke of some kind. I have had the chance to see it and use it: The Last One certainly exists and is no joke. In essence, it does all the chores which consume so much time in writing applications software. It sets up the files, creates a screen for entering data, and allows the user to specify his program through a kind of flowchart. At the end of all this, it goes away and writes a complete program in Microsoft Basic which can be saved and run just like any other. Given a fair wind, you could write a complete mailing list program in about an hour.

Program generators have been around for some time in the big-computing world, with more or less success. So the idea of The Last One is not unique or even particularly novel. However, it is one thing to write a program generator for use by professional programmers on a machine with virtually unlimited RAM and disc; quite another to squeeze the whole thing on to a micro in such a way that the cash customer can get to grips with it.

There is certainly some very clever code in it and one can believe the publisher's claim that it is the result of seven years' work by David Jones, the main author. However, it is open to doubt how far The Last One will make computing accessible to people who know nothing about it. Although the fiddly details of coding are done automatically — as if by a dogged but rather stupid assistant — the user still has to appreciate the basic syntax of programming. That is, he has to understand concepts like: program execution flowing through a listing — however simplified — of test and branch, of files and fields.



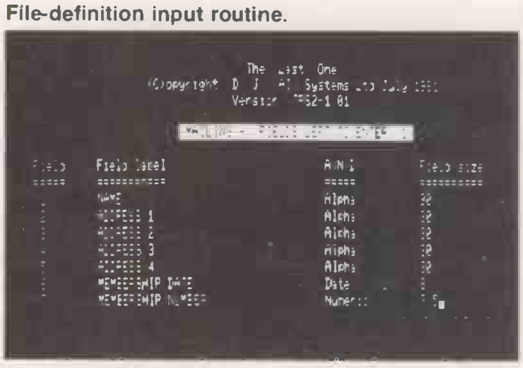
The branch-sorting routine.



The error message.

A typical sub-menu.

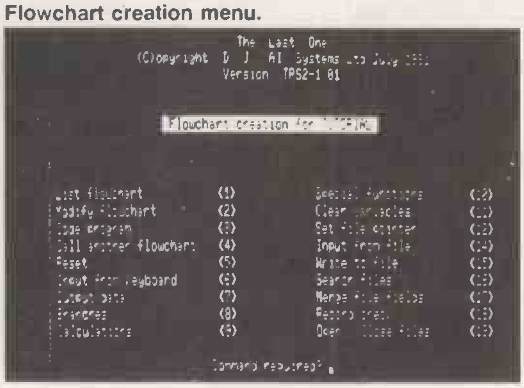
File-definition input routine.



A complete flowchart.

Main dispersal menu.

Flowchart creation menu.



In many ways, The Last One looks more like The First One — the start of a line of software that may, in five or 10 years' time, produce code which is truly useful to the incomputerate — if there are any by then.

Certainly, The Last One demonstrates the way the software market is fast becoming like the pop-music market. Given the rapidly-growing size and value of the microsoftware market, products need pop-style hype to be marketed successfully. Few programs have been hyped as energetically as this; rumour has it that $1million has been spent on advertising The Last One, and that when a sales office opened for business on the West Coast in the middle of this year, it took $9 millions' worth of orders in two weeks.

Whether there will be a corresponding number of happy customers may be another matter. The copy I saw was a development program, but there were many bugs in it. None of these bugs looked very serious in itself, but when a program as big and complex as this is infested, the seriousness of bugs goes up in proportion to the square or cube of their number.

Furthermore, the First Law of Computing applies:

The last N% of the work on any program takes (100-N)% of the time.

This tells us that every program takes an infinite time to write — which must be true, for the Second Law says:

No program is ever finished

Of course, programs are finished enough to be sold and used and no doubt The Last One will eventually be reduced to this happy state. In the mean time, however, it may become caught in the scissors of over-selling and under-development. If this happens, we would hope that people who may have doubts will be patient, because it clearly has many highly-promising features.

Apart from bugs, it looks as though there is a good deal of work still to be done on the design of the system. Once away from the program's entry points, there seem to be some convolutions in the user-interface.

Sharp MZ-80B

Mike Hughes reviews the latest small-computer system from the well-known and reputable Japanese company.

THE MZ-80B comprises a Z-80A microprocessor and associated electronics together with an 8in. green video display, an 1,800 baud cassette deck and a 59-position conventional QWERTY keyboard with extra keys for a numeric pad, cursor control, tape control and 10 user-defined functions.

All this is contained in a most attractive silver-and-black, rigid-plastic cabinet measuring 260mm. high by 43mm. wide by 52mm. deep. For review purposes, we used a Sharp MZ-80 FB twin double-sided disc drive and the Sharp MZ-80 P5 tractor-feed, dot-matrix printer.

The computer is a stand-alone unit and program and data storage is adequately catered for by the internal cassette drive. In this mode, it falls into the general category of personal computer with its 32K — optional 64K — of memory, a page-addressed, memory-mapped 2K VDU and a bootstrap loader in ROM which is selected from the memory architecture once a system has been loaded from tape.

An optional six-slot, busbar-extender unit can be added internally which will accept cards to drive other peripherals — in our case, we had the disc controller and the printer interface. Furthermore, one has the option of adding two 8K high-resolution, video-RAM cards which supplement the normal character VDU to allow you to superimpose two pages of graphics on the composite display whenever you want. Like the normal VDU, these two graphics RAMs are page-addressed. When this composite system is assembled, it presents the user with a very high-potential configuration.

The documentation of hardware and software is modularised. For printer and disc drive, there are simple instruction leaflets describing how to insert the respective interface boards and attach the external units. Also supplied are incredibly-detailed service manuals containing full circuits, board lay-outs and exploded mechanical drawings as well as trouble-shooting algorithms and parts lists.

The owners' manual deals with initial installation of the computer and gives a brief overview of the system architecture including the functions of the 8255 programmable peripheral interface, the 8253 programmable interval timer and the Z-80A-PI/O parallel I/O interface controller.

Almost half the manual is devoted to the Z-80 instruction set, timing wave forms for the Z-80 and similar matters relating to the PI/O. The computer's service manual leaves nothing to the imagination and contains full drawings, lay-outs and parts lists.

There is no resident software apart from the bootstrap ROM. All system software is supplied either on tape or disc, depending on your system configuration. We were supplied with the Sharp SB-5510 Tape Basic which includes the SB-1510 Monitor and the SB-6510 Disc Basic together with the same Monitor in disc format.

The monitor and Basic must be present in RAM concurrently as the monitor contains all the communications utilities. Each of these packages is provided with its own detailed user manual.

As well as the system software, the disc contained utilities for disc formatting and disc copying together with a set of programs designed to demonstrate the graphics capabilities of the machine.

From the documentation we were given, it appears that software for an assembler and Pascal is available but, rather surprisingly, no mention is made of a user-accessible disc-operating system. The monitor and Basic are loaded automatically — as soon as one has responded to the bootstrap's request "Disc or tape?" and any operating system which exists is transparent to the user.

The internal hardware is, at first glance, straightforward, but closer investigation reveals some extremely cunning features — associated mainly with page-addressing. Good use is made of the PPI and PI/O to organise and re-organise the system's memory architecture by means of I/O commands.

At power-on, the memory is organised for the IPL, Initial Program Load, in which the bootstrap ROM is switched into the architecture starting at address 0000H. To accommodate it, the bottom 32K of system RAM is moved upwards to start at address 8000H and, if the system has a full complement of 64K RAM, the top 32K is switched from the memory map.

During IPL, the system program is loaded into RAM starting at address 8000H. On completion of the load, the architecture is switched to remove the bootstrap ROM and change the start address of the RAM which now holds the system program so that it resides from address 0000H upwards. For a 64K system, the top 32K is switched back into the map providing an uninterrupted 64K of RAM from 0000H to FFFFH.

The normal character-display RAM generates a screen containing 24 lines with 40 characters per line but this can be altered through software — bit 5 of the PI/O port A — to give 80 characters per line. Normal or reversed-field characters can be displayed.

When operating with 80 characters per line, the 8in. screen's readability is considerably impaired, but is adequate for short periods of use. It might, however, give eyestrain to anyone using the system for long periods.

ABS	IMAGE/P	REM
ASC	INP	RENAME
ATN	INPUT	RESET
AUTO	INPUT #	RESTORE
BLINE	INPUT/T	RESUME
BOOT	INT	RETURN
CHAIN	KILL	REW
CHANGE	KLIST	RIGHT$
CHARACTERS$	LEFT$	RND
CHR$	LEN	ROPEN #
CLOSE	LET	ROPEN/T
CLOSE #	LIMIT	RUN
CLOSE/T	LINE	SAVE
CLR	LIST	SAVE/T
CONSOLE	LIST/P	SET
CONT	LN	SGN
COPY/P	LOAD	SIN
COS	LOAD/T	SIZE
CSRH	LOCK	SPACE$
CSRV	LOG	SQR
CURSOR	MID$	STEP
DATA	MON	STOP
DEF FN	MUSIC	STR$
DEF KEY	NEW	STRING$
DELETE	NEXT	SWAP
DIM	ON	TAB
DIR	OUT	TAN
DIR/P	PAGE/P	TEMPO
END	PATTERN	THEN
ERL	PEEK	TI$
ERN	POINT	TO
ERROR	POKE	UNLOCK
EXP	POSH	USR
FAST	POSITION	VAL
FOR	POSV	VERIFY
GET	PRINT	WOPEN #
GOSUB	PRINT #	WOPEN/T
GOTO	PRINT/P	XOPEN #
GRAPH	PRINT/T	
IF	READ	

Table 1. All the reserved words of the disc-Basic interpreter SB-6510.

The keyboard is operated as an I/O device via a matrix of output and input signals from the remaining bits of PI/O port A and the whole of port B which is pre-set to be an eight-bit wide input port.

The programmable peripheral interface chip is organised as two output and one input port which issue control instructions to the cassette drive: Stop, Play, Fast Forward, Rewind, Motor On/Off, Eject Tape, Write, Read, etc., the display, Reverse Video, the sound-generator gate and the front panel LED indicator lights.

All control of the cassette is via electronics or electronic-driven solenoids and, therefore, it becomes a simple matter for Sharp to provide software control of all the functions. The front-panel tape controls all operate through logic gates.

The square wave generated as a sound source by the PPI is fed via a panel volume control through a small power amplifier to an internal 32ohm loudspeaker which generates enough noise to be a confounded nuisance if the system falls into the wrong hands.

Depending on the condition of bit 7 of the PI/O port A — pre-selected to be an output port — addresses from D000H to FFFFH can be switched to the normal contiguous system RAM or to the video-RAM area which comprises a straightforward ASCII character display RAM and two other RAMs which are used to store graphics in dot matrices of 320 by 200 dots' resolution.

The character RAM occupies from D000H to DFFFH while the two graphics RAMs sit in parallel on addresses E000H to FFFFH. The video RAMs are normally being scanned to produce screen refresh data but either or both of the graphics areas can be switched in or out depending on the state of output port F4H.

By a combination of output commands to port A of the PI/O and port F4H, the video RAM can be switched into or out of the memory map and, when switched in, any one of the three RAM areas can be selectively written to or read from. It is, of course, possible that some large programs might contain video driving routines which lie in the area of D000H upwards. This could be embarrassing as this part of RAM is switched out during video access operations.

To overcome the problem, as if life is not complicated enough, a further line — bit 6 — of the PI/O port A will block-move the start address of the whole video RAM area down to 4FFFH.

All this is performed by the slick simplicity of a custom-built chip which, as well as producing the complex select signals, also generates row address selects for the

(continued on next page)

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four banks of 4116 D-RAMs which constitute the system memory.

Interfacing to the peripheral printer and disc drive is simplicity itself — umbilical cables with polarised plugs. The only problem is that a separate mains lead is required for each unit and a short earthing braid has to be connected between the computer and each peripheral. This is particularly annoying as it limits the separation of the units to only a few inches.

Although we were supplied with both tape and disc forms of Basic. we concentrated on the use of disc Basic for the purposes of the review. To load required the software disc to be inserted and the IPL program in the bootstrap ROM assumed control.

Loading was fully automatic and required no special commands to a disc-operating system; loading time was negligible — just a few seconds as opposed to about 1.5 minutes when loading Basic from tape.

The Basic system software consists of two parts: a monitor containing communication subroutines and other utilities which the Basic interpreter calls on from time to time, as well as a set of rudimentary commands which can be accessed by the user for de-bugging purposes and the Basic interpreter itself.

After initialisation, control passes straight to the Basic command mode which permits all the normal "immediate" commands as well as a number peculiar to the Sharp. One such command is MON which transfers control to the monitor with six command options invoked by single depressions of the prescribed alpha key:

M; permits inspection and change of Hex data in any address location.

D: Gives a Hex dump of memory between any two specified addresses. It is a very simple dump with eight values per line — ASCII codes are not decoded. Long dumps can be temporarily paused for inspection by holding down the spacer bar.

J: Transfers program control to any specified address location and is the only way control can be passed back to Basic — provided one can remember the start address of Basic — without doing another IPL.

S: Will generate a named file on cassette tape and save the contents of any specified block of memory on that file. If required one can specify a jump address to go with the file. If such an address is specified, execution from it occurs automatically after the file is loaded. Note that even with disc Basic, the monitor will only save a Hexadecimal file to tape. This is rather frustrating to the user and the only way to generate a machine-code disc file is to use the tape to disc-copy utility after executing the above routine.

V: Is a verify command which confirms that data on a cassette tape file matches the original data in the memory block from which it was saved.

L: Loads a named file from cassette tape into memory. If a jump address was specified program control is transferred automatically to that address, otherwise control is passed back to the monitor.

As mentioned, the functions of the monitor are extremely rudimentary and do not provide for setting break-points or displaying and changing register values.

The disc Basic SB-6510 is in a totally different class and contains no less than 118 keywords for commands statements and functions. These are briefly listed in table 1. Many are perfectly standard Basic words but the ones which carry out unusual operations on the MZ-80B are as follows:

Commands

DIR/P: Prints the file directory of a specified drive to the line printer.

LOAD/T: Loads Basic text from the cassette tape deck. The "T" differentiates between this and a load from disc.

SAVE/T: Saves Basic text to cassette tape whereas Save outputs text to disc.

VERIFY: Performs a comparison between data on cassette tape with that in the Basic text area.

MON: Transfers control to the monitor.

BOOT: Re-activates the initial program loader.

KLIST: Displays a list of the string definitions which have been allocated to the special function keys.

File-control statements

LOCK: A software write protect for specified files.

UNLOCK: Counteracts the effect of Lock for a specified file.

RENAME: Changes the name of a specified file.

DELETE: Deletes a specified file which has not been Locked.

CHAIN: Deletes current Basic program and loads a specified one transferring control to the new program.

SWAP: Like Chain, but saves the old program and when new program is completed, the old one is re-loaded and execution continues from where it left off — rather like a Call.

WOPEN: Creates a sequential-access disc file.

ROPEN: Opens a sequential-access disc file for reading.

XOPEN: Opens a random-access disc file for reading or writing.

WOPEN/T: Opens a sequential-access Tape file.

ROPEN/T: Opens a sequential-access Tape file for reading.

Other file statements ending with /T are associated with the cassette tape.

Definition statements

DEF KEY: Allows a string of text to be assigned to any one of the 10 special function keys. For example, allows Run to be a single keystroke operation if required.

Control statements

CURSOR: Moves the cursor to any position on the screen. The position of the cursor can be determined from the two system variables CSRH and CSRV — horizontal and vertical co-ordinates respectively.

CONSOLE: Has several functions: limits the number of lines which are scrolled; alters the number of characters per line from 40 to 80 or *vice versa*; reverses the display from light on dark to dark on light.

CHANGE: Reverses the function of the shift key for alphabetical characters.

REW: Rewinds cassette tape.

FAST: Fast-forwards the cassette tape.

TI: Sets the internal real-time clock.

MUSIC: Generates a melody from a string of data.

TEMPO: Sets the fundamental speed of playing music.

Graphic statements

GRAPH: Selects one or the other or both of the two graphic RAMs for writing to or displaying from.

SET: Puts a dot into a specified location in the operative graphics RAM.

RESET: Clears a dot from a specified location in the graphics RAM.

LINE: Draws a high-resolution bright line between specified points in graphics RAM.

BLINE: As for line but draws a black line.

POSITION: Used in association with Pattern to place a pointer to a position in the graphics RAM from where a pattern of dots is placed depending on the binary pattern of an ASCII data string. POSH and POSV are system variables defining position of the pointer.

POINT: Ascertains whether the dot at a specified location is set or re-set and allows a branch on the result.

Machine-Language statements

LIMIT: Truncates the amount of RAM available to Basic to leave space for user machine-code programs.

Printer-control statements

PRINT/P: Outputs all print statements to the printer.

IMAGE/P: Draws a dot pattern on the printer according to the value of the operand.

COPY/P: Causes the printer to copy either the current alpha-numeric character display or one or both of the current graphic diaplays.

PAGE/P: Defines a number of lines per page for the printer.

The Basic interpreter has obviously been designed to make full use of the very versatile graphics display hardware and with careful programming. the most stunning displays can be achieved. These are well illustrated by two of the example programs which are supplied — a spectacular Fruit machine with fruit-shaped fruit and an incredibly-detailed time zone map of the world with digital clocks showing the current real-time in various countries.

Conclusions

- **A very attractive computer with very powerful graphics capabilities. It is a pity that a full system involving discs and printer should need separate mains cables as this leads to an untidy set-up.**
- **While the Basic interpreter is perfectly adequate for most purposes — graphics handling is excellent — the built-in monitor leaves much to be desired. We have, however, been advised that Sharp is releasing CP/M configured for the MZ-80B so there will soon be a wealth of software — Basics, Pascals, Fortrans and assemblers which are well-tried and will run on the machine.**
- **The double-density, double-sided discs, although only 5.25in., provide very high-capacity program and data storage.**
- **Having the cassette-tape drive as well as discs is an agreeable luxury and offers an alternative medium, for back-up copies of valuable data.**
- **When operating with 40 characters per line, the screen is easily readable but, with such a small screen, the 80-character option creates a little eyestrain.**
- **Documentation — particularly for the hardware — is first class.**
- **It is hard to fault such a beautifully-designed machine which looks so stylish. It is a pleasure to handle and has so many useful and interesting features.**

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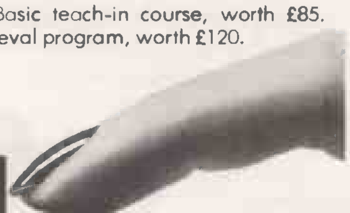

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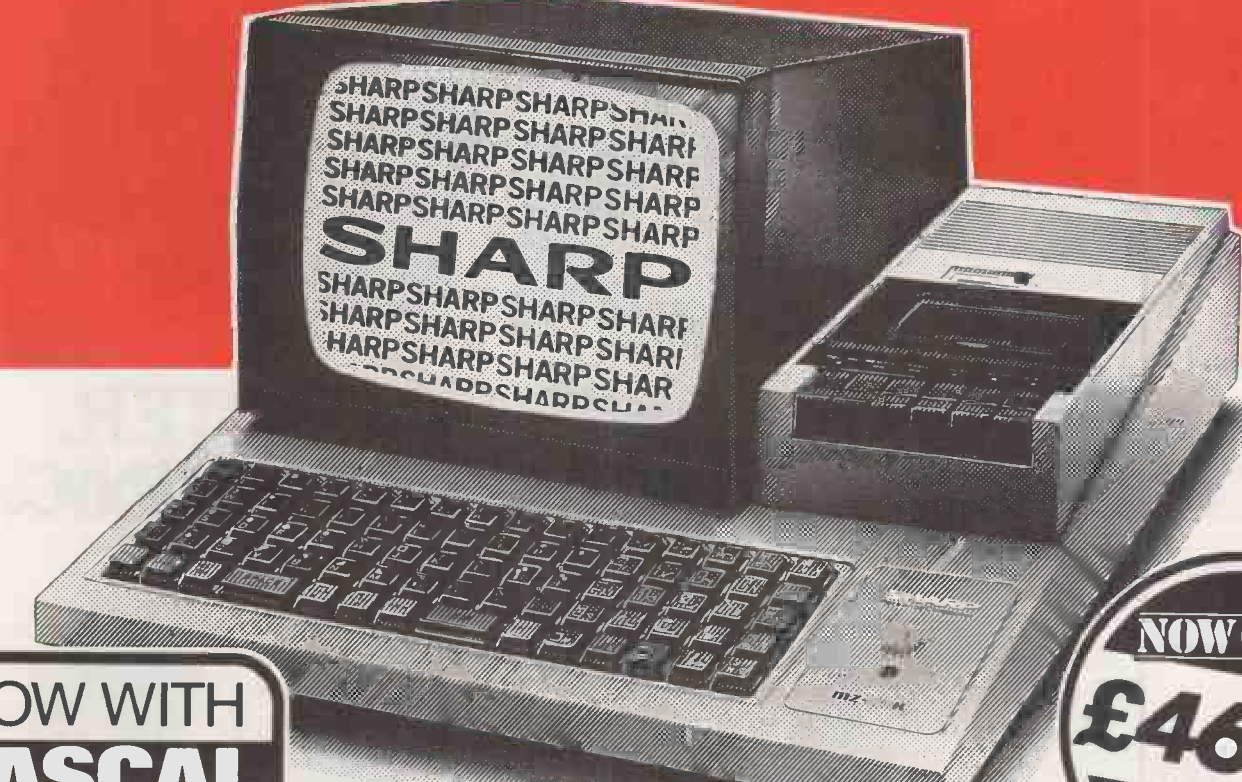

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● Circle No. 145

Shelton Sig/Net

by John Dawson

HIGH TECHNOLOGY in microelectronics continues to advance at breakneck speed along predestined curves for increases in chip-packing density, decreasing hardware cost, giga-MIPS processor speed, and all the paraphernalia of billion-dollar investment programs. Zero-cost processing is predicted for the end of the century and, maybe, negative-cost processing shortly after.

Once upon a time, computers were big and consumed a great deal of power. Then they were small and reached single-board proportions and the word was that computing power would be given to the individual. Now computing power is given to the individual. Yet often he must be a part of a multi-user microcomputer system. As computing power has increased, so has the temptation to regress into multiple usership of those parts of the system which are expensive enough to require sharing.

It is said that there are two groups of microcomputer cognoscenti in this country; those who were introduced to the subject by way of Commodore Pet and a second group who entered the microcomputing scene by buying and building a Nascom microcomputer. The first group are Basic-orientated systems users, while the second have developed an intense appreciation of hardware and Z-80 machine code.

Dr Chris Shelton designed the Nascom microcomputer. As the emphasis in microcomputing has shifted subtly from the individual owner using the machine in a domestic setting towards the application of microcomputers in offices and small businesses, so the single-board computer has declined somewhat in prominence, replaced by more powerful but more expensive machines.

Pin No.	Signal name	Description	Drive/ loading
1	DO	Data bit 0	MOS
2	GND	Ground	
3	D1	Data bit 1	MOS
4	GND	Ground	
5	D2	Data bit 2	MOS
6	GND	Ground	
7	D3	Data bit 3	MOS
8	GND	Ground	
9	D4	Data bit 4	MOS
10	GND	Ground	
11	D5	Data bit 5	MOS
12	IORD	Port Read	
13	D6	Data bit 6	MOS
14	DBDR	Data bus drive	
15	D7	Data bit 7	MOS
16	/Re-set	System re-set	O.C TTL
17	A0	Address 0	TTL
18	A1	Address 1	TTL
19	A2	Address 2	TTL
20	A3	Address 3	TTL
21	A4	Address 4	TTL
22	A5	Address 5	TTL
23	A6	Address 6	TTL
24	A7	Address 7	TTL
25	/IOWR	Port Write Strobe	TTL
26	GND	Ground	

Connector type: 26-way IDC ribbon cable connector e.g., RS 467-295
Pins are numbered with even numbers down one side and odd down the other. Coloured stripe on ribbon or arrow on connector indicates pin 1.

Figure 1. Sig/Net port bus allocation.

Single-board microcomputers have retained their popularity for the job they were first designed for — process control in industry — but the specifications for many commercially-orientated microcomputers now have a boring similarity, in the same way that the magnificent Bentley cars of the inter-war years have given ground to the indistinguishable Fiesta/Polo mass transport.

Yet, there are still interesting developments and advances to be made, often at low cost and with major impact on the economics or other aspects of the applications to which a microcomputer can be put. Whether or not it will become a standard in the future is hard to determine but the Shelton Sig/Net system is remarkable for a number of reasons.

For the Sig/Net range, Shelton claims: "The system is a new hardware design which offers the expansion potential of bus-based system at a price comparable with single-board computers. Support for virtually unlimited hard-disc storage peripherals and users is a major feature. A CPU/RAM module is the heart of our system and is designed for multi-user applications by simply adding more — as many CPU/RAMs as there are users or maybe more for task assignment or resource allocation".

The system is designed as a 26-way flexible cable port bus connecting a number of modules. The pin allocations for the port bus are set out in figure 1. Only the bottom eight address lines are carried in the bus and there are no memory request, clock or M1 lines. The Sig/Net rings may be used to interconnect a number of hardware modules and Neil Harrison of Shelton Instruments says that nine units can be connected to one ring. A ring-to-ring module can be used to connect to other rings so that at the second level, a system could comprise 81 modules.

There are many standard bus systems in existence and the proliferation is often confusing. One easy division is between internal and external buses. Internal buses such as the S-100, Nasbus, Tanbus and the Xilog Z-bus are all examples of fixed buses, often microcomputer backplanes, with defined features.

It is a characteristic of external buses that they tend to be literally flexible; the hardware normally takes the form of a multi-way cable with connectors fitted to one or both ends. The IEEE 488 bus is characteristic and the bus lines are shown in figure 2.

Research Machines Ltd has used flexible multi-way cable to interlink the boards internally in the RML 280-Z and 380-Z series since the machine's inception. There is no mechanical novelty in the Sig/Net ring and the breakthrough, if breakthrough there is to be, must lie in the electrical, protocol or functional specifications of the Sig/Net ring.

IEEE 488		Bus Lines
	DI 01	
	DI 02	
	DI 03	
	DI 04	
	DI 05	
	DI 06	
	DI 07	
	DI 08	
	DAV	Data valid
	NRFD	Not ready for data
	NDAC	Not data accepted
	ATN	Attention
	EOI	End or Identify
	SRQ	Service Request
	IFC	Interface Clear
	REN	Remote Enable

Figure 2.

There are five essential elements of a complete interface system:

- The mechanical features, for example, the connectors and the cables.
- The electrical design, for example, logical level, line capacitance and loading levels.
- The functions of devices connected to the bus, for example, in the IEEE 488 standard devices are classified as talkers, listeners or controllers.
- Communications protocol, an agreement about the way in which information is transmitted and received on the bus.
- A higher-level protocol defining the use which may be made of Information by its coding. *(continued on next page)*

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The Sig/Net ring has embryonic or viable definitions for the first three of the five elements of a specification. It is a part of general bus theory that at any time, only one device can be capable of initiating transfers on the bus.

Procedures for avoiding bus contention must be incorporated into either the electrical or software specification for the bus.

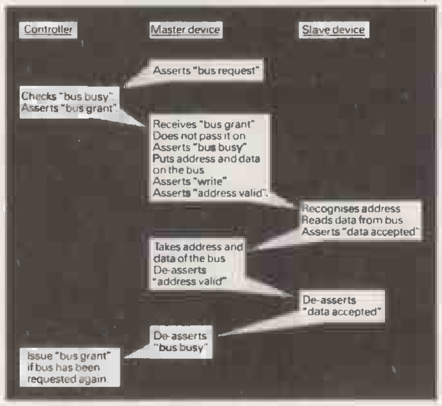

Figure 3.

Figure 3 illustrates a protocol for gaining bus mastership and sending data and is taken from a series of articles on computer buses in *Wireless World*, March 1979, by Dr Ian Witten.

Control of a bus is often exercised through a daisy-chain and the Nasbus, for example, has Interrupt Enable In, IEI, and Out, IEO, lines for running a daisy-chain function. The alternative to daisy-chaining the bus-grant signal is to add two lines to the bus for each device to handle bus request and bus grant signals.

Sig/Net is described as a port bus but has no bus-control lines in the general sense of the phrase. Connection between one Sig/Net ring and another must be handled by the ring-to-ring connector modules. There can be only one controller/bus master on each Sig/Net ring.

The IEEE 488 bus might also be described as a port bus in the sense that the five-bit address of a device is put on to the data lines by the controller with information on the ATN line to indicate that a command, as opposed to data, is present on the data line. In the Sig/Net port bus, the same functions would be achieved using address lines 0-7 for the device address and the IORD or IOWR lines for read/write control.

Communications external to the environment of the Sig/Net rings will be handled presumably in the usual way by transforming the eight-bit wide parallel data stream into a serial two-wire data flow.

Conclusions

● The power of Sig/Net lies in its ability to pass data from one module to another using low-cost, flexible multi-way cable. The cable has fewer conductors than other internal buses have used in the past. Judged as an internal bus, the Sig/Net system is an advance which has been made possible by the falling costs of dynamic RAM — it is a technical reflection of market progress.

● Although the system is built using a 4MHz Z-80A CPU, it seems that with some simple hardware modification, there is no reason why the Sig/Net module should be limited to the Z-80; a 6502 processor could work just as happily on this port bus.

● As an external bus the Sig/Net ring is unlikely to make any impact on laboratory-instrument control, now sewn up tightly by the IEEE 488/Hewlett-Packard Interface Bus. Industrial-process control is another matter, however, and the self-contained modules offered by Shelton Instruments with the ease of inter-connection offered by the flexible Sig/Net ring should prove attractive.

● Software remains of crucial importance and if Shelton is able to assemble a package consisting of his Sig/Net ring and a coherent control-orientated language, the combination could be almost irresistable. The barrier to zero-cost processing was always said to be the finite cost of the case in which the computer was housed; interconnections are an important design consideration and Sig/Net is an advance in modular systems which will allow hardware designers greater freedom.

Planning with model results

IT IS WIDELY accepted that large companies take several years to go bankrupt. It is also widely accepted that among the last people to realise that a company is going to the wall are those responsible for running it.

Often, the imminent disaster is revealed only when it becomes necessary to discuss the longer-term prospects of the company with some independent body, such as a bank.

As the people concerned realise the implications of the analysis they are conducting, their alarm often communicates itself to their creditors and the end follows in a rush. This is not an experience confined to smaller companies with no budgets for corporate-planning functions — Rolls-Royce Aerospace was being used by lecturers in Manchester Business School as just such an example.

The key to improving a business's awareness of its overall position and the quality of its decision-making lies in the subject of models. The fact is that whether he realises it or not, no manager ever manages anything as tangible as the division, company or department for which he accepts responsibility. What he in fact manages is a model and it can be argued that his effectiveness as a manager is solely governed by how good his model is.

A model of something is, in the most general sense, a representation of it. In the worlds of philosophy and science,

by D C Sutton

models do not have to look, to a layman's eyes, anything like the object or situation being represented. It may be an accurate scale model instantly recognisable as such, or it may be as abstract as a mathematical equation. The key requirement for a model is that there must be a way of relating each part of the thing modelled to a specific part of the model.

Thus, to return to our manager, what he is managing is a model of his reality, whether it be division, company, etc. The model is in his head and, if he is a good manager and provided his section is not too complicated, he will have a good idea of what will happen in a given situation.

The crux of the matter for management then is: how good are the models we are managing? Unfortunately, the realities we manage are very complicated whereas the amount of complexity we can handle in our heads is very limited. There are very few people indeed who can even solve one pair of simultaneous equations in their heads.

We pit MicroModeller against the accepted power and acceptable prices of VisiCalc and Desktop Plan.

Thus for even moderately-complicated management problems, we need some form of external help to augment our very limited modelling capacities. Unfortunately, management is carried out in the real world where time waits for no man to sit for hours at his desk with pencil and paper rubbing out and re-writing figures on his forecast sheets and decision tables.

It is finally being accepted, even by some accountants, that there is more to running a company than measuring and maintaining a tight watch on the cash-flow. Measurement can tell you what the effects of a decision were but not what the effects of a decision will be. Prediction requires an ability to understand, or at least anticipate, the nett effects of many interconnected factors.

For example, a decision to reduce stocks may reduce the money tied up in stock but, because of a reduction in responsiveness to demand fluctuations, longer delivery times may reduce the earnings and offset any saving of interest charges.

What is needed, therefore, is some way of capturing the relevant information about a company or department in a form which shows the important interactions and yet is easily assimilable by the managers in charge. Not only must this device contain the most up-to-date information, but it must also be capable of displaying estimated future conditions and allow the estimates to be changed at will.

Such a tool would allow all the quantifiable information to be made explicit for inspection and so provide a more definite plot of the current state of affairs. In addition, and of even greater benefit, the ability to try the effects of different estimates and decisions on future states enables the judgment of the manager to accommodate to some extent the unquantifiable aspects of his situation. Naturally, computers offer a way of answering both of these needs.

Until recently, the cost of computers and their related accessories meant that only the richer companies could afford them. The cost ensured that tasks with more immediately visible savings were given priority in the allocation of computer time. Only companies with very large management problems tended to consider the development of computer-based modelling as an aid to planning and so such programs tended to be tailor-made, large and expensive.

MicroModeller is the third modelling program to be released for the Apple. The other two are VisiCalc and Desktop Plan. In cost terms, it is a great deal more expensive but it claims to offer a great deal more.

It is perfectly possible to use any of the programs to organise and display, say, balance-sheet information. The powerful facilities for rapid re-calculation mean that figures can be altered at will and all the related totals will be corrected automatically. This can drastically reduce the time and effort required when, say, end-of-period book-balancing is required; each error and omission needs correcting often involving many tedious and repetitive corrections which ripple over the pages of figures.

The re-calculation facility, however, offers much more than a rapid means of correcting entries. Systematic and

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thoughtful experimentation can be used to simulate the effects of decisions before they are made, the "What if?" approach.

All three packages are designed around a worksheet which contains all the figures and relationships that the user has defined to represent his management problem. A worksheet may be thought of as a chart of ledger-like page consisting of rows and columns of figures. The rows and columns may be given names. Titles and subheadings may be included to make it easier to understand. For example, when the model is a financial one, the columns may be allocated to monthly or yearly results and totals and the rows associated with the individual sales and cost elements.

If we define a box as the intersection of a row and column then, when the model is set up, each box will contain a number or some explanatory text. Numbers may be entered individually or, and this is the great strength of all the packages, a number may be defined in terms of one or several of the other numbers in the model together with constants and mathematical functions.

Thus, a box may be made to contain an individually-defined number, the total of a row or column or a constant, or varying function of any other box. For example, an annual growth rate of sales may be defined along a row and the values for each year automatically calculated by the model once the initial figure has been entered.

The recommended procedure for forming models is to plan the lay-out of your worksheet with all the headlines and relationships defined on paper before you start to enter them into the computer. A key feature of these packages is the ease with which the figures and calculation rules may be entered or changed and the results viewed. VisiCalc wins hands down in this respect as both MicroModeller and Desktop-Plan require several stages to proceed from model definition to results display, whereas VisiCalc does it all at once.

When operating a model on MicroModeller, you proceed in the following steps:

- Sketch on paper the lay-out of the final report you want.
- Plan and enter the rules which will tell the model how to calculate the numbers which will be derived from whatever data you will enter to start the model. The program saves this on a logic file.
- Plan and enter the rules which will define the lay-out, headlines, titles, etc., of the result reports. The program saves this on a 'report' file.
- Assemble and enter the data which is available. This can be made easier by an option to specify and print a worksheet which can also be saved on a file. The entered data is saved on a data file.
- Instruct the computer to use the calculation rules on the data provided to determine all the other values in the model. Termed "using the logic".
- Ask the computer to display Dataview — or print out. Report the results for your inspection.
- Carry out any revisions necessary by returning to the second, third or fourth steps.
- If you want, you can then try the effect of changing data or calculation rules in the classic "what if?" mode.
- After each run of the model, you can request a hard-copy printout of the results or proceed to the options which give graphical representations of your results.

When you have set up a working model, the information about it is saved on several files. The essential information is distributed over three files: the Logic file, the Report file and the Data file. In addition, you may need to save the computed data on a Results file and the information to print out a blank data input form on a Worksheet file.

Of course, any modelling program must be designed around these functional areas, but it is not necessary to complicate the facilities to this extent. VisiCalc manages excellently in this respect: the user can switch from entering data to entering relationships at will, and every change is instantly re-calculated and visible on the worksheet which is constantly in view.

Both MicroModeller and Desktop Plan require the user to proceed to different sections of the program for each type of operation. In the case of MicroModeller, some of the behaviour of the Pascal operating system intrudes to a noticeable degree — many of the user-prompts are borrowed from it and are rather terse for the unsophisticated user.

Accepting that MicroModeller is more complicated to use than the other two programs, it offers extra capabilities which compensate. The functions and operations used to define the logic of models is impressive and has a strong financial bias.

In addition to the basic mathematical operations of addition, subtraction, division and multiplication, it is possible to evaluate the Internal Rate of Return of a row of cashflows, to evaluate depreciation automatically by a choice of bases on a row of capital investment figures, to derive interest payments automatically given the location of the principle and the repayment details and to compute the amount of tax loss carry forward given the profit and loss and the years eligible.

The highest or lowest figure in a row can be found. Figures from a box can be moved sideways to represent leading or lagging influences and even spread over several other periods to represent varying influences on other time periods. Logical comparisons are also available. While an ingenious user of VisiCalc could duplicate most of the functions, their ready availability in MicroModeller is a point in its favour.

As far as printing-out results is concerned, MicroModeller moves into its own. You can select the rows and columns of your model you want printed in any order you wish. Thus you can create several reports from the same model by choosing different combinations of rows and columns. You could print separately balance sheet, profit and loss, cashflow projections, sales forecasts and modelling assumptions even if the relevant rows are interspersed in the overall model. You can even have the rows and columns exchanged if it will help the interpretation of the results.

Apart from selecting the data to display on the report, you can define row and column titles which do not have to be identical to those you gave them when defining the model, thus you can make them appropriate to their intended use. Naturally, you can define report titles, headings and subheadings throughout the page and insert blank lines to aid readibility.

You can choose the format of the numbers to be printed from a wide range of useful options and you can vary the widths of the columns individually. Finally, you can arrange to insert dates and various explanatory comments at the time of printing to tailor even further individual versions of a report.

Most of this is well beyond what VisiCalc or Desktop Plan can offer although the latter is a more report-orientated package and may be adequate in many cases, and a skilful user can even make a VisiCalc printout reasonably presentable.

Another useful option for users in larger companies is the Consolidation facility. If you have models of, say, several departments, you can combine them into one master report to show the aggregate picture. You can add whole models or extract the key rows and merge these alone. Desktop Plan can achieve a relatively rudimentary type of consolidation, VisiCalc cannot.

In the area of visual display of results, MicroModeller is again impressive. Once you have run a model you can select critical rows or columns — or a combination of rows and columns — to be displayed in a variety of plotted forms. The range is comprehensive, including as it does:

- Pie charts, with an option to highlight a segment
- Bar charts, histogram form, with an option to stack several on top of each other
- Line graphs, with up to eight lines at once

All formats permit the user to define titles and labels or use those already defined for the model elsewhere. The user can also save the images plotted and recall them in a planned fashion to create an effective slide-show presentation of his results. Text-only slides can be prepared for inclusion and the package even has a trailing lead control switch to enable the computer to step through the stored sequence of slides under speaker control.

This device plugs into the games socket and also contains something to ensure that the program will run only when it is installed — to protect against pirate use.

Despite the seductiveness of this option, it should be borne in mind that the quality and definition of the Apple graphics are not up to photographic standards even with a high-quality video projector to enlarge the images. The user who needs to organise a visually-aided presentation of results will need to ensure that his audience will be small enough to cluster around a colour monitor rather than fill a lecture theatre.

Needless to say, neither VisiCalc nor Desktop Plan can offer these aids to presentation although there is a program available which can produce lines and bar charts from VisiCalc models.

I am an advocate of programs which require no expert computing knowledge on the part of the user. MicroModeller is not really in the same league as VisiCalc in this respect, even Desktop Plan is better in this area. The accepted way of protecting the innocent user from needing to know much more than the location of the on/off switch is to provide him at each stage with a menu of options from which he makes choices.

The principle of this menu-driven approach is that the user is at all times able to see a full list of the options available to him. MicroModeller's approach is to face the user with a terse prompt such as "Command?" and expect the user to discover all the valid responses by reading the manual.

There is a facility in MicroModeller which claims that a user can set up a prompting file so that unskilled users can operate the package. On examination, this proves, however, to be limited to making selections from anticipated alternatives to build models, print out reports, enter or consolidate data. The major requirement of being able to "What if?" is not available under this option.

MicroModeller provides a tutorial section in the manual and a prepared disc of demonstration data for the buyer to familiarise himself with some of the capabilities of the package. Initially, it seemed that the guide was indicating exactly what the user would see on the screen as he proceeded through the example — however, that correspondence soon broke down.

My progress, under tutorial command, to the graphics section was not smooth. The fault was partly due to poor arrangement of the manual. I was using a two-disc drive system and a different procedure was required from that for a three-disc system which MicroModeller tacitly assumed in the manual. Unfortunately, the paragraph containing the changeover instructions was some 17 pages and 30 minutes before I needed it. At the critical point, the tutorial contained no reminder of any likely problems. It was a a consequence of this, that I encountered a bug in the program itself.

I should have temporarily removed the disc containing the demonstration data and inserted one of the Apple language card system discs before telling MicroModeller to run the graphics section. As I did not do this, it caused problems when the program-running utility could not be found. The disc drive whirred briefly and then a message flashed on the screen asking me to insert the required system disc. Before I could act on this reasonable request, the disc drive again set in motion and the same message flickered on the screen. This continued and short of taking out a disc from a moving disc drive — not to be recommended if you want to use the disc again — the only way out was to switch off and start again. It was some time before I found the misplaced section in the manual that caused the trouble in the first place.

The whole area of disc management is very poorly covered in the manual and the user is likely to be at the mercy of the program as to which disc his data is saved on — unless he is very good at reading between the lines. The intrusion of the operating system could easily be reduced by copying vital utilities on to the MicroModeller program disc with an attendant reduction of complication for the user.

The print quality of the manual and the initial impression are excellent. It is unfortunate that the content should fall somewhat short of its first promise. The main criteria must be that its style assumes familiarity with computer concepts and a willingness to pore over the examples to clarify the rather sketchy explanations of some of the procedures — a task not made easier by the sprinkling of errors in the examples themselves.

This shortcoming is not unusual in the field of mainframe computer documentation but should be firmly stamped on in the microcomputer field if we want it to uphold the principle of user-friendliness which is promised by the better microcomputer programs arriving on the market.

As mentioned, the package is very poor with regard to on-screen prompting. The user has no idea what his options are unless he has the manual at hand. An index or at least quick-reference card would be very useful — particularly as many of the options are well buried in the text. Many with experience of mainframe modelling packages would not consider many of these complaints very serious but I feel that they are avoidable and should be removed if the program is to deserve success.

This evaluation would not be complete if it did not compare the costs of the three packages and the type of computer system they require to run. Both VisiCalc and Desktop Plan will run on a 32K Apple with one disc drive, MicroModeller requires a 48K Apple, the language card with Pascal and two disc drives.

If we accept that most Apple installations with any serious business usage will be 48K and two disc drives, there is still a hidden cost of £299 excluding VAT for the language card before a user could run MicroModeller on his business system. MicroModeller costs £425 excluding VAT and so you will have to spend £724 to run it even if you have the business system described. VisiCalc costs £85, Desktop Plan costs £75, and Apple Plot, the plotting program compatible with VisiCalc, costs £37.

Conclusions

- **MicroModeller is very strong on the display of results whether in terms of formal printed reports or in terms of the creation of visual aids to interpretation and presentation of the results.**
- **It is good in terms of the general quality of its packaging and presentation.**
- **In terms of the facilities it offers for the construction of relationships in models built by users, MicroModeller is also good.**
- **In money terms compared to VisiCalc and Desktop Plan, it seems poor value.**
- **It also seems poor in terms of clarity of its manual and of its ease of use by users with little previous experience of computers.**
- **MicroModeller should be considered by users who wish to develop complex models and experiment with them to improve their understanding and control of their businesses. It should also be considered by users for whom the clear presentation of data to others is of major importance.**
- **Users who are familiar with time-sharing modelling systems and want to have the same range of facilities at a fraction of the cost and with greater independence will also find it worth consideration.**
- **Those who already have a Language System installed and are, therefore, familiar with the Pascal operating behaviour could find it suitable as would those who will have the time or supporting staff to learn how to obtain the best from the undoubtedly wide range of facilities that MicroModeller offers.**
- **Such users will probably work in the planning departments of companies, they might also be teachers or researchers in academic institutions.**
- **MicroModeller does not seem appropriate for those who want a model-building package but do not want to spend time learning things like computer languages.**
- **MicroModeller should be viewed as a low-cost competitor to time-sharing or mainframe modelling packages rather than with the two ultra-low cost modelling packages VisiCalc and Desktop Plan.**
- **Unless you are an experienced computer modeller, I would suggest that you try VisiCalc first and only when you are sure that it does not satisfy your needs should you contemplate MicroModeller.**

An extraordinary experiment to control every level of the Chilean economy by computer was undertaken by the most controversial figure in the world of management science and applied cybernetics, Stafford Beer, between 1971 and President Salvador Allende's assassination in the military coup of 1973. Robert Bittlestone describes the facts behind this ambitious computer-controlled project.

The Chile Experiment

The Santiago ops room and, left, Stafford Beer.

HOW DO YOU control anything? — and what exactly does control mean? A key notion is feedback — comparing an input relating the actual state of some process to another input which defines a desired state for it, and adjusting the controlling output accordingly — figure 1.

That is how you cross a road, for example: the desired state is "reach the other side alive". The sensory input is "halfway across: oncoming vehicle". This controller has a three-state output: turn back, stay still, go forward — but the decision process is still a complicated one. Too complicated, apparently, for a microcomputer at present, since the micromouse which can cross a road in the rush-hour unscathed still awaits construction.

A key aspect of feedback is clearly the amount of information flowing round the system. If figure 1 were to reflect "crossing the road" more accurately, we would re-draw it as figure 2. A large amount of information is steadily being collected as you start crossing the road — car distances, approximate time to intercept, condition of road surface, etc. Likewise, considerable detail is involved in the output — exact direction in which to move, speed at which to walk or run, sudden stops — and so on. Both of these are high-variety channels. Notice that the desired state, "reach the other side alive", is of low variety in this context. A very useful definition of a controller is a device which tries to achieve a specified goal by balancing input variety with output variety. From this, it follows that only variety can control variety.

If you have a busy road to cross, it is no good being equipped with a microswitch on your big toe — but no eyes or ears. Even if you are festooned with sensors, your thinking processes must be able to react to them. So, one of the most central cybernetic ideas is known as Ashby's Law:

> The variety of a controller must be at least as great as that of the situation to be controlled.

Otherwise the controller cannot even recognise that it has a problem. Now you may think that this is all rather obvious — but here are some examples of its current, flagrant, abuse:

- Trying to run a 64Kbyte memory without parity bits and error correction
- Trying to computerise the Inland Revenue on a mainframe
- Trying to control the level of inflation via the money supply

The last example is even sadder than it looks since the money supply is not only unmeasurable to tolerable accuracy, but is very probably a constrained output from the economy and not an input at all.

You may have wondered where the two top lines in figure 2 are going. Who is saying what the desired state should be? Who is receiving the reports? In anything but the most simple of controllers, it is another controller which calls the tune. For example, you might think that a central-heating system was a simple controller reacting to the thermostat position — in fact there are two controllers.

The boiler has its own internal controller, which monitors the boiler temperature and shuts it down if it grows too hot, e.g., water supply fails. It receives its on/off instructions from another controller, which in turns reacts to the room thermostat setting. In its turn, the thermostat receives instructions from you.

Hierarchy of control is the name of the game. Low-level controllers have their tasks set by higher-level controllers — and they send back routine reports on how they are faring. They cry help to their boss controllers if things go wrong. One high-level controller can generally look after several lower-level ones. In figure 3 controller 2 is in charge of a number of controllers of type 1. Controller 2's brief is: "Move the index finger towards the thermostat." It then explodes this brief into a number of sub-tasks.

Various controller 1s then look after muscle tension, eye focusing and so on, reporting back progress to 1 — which assimilates the different messages into a report: "Reached thermostat—haven't yet". If you find the idea of hierarchy of control interesting, you might like to follow it up in William Powers' book *Behaviour: the control of perception*, Wildwood House 1973, which contains, among many other things, the best account of how it is neurophysiologically possible to play a game like Space Invaders.

If you look carefully at figure 3 you will see that the whole arrangement is recursive: the relationship of controller 2 to what it is trying to control — i.e., several controller 1s — is the same as the relationship of controller 1 to its own control task. This suggests a rather intriguing thought: if we learn the principles of control at one level, then in a very definite sense, we have learnt them for every level. If we could write a single, clever computer program to control things at one level — but recursion is an elusive concept.

Basic as a language cannot generally handle recursive programs, but other languages can: try the APL example in figure 4 which has been written with non-APL users in mind. It is worth pausing to consider how that program manages to work. Of course, in any attempt to design a computer system for general control, it would be the entire program suite, not just a particular program, which would be used recursively by different controllers at different levels on different — but interrelated — data.

The last general notion before we move to Stafford Beer's work is that although the overall structure within different recursive levels looks the same, the desired state and the reports produced about it are very different. As controller 2, we say "cross the road", and our eyes and visual cortex tell us whether we have succeeded. Yet the controller 1s are saying things like "move right foot at angle of 35 degrees a distance of two feet in 0.1 second's time.

So, the point is not just that these two "languages" are merely different: it is that the concepts of the top language just cannot be expressed in that of the lower level. They are not just incomprehensible — they are also unrecognisable. The top level is a metasystem relative to the lower level and it speaks a language which in relation we can call a metalanguage.

A viable system has an interesting definition — it means: "A system that wants to survive." Like you or I, or a firm, or the Church, your school or your university, but not, perhaps, a central-heating system.

Viable systems are much more complex than simple feedback systems, but then of

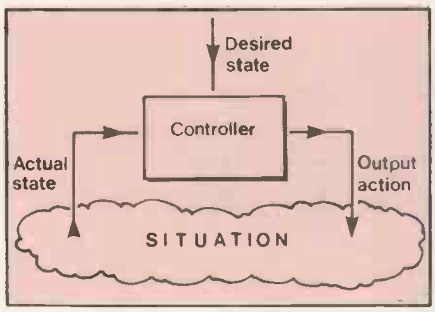

Figure 1. Control and feedback.

course they are much more interesting too. What Stafford Beer claims to have done in *Brain of the firm*—his book which describes the Chile project — is to have developed a model which holds for any viable system.

Now this is a most extraordinary and exciting idea. Surely, one feels, all the systems mentioned are entirely different? They are, but then again they are not — it all depends on how you regard them. Figure 5 is how he would regard a firm, for example, and figure 6 is a way of looking at you or me. Spot the differences — which are not so many, unsurprisingly, as, of course, the whole foundation of *Brain of the firm* rests on a dramatic new interpretation of how the human neurophysiological system works.

It rather looks as if Stafford Beer has drawn a plan for a first design for the secret of life. If nothing else, he has certainly created a language of ideas rich enough to allow us to talk about the problem.

A brief guide to the model is in order, although there really is no alternative to reading the book. Imagine a company organisation chart — there are, say, four operating divisions: A, B, C and D. Each division has its own divisional executive committee, or directorate. Relative to the group as a whole, we can call this level of the company, System 1. The next group-orientated function is that the co-ordination: coping with the implications of inter-divisional relationships without elevating all minor problems to group issues. This is System 2. Then we have operations control for the group itself: System 3. Then we have the planners, System 4, and lastly the group board, System 5.

Nothing particularly revolutionary about that, but in isolating vital functions straight from the human nervous system, Beer shows us where a given organisation is defunct. For a start, divisional directors are always having rows about petty inter-divisional items at board meetings — "My people tell me that Australia shipment was despatched late because your packers thought it was due after Easter" — which waste the time needed for more far-reaching discussions. This is attributable to a weak or non-existent System 2. The planning function is a miserable affair in most companies. System 4 is often vanishing or at best vestigial.

What Stafford Beer says is: look — these are the functions you must have, and this is the information which must flow up and down. How you spread these requirements among people is up to you — up to a point. There is no reason in principle why the board cannot do the planning itself. It is just that, while it is planning, it is not "boarding". Suppose you are in a lifeboat after the Titanic disaster. An argument breaks out among the survivors. Some want to row. Others want to design an outboard motor. Here is the issue:

- System 3 is about controlling the rowing — staying on course, etc.
- System 4 is about designing the outboard motor.
- System 5 is about deciding how many people should design, and how many row.

This is the key. You have to have a place where the buck stops which decides on the allocation of scarce resources at each level. Once the decision is made, there is no reason why the people of System 5 should not join the ranks of the designers, or the rowers — until the next decision — but know what you are doing at any instant. Such confusion is responsible for countless wasted boardroom hours.

Until now, we have begged the question of how the divisions themselves worked — the small diagrams written inside the divisions part of figure 5. If figure 5 represents an automobile manufacturing group, the four divisions might be Commercial vehicles, Domestic vehicles, Export, and so on. How, then, would the Domestic vehicles division work? Exactly the same way as the group.

It will have its own sub-divisions which will work in exactly the same way as the Domestic vehicles division. The idea here is that the internal workings of a group's divisions are just the same as the internal workings of the group itself.

Once you understand one, you understand them all. So you do not have to

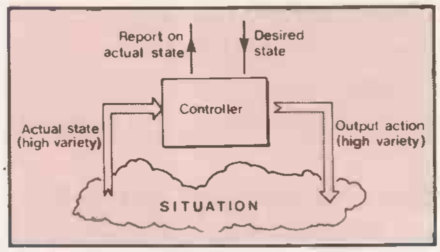

Figure 2. High-variety inputs and outputs.

learn a new theory for every company you encounter. You learn about Beer's five-tier model once; then you apply it in two ways:

- At any particular company level, via the Systems 1-2-3-4-5 structure.
- For the group as a whole, recursively within each division.

This way, you can go down to the individual department — even the individual employee — and what happens then? The whole concept started with neurophysiology — so start dissecting.

Let us look at the way in which Stafford Beer's model treats the information inside an organisation. In figure 5, there are many information routes. Start with the ones which traverse the central spinal column. Each division is set a goal from the operations directorate. There is no precedence implied between divisions: the spinal column is an information "bus". The operations directorate line down the centre. In turn, each division reports back to the operations directorate on how it is doing — ascending central axis.

So, the first implication is that we need a continuous monitoring device to check performance. What will this be? The good old-fashioned monthly comparison against budget? Most companies take at least three weeks after the end of the period to produce monthly management accounts. By the time the board meets to read them, they are up to seven weeks out of date.

The individual company figures have been very heavily massaged by the

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accountants *en route.* Instead of relating to production tons, actual cashflows or manning levels, which are real and measurable, they relate to monthly profits, which are a by-product of costing and accrual techniques and about as indicative of underlying company performance as a sparrow is of a pterodactyl.

If that were not enough, the annual budgets were far too soft — or unrealistically tough — and anyway, the main supplier has just announced a 25percent price increase which totally nullifies the basis for the budget. So, the accountants grumble and calculate a new one to take this into account. In other words, the targets are adjusted to move closer to actuality, which is the precise opposite of what control is all about. Once again, Stafford Beer proposes an entirely new approach to the problem.

How do we control oil tankers, or railway intersections, air space, electricity-generating stations and similar? With serried ranks of grey men in offices, poring over five-week-old reports? We first install a system of real-time information flows which carry the data when it happens to the place where it matters. At each node of the system, an event is monitored and filtered.

If it matters to the next level up — i.e., causes the current level's own goals to be transgressed — then a filtered version of

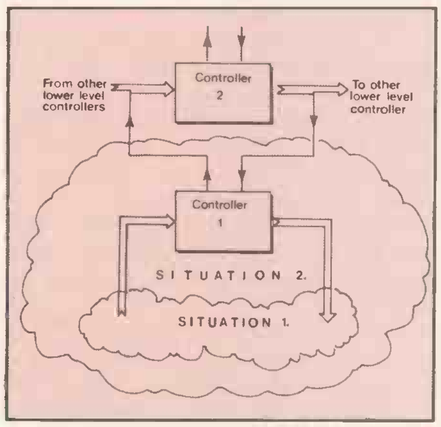

Figure 3. Hierarchies of control.

the message goes up also. It not, the level concerned has time to act on the information and do something about it, also in real time. If one of these sub-systems fails, alarm bells ring, and higher-level systems become involved.

This account of controlling tangible physical processes strikes one as perfectly normal, but it is precisely the way in which Stafford Beer suggests that we control our less tangible organisations. Real-time data should arrive at the lower-level controllers. These try to react to the problems which emerge and to solve them locally. If they fail, the next level up is informed automatically, as it is with a physical process. Instead of regarding our organisations as dull, lifeless things, we should be going about the task of installing and improving a nervous system inside the company.

To help in the task, Stafford Beer proposes a highly novel system of measuring performance, based on ratios of actuality — what really happened — against "capability" — the best we could do with existing resources — against "potentia-

```
   ∇R←FACTORIAL B
(1) ⍝ RECURSIVE FUNCTION TO
    CALCULATE FACTORIAL OF 'B'
(2) → 0 IF 1=R ←B
(3) R ←B×FACTORIAL B–1
   ∇
⍝NOTE: →0' MEANS 'GOTO 0' IE.
TERMINATE
```

Figure 4. A recursive program in APL.

lity" — what could be done if we invested new resources in the process.

These measures transcend the *ad hoc* ones currently used within organisations; they clearly distinguish between today's problems and those of tomorrow; they are usable at any level of the organisation. They effectively standardise the problem of control, so we can start to consider a recursive system package for cybernetic control.

Stafford Beer described how one might use Cyberstride, re-christened Microcyber for the 1980s — on a Z-80 S-100 microcomputer running the APL language.

First, you determine the company structure — never as easy a task as it sounds. Next, you think carefully about which of the parts of it are viable subsystems, and which are service functions forming part of the Systems 2, 3 or 4 of an identified level.

Having done all this, you know what is to be controlled. So at this point, recursion enters. We do not implement a huge system for the company. We implement a system for "a node, its relationships with things below, and its relationships with things above".

So, each node has its own disc. Each node formulates its capability models. Each node uses a microcomputer to process its daily data. Exceptions as detected are used to start a count-down. If the problem is fixed in time, all well and good. If not, the next level above is informed, in the interests of the viability of the entire system.

If someone forgets to use the system, his own data is on his own disc, and he takes it away with him. This guarantees his autonomy and the privacy of his day-to-day operations. The micro, however, contains a message file on its other disc. These are inter-level messages. Each time a user updates the system, the programs write a "prospective" message to the message file.

This message is addressed to the user's boss: it says: "Bloggs has not used the system: he must be ill/forgotten/whatever". The message has a release date for some time in the future. If Bloggs arrives in time, the message will be destroyed without being sent. If he does not, the next time Bloggs' boss uses the system, he receives the message. If Bloggs' boss does not use it himself, his boss's boss receives two messages.

All that happens here is that this is done much more quickly and efficiently, before a problem with performance at one local level has the chance to upset the entire company. Our concepts of democracy sometimes cloud the fundamental dilemma of a trade-off between efficiency and freedom. We feel that to be free, we have to be inefficient; to be efficient like the Japanese, apparently we have to abandon our freedom and become company men. Not so, says Stafford Beer, we can be efficient and free.

One of the most powerful features of the whole system is a forecasting and change detection system which was developed by Jeff Harrison, now of War-

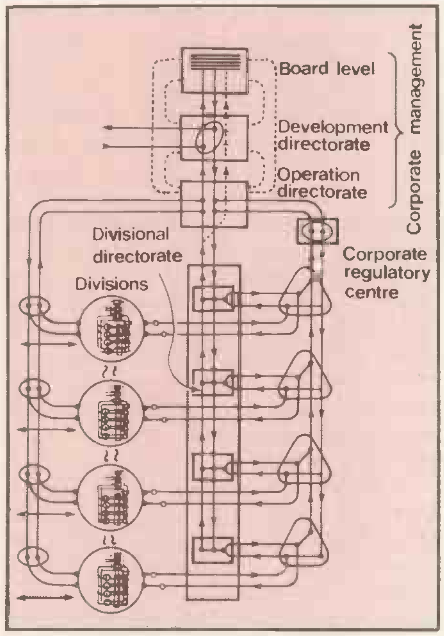

Figure 5. Generalised version.

wick University, and Colin Stevens, now a private consultant. It constantly and adaptively monitors reported results and presents the situation in terms of probabilities of No Change, Transient, a Step Change and/or a Slope Change. Long before the human eye can discern an adverse trend, the Harrison-Stevens system can provide early warnings of a precise nature.

Stafford Beer performed a huge project for Salvador Allende in Chile 1971–3. The almost day-to-day diary of this work in the new edition of *Brain of the firm* makes gripping reading. If you read the book, you will realise how deeply committed and involved Stafford Beer became with the project — and how fiercely the concept of participative democracy was pursued and maintained.

For very profound cybernetic reasons, it turns out that what matters in a project is the process of the project itself: not theories, not grand ideas, not "results"

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according to some prior criterion. So the extracts I give, with the permission of Stafford Beer himself and James Cameron, his publisher at John Wiley, are not intended to provide you with technical detail. They are to give you an insight into the reality of the project. Ultimately we who were not there can only try to imagine the extraordinary excitement and intense activity of a project like Chile.

The extracts are from *Brain of the firm*, Wiley 1981, second edition, a companion volume to *The heart of enterprise*, Wiley 1979, and see also the final chapter of *Platform for change*, Wiley 1977. Stafford Beer on the subject of microprocessors writes:

The point about microprocessing is its cheapness. That takes computers out of the hands of big business: a devastating development. And so it is. In the past, brilliant young people who wanted to work with computers had to toe the line — a line drawn with vigour and often ferocity by those who were making the money. The generally disastrous results are plain to see. The challenge to management renews itself after 25 years.

Microprocessors will constitute a much bigger revolution than the invention of computers themselves. As this is being written, the managerial response to these developments is amazement. We are back, all of a quarter-century later, to phase one. The other phases cannot reduplicate themselves in the same way, because the power of money will not exert the same influence.

Managers will surface, in this second electronic revolution, who will support the brilliant young men — because the money involved will be trivial. Appropriations will not have to go to board level, to be consistently misunderstood, and to be shot down by the vested interests of monied manufacturers.

It began in the summer of 1971. The manuscript of the first edition of the book you have so far been reading had gone to the publishers. I had also completed most of a book called *Platform for Change*, which is an account of my efforts to project managerial cybernetics internationally during 1970, and to which part of this story eventually became a suffix.

Like most Englishmen, I was aware that Dr Salvador Allende had become president of Chile the previous autumn — 1970. The fact was remarkable, because this was the first Marxist president to be democratically elected anywhere in the world, and at the time his new government was a focus of international attention. Moreover, it was a minority government, carrying 37percent of the electorate; therefore. it had a battle on its hands in both the congress and the senate.

Nothing daunted, the president had embarked on the massive nationalisation of the banks, and of the major companies working in Chile: naturally, for a Marxist, a programme of nationalisation of the means of production, distribution, and exchange was fundamental to his programme. This I knew; but I did not know the means whereby his wholesale nationalisation of the economy was being achieved. It was done through state agencies, and in particular through an institution called Corfo, *Corporación de Fomento de la Producción*.

The letter I received was sent from there, under the signature of the technical general manager, Fernando Flores. He

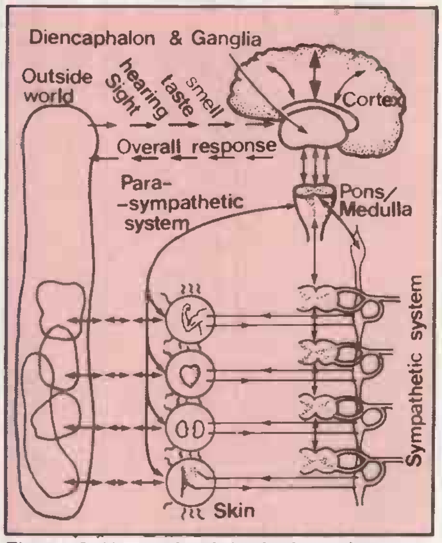

Figure 6. Neurophysiological version.

introduced himself also as the President of Intec, *Instituto Technologico de Chile,* which bears organisational comparison with the National Physical Laboratory in Britain — although it is of course much smaller.

He then went on to say that he was now "in a position from which it is possible to implement, on a national scale — at which cybernetic thinking becomes a necessity — scientific views on management and organisation." He hoped that I would be interested: I was.

On the evening of November 12, Fernando Flores arranged a dinner for all concerned in a very relaxed location. Beforehand, I was to go to the Ministry of Economics. There I reviewed matters with the Undersecretary. We went together to *La Moneda*, the presidential palace. Obviously, Flores had prepared the whole event.

Dr Allende had been forthright on this occasion, as he always remained. He particularly wished to be satisfied that the plans were decentralising, worker-participative, and anti-bureaucratic. Since these very intentions had been fundamental to our work, there had been no difficulty at all in convincing him.

It is also noteworthy that he exhibited an intellectual serenity in the process of grasping a vast new concept in a very short time that I found amazing. It was contrary to all previous, and subsequent, experience. Of course, he had been prepared; but other top men have also had their briefs. Of course, he might not really have understood; but a consultant learns to judge that by the questions. He did not waste a single one.

The "real-time economy" hurdle was rather difficult. If it were at all possible, why had not the First World done it? Because they did not understand managerial cybernetics. The Third World could leapfrog over their backs — given such understanding.

I took half an hour to sketch, on a piece of blank paper on the table between us, the model of any viable system — and its recursions. This was the substance of the two papers I had just written — but it included the cybernetic theory of this whole book. It is not possible to know how far he was prepared; but certainly it was known to me that the President had medical qualifications. Dr Allende had been a pathologist.

Again, his questions were probing, but he had no difficulty in accommodating to the model that is called *Brain of the firm*. Gradually, I built up, on that piece of paper between us, Systems 1, 2, 3 and 4. I explained the need for a system 5.

In relation to my first Chilean report, the remark came: "The government should be conceived as a viable system — system 5 being the President of the Republic". I drew the square on the piece of paper, labelled Five. He threw himself back in his chair. "At last", he said, "*el pueblo*", – the people.

The potency of cybernetic thinking was again being vindicated within the country of Chile; but how could this small, poor country withstand the pressures from outside? I have often been asked why we were not able to stipulate a behaviour which would accommodate that threat. It is like complaining that man, who is supposed to be an adaptive biological system, cannot adapt to a bullet through the heart.

On September 8, the President sent an order to the Cybersyn project team: it was the last that they were to receive. The operations room built on the Avenida Santa Maria was to be moved to the inside of the Palace, *La Moneda*. He well understood that none of the existing rooms was large enough to accommodate this apparatus, and allocated one of the most traditional and important rooms to be transformed for the purpose.

On September 11, 1973, I was fulfilling a last engagement in England prior to returning to Chile. It was in the City of London, and I was expounding these matters, and especially the *Externalities,* to an inner group of the Liberal Party, as represented in the City. The Party Leader sat in the front row. Following the official proceedings, there was considerable informal talk, and the gathering broke up slowly. Eventually, I left the building alone. It was to confront a newspaper placard in the street outside: Allende assassinated.

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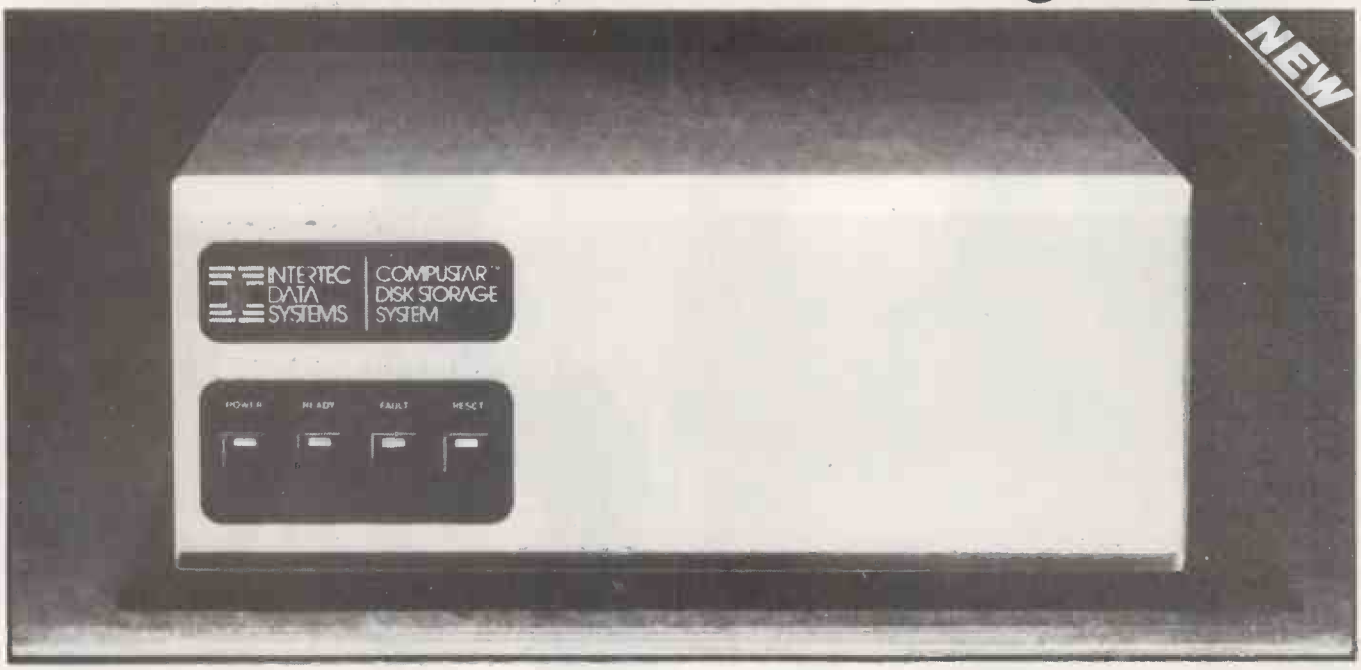

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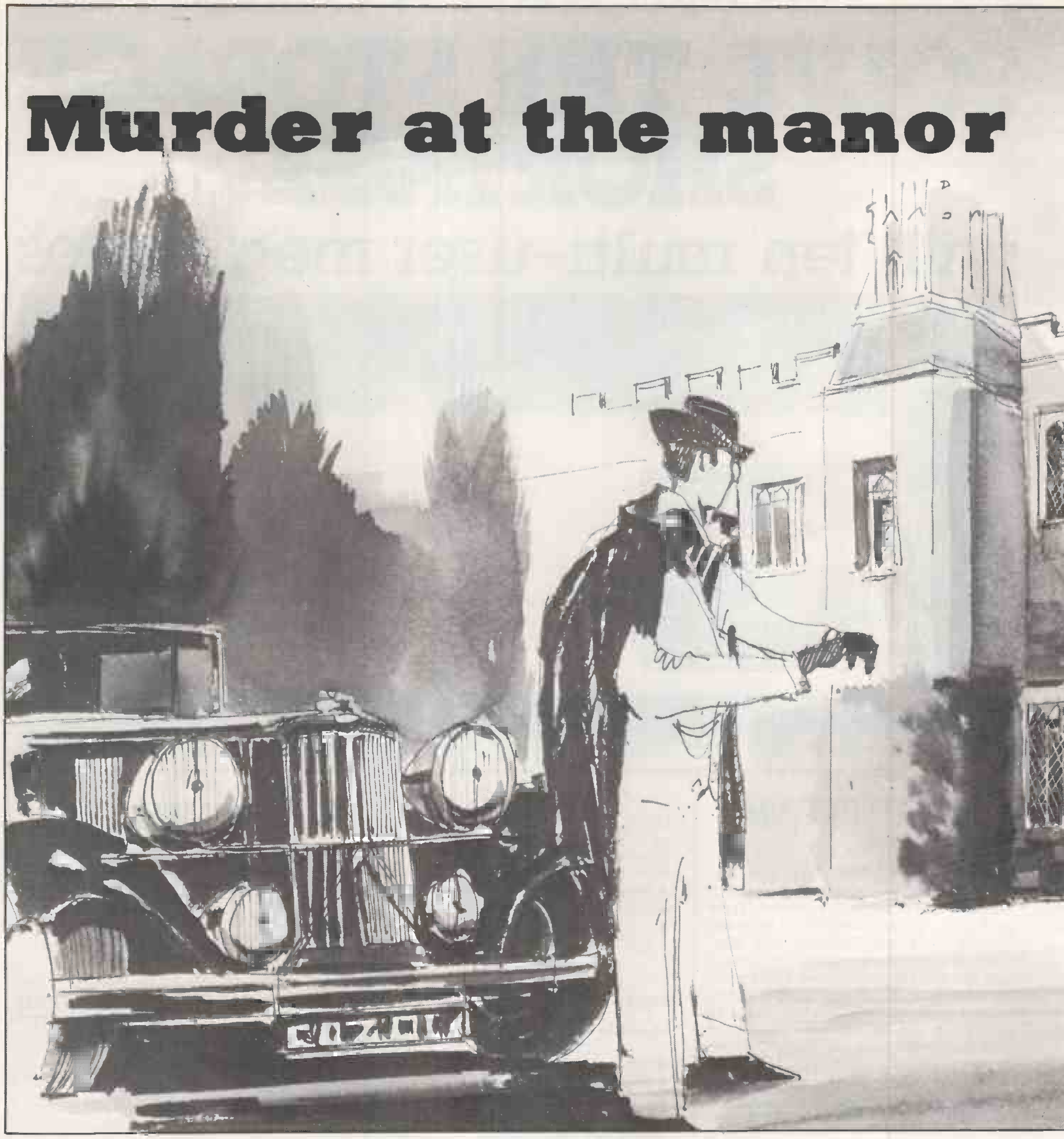
Murder at the manor



by P J Goss

THE PROGRAM prints to the screen in the form of a mystery novel in five chapters. The first three chapters print one full screen per chapter. As the story unfolds you are told in chapter two how to question the suspects.

Each time it is run, the story will alter slightly. This is done by making a random selection from three data strings at various points in the story. One of the three possible strings is printed in its relevant place. All random numbers are produced from one subroutine and the selection of the required data string, also a subroutine, is made by adding an offset to the random number.

The random-number routine is then used to select a murder room, variable D, and a map is printed of the manor with X marking the murder room. A murderer is randomly selected from one of seven suspects, variable M. The other. innocent suspects are randomly allocated rooms other than the murder room. These numbers are stored in a matrix, variable A.

The questions which can be asked of the suspects are room, time and number of people in that room. So the innocent suspects are allocated cast-iron alibis which are also stored in the matrix. The murderer is randomly allocated a room in which, of course, he could not have been present. His other two alibis are selected so that one is wrong and the other right. This will be his downfall because one of his answers will not tally with the answers from the other suspects.

```
10 DIM A(8,8)
260 V=GET(500)
270 PRINT
280 PRINT
290 PRINT
300 PRINT
310 PRINT "         CHAPTER ONE"
320 PRINT
330 R=3
340 GOSUB 3160
350 X=Z
360 GOSUB 3190
370 PRINT "  IT IS ";A$;" AS YOU ENTER THE"
380 R=3
390 GOSUB 3160
400 X=Z+3
410 GOSUB 3190
420 PRINT "SQUAD ROOM TO-NIGHT.THE ";A$
430 R=3
440 GOSUB 3160
450 X=Z+6
460 GOSUB 3190
470 PRINT "AND THE ";A$;" HAD BLOWN A FUSE"
480 R=3
490 GOSUB 3160
500 X=Z+9
510 GOSUB 3190
520 PRINT "'";A$;"!',YOU MOAN ,'HOW THE HELL DID I"
530 PRINT "LUMBER MYSELF WITH NIGHT DUTY.'BUT WORSE"
540 PRINT "WAS YET TO COME,YOU COULD FEEL IT IN YOUR ";
550 R=3
560 GOSUB 3160
570 X=Z+12
580 GOSUB 3190
590 PRINT A$
600 PRINT "YOU SETTLE AT YOUR DESK AND IDLY THUMB"
610 R=3
620 GOSUB 3190
630 X=Z+15
640 GOSUB 3190
650 PRINT "THROUGH A COPY OF ";A$;".YOUR THOUGHTS"
660 PRINT "TURN TO THE CHIEF ,'I BET HE'S HAVING"
670 R=3
680 GOSUB 3160
690 X=Z+18
700 GOSUB 3190
710 PRINT A$;" THE LUCKY SOD.'"
720 R=3
730 GOSUB 3160
740 X=Z+21
750 GOSUB 3190
760 PRINT "YOU PULL OUT A ";A$;" AND FUMBLE FOR YOUR"
770 PRINT "MATCHES WHEN ";
780 V=GET(1500)
790 PRINT "THE PHONE RINGS."
800 V=GET(200)
810 PRINT " 'HELLO',CRACKLES THE LINE."
820 PRINT " 'IS THAT THE POLICE?'."
830 R=3
840 GOSUB 3160
850 X=Z+24
860 GOSUB 3190
870 PRINT  A$;"YOU REPLY."
880 PRINT "'THERES BEEN A MURDER AT THE MANOR COME QUICKLY'."
```

(continued on next page)

The program then allows you to question the suspects in turn. You ask them two out of the possible three questions and the answers are taken from the matrix and converted into a printed answer by the string-select routine. After each suspect is questioned, you are asked if you can name the culprit. If you type "yes" and then name the wrong suspect, the real murderer will confess.

This program was written to run on Hewlett-Packard Basic for a mini computer. It is a simple version and there should be very little trouble in having the program up and running. All Rem statements can be removed and it should be possible to shorten the listing by including more than one statement on a line.

Care should be taken with Goto if this is necessary. It may not be necessary to Dimension strings and arrays as in line 10. If so this can be left out. The matrix-zero section, lines 1730 to 1780, may also be omitted if your Basic does this automatically when an array is Dimensioned.

The Wait statements are used to hold a screen of text for reading before it scrolls to the next page. The number in brackets is the wait time in milliseconds. This will probably have to be changed for micro-Basics. If you do not have a Wait statement in your Basic, a For-Next loop of suitable slowness will provide a delay.

It is important that the random routine should run randomly and you may have to experiment a little. The routine takes an integer variable, R, and produces an integer, Z, no greater than R or less than 1.

It may be necessary to change line 1490 to read ON Z GOTO 1500, 1530, 1560, 1590. Lines with an If-Then statement, e.g., 1850 IF S=M THEN 1910. may also have to be changed to If-Goto, e.g., 1850 IF S=M GOTO 1910. When entering the program on your machine, make sure all the spaces contained in quotation marks are entered correctly to ensure neat output to the screen.

(continued from previous page)

```
890 PRINT "YOUR MIGRANE STARTS TO COME ON BUT BEFORE YOU"
900 PRINT "CAN SAY ANYTHING THE LINE GOES DEAD."
910 V=GET(1000)
920 PRINT
930 PRINT
940 PRINT
950 PRINT "            CHAPTER TWO"
960 PRINT
970 PRINT "  YOU PULL YOUR WEARY BONES OUT OF THE CHAIR"
980 R=3
990 GOSUB 3160
1000 X=Z+27
1010 GOSUB 3190
1020 PRINT "AND TAKE YOUR ";A$;" OUT OF THE DRAWER."
1030 PRINT "  THE LIFT IS OUT OF ORDER SO YOU HAVE TO TAKE"
1040 PRINT "THE STAIRS DOWN TO THE CAR."
1050 R=3
1060 GOSUB 3160
1070 X=Z+30
1080 GOSUB 3190
1090 PRINT " 'THIS AINT GONNA DO MY ";A$;" MUCH GOOD',"
1100 PRINT " YOU MUTTER."
1110 R=3
1120 GOSUB 3160
1130 X=Z+33
1140 GOSUB 3190
1150 PRINT "YOU CLIMB IN TO YOUR ";A$
1160 PRINT "AND PUT YOUR FOOT HARD DOWN ON THE GAS. AS YOU"
1170 PRINT "PULL AWAY DOWN THE ROAD YOU REFLECT ON THE"
1180 PRINT "STANDARD QUESTIONS THAT THE SUSPECTS IN A MURDER"
1190 PRINT "CASE ARE ASKED."
1200 PRINT
1210 PRINT "1.WHERE WERE YOU AT THE TIME OF MURDER?"
1220 PRINT "2.HOW MANY OTHERS WERE WITH YOU ?      "
1230 PRINT "3.WHAT TIME DID YOU HEAR OF THE MURDER?"
1240 PRINT
1250 PRINT " YOU REALISE THAT TIME IS SHORT AND YOU WILL ONLY"
1260 PRINT "BE ABLE TO ASK EACH SUSPECT TWO QUESTIONS."
1270 PRINT
1280 PRINT " BUT YOU KNOW THAT THE MURDERER WILL LIE."
1290 V=GET(3000)
1300 PRINT
1310 PRINT
1320 PRINT
1330 PRINT "           CHAPTER THREE"
1340 PRINT
1350 PRINT "  YOU PULL UP OUTSIDE THE MANOR AND THE BUTLER"
1360 PRINT "TAKES YOU TO THE SCENE OF THE CRIME."
1370 PRINT "  ALL THE SUSPECTS ARE WAITING,SEVEN,INCLUDING"
1380 PRINT "CREEPS THE BUTLER.YOU TAKE THEIR NAMES."
1390 PRINT
1400 PRINT " MISS LUSTIE  MAJ.COCKUP   LADY WALLOP"
1410 PRINT "DR.DUNNIT  MR.P.BRAINS  A.TONKER  CREEPS"
1420 PRINT
1430 PRINT "  YOUR NEXT MOVE IS TO MAKE A QUICK SKETCH OF"
1440 PRINT "THE MANOR IN YOUR NOTEBOOK."
1450 REM*MURDER ROOM SELECT*
1460 R=4
1470 GOSUB 3160
1480 D=Z
1490 ON Z GOTO 1500,1530,1560,1590
1500 K$="X"
1510 R$="KITCHEN"
1520 GOTO 1610
1530 D$="X"
1540 R$="DINING ROOM"
1550 GOTO 1610
1560 L$="X"
1570 R$="LIVING ROOM"
1580 GOTO 1610
1590 S$="X"
1600 R$="STUDY"
1610 PRINT
1620 PRINT "(-------------------------------------)"
1630 PRINT "(                  I                  )"
1640 PRINT "(      STUDY       I    LIVING ROOM   )"
1650 PRINT "(";TAB(10);S$;TAB(19);"I";TAB(30);L$;TAB(39);")"
1660 PRINT "(------------------I------------------)"
1670 PRINT "(                  I                  )"
1680 PRINT "(   DINING ROOM    I      KITCHEN     )"
1690 PRINT "(";TAB(10);D$;TAB(19);"I";TAB(30);K$;TAB(39);")"
1700 PRINT "(-------------------------------------)"
1710 PRINT "  ALL YOUVE GOT TO DO NOW IS FIND THE CULPRIT."
1720 V=GET(20000)
1730 REM * MATRIX ZERO *
1740 FOR I=1TO8
1750 FOR J=1TO8
1760 A(I,J)=0
1770 NEXT J
1780 NEXT I
1790 REM *MURDERER SELECT*
1800 R=7
1810 GOSUB 3160
1820 M=Z
1830 REM *SUSPECTS ROOM SELECT TO MAT*
1840 FOR S=1 TO 7
1850 IF S=M THEN 1910
1860 R=4
1870 GOSUB 3160
1880 IF Z=D THEN 1870
1890 A(S,Z)=1
1900 A(S,5)=Z
1910 NEXT S
1920 FOR J=1TO4
1930 A(8,J)=A(1,J)+A(2,J)+A(3,J)+A(4,J)+A(5,J)+A(6,J)+A(7,J)
1940 NEXT J
1950 REM *SUSPECTS NUMBER ANSWER TO MATRIX*
1960 FOR S=1TO7
1970 IF S=M THEN 1990
1980 A(S,6)=A(8,A(S,5))-1
1990 NEXT S
2000 REM *TIME SELECT FOR OTHER ROOMS*
2010 FOR K=1 TO 4
2020 IF K=D THEN 2120
2030 R=3
2040 GOSUB 3160
2050 REM *MURDERER ROOM SELECT*
2060 FOR S=1TO7
2070 IF S=M THEN 2100
2080 IF A(S,5)<>K THEN 2110
2090 LET A(S,7)=Z
2100 NEXT S
2110 NEXT K
2120 REM *MURDERER ROOM ALIBI SELECT*
2130 R=4
2140 GOSUB 3160
2150 IF A(8,Z)<2 THEN 2130
2160 A(M,5)=Z
2170 REM *MURDERER NUMBER & TIME SELECT*
2180 R=2
2190 GOSUB 3160
2200 IF Z=1 THEN 2310
2210 REM *BAD NUMBER GOOD TIME ALIBI*
2220 A(M,6)=A(8,A(M,5))
2230 S=1
2240 IF S=M THEN 2260
2250 IF A(S,5)=A(M,5) THEN 2280
2260 S=S+1
2270 GOTO 2240
2280 A(M,7)=A(S,7)
2290 GOTO 2380
2300 REM *GOOD NUMBER BAD TIME ALIBI*
2310 A(M,6)=A(8,A(M,5))-1
2320 S=1
2330 IF S=M THEN 2350
2340 IF A(S,5)<>A(M,5) THEN 2370
2350 S=S+1
2360 GOTO 2330
2370 A(M,7)=A(S,7)
2380 PRINT
2390 PRINT
2400 PRINT
2410 PRINT "           CHAPTER FOUR"
2420 PRINT
2430 PRINT "   YOU ARE IN THE ";R$;" READY TO START"
2440 PRINT "QUESTIONING THE SUSPECTS."
2450 PRINT
2460 L=1
2470 X=40+L
2480 GOSUB 3190
2490 PRINT "  ";A$" ENTERS THE ROOM AND SITS DOWN."
2500 R=3
2510 GOSUB 3160
2520 X=58+Z+((L-1)*3)
2530 GOSUB 3190
2540 PRINT A$
2550 T=0
2560 FOR G=1TO2
2570 PRINT
2580 PRINT "  YOU ASK QUESTION NUMBER";
2590 INPUT Q
2600 IF Q=0 OR Q>3 THEN 2590
2610 IF Q=T THEN 2760
2620 T=Q
2630 ON Q GOTO 2640,2680,2720
2640 X=A(L,5)+36
2650 GOSUB 3190
2660 PRINT "   'I WAS IN THE ";A$;"'"
2670 GOTO 2780
2680 X=A(L,6)+48
2690 GOSUB 3190
2700 PRINT "   'BESIDE MYSELF,THERE WAS ";A$;"'"
2710 GOTO 2780
2720 X=A(L,7)+55
2730 GOSUB 3190
```

```
2740 PRINT "  'THE TIME WAS ";A$;"'"
2750 GOTO 2780
2760 PRINT "  'YOU'VE ALREADY ASKED ME THAT'"
2770 GOTO 2570
2780 NEXT G
2790 IFL=7 THEN 2880
2800 PRINT
2810 PRINT "  YOU ASK YOURSELF,'CAN I NAME THE MURDERER'";
2820 INPUT B$
2830 IF B$="YES" THEN 2880
2840 L=L+1
2850 IF L=8 THEN 2880
2860 PRINT
2870 GOTO 2470
2880 PRINT
2890 PRINT
2900 PRINT
2910 PRINT "        CHAPTER FIVE"
2920 PRINT
2930 PRINT "  ALL THE SUSPECTS ARE PRESENT AND YOU"
2940 PRINT "ACCUSE";
2950 INPUT B$
2960 X=40+M
2970 GOSUB 3190
2980 IF B$=A$ THEN 3050
2990 IF B$= RIGHT$(A$,LEN(A$)-5)THEN 3050
3000 PRINT "YOU ARE ABOUT TO MAKE THE ARREST WHEN"
3010 PRINT A$;" BREAKS DOWN AND CONFESSES."
3020 PRINT "YOUR DEDUCTION IS WRONG AND YOU ARREST"
3030 PRINT "THE REAL MURDERER."
3040 GOTO 3100
3050 PRINT "YOU ARREST THE MURDERER AND REFLECT THAT"
3060 X=48+L
3070 GOSUB 3190
3080 PRINT "YOUR DEDUCTION IS CORRECT AFTER QUESTIONING"
3090 PRINT A$;" SUSPECTS."
3100 PRINT
3110 PRINT
3120 PRINT "THE END"
3130 GOTO 3640
3140 REM *RANDOM INTEGER R=LIMIT*
3150 REM
3160 Z=INT(RND(1)*R+1)
3170 RETURN
3180 REM *DATA STRING SELECT X=NUMBER*
3190 RESTORE
3200 FOR Y=1TOX
3210 READ A$
3220 NEXT Y
3230 RETURN
3240 DATA "COLD AND DAMP","HOT AND STICKY","WET AND WINDY"
3250 DATA "COFFEE WAS COLD","BEER WAS WARM","CORONA WAS FLAT"
3260 DATA "FRIDGE","ELECTRIC FIRE","FAN"
3270 DATA "SHIT","BALLS","GOLLY"
3280 DATA "BUNION.","WATER.","BONES."
3290 DATA "HEALTH AND EFFICIENCY","EXCHANGE & MART","THE BEANO"
3300 DATA "HIS END AWAY","A GAME OF LUDO","A VASECTOMY"
3310 DATA "WOODBINE","HAVANA CIGAR","DOG-END"
3320 DATA"'WELL IT AINT A BROTHEL'"
3330 DATA "'WHY? DO YOU WANT TO BRIBE ME'"
3340 DATA "'SORRY ITS MY DAY OFF'"
3350 DATA "SAWN OFF SHOTGUN","SURGICAL TRUSS","SPUD GUN"
3360 DATA "HERNIA","RUPTURE","GAMMY LEG"
3370 DATA "KNACKERED OLD ANGLIA","GLEAMING CADDILAC","BUBBLE CAR"
3380 DATA "KITCHEN","DINING ROOM","LIVING ROOM","STUDY"
3390 DATA "MISS LUSTIE","MAJ.COOKUP","LADY WALLOP"
3400 DATA "DR.DUNNIT","MR P.BRAINS","A.TONKER","CREEPS"
3410 DATA "NONE","ONE","TWO","THREE","FOUR","FIVE","SIX","SEVEN"
3420 DATA "7:02","7:04","7:06"
3430 DATA"SHE IS A HORNY LITTLE THING AND KNOWS IT."
3440 DATA "SHE HAS BUCK TEETH AND ACNE."
3450 DATA "SHE CROSSES HER LEGS AND FLASHES HER THIGHS."
3460 DATA "HE SITS NERVOUSLY TWICHING HIS MOUSTACHE."
3470 DATA "HE BELCHES AND SAYS,'PARDON'."
3480 DATA "HE FURTIVELY CHECKS HIS FLIES."
3490 DATA "SHE HEAVES HER AMPLE BOSOM."
3500 DATA "HER WEIGHT MAKES THE CHAIR CREAK."
3510 DATA "SHE SAYS,'COME UP AND SEE ME SOMETIME."
3520 DATA "HE SPILLS HIS DRINK DOWN HIS TROUSERS."
3530 DATA "YOU NOTICE THAT HE IS WEARING TIGHTS."
3540 DATA "'YOU'RE A BIG BOY'HE SAYS."
3550 DATA "HE WIPES HIS MONOCLE WITH A PAIR OF KNICKERS."
3560 DATA "HE STAMMERS,'I NEVER TOUCHED HER YOUR HONOUR."
3570 DATA "HE SQUIRMS IN HIS CHAIR,SUFFERING FROM PILES."
3580 DATA "HIS ELBOWS LOOK VERY SORE."
3590 DATA "YOU CANT MAKE OUT WHAT THE BULGE IN HIS TROUSERS IS."
3600 DATA "THE HANKERCHIEF ON HIS HEAD IS NOT CLEAN."
3610 DATA "YOU NOTICE LIPSTICK ON HIS COLLAR."
3620 DATA "A SILVER SPOON FALLS OUT OF HIS POCKET."
3630 DATA "HE SAYS,'I HAVE GIVEN HER LADYSHIP MUCH PLEASURE'."
3640 END
```

Pinball wizardry of teaching program

The visual impact of animated graphics make the micro a powerful tool. Ivor Wood combines that power with the popular appeal of pinball to make a teaching program for schools statistics.

CLASS TIME is wasted if the teacher painstakingly calculates and re-writes — and the class copies — complete sets of results. while the most carefully-prepared overhead transparencies cannot project movement in real time.

Students often find statistics a difficult subject to grasp. not because of the relatively simple mathematics involved. but because of the jargon and concepts used.

Various mechanical teaching aids have been available for many years. They can. however. reveal only a limited aspect of the dynamics and cannot carry out a numerical analysis. The micro can do both. and more.

The newcomer to statistics has difficulty grasping how it is possible to plan for random events — repeatability among random behaviour is one of the cornerstones of the application of statistical theory to daily life.

The pinball machine found on seaside piers and in amusement arcades provides an excellent teaching model for this topic. In this machine. the insertion of a coin brings a steel ball into play, which is projected up the side of a vertical machine to fall on to a single pin set horizontally at the top of the machine.

The ball then bounces left or right to hit a second row of pins, moving further down rows of pins until it falls into one of the receiving cups at the bottom of the machine — the skill is to make the ball take one of the less likely routes which are worth more points.

If the machine had been perfectly engineered. there would be an equal chance of the ball bouncing left or right at any pin. Hence, to win the maximum prize, the ball would have had to bounce in the same direction at every pin to land in one of the outermost cups.

```
PROGRAMMED FOR UP TO 9 ROWS
PRESS  S  DURING RUN TO DELAY NEW TRACE

NO OF ROWS (TRIALS)? 9
NO OF REPETITIONS? 32
PROB OF LEFT BOUNCE? .5
```

Figure 1.

In a machine with 10 rows of pins, this would represent a probability of $1/2^{10}$: i.e., it would occur, in the long run. once every 1,024 occasions. The likelihood of the ball falling into any of the cups is given by the binomial distribution which was discussed in a recent article by Owen Bishop, *Practical Computing,* March 1981.

The pinball model can be used to demonstrate many of the concepts of statistics — expected value, mean. measure of variation, sampling distribution and hypothesis test. This last concept is no more than the jargon term for the kind of problem where you, say, take a fairly-balanced coin from your pocket and, having tossed it 10 times in succession, find it landed heads every time. Do you still believe that it was a fair coin. or, if in the pinball machine, the ball bounced to the left at every one of 10 rows of pins, do you have doubts about the precision of the engineering?

If a door-to-door salesman has an even chance of making a sale at any house. and he then sells to 10 successive houses. are you underestimating his abilities?

In statistics, each of these problems is described by the same model and has identical mathematics — that is why it is so invaluable to find a way of explaining the model so that the student can grasp intuitively what is involved.

An Apple demonstration program, The Great American Probability Machine, forms an array of pins and animates a ball bouncing at random through them. The chief virtue of this low-resolution graphics program lies in the impact of colour — each successive ball has a different random colour — and the satisfying "clink" sound from the loudspeaker as the ball hits each pin.

Because Apple low-resolution graphics are limited to the use of shapes based only on a unit rectangle, the program causes brick-shaped balls to bounce on brick-shaped pins. The only virtue of this incongruent behaviour is that the balls are able to stack themselves, colourfully. into neat columns at the bottom of the screen — thus building the sampling distribution of the result of that sample of runs.

While it is eminently suitable for a class of 14- or 15-year olds, a more analytic

Figure 2.

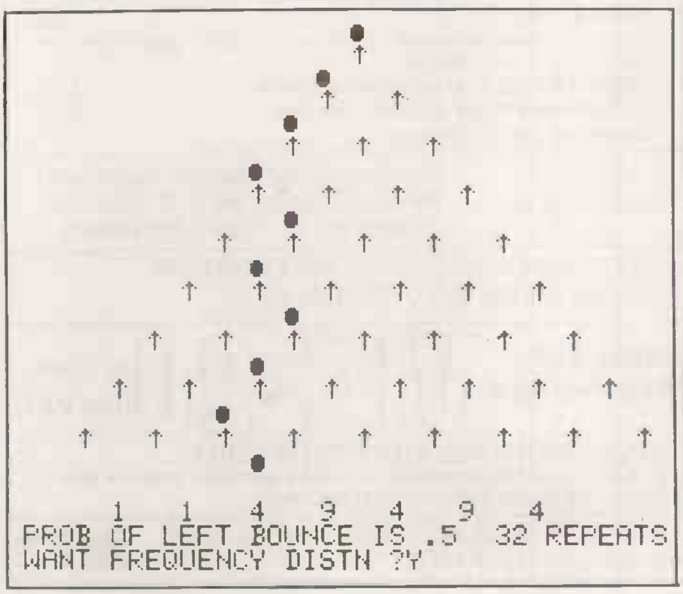


Figure 4.

```
MEAN= 4.7813  BOUNCES TO THE LEFT

NO  RIGHT BOUNCES       PROBY
 0       0          P( 0 )= 0
 1       1          P( 1 )= .0313
 2       1          P( 2 )= .0313
 3       4          P( 3 )= .125
 4       9          P( 4 )= .2813
 5       4          P( 5 )= .125
 6       9          P( 6 )= .2813
 7       4          P( 7 )= .125
 8       0          P( 8 )= 0
 9       0          P( 9 )= 0
                          =========
                              1
WANT OBSERVED-THEORY COMPARISON ?Y
```

program is required for teaching 18- to 50-year-olds. The Apple program allows no skew to be placed on the bounce of the ball and performs no statistical analysis of the results.

The following program has been written for Pet and will run on any 40-column machine, Basic 2.0, 3.0 or 4.0. It requires the input of the number of rows of pins to be simulated, the required skew on the ball and the number of runs to be made. It occupies 3Kbytes of user memory.

A full statistical analysis is performed and the lecturer has control over how long each section of the program is left on the screen. For those in the educational field who are somewhat pessimistic about the time it would take to write such a program, it may be of interest to note that after seeing the Apple demonstration program one morning, the Pet version was completed in the same afternoon — writing it directly on to the keyboard with minor assistance from pencil and the proverbial envelope back.

A further two hours has been spent in notating, tidying and shortening some of the original routines. The Find, Renumber and Dump facilities offered by the programmers' chip are invaluable aids to the fast development of programs on the Pet.

You can gain a useful description of the application of the program from the accompanying illustrations — dumped directly from the screen, *Practical Computing*, October 1980 — and from the following description of some of the more interesting parts of the program.

The Rem statements are clearly separated from the rest of the program lines by the method described in Pet Corner, *Practical Computing*, August 1980. Enter the line number, followed by any shifted letter, space bar, any shifted letter, and return. The slight waste of memory space is more than justified by the clarity of the resulting listing.

An initial declaration of the variables used in the program ensures faster running time and is a useful reminder of which letters have been used if the program is altered at a later date.

Should the user enter false prompts — figure 1 — he is requested to re-enter correct values. Pet has a true ball character among its graphic symbols CHR$ (209), and the upright arrow Poke screen memory, 30 reproduces more clearly on a large monitor than does a dot shape.

The array of pins may be written to the screen in a variety of ways. The most obvious method is to print a series of strings containing the pins in their correct positions on alternate rows. Alternatively, the pin positions could be drawn on squared paper and the ball shape Poked into the corresponding memory locations read from data statements, *Practical Computing*, June 1980.

(continued on next page)

```
1000 REM PINBALL:COPYRIGHT IT WOOD 1981
1010 REM VARIABLES USED
1020 X=0 MAX=0 R3=0:N2=0:SK=0:M=0:I=0
1030 Z9=0 R=0:Z=6:R6=0:P=0:X1=0:C=0
1040 F$="":R$="":CL$=""
1050 DIM N(50),F(10),P(10),O(10)
1060 REM CHR$(17=CSR DOWN,19=HOME,18=RVS,146=RVS OFF,209=BALL)
1070 REM CHR$(147=CLR SCR,163=LINE SYMBOL)
1080 DEF FNR4(X)=(INT(10000*X+0.5))/10000
1090
1100 REM ISSUE PROMPTS
1110
1120 PRINTCHR$(147):PRINT:PRINT:PRINT
1130 PRINT"       PINBALLS":PRINT:PRINT:PRINT
1140 PRINT"PROGRAMMED FOR UP TO 9 ROWS"
1150 PRINT"PRESS 'S' DURING RUN TO DELAY NEW TRACE"
1160 PRINT:PRINT:PRINT
1170 INPUT"NO OF ROWS (TRIALS)";R3
1180 IF R3>9 THENPRINT"TOO MANY ROWS":GOTO1170
1190 INPUT"NO OF REPETITIONS";N2
1200 INPUT"PROB OF LEFT BOUNCE";SK
1210 IF SK<0 OR SK>1 THENPRINT"NOT A PROBY":GOTO 1200
1220
1230 REM GENERATE FACTORIALS
1240
1250 F(0)=1:FOR I=1 TO 10:F(I)=I*F(I-1):NEXT I
1260
1270 REM PRINT PINTABLE:SCREEN(30) IS ARROW HEAD CHAR.
1280
1290 PRINTCHR$(147)
1300 Z9=1:M=32767:REM VIDEO SCREEN LOCATION START
1310 FOR R=3 TO 2*R3+1 STEP 2
1320 FOR Z=1 TO Z9
1330 POKEM+20+40*(R-1)-(R-3)+4*(Z-1),30
1340 NEXT Z
1350 Z9=Z9+1
1360 NEXT R
1370
1380 REM PRINT BALL PATH AFTER CLEARING PREVIOUS PATH
1390
1400 CL$="                                        "
1410 FOR Z=1 TO N2
1420 PRINTCHR$(19)
1430 FOR R6=1 TO R3+1:PRINTCL$:PRINT:NEXT R6
1440 PRINTCHR$(19)
1450 PRINTTAB(19);CHR$(209);:P=20:PRINT:PRINT
1460 FOR I=1 TO 2*R3 STEP2
1470 X=SGN(RND(1)-SK):IF X=0 THEN 1470
1480 IF I=1 THEN X1=X
1490 IF X1=X THEN P=P+X
1500 IF X<X1 THEN P=P-1
1510 IF X>X1 THEN P=P+1
1520 PRINTTAB(P-1+X);CHR$(209);:P=P+X:PRINT:PRINT
1530 X1=X
1540 NEXT I
1550 N(P-1)=N(P-1)+1
1560 PRINTCHR$(19):FOR I=1 TO 20:PRINTCHR$(17);:NEXTI
1570 FOR C=0 TO 40
1580 IF N(C)>MAX THEN MAX=N(C)
1590 IF N(C+1)>0 THEN PRINTTAB(C); N(C+1);
1600 NEXT C
1610 PRINT
1620     REM SLOW DOWN ROUTINE IF'S' PRESSED
1630     GET F$:IF F$<>"S" THEN 1650
1640     FOR Y=1TO 1600:NEXTY:F$=""
1650 NEXT Z
1660 PRINT"PROB OF LEFT BOUNCE IS"SK;TAB(25);N2"REPEATS"
1670
1680
1690 INPUT"WANT FREQUENCY DISTN";R$
1700 IF LEFT$(R$,1)<>"Y" THEN 1940
1710 PRINTCHR$(147)
1720 FOR I=MAX+1 TO 0 STEP -1
1730 FOR C=0 TO 40
1740 IF N(C)<=I THEN 1760
1750 PRINTTAB(C);CHR$(18);" ";CHR$(146);:REM INVERSE OF A SPACE
1760 NEXT C
1770 PRINT
1780 NEXT I
1790 FOR I=1 TO 40:PRINTCHR$(163);:NEXTI:PRINT
1800 PRINT
1810 FOR C=0 TO 40
1820 IF N(C+1)>0 THEN PRINTTAB(C); N(C+1);
```

(continued on next page)

(continued from previous page)

For example, the first three rows would be,

	row	column positions
●	1	20
● ●	3	18 22
● ● ●	5	16 20 24

However, since perhaps the secret of creative programming is to develop the facility to use multiple variable transformations in For . . . Next instructions, this method is shown in the program. Line 1330 transforms the series of numbers given in the example into the desired expression involving the row number R and the number of rows Z.

A ball is then input above the topmost pin and a random number generated to determine whether the bounce is to the left or the right at each pin it meets. This sequence traces the path of the ball through the pins. When completed, the count at the point of exit of the ball is incremented and displayed on the screen.

Before the next ball is introduced, the trace of the previous ball path is cleared by printing a string of spaces, CL$, on the rows between the pins. The pins are never cleared; the previous ball trace is. For teaching purposes, the length of time an individual trace is left on the screen may be lengthened by pressing the "S" key during play, line 1620. This sequence of events is repeated until the required number of repetitions is completed. The result of a run of 32 repeats and the trace of the final path is shown in figure 2.

The major advantage offered by this program for schools teaching lies in the immediate analysis that is now available. The distribution of the number of times the ball went through each exit point may be displayed on a vertical bar chart, figure 3. Obviously, with a 25-row screen, the bar chart of many hundreds of runs cannot be accommodated without the incorporation of a suitable scaling factor.

Alternatively, the time taken for the display to scroll down the higher peaks is sufficient evidence of the top part of the distribution. The height of the bar chart is held in the variable Max computed in line 1580 of the previous section of the program.

Next, the "number of times" distribution is converted to its probability form and both are displayed side by side in figure 4. While the displayed values are rounded to four decimal places — user-defined function FNR4, line 1080 — the sum is computed with the full accuracy offered by the computer.

(continued from previous page)

```
1830 NEXT C
1840 PRINT
1850 FOR C=0 TO R3
1860 PRINTCHR$(18);TAB(19-2*R3+4*C-1);C" ";
1870 NEXT C
1880 PRINT:PRINT "        "CHR$(18)" BOUNCES TO THE RIGHT"
1890 PRINT:PRINT:PRINT
1900 PRINT"PROB OF LEFT BOUNCE IS"SK;TAB(25);N2"REPEATS"
1910 PRINT
1920
1930
1940 INPUT"WANT ANALYSIS";R$
1950 IF LEFT$(R$,1)<>"Y" THEN 2120
1960 PRINTCHR$(147)
1970 FOR P=0 TO R3
1980 P(P)=N(19-R3*2+4*P)
1990 EV=EV+P*P(P)
2000 NEXT P
2010 PRINT"MEAN="FNR4(EV/N2)" BOUNCES TO THE LEFT"
2020 PRINT:PRINT
2030 PRINTCHR$(18)" NO "CHR$(146)" RIGHT BOUNCES      PROBY"
2040 FOR I=0 TO R3
2050 PRINTI,FNR4(P(I)),TAB(20)"P("I")="FNR4(P(I)/N2)
2060 P9=P9+P(I)/N2
2070 NEXT I
2080 PRINTTAB(26)"=========="
2090 PRINTTAB(28)P9
2100
2110
2120 INPUT"WANT OBSERVED-THEORY COMPARISON";R$
2130 IF LEFT$(R$,1)<>"Y" THEN END
2140 PRINTCHR$(147)
2150 PRINT" N","P(N) OBS","P(N) THEORETICAL":PRINT
2160 FOR I=0 TO R3
2170 O(I)=F(R3)/(F(I)*F(R3-I))
2180 NEXT I
2190 FOR I=0 TO R3
2200 PRINTI,FNR4(P(I))/N2,
2210 PRINTCHR$(18);FNR4(O(I)*(SK↑(R3-I))*((1-SK)↑(I)))
2220 EX=EX+I*O(I)*(SK↑(R3-I))*((1-SK)↑(I))
2230 NEXTI
2240 PRINT
2250 PRINT"OBSERVED EV="FNR4(EV/N2);
2260 PRINTCHR$(18);TAB(18);"THEORY SAYS";FNR4(EX)
2270 END
```

Finally, the observed probabilities resulting from the sequence of runs just completed are compared to those which would theoretically occur if an infinite number of runs were simulated.

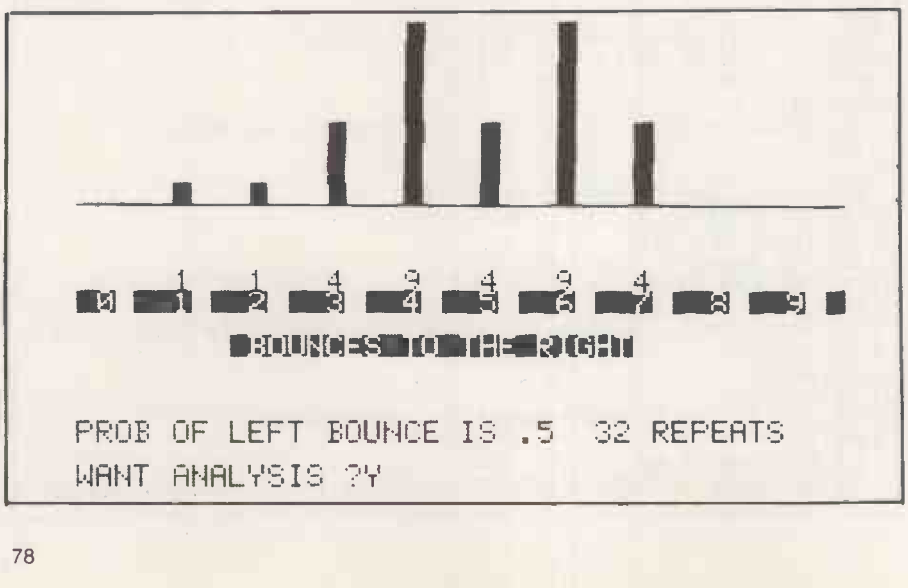
The final line on the screen displays the observed mean number of times the ball bounced left during its trace, and compares that number to the long-term theoretical number of left bounces.

In real life, business or scientific situations this single number, the sample mean — together with its measure of variation — provides the basis for estimation and prediction.

As a teaching tool, the program demonstrates a number of important features:

- It depicts randomness in dynamic action — a randomness that has a long-term pattern.
- It provides an easy-to-grasp explanation of observed probability distributions.
- It illustrates a model which may be used as a basis for discussing many statistical concepts. For example, the concept of expected value can be approached by asking the class what reward they would place on each exit cup.
- It clearly identifies the result of taking samples of larger size, and hence, cost in time waiting — when the observed results will ever more closely approach the theoretical values, whether a fair or skewed ball is used.

Figure 3.



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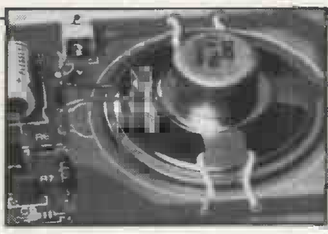

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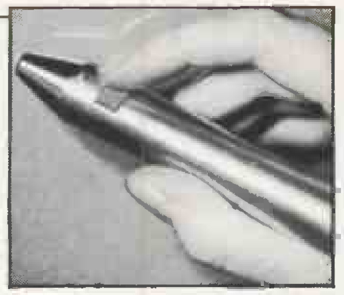

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Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

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.

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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.

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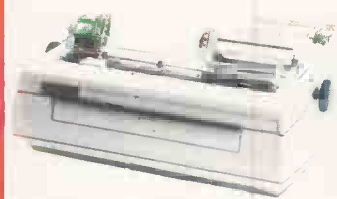

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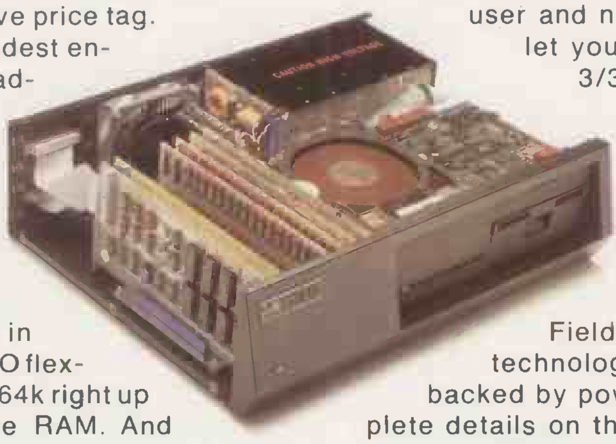

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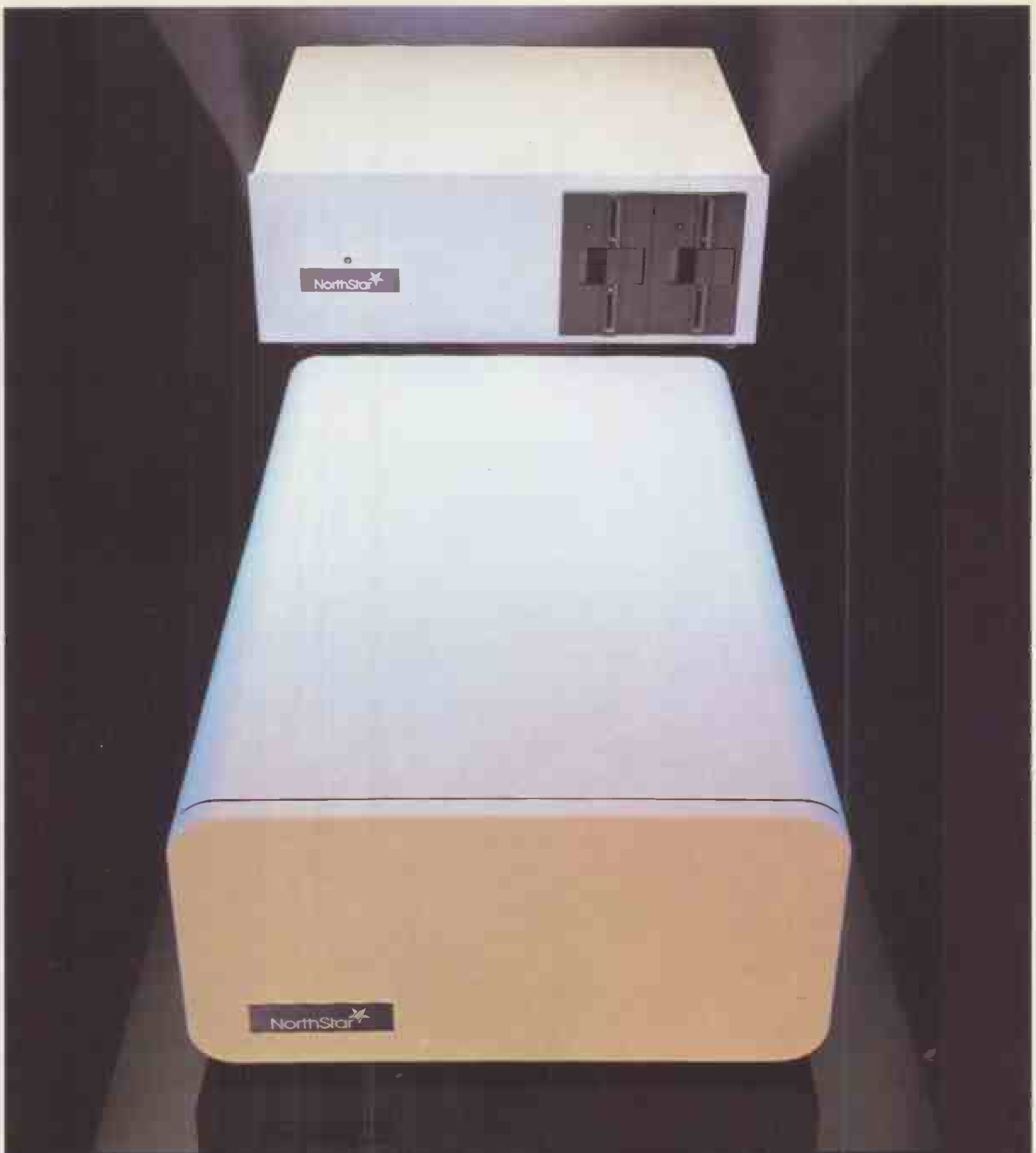

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SNAFU

By Bill Bailey

Paul was catapulted from sleep by a high-pitched squeal — the penultimate alarm call. He fumbled for the cancel button on the keypad. The sound died instantly and was replaced by a featureless melody. He drew back the sheets for a moment then grudgingly emerged and groped around the surface of the bedside table for the keypad. The clock register was displayed — 08.48 in 50mm. numerals. Working session began at 08.30.

His conscience dulled by sleep, he cancelled the clock and keyed his ID followed by shift code. He mis-typed, then swore, cancelled and began again. This time he completed successfully and activated the accept key. The red display died and was replaced by red 2mm. alphanumeric characters.

08.49 — Project week 27, Ultimate Electronics Ltd.
— P S Dickinson log in.

He manoeuvred himself into a sitting position then keyed the accept code for high-priority messages from the evening and night shifts.

08.51 — a5*** D S Dickinson
— Memo required to R&D Head to cover discrepancy between performance and projection for digitalisation of the Campmobile control module.
E B H
— B1* Paul
— Authorise financial cover for extra-man-hours on the re-design of engine-sensor multiplexer.
Eddie
— B2* P Dickinson
— Bubble packs are three months' delivery. No second source. What do you advise?
Miss R D Taylor, Purchasing
— B2* Paul
— RT stocks are low ....

He stared at the falling blocks of characters as they blurred into delightful coloured patterns then dimmed to grey. Paul felt the hardness of the headboard only briefly before he drifted back into peaceful slumber.

He awoke horribly to an ear-splitting scream. He dived for the keypad pressing keys indiscriminately. He cancelled then keyed the correct response. The awful signal died. Paul remembered that he was on shift. It occurred to him that a high-priority message must be waiting.

09.27 — a2***** P S Dickinson, Campmobile leader.
Marketing suggest that launch be cancelled due to lack of firm finishing date. If we cannot make '92 show, they want to pull out. Comments by 10.00 today.
Director R&D
Append: Pull your finger out Paul. You've been in 38 minutes, and haven't produced a response. Where are you? In bed?
Frank

The message was depressing but the appended reprimand was more ominous. Paul keyed a command to send the files, updated the previous evening, to the lounge terminal. He grabbed his dressing gown from the floor and stumbled from the bed, brushing against a glass of water on the bedside table.

The glass and contents fell neatly onto his slippers. He cursed then walked barefoot to the lounge, trailing his dressing gown behind him. He pulled back the curtains and stared at the uniform grey sky. He keyed in coffee at the terminal. As he sat down he remembered that the coffee dispenser was out of beans. The level sensor had failed and no warning was issued when the dispenser was empty. He cancelled and requested tea. The Hardcopy in the corner was silently oozing blank paper on to the carpet.

Paul leapt from his seat and kicked it savagely. Characters began to appear. He returned to the terminal and keyed in the file ID. The Hardcopy hiccupped then began to spew the required file. Paul stared unbelieving at its contents. There was a crude picture of an elephant, formed from plus signs followed by a stream of noughts and crosses games. Then there was the odd poem:

Tranquillity.
Evensong twilight.
Lessening influence.
A dimming ash spinning gently to stillness.
Cool scent upon the deepening fading, Sol.

Paul emitted a strangled cry. Where were the Campmobile breakdowns? The pcb throughput estimates for peak production? Where were the new projections based on the proposed manpower increases? The poem was undoubtedly his eldest daughter's — a 17-year-old who kept company with the New Luddites. Lost for words, Paul keyed her school code into the terminal. He contemplated AV contact but declined the idea of a row with his daughter in front of her class. He keyed his daughter's personal code and waited for her response.

— Message please? Miss Dickinson not available.
— Please get her to call home ASAP.

Paul left the terminal and headed for the kitchen. It was full of steam. The teamaker had not switched off. He removed a mug of tea from the dispenser and returned to the lounge. He looked disapprovingly at the black liquid. A tone sounded and he returned rapidly to the terminal where a message was displayed in the bottom-right of the screen.

Hello daddy
Daddy hello
d
a
d
d
y
HELLO

Paul typed

—You overwrote my work file you silly girl.

The reply came slowly.

— I took over from Amanda. She must have been accessing my file. I didn't know.

He remembered the elephant; his eight-year-old daughter's hallmark. A further message appeared.

— Mr Dickinson no personal messages in class.

Paul tried to type an apology but the message was not accepted. He cleared and created a new workfile. Paul watched the time, displayed in green on the left of the screen, change from 09.46 to 09.47. He sprang into action and began to format a memo to the director in scratchpad mode. A message suddenly appeared on the screen in blue.

— Domestic Information
Electricity payment due 1.10.92 Final demand imminent.
Tiolet paper now critical.
Soap powder refill required.
Verification of wash program for whites required.
Photopax standing charge increase.

The domestic net sometimes dropped a priority bit resulting in low-priority domestic data flashes breaking into work shift. Paul killed the flash and made a mental note to check the domestic ROM. His attention was drawn to the Hardcopy which was emitting a steady stream of children's comics, circulars and other documents.

"Do you have enough processing power in your home?
1MByte of non-volatile store free if you ...."
"Write symphonies in your own home . . ."
"Car Keypad fitted free while you wait ...."
"Privacy. Is yours threatened? Request poll 72 of the public referendum. Make your views known"

Paul forced his eyes back to the screen. 09.49 in green numerals. A green glow. A whitish glow. Grey — Paul came to with a start. He had clearly dozed off. He keyed for more tea and added a PS to the system to repeat every hour. He returned to scratchpad mode.

09.50 — To director R&D
— Urge you to keep the launch date, otherwise we will be too late. As marketing have pointed out, competitors are moving in fast and by the '93 show our lead will be lost.

At 09.58, Paul keyed the crude memo into the Formatter. The edited file checked to his satisfaction, Paul sent a copy to the office and another to his own Hardcopy. For the first time that day, he relaxed. He had just collected a mug of tea from the dispenser and activated the toaster manually when the telephone buzzed. It was the director's PA on visual: "Mr Dickinson, there's a special progress meeting at 11.00. You'll be attending"?

"I wasn't expecting one".

(continued on next page)

(continued from previous page)

"It's only just been arranged. Dr Miller has flown in from the States. You know how he is about the present crisis".

"I'll be there". Paul looked dazed. It was 10.16 and the journey took a good 30 minutes. He rushed up to the bedroom, threw on a suit, straightened his tie, cancelled his toaster from the bedside keypad and hurled himself down the stairs. He tore the paper stream from the Hardcopy and ripped out the relevant sheets. He tossed the remainder away and manipulated the terminal keys, cancelling the tea and opening the garage door.

Incredibly the car started first time but predictably, the garage door would not close as he reversed rapidly down the drive. Paul noticed that the speedometer display still dropped the most significant digit. The rest of the dashboard, which was brightly illuminated with digital readouts of battery voltage, temperature, vacuum, tyre pressure, and even the incoming signal level from the National Net — to point one of a dB — was working normally.

The report screen rolled out a constant stream of traffic information from the Net. Paul keyed Map Mode and set it to maximum intensity. The text on the screen disappeared and was replaced by an outline map. Paul swung the car into the kerb, narrowly missing a cyclist, and manipulated the display until the cursor, superimposed on the map, coincided with the junction some 20yd. ahead.

He then re-set the display to medium resolution and drove off at high speed. He keyed his workcode into the dash keypad and followed it with a trap on all messages below A status. He did this on the assumption that a cancellation of the meeting would merit A status. It began to rain. The wipers swept into life, imperceptibly quickening as the sky darkened.

The airflow from the dash gradually reduced and the dip indicator lit up. Paul keyed in the code for his route to the office. The text overlay area of the screen began to fill with a diversionary route and five hazard markers began to flash on the pre-programmed route which was superimposed on the outline map.

Paul noticed with growing alarm the changes in his environment. The traffic had slowed to a crawl, the windscreen was awash with water and the map was peppered with flashing dots. A flood warning appeared in the text area.

When Paul arrived at the conference room his Pocketpad displayed 11.05. Dr Miller, after giving Paul a disapproving stare, wasted no time in opening the meeting. He began by bemoaning the state of the industry and stressing the need to re-vitalise the processor market. Paul suppressed the first yawn successfully but the second was noticed. Dr Miller merely scowled but the director keyed a brief memo into his Pocketpad.

"Ominous", thought Paul. Dr Miller continued.

"Campmobile as a concept is OK. Combine the domestic processor with the automobile processor giving a motor caravan with the attributes of both — but what a small market. So little growth potential. If we were co-operating with Ford or General Motors, fine, but this tiny outfit in Dewsbury? Gentlemen, we need to open a new market not try to take a small share of an established one. I have with me today a new concept. Believe me, it has promise".

Here, Miller banged the table with his fist and turned his head through 180 degrees, displaying a huge, toothy grin. He then began to hurl thick photostat reports across the table. Paul scanned the title page: "POGO the perfect pet". He suppressed a smile.

Miller began to explain the astounding concept of the electronic poodle. A cybernetic marvel. In principle, a peripheral of the domestic Net, the bus extender being a low-speed, radio-data link to the electronic man's-best-friend with a silicon brain. The amiable pet would amble about the house in a random way, eating synthetic dog biscuits, sleeping — to recharge his cells via his charger-dog-basket — and performing useful chores such as picking up garbage.

Should the fortunate owner wish to summon his pet or modify its behaviour, he would only need to key in a command via any keypad or terminal.

"The benefits are legion", shouted Miller, fanatically. "No mess, no smell, no puddles, no lawsuits for fouling the sidewalk, no embarrassing sexual behaviour, no licence fees, no food bills". He paused for effect then continued: "This will make the flesh and blood version obsolete. If you've got shares in kennels or dogmeat factories, sell them today".

Paul misjudged the mood of the meeting. He smirked, then giggled. Miller stared at him with a look that would have turned Medusa to stone. The rest of the meeting twiddled their thumbs or stared at their blank screens as if expecting an important message.

"I'm sorry", said Paul, "but isn't it a little — trivial"?

"Trivial? Trivial"? spluttered Miller. "A new market? If you'd been around in the early days, whatever-your-name-is, you might understand. We created markets then. When everyone had a calculator, we sold 'em Astro-calculators and biorhythm calculators. We sold 'em calculators on their watches and ballpoints. Then we sold 'em toys that were calculators. If you don't like what we're doing here Mr —", Miller paused.

"Dickinson", interrupted the director coldly.

"Then go on home and don't come back".

"I'm sorry", said Paul, wishing he could lie more convincingly. "I'm beginning to like your idea".

"Now gentlemen", interrupted Miller, "The proposal here contains market surveys in Connecticut, Maine and Texas. The appended documents include a New York Department of Health report on canine habitation in the inner city, articles on 'The decline of the dog' and 'The U.S. Mail's number one enemy'. There are some papers from Harvard on canine parasites and statistics on canine assaults on public employees. Gentlemen, by the time our PR men have finished with the common-or-garden domestic dog —".

The car journey home was uneventful — once the car was started — until a Public Banner appeared on the onboard screen. Starting the car had been tedious because the car insisted on an intoxication check, in line with the new road traffic laws, because Paul has miskeyed the ignition code. He had to go through a sequence of reaction tests.

Unfortunately, these were very difficult to pass because the "5" key was sticking. The car then only agreed to start if Paul would acknowledge a series of status reports on malfunctioning systems. These were given in a sing-song voice — Paul cursed the fact that he had opted to have voice output fitted to his car as an optional extra.

"Fan belt tension is out of limits. Oil pressure is too low. Nearside front brake pad is badly worn".

"I'll fix them. I'll fix them. Why do you have to keep on telling me. What if the fan belt is loose? Cars never used to complain about trivial stuff like that", muttered Paul. Paul read the Public Banner.

WARNING: PUBLIC NETWORK, EAST SURREY — CRASH IMMINENT.

The ever-dynamic logo of the Public Net disappeared from the left-hand corner of the screen. The red dots and moving cursor became static. Paul was alone. He stared through the blackness at the road ahead. A few hundred yards away, he could see a ribbon of brakelights. The jams had begun quickly. Alone. Tranquillity. What was that odd poem?

Evensong twilight, lessening . . .influence
A dimming something spinning to stillness
Cool-scent upon the deepening Sol?

There was something vaguely interesting about the words but what did it mean? His daughter must be off her head. Where had he gone wrong? She had wanted for nothing. Tranquillity. Being alone with one's thoughts. He could understand that much. The joy of solitude.

The car's voice cut in sharply. "You are too relaxed. Do not fall asleep".

"Sorry", murmured Paul, apologetically. Luckily the car knew what to do. Paul was flooded with loud music in stereo and the blowers were turned on at full blast into his face. The momentary sense of peace disappeared and Paul was himself again.

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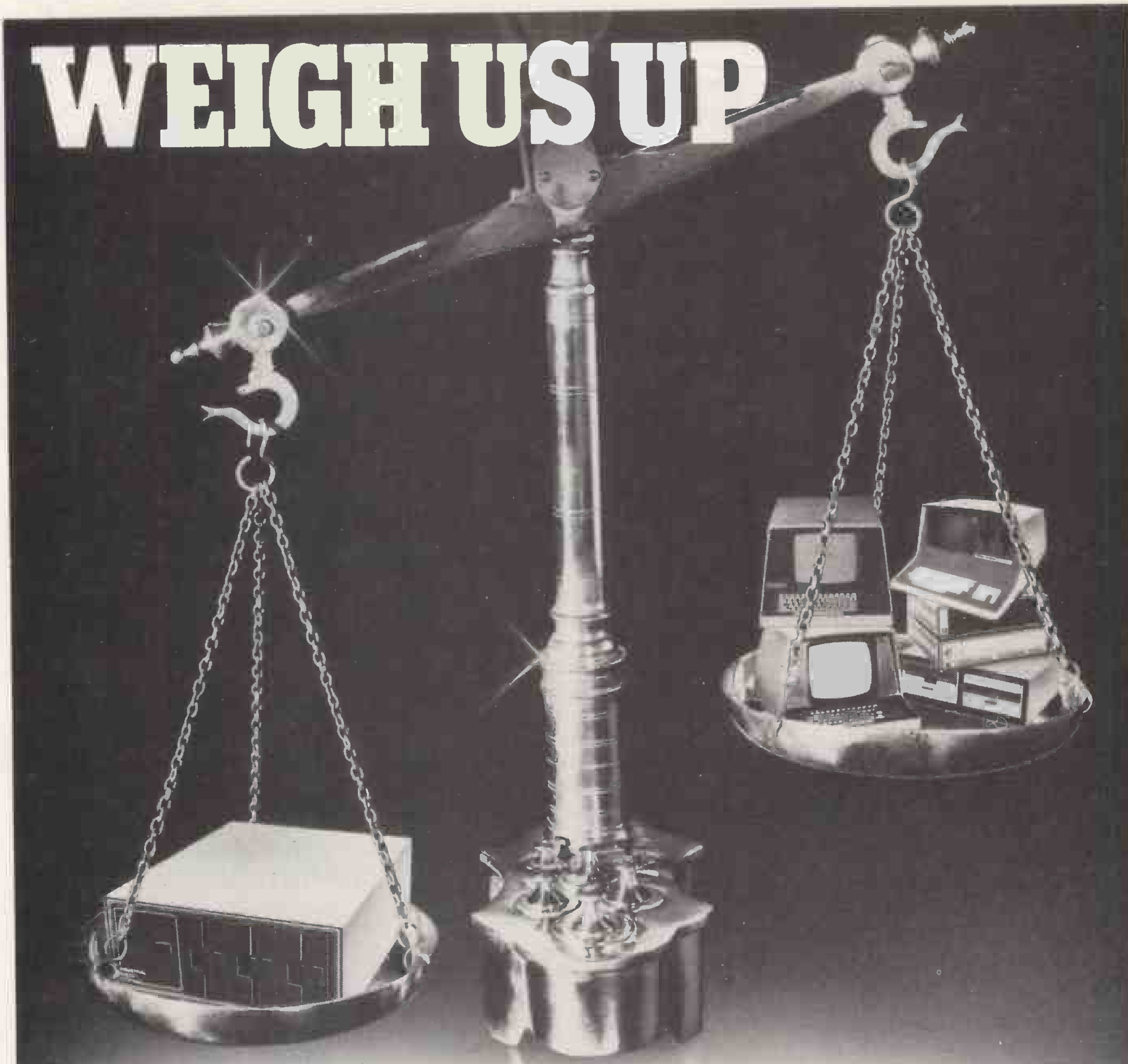

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● **Circle No. 158**

Micros make the grade

Filmatic Laboratories is a successful film-processing firm always seeking new techniques to improve efficiency. Tracy Ebbetts reports on how it incorporated a micro into film grading.

PART OF the charm of a well-made movie lies in the subtleties of light, shade and colour of the finished print. In one scene the director may want to hide the villain in murky shadows — in another, he may want the heroine floating in a sea of light. If the lighting cameraman has done his job properly, the negative film of both scenes will be equally well-exposed and the director will be appeased.

To produce these special effects — and many subtler adjustments in between — the laboratory which develops and prints the film employs a technician called the grader. He views the film frame by frame, using his skill to optimise the colour and density of each separate scene.

The grader has a choice of 125,000 variations of colour and intensity — 125,000 variations which he can use in any one scene and 125,000 again for the next. This could mean up to 200 light changes in a half-hour film. In the past, changes had to be recorded with a pencil and grading card; scene 1 might require 35 quantities of red, 25 of green and 13 of blue; the next scene might demand 15 quantities of red, 45 green and two blue and so on, all the way through the film. With all these numbers to record, there is a clear opportunity for disaster to strike when the grader transfers the numbers on to paper.

High chances

These numbers must then be put into a form which will operate the printing machines. This is done with a standard 1in. punch tape, so the numbers on the grading card have to be punched on to the tape. By now, there could be at least 1,200 digits — perhaps 200 scenes with three numbers on each which can range from 1 to 50. If one digit is wrong, there are high chances that the grader could ruin many feet of valuable filmstock.

The grader has a very responsible job: if he is on, say, scene 50 and he remembers a similar, earlier, scene he might change his mind about the colour grading — he has a job of instant decision and modification. The record system which permits such decision-making — until now the domain of pencil, grading card and rubber — must be flexible; an obvious job for a microcomputer.

Further complication

There is, however, a further complication — and one which augurs well for the adoption of a micro but badly for pencil and grading card: a new technique in motion pictures requires that every frame seen by the grader has to be counted to locate the precise start of a scene where the density and colour must change. There are 40 frames to every foot of film and a scene can be anything from 1ft. to 20ft. long: the frame number at the change of scene must be recorded.

When a picture fades out or dissolves on the screen, another calculation is required which then has to be translated into another series of numbers which are put on to the punch tape and into the printer.

Filmatic has chosen a standard Apple to take on this complicated and laborious task. The grader's job has been simplified: the computer is plugged into a frame counter, the film is wound through a sprocket on which there is a copper wheel that interrupts the light, one per frame. This is synchronised with the frame counter. The frames are counted and the information is typed on the keyboard. When this task is complete, it is recorded on floppy disc. The disc is used to create hard copy and punch tape.

Before the computer arrived, the grader's worst task always occurred after the film's first processing, when the customer sees it in the theatre and discusses various aspects with the Filmatic team. Often, the client requires changes. He could have intended a particular scene to give the impression of dusk and require the colours to be warmer. The grader makes a note of the particular frame and scene. He might have to make 30 corrections: the hard copy and the punch tape are now wrong. The grader must recover the information and correct it.

The software Filmatic has for its Apple can recover any scene if the operator keys the correct information. Whatever is required is keyed and the Apple creates a new tape and hard copy. In the past, the scene at fault had to be erased and replaced by the new numbers. The client would then say that he is not happy with scene 132 and ask for it to be cut. The film can be edited with little difficulty but the colour and density on the punch tape will not now correspond with the film. This requires a major operation of re-writing the whole film.

Corrected tape

The Apple is programmed to move anything up or across, to delete, correct and end with the numbers on the screen, asking IS THIS CORRECT? When "Y" — yes — is keyed, a hard copy and another corrected punch tape can be created.

All this allows the grader more time for creative work. The long, laborious job of typing, writing, erasing and re-writing is over. The film can be processed faster and more efficiently. Accompanied by a Facit printer and tape punch, the total cost including software and integration was about £10,000. Filmatic intends to spend more money on micros to rid itself of unnecessary manual labour. Employees will be able to concentrate their talents on the more serious work a machine could not do. However, the micros will have to be introduced slowly as there is a limit to how much time can be used for training.

This is the first application of the Apple in this role in the U.K. and the software was written by Cine Lab Services Ltd which specialises in building customised equipment for the film industry.

THE LIMITS OF MY WORLD

MATHEMATICS is a language, or set of languages, and it is the most social of all human constructions. Mathematics is totally invented by man to serve all manner of divers purposes. The idea that languages structure thought has a broad relevance in that the questions we ask, and the ways in which the answers are obtained, depend on the symbols we are able to use.

The symbols we use are those we derive from our languages, and the ways in which we use the symbols depend on our

By Boris Allan

languages. The reason why the use of structured programming languages is so popular in teaching is that it is hoped to make the student programmers think in a structured manner using a structured vocabulary — with Goto not part of that vocabulary.

Structured thought is just as likely to develop if the person in question thinks in a structured way about life in general: the total environment in which students are taught should encourage structured thought, but more importantly it should encourage original thought.

It is reported of Archimedes that, after his discovery of the mathematical equations describing the operation of levers, he claimed: "Give me where to stand, and I will move the earth". Such is the power of the imagination unleashed through a few simple equations.

Einstein found that the symbolism of the tensor calculus gave rise to new insights and results when applied to gravity fields in *The general theory of relativity* — some might never have been unearthed without the tensor symbolism.

Dirac in his description of atomic structure found the use of a matrix symbolism productive of new results, and new insights. Both tensor calculus and matrix algebra were mathematical languages which had been in existence for some time before their sudden new relevance was found.

This process, where a symbolism is invented for one purpose and finds a highly-illuminating application in another, has recently been illustrated in computing. It is worth noting that the symbolism in question was invented outside computer science.

First, I shall describe Ackerman's function which is used to test the efficiency of programming languages which have recursive facilities — I give Pascal and Basic routines; second, I discuss a new mathematical symbolism — designed to make the description of large numbers more manageable; and, third, I show how the symbolism can be used to give an exact non-recursive solution of the function — the derivation of general equation being by bottom-up methods of analysis.

Ackerman's factorial function can be described recursively by two conditions:

1 If N $\geq$ 1 then

FACTORIAL (N) = N*FACTORIAL (N–1)

2 If N $\leq$ 0 then

FACTORIAL (N) = 1

and it is called a primitive recursive function, in that it is determinate in execution

Call	Expansion	Condition	Stack
1	A(2,1)	0	SS(1)
2	A(1,A(2,0))	3	SS(2)
3	A(1,A(1,1))	2	SS(2)
4	A(1,A(0,A(1,0)))	3	SS(3)
5	A(1,A(0,A(0,1)))	2	SS(3)
6	A(1,A(0,2))	1	SS(2)
7	A(1,3)	1	SS(1)
8	A(0,A)1,2))	3	SS(2)
9	A(0,A(0,A(1,1)))	3	SS(3)
10	A(0,A(0,A(0,A(1,0))))	3	SS(4)
11	A(0,A(0,A(0,A(0,1))))	2	SS(4)
12	A(0,A(0,A(0,2)))	1	SS(3)
13	A(0,A(0,3))	1	SS(2)
14	A(0,4)	1	SS(1)
x	5	1	x

Table 1. The expansion of A(2,1).

— it can also be easily expressed in a non-recursive form

FACTORIAL (N) = 1x2x . . . x(N–1) xN

for N $\geq$ 1. Many recursively-defined functions and recursively-defined procedures have non-recursive forms which can be used to calculate the value of the function: Ackerman's function, however, does not seem to have an effectively computable non-recursive form and is what is termed a general recursive function.

The difference between the factorial

Call	Expansion	Condition	Stack
1	A(2,2)	0	SS(1)
2	A(1,A(2,1))	3	SS(2)
3	A(1,A(1,A(2,0)))	3	SS(3)
4	A(1,A(1,A(1,1)))	2	SS(3)
5	A(1,A(1,A(0,A(1,0))))	3	SS(4)
6	A(1,A(1,A(0,A(0,1))))	2	SS(4)
7	A(1,A(1,A(0,2)))	1	SS(3)
8	A(1,A(1,3))	1	SS(2)
9	A(1,A(0,A(1,2)))	3	SS(3)
10	A(1,A(0,A(0,A(1,1))))	3	SS(4)
11	A(1,A(0,A(0,A(0,A(1,0)))))	3	SS(5)
12	A(1,A(0,A(0,A(0,A(0,1)))))	2	SS(5)
13	A(1,A(0,A(0,A(0,2))))	1	SS(4)
14	A(1,A(0,A(0,3)))	1	SS(3)
15	A(1,A(0,4))	1	SS(2)
16	A(1,5)	1	SS(1)
17	A(0,A(1,4))	3	SS(2)
18	A(0,A(0,A(1,3)))	3	SS(3)
19	A(0,A(0,A(0,A(1,2))))	3	SS(4)
20	A(0,A(0,A(0,A(0,A(1,1)))))	3	SS(5)
21	A(0,A(0,A(0,A(0,A(0,A(1,0))))))	3	SS(6)
22	A(0,A(0,A(0,A(0,A(0,A(0,1))))))	2	SS(6)
23	A(0,A(0,A(0,A(0,A(0,2)))))	1	SS(5)
24	A(0,A(0,A(0,A(0,3))))	1	SS(4)
25	A(0,A(0,A(0,4)))	1	SS(3)
26	A(0,A(0,5))	1	SS(2)
27	A(0,6)	1	SS(1)
x	7	1	x

Table 2. The expansion of A(2,2).

function and Ackerman's function is very important in computing, e.g.:

> Of course, computing the factorial function recursively is inefficient and pointless, but there are algorithms which are essentially recursive in nature and some which cannot be carried out in any other way. One example is the computation of Ackerman's function. Meek, 1978:91.

Ackerman's function can be described by three conditions

1 If M = 0 then

A(M,N) = N+1

2 If N = 0 then

A(M,N) = A(M–1,1)

3 If M > 0 and N > 0 then

A(M,N) = A(M–1,A(M,N–1))

and to show that Ackerman's function is rather more complex, and less predictable, than the factorial function, A(2,1) is worked out by hand in table 1.

Table 1 has four columns: the call number; the current stage of the expansion of Ackerman's function for that call; the condition — 1 to 3 — used to produce the expansion from that of the previous call; and the depth of nesting of the expression, SS, i.e., the numbers of pairs of brackets in the expression.

In a computer, SS corresponds roughly to the stack of return addresses and similar items held during the execution of a recursive routine: think of SS as the subroutine stack. In table 1,

A(2,1) = 5

and the maximum depth of stacking is 4; in general the size of the stack needed is A(M,N)–1.

> Ackerman's function is notable because it is believed that there are certain functions which are easily defined recursively but which cannot be defined in terms of ordinary algebraic expressions. The nearest one approaches to an algebraic definition of Ackerman's function contains exponents connected by a string of dots — Higman, 1977:21.

and the function is used principally to test the extent of the complexity allowed by an implementation of a recursive programming language.

A program is written with a recursive function A(M,N) and run with different values of M and N. Such a program is the Pascal Program Ackerman: for Apple Pascal on an Apple II, A(3,1) = 13, A(3,2) = 29, A(3,3) = 61, A(3,4) = 125, and when A(3,5) was calculated the system crashed, without an error message, because of a stack overflow.

The pattern 13, 29, 61, 125, is 2^4–3, 2^5–3, 2^6–3, 2^7–3, and so A(3,5) would appear to be 2^8–3 = 253: and this the value of A(3,5) which is calculated by another method. As the subroutine stack is so quickly consumed by Ackerman's function for even small values of M and N, the other method has to use a non-recursive procedure which copies the way in which a recursive function would be implemented, with a subroutine stack, SS, of 1,000 elements.

The algorithm follows closely that given in Guttman, 1977:111: codings are given in Atom Basic — program Ackerman's Function — and Apple Pascal — Program Ackerman-Investigation. A flowchart for the algorithm is shown in figure 1.

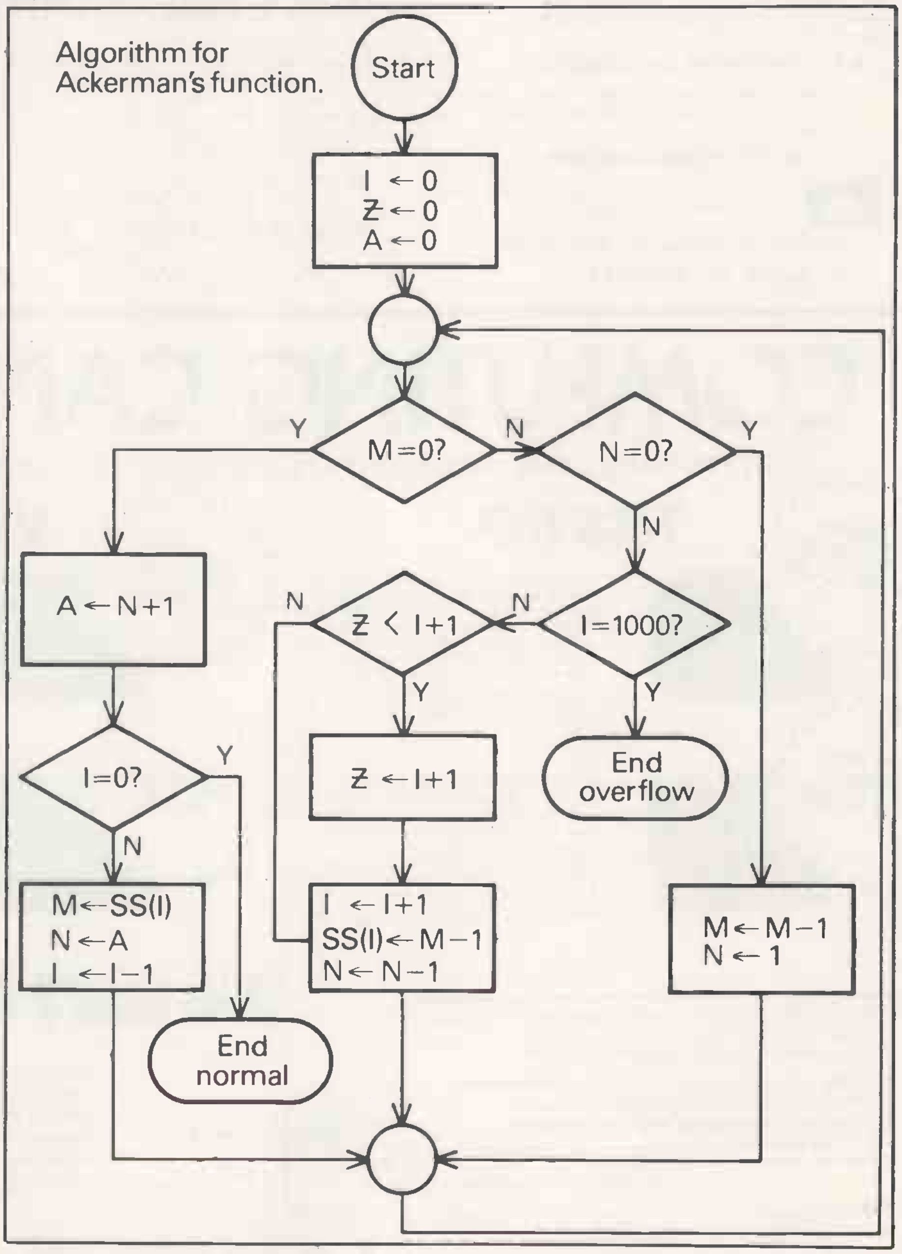
Use of either program allows a check of the earlier supposition that the depth of stack (Z+1) is always equal to A(M,N) minus unity. Calculations of A(4,1) is impossible using most computers, even with a simulated stack such as SS: A(4,1) = 65 533, so this computation requires a stack of 64K elements, or 128Kbytes for the stack alone at two bytes per integer.

With the recursive factorial function, we always know beforehand just how large a stack will be needed — N elements for Factorial (N) — and how many calls will be made, again N. This is what I meant earlier when I said that the factorial function was determinate in execution.

In the case of Ackerman's function, the maximum depth of stack is not known, nor the number of calls of the function to be made. For the example of A(2,1) in

(continued on page 95)

Figure 1.



(continued from page 93)
table 1, the maximum depth was 4 and the number of calls was 14: the corresponding values for A(2,2) are 6 and 27; and the values for A(2,0) are 2 and 5.

The expansion of the calls for A(2,2) is shown in table 2, but you might like to try expanding A(2,2) before looking at table 2.

What has been established is this: there are certain functions, general recursive without being primitive, which, it would seem, are computable by recursive methods but not by non-recursive methods. If we operate within the mathematical language presupposed by a recursive analysis, there is no way in which a non-recursive solution can appear. We

```
VAR M,N,ANS : INTEGER;
FUNCTION A(M,N : INTEGER) : INTEGER;
BEGIN
  IF M=0 THEN A:=N+1
    ELSE
    IF N=0 THEN A:=A(M-1,1)
      ELSE A:=A(M-1,A(M,N-1))
END;
BEGIN(* OF MAIN PROGRAM *)
  M:=1;
  WHILE M)=0 DO
  BEGIN
  WRITELN;WRITELN;
  READLN(M,N);
  ANS:=A(M,N);
  WRITELN('A(',M,',',N,') = ',ANS);
  WRITELN
  END
```

Program Ackerman.

noticed the patterning of values for A(3,N) — 13, 29, 61, 125, 253, . . . — so there would seem to be something simple trying to escape, but this pattern appeared from imagination and not the recursive language.

A recursive language produces a mode of thought similar to that of a sausage machine, and no ingenuity in the design of sausage machines will make further ingenuity unnessary.

To exercise ingenuity requires imagination, and Joseph Griffin is concerned with imagination: How can we describe unimaginable numbers in a simple way? He begins by noting that large numbers are hardly exceptional, for at whatever value we start to class numbers as in some way large, there will always be more big numbers than small numbers.

Big numbers are remote from our intuition because we are unable to perceive the millions and billions around us, as easily as we can perceive the twos and threes. If the earlier quotation from Higman is studied, we can see that he, too, identifies large numbers as awesome and out of this world. Joseph Griffin's aim is to demonstrate one way of obtaining large results from computations on small numbers.

The addition operator "+" and the multiplication operator "x" produce results only slightly larger than the two numbers they combine, e.g.,

$$2 + 3 = 5 \qquad 5 + 5 = 10$$
$$2 \times 3 = 6 \qquad 5 \times 5 = 25$$

but for positive integers greater than unity, we are able to say

$$X + Y \leq X \times Y$$

and if + and x are so ordered, the next operator will be the exponentiation operator "↑". Joseph Griffin uses E in his article; but E has a different meaning for most programming languages, and ↑ or ** are normally used. The exponentiation operator gives

$$2 \uparrow 3 = 8 \qquad 5 \uparrow 5 = 3215$$
$$3 \uparrow 2 = 9$$

and thus, if

$$X = Y \geq 1$$
$$X + Y \leq X \times Y \leq Y \uparrow X \leq X \uparrow Y.$$

Once it is realised that

$a \times b = a+a+a+ \ldots +a+a$ (b "a"s)

and

$a \uparrow b = axaxax \ldots xaxa$ (b "a"s)

the next operator in the sequence must be G_4, defined by

$a\,G_4 b = a \uparrow a \uparrow a \uparrow \ldots \uparrow a \uparrow a$ (b "a"s)

to be computed from right to left

$4\,G_4\,5 = 4 \uparrow (4 \uparrow (4 \uparrow (4 \uparrow 4)))$

Griffin uses ·1 in his article, not G_4, but as the operator is 4th in the sequence and the ideas are due to Griffin, I hope my change is sensible — later it will be found that this slight change in symbolism makes an equation "look better".

We have, therefore,

G_1 is +

G_2 is x

G_3 is ↑

and to use 2,3 and 5,5 as above we find

$2\,G_4\,3 = 2 \uparrow (2 \uparrow 2)$ $5\,G_4\,5 =$

$5 \uparrow (5 \uparrow (5 \uparrow (5 \uparrow 5)))$

$= 2 \uparrow 4$ = a very big number

$= 16$

The sequence of G operators is easily extended

$3G_1 2 = 5$

$3G_2 2 = 6$

$3G_3 2 = 9$

$3G_4 2 = 27$

$3G_5 2 = 7\,625\,597\,484\,987$

$3G_6 2$ = an enormous number

and take note of this sequence of 2,3 operations

$2G_1 3 = 5$	$A(1,0) = 2$
$2G_2 3 = 6$	$A(2,0) = 3$
$2G_3 3 = 8$	$A(3,0) = 5$
$2G_4 3 = 16$	$A(4,0) = 13$
$2G_5 3 = 65\,536$	$A(5,0) = 65\,533$

which differs from the 3,2 sequence, and seems to have an affinity with parallel sequence of values of Ackerman's function:

$$1 \quad A(M,O) = 2G_M 3 - 3$$

It is a distinctly non-recursive, ordinary algebraic expression which allows Ackeran's function to be carried out in a non-recursive manner for at least one particular case — N = 0.

The result in equation 1 was produced using a bottom-up method of analysis: the simplest of cases were isolated, the pattern found — easily once we were in the possession of a vocabulary enriched by the G operators — and then a general result was found by inductive reasoning — an expression far easier to calculate than the recursive top-down algorithm.

```
VAR M,N,I,A,Z,X,Y,EXIT : INTEGER;
    SS : ARRAY[1..1000] OF INTEGER;

PROCEDURE ONE;FORWARD;
PROCEDURE TWO;FORWARD;
PROCEDURE THREE;FORWARD;
PROCEDURE FOUR;FORWARD;
PROCEDURE FIVE;FORWARD;
PROCEDURE SIX;FORWARD;
    (* TO SAVE PROBLEMS ABOUT ORDER *)
PROCEDURE ONE;
  BEGIN
  A:=N+1;
  IF I)0 THEN THREE
         ELSE EXIT:=1
  END;
PROCEDURE TWO;
  BEGIN
  IF N=0 THEN FOUR
         ELSE FIVE
  END;
PROCEDURE THREE;
  BEGIN
  M:=SS[I];
  N:=A;
  I:=I-1
  END;
PROCEDURE FOUR;
  BEGIN
  M:=M-1;
  N:=1
  END;
PROCEDURE FIVE;
  BEGIN
  IF I=1000 THEN EXIT:=1
            ELSE SIX
  END;
PROCEDURE SIX;
  BEGIN
  IF Z(I+1 THEN Z:=I+1;
  I:=I+1;
  SS[I]:=M-1;
  N:=N-1
  END;
BEGIN (*MAIN PROGRAM*)
  M:=0;
  WHILE M=M DO
  BEGIN
    I:=0;
    Z:=I;
    A:=I;
    EXIT:=0;
    WRITELN;WRITELN;READLN(M,N);
    X:=M;Y:=N;
    REPEAT
      IF M=0 THEN ONE ELSE TWO
    UNTIL EXIT=1 ;
    WRITELN('A(',X,',',Y,') = ',A);
    WRITELN;
    Z:=Z+1;
    WRITELN('MAX DEPTH OF STACK IS ',Z)
  END
END.
```

Program Ackerman investigation.

However, equation 1 is only part of the story — it is true only for N = 0 — but already we have progressed far beyond the predictions of many: the many who have a restricted vocabulary due to the influence of top-down only thinking so popular among computer scientists.

It takes an unthinkable degree of self-esteem on the part of some computer scientists to suggest that the use of, say, Basic be banned. We have travelled part of the way in clarifying Ackerman's function, how much further can we go with bottom-up methods?

Earlier we found a pattern for A(3,N), and this pattern will be written using G operators

$A(3,0) = 5 = 2G_3 3 - 3$

$A(3,1) = 13 = 2G_3 4 - 3$

$A(3,2) = 29 = 2G_3 5 - 3$

$A(3,3) = 61 = 2G_3 6 - 3$

$A(3,4) = 125 = 2G_3 7 - 3$

$A(3,5) = 253 = 2G_3 8 - 3$

remember $2^5 = 2 \uparrow 5 = 2G_3 5$.

With a small dose of imagination — and

(continued on next page)

(continued from previous page)
a glance at equation 1 — we can produce an ordinary algebraic expression using G operators

2 $A(M,N) = 2G_M(N+3) - 3$

and this expression, 2, allows us to carry out the computation of Ackerman's function in a non-recursive manner.

It might be argued that the derivation of 2 is ingenious but has no mathematical basis — there is no mathematical proof, merely a series of imaginative guesses. Unfortunately for those who would wish to argue this way, Kapur and Kapur have provided a mathematical derivation of 2. The Kapurs' use of Griffin's original symbolism and in that notation.

$A(M,N) = 2*_{M-3}(N+3) - 3$

which is why I say equation 2 "looks better". The Kapurs' article is an example of how a powerful result can appear relatively unheralded — I cannot claim any originality on my own part in the derivation of 2, as my ideas derived from the Kapurs' work — they deserve much credit for realising the latent power of the Griffin approach.

The method of proof used in their article is similar to mine, in that they establish results for simple cases, and then by mathematical induction, reach their general result.

The upshot is that I am convinced there is something wrong with computer studies education. Too many students are being taught good programming practice by means of a structured language; too few are being taught to exercise their ingenuity.

One reason why so many good programmers are young in years is that they have not had the originality knocked out of them by a proper course. They enjoy programming in Hex or using assemblers despite being told, by spoil-sports in the over-selfconscious parts of the media, that nobody programs in Hex these days, and that such programming leads to poor programming styles.

School teachers often know less than their pupils, and so are unable to direct their pupils into structured channels — thankfully.

This is not to say that people should not try to develop an efficient and effective programming style — if computer scientists program as well as they write English, they must have many incoherent and verbose programs. Style develops with experience, but style without originality is arid.

Ackerman's function has lost its mystique — it has been reduced to a simple equation without conditionals. If one were to believe computer scientists, the impossible has been made possible. Wittgenstein wrote in the *Tractatus Logico-Philosophicus.*

> The limits of my language stand for the limits of my world.

and the world of non-recursive algorithms has increased its limits to include Ackerman's function; and who knows what else?

Ackerman's function.

```
10    REM ACKERMAN'S FUNCTION
20    REM A PROGRAM WRITTEN IN ATOM BASIC
30    REM BY
40    REM G J BORIS ALLAN
50    REM
60    REM THE ALGORITHM IS BASED ON A
70    REM FORTRAN ROUTINE GIVEN IN
80    REM "PROGRAMMING AND ALGORITHMS"
90    REM BY A J GUTTMAN (H.E.B, 1977 :p111)
100   REM
110   REM
1010  DIM SS(1000); REM THIS IS THE "STACK"
1020x INPUT X,Y; REM THESE WILL BECOME M AND N
      IN A(M,N)
1030  M=X; N=Y; PRINT '' ; REM PRINT BLANK LINES
1040  GOSUB a
1050  @=2; PRINT "A(" X "," Y ") = ";@=6; PRINT A;
      REM @ IS A FORMATTER (WIDTH OF INTEGER)
1060  PRINT '' "MAX DEPTH OF STACK IS" Z+1 '
1070  GOTO x
1080  END
1990  REM
2000a A=0; I=A; Z=A; REM INITIALIZATIONS OF
      ACKERMAN'S FUNCTION, STACK COUNTER, MAX STACK
2010z IF M>0 GOTO b; REM CONDITION (1) CHECK
2020  A=N+1; IF I>0 GOTO c; REM CHECK TO SEE IF
      STACK NOW EMPTY
2030  RETURN
2040b IF N>0 GOTO d; REM CONDITION (2) CHECK
2050  M=M-1; N=1; GOTO z
2060d IF I<1000 GOTO e; REM IS STACK FULL?
2070  PRINT "STACK OVERFLOW" '; A=0; RETURN; REM
      EXIT ON STACK OVERFLOW
2080e IF Z<I+1 Z=I+1
2090  I=I+1; SS(I)=M-1; N=N-1; GOTO z; REM CONDITION
      (3) IS OPERATIVE GOING DOWN
2100c M=SS(I); N=A; I=I-1; GOTO z; REM GOING BACK
      UP THE STACK
2110  PRINT "IMPOSSIBLE BRANCH"; RETURN; REM
      WE SOULDN'T BE HERE !
```

References

Griffin J, 1978, Mathematical Magnitude. International journal of mathematics education in science and technology, volume 9.

Guttman A J, 1977, Programming and algorithms, *London: HEB.*

Hardy G H, 1967, A mathematician's apology. *Cambridge: UP.*

Higman B, 1977, A comparative study of programming languages, *second edition. London: Macdonald and Jane's.*

Kapur J N and Kapur S, 1981, On Ackerman's Function. International journal of mathematics education in science and technology, volume 12.

Kline M, 1972, Mathematics in Western culture. *Harmondsworth: Penguin.*

Meek B, 1978, Fortran, PL/I and the Algols. *London: Macmillan.*

Wilder R L, 1974, The evolution of mathematical concepts. *London: Transworld.*

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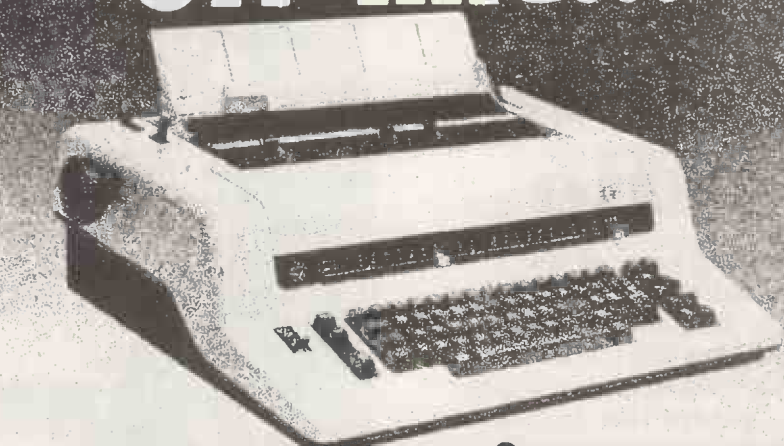

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Fortran: the language which refuses to die

Answering some of the criticisms commonly levelled against it, Paul Martin investigates Fortran and analyses the features which have enabled this 25-year-old language to survive for so long.

IT IS OFTEN claimed that Fortran, FORmula TRANslation, should not be used because, at 25 years, it is an old language. What a strange argument — algebra goes back further than that and, despite its age, is still in use because it is a very effective way to define and solve problems. The same is true of Fortran. Do not be deceived into thinking that Pascal is a modern language — it was introduced some 14 years ago.

During the 14 years that the two languages have existed together, their progress has been markedly different. Pascal was developed as a logical, structured language which could show very effectively the techniques of computer programming. It is firmly established in the computer science departments of universities all over the world, and is the normal means of expressing new aspects of operating-system theory in the academic software journals.

The academics then announced Pascal to the computer industry as The Language; the means to revolutionise the production of software. The computer industry looked at Pascal, saw that it had good points, yet found itself unable to make use of it. For the real world, the use of computers to solve problems differs from their use to test theories. First, you need a compiler which will run on your computer; then you need a language which provides reasonable file handling, usable input/output facilities, and one which is easy to interface to operating systems and non-standard devices. Secondly, it helps if the language has a definite standard to which the various implementations try to conform.

As Pascal could not fulfil the industry's requirements, it did not gain much popularity outside the universities. Even within the universities, those departments such as the sciences and engineering which used the computer for problem-solving rather than producing elegant programs have continued to rely on Fortran because it suits their needs better.

Fortran's easy interfacing to operating systems meant that the manufacturers of minicomputers implemented it on their machines before the other high-level languages. Even on micros, it became available long before Pascal. This interfacing simplicity led to Fortran becoming the industry's main real-time language — even for commercial systems such as those for online banking. While Fortran has, over the years, lost its dominant position as a real-time language, it has evolved and provides many of the facilities required for modern programming

Modular programs

Although Fortran is not the best language for all applications, it is certainly capable of being used for most: accountancy systems, factory-control systems, many word-processing programs and the original Adventure program have all been written in Fortran.

As well as the fashion for structured languages in the computer world, there is also a large amount of support for modular programming; the division of a program into a number of simple modules. Because these modules have only simple functions, they can be small and their coding is easily understood. On large projects, structured languages have not shown any outstanding advantages over modular programming in terms of development time, reliability, or ease of maintenance.

Once you extend Fortran, by using a pre-processor such as Ratfor, to be a structured language, then you have a language which is more than a match for Pascal. Ratfor shares the same structure as the "C" language while retaining complete compatibility with ordinary Fortran modules.

Anyone with doubts about the practicality of Ratfor has only to read the book *Software tools* by Kernishan and Plauser.

For the benchmarks, I have translated five of the Pascal benchmark programs into Fortran as shown in the listings. They were then compiled using Microsoft Fortran 80, which produces only 8080 code, and then run on a Vector MZ under the CP/M operating system.

Because Fortran is so very fast, it is necessary to have an outer loop or magnifier of 100,000 instead of the 10,000. The times shown for 100,000 have all been rounded up to the nearest second, and these times were then divided by 10 to obtain the times for 10,000 loops.

When comparing these times to those Pascal timings which have been published, it is important to separate those for 16-bit machines — Micro-engine, PDP-11, Z-8002—from those for eight-bit micros. For, although 8080 Fortran is faster than Pascal on 16-bit machines, it is many more times faster than eight-bit Pascal.

Before leaving the subject of the Pascal benchmarks, I must ask why does the right-hand side of the expression in the Real arithmetic program consist only ot integers. Eight-bit micros are so inefficient at handling floating-point arithmetic that Fortran would probably have no advantage over Pascal if real numbers were used.

Program Name	Timings	
	100,000	10,000
Magnifier	3.0	0.3
Real arithmetic	140.0	14.0
Vector	81.0	8.1
Memory Access	35.0	3.5
Reference	13.0	1.3

The first major difference between Fortran and the Basic available on most micros is that Fortran is a "compiled" language while Basic is usually implemented as an interpreted language. An interpreter operates on the program text itself. Each line is checked for correctness, converted into an executable form, executed and then overwritten by the next line converted.

While this approach has the great advantage of allowing simple and rapid changes to be made to the program during development, this ability is bought at a considerable cost in terms of execution speed — the result of having to convert each line each time that it is executed.

Another disadvantage is that the interpretor must be able to execute any of the functions — square-root, sine, etc. — which may be encountered in programs submitted for execution, although in smaller machines this extra use of space is disguised a little by storing the interpreter in ROM.

Would it not be a good idea if we kept a copy of the converted code and loaded that into memory each time we needed to execute the program? If we included in the program only those functions actually required, we could save space.

This is in fact what we do do when we use the compiler approach. The compiler examines the source code to ensure that it conforms to the standards for the language, generating error messages where it does not, producing as its output a listing of the source code — including the error messages — and an object module.

An object module is one which contains the machine-code instructions to be executed, but without the addresses of any data accessed or the addresses of any other routines called by this module. A program called the linker is then used to build an executable program from a list of modules to be included.

The linker collects the modules required, gives each one an address in memory and then fills in the missing addresses. If the program requires any of the Fortran standard functions, the code for these is extracted from the Fortran library for inclusion in the program.

Why do we do the job in two stages? Why not have the compiler produce an executable program? Are there any advantages to having a linker? Looking at a single, small program in isolation, there would not appear to be any particular advantages; the advantages become apparent when you consider programs which do similar things, or when you look at large programs written by more than one person.

Even if the only high-level language you have used is Basic you will have discovered subroutines. These are sequences of instructions which need to be executed at a number of different places within a program. Instead of including the sequence of instructions at each place they need to be executed, we have only one copy of the instructions in the form of a subroutine and the main program contains a subroutine call at each of the places where its execution is required.

The subroutine call causes program execution to leave the main code and go to the subroutine code and execute those instructions. Each subroutine is terminated by a return instruction which causes program execution to transfer to the instruction following the call to this subroutine.

In the Basic, subroutines are called by a Gosub to a line number within the current program while the Fortran subroutine structure is somewhat more flexible. The important differences to notice are that subroutines are called by name using the Call instruction, and that subroutines exist as separate modules.

Once a subroutine has, therefore, been written and debugged for use in one program, it can be included in as many programs as you like. All you have to do when you want to execute the subroutine in a program is to call it by name, and then to include it in the list of modules to be linked.

Large programs can be divided into a set of subroutines, which can then be written and tested independently — by different people if need be. In fact most of the languages in use in the commercial world of programming include the facility. to write a program as independent modules which are then linked together.

Flexible facility

If, as in Basic, subroutines referenced specific items of data, there would be little advantage to be gained by separating subroutines from the main program. Fortran provides flexibility by allowing each call to a subroutine to include a list of the data items to be used by the subroutine.

This list is a list of the addresses of the data items to be used, their contents being accessed at run time. Example 1 shows a program which produces the sum and the average of an array of integers, the number of integers in the array passed as one of the data items — these data items passed are referred to as the subroutine's arguments.

Having a formalised way of passing arguments to a subroutine allows the subroutine to be written in assembler if required. This makes it very easy to provide your programs with subroutines to handle non-standard devices.

Subroutines which are to be used again and again in different programs or by different people can be filed in libraries. So, instead of having to give the linker program a list of these standard routines, you just include the library name and the linker will extract those routines you have called in your program. This means that in large programming establishments, each problem has to be solved only once — any programmer just has to include the appropriate subroutine call in his program.

If you add to this the fact that, with Fortran compilers on most of the machines in use conforming to the same standard, subroutines are passed freely between users, you can see that current users of Fortran have a huge source of 25

Five programs which exemplify some of Fortran's main features.

```
 C  MAGNIFIER PROGRAM
C
    LOGICAL BELL, LOOP
C
C
    BELL = 7
    WRITE (2,1000) BELL
C
C  EXTRA LOOP OF TEN
C  GIVES MAGNIFIER LOOP OF 100.000
C
    DO 600 LOOP = 1.10
C
C  MAIN LOOP
C
    DO 500 K = 1.10000
500 CONTINUE
600 CONTINUE
C
    WRITE (2,1000) BELL
C
    STOP
C
1000        FORMAT ('+',A1)
C
    END

 C  REAL ARITHMETIC PROGRAM
 C
    LOGICAL BELL, LOOP
 C
 C
    BELL = 7
    WRITE (2,1000) BELL
 C
 C  EXTRA LOOP OF TEN.
 C  GIVES MAGNIFIER LOOP OF 100,000
 C
    DO 600 LOOP = 1,10
 C
 C  MAIN LOOP
 C
    DO 500 K = 1.10000
 C
 C  CODE FOR TEST
C
    K = FLOAT ( K/2+3+4-5 )
C
500 CONTINUE
600 CONTINUE
C
    WRITE (2,1000) BELL
C
    STOP
C
1000        FORMAT ('+',A1)
C
    END

C  VECTOR PROGRAM
C
    INTEGER MATRIX(11)
    LOGICAL BELL, LOOP
C
C
    BELL = 7
    WRITE (2,1000) BELL
C
C  CLEAR FIRST ENTRY IN ARRAY.
C
    MATRIX(1) = 1
C
C  EXTRA LOOP OF TEN
C  GIVES MAGNIFIER LOOP OF 100.000
C
    DO 600 LOOP = 1.10
C
C  MAIN LOOP
C
    DO 500 K = 1.10000
C
C  CODE TO TEST
C
    DO 200 J = 2,11
    MATRIX(J) = MATRIX(J-1)
200 CONTINUE
C
500 CONTINUE
600 CONTINUE
C
    WRITE (2,1000) BELL
C
    STOP
C
1000        FORMAT ('+',A1)
C
    END
 C  REFERENCE PROGRAM
 C
    LOGICAL BELL, LOOP
 C
 C
    BELL = 7
    WRITE (2,1000) BELL
    J = 0
C
C  EXTRA LOOP OF TEN
C  GIVES MAGNIFIER LOOP OF 100.000
C
    DO 600 LOOP = 1,10
C
C  MAIN LOOP
C
    DO 500 K = 1.10000
C
C  CODE TO TEST
C
    CALL SUB1(J)
C
500 CONTINUE
600 CONTINUE
C
    WRITE (2,1000) BELL
C
    STOP
C
1000        FORMAT ('+',A1)
C
    END
C  MEMORY ACCESS PROGRAM
C
    INTEGER L
    LOGICAL BELL, LOOP
C
C
    BELL = 7
    WRITE (2,1000) BELL
C
C  EXTRA LOOP OF TEN
C  GIVES MAGNIFIER LOOP OF 100,000
C
    DO 600 LOOP = 1.10
C
C  MAIN LOOP
C
    DO 500 K = 1,10000
C
C  CODE TO TEST
C
    DO 200 J = 1,10
    L = J
200 CONTINUE
C
500 CONTINUE
600 CONTINUE
C
    WRITE (2,1000) BELL
C
    STOP
C
1000        FORMAT ('+',A1)
C
    END

    SUBROUTINE SUB1(IVAL)
C
    CALL SUB2(IVAL)
C
    RETURN
C
    END

****** SUB2/3/4 SAME AS SUB 1 ******

    SUBROUTINE SUB5(IVAL)
C
    IVAL = 1
C
    RETURN
C
    END
```

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years' experience on which to build.

With the most popular micro language, Basic referred to as pigeon Fortran, it is probably best to describe Fortran in terms of the differences between it and Basic.

Looking at example 1, the first major difference you will see is that very few of the lines have line numbers on them. This is because Fortran uses numbers which occur at the start of lines as labels; that is, you only give a line a number if you want to refer to it from another line.

You will notice, also, that most of the lines do not begin at the first-character position. This results from Fortran having a definite format to use for input lines, necessary in the days when punched cards were the main form of input to computers.

Each Fortran line consists of up to 80-character positions, arranged as follows:

1 Positions 1 to 5
  a numeric statement label if required.
2 Position 6
  continuation character field.
3 Positions 7 to 72
  contain the statement
4 Positions 73 to 80
  identification field.

All the punched cards in a program would have a sequence number punched in this position. This would enable the cards to be replaced in the correct order should they be dropped. Also, some editors work on a sequence-number basis. Most programmers ignore the identification field when using computers with terminals for input and editing.

Comment lines, the equivalent of the Basic Rem, are indicated by a "C" in the first character position. These comment lines are ignored by the compiler. Each Fortran statement must begin on a new line, but can extend over more than one line. Continuation lines are marked by setting the continuation character, position 6, to contain a character other than zero or a blank.

A statement can be spread over as many continuation lines as you like. It is important to note that spaces are ignored within statements, so that Go To and Goto, for instance, are treated the same.

At this point we must divide statements up into two distinct groups: executable and non-executable statements. The most commonly-used executable statement is the assignment statement, such as

```
A = B + C
```

which in Basic would be

```
LET A = B + C
```

not much different. A more complex example might be

```
A = Z + ((X * Y) - 25)
```

which most Basic programmers would still understand. As well as the unconditional Goto of the form

```
GOTO 120
```

Fortran has two extra forms; the computed Goto and the assigned Go To. The computed Goto is of the form

```
GO TO (L1, L2, L3, . . ., n) ,K
```

where L1, L2, etc., are statement labels and K is an integer variable whose value is not less than one and not greater than "n". When K is one, contol goes to the line that begins with label L1; when K equals two, control goes to the second label, and so on. If K is not in the valid range, control goes to the statement following the Goto statement.

The assigned Goto is a little complex. It must be preceded by an Assign statement which sets an integer variable to a value

```
C    EXAMPLE PROGRAM ONE
C
C
C    THIS IS A COMMENT LINE
C
     INTEGER FRED
C
C   INPUT LOOP SIZE
C
50   WRITE (1,1000)
     READ (3,2000) IVAL
C
C   CLEAR THE SUM
C
     FRED = 0
C
C   NOW ADD UP THE NUMBERS
C
     DO 100 K = 1,IVAL
C
     FRED = FRED + K
C
C    DISPLAY ANSWER
C
     WRITE (1,1010) IVAL,FRED
C
C EXIT FROM PROGRAM
C
     STOP
C
C OUTPUT FORMATS
C
1000       FORMAT ('OTYPE IN
1010       FORMAT ('SUM OF '
C
C  INPUT FORMATS
C
2000       FORMAT (I6)
C
     END
```

Example 1.

which corresponds to a statement lable used in the program. The assigned Goto then causes control to Goto the statement whose lable equals the value of the integer variable:

```
ASSIGN 30 TO JUMP
IF (K.LT.0) ASSIGN 20 TO JUMP
. . .
. . .
GO TO JUMP, (20, 30, 40)
```

never use the assigned Goto because it is very difficult, when looking at a listing, to follow the flow of a program which contains them.

The example just given contains another of the Basic-like statements in Fortran, the If statement. In the logical If statement, Fortran differs from Basic only in that characters are used instead of symbols:

```
IF (K.LT.J) GOTO 140
IF (LB.EQ.15.OR.K.GT.50) Z = 25
```

Besides the logical If, Fortran also has the arithmetic If.

```
IF (K) L1, L2, L3
```

where K is an arithmetic expression and L1, L2, and L3 are statement labels. Should K be less than zero, control goes to L1; if K equals zero, control goes to L2; L3 receiving control if K is greater than zero:

```
GOTO (K) 1300, 200, 458
GOTO (Z-10) 35, 100, 45
```

Example 1 contains the Fortran equivalent of the Basic For loop, the Do loop. A Basic loop of the form

```
FOR K = 1 TO 20
LET J = J + (K * 3)
NEXT K
```

would be written in Fortran as

```
DO 200 K = 1,20
J = J + (K * 3)
200 CONTINUE
```

and the more complex form

```
FOR K = 4 TO 20 STEP 4
```

would appear in Fortran as

```
DO 200 K = 4,20,4
```

Unfortunately, Fortran has a number of limitations in the way that loops are controlled. The most important of these is that the control value, for example, K, must be a positive integer, as must the start, end, and step values. So, although the Basic loop

```
FOR K = 18 TO 2 STEP -2
L = L + K
NEXT K
```

could be coded easily in Fortran as

```
DO 200 J = 2, 18, 2
K = 20 -J
L = L + K
200 CONTINUE
```

it is not really very neat. It has to be admitted that the way Fortran handles loops is the biggest black mark against it. In practice, it never seems, however, to produce the kind of difficulties one might have expected.

Fortran supports the following data types. First, integers:

```
REAL
DOUBLE PRECISION
LOGICAL
LITERAL
```

with most compilers allowing the Logical data type to be used as a single-byte integer.

Fortran allows you to set the type of a variable in one of two ways, implicitly and explicitly. With explicit typing, you define the type and name of the variable at the beginning of the program, e.g.,

```
INTEGER VALUE, SUM, COUNT
REAL PRICE, TEMP, WAGES
LOGICAL CHAR, FLAG, CHOICE
```

Any variables used which have not been explicitly defined are given the appropriate implicit type. With implicit typing, the first letter of the variable's name defines its type to be either integer or real. If the name begins with I, J, K, L, M or N, it is typed as an integer: any other letters cause it to be typed as real.

Arrays can be defined in an explicit statement:

```
INTEGER FRED, VALUE(2,10), COUNT
```

else they can be given merely a size, as in

```
DIMENSION VALUE(2,10)
```

Before we can see the use of the Dimension statement, we must look at the concept of common data.

Fortran subroutines are usually written as separate modules, compiled independently and then linked to the main program. The compiler does not pass information about the data used in a module to the linker, and so the data within each module is independent of any data in the other modules — even when other modules have variables with the same name. To make variables accessible to other modules, they can be put into Common areas. They then become available to any module that contains a copy of that Common area definition.

```
COMMON /AREA1/ I1,I2,I3
```

will cause a common-block storage area Area1 to be created with space for the three variables I1, I2, I3. Where a common statement defines an array, such as:

```
COMMON /HOLD/ JVAL, KVALS(2,4), KTOT
```

(continued on next page)

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then the array must not have been previously declared.

The Equivalence statement is used to assign different names to the same storage locations, or to re-define the storage type, hence:

```
EQUIVALENCE (FRED, ROGER)
```

causes the variables Fred and Roger to share the same storage locations at program execution. If you wanted access to each of the four bytes used to hold a particular real number, you could define it as:

```
LOGICAL BVAL(4)
REAL NUM
EQUIVALENCE (NUM,BVAL(1))
```

As well as allowing you to define the data storage to be used in a statement, Fortran allows you to initialise data items to particular values before the program starts to execute. The Data statement takes the form of a list of the items to be initialised followed by the values to be set; these values being inside two slash characters.

```
REAL JOE,TOM
INTEGER COUNT,SIZE
DATA JOE,TOM,COUNT,
  SIZE/20.3,44.0,1,72/
```

sets the data up as

```
JOE = 20.3,
TOM = 44.0,
COUNT = 1,
and SIZE = 72
```

When a simple calculation has to be used in many places in a program module, such as the calculation of cylinder volume, it can be defined as a local function:

```
VOL(RAD,HITE) =
    (( RAD**2) * PI) * HITE
```

This function can then be used as a single value in statements:

```
WATE = DENST * VOL(A,B)
```

If, however, you want to use it in a number of modules or to place it in a library so that you can use it in other programs, you must create it as an independent module. This would take the form:

```
FUNCTION CYLVOL(RAD,HITE)
CYLVOL =
(( RAD**2 ) * PI) * HITE
RETURN
END
```

Note that the rules regarding implicit and explicit typing apply to the function name. This is because the function's result is used as if it were an ordinary variable. To produce an integer result from the volume function, its first line would have to be:

```
INTEGER FUNCTION
    CYLVOL(RAD,HITE)
```

A subroutine differs from a function in that it does not produce a single result for use within a statement. For instance, a subroutine to clear arrays to zeros might take the form:

```
    SUBROUTINE
      CLEAR(IARRAY,ISIZE)
    DIMENSION IARRAY(ISIZE)
    DO 100 K = 1,ISIZE
    IARRAY(K) = 0
100 CONTINUE
    RETURN
    END
```

and could then be used in programs by

```
INTEGER HOURS(40),DAYS(50)
CALL CLEAR(HOURS,40)
CALL CLEAR(DAYS,50)
```

This example also shows another use for the Dimension statement — that of allowing subroutines which handle arrays to be written to handle arrays of any size.

The other type of independent module provided in Fortran is the Block-data module, used to initialise common data. This begins with a statement:

```
BLOCK DATA module-name
```

and can contain as many Common definitions and Data statements as are needed. The Block-data module is not an executable module; it is used by the linker to give common data initial values. So, if you were writing programs to synthesise music, you could define and initialise an array of frequency values in a Block-data module and then link it into each program you produced.

With an application such as music synthesis, you would probably write subroutines to read the keyboard, load the synthesiser resisters, and calculate timing. Once these subroutines were tested, they could be included in all your programs without your having to re-test them.

Fortran provides both formatted and unformatted input/output facilities. Formatted I/O is when data is transmitted between the computer and I/O devices such as terminals and printers, and takes the form of printable characters.

Unformatted I/O, on the other hand, transfers data in the form in which it is held within the program — that is, as binary values. In micro applications, unformatted I/O is used mainly for accessing disc files.

With formatted I/O, the user specifies a device to be used, the label of the statement that defines the format of the input or output, and the actual data to be used.

```
 100 WRITE (1,1000)
     READ (1,2000) K
     ...
     DO 200 J = 1,12
     L = J * K
     WRITE (1,1010) J,K,L
 200 CONTINUE
     GOTO 100
     ...
     ...
1000 FORMAT (' ENTER NUMBER 1 TO 12
     : ',12)
1010 FORMAT (' ',12,' TIMES ',12,' IS ',13)
2000 FORMAT (12)
     END
```

This routine would print out the multiplication tables for any number in the range one to 12 in the form.

```
...
10 TIMES 12 IS 120
11 TIMES 12 IS 132
```

on device number one. There are a number of ways in which numbers can be handled, but for most purposes the F and I conversions will be used. The I conversion takes the form, Iw, where w is the field width, including sign. An integer output using the I conversion will be right-justified within the output field and preceded by a minus sign if it is negative.

The I conversion is also used to input integer values which are assumed to be positive unless preceded by a minus sign.

The F format for outputting real numbers takes the form, Fw.d, where w is again the field width — this time, including sign and decimal point, and d is the number of decimal places.

Literal constants to be output are included in the format by using single quotes. Text input is provided with the A conversion, An, where n is the number of characters to be input. The text is then input as ASCII bytes but can be packed into real or integer variables — strings are produced by packing the data into logical arrays. The reverse conversion takes place on output, with each byte sent to the output device as an ASCII byte.

With the carriage control character, the first output character is not printed but is used to decide what action has to be taken before the line is printed. The appropriate characters and the actions taken are:

0 means skip two lines.
1 means insert a form-feed.
+ means add to the end of the previous output.
any other character causes a one line skip.

Unformatted reads and writes transfer the data to the logical device specified without doing any conversion. To access a file, you should first open it as a logical device, closing it after use.

There are probably more books written about Fortran than almost any other language, so it is not possible to recommend a single book as being the best book on the languages. Unfortunately, also, most of the Fortran books available in public libraries date from the days then punched cards were the main form of input to machines, and may appear somewhat off-putting for their first few chapters before they tackle the language.

A book I can recommend is *Fortran Techniques* by A Colin Day. This is not a teach-yourself text on the language, but deals with the use of Fortran for applications other than number crunching.

There are probably two types of micro user who would best benefit from Fortran. First, there are those who require the speed of execution of assembly language but are worried by the time and effort needed to write and test assembly code.

Fortran can be written almost as a high-level assembler; one that takes care of register handling and other mechanical aspects of assembly language programming. The programs produced will require more memory than assembler programs, be only slightly slower running, but undoubtedly be quicker to write.

The second type of user who may benefit from Fortran is the person who wants to upgrade from Basic because he needs more speed or better use of disc space for files, but finds it difficult to learn Pascal. These users will find the change to Fortran from Basic very simple, and will be rewarded by more efficient programs.

Any disc-based micro needs a method of making back-up disc copies. John and Timothy Lee examined some of the provisions operating systems have for making duplicate discs and found them wanting. They now present a fast alternative.

How to make copies of your discs — faster

```
0100                  ORG     100H
0100 C32C01           JMP     START

              ;       PROGRAM TO COPY DISKS TRACK BY TRACK
              ;
              ;       WRITTEN BY T.D. LEE     SEP 80
              ;

0023 =        NTRACK  EQU     35              ;35 TRACK DISKS ON
                                              ;HORIZON.
                                              ;NTRACK IS 16 BIT NUMBER

                                              ;SECTOR DECODE TABLE

                                              ;THIS GIVES ORDER IN
                                              ;WHICH SECTORS ARE TO
                                              ;READ FOR MAXIMUM SPEED

0103 01020304 TABLE:  DB      01,02,03,04     ;NORTH STAR BLOCK 1
0107 0D0E0F10         DB      13,14,15,16     ;           BLOCK 4
010B 191A1B1C         DB      25,26,27,28     ;           BLOCK 7
010F 25262728         DB      37,38,39,40     ;           BLOCK 10
0113 090A0B0C         DB      09,10,11,12     ;           BLOCK 3
0117 15161718         DB      21,22,23,24     ;           BLOCK 6
011B 21222324         DB      33,34,35,36     ;           BLOCK 9
011F 05060708         DB      05,06,07,08     ;           BLOCK 2
0123 11121314         DB      17,18,19,20     ;           BLOCK 5
0127 1D1E1F20         DB      29,30,31,32     ;           BLOCK 8

012B 00               DB      0               ;END OF TABLE

0400 =        BUFFER  EQU     0400H           ;DISK BUFFER
0009 =        TAB     EQU     09H             ;ASCII TAB
000D =        CR      EQU     0DH             ;RETURN
000A =        LF      EQU     0AH             ;LINEFEED
001B =        ESC     EQU     01BH            ;ESCAPE

012C 310004   START:  LXI     SP,BUFFER       ;SET STACK

012F 111F02   AGAIN:  LXI     D,SIGNON
0132 0E09             MVI     C,9
0134 CD0500           CALL    5               ;PRINT SIGNON MESSAGE

0137 0E01     GETCH:  MVI     C,1
0139 CD0500           CALL    5               ;GET CHAR
013C FE1B             CPI     ESC             ;IS IT ESCAPE
013E CA0A02           JZ      REBOOT          ;YES THEN REBOOT
0141 FE0D             CPI     CR              ;IS IT <CR>
0143 C23701           JNZ     GETCH           ;NO THEN REPEAT

                                              ;PRINT NTRACK '*'s
0146 0623             MVI     B,NTRACK
0148 C5       STAR:   PUSH    B               ;SAVE NO. OF STARS
0149 0E02             MVI     C,2
014B 1E2A             MVI     E,'*'
014D CD0500           CALL    5               ;PRINT '*'
0150 C1               POP     B               ;RESTORE NO. OF  STARS
0151 05               DCR     B               ;DECREMENT NO. OF STARS
0152 C24801           JNZ     STAR            ;REPEAT
0155 11F702           LXI     D,CRLF
0158 0E09             MVI     C,9
015A CD0500           CALL    5               ;PRINT CRLF

015D 010000           LXI     B,0             ;TRACK = 0
0160 C5       NXTTRK: PUSH    B               ;SAVE TRACK

0161 0E0E             MVI     C,14
0163 1E00             MVI     E,0
0165 CD0500           CALL    5               ;LOGIN DISK A

0168 C1               POP     B               ;RESTORE TRACK
0169 C5               PUSH    B               ;SAVE TRACK
016A CDD401           CALL    SETTRK          ;SET TRACK
```

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FAILURE to make back-up copies will sooner or later lead to the irretrievable loss of the contents of a disc. Most operating systems provide a copying method, but it may be cumbersome, or slow — or both. For example, with CP/M it is necessary to use Sysgen to copy the outer two tracks which contain the operating system, and Pip to copy the user's files from the remaining tracks.

Furthermore, this process is slow and, for example, Pip takes about four minutes to copy the user files — one side of a 5.25in. disc equals 164K — on a double-density North Star Horizon. To this must be added the time taken to copy the system tracks. This time compares very badly to the one minute taken by the North Star Copy-Disc routine.

The primary reason for this significant difference is that the North Star Copy-Disc routine copies the disc track by track regardless of the contents: Pip copies data file by file. Since the sectors on disc which comprise a CP/M file are skewed — logically contiguous sectors are not physically contiguous — by a factor of five or six, it may take five or six revolutions of the disc to read a single track.

Copying on a file-by-file basis also requires frequent read-and-write accesses to the file directory which means moving the disc-head almost to the outer edge of the disc. A track-by-track copying algorithm has three distinct advantages:

- It copies the system tracks and the user's files, replacing the functions of Sysgen and Pip.
- Reading and writing can be accomplished with fewer disc revolutions, thus reducing the time taken.
- Disc-head movement is minimised which further reduces the time taken.

We wrote a machine-code program, Copydisc, to provide a fast method for copying discs track by track under the CP/M operating system. We used Intel 8080 mnemonics since they may be assembled directly using the CP/M assembler ASM.COM. A listing of the source program is given, followed by customisation notes.

A message prompts the user to arrange the discs so that the one to be copied is in drive A and the disc to be copied on to occupies drive B. The entire contents of the first track are read from drive A into RAM at address Buffer — 400 Hex — and then written to drive B. The process is repeated for the second and subsequent

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tracks until the 35 NTrack tracks have been copied.

Each track is divided by CP/M into a number of 128-byte sectors. In reality, the disc controller reads and writes blocks of data, and the size of the block is fixed for a particular disc board. The size of a block may be 128 bytes as on single-density 8in. IBM-format discs, 256 bytes as on double-density 8in. or single-density North Star, 512 bytes as on double-density North Star, or some other multiple of 128 bytes.

The order in which the data blocks are accessed by the program has a significant effect on total time taken to copy the disc. For this reason, the program includes a sector-decode table which determines the number of sectors per track and the order in which they are accessed. This table should be customised for any particular system.

The program requires precise control in positioning disc-heads to be able to access individual tracks and sectors. CP/M does not provide such control through its normal calls. However, by calling appropriate subroutines in the machine-dependent part of CP/M called the Basic Input-Output System — Bios — the program gains such control.

At the beginning of Bios is a jump table which provides branches to the input/output subroutines. The address of this jump table depends on the particular version of CP/M and on the amount of memory available. At address zero there is, however, always a jump to this table which is used for warm-booting CP/M.

The program examines the jump at zero to determine the address at which Bios begins — in fact the address is three bytes into Bios. Using this, the program calculates the address in the jump table for each of the various disc functions as appropriate.

For example, the set-track subroutine in Bios is accessed through the jump 30 bytes, i.e., 1E Hex, into Bios. Thus to set the track, the program determines the start of Bios from the jump at address zero, and jumps to the location 1E bytes further on which is the correct point in the jump table to branch to the set-track subroutine.

The program accesses the set-track, set-sector, read-sector and write-sector subroutines by this devious method. Provided users have not modified the jump at address zero, the procedure should work.

At the beginning of the transfer, a row of asterisks is printed corresponding in number to the number of tracks present on the disc. As each track is written on drive B, an extra asterisk is printed in a second row beneath the first. This provides a visual indication of how far the copying has progressed.

A number of user errors are detected and reported. These are discs missing or wrongly inserted, or disc door not shut properly on either drive A or B, resulting in: BDOS SELECT ERROR. An incorrect read or write operation should be detected by Bios and will result in a non-recoverable disc error.

The listing has been optimised for North Star double-density discs, and the following changes should be made for other disc systems:

- NTrack at present set at 35 should be changed to the number of tracks present — 77 on single-density 8in. on IBM format.
- The sector decode table must be re-written as follows. First, find how many sectors of 128 bytes occur in each disc block of data— four for double-density North Star, one for single-density 8in. IBM format. Next, write the sector numbers which correspond to each disc block. For example, North Star double-density blocks comprise four sectors, hence:

sectors	block
1, 2, 3, 4	1
5, 6, 7, 8	2
9, 10, 11, 12	3
....	
....	
37, 38, 39, 40	10

Code the table with the blocks in ascending order as shown. The table must be finished with a dummy line containing a zero. The program should then be assembled, run and timed. Should the time taken to complete the copy be excessive, the order of the blocks should be changed to 1, 3, 5 . . . 2, 4, 6 . . . This corresponds to skewing the blocks by a factor of two. The program should be re-assembled, re-run and timed again.

Three results are possible: the new time is much smaller than previously obtained — the current version is optimised. The new time is nearly double that previously obtained — the previous arrangement was the optimum. The new time is slightly worse than that previously obtained. In this case the optimum has not been reached. The sector table should be re-assembled with a skew of three — that is, the order of the blocks changed to:
1, 4, 7 . . 3, 6, 9 . . . 2, 5, 8 . . .

If this does not produce a dramatic reduction in time, try a skew of four, and so on.

It is not possible to say precisely how long the optimum time will be since it will depend on the size of the disc, density and make of disc drive and controller. You can gain some indication of the expected time from the time of about one minute obtained for copying a double-density North Star Horizon disc.

Finally, a note of warning. Since this copying program works on a track-by-track basis, the disc in drive B will be identical to the disc in drive A at the end of the run. That means any information previously stored on disc B will be overwritten.

(continued from previous page)

```
016D 210301          LXI    H,TABLE      ;SET SECTOR
0170 110004          LXI    D,BUFFER     ;DMA BUFFER

0173 E5     NXTSEC:  PUSH   H            ;SAVE SECTOR
0174 D5              PUSH   D            ;SAVE DMA

0175 CDDA01          CALL   SETSEC       ;SET SECTOR

0178 D1              POP    D            ;RESTORE DMA
0179 D5              PUSH   D            ;SAVE DMA
017A 0E1A            MVI    C,26
017C CD0500          CALL   5            ;SET DMA

017F CDE301          CALL   READ         ;READ SECTOR

0182 D1              POP    D            ;RESTORE DMA
0183 218000          LXI    H,080H
0186 19              DAD    D            ;CALC NEW DMA
0187 EB              XCHG                ;GIVE TO DE

0188 E1              POP    H            ;RESTORE SECTOR
0189 23              INX    H            ;NEXT SECTOR
018A 7E              MOV    A,M
018B FE00            CPI    0            ;LAST SECTOR ?
018D C27301          JNZ    NXTSEC       ;REPEAT

                                         ;ONE TRACK NOW IN
                                         ;RAM BUFFER. SAVE
                                         ;IT ON DISK B
0190 0E0E            MVI    C,14
0192 1E01            MVI    E,1
0194 CD0500          CALL   5            ;LOGIN DISK B
0197 C1              POP    B            ;RESTORE TRACK
0198 C5              PUSH   B            ;SAVE TRACK
0199 CDD401          CALL   SETTRK       ;SET TRACK

019C 210301          LXI    H,TABLE      ;SET SECTOR
019F 110004          LXI    D,BUFFER     ;DMA BUFFER

01A2 E5     NXTSE:   PUSH   H            ;SAVE SECTOR
01A3 D5              PUSH   D            ;SAVE DMA
```

(continued on next page)

(continued from previous page)

```
01A4 CDDA01           CALL    SETSEC      ;SET SECTOR

01A7 D1               POP     D           ;RESTORE DMA
01A8 D5               PUSH    D           ;SAVE DMA
01A9 0E1A             MVI     C,26
01AB CD0500           CALL    5           ;SET DMA

01AE CDF301           CALL    WRITE       ;WRITE SECTOR

01B1 D1               POP     D           ;RESTORE DMA
01B2 218000           LXI     H,080H.
01B5 19               DAD     D           ;CALC NEW DMA
01B6 EB               XCHG                ;GIVE IT TO DE

01B7 E1               POP     H           ;RESTORE SECTOR
01B8 23               INX     H           ;NEXT SECTOR
01B9 7E               MOV     A,M
01BA FE00             CPI     0           ;LAST SECTOR ?
01BC C2A201           JNZ     NXTSE       ;REPEAT

                                          ;TRACK WRITTEN ON B

01BF 0E02             MVI     C,2
01C1 1E2A             MVI     E,'*'
01C3 CD0500           CALL    5           ;OUTPUT  '*'

01C6 C1               POP     B           ;RESTORE TRACK
01C7 03               INX     B           ;NEXT TRACK
01C8 21DDFF           LXI     H,-NTRACK
01CB 09               DAD     B           ;HL=TRACK-NTRACK
01CC 7C               MOV     A,H
01CD B5               ORA     L           ;SET Z IF HL=0
01CE C26001           JNZ     NXTTRK      ;NO THEN REPEAT

01D1 C32F01           JMP     AGAIN       ;MORE TRACKS TO COPY

                                          ;UTILITY SUBROUTINES


                                          ;THE SUBROUTINES
                                          ;BELOW CALL BIOS
                                          ;DIRECTLY RATHER
                                          ;THAN THROUGH CP/M

01D4 2A0100   SETTRK: LHLD    1           ;GET WARM BOOT ADDR
01D7 2E1E             MVI     L,01EH      ;HL=SETTRK ADDRESS
                                          ;BC=TRACK
01D9 E9               PCHL                ;JUMP TO BIOS
                                          ;SET TRACK

01DA 0600     SETSEC: MVI     B,0
01DC 4E               MOV     C,M         ;BC = SECTOR
01DD 2A0100           LHLD    1           ;GET WARM BOOT ADDR
01E0 2E21             MVI     L,021H      ;HL=SETSEC ADDRESS
01E2 E9               PCHL                ;JUMP TO BIOS
                                          ;SET SECTOR

01E3 2A0100    READ:   LHLD    1          ;GET WARM BOOT ADDR
01E6 2E27              MVI     L,027H     ;HL=READ ADDRESS
01E8 22EC01            SHLD    R2+1       ;SET UP CALL ADDR
01EB CD0000    R2:     CALL    0          ;CALL BIOS READ
01EE B7                ORA     A          ;SET FLAGS
01EF C8                RZ                 ;RETURN NO ERROR
01F0 C30202            JMP     ERROR

01F3 2A0100    WRITE:  LHLD    1          ;GET WARM BOOT ADDR
01F6 2E2A              MVI     L,02AH     ;HL=WRITE ADDRESS
01F8 0E02              MVI     C,2
01FA 22FE01            SHLD    W2+1       ;SET UP CALL ADDR
01FD CD0000    W2:     CALL    0          ;CALL BIOS WRITE
0200 B7                ORA     A          ;SET FLAGS
0201 C8                RZ                 ;RETURN NO ERRORS

0202 11FA02    ERROR:  LXI     D,DISK
0205 0E09              MVI     C,9
0207 CD0500            CALL    5          ;PRINT ERROR MESSAGE

020A 11CB02    REBOOT: LXI     D,CPM
020D 0E09              MVI     C,9
020F CD0500            CALL    5          ;PRINT MESSAGE

0212 0E01      WAIT:   MVI     C,1
0214 CD0500            CALL    5          ;GET CHAR
0217 FE0D              CPI     CR         ;IS IT <cr>
0219 C21202            JNZ     WAIT       ;KEEP WAITING
021C C30000            JMP     0          ;REBOOT CP/M


021F 0D0A0A0A  SIGNON: DB      CR,LF,LF,LF
0223 0909436F70        DB      TAB,TAB,'Copydisk'
022D 0D0A0909          DB      CR,LF,TAB,TAB
0231 3D3D3D3D3D        DB      '========='
0239 0D0A0A0A          DB      CR,LF,LF,LF
023D 5468697320        DB      'This program copies'
0250 2074686520        DB      ' the entire contents'
0264 0D0A              DB      CR,LF
0266 6F66204469        DB      'of Disk A to Disk B'
0279 0D0A              DB      CR,LF
027B 546F20436F        DB      'To Copy, insert the'
028E 206469736B        DB      ' disks appropriate and'
02A4 2070726573        DB      ' press RETURN.'
02B2 0D0A              DB      CR,LF
02B4 546F207175        DB      'To quit press ESCAPE'
02C8 0D0A24            DB      CR,LF,'$'

02CB 0D        CPM:    DB      CR
02CC 506C616365        DB      'Place CP/M disk in Drive A'
02E6 20616E6420        DB      ' and press RETURN'
02F7 0D0A24    CRLF:   DB      CR,LF,'$'

02FA 0D0A      DISK:   DB      CR,LF
02FC 4E6F6E2052        DB      'Non Recoverable Disk Error'
0316 0D0A24            DB      CR,LF,'$'
```

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The Generalised Inverse

Alan Mackay discusses the problem-solving Generalised Inverse and demonstrates this technique's very healthy track record by showing how it was used in a first-century AD Chinese volume.

今有五羊四犬三雞二兔直錢一千四百九十六四
犬六雞三兔直錢一千一百七十五三羊一犬七雞
直錢九百五十八二羊三犬五雞一兔直錢八百六
問羊犬雞兔價各幾何
荅曰羊價一百七十七　犬價一百二十一
二十三　兔價二十九
術曰如方程以正負術入之
草曰列所問數同前軆求
羊　犬　雞　兔　價直
二　三　五　一　八百六十一
三　一　七　五　九百五十八

PEOPLE complain of having to learn about matrices in the new mathematics, but they are not really very new. In the first century AD Chinese book *Nine chapters of arithmetic technique* the following problem is given and solved:

5 sheep + 4 dogs + 3 hens + 2 hares cost 1,496 coins
4 sheep + 2 dogs + 6 hens + 3 hares cost 1,175 coins
3 sheep + 1 dog + 7 hens + 5 hares cost 958 coins
2 sheep + 3 dogs + 5 hens + 1 hare cost 861 coins

How much does each type of animal cost? Can you write a program in Basic to solve the equation? The block of simultaneous equations

$a_{11}x_1 + a_{12}x_2 = h_1$
$a_{21}x_1 + a_{22}x_2 = h_2$

can be written in matrix notation as:

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} h_1 \\ h_2 \end{bmatrix}$$

or [A] [X] = [H]

These are rules for writing the matrix [B] which is the inverse of [A] but they are very tedious for more than three or four equations and a computer program is convenient. If we can find [B], then the solution of the equation is:

[X] = [B] [H]

i.e.,

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & h_1 \\ b_{12} & b_{22} & h_2 \end{bmatrix}$$

or

$x_1 = b_{11}x_1 + b_{12}h_2$
$x_2 = b_{21}x_1 + b_{22}h_2$

which is what you would get if you solved the equations the hard way.

$$\text{If } \begin{bmatrix} A \end{bmatrix} = \begin{bmatrix} 3 & 5 \\ 2 & 9 \end{bmatrix} \text{ then } \begin{bmatrix} B \end{bmatrix} = \begin{bmatrix} 9/17 & -5/17 \\ -2/17 & 3/17 \end{bmatrix}$$

so that if $[H] = \begin{bmatrix} 17 \\ 34 \end{bmatrix}$

$x_1 = (9/17).17 - (5/17).34 = -1$
$x_2 = (-2/17).17 + (3/17).34 = 4$

Thus, $3x_1 + 5x_2 = 17$
$2x_1 + 9x_2 = 34$

has the solution $x_1 = -1$, $x_2 = 4$

Our program Geninv works by calculating B from A but in more general form which solves a wider range of problems also, as the examples show.

In a full version of Basic with matrix statements, a program to solve N simultaneous equations of this type for N unknowns is as follows:

```
100 READ N
110 DIM A(N,N), H(N), X(N), B(N,N), C(N)
120 FOR I=1 TO N : FOR J=1 TO N
130 READ A(I,J)
140 NEXT J
150 READ H(I)
160 NEXT I
170 REM coefficients in A, RH side terms in H
180 REM equations are AX=H, answer is
      X=INV(A)*H
190 MAT B= INV(A)
200 MAT X= B*H
210 MAT C=A*X
220 PRINT "ANSWERS"
230 FOR I=1 TO N
240 PRINT I, X(I)
250 NEXT I
260 PRINT "CHECK MULTIPLY FOR
      R.H.S."
270 FOR I=1 TO N
280 PRINT I, H(I), C(I)
290 NEXT I
300 DATA 4
310 DATA 5,4,3,2,1496
320 DATA 4,2,6,3,1175
330 DATA 3,1,7,5,958
340 DATA 2,3,5,1,861
```

The answers are: 177 sheep, 121 dogs, 23 hens and 29 hares.

The matrix statement

MAT B=INV (A)

is an invaluable feature of full versions of Basic. If we take, for example, Microsoft Basic, we have arrays, but no special matrix statements, so that we have to write a special inversion segment in our program. This is not difficult, but we can as easily write a segment to give us the generalised inverse of a matrix, which enables us to solve many more problems.

This function occurs only in the most advanced programming languages and is an important feature of APL enabling arrays to be handled as easily as ordinary numbers. The difficulty is the division of arrays which is done by multiplying by the inverse matrix.

If the determinant of a matrix is zero, or if the matrix is not square, it has no ordinary inverse, but a generalised inverse can always be found which enables our calculations to continue.

If we write a block of equations in matrix notation, adding the dimensions of the arrays in brackets, we have

A(N,M)*X(N,1) = H(N,1)

and the solution is

X(N,1) = A ⁻¹(N,N)*H(N,1)

where A^{-1} is the matrix inverse to A.

A^{-1} (N,N)*A(N,N) = I(N,N)

the unit matrix.

Sometimes our equations may have no solution because the determinant of A has no inverse. The program fails and the system reports: "Nearly zero determinant" or: "Nearly singular matrix". We may also have more equations than we need, as in many cases of physical measurements, and the equations may not be exactly consistent with each other, so that we want the "best" values of the unknowns.

In this case it is possible to define a generalised inverse A (M,N) for any matrix A(N,M) which enables us to obtain the "best" answer under all circumstances, from

X(N,1) = A+(N,M)*H(M,1)

obtaining N unknowns from M equations.

If there is an exact answer, we obtain it. If there are more equations than unknowns, we obtain the least-squares answer where the discrepancies in the equations are minimised, and if there are fewer equations than unknowns, so that the latter cannot be determined at all, we still obtain an answer consistent with the data.

As an additional step, which I will not explain here, we could obtain all possible answers, but the important thing is that the program does not crash and can continue. This is invaluable if the program is driving a robot or some such device. If the robot does not have enough data, it still takes the best possible action, even although the problem with which it is presented cannot be solved.

The only question is how to calculate the generalised inverse A + (M,M) of an array A(N,M). This is best done by an iterative method, like finding a square root by iterating a guess and improving it.

We start with a guess, putting very small numbers into our array, and then use this approximation to obtain a better approximation. B_{k+1} is the next approximation obtained from B_k, the previous one.

$B_{k+1} = [B_k\ 2{*}I(N,N) - A(N,M){*}B_k(M,N)]$

This iteration is continued until the trace of

A(N,M)*B(M,N)

is close to an integer. The trace of a square array is the sum of its diagonal terms

Q(1,1)+Q(2,2)+Q(3,3) . . . .

In the present version of Microsoft Basic, we obtain only six significant figures so that we should set the trace to be within 10^{-4} or 10^{-5} of an integer. Here is a program in Microsoft Basic to calculate the generalised inverse of a matrix.

```
1430 DATA 5,4
RUN
K=8.03213E-04
CONSTANT FOR INTEGRAL TRACE= 1E-05
RANK OF MATRIX = 4
SOLUTIONS TO EQUATIONS
1        177
2        121
3        23
4        28.9999
NUMBER OF EQUATIONS=5
NUMBER OF UNKNOWS=4
CALCULATED AND OBSERVED R.H.S.
1496        1496        8.54492E-04
1175        1175        6.10352E-04
957.999     958         6.10352E-04
860.999     861         7.93457E-04
860.999     861         7.93457E-04
```

This is an example of solution of a block of redundant equations — more than are necessary for the solution. The usual inversion method will fail under such conditions.

```
1430 DATA 6,4
RUN
K=5.84795E-04
CONSTANT FOR INTEGRAL TRACE=1E-05
RANK OF MATRIX=4
SOLUTIONS TO EQUATIONS
1        176.889
2        121.114
3        23.0467
4        28.9784
NUMBER OF EQUATIONS=6
NUMBER OF UNKNOWNS=4
CALCULATED AND OBSERVED R.H.S.
1496        1496        3.66211E-04
1175        1175        3.66211E-04
958         958         -3.66211E-04
861.333     861         -.333435
861.333     861         -.333435
861.333     862         .666565
```

This is an example of the calculation of the best solution when there is more data than is necessary. The six equations are slightly discrepant and the program gives the best fit minimising the errors.

```
1430 DATA 3,4
RUN
K=1.82149E-03
CONSTANT FOR INTEGRAL TRACE=1E-05
RANK OF MATRIX=3
SOLUTIONS TO EQUATIONS
1        155.909
2        142.772
3        31.845
4        24.9175
NUMBER OF EQUATIONS=3
NUMBER OF UNKNOWNS=4
CALCULATED AND OBSERVED R.H.S.
1496        1496        -1.2207E-04
1175        1175        -6.10352E-04
958         958         -1.83105E-04
```

Here we are asking the impossible since we cannot find four unknowns from three equations but the generalised inverse method gives us a consistent solution with the smallest numbers.

```
1430 DATA 7,4
RUN
K=4.69484E-04
CONSTANT FOR INTEGRAL TRACE=1E-05
RANK OF MATRIX=4
SOLUTIONS TO EQUATIONS
1        197.522
2        98.3226
3        33.2321
4        3.68205
NUMBER OF EQUATIONS=7
NUMBER OF UNKNOWNS=4
CALCULATED AND OBSERVED R.H.S.
1487.96     1496        8.03784
1197.17     1175        -22.173
941.924     958         16.0757
859.855     861         1.14496
859.855     861         1.14496
859.855     862         2.14496
508.592     500         -8.59204
```

Here we are solving seven discrepant equations for four unknowns and the program gives us the best fit minimising the sum of the squares of the discrepancies.

```
1430 DATA 4,4
RUN
K=1.1655E-03
CONSTANT FOR INTEGRAL TRACE=1E-05
RANK OF MATRIX=4
SOLUTIONS TO EQUATIONS
1        177
2        121
3        23
4        28.9999
NUMBER OF EQUATIONS=4
NUMBER OF UNKNOWNS=4
CALCULATED AND OBSERVED R.H.S.
1496        1496        -3.66211E-04
1175        1175        -2.44141E-04
958         958         1.83105E-04
861         861         1.2207E-04
```

This is the original Chinese problem and here the program gives the exact answer to the full accuracy of the machine.

Taking the second program and using the generalised inverse, we can solve the same Chinese problem in a number of more general forms:

- We set the dimensions of the array, statement 2010, to 4,4, so that we read in four equations. This gives the correct answer.
- Set the number of equations to 5, statement 2010 becomes DATA 5,4, using the fourth equation twice, and the program still gives us the correct answer.
- Add on one or two inconsistent equations, setting the array to 6,4 or 7,4 and we obtain the "best" fit of the estimates to the data. The sum of the squares of the discrepancies is minimised.
- Take fewer equations than are necessary for solving for four unknowns. Set the array size to 2,4 or 3,4. We still obtain the best estimates for all four unknowns, not unique values but values consistent with everything we know.

The generalised inverse can also be used for many other applications but these examples should furnish materials for experiment.

```
100 REM GENERALISED INVERSE OF X(N,M)
110 READ N,M
120 DIM H(N),P(M),Q(N)
130 DIM X(N,M), Y(M,N), W(M,N), Z(N,N), A(M,M)
140 REM MATRIX ENTERED IN X AND RETURNED IN Y
150 REM READ IN MATRIX
160 FOR I=1 TO N
170 FOR J=1 TO M
180 READ X(I,J)
190 W(J,I)=X(I,J)
200 REM W IS TRANSPOSE OF X
210 NEXT J
220 REM R.H.S. OF EQUATION
230 READ H(I)
240 NEXT I
250 K=0
260 FOR I=1 TO N
270 FOR J=1 TO N
280 Z(I,J)=0
290 FOR L=1 TO M
300 Z(I,J)=Z(I,J)+X(I,L)*W(L,J)
310 NEXT L
320 K=K+ABS(Z(I,J))
330 NEXT J
340 NEXT I
350 K=1/K
360 PRINT "K=";K
370 REM SMALL CONSTANT
380 D=1E-5
```

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```
390 PRINT "CONSTANT FOR INTEGRAL TRACE=";D
400 PRINT "TRACE+2*N"
410 FOR I=1 TO M
420 FOR J=1 TO N
430 REM FIRST APPROXIMATION TO INVERSE
440 Y(I,J)=K*W(I,J)
450 NEXT J
460 NEXT I
470 FOR I=1 TO N
480 FOR J=1 TO N
490 Z(I,J)=0
500 FOR L=1 TO M
510 Z(I,J)=Z(I,J)+X(I,L)*Y(L,J)
520 NEXT L
530 NEXT J
540 NEXT I
550 REM TRACE=T
560 T=0
570 FOR I=1 TO N
580 Z(I,I)=Z(I,I)-2
590 T=T+Z(I,I)
600 NEXT I
610 PRINT 2*N+T
620 FOR I=1 TO M
630 FOR J=1 TO N
640 W(I,J)=0
650 FOR L=1 TO N
660 W(I,J)=W(I,J)+Y(I,L)*Z(L,J)
670 NEXT L
680 NEXT J
690 NEXT I
700 FOR I=1 TO M
710 FOR J=1 TO N
720 Y(I,J)=-W(I,J)
730 NEXT J
740 NEXT I
750 IF ABS(T-INT(T)-1) < D THEN 780
760 IF ABS(T-INT(T)) < D THEN 780
770 GO TO 470
780 REM REPEAT UNTIL T IS AN INTEGER
790 FOR I=1 TO M
800 FOR J=1 TO M
810 A(I,J)=0
820 FOR L=1 TO N
830 A(I,J)=A(I,J)-Y(I,L)*X(L,J)
840 NEXT L
850 NEXT J
860 NEXT I
870 PRINT "RANK OF MATRIX="; 2*N+T
880 REM REMOVE NEXT STATEMENT FOR FULL PRINTOUT
890 GO TO 1240
900 PRINT "GENERALISED INVERSE"
910 PRINT
920 FOR I=1 TO M
930 FOR J=1 TO N
940 PRINT Y(I,J),
950 NEXT J
960 PRINT
970 PRINT
980 NEXT I
990 REM CHECKING PROCEDURE
1000 PRINT
1010 PRINT "ORIGINAL MATRIX"
1020 FOR I=1 TO N
1030 FOR J=1 TO M
1040 PRINT X(I,J),
1050 NEXT J
1060 PRINT
1070 PRINT
1080 NEXT I
1090 PRINT
1100 PRINT "PRODUCTS"
1110 FOR I=1 TO M
1120 FOR J=1 TO M
1130 PRINT A(I,J),
1140 NEXT J
1150 PRINT
1160 NEXT I
1170 PRINT
1180 FOR I=1 TO N
1190 FOR J=1 TO N
1200 PRINT Z(I,J),
1210 NEXT J
1220 PRINT
1230 NEXT I
1240 PRINT "SOLUTIONS TO EQUATIONS"
1250 FOR I=1 TO M
1260 P(I)=0
1270 FOR J=1 TO N
1280 P(I)=P(I)+Y(I,J)*H(J)
1290 NEXT J
1300 PRINT I, P(I)
1310 NEXT I
1320 PRINT "NUMBER OF EQUATIONS=";N
1330 PRINT "NUMBER OF UNKNOWNS=";M
1340 PRINT "CALCULATED AND OBSERVED R.H.S."
1350 FOR I=1 TO N
1360 Q(I)=0
1370 FOR J=1 TO M
1380 Q(I)=Q(I)+X(I,J)*P(J)
1390 NEXT J
1400 PRINT Q(I),H(I),H(I)-Q(I)
1410 NEXT I
1420 REM TEST DATA
1430 DATA 4,4
1440 DATA 5,4,3,2,1496
1450 DATA 4,2,6,3,1175
1460 DATA 3,1,7,5,958
1470 DATA 2,3,5,1,861
1480 DATA 2,3,5,1,861
1490 DATA 2,3,5,1,862
1500 DATA 1,2,3,4,500
```

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Further Fourier transforms

THE ARTICLE in the December 1980 issue of *Practical Computing* about the Fast Fourier Transform, FFT, gives an interesting insight into applications on the Pet, thanks to the author Ben Rogers. If you have no FFT program written in machine language, the Basic program suggested in the article is a useful way to become acquainted with numerical spectral analysis.

After a few trials with this FFT program, you might feel disappointed because of the amount of storage needed, but especially when you have to wait for the results of a transform. It takes 8K of memory and more than four minutes to perform the FFT with 256 sampling points.

With 1,024 sampling points, you need 27K and even more than 19 minutes. The time intervals include the execution of bit reversal and FFT algorithm only. Data preparation and display of input and output data take extra time.

I tried to improve the Basic-FFT and wrote a new program, the properties of which are briefly illustrated by the following list:

Sampling points	Execution time FFT and bit reversal	Memory complete program
256	1minute 16seconds	5.4K
512	2minutes 52seconds	8.3K
1,024	6minutes 17seconds	14.0K

The program without arrays occupies about 2.5K of memory. Besides subroutines for the FFT and the bit reversal, it contains data preparation, drawing of input and output graphs and run-time calculation. These parts may be changed easily and you can save even more space. As an example, for comparison purposes, an input signal of the same type of sine wave was used as in the old program.

You need not be an expert to understand the improvements introduced. Perhaps you will already know the basic ideas used, because hundreds of articles have been published since 1966 when Cooley and Tuckey found the FFT algorithm. I want to explain how the Basic-version of the FFT can be optimised with respect to run-time and memory economy.

Program execution speed on the Pet may be increased considerably, if you stick to the rules given in the manufacturer's manual:

1. Use variables instead of constants.
2. Order your definitions of variables carefully.
3. Use Next statements without the index variable.

The program lines 50, 60 — variables N0, N1 to N9 — are initially set to 0, 1, to 9 to follow rule 1. Variables in lines 20, 30 and 40 are initialised in advance following

by W Barbiz

rule 2 because they are used very often during execution time. According to 3 all For-Next loops within the program use Next without index variable to save time which would otherwise be lost for the index check.

The execution of the FFT algorithm results in a set of output data which has a different order in comparison to the original order of input data. A rearrangement or data shuffle is necessary either before or after the performance of the FFT. The procedure is well known as bit reversal and can be done without any auxiliary array.

In this case, it it called "in place bit reversal" and the whole FFT is performed in place. This idea is crucial if you want to economise in space, and many Fortran programs published since 1966 take advantage of this idea. One example may be found in Markel's article.

The time necessary to re-order the data depends mainly on the number of auxiliary calculations to carry out the bit reversal algorithm. From a programmer's point of view, the reversal subroutine in Ben Rogers' article is elegant, because it is very short. Unfortunately, there are so many arithmetic and logical calculations and conversions to be executed that the bit reversal takes as much time as the FFT algorithm itself.

This disadvantage is found in many published Fortran programs but it has been avoided by Markel. Markel presents an algorithm with nested loops using a minimum amount of arithmetic. The reversal of 2^q data is carried out within q nested loops.

Markel's Fortran subroutine was slightly altered and re-written in Basic — see lines 6000-6200. Unfortunately, no more than eight For-Next loops may be nested in a Pet-Basic subroutine, so two further conditional branches have been programmed — lines 6180, 6190 — to establish a total of 10 loops for a maximum of 1,024 data points. In this case, the bit reversal is executed in 33 seconds only, i.e., nine percent of the 6 minutes 17 seconds run-time total for the complete FFT.

Auxiliary data in the performance of the FFT are the trigonometric coefficients sin $(k2\pi/n)$, cos $(k2\pi/n)$ with $n = 2^q$ and $k = 0 \ldots n/2$.

Do not store them all because only one quarter of the data are really different. A look-up table should only contain the data sin $(k2\pi/n)$ for $k = 0 \ldots n/4$ to keep your memory free from redundant data.

If you want to use such a minimum tabel with the FFT, the coefficients have to be chosen in a more sophisticated way than in an ordinary program. Lines 7030 — 7050 reflect this complication. Nevertheless, it pays and does not cause any considerable increase of execution time.

The run-time of the FFT is mainly determined by the number of arithmetic calculations to be carried out within the For-Next loops in lines 7000 — 7110. The loops have been arranged to minimise the amount of calculations. Especially, the operations of the inner loop 7060 — 7100 are chosen very carefully resulting in only four multiplications and eight additions or subtractions.

In Rogers' program, a theoretical limit of about 50 seconds is stated for the FFT with 256 points on the Pet. The new FFT subroutine presented needs 68 seconds and does not seem to be far from the optimum.

References

Rogers B, Fast Fourier Transforms, Practical Computing, *December 19, 80, pp 91 – 93.*
CBM 2001 – 16, -32, 3016, 3032*,* Professional computer user manual, *June 1979, P/N 320856-3, Commodore Business Machines Inc.*
Markel J D, FFT Pruning, IEEE Transactions, *AU-19, number 4, December 1971, pp 305 – 311.*

The fast Fourier Transform program in Basic.

```
10 REM***FFT PROGRAM***
20 A=0:B=0:F1=0:F2=0:F1=0:P2=0:CC=0
30 SS=0:I=0:IS=0:T=0:Z=0:DT=0
40 L=0:D=0:X=0:Y=0
50 N0=0:N1=1:N2=2:N3=3:N4=4
60 N5=5:N6=6:N7=7:N8=8:N9=9
100 PRINT"WHAT POWER OF 2?"
110 PRINT"(MAXIMUM VALUE OF 10 ALLOWED)"
120 INPUT Q:IFQ>10GOTO100
200 P=Q-N1:R=N2↑Q-N1:R2=N2↑P:R4=N2↑(P-N1)
210 DIM RE(R),IM(R),SI(R4)
290 REM***LOOK-UP TABLE COMPUTATION***
300 K=π/R2:FORX=N0TOR4
310 SI(X)=SIN(K*X):NEXT
990 REM***INPUT DATA GENERATION***
1000 FORX=N0TOR
```

(continued on next page)

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```
1010 RE(X)=SIN(K*X*(F+0.1)):IM(X)=N0:NEXT
1990 REM***DRAW INPUT GRAPH***
2000 FORX=N0TOR:O$="*"
2010 A=INT(19.5*(1+RE(X))):IFA=N0GOTO2030
2020 FORI=N0TOA-N1:O$=" "+O$:NEXT
2030 PRINTO$;:IFA<39THENPRINT
2040 NEXT
2990 REM***THIS IS THE FFT***
3000 PRINT"IN PLACE FFT AND BIT REVERSAL"
3010 TI$="000000":GOSUB6000:TE$=TI$
3020 PRINT"REVERSAL RUNTIME:";:GOSUB4500
3030 TI$="000000":GOSUB7000:TE$=TI$
3040 PRINT"FFT-RUNTIME:";:GOSUB4500
3050 STOP
3990 REM***DRAW OUTPUT GRAPH***
4000 MAX=N0:FORX=N0TOR
4010 RE(X)=SQR(RE(X)*RE(X)+IM(X)*IM(X))
4020 IFRE(X)>MAXTHENMAX=RE(X)
4030 NEXT
4100 MAX=39/MAX:FORX=N0TOR:O$="*"
4110 A=INT(MAX*RE(X)):IFA=N0GOTO4130
4120 FORI=N0TOA-N1:O$=" "+O$:NEXT
4130 PRINTO$;:IFA<39THENPRINT
4140 NEXT
4150 END
4490 REM***RUNTIME CALCULATION***
4500 TM$=MID$(TE$,N3,N2)
4510 IFVAL(TM$)=VAL("00")GOTO4530
4520 PRINTTM$;" MIN, ";
4530 PRINTRIGHT$(TE$,N2);" SEC"
4540 RETURN
5990 REM***IN PLACE BIT REVERSAL***
6000 FORX=N0TON9:L(X)=N1:NEXT
6010 FORX=N0TOP:L(X)=N2↑(Q-X):NEXT
6020 FORX=N0TON9:L1(X)=L(X)-N1:NEXT
6030 X=N0:X1=N0
6040 X2=X1
6050 FORX3=X2TOL1(N7)STEPL(N8)
6060 FORX4=X3TOL1(N6)STEPL(N7)
6070 FORX5=X4TOL1(N5)STEPL(N6)
6080 FORX6=X5TOL1(N4)STEPL(N5)
6090 FORX7=X6TOL1(N3)STEPL(N4)
6100 FORX8=X7TOL1(N2)STEPL(N3)
6110 FORX9=X8TOL1(N1)STEPL(N2)
6120 FOR Y=X9TOL1(N0)STEPL(N1)
6130 IFX>=YGOTO6150
6140 A=RE(X):RE(X)=RE(Y):RE(Y)=A
6150 X=X+N1
6160 NEXT:NEXT:NEXT:NEXT
6170 NEXT:NEXT:NEXT:NEXT
6180 X2=X2+L(N9):IFX2<=L1(N8)GOTO6050
6190 X1=X1+N1:IFX1<=L1(N9)GOTO6040
6200 RETURN
6990 REM***FFT SUBROUTINE***
7000 FORS=N0TOP:PRINT"STAGE",S
7010 T=N2↑S:T1=T-1:IS=N2*T
7020 D=N2↑(P-S):DT=IS*(D-N1):L=N0
7030 FORZ=N0TOT1:IFL<R4GOTO7050
7040 SS=SI(R2-L):CC=-SI(L-R4):GOTO7060
7050 SS=SI(L):CC=SI(R4-L)
7060 FORI=N0TODTSTEPIS:A=I+Z:B=A+T
7070 F1=RE(A):P1=CC*RE(B)-SS*IM(B)
7080 F2=IM(A):P2=SS*RE(B)+CC*IM(B)
7090 RE(A)=F1+P1:IM(A)=F2+P2
7100 RE(B)=F1-P1:IM(B)=F2-P2
7110 NEXT:L=L+D:NEXT:NEXT
7120 RETURN
```

Business software: order from the menu

By the astute use of menus, a user can be guided through even the most complex software systems. Charles Somerville shows how.

MENU-DRIVEN is an expression you will find in many advertisements for business software. It means that the user directs the flow of processing by making choices from a menu of options displayed on the screen.

After the processing for each selection has been completed, the menu is displayed again and a further choice made. To accelerate ordering from the menu, selections are made by number. In our programs, a menu screen might look like this:

```
HISTORIC CAR REGISTER SYSTEM

MAIN MENU
THE FOLLOWING OPTIONS ARE AVAIL-
ABLE
1 — ADD NEW CAR
2 — DISPLAY/UPDATE CAR DETAILS
3 — DELETE CAR
4 — PRINT REPORTS
5 — CLOSE DOWN
PLEASE ENTER THE NUMBER COR-
RESPONDING TO YOUR CHOICE: 9
REPLY MUST BE A NUMBER BETWEEN
1 AND 5 — PLEASE TRY AGAIN
FOR EXTRA HELP TYPE ? AND PRESS
RETURN
```

In choosing from the main menu, the user has entered a number which does not correspond to any of the choices. Since the menu routine uses the input routine printed last month, an error message is displayed in high intensity automatically, and the cursor moves back to allow a new choice to be entered. The help facility is explained at the bottom of the screen, and typing a question mark will produce a display showing exactly how to enter a menu selection.

Note that this is the main menu. In any program which requires the user to direct the order in which work is performed, the main-menu screen is the first thing the user should see after starting the system. It assures that the user is always guided through the system by a consistent question-and-answer dialogue.

There can be other menus. If the user were to select option 4 — print reports — from the main menu, he might be presented with a second menu screen:

```
HISTORIC CAR REGISTER SYSTEM

PRINT REPORTS
THE FOLLOWING OPTIONS ARE AVAIL-
ABLE
1 — PRINT FULL LISTING
2 — PRINT SUMMARY BY MAKE
3 — PRINT DETAILS FOR ONE CAR
4 — RETURN TO MAIN MENU
```

A system can have as many menus as necessary but, it is good practice to minimise the number of options offered in a single screen to avoid overwhelming the less-confident user.

The routine given restricts the maximum number of choices in a single menu to 12. If you use a hierarchy of menus, the last choice on each should be a return to the preceding menu — see option 4 — which offers you Return To Main Menu.

You will see that the menu displays follow the standard screen format from the first article in this series — July 1981. The current menu selection is displayed on line four, and the display of selections and the user's response are contained in the working area.

```
10000 'HISTORIC CAR REGISTER SYSTEM
10010 GOSUB 30000 'COMMON INITIALISATION ROUTINE
10020 GOSUB 20000 'APPLICATION INITIALISATION ROUTINE
10030 DONE%=NO%
10040 MENU%=1
10050 WHILE NOT DONE%
10060      GOSUB 35000 'MENU DISPLAY
10070      CHOICE%=CHOICE%+5*(MENU%-1)
10080      ON CHOICE% GOSUB 11000, 12000, 13000, 14000, 15000, 16000,
17000, 18000, 19000
10090 WEND
10100 END
11000 'ADD NEW CAR
11999 RETURN
12000 'DISPLAY/UPDATE CAR DETAILS
12999 RETURN
13000 'DELETE CAR
13999 RETURN
14000 'PRINT REPORTS
14010 MENU%=2
14999 RETURN
15000 'CLOSE DOWN
15010 DONE%=YES%
15020 RESET
15030 PRINT CLS$
15999 RETURN
16000 'PRINT FULL LISTING
16999 RETURN
17000 'PRINT SUMMARY BY MAKE
17999 RETURN
18000 'PRINT DETAILS FOR ONE CAR
18999 RETURN
19000 'RETURN TO MAIN MENU
19010 MENU%=1
19999 RETURN
20000 'APPLICATION INITIALISATION
20010 PRINT CLS$ FNTAB$(27,1) "HISTORIC CAR REGISTER SYSTEM"
20020 PRINT FNTAB$(27,2) STRING$(28,"-")
20030 DIM MENUS$(2,6)
20040 MENUS$(1,1)="ADD NEW CAR"
.
.
.
20090 MENUS$(1,6)=""
20100 MENUS$(2,1)="PRINT FULL LISTING"
.
.
.
20140 MENUS$(2,5)=""
20150 DIM CODES$(3)
20160 CODES$(1)="MAKES"
20170 CODES$(2)="MODELS"
20180 CODES$(3)=""
20190 CARFILE%=3
20200 OPEN "R",CARFILE%,"CARFILE",20
20210 FIELD CARFILE%, 2 AS CARNUMBER$, 8 AS CARDATENEW$, 8 AS
CARREGNO$, 1 AS CARMAKE$, 1 AS CARMODEL$
29999 RETURN
30000 'COMMON INITIALISATION ROUTINE
.
.
.
30900 DIM XCODES$(2,60), XSIZE%(2), XTOP(2) 'ALLOW FOR TWO TABLES OF UP
TO SIXTY DESCRIPTIONS
30999 RETURN
```

Listing 1. Historic-car register: program skeleton.

You need only tell the routine the selections available and it displays them, accepts the user's response, and uses the input routine to check the reply, print error messages and display help information if required.

It also maintains the current menu selection display, allows the user to verify that he has made the correct choice, and clears the working area which will be used by your application routine.

The number of the selection chosen is passed back to you in Choice%, ready for you to use as an index to the appropriate routine with an On Choice% Gosub statement.

The selections used in the menu displays are held in an array, named, appropriately, Menus$. You must dimension and load the array as part of the initialisation of your program. As more than one menu may be used in a program, Menus$ is a two-dimensional array, where the first subscript identifies a particular menu, and the second a selection within the menu.

For the two menus in the Historic Car Register System, Menus$ would be laid out thus:

MENUS$(1,1) "ADD NEW CAR"	MENUS$(2,1) "PRINT FULL LISTING"
MENUS$(1,2) "DISPLAY/UPDATE CAR DETAILS"	MENUS$(2,2) "PRINT SUMMARY BY MAKE"
MENUS$(1,3) "DELETE CAR"	MENUS$(2,3) "PRINT DETAILS FOR ONE CAR"
MENUS$(1,4) "PRINT REPORTS"	MENUS$(2,4) "RETURN TO MAIN MENU"
MENUS$(1,5) "CLOSE DOWN"	MENUS$(2,5) " "
MENUS$(1,6) " "	MENUS$(2,6) " "

The dimensions of the array will depend on the number of menus used, and the largest number of selections in any one menu. Since the menu routine recognises the end of the menu by a null string, i.e., Menus$ (menu, selection)=""), an extra element of the array is required at the end of each menu, and our two menus will require an array dimensioned as Dim Menus$ (2,6).

Having dimensioned and loaded the array in your program's initialisation code, all you need to pass to the menu routine is the number of the menu you want displayed in the variable Menu%. Hence, to display the main menu:

```
MENU%=1
GOSUB 35000          'MENU ROUTINE
ON CHOICE% GOSUB .....
```

Listing 1 shows the skeleton of a program for the Historic Car Register System, and includes the code to load and use the two menus.

Next time you eat in a Chinese restaurant, watch the waiter as he takes your order. He will probably use a notepad so small that it fits in the palm of his hand. He can use a tiny scrap of paper because he writes down your order still in its coded, i.e., numeric, form. Just as his use of information technology is postponing the demise of the rain forest, so can a system of coding avert the dreadful day when the "Disc full" message appears.

If we turn again to historic cars, we might wish to hold details of 2,000 cars of 30 different makes. Since the make might be anything from AC to De Dion-Bouton, we would have to reserve at least 14 bytes of each record to store the make, or about 28K for the 2,000 cars.

However, if we do not store the full description, but give each make a one-byte code, the space requirement is reduced significantly. Only one byte of each record is needed, plus a table of 30 14-byte descriptions to interpret the codes — a total of less than 2.5K.

The routines given allow you to use codes like this with negligible programming effort. The decoding tables are stored on disc, each under a distinct name so that they can be used by more than one program without having to be copied into each. The tables are built, extended and moved between disc and memory without any effort from the programmer. The routines will:

- Encode from a description to a single-byte code.
- Decode from a single-byte code back to the description,
- Display a menu of descriptions on the screen and accept a selection by number,
- Allow a new choice to be added to the menu if the required selection is not present.

When presenting a menu of descriptions on the screen, the last six lines of the working area are used, formatted thus:

```
ENTER THE NUMBER CORRESPONDING
TO YOUR CHOICE IN THE LIST BELOW, OR
PRESS RETURN TO ADD A NEW CHOICE
TO THE LIST:
1 — LOTUS     2 — ROLLS-ROYCE
3 — MORGAN    4 — FERRARI
5 — DE DION BOUTON   6 — AC
7 — BENTLEY
```

If the user decides to add a new choice, the display is replaced by:

```
ENTER THE NEW CHOICE OR PRESS
RETURN TO CHOOSE FROM THE LIST
AGAIN:
ALFA ROMEO
HAS THE NEW CHOICE BEEN ENTERED
                        CORRECTLY?
```

Here the user has added Alfa Romeo as a new choice. In the future, whenever the list is displayed, Alfa Romeo will be shown as an eighth option. The table on disc is updated by the routine automatically, so that all programs using the car register file will be able to decode it correctly.

The routine automatically spaces the selections to suit the description length and will display multiple menus of selections where there are a large number of choices.

To use the routines, you must first specify in an array, Codes$, the names of the tables you intend to use. Each table has a name of one to eight characters and is stored on disc in the file name.Cod — e.g., the table of makes is in Makes.Cod. For our historic cars we will want one list called Makes and a second called Models, so we will set up Codes$ as follows:

```
DIM CODES$(3)
CODES$(1)="MAKES"
CODES$(2)="MODELS"
CODES$(3)=""
```

Once again, a null element in the array signifies the end of the list to the routines.

The variable Codings is used to pass the coded form of a selection and Decode$ for the full description. Code$ contains the name of the list being used. Therefore, to convert a make from its coded form to the printable form, use:

```
CODE$="MAKES"
CODING$=code from record
GOSUB 36000
```

and the make will be returned in Decode$. If Coding$ specifies a code which does not exist, or Code$ names a table not listed in the array Codes$, then OK% will be set to No% and can be tested by:

```
IF NOT OK% THEN print error message
```

Displaying a menu, or menus, of descriptions and receiving in return the selected description and its coding is only slightly more complicated. Add% is set to Yes% or No% to specify whether the user may add a new choice to the menu. The numbers of the help messages to be used in guiding the user must also be given.

Helpold% is set to the number of the help message to be displayed if the user requires assistance in making a choice. If Add% is set to Yes%, Helpnew% should specify the help message used when adding a new choice to the menu.

So, to display the menu of makes, and possibly add a new choice:

```
CODE$="MAKES"
ADD%=YES%
HELPOLD%=number of chosen message
HELPNEW%=number of chosen message
GOSUB 37000
```

The code to be stored on disc will be returned in Coding$ and the full description in Decode$. OK% will be set to No% only if Code$ is not found in Codes$. The help message should have been previously set using the program you wrote after last month's article.

If you wish to encode information from an existing file, then a call to the routines in the form:

```
CODE$="MAKES"
DECODE$=description from old file
GOSUB 38000
```

will return the correct code in Coding$. If the description in Decode$ is not found in the table, OK% will be set to No% and you can use:

```
IF NOT OK% THEN GOSUB 39000
```

to add the new choice to the table and obtain its new coding. From now on, the historic car register program will be developed each month, so before next month try the following:

(continued on next page)

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Create the two code files Makes.Cod and Models.Cod. This is done by opening a sequential file for output and then writing the length of the description as the first record of the file:

```
OPEN "O",3,"MAKES.COD"
WRITE # 3, 14
CLOSE 3
RESET
```

Note that file numbers 1 and 2 are used by the input and code routines respectively, so you should make a practice of using files # 3 onwards. To use more than a total of three files, start MBasic with:

```
MBASIC /F:n
```

where n is the total number of files required.

Start building up the car register program. Include the skeleton program in listing 1 and all the routines given so far. If you replace the missing application routines by Return statements, you will be able to try the two menus.

If you are familiar with random files, complete the "Add new car" routine to write a record made up of:

- Number on the register — use as random record number
- Make — in coded form
- Model — in coded form
- Date first registered
- Registration number — i.e., as on the number plate

Use the input and code routines to ask for the information. Do not worry about the slightly odd display the code routine gives you before you add the first description to the menu. The application initialisation routine opens and defines the car-register file for you.

Listing 2. Menu routine.

```
35000 'MENU DISPLAY
35010 REPLY$="NO"
35020 WHILE REPLY$="NO"
35030      IF MENU%=1 THEN PRINT X0104$ CLL$ X3604$ "MAIN MENU"
35040      PRINT X1606$ "THE FOLLOWING OPTIONS ARE AVAILABLE"
35050      XCHAR$="-"
35060      XCNT%=0
35070      WHILE XCHAR$<>"" AND XCNT%<12
35080          XCHAR$=MENUS$(MENU%,XCNT%+1)
35090          IF XCHAR$<>"" THEN XCNT%=XCNT%+1: PRINT
FNTAB$(16,XCNT%+7) XCNT%: PRINT FNTAB$(20,XCNT%+7) "-" XCHR$
35100      WEND
35110      PRINT X1321$ "PLEASE ENTER THE NUMBER CORRESPONDING TO YOUR
CHOICE:"
35120      TYPE%=NUMBER%: HELP%=3: NULL%=NO%: CURSOR$=X6721$
35130      MIN=1: MAX=XCNT%
35140      GOSUB 31000
35150      CHOICE%=VAL(REPLY$)
35160      XCHAR$=MENUS$(MENU%,CHOICE%)
35170      XCNT%=(81-LEN(XCHAR$))/2
35180      PRINT X0104$ CLE$ FNTAB$(XCNT%,4) XCHAR$
35190      PRINT X2606$ "IS THIS THE CORRECT CHOICE:"
35200      TYPE%=CONFIRM%: HELP%=4: NULL%=NO%: CURSOR$=X5406$
35210      GOSUB 31000
35220 WEND
35230 PRINT X0106$ CLL$
35240 RETURN
```

Listing 3. Code routines.

```
36000 'FROM CODING TO DESCRIPTION
36010 OK%=NO%
36020 GOSUB 36500
36030 IF NOT XFOUND% THEN RETURN
36040 XCNT%=ASC(CODING$)
36050 IF XCNT%> XTOP%(XCODE%) THEN RETURN
36060 OK%=YES%
36070 DECODE$=XCODES$(XCODE%,XCNT%)
36080 RETURN

36500 'CHECK THAT REQUIRED TABLE IS LOADED
36510 XFOUND%=NO%
36520 XCODE%=1
36530 WHILE NOT XFOUND% AND CODES$(XCODE%)<>""
36540      IF CODE$=CODES$(XCODE%) THEN XFOUND%=YES% ELSE
XCODE%=XCODE%+1
36550 WEND
36560 IF NOT XFOUND% THEN RETURN
36570 IF XSIZE%(XCODE%)<>0 THEN RETURN
36580 OPEN "I",XCODEFILE%,CODE$+".COD"
36590 INPUT#XCODEFILE%, XSIZE%(XCODE%)
36600 XCNT%=0
36610 WHILE NOT EOF(XCODEFILE%)
36620      XCNT%=XCNT%+1
36630      INPUT#XCODEFILE%, XCODES$(XCODE%,XCNT%)
36640 WEND
36650 CLOSE XCODEFILE%
36660 XTOP%(XCODE%)=XCNT%
36670 RETURN
37000 'DISPLAY MENU(S) OF DESCRITPIONS
37010 OK%=NO%
37020 GOSUB 36500
37030 IF NOT XFOUND% THEN RETURN
37040 XLEN%=XSIZE%(XCODE%)
37050 XCNT%=80/(XLEN%+8)    'INTEGER DIVISION
37060 XROW%=(XTOP%(XCODE%)+XCNT%-1)/XCNT%     'INTEGER DIVISION
37070 IF ADD% THEN IF XROW%>4 THEN GOSUB 37200 ELSE GOSUB 37400 ELSE IF
XROW%>5 THEN GOSUB 37600 ELSE GOSUB 37800
37080 PRINT X0116$ CLE$
37090 RETURN
37200  'MULTIPLE MENUS WITH ADDITION
37210  WHILE NOT OK%
37220      PRINT X0116$ CLE$
37230      PRINT X0116$ "ENTER THE NUMBER CORRESPONDING TO CHOICE FROM
THE LIST BELOW:"
37240      PRINT X0117$ "OR PRESS RETURN IF YOUR CHOICE IS NOT THERE:"
37250      TYPE%=NUMBER:HELP%=HELPOLD%:NULL%=YES%:CURSOR$=X4617$
37260      MIN=1:MAX=XTOP%(XCODE%)
37270      XCNT%=1
37280      WHILE XCNT%<=XTOP%(XCODE%)AND NOT OK%
37290          XROW%=18
37300          GOSUB 38700
37310          GOSUB 31000
37320          IF REPLY$<>""THEN OK%=YES%
37330      WEND
37340      IF OK% THEN
                XCNT%=VAL(REPLY$):
                CODING$=CHR$(XCNT%):
                DECODE$=XCODES$(XCODE%,XCNT%)
           ELSE
                GOSUB 38500
37350  WEND
37360  RETURN
37400  'SINGLE MENU WITH ADDITION
37410  WHILE NOT OK%
37420      PRINT X0116$ CLE$
37430      XROW%=18
37440      XCNT%=1
37450      GOSUB 38700
37460      PRINT X0116$ "ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE
FROM THE LIST BELOW,"
37470      PRINT X0117$ "OR PRESS RETURN TO ADD A NEW CHOICE TO THE
LIST:"
37480      TYPE%=NUMBER%:HELP%=HELPOLD%:NULL%=YES%:CURSOR$=X4917$
37490      MIN=1:MAX=XTOP%(XCODE%)
37500      GOSUB 31000
37510      IF REPLY$="" THEN
                GOSUB 38500
           ELSE
                OK%=YES%:
                XCNT%=VAL(REPLY$):
                CODING$=CHR$(XCNT%):
                DECODE$=XCODES$(XCODE%,XCNT%)
37520  WEND
37530  RETURN
37600  'MULTIPLE MENUS WITH NO ADDITION
37610  PRINT X0116$ CLE$
37620  PRINT X0116$ "ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE FROM
THE LIST BELOW,"
37630  PRINT X0117$ "OR PRESS RETURN IF YOUR CHOICE IS NOT THERE:"
37640  TYPE%=NUMBER%:HELP%=HELPOLD%:NULL%=YES%:CURSOR$=X4617$
37650  MIN=1:MAX=XTOP%(XCODE%)
37660  XCNT%=1
37670  WHILE NOT OK%
37680      IF XCNT%>XTOP%(XCODE%) THEN XCNT%=1
37690      XROW%=18
37700      GOSUB 38700
37710      GOSUB 31000
37720      IF REPLY$<>"" THEN OK%=YES%
37730  WEND
37740  XCNT%=VAL(REPLY$)
37750  CODING$=CHR$(XCNT%)
37760  DECODE$=XCODES$(XCODE%,XCNT%)
37770  RETURN
37800  'SINGLE MENU WITH NO ADDITION
37810  PRINT X0116$ CLE$
37820  PRINT X0116$ "ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE FROM
THE LIST BELOW:"
37830  XROW%=17
37840  GOSUB 38700
37850  TYPE%=NUMBER%: HELP%=HELPOLD%: NULL%=NO%: CURSOR$=X6816$
37860  MIN=1:MAX=XTOP%(XCODE%)
37870  GOSUB 31000
37880  OK%=YES%
37890  XCNT%=VAL(REPLY$)
37900  CODING$=CHR$(XCNT%)
37910  DECODE$=XCODES$(XCODE%,XCNT%)
37920  RETURN
38000 'FROM DESCRIPTION TO CODING
38010  OK%=NO%
38020  GOSUB 36500
38030  IF NOT XFOUND% THEN RETURN
38040  XCNT%=1
38050  WHILE XCNT%<=XTOP@(XCODE@) AND NOT OK@
38060      IF DECODE$=XCODE$(XCODE%,XCNT%) THEN
              OK@=YES@
           ELSE
              XCNT@=XCNT@+1
38070  WEND
38080  CODING$=CHR$(XCNT%)
38090  RETURN
38500  'ASK FOR NEW ADDITION TO LIST
38510  PRINT X0116$ CLE$
38520  PRINT X0116$ "ENTER THE NEW CHOICE OR PRESS RETURN TO CHOOSE
FROM THE LIST AGAIN:"
38530  TYPE%=STRING%:HELP%=HELPNEW@:NULL@=YES@:CURSOR$=X0118$
38540  MIN=1:MAX=XTOP%(XCODE%)
38550  GOSUB 31000
38560  IF REPLY$="" THEN RETURN
38570  DECODE$=REPLY$+SPACES$(XSIZE%(XCODE%)-LEN(REPLY$))
38580  PRINT X1620$ "HAS THE NEW CHOICE BEEN ENTERED CORRECTLY:"
38590  TYPE%=CONFIRM%:HELP%=5:NULL%=NO%:CURSOR$=X5920$
38600  GOSUB 31000
38610  IF REPLY$="NO" THEN RETURN
38620  OK%=YES%
38630  GOSUB 39000
38640  RETURN
38700  'DISPLAY A MENU OF DESCRIFTIONS
38710  WHILE XROW%<=21 AND XCNT%<=XTOP%(XCODE%)
38720      XCOL%=1
38730      WHILE XCNT%<=XTOP%(XCODE@) AND XCOL@+XLEN@<=73
38740          PRINT FNTAB$(XCOL@,XROW@) XCNT@ " "
38750          PRINT FNTAB@(XCOL@+5,XROW@) "-" XCODE$(XCODE@,XCNT@)
38760          XCOL@=XCOL@+XLEN@+8
38770          XCNT@=XCNT@+1
38780      WEND
38790      XROW%=XROW%+1
38800  WEND
39000  'ADD NEW CHOICE TO TABLE
39010  XCNT@=XTOP@(XCODE@)+1
39020  CODING$=CHR$(XCNT@)
39030  XTOP@(XCODE@)=XCNT@
39040  XCODES$(XCODE@,XCNT@)=DECODE$
39050  OPEN "0",XCODEFILE@,CODE$+".COD"
39060  WRITE#XCODEFILE@, XSIZE@(XCODE@)
39070  FOR XCNT@=1 TO XTOP%(XCODE@)
39080      WRITE#XCODEFILE@,XCODES$(XCODE@,XCNT@)
39090  NEXT XCNT@
39100  CLOSE XCODEFILE@
39110  RETURN
```

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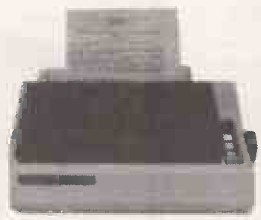

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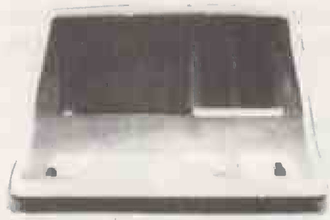

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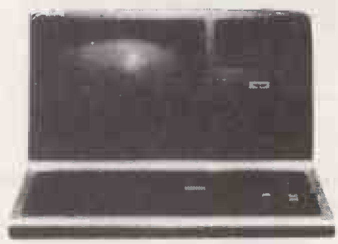

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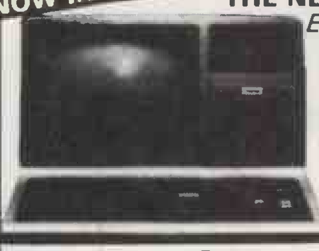

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Inverse video

IN THE August 1980 issue, on the ZX-80 page, a Basic routine was published which converted Print statement text into inverse video, writes Martin Robinson of Pontefract, West Yorkshire. My machine-code version of this routine operates much more quickly. The program can be Poked into memory between about 17000 and 17370 which, according to Sinclair Research, is usually free RAM. This depends on the size of the program display and stack.

As the program occupies only 15 bytes, it should be possible to use it when even a large program is in memory. The program can change only the Print statement on the first line to inverse video. Others can be changed by altering the line number to make it the first line, executing the program and then replacing that line in its correct position.

The program is executed by a USR(x) instruction where x is the address of the first byte of the program. Here is an assembly listing and also the op-codes which are Poked into memory.

Assembler	Op-codes
LD BC,16428	1 44 64
LD A,(BC)	10
CP 1	254 1
JR Z,6	40 6
ADD A,128	198 128
LD (BC), A	2
INC BC	3
JR 244	24, 244
RET	201

The Compare in the third line is to test for the quotation marks at the end of the Print. Relative jumps are used instead of jumps to specific addresses because this means the routing can be located anywhere in memory without any alterations and also for a saving of two bytes.

Scrolling data

A SHORT routine I have written for the ZX-81 with update ROM can be used to give scrolling input of data next to a user's prompt, writes Paul Newman of Leiston, Suffolk. A very annoying feature of the ZX-81 is that you cannot have a prompt for certain data.

```
10 LET B$=""
20 SCROLL
30 PRINT "your prompt";
40 PAUSE 40000
50 POKE 16437,255
60 LET A$=INKEY$
70 IF CODE A$=118 THEN GO TO 110
80 IF A$="" THEN GO TO 60
90 LET B$=B$+A$
100 GOTO 40
110 PRINT B$
120 GOTO 10
```

This works for strings; if numbers are required, change as follows:

```
110 LET K=VAL B$
120 PRINT K
130 GOTO 10
```

Various checks on data could be provided as the user desires. I have used this in several programs and it has proved very neat and useful. It is not quite "compute and display" — but is close to it. When using the Pause facility on the new ROM, hitting the space key causes an interrupt. If you need spaces in string inputs, use* or another of the shifted characters on the bottom row of keys.

Dec to hex again

I HAVE written two small programs which are a vast improvement on Sarbjit Singh's efforts, March 1981, for decimal to Hex, and *vice versa* writes Howard Parry of Atherton, Manchester. They are reasonably fast.

```
5  PRINT "ENTER HEX. VALUE"
10 INPUT H$
15 LET D=((CODE(H$) − 28)*16)+
   ((CODE(H$(2)))−28)
20 PRINT H$;"=";D
```

```
5  PRINT "ENTER DECIMAL VALUE"
10 INPUT D
15 LET G$=(CHR$(28+INT(D/16)
   ))+CHR$(28+(D−INT(D/16)*16))
20 PRINT D;" = ";G$
```

. . . and again

MY DECIMAL-to-binary converter differs entirely from previous programs in the way that the program itself does no conversion at all, writes Egidio Debono of Qormi, Malta. The program, variables and data are all held in memory as binary digits, thus, if you input a number between −32767 and 32767, it is held somewhere in memory as a signed 16-bit number.

The monitor would have already performed the required conversion for you before storing it. You need only know where it is stored to print each of the 16 bits one after the other. However, because the internal structure of the Z-80/ZX-80 stores numbers, however small, in two bytes; first the least-significant byte, LSB, then the most-significant one, MSB. Therefore, you have to start printing the eight bits of the second byte, MSB, first.

The second difference is that the subroutine which makes the 16 bits easily available for printing is written in machine code. This subroutine transfers the bits to 16 consecutive bytes starting at address 16808. For those who are perplexed by the USR(X) function on the ZX-80, this program is a good example of how good machine-code subroutines could be integrated into Basic programs.

Once you have entered the program it is wise to Save it on tape even before running it. This will save you the trouble of having to re-enter the entire program should the monitor fail when executing the subroutine. This will most probably happen if you fail to key line 15 correctly, or if you omit or insert any character/s in any line.

In the event that the program does not work, try this for a check. Run the program and enter 6 ** 6 when the prompt sign appears. Hit Newline and the program should stop indicating an arithmetic overflow. Returning to immediate mode input Print A followed by Newline and 16806 should appear on the screen. If not, you must check your program for any errors, character by character. If it is, and the program still will not work, check line 15 only.

The subroutine is in Z-80 mnemonics together with the addresses in decimal.

```
16824  LD HL,16807   ;Point HL to MSB
                     of D(0)
16827  LD DE,16808   ;Point DE to first

of 16 bytes16830
                     counter
16832  XOR A         ; Zeroise
accumulator
16833  SLA, (HL)     ;Shift byte left
                     through Carry
16835  ADC A,A       ;Add Carry to
                     accumulator
16836  LD(DE), A     ;Store accumulator
16837  INC DE        ;Point to next
                     storage location
16838  DJNZ,16832    ;Go back to 16832
                     if not ready
16840  DEC HL        ;Else point HL to
                     preceding byte
16841  LD A, 165     ;Have the two bytes
16843  CP L          ;been processed?
16844  RET Z         ;If yes then return
                     to Basic
16845  JR 16830      ;Else go back to
                     16830
```

Big characters

THIS PROGRAM runs on a 1K ZX-80, accepts four characters and then prints them out eight times their original size, or 16 times their height and/or 16 times their original width for two characters, writes Colin Mongardi of Eastbourne, East Sussex. The program works by taking values from the character generator in the ROM, converting them to binary and then displaying them.

If double-height characters are needed, the following lines should be added:

```
85 FOR C = 1 TO 2
195 NEXT C
```

Double-width characters can be achieved by:

```
90 FOR S = 1 TO 2
171 — the same as line 170
```

The characters can be made to appear grey by multiplying by nine in line 170 rather than by 128.

```
10 DIM C(8)
20 DIM D(4)
30 INPUT U$
40 FOR T=1TO4
50 LET D(T)=CODE(U$)
60 LET U$=TL$(U$)
70 NEXT T
80 FOR Q=0TO7
90 FOR S=1TO4
100 LET N = PEEK
(D(S)*8+3584+Q)
110 FOR T=1 TO 8
```

(continued on page 121)

(continued from page 119)

```
120 LET B=N
130 LET N=N/2
140 LET C(9-T)=B-N*2
150 NEXT T
160 FOR T=1TO8
170 PRINT CHR$(C(T)*128);
180 NEXT T
190 NEXT S
200 NEXT Q
```

Screen scroll

This machine-code routine scrolls the screen of the ZX 80 one line when it is called. It does this by locating the second newline character on the screen and setting the video pointer to it. The line counter, location 16421, is then incremented. The code is re-locatable and can be Poked into a dummy Rem statement at the beginning of the program.

42,12,64,62,100,198,18,35,237,177,43,34, 12,64,33,37,64,52,201.

The equivalent in assembler is:

```
SCROLL: LD HL, (16396)
        INC HL          ;Load video pointer
        LD A,118        ;Newline character for search
        CPIR            ;Search
        DEC HL          ;Adjust
        LD (16396)?HL   ;Store new pointer
        LD HL, 16421    ;Line counter
        INC (HL)        ;Adjust
        RET
```

I would be interested to know if anyone has developed an assembler — full Z-80 mnemonics — as even the shortest machine-code programs are hard to translate from assembler to decimal, for a 4K ZX-80.

I think that you have a very good page for a very good, and affordable, computer, but I would like to see a little bit more initiative displayed, for example a decimal-to-Hex conversion takes only one line rather than the 10 in some programs:

```
PRINT CHR£(X/16+28); CHR£((X-(X/16)*16+28)
```

Binomial expansion

TWO FEATURES of ZX-80 Basic can be used to write easily-understood programs, writes Robert Oakeshott of Awbridge, Hampshire. The first is the ability to use long variable names, the second is the ability to use computed Goto and Gosub. If a variable with the name a label is initialised with the label's line number, later jumps or calls can be made to the label by name.

The format of the instruction is the same as usual, except that the line number following the Goto or Gosub is replaced by the label's name, e.g., GOSUB GETINPUT, where Getinput has been defined earlier.

This program will expand an equation of the form $(1+ax)^n$ in terms of ascending powers of x. The program prompts input of "a" and "x" which must, if the program is used on a standard ZX-80, be integers. An interesting feature of the program is the subroutine at line 500 which traps any impending arithmetic overflow.

The program could be adapted to fill an array with the values, which could then be used in a program such as the one published in your March 1981 issue.

One feature lacking from ZX-80 Basic is string arrays. The second program supplies routines to create, and to access a string array of up to 25 elements.

To set the array, the routine at line 1200 should be called. Line 1250 sets the variable MS to the maximum subscript. The top subscript can be 25 if 1 is a valid subscript, or 24 if 0 is the lowest valid subscript.

To recall an element's contents, the subroutine Get can be used. This transfers the element pointed to by E to A$. To store a value in the array, Put is used. This subroutine stores the contents of A$ in the element of the array pointed to by E.

The Put and Get routines use the same transfer routine at line 1100, which is modified appropriately using Pokes. to make the program re-locatable, the subroutine at line 1000 finds where the program is located, and the set up routines calculate the position of the needed points in the transfer instruction.

Variables

A$: This is the variable used to pass data to and from array via the Put and Get routine.
B$ to Z$: Either hold array, or unused. Array held in top strings. e.g., Z$, Y$, etc.
BS: This is the code of the name of the last string not used in the array, or of the first string used if 0 is a valid subscript.
DL: This is the location of the first letter after the Let in line 1110.
DS: This is the value Poked to DL in order to adjust the variable set in line 1110.
E: This is used by the Put and Get routines as the subscript to the array.
MS: This is the maximum subscript for the array.
POS: This points to the character following the last parenthesis on line 1010.
SL: This is the location of the first character after the equals sign on line 1110.
SO: This is the value Poked to location SL to adjust the variable read from.

Subroutines

Line	Name	Function
1000	Find own position	Sets POS to location of end of line 1010
1100	Do move	Transfers data to and from array.
1200	Set up array	Creates a string array with maximum subscript MS
1400	Put	Transfers data from A$ to element E in array
1500	Get	Transfers element E of array to A$
1600	Finish	Completes Get and Put routines

ZX-80 binomial expansion.

```
100 CLS
110 PRINT "                1+AX)**N"
120 PRINT "N=";
130 INPUT N
140 PRINT N
150 PRINT "A=";
160 INPUT A
170 PRINT A
180 PRINT
190 PRINT 1
200 LET A$="ENTER NEWLINE"
210 LET B$=" FOR ANOTHER RUN"
220 IF A=0 THEN GOTO 600
230 LET P=1
240 LET C=1
250 LET L=5
300 LET S=N-P+1
310 IF S=0 THEN GO TO 600
320 LET T1=S
330 GO SUB 500
340 LET C=(C*S)/P
350 LET T1=A
360 GO SUB 500
370 LET C=C*A
380 IF P=1 THEN PRINT C;"X"
390 IF P>1 THEN PRINT C;"X**";P
400 LET L=L+1
410 LET P=P+1
420 IF L<20 THEN GO TO 300
430 LET L=0
440 PRINT A$;" TO CONTINUE";
450 GO SUB 700
460 CLS
470 GO TO 300
500 LET T1=ABS(T1)
510 LET T2=ABS(C)
520 IF 32767/T1>T2 THEN RETURN
530 PRINT "OVERFLOW-EXPANSION
    ABORTED"
600 PRINT
610 PRINT A$;B$
620 GO SUB 710
630 RUN
700 PRINT ".N";B$;
710 PRINT ".E TO END";
720 INPUT S$
730 IF S$="" THEN RETURN
740 IF S$="E" THEN STOP
750 IF S$="N" THEN RUN
760 GO TO 720
```

ZX-80 string array.

```
1000 REM FIND OWN
POSITION
1010 LET POS=256*
PEEK(16423)+PEEK(16422)
1020 RETURN
1100 REM DO MOVE
1110 LET A$=A$
1120 RETURN
1200 REM SET UP ARRAY
1210 GO SUB 1000
1220 LET DL=POS+19
1230 LET SL=DL+3
1240 REM SIZE ARRAY
1250 LET MS=10
1260 LET BS=63-MS
1270 LET A$=""
1280 FOR E=1 TO MS
1290 GO SUB 1400
1300 NEXT E
1310 RETURN
1400 REM PUT
1410 LET SO=38
1420 LET DS=E+BS
1430 GO TO 1600
1500 REM GET
1510 LET SO=E+BS
1520 LET DS=38
1600 REM FINISH
1610 POKE SL,SO
1620 POKE DL,DS
1630 GO TO 1100
```

Floppy tape speed

I HAVE found that there can be some incompatibility between various floppy tapes which have their drives running at different speeds, writes John Newgas of London E10. It is possible to adjust the speed of the drive very easily by opening up the unit.

This program will give a speed index for your Aculab. To use the program to measure your Aculab-unit's speed, use a wafer, with or without programs, which was originally formatted on your machine. More accurate readings are obtained with longer wafers. I normally use a 50ft. wafer.

```
10  DEFINT J, K, L
20  @ LIST
30  J=INP(240)
40  IF J = 127 THEN GOTO 100
50  K = K + 1
60  GOTO 30
100 INPUT "HOW MANY SECTORS
   WERE LISTED IN TOTAL"; L
110 PRINT "THE SPEED INDEX IS
   ";K/L
120 END
```

My Aculab shows a speed index of 21.85 on average for most tapes. I have some wafers which are slightly sticky or stiff — normally, I can hear this when they are running. The program shows any changes in the running speed as they are worn in. The Aculab will normally read wafers without trouble with a 15percent speed margin.

For another user to use my wafers and synchronise his machine to mine, he should run the program with my wafer and adjust his machine speed to give my standard index. The program gives only a relative speed measure. The measurements made on your own wafers will nearly always show the same index unless you have changed the drive speed. The index measures the change between the speed used for formatting — @ NEW — and the speed when the program is run. Do not use 75ft. wafers for calibration with this program.

Video headings

LISTING 1 is an assembler program designed to protect headings on the video screen when a large number of lines of data have to be listed, writes Dennis Long of Rochester, Kent. You have the choice of how many lines from the top of the screen are protected.

To help explain how it works, Basic demonstration program — listing 2 — has been prepared. The assembled machine-code program is included in data statements at the end of the program. you may find the two checking routines in lines 50 and 130 of particular interest as they prevent you from setting it up incorrectly.

- Check 1 ensures that you have set Mem Size correctly, for this version of the machine-code program it should be set to 32703.
- Check 2 ensures that the machine-code program has been correctly loaded into memory; if it has not, it is reloaded automatically.

There are two subroutines which are not used by the program in lines 480 and 510. Line 50 allows you to zero the machine-code program addresses in memory, simply by typing Goto 510. While the former prints the machine code in decimal on to the screen by Typing Goto 480.

Pay particular attention to lines 250 and 260; if you have Level II only, use line 260 and omit line 250. If you have disc Basic, use line 250 and forget about 260.

The body of the program works by using variable "Q" to determine where the next line should be printed using a Print at Q, statement. If "Q" becomes greater than 896, i.e., it is about to print on the bottom line of the screen, then the Scroll machine-code program is called from line 350. This routine — SC = USR(LN) — is all that is needed to blank the line on the screen below line "LN" and move all the others up one line.

When the program asks you for a line number, it will change the value of "LN" to the number you enter. It should lie within the range 0 to 14. The machine-code program, however, checks this, so that if you enter a number greater than 14 it is set to line 14 automatically.

Pound signs

MANY THANKS to James Bamber, Tandy Forum, April 1981, for revealing the existence of the six extra characters the lower-case modification will deliver, writes Alun Evans of Ynysforgan, Abertawe. Tandy is rather coy about them — there is no mention of them in the documentation supplied with the software driver program, Ulcbas.

By following one of the procedures detailed here, Ulcbas may be modified so that the computer displays the pound sign or any one of the other new signs, from the keyboard by using Shift and, @ Which of the suggested methods you use depends on your system and software resources.

Here are the instructions for the permanent alteration of Ulcbas, using TBUG.

- Load TBUG.
- Load Ulcbas with the TBUG L command. Ulcbas resides in 7000H to 73FFH before it re-locates itself.
- use the TBUG M command to enter the following opcodes: they are entered from 6FFBH to 6FFFH 21, 47, 72, 36, 60 and are all Hex.
  This is
  LD HL,7247H
  LD (HL),60H
  To obtain, another character, other than £, replace the final byte, 60H, with the Hex ASCII code for that character.
- Save the changes with
  P 6FFB 73FF 6FFB LCASE2

Here are the changes withour TBUG for non 16K systems. The point of this method is that the driver is modified before it re-locates itself and so the change works for all size memories.

- Load Ulcbas.
- Type Break in response to the prompt.
- Poke 29255,96 The 96 is for the £ sign. You can substitute any other ASCII character code but in decimal form this time.
- Type System.
- Type /28672.

Finally, here are the modifications for use without TBUG. For 16K systems:

- Load Ulcbas.
- Answer the prompt with / as normal.
- Modify the program in its relocated position with POKE32732,96.

No matter which of these modifications you use, the end result is the same: Shift and @ displays the £ sign. Note though, that Shift and @ will still halt the Basic program execution and will still stop long Listings as before.

```
00100 ;***************************************************
00110 ;****      "SCROLL" - DENNIS V. LONG (C) - 1980   ****
00120 ;****       ROCHESTER - KENT - ENGLAND            ****
00122 ;****###########################################****
00125 ;**** FOR TRS-80 MODEL I - LEVEL II OR DISK BASIC ****
00130 ;****+++++++++++++++++++++++++++++++++++++++++++****
00140 ;**** ROUTINE TO PROTECT LINES AT THE TOP OF THE  ****
00150 ;**** SCREEN.  BY USING A USRX(N) CALL, ALL LINES ****
00160 ;**** BELOW LINE N WILL BE SCROLLED UP ONE LINE.  ****
00170 ;**** LINE N+1 SCROLLS UNDER LINE N............   ****
00180 ;***************************************************
00190          ORG     7FC0H           ;START LOCATION
00200 START    CALL    0A7FH           ;GET LINE NUMBER IN 'L'
00210          LD      A,L             ;PUT IT IN 'A'
00212          CP      0H              ;TEST FOR ZERO
00214          RET     Z               ;RETURN TO BASIC IF TRUE
00220 MAX      CP      0FH             ;TEST FOR 15 OR MORE
00225          JP      P,ERROR         ;ERROR IF TRUE
00230          LD      HL,3C00H        ;SCREEN START
00240          LD      DE,0040H        ;1 LINE WIDTH
00250          LD      B,A             ;SET UP COUNTER
00260 LOOP     ADD     HL,DE           ;GET START OF LINE
00270          DJNZ    LOOP            ;LOOP TILL 'B' IS ZERO
00280          PUSH    HL              ;SAVE SCROLL START
00290          ADD     HL,DE           ;GET NEXT LINE
00300          POP     DE              ;GET FIRST LINE IN 'DE'
00310          PUSH    HL              ;SAVE NEXT LINE
00320          LD      HL,3FC0H        ;END OF SCRN LINE 15
00330          SBC     HL,DE           ;GET NO OF BYTES TO MOVE
00340          PUSH    HL              ;SAVE 'HL'
00350          POP     BC              ;PUT IT IN 'BC'
00360          POP     HL              ;RESTORE NEXT LINE TO'HL'
00370          LDIR                    ; S C R O L L
00380          LD      B,3FH           ;COUNTER FOR SCRN LINE
00390          LD      A,20H           ;ASCII FOR BLANK
00400 LOOP1    LD      (DE),A          ;BLANK OUT ADDR. IN 'DE'
00410          INC     DE              ;POINT TO NEXT SPACE
00420          DJNZ    LOOP1           ;LOOP TILL 'B' IS ZERO
00430          RET                     ;RETURN TO BASIC
00432 ERROR    LD      A,0EH           ;MAKE 'A'=14
00434          JR      MAX             ;TRY AGAIN
00440          END

HEXADECIMAL MEMORY DUMP OF - SCROLL

7FC0  CD 7F 0A 7D FE 00 C8 FE 0F F2 E0 7F 21 00 3C 11
7FD0  40 00 47 19 10 FD E5 19 D1 E5 21 C0 3F ED 52 E5
7FE0  C1 E1 ED B0 06 3F 3E 20 12 13 10 FC C9 3E 0E 18
7FF0  D6 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

10 REM * *  SCROLLING LINE PROTECTER * *
20 REM * *      BY DENNIS V. LONG      * *
```

(continued on next page)

(continued from previous page)

```
 30 REM * * USES MACHINE CODE ROUTINE * *
 40 '
 50 REM * CHECK THAT MEMORY SIZE HAS BEEN SET CORRECTLY *
 60 IF PEEK(16599)*256+PEEK(16598)=>32704 THEN PRINT"YOU HAVEN'T
    SET  -  MEMORY SIZE TO  32703 OR LESS !":STOP
 70 '
 80 REM * INITIAL DISPLAY *
 90 CLS:PRINT TAB(12)"THIS PROGRAM TESTS THE SCROLL ROUTINE"
100 PRINT TAB(20)"SITUATED AT 7FC0 - 32704 "
110 FOR N=0 TO 300:NEXT N
120 '
130 REM * CHECK THAT MACHINE CODE PROGRAM IS IN MEMORY *
140 IF PEEK(32704)=205 AND PEEK(32752)=214 THEN 160
150 CLS:PRINT"YOU HAVE NOT LOADED THE MACHINE CODE ROUTINE YET":
    GOSUB 380:FOR N=0 TO 1000:NEXT N:GOTO 90
160 PRINT"
    GOOD - I HAVE TESTED FOR THE SCROLL ROUTINE AND FOUND IT O.K."
170 '
180 REM * INITIALIZE PROGRAM *
190 CLEAR 100:DEFINT A-Z:LN=6
200 X=0:PRINT@334,"I AM GOING TO DISPLAY A NUMERIC ARRAY"
210 PRINT"IT WILL BE PRINTED OUT WITH AN AREA OF SCREEN PROTECTED"
220 INPUT"PRESS <ENTER> TO CONTINUE........... ";C
230 '
240 REM* DEFINE USER ROUTINE - Note different methods *
250 DEF USR=32704  'use this method for DISK BASIC.
260 'POKE 16526,192:POKE 16527,127 use this for LEVEL II, without
    the "'" of course.
270 '
280 REM * PRINT AN ARRAY OF DATA TO SCREEN *
290 Q=512:FOR N=0 TO 50:GOSUB 350:PRINT@Q,;:FOR M=0 TO 11
300 X=X+10:PRINT USING"#### ";X;
310 NEXT M:PRINT:NEXT N
320 GOSUB 350:PRINT@Q,"CLEVER, ISN'T IT !  TO ";:INPUT"TRY AGAIN
    - ENTER LINE NUMBER ";LN:PRINT@128,CHR$(31):GOTO 200
330 '
340 REM * KEEP TRACK OF LINE NO. BEING PRINTED - AND SCROLL *
350 Q=Q+64:IF Q>896 THEN SC=USR(LN):Q=896:RETURN ELSE RETURN
360 '
370 REM * ROUTINE TO LOAD MACHINE CODE *
380 PRINT@200,"LOADING MACHINE CODE INTO MEMORY NOW -";
390 RESTORE:FOR N=32704 TO 32760: READ D:PRINT@239,CHR$(30);D;:POKE
    N,D:NEXT N:RETURN
400 DATA 205,127,10,125,254,0,200,254
410 DATA 15,242,237,127,33,0,60,17,64
420 DATA 0,71,25,16,253,229,25,209,229
430 DATA 33,192,63,237,82,229,193,225
440 DATA 237,176,6,63,62,32,18,19,16
450 DATA 252,201,62,14,24,214,0,0,0,0
460 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0
470 '
480 REM * USEFUL SUBROUTINE TO READ MACHINE CODE TO SCREEN *
490 FOR N=32704 TO 32760:PRINT PEEK(N);",";:NEXT N:STOP
500 '
510 REM * USEFUL SUBROUTINE TO ZERO MACHINE CODE IN MEM. *
520 FOR N=32704 TO 32760:POKEN,0:NEXT N:STOP
530 REM* * * * * ABSOLUTE END * * * * *
```

Bugs

AS A REGULAR reader of *Practical Computing,* I am very glad to find that 6502 users, especially the ones who have Superboard II or UK101, are able to exchange ideas through the 6502 Special, writes K K Ho of Kowloon, Hong Kong. However, once in a while one may find the subroutines submitted are not workable because of bugs in them.

For instance, the "Moving data routines" in the November 1980 issue does not work at all just because there is an instruction missing. I also find that the routine does not clear the top line of the video RAM and that the screen will be filled in the same way every line. By fixing the bug and adding the clearing the top-line part, I have the following new routine:

```
0222  LDA  #$FF       A9 FF
0224  STA  $61        85 61
0226  LDA  #$D3       A9 D3
0228  STA  $62        85 62
022A  LDY  #$00       A0 00
022C  LDA  (61),Y     B1 61
022E  LDY  #$20       A0 20
0230  STA  (61),Y     91 61
0232  DEC  $61        C6 61
0234  LDA  $61        A5 61
0236  CMP  #$FF       C9 FF
0238  BNE  $022A      D0 F0
023A  DEC  $62        C6 62
023C  LDA  $62        A5 62
023E  CMP  #$CF       C9 CF
0240  BNE  $0228      D0 E6
0242  LDA  #$20       A9 20
0244  LDX  #$24       A2 24
0246  STA,X $D000     9D 00 D0
0249  DEX             CA
024A  BNE  $0246      D0 FA
024C  RTS             60
```

Like the original routine, this one also uses the spare locations 0061-0064 in page zero and can be called by

X = USR(x)

after setting the USR pointer with

POKE 11,34:POKE 12,2

The data can be moved in different directions across the screen with different values in $022F.

B-squiggle

WITH REFERENCE to the query from Robert Schiffreen about the B-squiggle error code in the 6502 page of June 1981 *Practical Computing,* I have written a short routine which will do the task requested, writes Philip Burden of Stockport, Cheshire. It has been tried and tested on my 16K Superboard 2 and found to be bug-free. With one alteration, it can be completely re-locatable for use anywhere in memory.

The program occupies the free RAM area not used by Basic. Only Switching off will clear it from memory. Location 0226 contains the ASCII code for the Esc key, but any key may be used by changing the code. Location 0232 contains the screen-fill character — in this case, a Space, but any character may be used. The program is activated by the following Pokes after a reset, and these Pokes must be typed on the same line to avoid a system crash

POKE536,34:POKE537,2

(continued on next page)

J R Barber's square puzzle, see next page.

```
175   Y = Y + 1  : IF Y > 16 THEN 196
196   GOSUB  700
198   IF FF = 0 THEN RESTORE : GO TO 130
700   REM  CHECK ROUTINE
710   A = 53425  ;  T = 0
720   DATA  0, 3, 6, 9, 148, 151, 154, 157, 296, 299.
730   DATA  302, 305, 444, 447, 450, 453.
740   READ B : EE = PEEK (A + B) : EE = EE - 64
750   FOR CC = I TO 4  :  FOR DD = 1 TO 4
760   S (CC,DD) = EE  :  NEXT DD  :  NEXT CC
770   S (4,4)  =  16
780   FOR I = 1 TO 4  :  FOR J = 1 TO 4
790   FOR K = 1 TO 4  :  FOR L = 1 TO 4
800  IF S (I,J) > S (K,L) THEN T = T + 1
810  NEXT L  :  NEXT K
820  S (I,J) = 16
830  NEXT J  :  NEXT I
840  IF T - 2 * INT (T/2) = 0 THEN FF = 1 : RETURN
850  FF = 0 : RETURN
```

Philip Burden's B-squiggle.

```
10  FOR X = 546 TO 580 : READ A : POKEX,A
NEXT
20  DATA 32,186,255,201,27,208,3,32,47,2
30  DATA 76,153,163,160,0,169,32,153,0,208
40  DATA 153,0,209,153,0,210,153,0,211,200
50  DATA 208,241,169,13,96
60  POKE 536,34 : POKE 537,2
70  POKE 11,47 : POKE 12,2
80  NEW
```

(continued from previous page)

For software control of the screen-clear routine:
POKE11,47:POKE12,2 and use X = USR(X).

Factorials

AFTER noticing a program for factorials of numbers in ZX-80 Line-up. I decided that you might like my Superboard program for the same purpose, writes F S Dewhirst of Keighley, West Yorkshire.

As far as I know, there are no restrictions in its use, since it calculates the size of the array before starting the factorial calculations. The fact that it includes LOG(X) is not a cheat or an approximation.

It takes less than two minutes to calculate 100!, and a slight alteration to the program allows it to calculate 1!, 2! to 100! in slightly more than an hour.

Square puzzle

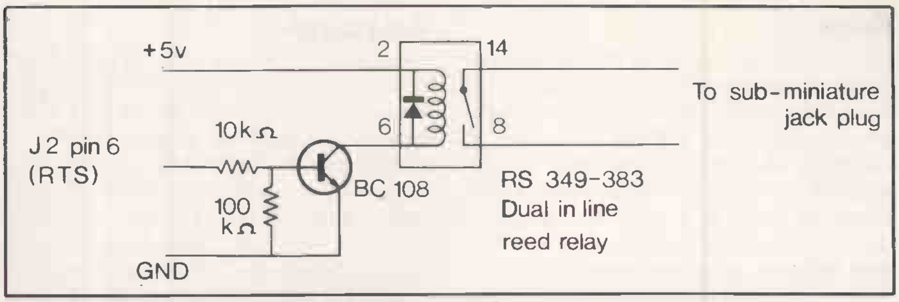
I ENJOYED adapting P J Cooper's 6502 Special May 1981 Square Puzzle for the UK 101, writes J R Barber of Ipswich, Suffolk. However I would imagine the reason he reckons the puzzle may take a day to solve is the fact that only half the puzzles generated are possible to solve. According to Spencer's *Game playing with Basic*, there are 10, 461, 394, 944, 1,000, number arrangements which are possible and a similar amount which are impossible.

This simple check routine, adapted from the book, will check each random arrangement before the game begins and reject it if necessary, replacing it with another. I have written the routine to work in the original Superboard program. The Data statements contain the VDU position of each letter added to 'A'.

Cassette relay

OHIO Superboard owners can easily add a cassette-control relay to their machines allowing data files on cassette to be split into suitable blocks for I/O under program control, writes A Goodhew of Peterborough, Cambridgeshire.

The RTS signal from pin 5 of the 6850P ACIA terminates at pin 6 on the J2 connector at the top left of the board. This may be set High with Poke 61440,81 or Low with Poke 61440,17. The following simple circuit makes use of these pokes to turn a relay on/off to control the motor in the cassette deck via the remote socket.



Tony Goodhew's circuit diagram, and below, F S Dewhirst's factorials program.

```
100  PRINT : PRINT : PRINT"THE PROGRAM GIVES"
 : PRINT
110  PRINT"6 DIGITS AT A TIME." : PRINT
120  PRINT : PRINT"PRESS SPACE BAR FOR" :
PRINT
130  PRINT"FURTHER DIGITS." : PRINT : PRINT
140  PRINT"ENTER NUMBER";N : PRINT
150  FOR X = 1 TO N: Y=Y+LOG(X) : Z=Y/LOG(10)
 NEXT
160  Z=INT(Z/3)+1: DIMA(Z) : A(1)=1 : FOR F=1
TO N : C=0 : FOR Y=1 TO Z : B=F*A(Y)+C
170  C=INT(B/1000) : A(Y)=B-C*1000 : NEXTY,F
180  PRINT"FACTORIAL";N;" IS " PRINT
190  FOR X=Z TO 1 STEP -1
200  W=W+1 : IF W=3 THEN GOSUB 240 : PRINT :
PRINT : W=1
210  S=INT(A(X)/10) : R=A(X)-S*10 :
P=INT(S/10) : Q=S-P*10
220  PRINT P;Q;R; : NEXT : PRINT
230  PRINT : PRINT : PRINT : RUN140
240  POKE530,1 : POKE 57088,253 : IF
PEEK(57088)=239 THEN RETURN
250  GOTO240
```

The program demonstrates its simple use in Basic with six subroutines:

4000 Wait for key to be pressed. Character is left in R$ if needed.
3000 Run past the blank leader on tape.
1000 Open a block before writing data — record the syncronisation fields.
1100 Close a written block — turns off motor and unSaves.
2000 Open a block when reading tape — waits for correct syncronisation fields.
2100 Close a read block — motor off and unLoads.

I have found these routines very reliable using a clock speed of 2MHz. Set up a simple blocked file and read and display the data from the file a block at a time under operator control.

Data filing

The string constants of '%%%%%' and '# # # #' are used for synchronisation and the delay loops allow the motor to reach full speed before data transfer.

Those who have fitted a PIA can control more than one recorder by changing the Pokes in the subroutines to drive extra relays via the I/O lines from the PIA. One recorder can read data from tape and after updating the information the modified data may be sent to the other recorder. In this way large data files may be maintained on a small machine.

```
100 REM SIMPLE BLOCKED FILES
110 REM     Written by Tony Goodhew
120 C$=CHR$(26):REM Screen clear with CEGMON
130 R=61440:REM Relay address(81=on/17=off)
140 POKER,17
200 PRINTC$"Write or Read file? (W/R) ";
210 GOSUB4000:IFR$="R"THENPRINTR$:GOTO500
220 IFR$<>"W"THEN210
230 PRINTR$
300 PRINTC$:INPUT"File name";H$
310 INPUT"Number of records";N:N=INT(SQR(N*N))
320 PRINTC$:GOSUB3000:GOSUB1000:PRINTH$:GOSUB1100
330 FORI=1TON
340 PRINTC$:INPUT"String";S$:INPUT"Number";X
350 GOSUB1000:PRINTS$:PRINTX:GOSUB1100
360 NEXTI
370 GOSUB1000:PRINT"EOF":PRINT9E9:GOSUB1100
380 SAVE: PRINTC$;H$;" written":END
500 PRINTC$:INPUT"File name";Q$
510 PRINTC$"Put cassette in deck,play & touch SPACE":GOSUB4000
520 PRINTC$:GOSUB2000:INPUTH$:GOSUB2100
530 PRINTC$:IFQ$<>H$THENPRINT"WRONG TAPE: "H$" found not "Q$:END
540 SAVE:PRINT"Contents of "H$:PRINT:K=0
550 GOSUB2000:INPUTS$:INPUTX:GOSUB2100
560 IFS$="EOF"THEN600
570 SAVE:PRINTS$,X:K=K+1:GOTO550
600 SAVE:PRINT:PRINT"End of file":PRINTK" records were found":END
999 REM ** OPEN BLOCK - WRITE **
1000 POKER,81:FORU=1TO300:NEXTU:SAVE
1005 FORU=1TO3:PRINT"%%%%%":NEXTU:PRINT"#####"
1010 FORU=1TO50:NEXTU:RETURN
1099 REM ** CLOSE BLOCK -WRITE **
1100 FORU=1TO900:NEXTU:POKER,17:POKE517,0:RETURN
1999 REM ** OPEN BLOCK -READ **
2000 POKER,81:FORU=1TO700:NEXTU:LOAD
2010 INPUTL$:IFRIGHT$(L$,2)<>"##"THEN2010
2020 PRINTC$:RETURN
2099 REM ** CLOSE BLOCK -READ **
2100 POKER,17:POKE515,0:RETURN
2999 REM ** RUN PAST LEADER **
3000 POKER,17:PRINT"RECORD & PLAY then touch SPACE"
3010 GOSUB4000:PRINTC$"LEADER":POKER,81:FORU=1TO20000
3020 NEXTU:POKER,17:RETURN
3999 REM** GET **
4000 POKE11,0:POKE12,253:X=USR(X):R$=CHR$(PEEK(531)):RETURN
OK
```

Graph plotter

HERE IS a simple graph plotter which will graph any function you give it — as long as it is not a line of zero gradient — and display in in HG2, writes Kieron Leech of Warrington, Cheshire.

To use it, first type the function you want plotting as defined function A in line 40, then run it. You will be asked if you have an Apple, and if not it assumes you have an ITT 2020. This part is due to the fact that the ITT 2020 has a HG2 screen 360 by 192, against the Apples 280 by 192. This means that you can have a slightly better graph on an ITT than an Apple, so it takes this into account when plotting the graph.

Once it knows what machine you have, it asks you the two x-co-ordinate limits between which you want the graph to be drawn. The first number you give it should be the lower x co-ordinate, the second the higher. If this is not so, the program will ask for them to be inputted again.

Once it knows the range of values between which you want to plot, it first works out all the y values for all the x values in the range, finding the maximum and minimum values as it goes along. From these, it calculates the scaling factor needed to draw the graph.

It will then draw the graph, and if the x or y axis is crossed by the graph, it will put them in their correct place. Once it finishes, it will leave you in HGR2, but returns itself to the command mode for you.

Decimal line-up

I WAS most interested in the two programs published in Apple Pie June 1981, writes Gerard Noel of London NW8. Yet neither of them really fills the bill for someone who wants a simple subroutine for producing any figure to two decimal places, including trailing zeros, for columns of financial figures — where ".00" and ".50" are required, for example.

My company, a licensed dealer in securities, uses the Apple to produce contract notes for buying and selling stocks and shares. The number of shares and the price per share are input, and the program automatically calculates and prints the total, the commission at various appropriate rates, the VAT on the commission, the rate of contract note stamp, the rate of stamp duty, and whether the CSI levy is chargeable. The costs are then added up and a grand total printed.

Each £/p figure (F) is rounded using the stndard formula

F = INT(F*100+.5)/100

followed by

X = F:GOSUB 2000.

Our Gosub 2000 subroutine which returns a string XZ$ — the required number of two decimal places including trailing zeros. F$ = ZX$ restores the relationship between F and F$ for the value and the string.

This may not be a highly-elegant program, but I am a self-taught programmer and the program works, producing the desired answer in a form where the decimal points can be lined up by a Tab instruction incorporating the string length, e.g.,

PRINT TAB(40-LEN(F$));F$.

```
]LIST 2000,2150
2000 XX$ = ".00"
2010  IF X =  INT (X) THEN XY$ =
      STR$ (X)
2020  IF X < >  INT (X) THEN  GOTO
     2040
2030 XZ$ = XY$ + XX$: RETURN
2040 W = X -  INT (X)
2050 W = W + .00001
2060 W$ =  STR$ (W)
2070 V$ =  LEFT$ (W$,3)
2080 V =  VAL (V$)
2090 U$ =  STR$ (V)
2100 P =  INT (X)
2110 XY$ =  STR$ (P)
2120 AA$ =  STR$ (0)
2130  IF  LEN (U$) = 2 THEN XZ$ =
     XY$ + U$ + AA$: GOTO 2150
2140 XZ$ =  STR$ (X)
2150  RETURN
```

```
10  TEXT : HOME : VTAB 7
20  PRINT "DO YOU HAVE AN APPLE (Y/N) ..?";: GET A$: IF A$ =
     "Y" THEN K = 280: GOTO 40
25  PRINT : PRINT
30  PRINT "THEN I ASSUME YOU HAVE AN ITT 2020":K = 360
40  DEF  FN A(X) =  SIN (X / 100) -  COS (X / 50)
50  PRINT : PRINT : PRINT : INPUT "WHAT X VALUES DO YOU WANT
     TO PLOT THE   GRAPH BETWEEN   ?";X1,X2
60  IF X2 <  = X1 THEN  HOME : GOTO 50
70  PRINT : PRINT : PRINT "PLEASE WAIT WHILE I WORK"
80  DIM Y(K):MA =  - 1E30:MI = 1E30:P = 0
90 XS = (X2 - X1) / (K - 1):X = X1: FOR P = 0 TO K - 1:X = X
    + XS
100 Y =  FN A(X):Y(P) = Y: IF MA < Y THEN MA = Y
110  IF Y < MI THEN MI = Y
120  NEXT
130  HGR2 :XS = (K - 1) / (X2 - X1):YS = 191 / (MA - MI): HCOLOR=
     3
140  IF X2 > 0 AND X1 < 0 THEN  HPLOT ( - X1) * XS,0 TO ( -
     X1) * XS,191
150  IF MA > 0 AND MI < 0 THEN  HPLOT 0,191 + MI * YS TO K -
     1,191 + MI * YS
160  FOR I = 0 TO K - 1
170  HPLOT I,191 - (Y(I) - MI) * YS
180  NEXT
```

Applesoft print

THIS MACHINE-CODE program is designed to use control characters to tell the computer to print applesoft commands, writes Malcolm Whapshott of Farnham, Surrey. There are 21 different control characters which can be used, including Ctrl-I and Ctrl-D but excluding Ctrl-C, H, M, U, and Ctrl-X as they are used by the operating system and basic.

Keyword was written using the assembler included in the DOS toolkit to load using the re-locating loader, which is why the listing starts at $0800 instead of higher in memory. The program works by intercepting the characters as they are typed from the keyboard, then checking them to see if they are control characters.

If they are not control characters, they are sent to the input-routine DOS is using at the time. This does not have to be the monitor routine, but it can be another single-key input routine, if it was loaded first. I intend to use Keyword with the DOS toolkit automatic line-numbering facility to simplify the entering of programs.

If Keyword becomes disconnected for any reason, it will re-connect itself by invoking the USR command — if you do not overwrite the jump at $OA. Re-set, in£x will disconnect Keyword which can be useful if, for instance, you wish to enter the monitor and use some of the facilities activated by control codes.

As the program was written to work with the maximum amount of memory — if it is intended to use it either on a smaller system, or without DOS — some changes are necessary. Monreg has to be changed — read page 105 of the DOS manual, for DOS or $38 for cassette-based systems. Cassette users should delete the "JSR DOS" code, $20, $EA, $03.

The format for the stored commands is that they are stored in their ASCII form with their most significant bit set high and the words are terminated by a space, $AO.

```
SOURCE FILE: KEY WORD
0000:            1 ********************
0000:            2 *                  *
0000:            3 *                  *
0000:            4 * KEY WORD         *
0000:            5 *       BY         *
0000:            6 *       MALCOLM    *
0000:            7 *       WHAPSHOTT  *
0000:            8 *                  *
0000:            9 *     (C) 1981     *
0000:           10 *                  *
0000:           11 ********************
0038:           12 KSWL     EQU  $38
0039:           13 KSWH     EQU  $39
03EA:           14 DOS      EQU  $3EA
0065:           15 ADRS     EQU  $65
0047:           16 YREG     EQU  $47
AA55:           17 MONREG   EQU  $AA55
FF3A:           18 BELL     EQU  $FF3A
000A:           19 USR      EQU  $0A
0000:           20          REL
----- NEXT OBJECT FILE NAME IS KEY
0800:           21          ORG  $800
0800:AD 55 AA   22 START    LDA  MONREG      ;INITIALISATION ROUTINE
0803:8D 8E 08   23          STA  REG+1       ;TAKE INPUT REGISTER
0806:AD 56 AA   24          LDA  MONREG+1    ;FROM DOS AND SAVE
0809:8D 8F 08   25          STA  REG+2       ;AT REG +1
080C:A9 24      26          LDA  £>START2    ;LOAD START OF
080E:85 38      27          STA  KSWL        ;ROUTINE INTO
0810:A9 08      28          LDA  £<START2    ;KEYBOARD INPUT SWITCH
0812:85 39      29          STA  KSWH        ;IN DOS
0814:20 EA 03   30          JSR  DOS
0817:A9 4C      31          LDA  £$4C        ;ALTER USR JUMP
0819:85 0A      32          STA  USR         ;TO START OF
081B:A9 00      33          LDA  £>START     ;INITIALISATION
081D:85 0B      34          STA  USR+1       ;ROUTINE
081F:A9 08      35          LDA  £<START
0821:85 0C      36          STA  USR+2
0823:60         37          RTS
0824:20 8D 08   38 START2   JSR  REG         ;READ KEYBOARD
0827:C9 A0      39          CMP  £$A0        ;IS IT A CONTROL CHARACTER?
0829:B0 61      40          BCS  CONT3       ;IF NOT, HANDLE IN NORMAL WAY
082B:84 47      41          STY  YREG        ;YES, SO SAVE Y
082D:A0 15      42          LDY  £$15
082F:88         43 CHRSRCH  DEY
0830:30 5A      44          BMI  CONT3       ;CHARACTER NOT IN LIST
0832:D9 91 08   45          CMP  CHRTBL,Y    ;IS IT A MATCH?
0835:D0 F8      46          BNE  CHRSRCH     ;NO
0837:E0 F0      47          CPX  £$F0        ;LINE BUFFER NEARLY FULL?
0839:B0 4A      48          BCS  CONT2       ;YES
083B:98         49          TYA
083C:0A         50          ASL  A           ;DOUBLE
083D:A8         51          TAY              ;Y REGISTER
083E:B9 A7 08   52          LDA  STRTADR,Y   ;LOAD STARTING
0841:85 65      53          STA  ADRS        ;ADDRESS INTO
0843:C8         54          INY              ;ZERO PAGE
0844:B9 A7 08   55          LDA  STRTADR,Y
0847:85 66      56          STA  ADRS+1
0849:A9 61      57          LDA  £>INPUT2    ;ALTER KEYBOARD
084B:85 38      58          STA  KSWL        ;INPUT SWITCH
084D:A9 08      59          LDA  £<INPUT2    ;POINT TO START
084F:85 39      60          STA  KSWH        ;OF INPUT ROUTINE
0851:20 EA 03   61          JSR  DOS
0854:A0 00      62          LDY  £$00        ;INITIALISE Y REGISTER
0856:B1 65      63          LDA  (ADRS),Y    ;GET 1ST CHARACTER
0858:48         64          PHA              ;SAVE ON STACK
0859:A4 47      65          LDY  YREG        ;RESTORE Y REGISTER
085B:A9 00      66          LDA  £$00        ;INITIALISE Y REGISTER
085D:85 47      67          STA  YREG        ;FOR "INPUT"
085F:68         68          PLA              ;LOAD 1ST LETTER OF WORD
0860:60         69          RTS              ;PRINT IT
0861:A5 47      70 INPUT2   LDA  YREG        ;SWAP Y REGISTER
0863:84 47      71          STY  YREG        ;WITH CONTENTS
0865:A8         72          TAY              ;OF YREG
0866:C8         73          INY
0867:B1 65      74          LDA  (ADRS),Y    ;READ IN NEXT LETTER
0869:C9 A0      75          CMP  £$A0        ;IS IT A SPACE?
086B:F0 08      76          BEQ  CORRECT     ;YES, SO END OF WORD
086D:48         77          PHA              ;SWAP Y REGISTER
086E:98         78          TYA              ;WITH YREG
086F:A4 47      79          LDY  YREG        ;AND PRINT
0871:85 47      80          STA  YREG        ;NEXT LETTER
0873:68         81          PLA
0874:60         82          RTS
0875:A9 24      83 CORRECT  LDA  £>START2    ;ALTER KEYBOARD INPUT
0877:85 38      84          STA  KSWL        ;SWITCH TO POINT TO
0879:A9 08      85          LDA  £<START2    ;START2
087B:85 39      86          STA  KSWH
087D:20 EA 03   87          JSR  DOS
0880:A4 47      88          LDY  YREG        ;AND RESTORE Y REGISTER
0882:A9 A0      89          LDA  £$A0        :PRINT SPACE FOR
0884:60         90          RTS              ;CLARITY
0885:20 3A FF   91 CONT2    JSR  BELL        ;SOUND SPEAKER
0888:A4 47      92          LDY  YREG
088A:A9 A0      93          LDA  £$A0        ;PRINT SPACE
088C:60         94 CONT3    RTS
088D:4C 90 08   95 REG      JMP  OFLOW       ;DUMMY ADDRESS
0890:EA         96 OFLOW    NOP
0891:81 82 84   97 CHRTBL   DFB  129,130,132,133,134,135,137 ;CONTROL CHARACTERS
0894:85 86 87
0897:89
0898:8A 8B 8C   98          DFB  138,139,140,142,143 ;ALLOWED
089B:8E 8F
089D:90 91 92   99          DFB  144,145,146,147,148,150
08A0:93 94 96
08A3:97 99 9A  100          DFB  151,153,154,155
08A6:9B
08A7:F3 08     101 STRTADR  DW   READ        ;STARTING ADDRESSES

08A9:43 09     102          DW   MID$        ;OF THE WORDS
08AB:D7 08     103          DW   CATALOG
08AD:E4 08     104          DW   STEP
08AF:31 09     105          DW   GOTO
08B1:14 09     106          DW   GOSUB
08B3:D1 08     107          DW   INPUT
08B5:DF 08     108          DW   THEN
08B7:E9 08     109          DW   NEXT
08B9:21 09     110          DW   LIST
08BB:3C 09     111          DW   RIGHT$
08BD:2C 09     112          DW   POKE
08BF:26 09     113          DW   PEEK(
08C1:FD 08     114          DW   HOME
08C3:10 09     115          DW   RUN
08C5:EE 08     116          DW   DATA
08C7:02 09     117          DW   TRACE
08C9:36 09     118          DW   LEFT$
08CB:F8 08     119          DW   TEXT
08CD:08 09     120          DW   NOTRACE
08CF:1A 09     121          DW   RETURN
08D1:C9 CE D0  122 INPUT    ASC  $INPUT      $ ;THE WORDS
08D4:D5 D4 A0
08D7:C3 C1 D4  123 CATALOG  ASC  $CATALOG    $
08DA:C1 CC CF
08DD:C7 A0
08DF:D4 C8 C5  124 THEN     ASC  $THEN       $
08E2:CE A0
08E4:D3 D4 C5  125 STEP     ASC  $STEP       $
08E7:D0 A0
08E9:CE C5 D8  126 NEXT     ASC  $NEXT       $
08EC:D4 A0
08EE:C4 C1 D4  127 DATA     ASC  $DATA       $
08F1:C1 A0
08F3:D2 C5 C1  128 READ     ASC  $READ       $
08F6:C4 A0
08F8:D4 C5 D8  129 TEXT     ASC  $TEXT       $
08FB:D4 A0
08FD:C8 CF CD  130 HOME     ASC  $HOME       $
0900:C5 A0
0902:D4 D2 C1  131 TRACE    ASC  $TRACE      $
0905:C3 C5 A0
0908:CE CF D4  132 NOTRACE  ASC  $NOTRACE    $
090B:D2 C1 C3
090E:C5 A0
0910:D2 D5 CE  133 RUN      ASC  $RUN        $
0913:A0
0914:C7 CF D3  134 GOSUB    ASC  $GOSUB      $
0917:D5 C2 A0
091A:D2 C5 D4  135 RETURN   ASC  $RETURN     $
091D:D5 D2 CE
0920:A0
0921:CC C9 D3  136 LIST     ASC  $LIST       $
0924:D4 A0
0926:D0 C5 C5  137 PEEK(    ASC  $PEEK(      $


0929:CB A8 A0
092C:D0 CF CB  138 POKE     ASC  $POKE       $
092F:C5 A0
0931:C7 CF D4  139 GOTO     ASC  $GOTO       $
0934:CF A0
0936:CC C5 C6  140 LEFT$    ASC  $LEFT$      $
0939:D4 A4 A0
093C:D2 C9 C7  141 RIGHT$   ASC  $RIGHT$     $
093F:C8 D4 A4
0942:A0
0943:CD C9 C4  142 MID$     ASC  $MID$       $
0946:A4 A0

*** SUCCESSFUL ASSEMBLY: NO ERRORS

  65 ADRS       FF3A BELL       08D7 CATALOG    082F CHRSRCH
0891 CHRTBL     0885 CONT2      088C CONT3      0875 CORRECT
08EE DATA       03EA DOS        0914 GOSUB      0931 GOTO
08FD HOME       0861 INPUT2     08D1 INPUT        39 KSWH
  38 KSWL       0936 LEFT       0921 LIST       0943 MID
AA55 MONREG     08E9 NEXT       0908 NOTRACE    0890 OFLOW
0926 PEEK       092C POKE       08F3 READ       088D REG
091A RETURN     093C RIGHT      0910 RUN        0824 START2
0800 START      08E4 STEP       08A7 STRTADR    08F8 TEXT
08DF THEN       0902 TRACE        0A USR          47 YREG

  0A USR          38 KSWL         39 KSWH         47 YREG
  65 ADRS       03EA DOS        0800 START      0824 START2
082F CHRSRCH    0861 INPUT2     0875 CORRECT    0885 CONT2
088C CONT3      088D REG        0890 OFLOW      0891 CHRTBL
08A7 STRTADR    08D1 INPUT      08D7 CATALOG    08DF THEN
08E4 STEP       08E9 NEXT       08EE DATA       08F3 READ
08F8 TEXT       08FD HOME       0902 TRACE      0908 NOTRACE
0910 RUN        0914 GOSUB      091A RETURN     0921 LIST
0926 PEEK       092C POKE       0931 GOTO       0936 LEFT
093C RIGHT      0943 MID        AA55 MONREG     FF3A BELL
```

Clear display

HERE ARE two short machine-code subroutines which I use a good deal, and may be of some use to fellow new-Rom Pet users, writes Stewart Sargaison of Berkhampsted, Hertfordshire.

The first is an eight-byte routine which clears the display:

```
PHA        48        ; store accumulator on
                       stack
LDA#147    A9 93     ; load accumulator with
                       147
JSR        20 D2 FF  ; jump to Basic
PLA        68        ; recall accumulator
RTS        60        ; return
```

The second routine is a very random, pseudo random-number generator. It calls the Basic RND function. The routine produces numbers from 0 to 255, they are stored at locations 136, 137, 138, 139, 140. As they are zero-page locations, the code to call one up takes two bytes not three:

```
PHA        48        ; save contents of all
                       registers
TXA        8A        ;
PHA        48        ; on the stack as
TYA        98        ; the Basic will use all
                       all
PHA        48        ; of them
JSR 57215  20 7F DF  ; call Basic RND
PLA        68        ; restore all registers
TAY        A8        ;
PLA        68        ;
TAX        AA        ;
PLA        68        ;
RTS        60        ; return.
```

Going for broke

COMPANY simulates the competition between up to 10 companies selling a product differentiated by brand advertising, writes Nicholas Lloyd of Rottingdean, Sussex. You start the game with £15,000 and must try to make £100,000. The game ends when a player achieves this goal or goes bankrupt.

You start with an inventory of 100 units on which you must pay £5 warehouse costs per 100 units per quarter, and will increase if you misjudge production, advertising, and the price per unit. At the beginning of the game, you are asked to input your initial labour-force and plant size after which you may only change your labour-force by 10 men a quarter and your plant size by two.

Each man costs £10 to employ per quarter and can make up to 20 units, but when the initial values are set, this is not payable. Each factory unit costs £1,800 to buy during the initial period and then changes to £2,000 and may produce up to 100 units per quarter. Raw materials needed to make each unit cost £10.

This program was written for the Pet, but should be easy to convert for other machines. Notes for conversion:

- POKE 59468, 14 changes the display to small print, and POKE 59468, 12 changes it back to capitals. Words containing graphics characters have had those letters shifted to produce capitals while the display is still in lowercase.
- A reversed heart as in line 10 means clear screen.
- A reversed R, as in line 10 means reverse field on, and the following reversed horizontal line means reverse field off.
- A reversed Q means cursor down, a reversed vertical line means cursor left, and a reversed close bracket, as in line 990, means cursor right.

```
10 POKE59468,14:PRINT"▮         ▮ ─ ┌ \ ┐ ♠ ╱ │ ▮"
210 PRINT"▮▮LABOUR COSTS $10 PER MAN.":PRINT"▮▮AW MATERIALS COST $10 PER UNIT."
230 PRINT"▮⌐ACH PLANT UNIT COSTS $2000 ($1800)▮▮▮▮▮▮AT START."
235 PRINT"▮$10/ROUND FIXED COST/PLANT UNIT.":PRINT"▮▮▮"SPC(10)"▮⌐─¯●● ♠ ╱¯ │"
250 GETY$:IFY$=""THEN250
440 POKE59468,12:F=10:G=10:O=0:Y=0:PRINT"▮HOW MANY COMPANIES ARE THERE"
460 INPUTN:FORA=1TO500:NEXTA:PRINT"▮":IFN>10ORN<0ORN<>INT(N)THEN460
480 FORL=1TON:K(L)=15000:V(L)=100:M(L)=0:NEXTL:FORL=1TON:PRINT"▮▮COMPANY "L
482 PRINT"──────────────":PRINT"▮INITIAL WORKFORCE":INPUTJ(L):IFJ(L)<0THENJ(L)=0
484 PRINT"▮INITIAL PLANT SIZE":INPUTM(L):IFM(L)<0THENM(L)=0
486 IFM(L)>8THENPRINT"YOU HAVE NOT GOT THAT MUCH MONEY!!":GOTO484
487 K(L)=K(L)-(M(L)*1800):FORA=1TO800:NEXTA:NEXTL
488 FORA=1TO800:NEXTA:FORL=1TON:GOSUB920:PRINT"▮COMPANY "L:PRINT"──────────────"
500 PRINT"▮PRODUCTION LEVEL":INPUTA(L):IFA(L)<=0THENA(L)=1
540 PRINT"▮ADVERTISING BUDGET":INPUTB(L)
575 PRINT"▮PRICE/UNIT":INPUTC(L):IFC(L)>100THENPRINT"▮PRICE TOO GREAT":GOTO575
577 IFC(L)<0THENPRINT"▮PRICE TOO LOW":GOTO575
580 PRINT"▮CHANGE IN WORK FORCE":INPUTD(L)
597 IFABS(D(L))>10THENPRINT"▮HANGE TOO GREAT":GOTO580
600 D(L)=INT(D(L)):J(L)=J(L)+D(L)
610 PRINT"▮CHANGE IN PLANT SIZE":INPUTE(L)
623 IFABS(E(L))>2THENPRINT"▮CHANGE TOO GREAT":GOTO610
625 IFM(L)+E(L)>15THENPRINT"▮PLANT SIZE TOO LARGE":GOTO610
627 IFM(L)+E(L)=0THENM(L)=0ANDE(L)=0
630 M(L)=M(L)+E(L):X(L)=M(L)*100:IFX(L)>=A(L)THEN650
645 PRINT"▮▮▮PRODUCTION EXCEEDS PLANT CAPABILITY":FORA=1TO1000:NEXTA:GOTO500
650 O(L)=J(L)*20:IFO(L)>=A(L)THEN670
655 PRINT"▮▮▮PRODUCTION EXCEEDS WORKERS CAPABILITY":FORA=1TO1000:NEXTA:GOTO500
670 S(L)=INT((B(L)/(C(L)*M(L)+N))+((100-C(L))*(B(L)/(A(L)+V(L)))))
672 V(L)=V(L)+A(L):IFS(L)>V(L)THENS(L)=V(L)
673 FORP=1TON:T(P)=0:FORZ=1TON:T(P)=T(P)+V(Z):NEXTZ:Q(P)=(V(P)/T(P))*100:NEXTP
674 V(L)=V(L)-S(L)
675 P(L)=S(L)*C(L)*1.5-((2000*E(L))+(J(L)*G)+(A(L)*F)+(10*M(L))+(V(L)/100*5))
680 FORQ=1TO1000:NEXTQ:PRINT"▮":NEXTL:O=O+1:PRINT"▮▮UARTER "O:FORA=1TO1000:NEXT
760 FORL=1TON:K(L)=K(L)+P(L):IFV(L)<0THENV(L)=0
790 GOSUB920:IFK(L)>100000THENPRINT"▮▮▮COMPANY "L" HAS WON"Y=1
800 IFK(L)<-1000THENPRINT"▮▮▮COMPANY "L" HAS GONE BANKRUPT":Y=5
840 NEXTL:R=INT(RND(3)*15):IFR=7THENG=G+1:PRINT"▮▮▮NEW COST OF LABOUR-"G
850 IFR=9THENG=G-1:PRINT"▮▮▮NEW COST OF LABOUR:"G
860 IFR=11THENF=F+1:PRINT"▮▮▮RAW MATERIALS NOW COST:"F
870 IFY<>0THENEND
880 GOTO488
920 Q(L)=(INT(Q(L)*100))/100:PRINT"▮COMPANY "L:PRINT"──────────────"
930 PRINT"▮ MARKET SHARE "Q(L):PRINT"▮ NUMBER SOLD  "S(L)
950 PRINT"▮ PROFIT       "P(L):PRINT"▮ INVENTORY    "V(L)
970 PRINT"▮ PLANT SIZE   "M(L):PRINT"▮ WORKFORCE    "J(L)
990 PRINT"▮ TOTAL ASSETS "K(L):PRINT"▮▮▮▮▮▮▮▮▮PRESS A KEY▮"
1010 GETU$:IFU$=""THEN1010
1020 RETURN
```

Restore disc

THE PET disc units 2040/3040 with original DOSs use track 18 as the directory track, writes M J Valentine of Rotherham, South Yorkshire. Since the track contains all the data necessary to locate program and sequential files, if a directory error occurs, all the data may be lost.

In practice, such problems occur as a result of power-down or disc errors. If a file has not been correctly closed, an error usually results. On detailed examination of such crashed discs, I found the directory entries intact — the only corruption was of the link data to the next sector.

On manual adjustment of the link data, I could restore the directory. This program does just that. The link data is the first two bytes of each block pointing to the next track and sector to be read. The program reads the appropriate block into disc memory. It then modifies the block in memory with the "m-w" command, and rewrites the block, with the links in place as the DOS would. This is usually enough to restore the directory. If a disc verify is functioned, a usable disc results.

In practice, this has worked for an unlistable directory, and produced a disc that will function. Usually, several entries have been lost. These could be copied from a back-up using DUM as supplied by Commodore.

```
10 REM RESTORE DISK FOR PET 2040/3040(ORIGINAL DOS)
100 INPUT"DRIVE";D$:OPEN15,8,15,"I"+D$
110 GOTO150
120 INPUT#15,EN$,EM$,ET$,ES$
130 PRINTD;T;S" = "EN$","EM$","ET$","ES$:RETURN
140 GOSUB120:CLOSE15:CLOSE2:RUN
150 D=VAL(D$):T=18:READS:
160 READNS:CH=12:IFNS=0THENPRINT#15,"V"D$:GOSUB120:END
170 OPEN12,8,12,"#":GOSUB120
180 PRINT#15,"U1";CH;D;T;S:GOSUB120
190 PRINT#15,"M-W"CHR$(0)CHR$(65)CHR$(1)CHR$(T)
200 PRINT#15,"M-W"CHR$(1)CHR$(65)CHR$(1)CHR$(NS)
210 PRINT#15,"U2";CH;D;T;S:GOSUB120
220 CLOSE12:S=NS:GOTO160
230 DATA1,4,7,10,13,16,19,2,5,8,11,14,17,3,6,9,12,15,18,0
```

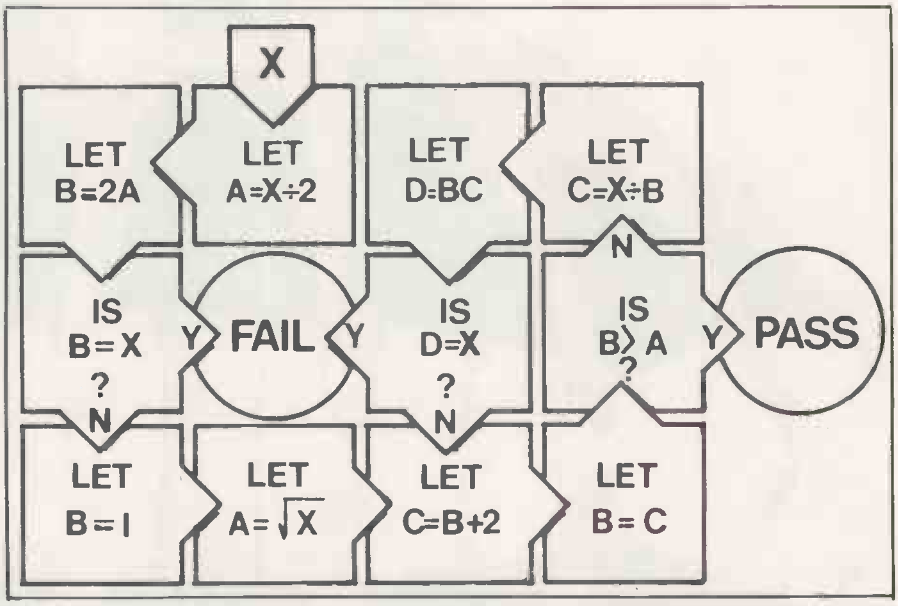
The mystery of the cave painting

THIS diagram is one of a series discovered in a cave, South of Earlestown. It clearly proves that Post-Glacial Lancashire man had a rudimentary grasp of computer-type logic.

Indeed, the Earlestown Research Colony has proved that the lack of a satisfactory power supply was the only reason why the flint-chip circuitry — also found in the cave — had not been removed from its cartons. Naturally, the computers of the day supported integer arithmetic only — they were not capable of handling fractions. For example, the statement in one of the logic "boxes", that A=X÷2, makes A=3 — not 3½ — if X is equal to 7.

The great puzzle is, however, to discover what is done by this piece of logic. Can you assist? Answers to *Practical Computing* puzzle, Room L310, Quadrant House, The Quadrant, Sutton, Surrey SM25AS.

We shall reveal the correct solution next month.



Mouse sensors

CLOSE examination of the faces of proud mouse builders as their mouse makes its first trip round a maze tells you a good deal about how well their mouse is doing. Unless — or should I say until — a mouse becomes physically stuck, it is virtually impossible for a spectator to tell whether it is doing what is expected of it. The owner, however, is almost certainly doing a mental emulation of his mouse and comparing it to the real thing.

When attitudes of careless indifference or nervous excitement start disintegrating, you can be fairly sure the owner has gone into an error-detection mode which normally ends in a system dump.

Of course, the difference between the mental mouse and the real thing is that the mental mouse has bug-free software and three-dimensional vision. Discounting programming errors you are left with the difference between what the owner and the mouse see. That is, the performance of the sensors.

Unless you have constructed a mouse you may not appreciate just how difficult it is to design a set of sensors which produce sufficient information for its brain. I must admit that when I started thinking about sensors, I thought I was at a disadvantage because I did not know much about electronics, infra-red or ultrasonics. It is a sobering fact, however, that nobody has yet demonstrated any entirely satisfactory electronic sensors.

Energy saving

Unless you are a real electronics expert, mechanical sensors are best — and even some of the electronics experts think so, too. All my sensors are mechanical. If nothing else, you can always see and/or hear what the sensors are doing. Another point worth considering is the fact that mechanical sensors do not consume any current.

All the front sensor needs to do is inform the CPU of a wall in front in sufficient time for the mouse to stop, preferably in the middle of the current square.

I use a micro switch with a floppy arm sticking forward at an upward angle of about 45°. The switch closes 1in. away from the wall allowing .5in to stop the mouse. The floppiness and the upward angle of the arm ensures it rides over the tops of walls when turning round. If you are not careful, mechanical sensors can be in the way when the mouse is manoeuvring.

Side sensors have a great deal more to do. The most obvious requirement is to give the mouse sufficient information for it to steer in a straight line. Less obvious is the need to detect side openings accurately for the mouse to turn. In the same way as the front sensor, the side sensor needs to detect an opening allowing the mouse sufficient time to stop.

On the French mouse Kim, this limits its speed. At its original top speed, by the time Kim had detected a side opening, decided to turn and then stopped, it had gone past the opening.

It is worth remembering that the narrower your mouse, the less critical the quality of your side sensors. My mouse has a clearance on both sides of .5in. This is not really enough. Do not forget that if you try to control your mouse within some tolerance — like + .125in. as I do — excursions outside this band take time and distance to correct, thus eating into your safety margin.

To highlight design problems, I would like to give a brief history of my own attempts at designing sensors. I do not claim any technical knowledge to consolidate my results and conclusions — only that they worked for me.

by Nick Smith

Having built my chassis, I attached a micro-switch to the side with adhesive tape and aimed it at a wall at a narrow angle. The idea was that when the micro-switch closed, the opposite wheel would slow down and the mouse would turn away from the wall. Much to my delight it worked.

After two ecstatic hours bouncing my mouse backwards and forwards, the implications of the fact that the mouse was bouncing off the wall at a greater angle when it hit it sank in. This is shown in figure 1. So the first rule is — you must bounce off a wall at a narrower angle than you hit it.

I decided the solution was greater sensitivity. Figure 2 shows that sensitivity can be increased by moving your sensors forward. This is simply because a sensor at Point A moves further sideways than a sensor at Point B for a given change in direction of the mouse. By attaching the micro-switch with adhesive tape to a ruler and the ruler to the mouse, I convinced myself of the second rule: The further forward your sensors the better. Unfortunately, my sensor was now so far forward that my mouse would never negotiate corners, let alone turn round in a dead-end. Further thought and observation unearthed a major cause of the problems.

The micro-switch I was using had a good deal of hysteresis. Hysteresis means the switch turns on at one position and off at another. In terms of my mouse, the switch turned on when the mouse was .5in. from the wall but did not turn off again until the mouse was 1in. away — thus magnifying any error.

If you do not understand, listen to a micro-switch turning on and off as you move the actuator. Rule number 3: Beware of hysteresis. The solution was touch contacts made out of paperclips. It is worth remembering that paperclips are springy, can be bent to shape and can be soldered.

Paperclip sensors worked perfectly in straight passages but had a nasty tendency to jam on corners and in deadends. Back at the drawing board, I reluctantly arrived at rule number 4: You cannot design springy bits of metal which protrude from the sides of your mouse which will never jam.

This testing did, however, teach me the third law of dynamics, which I forgot to include with the first two — May 1981 issue: Any mouse that moves by bouncing off side walls, necessarily becomes stuck at side turnings — this is shown in figure 3. I am amazed by the number of people caught by this.

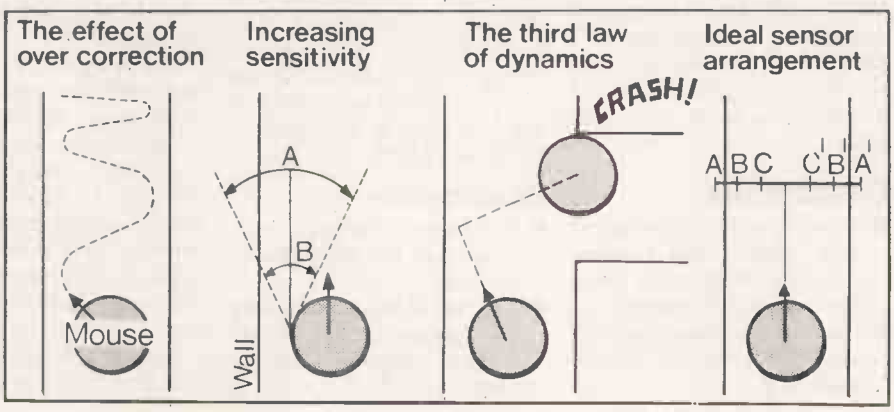
Once you realise that being too close to one wall is equivalent to being too far away from the wall on the other side you come up with rule 5: Your mouse needs two sensors each side, one to tell it that it is too close and one to tell it that it is too far away from either or both side walls.

Final feature

That covers steering requirements but there is still one essential feature missing. You also need a sensor to detect the presence, or otherwise of a wall. This sensor must be able to detect a wall over the maximum possible deviation of the mouse so that it can answer this question: Am I too far away from a wall because it isn't there?

The side-wall detector also pinpoints side openings and should be used to set the mouse up for left and right turns. My final ideal side sensor arrangement is shown in Figure 4. Points A and A1 are long distance wall detectors. Points B and B1 are "too far away" detectors and points C and C1 "too close" detectors.

Figure 1. Figure 2. Figure 3. Figure 4.



TRS-80 interfacing, book 2

By Jonathon A Titus et al. Published by Sams/Prentice-Hall, 254 pages, paper. Price £7.10. ISBN 0-672-21739-2.

I HAVE not had the pleasure of dealing with the first *TRS-80 interfacing book* — pleasure, because book 2 is readable, down-to-earth and useful.

Tandy TRS-80/Video Genie micros are popular in the U.K.; they are well-established, well-supported and are easy to use. This book is sure to be welcomed by owners who want to look outside pure programming to link their computer with the real world. The possibilities of replacing your heating control with a computer, or — more seriously — winning the micromouse handicap, are entrancing, and are gaining a big following.

Not all the book is practical in the sense of telling you how to interface the heating or beat the other micromice, but a field like this needs a good examination of the theoretical background. However, perhaps half of the book is relevant to the workshop, and any user will be able to find here plenty of ideas — however unambitious or ambitious he may be.

Logical order

After the introductory chapter, we deal logically with analogue-to-digital conversion, data capture and sampling and data analysis. A good selection of circuits and programs is provided. The same applies to the lengthy chapter on serial communications, USART and UART chips, and remote control.

Finally, there is a very necessary — and still readable — chapter on TRS-80 interrupts. This is a good book for those with the background necessary to tackle the material. If you are not sure whether you fit the bill, borrow a copy first from your user group.

Conclusions

- **A very useful coverage of data capture and external control techniques for TRS-80/Video Genie owners.**
- **Users of other machines will also find plenty of helpful leads in it.**

Son of cheap video

By Don Lancaster. Published by Sams/Prentice-Hall, 223 pages, paper. Price £5.80. ISBN 0-672-21723-6.

IF THE title of this book means anything to you, you certainly will not have to comply with the unambiguous instruction in its preface: "If you're not one of us, go away". Perhaps a welcome like that makes the hardware novice even more keen to join the club.

The Cheap Video Cookbook became a cult publication in the States, though did not seem to make much impact in Britain. It aimed at helping owners of micros like the Kim to achieve up-market output with minimal expenditure. Money, that is — the time required for such projects can be afforded only by the really dedicated.

Scungy video

Son of cheap video is "scungy video". Scungy video costs, says Lancaster, $7. in chips and things, and — I guess — a few person-weeks of effort. Scungy gives complete video display for a good range of micro-micros with less electronics, memory, and money than cheap video.

I am not a hardware addict, but I read the book avidly and learned a good deal. The "snuffler", for instance — it brilliantly picks up the TV set's fly-back pulses and uses them to synchronise the video output lines. Cost? — $1.

Kim is a 6502 micro, but owners of 8080 and Z-80 gear are catered for as well. The do-it-yourself character-generator information can help them, too. There are two chapters on cheap video for the 8080, embodied in the Heathkit H8. Finally, lower-case for the Apple II, initiating you into text-editing and your own computerised mailings. A lovely book — but why should it cost so much more here in the U.K. than in the States — £5.80 and $8.95.

Conclusions

- **Hardware hackers will drool over this collection of projects.**
- **The rest of us should ignore the "go away" in the preface — there is much to learn.**

Computer programming in Basic

By L R Carter and E Huzan, published by Hodder and Stoughton (U.K.) and David McKay in the U.S. U.K. price £1.75. 164 pages paperback. ISBN 0-340-24882-3.

THE LATEST of a spate of Basic programming books to appear in the last few years. It is also the latest title in the highly-regarded *Teach Yourself* series.

Teach Yourself books are not market leaders, except, perhaps, in the field of language. There are few on computing to date — and this title is a timid and unexciting coverage which is certainly not going to rocket to the top in the field.

TY Basic owes much to mainframe work of the 1970s and just about nothing to 1980s' micros. It could have been helpful to Open University PM951 students who could not get to grips with their excellent manuals — but that course closes this year. Certainly, I cannot see this book being of value to readers of this magazine, whether experienced programmers wanting to learn about Basic, or school students given a ZX-81 for their birthday.

Conclusions

- **Give this book to your rival as a present.**
- **Otherwise give it a miss.**

Eric Deeson

Karel the robot

By Richard Pattis. £3.55. ISBN 0-471-08928-1. 103 pages paperback.

THE TITLE of this book suggests science fiction, *Karel the Robot* – perhaps the title of a fifties' B-movie? It is frightening to realise that much of the technology we have to hand today was beyond the imagination of the fifties' science-fiction writers.

The mention of science fiction when reviewing a serious work is not flippancy though — the book is designed to capture the imagination of students. Through the experience of controlling the motions of a robot, the concepts of programming can be learnt in a way that is interesting.

Subtitled *A gentle introduction to the art of programming,* the book prepares the ground so that the student learns sound programming principles. Sound programming principles, as everyone by now will have realised, means Pascal. Often treated as a dirty word, Pascal is a computer language much favoured by educationalists.

Because of the increasing importance of Pascal in schools and colleges all over the world, this book will find its way on to library shelves everywhere. As a reference work, *Karel the robot,* will no doubt be a popular work with students.

Conclusions

- **This book is an ideal introduction for anyone considering learning Pascal — or Comal, later.**
- **As a reference work, the book is interesting and useful.**
- **A must for the educational library.**

How to debug you personal computer

By Bruce and Huffman. £5.50 Prentice Hall International, ISBN 0-8359-2924-8. 154 pages paperback.

WHAT MAKES this book so poor is not just that it plumbs the depths of poor typesetting, nor is it the sloppy planning and lay-out — even the lack-lustre example programs are not enough to condemn this book out of hand. All these points though should be borne in mind, together with the rather odd idea of deliberately publishing programs which do not work.

The idea is that as you read the book you learn how to debug non-working programs. This might work if the debugging tips were not confined to the down-right obvious. One chapter is devoted to telling the reader to use flowcharts, as a programming aid. The entire chapter could be written in one sentence: If your program does not work, try using a flowchart. In fact the whole book could be condensed into two pages without any loss of clarity.

Conclusions

- **This book is the nadir — by far the worst book I have ever seen.**

Bill Bennett

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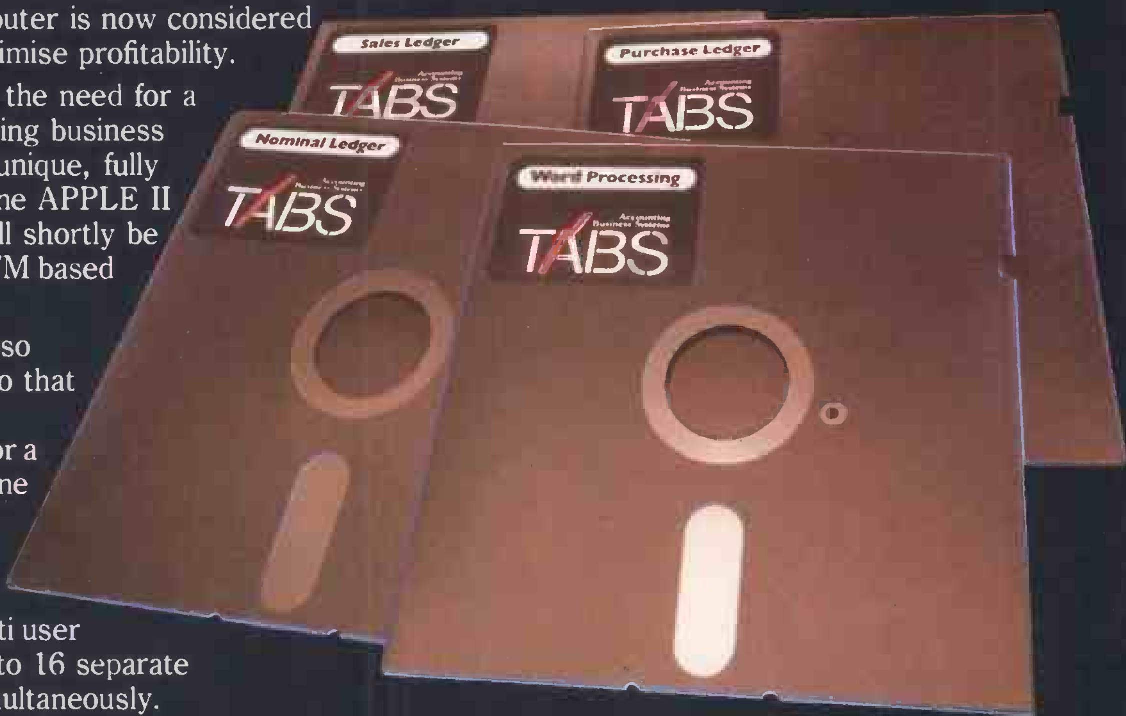

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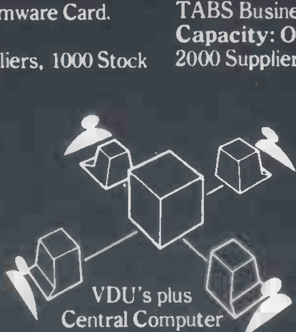

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Specially written to link CP/M on the Morrow M10, M20 and M26 hard disk drives to quad capacity mini-floppy disk drives in the North Star Horizon computer. With **STARLINK** file transfer is simply accomplished using the standard CP/M "PIP" utility. **STARLINK** is available as a single or multi-user system. The multi-user version supports upto seven users each with upto 56K memory. **STARLINK** also supports tape cartridge backup for the Morrow hard disks.

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 **KOS–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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Complicated plot, simple story

There are now many inexpensive micros on the market which can, given the right software, plot graphs effectively. Peter Hodkin shows how to tap the Pet's impressive graph-plotting potential and, with the help of two useful example programs, how to cope with the problems.

WHENEVER one has two dependent quantities, such as the diameter and circumference of a circle, where any change in one means a change in the other, it is often useful to produce a visible display, a graph, say, of the relationship between the two quantities. A graph demonstrates how as one changes, so does the other.

However, before one can plot a graph, one must first have calculated for all the different sizes of the one quantity, the corresponding sizes of the other quantity. One may do this either by laboriously taking various measurements, or more simply by finding the mathematical relationship between the two quantities. With the diameter and circumference of the circle the relationship is simple:

circumference = diameter x π

Thus we can easily feed in various values for the diameter and calculate the corresponding sizes of the circumference. Once we have this information, we can plot the graph.

We say that the circumference is a function of the diameter. To indicate in a general way that one quantity "y" is a function of another "x" we use the notation $y=f(x)$.

When we have our function

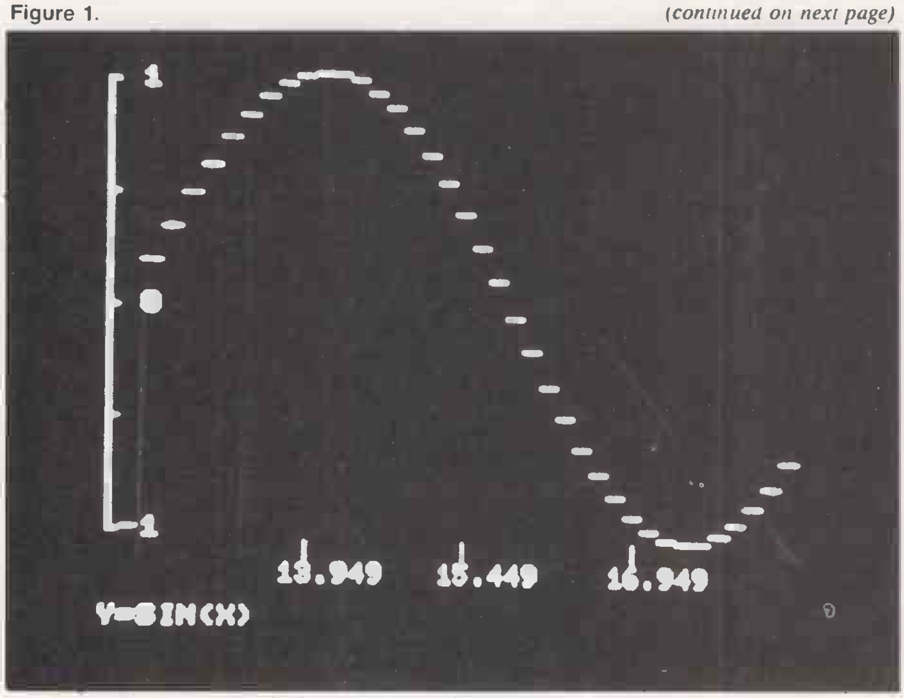
$y=\pi tx$, $y=\sin x$ $y=x+2$ etc.,

we can easily plot the graph of it by feeding in values of "x" and finding the corresponding values of "y". However, to have an accurate graph, one must plot many points, and this can be highly tiresome and time-consuming. A computer should be able to perform the task far more effectively, and with a minimum of trouble to its operator.

However, when one tries to design a program for the Pet to do this, one is immediately faced with three main problems which would seem to prevent us

(continued on next page)

Figure 1.



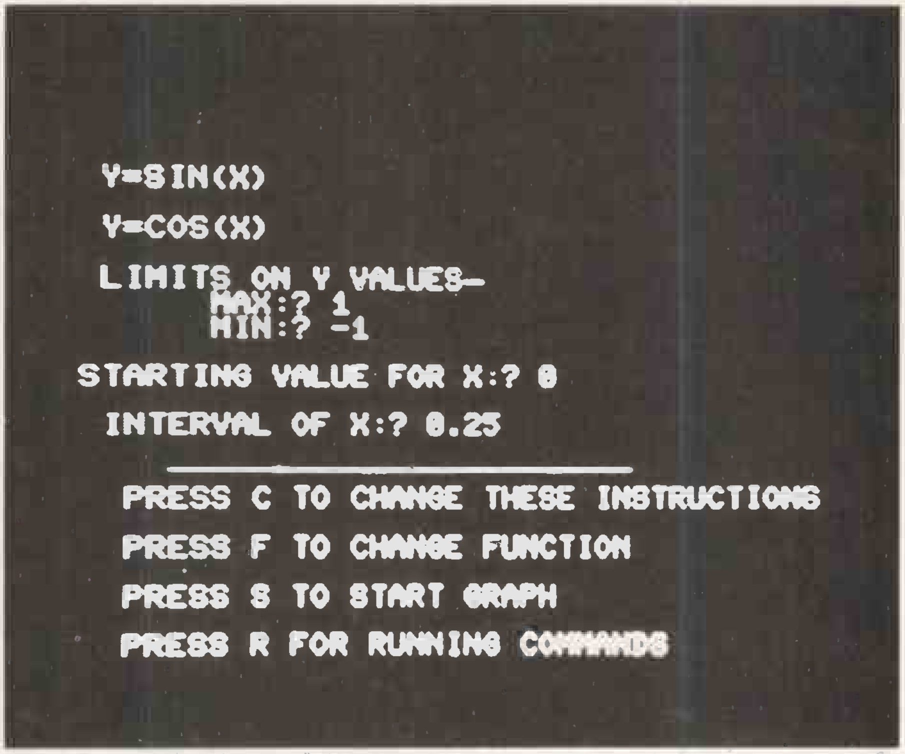


Figure 2.

(continued from previous page)

from plotting a detailed graph from which we can obtain accurate information.

First, the small Pet screen would seem to limit us to very small graphs. Secondly, the limitations of the Pet graphics would seem to mean extremely poor definition. Thirdly, as a result of these two, the graph one produces would seem to be good for only simple demonstrations as it would be only a small, rough outline of a curve.

Indeed, various graph-plotting programs already on the market are good only for simple demonstrations for these very reasons. In Graph-plotter — program 1 — these three problems have been solved, and one can obtain accurate information from it.

Before we look at how these problems were solved, we shall briefly consider another problem. That is the problem of entering one's function. The only way to do this effectively is to enter the function into the program. In some programs, this has meant writing a whole line, with a line number, then perhaps DEF FNA(X)=, and then one's function.

After that, of course, one would have to return it and run. This is very clumsy and laborious, and in Graph-plotter, the function is entered on an input, the program lines are written automatically and returned by the computer. If you look at lines 25-30, you will see how this is done.

The keyboard input buffer is "loaded" with four Returns and the computer is told they are there. When a program ends, the computer immediately empties the contents of this buffer on to the screen, thus in this case returning the lines which have just been printed, and running again. Hence, the user can enter his function with the minimum possible trouble.

Now then let us look at how to solve these three major problems. First, we have to tackle the problems of the graph being limited to the screen size. In Graph-plotter, this was solved by making the graph continuous — that is, having the curve move, under the user's control, from right to left across the screen.

As you can see from figure 1, "x" and "y" values are marked on the screen, the "x" values must thus be incremented accordingly as the curve moves. This was a relatively simple problem to solve; more difficult was how to make the curve, generated at the right-hand side of the screen, move across, and be cancelled on the left-hand side of the screen.

One way of doing this would be to Poke the curve across — that is, Poking each part of the curve in at one place to its left, and Poking a blank in its old position. This, however, proved to be too slow and awkward a method, and a far better way was one which literally pulled the line across.

I found that by printing Delete (CHR$(20)) at the start of each line, the curve moves smoothly from right to left. Thus all one has to do is to Poke in the correct part of the curve on the right of the screen, pull the screen one place to the left, and Poke in the next. In lines 600-640,Z(1) is the location in the far-right column in which the character R(1) is placed; C, G and D are the "y" values marked on the screen.

The "x" axis can now be of whatever length, and to whatever scale the user wants. All he must do is to specify a starting value for "x", and the amount by which it is incremented each time — see figure 2.

The "y" axis is, however, still limited to the height of the screen. As you can see from figure 2, the user specifies which part of the "y" axis he requires by setting the maximum and minimum limits for it. Thus he also sets the scale for the "y" axis.

This brings us to the problem of which characters to use to make the curve. The important factor is to be able to show as many different positions up the "y" axis as possible. One already has an indefinite number of positions along the "x" axis, and one can make the interval between those "x" values plotted as small as one likes.

Given Pet graphics, the characters which will allow the finest definition are the horizontal lines which are in eight positions. With these, one can divide whatever part of the "y" axis you choose into 168 distinct parts on the screen. Graph-plotter then plots graphs with very fine definition, and one can obtain accurate information from it.

A number of additional features have also been added to increase the programs effectiveness and usefulness. While the graph is being generated on the screen, the user has a number of one-key running commands at his disposal, with these he is able to:

- Freeze or re-start the graph
- Change the section of "y" axis or the amount by which "x" is incremented
- Change the function itself
- Specify a particular "x" value and obtain the exact "y" value and the gradient at that point.

Those with printers might also wish to add another running command. By adding the following lines one can obtain an instant printout of the screen. When you have the graph you require on the screen, press@.

```
5000 OPEN 4,4
5010 FOR Y=0 to 24; FOR XX=0 to 39:
Q=PEEK (32768+40*Y+XX)
5020 IF Q>63 THEN Q=Q+128
5030 IF Q<32 THEN Q=Q+64
5040 PRINT #4, CHR$ (Q); "(RVS OFF)";
NEXT XX
:PRINT #4: NEXT Y: CLOSE 4: RETURN
715 IF B$="@" THEN GOSUB 5000
```

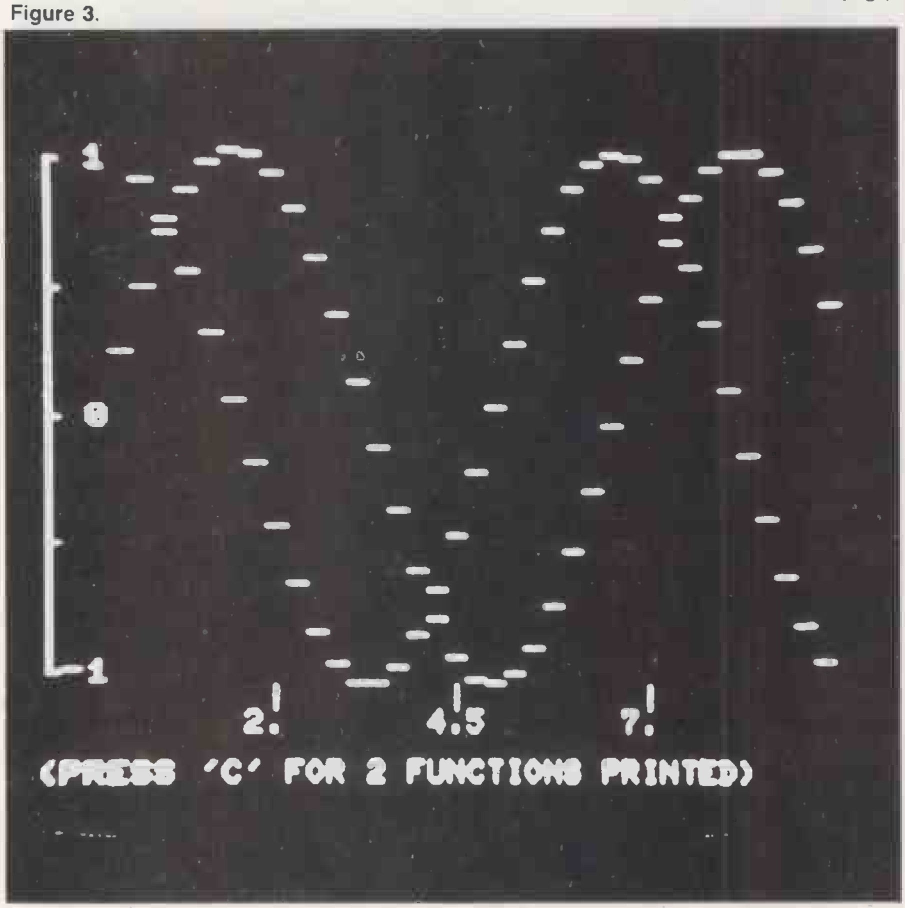
In addition, Graph-plotter has one other extremely useful feature: it can, if the user requires, plot two graphs at once — see figure 3. Graph-plotter can handle virtually any function in the form $y=f(x)$ one might have. Remember that the Pet manual includes a number of equations for more unusual expressions such as inverse sine.

The second program, Parametrics, deals with parametric functions in the form $x=f(t)$ and $y=g(t)$, where "t" is a third quantity and f and g indicate different functions on "t". This third quantity, "t", is called a parameter — hence parametric functions.

Imagine a circle drawn on an "x" and a "y" axis, with the centre of the circle at the point where the axes cross. The radius of the circle we shall say, for simplicity's sake, is equal to one unit. Imagine how a point moving around that circle at a constant speed moves with respect to the two axes.

(continued on next page)

Figure 3.



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One can see that it swings between +1 and −1 along the "x" axis and similarly along the "y" axis. It is obvious, then, that a function in the form y=f(x) would not do to generate this trace. That function implies that one can have any value for "x", and in the case of a circle, this is plainly not true.

One must then introduce a third quantity, for instance, time, which we will label "t", and have two functions x=f(t) and y=g(t). With what functions then can we generate a circle as "t" is incremented? The answer is x=sin(t) and y=cos(t). You will notice that both functions keep the "x" and "y" values within the range +1 and −1.

One can use parametric functions then to draw circles, ovals, trochoids, deltoids, cardiods and countless other regular and irregular shapes. These graphs still show the relationship between a quantity "x" and a quantity "y", but instead of showing how the "y" quantity changes as one alters the "x" quality, they show how the "x" and "y" quantities change as one alters another quantity "t".

Let us then consider a program to generate such graphs. One is faced with similar problems to those before. However, we cannot solve them in the same way. The graph cannot move continuously from right to left as it is "t" and not "x" which, is now being incremented for the plot. In the case of the circle, for example, while "t" grows increasingly larger, "x" moves to and fro between +1 and −1.

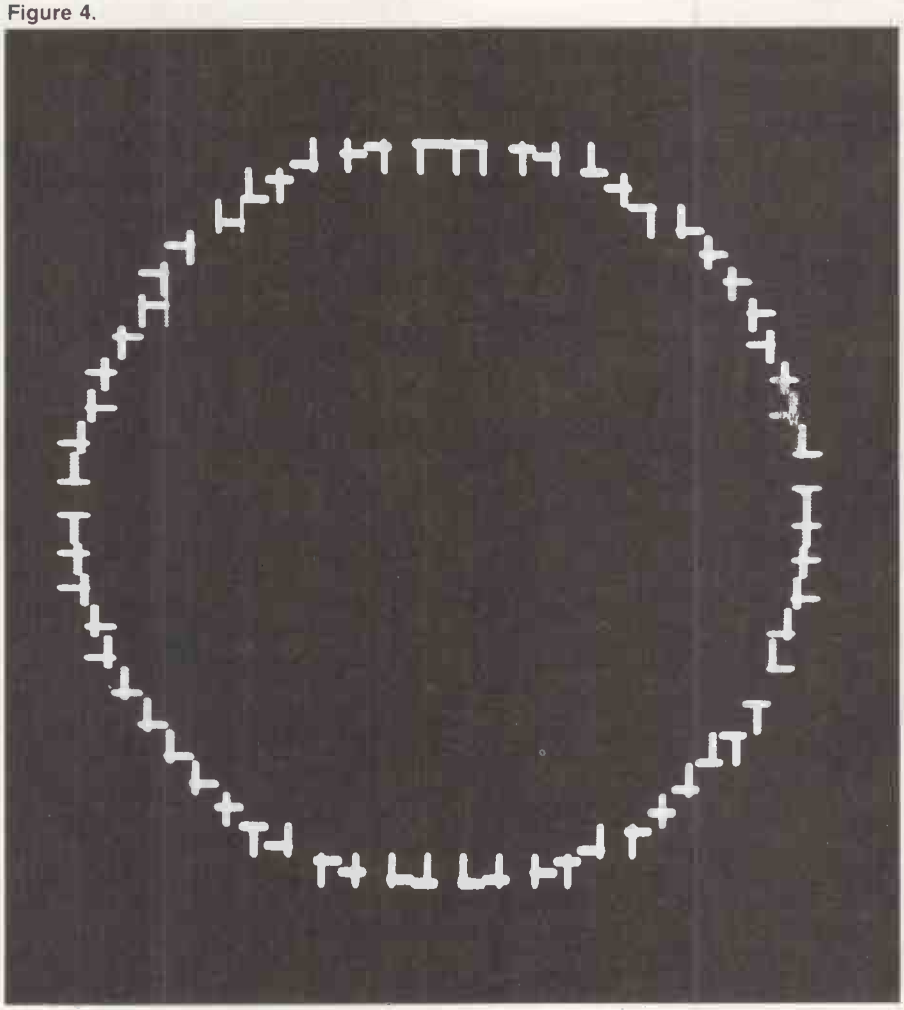
In Parametrics, the whole graph must be generated on a stationary screen. The user specifies which part of the "y" axis and which part of the "x" axis he requires. One must attempt to achieve the finest definition we can from our choice of characters. If we use horizontal lines, as before, we have the "y" axis divided into 192 distinct parts, but the "x" axis is divided into only 40.

Supposing we use vertical lines, there are eight different forms of these also. With them, the "x" axis can be divided into 320 distinct parts, but then the "y" axis can only be divided in 24. Both of these would seem to be far from satisfactory.

Examining the other characters, one finds that one could use the quarter-square as our basic unit. With these characters, we could divide the screen into 48 by 80 different parts, giving us a total of 3,840 plottable positions. This is, however, only half the total we could have obtained using vertical or horizontal lines — they both give us 7,680.

Now consider what we could achieve if we were to lay the horizontal and vertical lines on top of one another. We could

Figure 4.



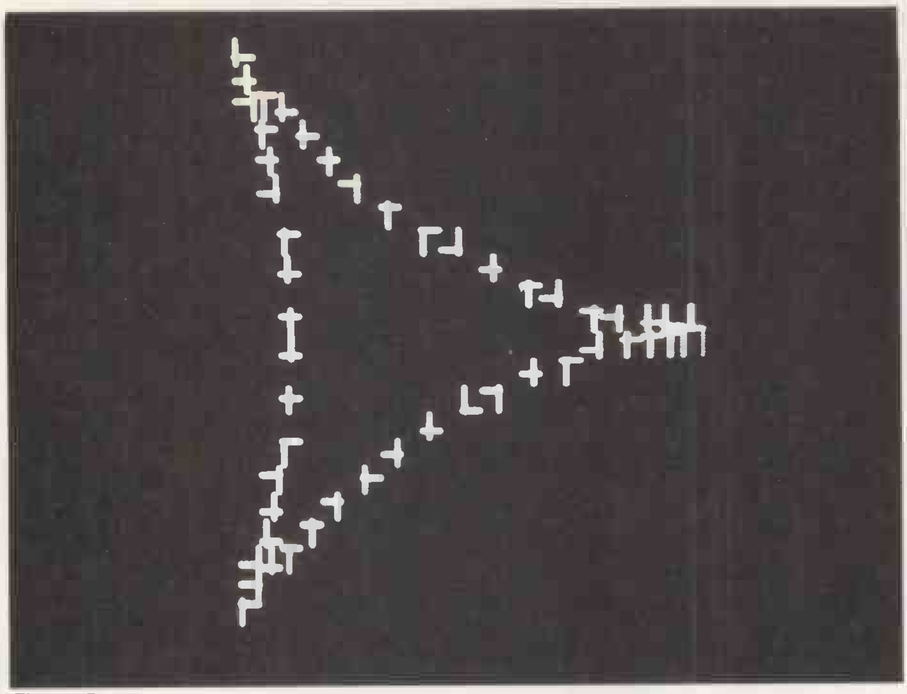


Figure 5.

divide the screen into 192 by 320 distinct parts, giving us a total of 61,440 different plottable positions.

In Parametrics, that is exactly what is done. Lines 2-12 contain a machine-code routine which can superimpose the horizontal and vertical lines on top of one another. Instead of the horizontal and vertical lines being Poked on to the screen, they are Poked into two separate blocks of memory. These blocks of memory are then transferred in turn on to the screen by the machine-code routine. This is done so quickly that the horizontal and vertical lines appear to be continually on the screen, thus creating new characters — see figure 4.

Like Graph-plotter, Parametrics has a number of one-key running commands — see lines 3000-3100. Because of the machine-code routine, however, both the trace and the execution of these commands are rather slow. For this reason there is a second version of Parametrics which excludes the machine code, and plots horizontal lines. The changes to be made are listed after Parametrics. This version is somewhat quicker and you may decide you prefer it.

Together, Graph-plotter and Parametrics form an effective and useful graph-plotting package for the Pet and are capable of expressing the vast majority of real two-dimension functions.

A cassette of these two programs as well as two other useful mathematical programs is directly available for £2 plus 50p postage and packing from Peter Hodkin, Finchingfield, West Lane, East Grinstead, West Sussex RH19 4HH, and please state whether you have an old- or new-ROM machine.

Program 1. Graph-plotter.

```
0 PRINT"♥":GOSUB3000
1 GOTO10
2 A$="X
3 PRINT"♥"
4 DATA99,69,68,67,64,70,82,100
5 FORI=7TO0STEP-1:READWW(I):NEXT:Y=1
6 GOTO50
7 REM*********************************
8 REM***(C)PETER HODKIN 1980*********
9 REM*********************************
10 PRINT"♥DO YOU WISH 1 OR 2 FUNCTIONS GRAPHED ?"
11 GETB$:IFVAL(B$)=0THEN11
12 PRINT"♥NOW WRITE FUNCTION";:IFB$="2"THENPRINT"S";
13 PRINT" IN TERMS OF X:"
14 INPUT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒Y=";A$
15 IFB$<>"2"THEN19
17 INPUT"▒▒▒▒▒▒▒Y=";C$
18 W$="DEF FNG(X)="+C$:GOTO20
19 C$="":W$=""
20 PRINT"♥▒▒▒▒▒1000 DEF FNA(X)="A$
25 PRINT"2 A$="CHR$(34);A$
26 POKE158,4:POKE623,13:POKE624,13:POKE625,13:POKE626,13
27 PRINT"1005"W$":C$=";CHR$(34);C$
30 PRINT"R /2▒▒":END
50 PRINT"♥▒▒▒▒▒▒▒Y="A$
51 GOSUB1000
55 IFC$<>""THENPRINT"▒▒▒Y="C$
60 PRINT"▒▒▒LIMITS ON Y VALUES-"
70 INPUT"▒▒▒▒▒▒▒MAX:";C
80 INPUT"▒▒▒▒▒▒▒▒MIN:";D
85 IF C<=D THEN 60
```

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```
86 INPUT"STARTING VALUE FOR X:";X
87 X=INT(X*65536+.5)/65536
94 INPUT"INTERVAL OF X:";E
95 E=INT(E*65536+.5)/65536
104 IFE=0THENPRINT"   INTERVAL TOO SMALL":GOTO94
110 F=C-D:F(1)=F/21
115 PRINT"
120 PRINT"PRESS C TO CHANGE THESE INSTRUCTIONS"
130 PRINT"PRESS F TO CHANGE FUNCTION"
140 PRINT"PRESS S TO START GRAPH"
145 PRINT"PRESS R FOR RUNNING COMMANDS
150 GET B$:IF B$=""THEN 150
160 IF B$="C"THEN50
170 IF B$="S"THEN199
180 IF B$="F"THEN 0
185 IF B$="R"THEN191
190 GOTO150
191 PRINT"RUNNING COMMANDS"
192 PRINT"
193 PRINT"'S' - TO STOP OR RESTART GRAPH":PRINT"'X' - TO FIND PRECISE"
194 PRINT" Y VALUE AND          GRADIENT FOR ANY SPECIFIED X VAL.";
195 IFC$<>""THENPRINT"'2' - AS ABOVE FOR 2ND FUNCTION
196 PRINT"'C' - TO CHANGE Y VALUE LIMITS,ETC"
197 PRINT"'F' - TO CHANGE FUNCTION
198 PRINT"          PRESS S TO START GRAPH":GOTO150
199 K=32807
200 J=X-(10*E):I=X-(20*E):H=X-(30*E)
210 G=(.5*F)+D
220 PRINT"
230 PRINT""C
232 PRINT""G
234 PRINT""D
240 PRINT"|||"
245 J=INT(J*1000)/1000:I=INT(I*1000)/1000:H=INT(H*1000)/1000
250 PRINTSPC(27);J""
252 PRINT""SPC(17);I
254 PRINT""SPC(8);H
255 IFC$<>""THENPRINT"(PRESS 'C' FOR 2 FUNCTIONS PRINTED)":GOTO400
256 IF LEN(A$)>37THENPRINT"Y="LEFT$(A$,32)"....":GOTO400
260 PRINT"Y="A$""
400 Y=1:BI=FNA(X)
420 IF BI>C OR BI<D THENZ(Y)=32767:GOTO530
430 L=BI-D
440 M=L/F(1):K(1)=M:N=INT(M)
450 M=INT(M)+1:M=21-M
460 Z(Y)=K+(M*40)
500 O=K(1)-N
510 R(Y)=WW(O*8)
530 IFC$<>"" AND Y=1 THENBI=FNG(X):Y=2:GOTO420
600 POKEZ(1),R(1)
605 IFC$<>""THENPOKEZ(2),R(2)
610 PRINT""C""CHR$(20):FORI=1TO9:PRINT""CHR$(20):NEXT
620 PRINT""G""CHR$(20)
630 FORI=1TO9:PRINT""CHR$(20):NEXT
640 PRINT""D""CHR$(20)
650 PRINT""
660 X=X+E
670 J=X-(9*E):I=X-(19*E):H=X-(29*E)
671 IFPEEK(151)=1THEN674
672 J=INT(J*1000)/1000:I=INT(I*1000)/1000:H=INT(H*1000)/1000
674 PRINT"              .          .          "
675 PRINT""SPC(27);J""
680 PRINT""SPC(17);I
685 PRINT""SPC(8);H""
700 GET B$:IF B$=""THEN 760
710 IF B$="C"THENRUN2
720 IF B$="S"THEN2000
730 IF B$="F"THEN RUN
740 IF B$="X" THEN 800
750 IFB$="2"THENZZ=1:GOTO800
760 GOTO400
800 PRINT""
801 PRINT"
803 Q=X
805 IFC$=""THENZZ=0
810 INPUT"X=";X$:X=VAL(X$)
815 BI=FNA(X)
816 IFZZ=1THENBI=FNG(X)
817 PRINT"                              "
818 Q(4)=(INT(BI*100000))/100000
820 PRINT"X="X",Y="Q(4)
825 Q(3)=X
830 X=X-.0000001
831 BI=FNA(X)
832 IFZZ=1THENBI=FNG(X)
835 Q(1)=BI:X=X+.0000002
840 BI=FNA(X)
841 IFZZ=1THENBI=FNG(X)
845 Q(2)=(BI-Q(1))/.000002
847 Q(2)=(INT(Q(2)*1000))/1000
850 PRINT"X="Q(3)",Y="Q(4)",GRAD:"Q(2)
860 ZZ=0
890 X=Q
892 GET B$:IF B$="" THEN892
894 PRINT"                              "
896 IF B$="C" THENRUN2
897 IF B$="S" THEN400
898 IF B$="F" THENRUN
899 IF B$="X" THEN800
900 IFB$="2"THENZZ=1:GOTO800
```

```
950 GOTO892
1000 DEF FNA(X)=X
1005 DEF FNG(X)=X:C$="X
1010 RETURN
2000 GET B$:IF B$="" THEN2000
2010 IF B$="C"THENRUN2
2020 IF B$="S"THEN400
2030 IF B$="F"THEN RUN
2040 IF B$="X" THEN 800
2045 IFB$="2"THENZZ=1:GOTO800
2050 GOTO2000
3000 PRINT"GRAPH PLOTTER"
3005 PRINT"BY PETER HODKIN
3006 FORI=1TO1000:NEXT:PRINT"DO YOU WISH INFORMATION (Y/N) ?"
3007 POKE59490,60
3010 GETA$:IFA$<>"Y" AND A$<>"N"THEN3010
3015 IFA$="N"THENRETURN
3020 PRINT"INFORMATION"
3025 PRINT""
3030 PRINT"   WELCOME TO 'GRAPH PLOTTER' - A VERY   POWERFUL GRAPH PLOTTIN";
3035 PRINT"G PROGRAM FOR THE PET(NEW ROM).IT GIVES THE USER COMPLETE";
3040 PRINT" CONTROL AND PLOTS GRAPHS WITH EXTREMELY FINE DEFINITION.";
3050 PRINT"  IT IS EVEN ABLE TO    DRAW TWO GRAPHS AT ONCE!":PRINT"  OTHER ";
3060 PRINT"FEATURES INCLUDE:-"
3070 PRINT" *CONTINUOUS GRAPHS WHICH YOU MAY STOP    AND RESTART AT ANY TIME";
3075 PRINT"(WITH 'S')."
3080 PRINT" *USER DETERMINED Y LIMITS,STARTING       VALUE OF X,AND INTERVAL";
3085 PRINT" OF X           (IT IS A CONTINUOUS GRAPH REMEMBER)    ";
3090 PRINT" THIS GIVES THE USER AN ALMOST            LIMITLESS CAPABILITY TO ";
3095 PRINT"LOOK IN DETAIL  AT ANY PART OF THE GRAPH.";
3100 PRINT" FURTHERMORE"
3105 PRINT"THESE VALUES CAN BE CHANGED AT ANY"
3110 PRINT"  TIME SIMPLY BY PRESSING 'C'."
3115 PRINT"      PRESS 'RETURN' TO CONTINUE";
3120 GETA$:IFA$=""THEN3120
3122 IFASC(A$)<>13THEN3120
3125 PRINT" *WILL GIVE EXACT Y VALUE FOR ANY X       SPECIFIED,& THE ";
3126 PRINT"GRADIENT AT THAT POINT";
3130 PRINT"   - SIMPLY PRESS 'X' AT ANY TIME"
3135 PRINT"  (OR IF 2 FUNCTIONS BEING GRAPHED PRESS";
3140 PRINT"  'X' FOR 1ST AND '2' FOR SECOND)."
3145 PRINT" *WILL CHANGE FUNCTIONS IMMEDIATELY -"
3150 PRINT"  SIMPLY PRESS 'F' AT ANY TIME.
3155 PRINT" *TAKES FUNCTIONS UP TO TWO LINES LONG!
3160 PRINT" *WILL GRAPH ANY FUNCTION MADE OF THE"
3165 PRINT"  FOLLOWING COMMON SYMBOLS & WORDS:-"
3168 PRINT:
3170 PRINT"   +   -   /(DIVIDE BY)  *   .   (   )"
3172 PRINT:
3175 PRINT"   SIN   COS   TAN   ATN(1/TAN)   LOG "
3178 PRINT:
3180 PRINT"   EXP   E   ↑(TO THE POWER OF)  π"
3182 PRINT:
3185 PRINT"      & ALL THE NUMBERS - IN FACT ALL"
3190 PRINT"  THE NORMAL MATHEMATICAL EXPRESSIONS"
3195 PRINT"  THAT THE PET CAN HANDLE."
3200 PRINT"      PRESS 'RETURN' TO CONTINUE";
3220 GETA$:IFA$=""THEN3220
3222 IFASC(A$)<>13THEN3220
3230 PRINT"IMPORTANT ADDITIONAL NOTES:"
3235 PRINT" 1) IF YOUR FUNCTION INCLUDES A DIVISION";
3240 PRINT"    ('/') THERE MAY BE VALUES OF X "
3245 PRINT"    WHICH MAKE THE FUNCTION A DIVISION"
3250 PRINT"    BY ZERO - THE COMPUTER CANNOT HANDLE";
3255 PRINT"    THIS,AND WILL COME OUT OF THE"
3260 PRINT"    PROGRAM IF IT HAS TO DIVIDE BY ZERO.";
3265 PRINT"    SHOULD THIS HAPPEN SIMPLY RE-RUN"
3270 PRINT"    AND CHANGE THE STARTING VALUE,OR"
3275 PRINT"    INTERVAL,OF X.
3280 PRINT"2) BECAUSE OF CERTAIN PROBLEMS THE PET
3285 PRINT"    HAS IN DEALING WITH DECIMALS,WHAT
3290 PRINT"    EVER YOU PUT FOR YOUR STARTING
3295 PRINT"    VALUE AND INTERVAL OF X ARE ROUNDED
3300 PRINT"    TO THE NEAREST 1/65536TH.
3302 PRINT"3) ON THE GRAPH ITSELF THE X VALUES ARE
3304 PRINT"    SHOWN TO 3 DECIMAL PLACES.KEEP '='
3306 PRINT"    PRESSED TO SEE MORE PLACES.
3310 PRINT" YOU DO NOT REALLY HAVE TO REMEMBER ANY
3320 PRINT"OF THIS INFORMATION AS ALL IS EXPLAINED
3330 PRINT"AS YOU GO ALONG.
3415 PRINT"        PRESS 'RETURN' TO START";
3420 GETA$:IFA$=""THEN3420
3422 IFASC(A$)<>13THEN3420
4000 RETURN
```

Program 2. Parametrics.

```
0 REM*********************************
1 REM*******(C)PETER HODKIN 1980*****
2 DATA169,32,162,0,157,0,32,157,0,33,157,0,34,157,0,35,157,0,36,157
3 DATA0,37,157,0,38,157,0,39,232,240,3,76,62,3,96,234,234,234,234
4 DATA234,173,252,3,141,251,3,173,119,3,141,252,3,173,251,3,141,119
5 DATA3,162,240,76,122,3,234,189,255,31,157,39,128,189,239,32,157,23
6 DATA129,189,224,33,157,8,130,189,209,34,157,249,130,202,240
7 DATA3,76,122,3,76,46,230,234,234,234,234,234,234,234,189,255,35,157
8 DATA39,128,189,239,36,157,23,129,189,224,37,157,8,130,189,209,38
9 DATA157,249,130,202,240,3,76,162,3,76,46,230,234,234,234,234,234,120
10 DATA 169,46,133,144,169,230,133,145,88,96,234,234,234,234,234,120
11 DATA 169,98,133,144,169 ,3,133,145,88,96,234,234,234,234,234,234,234
12 DATA 234,234,234,234,234,234,234,234,234,234,234,234,234,234,234,234,234,0,1
62,4
```

(continued on next page)

(continued from previous page)

```
14 FORI=826TO1021:READA:POKEI,A:NEXT
19 SYS(968)
20 PRINT"PARAMETRIC FUNCTIONS"
21 PRINT"
31 PRINT"             (IN TERMS OF T)"
41 INPUT"X=";X$:INPUT"Y=";Y$
51 PRINT"121 DEF FNX(T)="X$
61 PRINT"131 DEF FNY(T)="Y$
71 PRINT"141 X$="CHR$(34);X$
81 PRINT"151 Y$="CHR$(34);Y$
91 PRINT"GOTO121"
101 PRINT"":POKE158,5:POKE623,13:POKE624,13:POKE625,13:POKE626,13
111 POKE627,13:END
124 POKE60,12:POKE62,60:POKE63,7
125 FORI=0TO8:READY(I):NEXT:FORI=0TO8:READX(I):NEXT
161 SYS(968):SYS(826)
163 PRINT"":INPUT"Y TOP";YT:INPUT"Y BOTTOM";YB:INPUT"X RIGHT";XR
165 INPUT"X LEFT(PUT 'Y' TO SCALE)";XL$
168 XL=VAL(XL$)
171 YI=(YT-YB)/24:IFXL$="Y"THENXI=.8*YI:XL=XR-(40*XI):PRINT"X LEFT ="XL
175 XI=(XR-XL)/40
191 INPUT"STARTING VALUE FOR T";S
201 INPUT"INTERVAL OF T";IT
205 POKE158,0
211 PRINT" ——————————————————————————
212 PRINT"PRESS 'S' TO START GRAPH
213 PRINT"PRESS 'R' FOR RUNNING COMMANDS
214 GETA$:IFA$=""THEN214
215 IFA$="R"THENGOSUB3000
221 T=S:P=32767
231 PRINT""
235 SYS(984)
241 Y=FNY(T):Y=Y-YB
251 YY=INT(Y/YI)
255 IFPEEK(152)THENGOSUB400
261 IFPEEK(158)THEN341
271 X=FNX(T):X=X-XL:XX=INT(X/XI):IFXX<0ORXX>40THENY(C)=32:GOTO331
281 D=INT((((X/XI)-XX)*8)+.5)
291 POKEP-24616,Y(C)
301 P=33728-(YY*40)+XX:IFP<32808ORP>33767THENP=32767
311 POKEP-23592,X(D)
321 C=INT((((Y/YI)-YY)*8)+.5)
331 T=T+IT:GOTO241
341 GETA$:IFA$="T"THEN500
345 IFA$=" "THENGOSUB400:GOTO341
346 IFA$=""GOTO341
351 IFA$="F"THENRUN19
355 IFA$="C"THEN161
360 GOTO271
400 GOSUB1000
401 PRINT"T="INT(100*T)/100"X="INT(100*FNX(T))/100"Y="INT(100*FNY(T))/100
410 RETURN
500 GOSUB1000:INPUT"T=";T$:S=VAL(T$)
510 GOSUB1000:PRINT"T="S"X="INT(1E4*FNX(S))/1E4"Y="INT(1E4*FNY(S))/1E4
520 GETA$:IFA$=""THEN520
523 GOSUB1000:S1=S+.000001:S2=S-.000001
525 IFA$="G"THEN600
530 IFA$="X"THEN650
535 IFA$="Y"THEN700
536 IFA$="F"THENRUN19
537 IFA$="C"THEN161
540 IFA$<>""GOTO271
600 X5=FNX(S1)-FNX(S2):IFX5=0THENG=0:GOTO630
610 Y5=FNY(S1)-FNY(S2):G=Y5/X5
630 PRINT"T="S"GRADIENT="INT(100*G)/100:GOTO520
650 IFS1=S2THEN720
651 X5=FNX(S1)-FNX(S2):PRINT"T="S"CH.RATE X="INT(100*X5/(S1-S2))/100:GOTO520
700 IFS1=S2THEN720
701 Y5=FNY(S1)-FNY(S2):PRINT"T="S"CH.RATE Y="INT(100*Y5/(S1-S2))/100:GOTO520
720 PRINT"T IS TOO LARGE TO CALCULATE GRADIENT!!":GOTO520
1000 PRINT"                                            "
1010 RETURN
1351 DATA100,82,70,64,67,68,69,99,99
1361 DATA101,84,71,66,93,72,89,103,103
3000 PRINT""       *RUNNING COMMANDS*
3010 PRINT" 'SPACE BAR' - FREEZES GRAPH
3020 PRINT" 'SHIFT' - GIVES T,X AND Y VALUES
3030 PRINT" 'C' - ALLOWS USER TO CHANGE Y MAX,ETC
3040 PRINT" 'F' - ALLOWS USER TO CHANGE FUNCTIONS
3050 PRINT" 'T' - ALLOWS USER TO SPECIFY A T VALUE:";
3060 PRINT"GIVES X AND Y VALUES FOR THIS T.";
3070 PRINT"AFTER SPECIFYING T YOU MAY GET          THE FOLLOWING:-
3080 PRINT"             'G' - GRADIENT AT POINT
3090 PRINT"             'X' - RATE OF CHANGE OF X
3095 PRINT"             'Y' - RATE OF CHANGE OF Y
3100 PRINT" (ANY OTHER KEY) - UNFREEZE GRAPH
3110 PRINT"     PRESS ANY KEY TO START GRAPH
3450 POKE158,0
3500 GETA$:IFA$=""THEN3500
3510 RETURN
```

```
2 REM
3 REM
4 REM
5 REM
6 REM
7 REM
8 REM
9 REM
10 REM
11 REM
12 REM
14 REM
19 REM**MUST KEEP THIS LINE**
161 REM
235 REM
291 POKEP,Y(C)
311 POKEP,X(D)
```

BUYERS' GUIDE

Printers

The Peripherals Buyers' Guide is a survey of printers suitable for small computers. We have excluded any system which costs significantly more than £2,000. The printers are listed in alphabetical order. The addresses of the main suppliers are listed at the end of the guide.

Printers may be divided into several categories. The highest-quality printing is produced by the daisywheel-type which creates text in various type-faces, according to the wheel used. The quality ranges from excellent typing to rather poor book printing and generally there is a proportional-spacing facility. Those machines tend to be expensive and slow. Daisywheels can be either plastic — inexpensive, but must be replaced often — or metal — expensive but durable.

For faster printing, you must turn to dot-matrix machines. The print quality tends to be poor and the machines noisy. Older machines use a 7-by-5 matrix which puts the descenders of letters such as 'y' above the line. That makes bulk text difficult to read. Better printers use a matrix nine dots deep to give true descenders. Recently, several firms have produced dot-matrix printers which give an approximation to typewriter printing and proportional spacing. They are less expensive than daisywheel machines, work faster and could well be used for correspondence-quality work.

Some dot-matrix printers employ sensitised paper to produce printing by more direct electrical effects. They are often quiet and fast, but the paper can be expensive, unpleasant to handle and hard to obtain.

The trend is to build more processing power into printers. That means they offer increasingly varied features, so it is hard to categorise them precisely.

A printer has to be connected to the computer by a cable and a more or less standard interface. The normal interfaces are the Centronics parallel, RS232 serial port — also known as the V-24 — and 20mA current loop. IEEE is a parallel interface used by Pet; 'cpl' means characters per line, 'cps' means printing speed in characters per second. Allow five characters to the word.

The more intelligent printer prints as its head moves in both directions across the paper — bi-directional printing. Still more

intelligent ones end the head movement at the ends of short lines. These two features can more then treble the working speed.

Printers use two types of paper: plain paper fed — like a typewriter — pinch- and pin- or sprocket- or tractor-fed with holes along the margins. That paper can be supplied fan-folded or in rolls.

Pinch feeding is more expensive but is convenient for letters. Only a few machines will accept both pinch- and pin-fed paper. It is possible to obtain headed letter paper bonded lightly on to pin-fed, fan-folded computer paper for word processors.

Some printers allow direct control of the print-head to give graphics. KSR means keyboard, send and receive, ASR means automatic send and receive, RO means receive only. KSR machines can be used as electric typewriters in local mode.

Comb or line printers have a whole line's worth of dot hammers so they can print a line of text at a time. They tend to be very expensive and very noisy but produce an enormous quantity of work.

ADDMASTER

400 receive only — *£242*
Uses 2½in. Tally roll paper, 16cpl, 48 cps. Main U.K. agent Clary Ltd.

420/426 receive only — *£246*
Dot matrix grade-one Tally roll paper at £5 for 20 rolls. BCD serial or 10-line serial interfaces, 12 cpl, 36 cps.

ANADEX

Main U.K. agent Anadex Ltd

DP-500 — *from £367*
Dot matrix, tractor feed, paralell interfaces, 18 cpl, 45 cps.

DP-660 — *from £700*
Dot matrix, pinch feed for printing labels, uses sprocket feed. Parallel interface. 19 cpl, 57 cps.

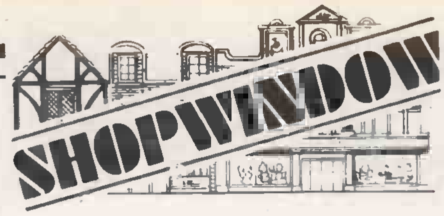
DP-750A — *from £800*
Dot matrix, RS232C 20mA current loop, 21 cps, 25 cps.

FP-600 — *from £65*
Dot matrix ticket or form printer, from four columns to 19 columns parallel interface, 19 cpl, 44 cps.

DP-9500 Series — *£895 upwards*
Dot matrix, tractor feed, nine-wire print head, bi-directional printing, three ASCII interfaces as standard — parallel bit, RS232C, current loop — 120-200 cps, 132-220 columns, 7x9, 9x9 or 11x9 matrices depending on model. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-8000 — *£550*
Dot matrix, pinch feed, bi-directional printing, fan-fold paper up to 9.5 in. up to three copies. Three ASCII interfaces — parallel bit, RS232C, current loop — 112 cps, 80 column, 9x7 matrix. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-1000 Series — *from £395*
Dot matrix, tractor feed, internal data storage, roll-type paper for 40 columns at £11 for box of 10 rolls, three basic ASCII-compatible interfaces are available. 40 cpl, 50 cps, 40 columns, 5x7 matrix. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services.



AXION CORPORATION

Main U.K. agent Memec Systems Ltd

EX-820 receive only — *£500*

Electro-sensitive dot matrix includes plotting capability for full graphics, paper at £3 for a 240ft. roll, RS232C or 20mA serial and ASCII parallel, 20/40/80 cpl and up to 160 cps, 5x8 matrix.

EX-850 Video Printer — *£500*

Electro-sensitive dot matrix, aluminised paper at £3/240ft. roll. Needs only the video signal from user's. Normal resolution 13.5 seconds per screen, high resolution 27 seconds per screen.

EX801/802 receive only — *£279*

Electro-sensitive, dot matrix, aluminised paper at £3 for a 240ft. roll, RS232C, Centronics, Apple, Pet, and Tandy interfaces, 20/40/80 cpl, 160 cps, 5x8 matrix.

BASE 2

800-MST — *from £385*

Impact dot matrix, bi-directional, tractor feed up to 9½in., RS232C, 20mA, IEEE-488, Centronics and parallel interfaces, up to 132 cpl and 60 cps, with 5x7 matrix. Main U.K. agents Microbyte and Maclin-Zand Elecronics Ltd.

CENTRONICS

Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Models 700, 701, 702 and 703 — *P.O.A.*

Impact dot matrix, uses fan-fold paper, parallel, serial RS232C interfaces 132 cpl, up to 180 cps, 5x7 or 7x7 matrices.

Model 791 — *P.O.A.*

Demand-document printer, impact, dot matrix, up to 12-part forms using bottom feed tractor, standard parallel interface, with serial RS232C interface option, 80 cpl, 60 cps, 5x7 matrix.

Model 730 — *£375*

Impact, dot matrix, uses roll paper up to 8.5 in. wide, fan-fold paper up to 9.5 in. wide and cut sheet up to three-ply paper and two carbons, parallel-standard interface with serial RS232 option, 80 cpl, 100 cpls, 7x7 matrix. Also from: Datac Ltd, Rair Ltd, Comma Computers and MIBF.

Model 737 — *£425*

Impact dot matrix, roll fan-fold or cut sheet paper, standard parallel interface, serial RS232C option, 80 cpl mono-spaced mode, 50 cps mono-spaced mode, 80 cps proportional mode, 7x8 matrix mono-spaced, 9x9 proportional. Also from: Datac Ltd.

Model PI Microprinter and Model SI Microprinter — *P.O.A.*

Non-impact dot matrix electro-sensitive uses aluminium-coated paper roll, parallel interface, serial RS232C interface, up to 80 cpl, and 150 lines per minute, up to 200 cps. Also from: Datac Ltd.

Model 780 — *P.O.A.*

Impact, dot Matrix, pinch-roll paper feed for roll paper, tractor-feed option for rear- and bottom-feed forms and fan-fold paper, parallel interface with serial RS232C option, 80 cpl, 60 cps, 5x7 matrix.

Model 779 — *P.O.A.*

Impact, dot matrix, pinch-roll paper feed for roll paper, with fan-fold, tractor feed option, standard parallel interface with RS232C serial option, 80-132 cpl, 60-110 cps, 5x7 matrix.

Model 704 — *P.O.A.*

Impact, dot matrix, uses fan-fold paper, RS232 serial interface, 132 cpl, 180 cps using 7x7, 9x7 and 9x9 matrices.

Model 761 read only or keyboard send/receive — *P.O.A.*

Impact, dot matrix, uses fan-fold paper, RS232C/CCITT V24 or DC current loop interfaces, 132 cpl, 60 cps, 7x7 matrix.

SHOPWINDOW

COMMODORE

CBM 3022 — *£425*

Tractor-feed printer, uses fan-fold paper with three-in. to 12in. width, cost of paper £10 per 1,000, IEEE interface, 80 cpl, 150 cps, 6x7 matrix. Main U.K. agent Davinci Computers Ltd.

COMPUTER DEVICES INC

Miniterm 1201, 1202, 1203 — *from £936*

Thermal mechanism, uses Thermal Type B paper at £2.40 per roll, RS232 or parallel — 1201 only — interfaces, 80 or 132 cpl, 10/30 cps, 7x5 matrix. Main U.K. agent Teleprinter Equipment Ltd.

DATAC

Main U.K. agent Datac Ltd

414 free-standing assembly receive only — *£130*

Electro-sensitive, matrix printer type 245L, electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll for 20 off, six-bit parallel ASCII, character serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 character per serial, 7x5 matrix.

DMI-40P free-standing terminal, receive only — *£350*

Impact, matrix, uses pressure-sensitive roll paper, 10mm.-wide ordinary paper version, using ink ribbon. Cost of paper £1 per roll, seven-bit parallel ASCII, character serial, RS232C or graphics, 40 or 20 cpl, up to 80 cps, 7x5 matrix.

411C compact panel mounting, receive only — *£209*

Electro-sensitive matrix type 245L or R, uses electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll, six-bit parallel, serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 cps, 7x5 matrix.

411 panel mounting, receive only — *£189*

Electro-sensitive matrix printer type 245L or R, uses electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll. Interfaces include six-bit parallel ASCII, character serial, four-bit parallel BCD, character parallel EIA/RS232C, CCITT/V24 and 20mA current loop, under development 40 cpl, 32 to 80 cps, 7x5 matrix.

313 panel-mounting, receive only and 312 free-standing, receive only — *£269*

Impact matrix type PU-1100, Tally roll paper, 59mm. wide x 36m. long at 60p per roll, CCITT/V24 or EIA RS232C or 20mA current loop interfaces, up to 20 cpl and up to 36 cps, 7x5 matrix.

412/1 and 412/5 receive only — *£255*

Electro-sensitive dot matrix type 245L, uses electro-sensitive aluminium-coated paper, 59mm. x 30m. at 90p per roll, six-bit parallel, ASCII, character serial and four-bit parallel BCD, character parallel, RS232C/V24 interfaces, 20mA current loop under development, 16, 20, 32 or 40 cpl, 32-80 cps, 7x5 matrix.

522/1 and 522/4 receive only — *£499 (522/1)* *£535 (522/4)*

Impact matrix type, roll paper, 114mm. x 75m. up to three copies plus original, cost of paper £1.10 per roll. Parallel interface and RS232C, 20mA current loop and parallel buttered, asynchronous interfaces — (522/4). 40 cpl, 100 cps instantaneous rate, 33 cps average rate — including CR and LF. 7x5, 7x10.

DATA DYNAMICS

Main U.K. agent Data Dynamics Ltd

303 Printer — *£980*

Dot matrix, up to six-part stationery width from 3m to 15.375in., V24/RS232C, 20mA current loop, 132 cpl, 30 or 60 cps, 7x7 matrix.

ZIP ASR/K7 twin cassette — *£2,000*
Dot matrix format, uses standard Teletype roll paper, V24, RS232C, or 20mA current loop operating at half or full duplex, 80 cpl, 10 or 30 cps switch selected, 5x7 matrix.

ZIP 30 keyboard printer, RO, ASR, or KSR — *ASR £1,800, RO & KSR £950*
Dot matrix, standard roll paper, 20mA half or full duplex current loop or V24 RS232C, 80 cpl, 10 or 30 cps — switch selected, 5x7 matrix.

390 eight-level and 392 five-level — *ASR from £1,250, LSR from £900, RO from £800*
ASR, KSR and read-only versions. Impact printers, friction or sprocket feed, 8.5in. paper with roll diameter 5in. 74 or 86 cpl, 6.6 or 10 cps.

Models 32 and 33 page printers — *ASR from £1,100, KSR from £800, RO from £700*
Available in ASR, KSR and receive-only versions. Friction or sprocket feed, 20mA or 60mA parallel, up to 86 cpl, 6.6 or 10 cps.

DATA GENERAL CORPORATION

Dasher TP1 Printer models 6040 and 6041 — *From £1,598*
6040 standard keyboard and can be used as a typewriter. 6041 is a receive-only terminal printer without keyboard, 30 or 60 cps, switch selectable, EIA-RS232C interfaces, 5x7 dot matrix. Main U.K. agent Data General.

DATAPLUS

400 series receive-only Model 480 — *£475*
Impact dot matrix, uses standard Tally roll, up to 3.75in. side, from 80p per roll, RS232C, V24, 20mA current loop, but parallel IEEE, Pet and Apple interfaces, 30/40 cpl, 110 cps, 7x5 and 7x10 matrices. Main U.K. agent Dataplus Ltd.

DATASOUTH CORPORATION

DS-180 — *£1,360*
Impact, matrix printer, uses fan-fold paper, RS232C, current loop, and parallel interfaces, 132 cpl, 180 cps, 9x7 matrix. Main U.K. agent Datatrade Ltd.

DIABLO

HY type II receive only — *P.O.A.*
Impact daisywheel plastic or metal print wheel, parallel, interface, 132 10-pitch cpl or 158 12-pitch cpl, 40/45/55 cps. Main U.K. agent Diablo Systems Ltd.

630 receive only — *£1,725*
Daisywheel, metal/plastic printwheels, standard listing or single sheet paper, RS232C, V24 with optional bus interface, 132 cpl at 10 pitch, 158 cpl at 12, 198 cpl at 15, up to 40 cps with automatic bi-directional printing. Main U.K. agent Geveke Electronics.

DIGITAL EQUIPMENT

DecWriter LA34 KSR — *£824*
Dot matrix, uses roll or fan-fold paper, friction-feed, up to five copies, V24 or 20mA interfaces, adjustable up to 256 cpl, 30 cps, 7x9 matrix. Main U.K. agent Extel.

A120 — *from £1,645*
7x7 dot matrix, EIA or 20mA option, up to 217 cpl, 180 cps. Main U.K. agent Wilkes Computing.

SHOPWINDOW

DIGITRONIX

Mini-Printer — *£195*

32 column electro-sensitive, 110-4,800 baud, ASCII Serial inputs at RS232C, 20mA, 64 font at 64 cps. Main U.K. agent Digitronix.

ELECTROGRAPHIC AV

EG-800 receive only — *from £450*

Impact, matrix printer, uses any type of paper, parallel, RS232C, TRS-80, Apple interfaces, 80 cpl, 150 cps, 7x5 or 7x6 matrices. Main U.K. agent Electrographic AV Ltd.

500 series receive only — *from £175 for mechanism only*

Impact, matrix printer, uses 3.5in. Tally roll paper and flat documents, serial or parallel interfaces, 40 cpl, 120 cps, 7x5 or 7x6 matrices. Main U.K. agent Electrographic AV Ltd.

EPSON

TX-80 — *£395*

Impact, dot matrix, friction pin-feed RS232C, V24, 20mA current loop, bit parallel, Centronics, IEEE, Pet, Apple and TRS-80 interfaces, 80 cpl, 150 cps, 7x5 or 7x10 matrices and graphics. Optional PROM chips for high-resolution graphics. Main U.K. agent Dataplus Ltd.

MX-80 — *£425*

Impact, dot matrix, accepts any type of paper, Centronics parallel interface, optional serial and IEEE 488 interfaces, 44, 66, 80, 132 cpl, 80 cps, 9x9 matrix — 2.1 x 3.1mm. High resolution graphics.

EXTEL CORPORATION

M30 receive only keyboard send/receive and automatic send/receive — *£895*

Impact, dot matrix printer, uses roll or fan-fold paper, V24 or 20mA interfaces, 80 cpl, 30 cps (50 with buffer) 5x7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

M30 B208L keyboard send/receive — *£1,270*

Dot matrix, uses roll paper, V24 or 20mA interfaces, 80 cpl, 30 cps, 5x7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

FACIT

4520 and 4521 — *£583*

Seven-wire print head, uses roll paper Telex type (Facit 4520), friction feed, fan-fold (Facit 4521) pin feed, serial, V24/RS323C, Centronics parallel interfaces, both fitted as standard, 80 cpl, 100 cps at 12 characters per inch, 9x7 matrix. Main U.K. agent Facit Ltd.

GENERAL ELECTRIC, U.S.A.

ITT 3330 — *£1,496*

Impact dot matrix, pin feed, V24 interface, 132 cpl, 10, 20 or 30 cps, 7x9 matrix. Main U.K. distributor ITT Business Systems U.K.

HEATH ELECTRONICS

WH14 — *£510*

Dot matrix, uses edge-punched fan-fold paper, 20mA, RS232C interfaces, 80, 96, 132 cpl, 132 cps, 5x7 matrix. Main U.K. agent Heath Electronics U.K. Ltd. (OEM sales).

INTEGRAL DATA SYSTEMS

Paper Tiger Model 460 *from £700*
Dot Matrix, impact printer, pin-feed fan-fold paper, parallel, RS232C, 150 cps, 24x9 matrix. Main U.K. agent Teleprinter Equipment Ltd. and Microsense Computers Ltd.

LEAR SIEGLER INC

300 series *from £965*
Dot matrix, uses standard paper, RS232C, 20mA parallel interfaces, Centronics 701/703 type 132 cpl, 180 cps, 9x7 or 9x9 matrices. Main U.K. agent Penny & Giles Data Recorders Ltd.

LOGABAX

LX-213 *£1,590*
Dot matrix printer, plain paper, fan-fold or cut up to six-ply, RS232C or V24 interfaces, 132 cpl, 218 cpl, 180 cps, 9x7 matrix, optimised bi-directional printing. Main U.K. agent Brospa Data Ltd.

LRC EATON

7000+ *£250*
Dot matrix printer, uses roll paper, RS232, IEEE, current loop and parallel interfaces, 20, 32, 40 and 64 cpl software selectable by option, 40 cps, 7x7 matrix. Main U.K. agent Russet Instruments.

MALIBU ELECTRONICS CORPORATION

Masterprint 165 *£1,400*
Dot matrix, fan-fold paper, RS232C, current loop and parallel interfaces, 132 cpl, 165 cps, 10x9 matrix with 18x9 matrix character set which approaches word-processing quality, graphics. Main U.K. agent MBS Terminals Ltd.

MANNESMAN TALLY

Main U.K. agent Data Design Techniques Ltd

M-80 MC *from £875*
Dot matrix, 9.5in. pin feed paper, all interfaces, 80/132 cpl, 200 cps, 7x9 or 9x9 matrices.

T1612 keyboard send/receive *£1,612*
Dot matrix, single or multi-part paper, pin feed, RS232C or 20mA interfaces, 132/218 cpl, 160 cps, 7x9 or 9x9 matrices.

T1612 receive only *£1,475*

T1602 *£1,395*
Dot matrix single- or multi-part paper, pin feed, Data Products, Centronics and serial interfaces, 132 cpl, 160 cps, 7x9 matrix.

MICRO PERIPHERALS INC

MPI-88T *£535*
Dot matrix printer, uses fan-fold, roll and cut-sheet paper, RS232C, current loop and parallel interfaces, 80/96/120/132 cpl, all software-selectable, 120 cps, 7x7 matrix. Main U.K. agent Russet Instruments.

NEWBURY LABORATORIES

Model 8300 *from £475*
Dot matrix, pin-feed paper up to 9.5in., eight-bit parallel interface or CCITT V24, RS232C interfaces, 10 characters per inch, 125 cps, 7x9 matrix. Main U.K. agent Newbear Computing Store.

NIPPON ELECTRIC COMPANY

Spinwriter *£1,500*
Combines golf-ball daisywheel and thimble mechanism, uses continuous or single-sheet computer paper, RS232C serial (RO and KSR), Centronics-compatible and Diablo-compatible interfaces, 8080 input bus line, current loop, 55 cps, solid-font matrix. Main U.K. agent Memec Systems Ltd.

OKI

Microline 80A *£500*
Dot matrix, 9x7, 80 cps, 80 or 132 cpl, pin, traction or friction feed, RS232, 20mA Centronics. Main U.K. agent X-Data.

Microline 82 *P.O.A.*
Dot matrix, impact printer, 80 cps, bi-directional logic-seeking, 40, 66, 80 or 132 cpl, pin, friction or tractor feed, serial and parallel interface, 160 characters. Main U.K. agent X-Data.

QUME

Sprint 5/45 receive only *£1,795*
Daisywheel mechanism, uses plain paper, fan-fold or cut appear A4 up to six-ply, RS232C or V24 interfaces, 156 cpl at 12 pitch, 45 cps. Main U.K. agents, Brospa Data Ltd., Access Data Communications and ISG Data Sales.

RAIR

Main U.K. agent Rair Ltd

820/825 Desk-top printer *£1,090*
Dot matrix, RS232C interface, 132 cpl, 75 or 150 cps, 7x7 matrix.

DecWriter IV keyboard printer, KSR and read only *£795*
Dot matrix, uses standard listing paper, RS232C current loop interface, 215 cpl, 30 or 180 cps, 9x7 matrix.

M200 *£1,995*
Dot matrix, uses continuous paper, parallel or serial interface, 132 cpl, 340 cps, double 7x9 matrix.

DecWriter III *£1,550*
Dot matrix, uses continuous listing paper, RS232C or 20mA, current loop interfaces, 132-215 cpl, 180 cps, 7x7 matrix.

RICOH

RP-1600 *£1,295*
Daisywheel, uses single-sheet or continuous paper, Centronics and compatible interfaces, 132 cpl, 60 cps. Main U.K. agent Nexos (U.K.) Ltd.

ROXBURGH PRINTERS

X80 SP printer/plotter *from £896*
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Son of Hexadecimal Kid

Samson has just met Mantissa, a fellow student at the Institute of Esoteric Ideas, and been completely bowled over by her. Yet their absorbing conversation about flower power is cut short when Seymour Crayfish interrupts to remind Mantissa she has a date with him.

"Bye Sampson", she said. "It's been good talking to you".

"Good-bye", he croaked, his voice choked with jealousy. As she left she brushed her hand lightly against Samson's. Then she was gone. Seymour Crayfish turned and walked after her. Samson sat there unable to move.

Her parting gesture had imprinted itself on his skin. For days afterwards he could still feel the fleeting touch of her fingertips. He almost expected an outline of her hand to show up as stigmata in red weals on his flesh, so distinctly had his nerve-ends memorised that brief moment of contact.

From then on, there was only one thought in his mind — Mantissa. He neglected his studies. Computers no longer held the same fascination for him: gone were the days when he could spend hours flushing out a recalcitrant program bug or tidying up the last detail of a screen format. Even his astro-pinball rating slumped miserably. From being a star pupil, he fell to the bottom of the class.

Since he was already in disciplinary trouble for taking the name of Mega-brain in vain, this was bound to lead to his eventual downfall, but he did not care. He went around in a trance. It was as if the 1,001 thoughts that had crowded and jostled in his brain until the day he met Mantissa were just squatters who had been summarily evicted and now stood huddled miserably on the pavement with nowhere to go.

Occasionally, he saw her on her way to a lecture or in the student cafe surrounded by a group of admirers, usually — he noted bitterly — including Seymour Crayfish. On such occasions she was invariably polite and friendly towards him, though he tended to drown in a quicksand of tongue-tied embarrassment.

What Samson had not come to terms with was that Mantissa was kind to everyone. Not only was she very beautiful, she was very amiable too. Like all natives of Ghendor-Ghendoran she had a touch of the psycho-chameleon.

A psycho-chameleon is a small reptile found in the luxuriant tropical forests of Ghendor which feeds on the kaleidoscope plant. It protects itself from its enemies by sensing what would-be predators fear most and projecting just such an image back at them. By studying this lowly creature in its natural habitat, the Ghendorans eventually understood its behaviour well enough to build a micro-electronic device which mimicked some of its capabilities.

This device used sophisticated pattern-recognition algorithms to detect and enhance the minute electrical discharges given off by thinking and the latest holographic laser-imaging techniques to relay back the desired picture.

It enabled its user to present himself or herself as whatever most appealed to another being — or indeed to present a different favoured mask to several others at the same time. It did not so much falsify the facts as selectively highlight or play down aspects of the truth. Furthermore, it was small enough to be worn as a lapel-badge or brooch. This little charmer had, through the centuries, done much to safeguard the prosperity of Ghendor and its citizens.

One activity Samson did find time for in his zombie-like state was perusing the encyclodatabase for information about Mantissa's home planet. There he learned all this — but by then it was too late. He realised that neither he nor anyone else had seen the real Mantissa, but the knowledge fell on barren ground. The spell had already done its work.

One evening, the moment for which he had been yearning arrived. He was returning from a meeting with Dr Catharsis at which his recent lack of progress in his studies had been discussed and at which he and Zapple had been given one last chance to prove themselves. He decided to call in at the library at a time when it was unlikely to be crowded and do some further research on Ghendor-Ghendoran.

He entered to find the library quite deserted, except for Mantissa who was sitting at one of the encyclodata readers. She looked round and saw him.

"Oh, Samson, do you think you could do me a favour"?

"Certainly".

"I'm having trouble with this thing. Do you know how to work it"?

"Well, I've used it a good deal recently".

"That's good, because I'm stuck. I'm trying to look up an article on vegetative computer systems but I can't find any reference to it at all".

Samson made to lean over and reach the keyboard, but she moved her chair slightly aside and gestured for him to sit down.

"Make yourself comfortable", she said. "Draw up a chair".

He pulled up a seat next to her and started typing at the keys.

"It's organised as a hierarchical view-database", he explained, thrilled to be so near her and glad she had probed him on a topic where he felt himself competent.

"I press the button here and that takes us to the master bibliographic index. Now we can try under "Ve" for vegetative computing. By the way, do you know the author"?

"No. It was written by a woman, but I'm afraid I've forgotten her name".

With a great effort he wrenched himself back to the viewer. "Never mind. Let's try 'Ve'. We could go to the annual catalogue, but since we don't know the date it would take ages to step through it: Now, here we are. 'VDUs', 'Vector Processors', 'Vedic Mathematics' . . . 'Vegetative Computation and Computer Systems' by Daisy Wheel. There you are. We've found it. I'll just put in a queue request and you'll have a microfiche copy waiting in your output pigeon-hole tomorrow morning".

Just at that moment Samson felt a gentle pressure against the side of his knee. He could hardly believe it. Yes, it was true — their legs had met under the table. Now they were both pressing: it could not be an accident.

"It's a dream", thought Samson. "It has to be a dream". His heart pounded and his breath came in fitful gulps as Mantissa's lips, now only centimetres away, framed the kiss he had yearned for so desperately. Then he leant forward and bit her on the neck.

"Ow", she yelled. "What do you think you are doing"? She jumped up clutching her wound and staggered, crying, towards the door.

Poor Mantissa. She was used to being adored, but Samson was the only one who had still loved her when the low-battery warning indicator flashed on her chameleon brooch. That night in the library, though he had not noticed, she had deliberately left it switched off. A moment ago everything had seemed possible — and now this. Bitterly, she vowed never again to expose her naked self, and turned her camouflage device back on, retreating into the prison of her emotional armour-plating.

Poor Samson, He was still sitting there stunned by his own action, almost as distraught as Mantissa. She could not know, and nor did he, that it was the parasitic programmable virus which had infiltrated his defenceless blood-stream before he was even born that caused him to act as he did. Twice now, in its relentless quest for new host bodies, it had incited him to meaningless violence that had brought his world crashing round his ears.

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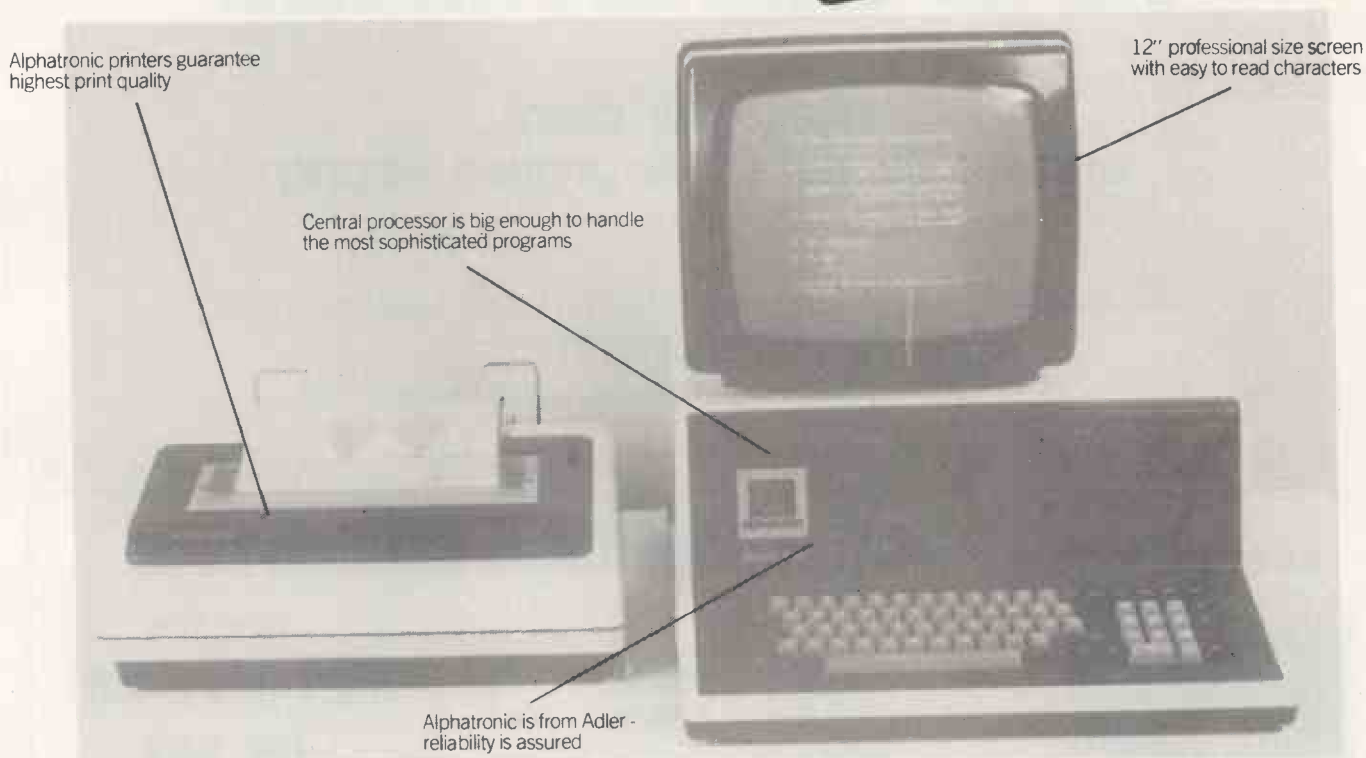

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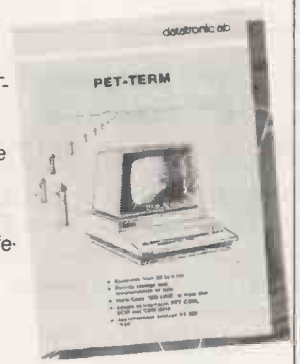

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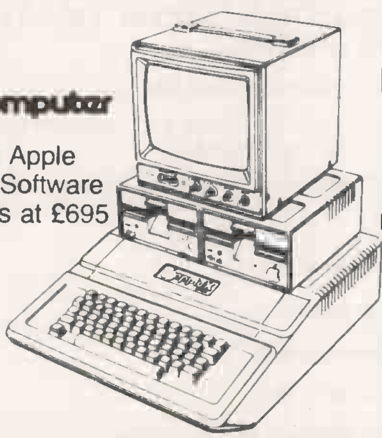

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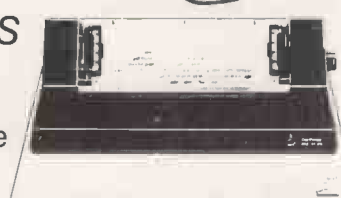

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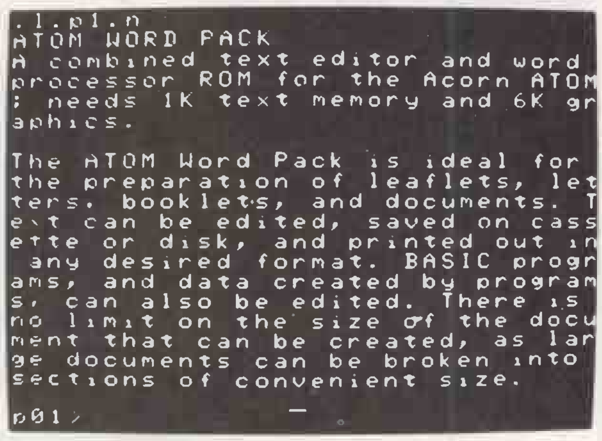

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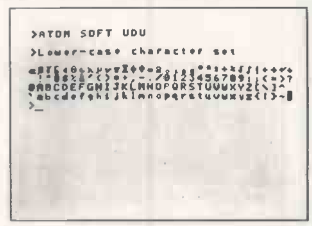

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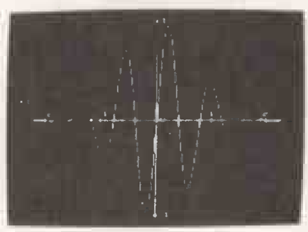

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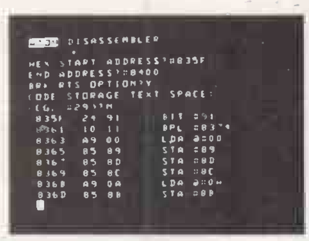

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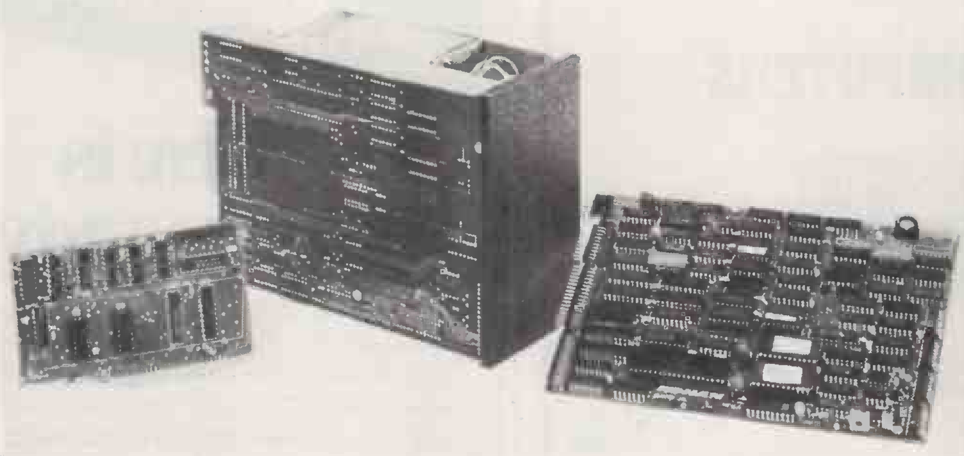

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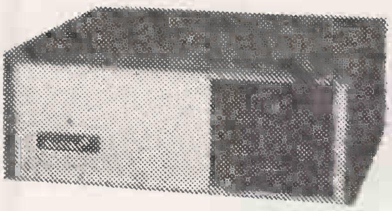

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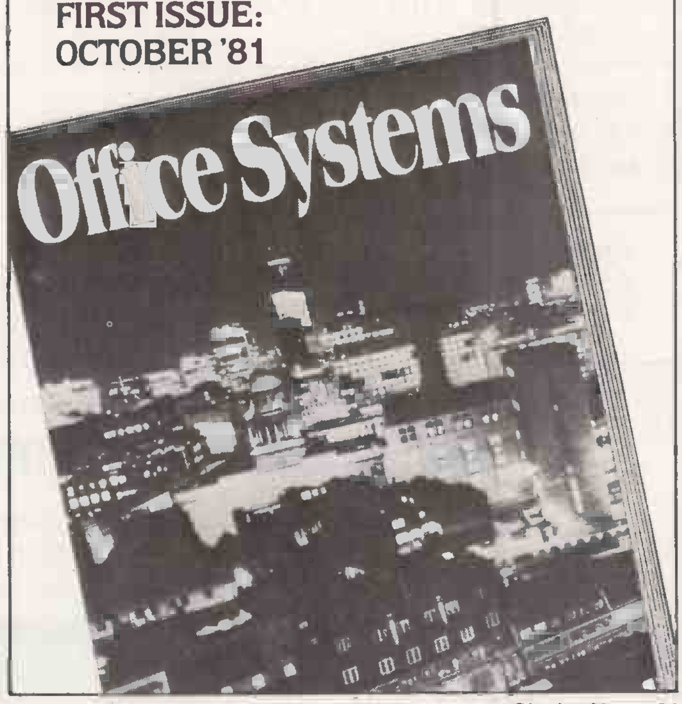

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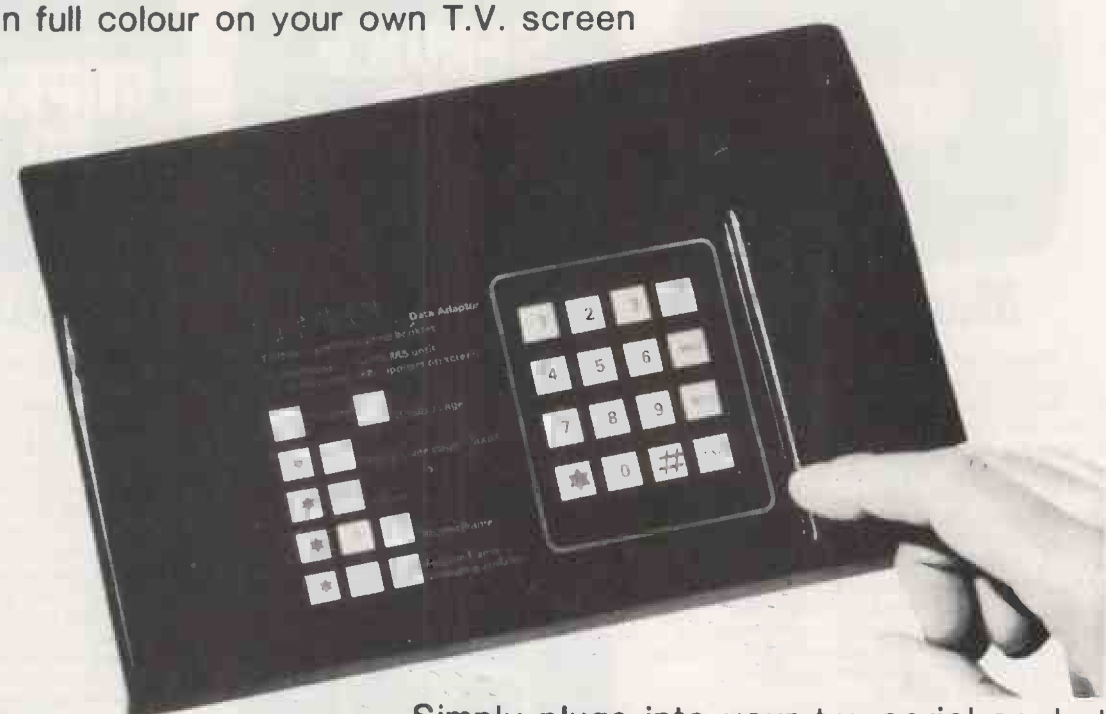

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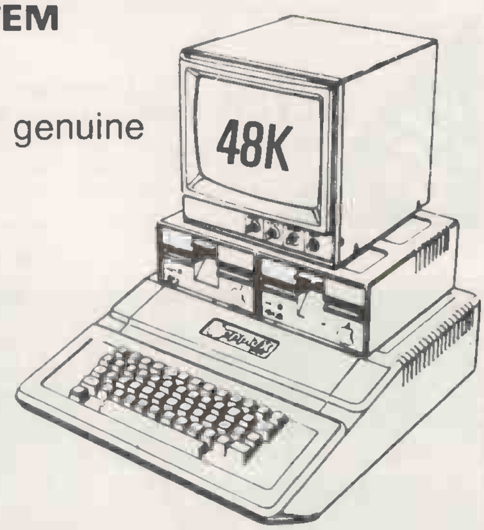

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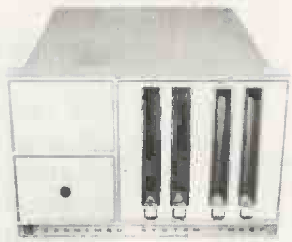

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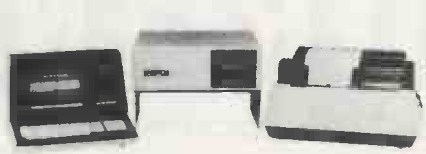

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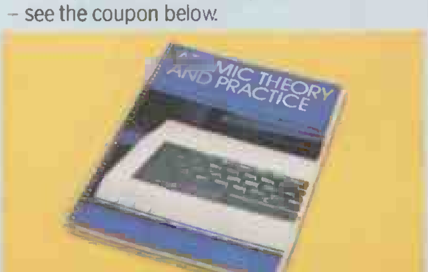

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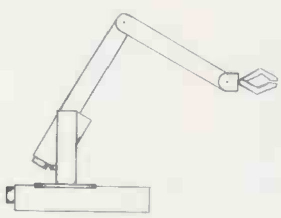

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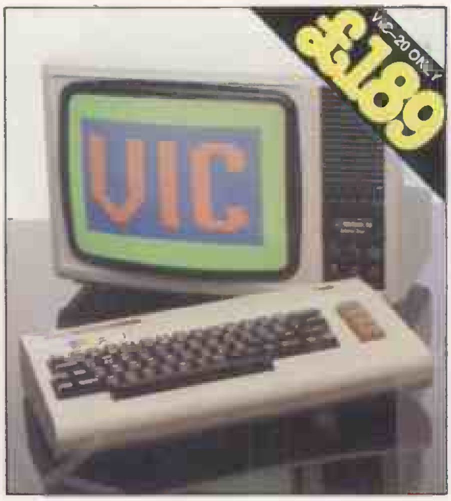

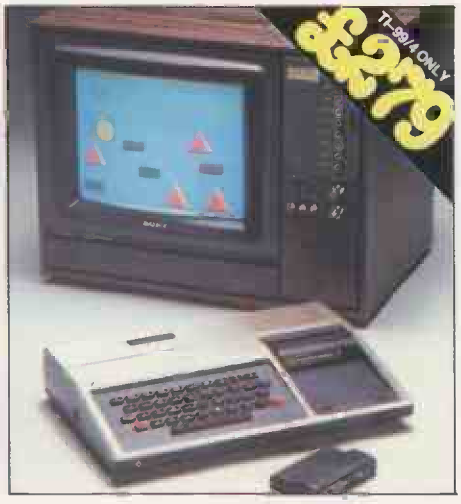

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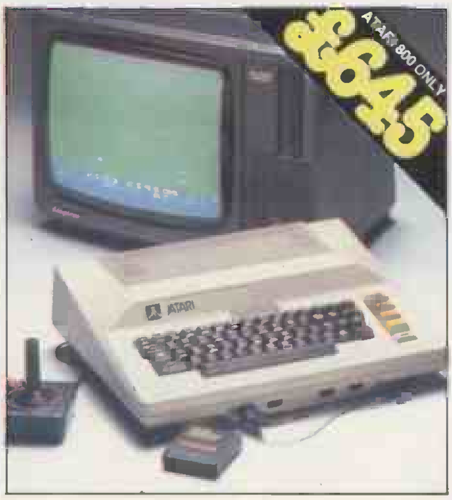

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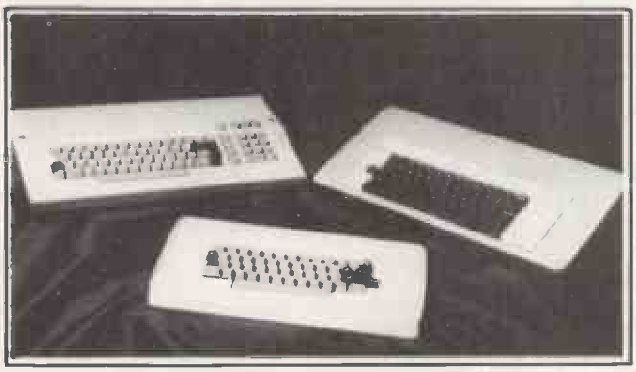

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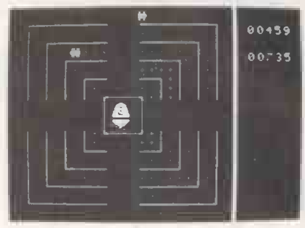

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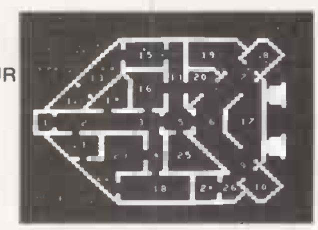
Snake Grow yourself a snake by guiding it towards digits which it eats. Program 2K, graphics ½K.



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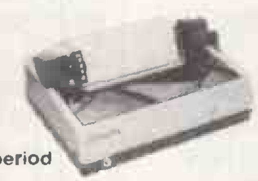

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Assembled & Tested. With MPU-A £570.00
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Includes I-8015 system and DS-8 Disk system w/CPM 2.2.
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BHL-5201

BHL-5200

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BHL-5201 ☐

BHL-5200 ☐

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Position/Dept.

Company

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PC1

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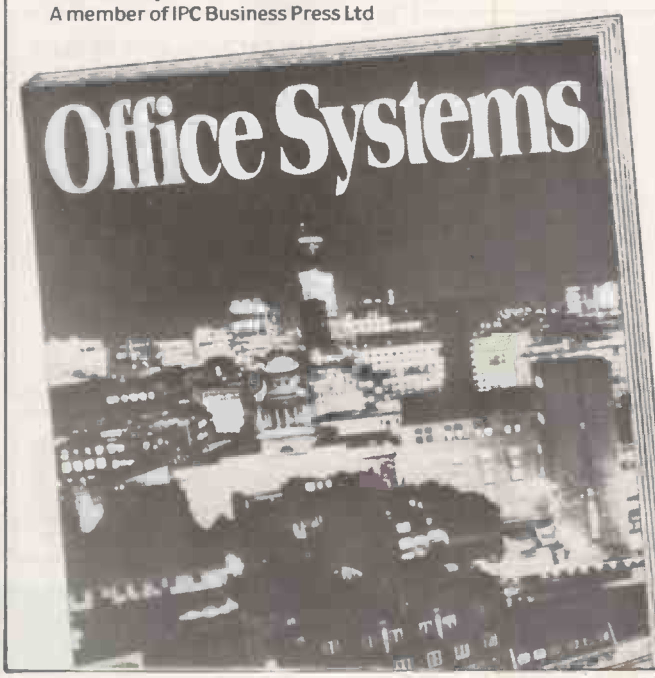

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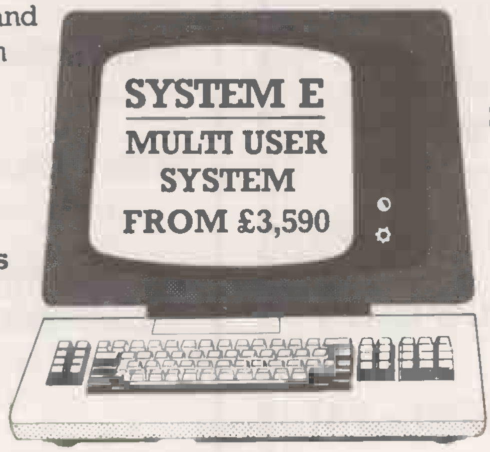

- Accountants
- Estate Agents
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- Solicitors
- Architects
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- Chemists
- Farmers
- Bankers
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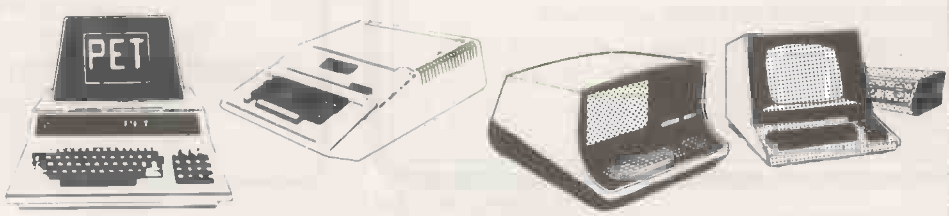

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6502CPU	495
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6530RRIOT	1350
6532RIOT	795
6545CRTC	1450
6551ACIA	785
6592PC	27
6800	375
6802	550
6809	1395
6810	175
6821	175
6840	470
6843	1459
6845	975
6847	795
6850	175
6852	195
8080A	450
8085A	550
81LS95	99
81LS96	99
81LS97	99
8212	210
8214	425
8216	200
8251	400
8253	799
8255	399
8257	800
8T26A	135
8T28A	135
8T31A	350
8T95N	135
8T97N	135
AY-3-1015	395
AY-5-1013	375
AY-5-2376	700
MC1488	62
MC1489	62
MC14411	695
MC14412	800
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ZN428	478
ZN429	210
ZN1034	200
ZN1040	685

TTL74

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	28
7407	28
7408	16
7409	16
7410	14
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7412	20
7413	24
7414	32
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7417	25
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7430	16
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7440	17
7441	68
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7445	65
7446	55
7447	50
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7460	16
7470	35
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7473	30
7474	25
7475	40
7476	30
7480	48
7481	120
7482	70
7483	50
7484	80
7485	95
7486	26
7489	205
7490	28
7491	45
7492	30
7493	30
7494	34
7495	50
7496	45
7497	120
74100	85
74104	54
74105	55
74107	32
74109	35
74110	40
74111	55
74112	170
74116	88
74118	80
74119	90
74120	75
74121	30
74122	45
74123	50
74125	42
74126	40
74128	42
74132	48
74136	35
74141	70
74142	190
74143	250
74144	250
74145	70
74147	99
74148	75
74150	80
74151	45
74153	45
74154	75
74155	75
74156	75
74157	45
74159	99
74160	60
74161	60
74162	62
74163	64
74164	64
74165	62
74166	65
74167	185
74170	168
74172	290
74173	65
74174	72
74175	72
74176	55
74177	75
74178	95
74179	68
74180	65
74181	140
74182	75
74184	99
74185	99
74188	290
74190	70
74191	70
74192	70
74193	65
74194	75
74195	65
74196	65
74197	65
74198	99
74199	99
74221	80
74246	150
74247	150
74248	150
74249	150
74251	80
74265	65
74273	195
74278	160
74279	90
74283	90
74284	199
74285	199
74290	105
74293	125
74297	236
74298	100
74365	55
74366	55
74367	55
74368	55
74390	99
74393	99
74490	120

74LS

LS00	12
LS01	13
LS02	14
LS03	14
LS04	15
LS05	15
LS06	15
LS08	15
LS09	15
LS10	15
LS11	15
LS12	15
LS13	30
LS14	48
LS15	15
LS20	15
LS21	15
LS22	15
LS26	18
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LS28	20
LS30	18
LS32	15
LS33	16
LS37	16
LS38	16
LS40	16
LS42	35
LS47	40
LS48	80
LS49	60
LS51	15
LS54	15
LS55	30
LS63	150
LS73	25
LS74	25
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LS78	24
LS83	50
LS85	80
LS86	38
LS90	35
LS91	80
LS92	36
LS93	36
LS95	45
LS96	120
LS107	43
LS109	30
LS112	30
LS113	40
LS114	35
LS122	44
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LS124	105
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LS126	30
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LS136	28
LS138	35
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LS145	75
LS147	199
LS148	99
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LS164	48
LS165	145
LS166	85
LS170	170
LS173	72
LS174	72
LS175	59
LS181	130
LS183	275
LS190	58
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LS192	58
LS193	65
LS194	40
LS195	40
LS196	58
LS197	85
LS200	345
LS221	60
LS240	96
LS241	96
LS242	85
LS243	85
LS244	80
LS245	118
LS247	40
LS248	65
LS249	68
LS251	40
LS253	40
LS257	48
LS258	40
LS259	85
LS261	195
LS266	25
LS273	90
LS275	290
LS279	88
LS280	250
LS283	45
LS290	57
LS293	46
LS295	215
LS298	130
LS299	420
LS300	175
LS302	175
LS320	270
LS323	270
LS324	200
LS325	320
LS326	330
LS327	315
LS347	150
LS348	190
LS353	185
LS353	185
LS365	37
LS366	37
LS367	37
LS368	90
LS373	75
LS374	75
LS375	48
LS377	90
LS378	69
LS379	65
LS384	250
LS385	378
LS386	28
LS390	62
LS393	60
LS395	199
LS396	190
LS398	275
LS399	220
LS445	140
LS447	195
LS471	620
LS490	245
LS541	135
LS571	620
LS640	225
LS641	225
LS645	210
LS668	175
LS669	150
LS670	175
LS673	550
LS674	750

74L

74L00	68
74L30	50
74L47	320
74L75	145
74L85	349
74L121	165
74L123	325

74S Series

74S00	60
74S04	73
74S132	138
74S138	240
74S158	240
74S188	210
74S189	158
74S194	380
74S195	795
74S201	
74S241	540
74S262	850
74S287	325
74S288	210
74S470	325
74S472	1150
74S475	825
74S571	620

75 Series

75108	350
75150	140
75154	150
75450	95
75451	70
75454	225
75491	89
75492	95

CRYSTALS

100KHz	290
200KHz	370
455KHz	383
1.0MHz	300
1.008MHz	395
1.28MHz	392
1.6MHz	323
1.8MHz	323
1.8432MHz	300
2.0MHz	305
2.4576	300
3.2768	300
3.57954M	195
4.0MHz	290
3.6864M	300
4.032MHz	323
4.433619M	135
5.0MHz	300
5.185MHz	323
5.24288M	425
6.0MHz	300
6.144MHz	295
6.5536MHz	290
7.0MHz	290
7.168MHz	290
7.680MHz	323
8.0MHz	300
8.08333M	362
8.867237M	362
9.375MHz	323
10.0MHz	300
10.7MHz	323
12.0MHz	392
14.31818M	362
16.0MHz	290
18.0MHz	300
18.432M	323
19.968MHz	300
20.0MHz	323
26.0MHz	383
26.69MHz	290
27.145MHz	300
27.648MHz	323
38.6667M	350
48.0MHz	323
100.0MHz	323
116.0MHz	300

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14 pin	10	35
16 pin	10	42
18 pin	16	52
20 pin	22	60
22 pin	25	70
24 pin	25	70
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Monitor Functions include:
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2x18way	140p	120p
2x22way	150p	125p
2x25way	165p	160p
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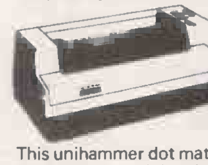

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SUITABLE FOR ALL PET COMPUTERS
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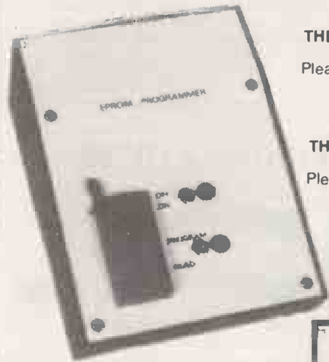

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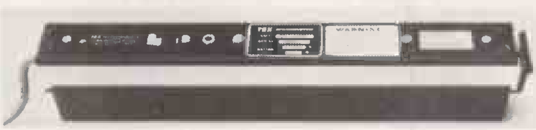

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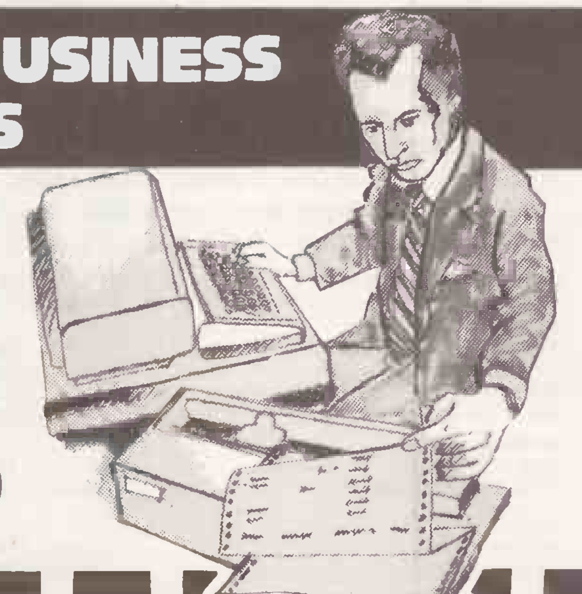

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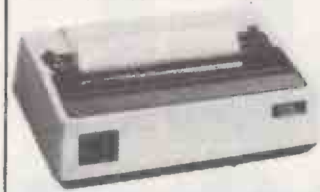

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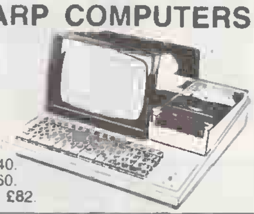

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INNOVATIVE

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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!

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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 suprising 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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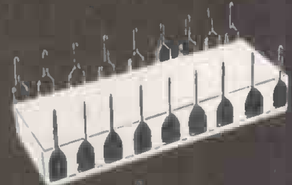

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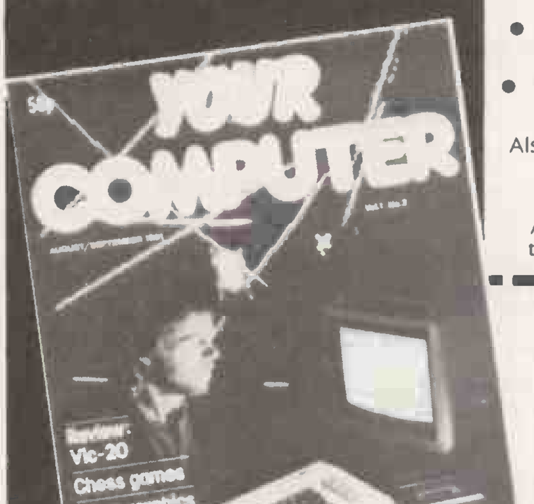

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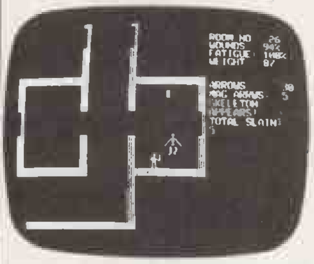

Temple of Apshai during play on the Apple computer.

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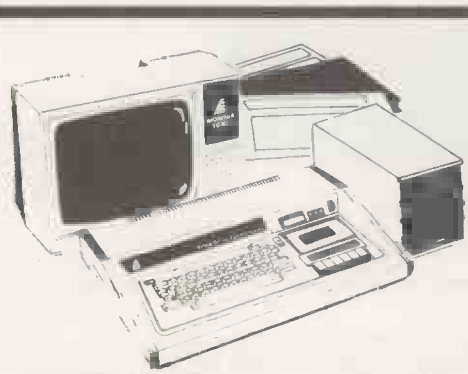

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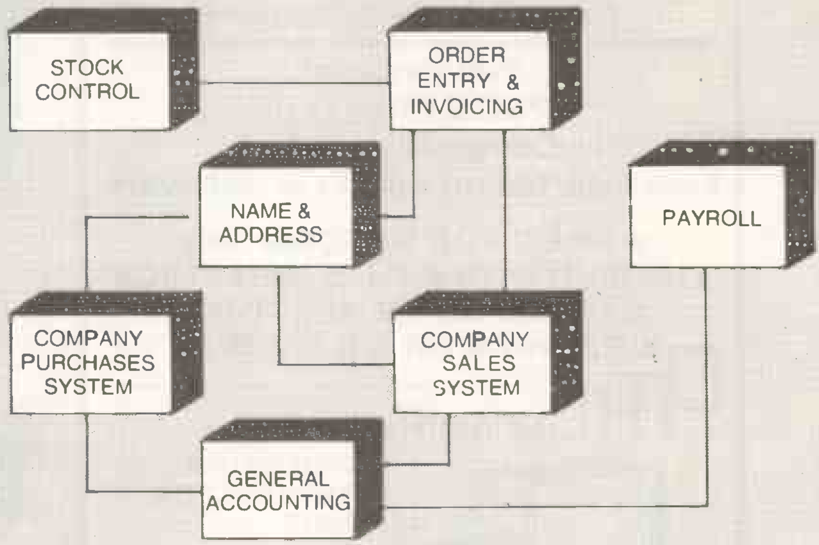

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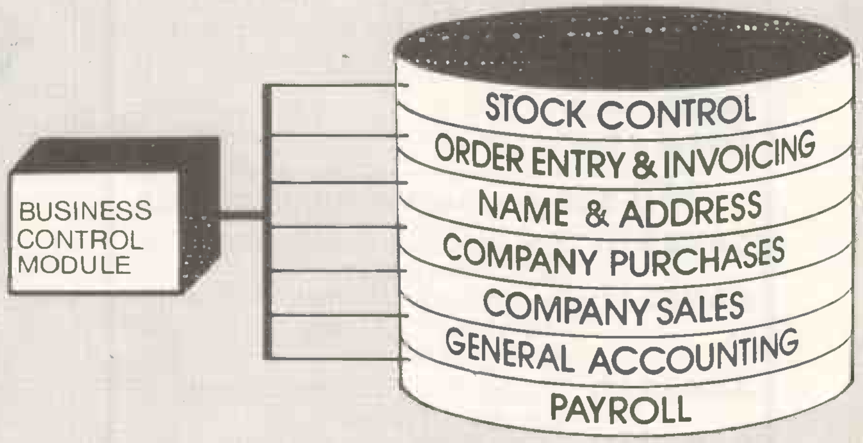

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74150	120p
74151A	50p
74153	50p
74154	90p
74155	60p
74156	60p
74157	50p
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74160	70p
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74162	70p
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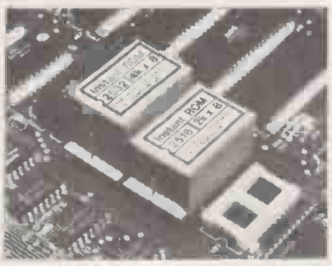

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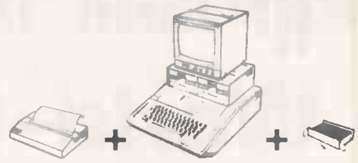

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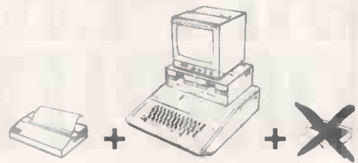

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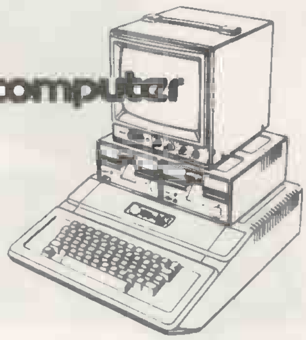

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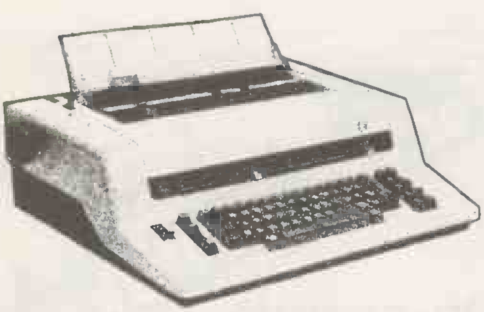

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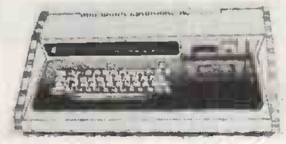

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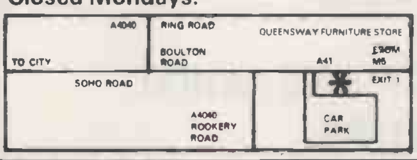

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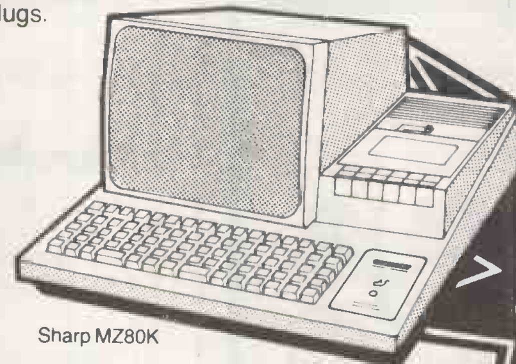
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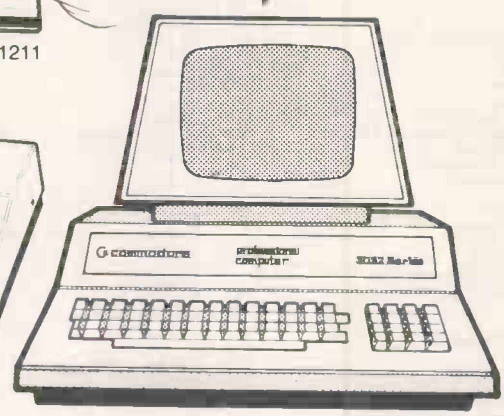
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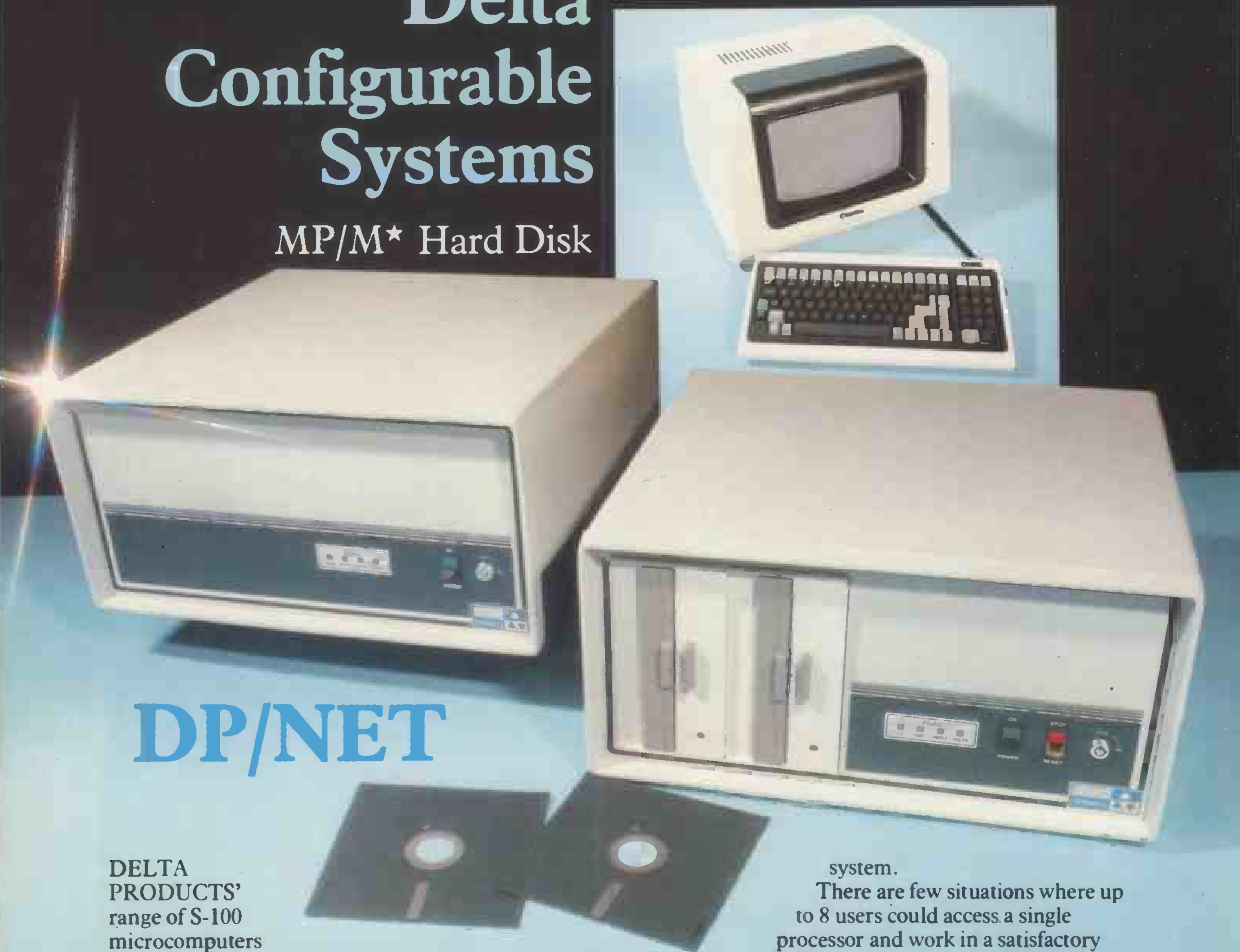

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