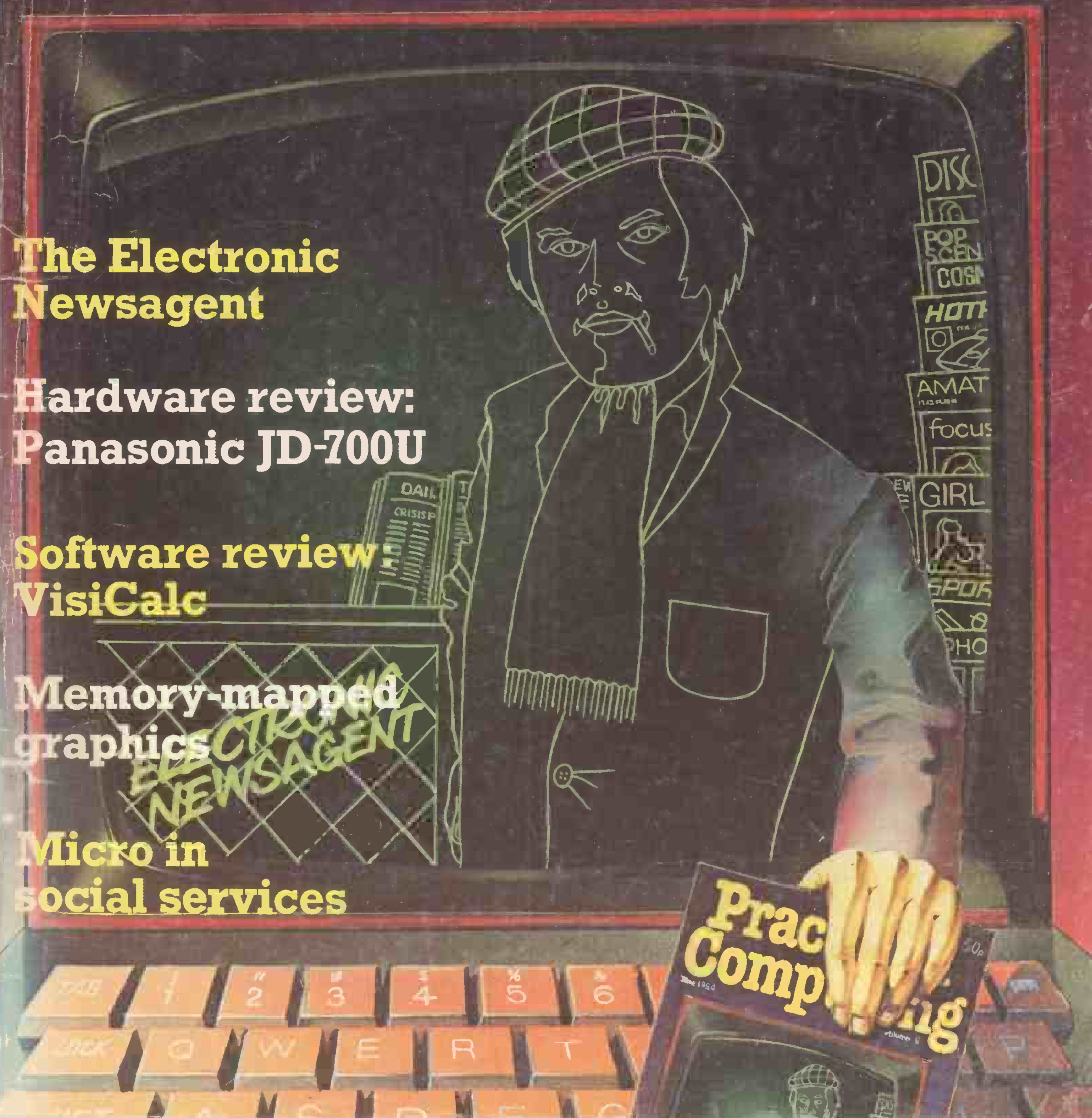
Practical Computing

60p

June 1980
Volume 3 Issue 6



The Electronic Newsagent

Hardware review: Panasonic JD-700U

Software review: VisiCalc

Memory-mapped graphics

Micro in social services

The best computers PLUS the best service

At MicroCentre, we're concentrating our resources on what we genuinely believe are the very best computers available today. . . . Cromemco computers, naturally. This way we can offer you the best deal possible.

Cromemco Model Z-2H hard disc computer. 10 megabyte hard disc, 2 floppy discs, Z-80 computer and 64K memory. MicroCentre price £5,326.

What we don't do

What we don't do is spread our expertise thinly amongst umpteen different systems, or try to stock every S100 product on the market. We don't claim to offer "impartial" advice on the best buy. And we don't sell from price lists or catalogues.

The MicroCentre approach

Some micro-computer suppliers work like that, but we don't. Because we realise that when you're buying a computer you want more than the "brochures and boxes" approach. You want to see computers running; to try them out with different software products; to study the documentation; above all, you want expert answers to your most searching questions.

Cromemco specialists

That's why we've specialised in Cromemco systems. Not simply because we think Cromemco systems are the best serious computers available at the price. But because by doing so we can dedicate our time, energy and resources to giving you the highest standard of Cromemco support possible.

Demonstrations

So when you visit MicroCentre expect to find Cromemco systems on permanent demonstration; expect the full range of Cromemco peripherals; single-user and multi-user systems; and interactive graphics.

Software

Expect a choice of operating systems and compilers to evaluate; expect complete documentation; and expect the largest collection of Cromemco systems software in the UK.

Expertise

Expect to find in-depth professional expertise at MicroCentre, the kind that is only acquired by installing Cromemco systems all over Britain. Expect a thorough appreciation of how Cromemco systems can be applied . . . in business, scientific research, industrial engineering, medicine and education.

Support

Expect to get frank, accurate answers to your questions at MicroCentre. Above all, once you've bought a Cromemco system from us, expect to get a very high standard of technical support with your hardware enhancements and continuing software needs.

At MicroCentre, simply expect the best.

MicroCentre's Cromemco demonstration room, with the full range of Cromemco computers, peripherals, operating systems and software products on permanent exhibition. Why not pay us a visit? We're only an hour's Shuttle flight from Heathrow!

For Cromemco... call the experts

NOW IN SPACIOUS NEW SHOWROOMS

Tel. 031-556 7354

Micro Centre

STILL IN CENTRAL EDINBURGH

Complete Micro Systems Ltd., 30 Dundas Street, Edinburgh EH3 6JN

● **Circle No. 101**

Read all about it — newsagents who use microcomputers to remove the drudgery from every-day chores.

Editor
Peter Laurie
Staff Writer
Duncan Scot
Production Editor
Toby Wolpe
Art
Margaret Smith
Editorial Secretary
Susie Manning
Advertisement Manager
Tom Moloney
Advertisement Executives
David Lake
Jeff Weinrich
Advertisement Secretary
Stephanie Hill
Consultants:
Technical **Nick Hampshire**
Software **Mike McDonald**
Videotex **Peter Sommer**
Publisher
Chris Hipwell
Editorial: 01-261 8752
Advertisements: 01-261 8000

Published by IPC Electrical Electronic Press Ltd, Dorset House, Stamford Street, London SE1 9LU, tel 01-261 8000, Telex/grams 25137 BISPRSG
Typesetting and artwork by Bow-Towning Ltd, London EC1
Printed by Eden Fisher Ltd, Southend-on-Sea
Distributed by IPC Sales and Distribution Ltd, 40 Bowling Green Lane, London EC1R 0NE
Subscriptions: UK, £6 per annum; Europe (ex UK), £12; rest of the world, £18 (including airmail postage). Enquire Subscription Manager, IPC Business Press (S & D) Ltd, Oakfield House, Perrymount Road, Haywards Heath, Sussex RH16 3DH, tel 0444 59188

ISSN 0141-5433

Would-be authors are welcome to send articles to the Editor but *PC* cannot undertake to return them. Payment is at £30 per published page. Programs intended for publication should ideally be justified to 22 or 44 or 66 characters per line.

Every effort is made to check articles and listings but *PC* cannot guarantee that programs will run and can accept no responsibility for any errors.

CONTENTS

The Cromemco Z-2H

NEW from Comart

11 Megabytes of hard disc storage in a fast, new, table-top computer.

- Fast Z80A 4MHz processor
- 11-megabyte hard disc drive
- Two floppy disc drives
- 64K RAM memory
- RS-232 serial interface
- Printer interface
- Extensive software available

Contact us direct or call your nearest Comart dealer

CAMBRIDGE	**CAMBRIDGE COMPUTER STORE**, Cambridge (0223) 68155
CAMBERLEY	**MICROBITS**, Camberley Surrey (0276) 34044
ILFORD	**THE BYTE SHOP**, Ilford Essex 01-554 2177
	also at Tottenham Court Road, London 01-636 0647
LEEDS	**HOLDENE LIMITED**, Leeds (0532) 459459
	also at Wilmslow Cheshire (0625) 529486
LONDON	**DIGITUS LIMITED**, London W1 01-636 0105
LUTON	**ISHERWOODS**, Luton Bedfordshire (0582) 424851
MANCHESTER	**MICROCOMPUTERMART**, Manchester (061-832) 2269
	also at West Park Leeds (0532) 788466
NEWBURY	**NEWBEAR COMPUTING STORE**, Newbury Berks (0635) 30505
	also at Stockport Cheshire (061-491) 2290
NEWPORT	**MICROMEDIA**, Newport Gwent (0633) 50528
NOTTINGHAM	**COMPUTERLAND LIMITED**, Nottingham (0602) 40576
	also at Birmingham (021 622) 7149
	Manchester (061 834) 0220
	Glasgow (041 332) 2468
SHEFFIELD	**HALLAM COMPUTER SYSTEMS**, Sheffield (0742) 663125
SOUTHAMPTON	**XITAN SYSTEMS LIMITED**, Southampton (0703) 38740

comart specialists in microcomputers

Comart Ltd., P.O. Box 2, St. Neots, Huntingdon, Cambs, PE19 4NY. Tel: (0480) 215005 Telex: 32514

• Circle No. 106

Britain's first comp

A complete personal computer for a third of the price of a bare board.

Also available ready assembled for £99.95

The Sinclair ZX80.

Until now, building your own computer could easily cost around £300 – and still leave you with only a bare board for your trouble.

The Sinclair ZX80 changes all that. For just £79.95 you get *everything* you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to your own cassette recorder and black and white or colour television; everything!

And yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers on the market at several times the price. The ZX80 is programmed in BASIC, and you could use it to do quite literally anything from playing chess to running a power station.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. Once assembled, it immediately proves what a good job you've done. Connect it to your TV set... link it to an appropriate power source*... and you're ready to go.

Your ZX80 kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs – all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to any portable cassette recorder.)
- FREE course in BASIC programming and user manual.

Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available – see coupon.)

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

Two unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you – don't worry. They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.)

A hardware manual is also included with every kit or built machine.

Z80A microprocessor – new, faster version of the famous Z-80 microprocessor chip, widely recognised as the best ever made.

UHF TV modulator.

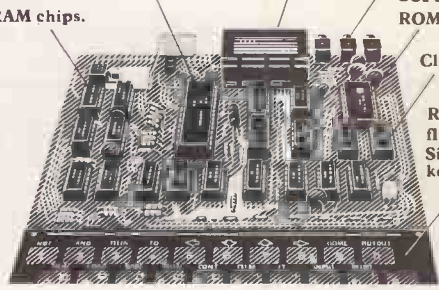
Sockets for TV, cassette recorder, power supply.

SUPER ROM.

RAM chips.

Clock.

Rugged, flush, Sinclair keyboard.



TVJ MICROCOM...

For Hardware, Software, Peripherals...

PET 2001

from £475

commodore authorised dealers

BASIC SYSTEMS

PET 3016 (16K RAM and large keyboard)*	£675.00
PET 3032 (32K RAM and large keyboard)*	£795.00
PET 2001-8 (PET with 8K memory + integral cassette	£475.00
PET 3008 (8K) with large keyboard	£475.00
PET C2N External Cassette Deck	£53.00

ACCESSORIES

IEEE/RS232 Serial Interface 'A' Output only	£106.00
IEEE/RS232 Serial Interface 'B' Input/Output	£186.00
Programmers Toolkit – 10 powerful new commands for your Pet – plug in ROM chip 8K and 16/32K resp	£75/£55
IEEE-448/Centronics type parallel Interface	£35.00
IEEE to Pet Cable	£19.00
IEEE to IEEE cable	£24.00
PETSET 1 16 Channel AD Convertor c.w. all interfacing requirements	£166.00

TRS 80

from £365

From Radio Shack Corp.

BASIC SYSTEMS

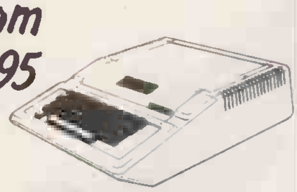
TRS 80, 4K Level I consisting of Keyboard with 4K memory, Video Unit, Cassette Drive and 240v power supply unit	£365.00
TRS 80, 4K Level II (as above with Level II Basic)	£425.00
TRS 80, 16K Level II (as above with 16K memory)	£499.00
TRS 80, Expansion Interface with 16K RAM	£275.00
TRS 80, Expansion Interface with 32K RAM	£360.00

ACCESSORIES

TVJ 232 serial interface	£35.00
Centronics Parallel Printer Interface (direct to keyboard)	£40.00
TRS 80, Voice Synthesizer	£345.00
TRS Voxbox – speech recognition system	£135.00
TRS 80, Numeric Key Pad supplied and fitted	£49.00
Radio Shack Phone Modem	£160.00
UHF Modulators (encased with leads for 625 lines)	£20.00
RAM upgrade (4-16K, 16-32K, 32-48K) supplied and fitted at our premises (Kit £80.00)	£85.00
S100 interface for TRS 80 (6 slots)	£375.00
TRS80 CPU 3 speed mod.	£26.00

APPLE II

from £695



apple authorised dealers

BASIC SYSTEM

Apple II Plus computer – APPLESOFT extended basic in ROM — (16K RAM) - video output £695

ACCESSORIES

Apple black and white modulator for domestic TV	£14.00
Eurocolor card – provides colour on domestic TV	£79.00
Parallel Printer Interface Card	£104.00
High Speed Serial (RS232C) Interface Card	£113.00
Communications Card	£130.00
Centronics Card	£130.00
Integer Basic Firmware Card	£116.00
PASCAL language system – includes language card to provide user with PASCAL, PALSOFT & INTEGER BASIC	£299.00
Real time clock/calendar card – 1/1000 sec to 388 days with interrupt, software controllable	£128.00
Speechlab – provides voice control for the Apple	£127.00
Supertalker – adds human speech output!	£136.00
ALF Music Synthesizer Card	£180.00
A1-02 Data Acquisition Card	£180.00
Graphics Tablet	£462.00
AC Line Controller	£270.00
RAM Upgrade (16-32K, 32-48K)	£69.00
Hobby Prototype Card	£20.00
Romplus – u, l/c, mixed text/graphics	£105.00

SORCEROR

from £740

authorised dealers

BASIC SYSTEMS

Sorceror (inc UHF Modulator)

16K RAM	£740.00	32K RAM	£790.00	48K RAM	£840.00

ACCESSORIES

Exidy Video Disk Unit (High Resolution monitor with Integral 630K Dual Drive)	£1790.00
Exidy S100 Unit	£240.00
Exidy Video Monitor	£240.00
CP/M on Disk	£145.00

ADVANCED SYSTEMS

ADVANCED SYSTEMS

TRS 80 Model II with integral 8" floppy disk drive and up to 64K RAM. Expandable up to 3 Megabytes Disk Storage (Available for demonstration – by appointment only). P.O.A.

ACT 800 Systems providing 108K RAM, 46K User RAM, full size screen, high-res graphics, Ultra-fast data access and up to to 4·8 MBytes on-line disk storage P.O.A.

Special Offers!

PET BUSINESS SYSTEM

comprising CBM 3032 Micro computer, CBM 3040 Dual Disk Drive, CBM 3022 Tractor Feed Printer and all cables £1999.00

News!

TVJ ARE ON THE MOVE!

Our Head Office is moving to larger and more prestigious showrooms (hopefully mid-May)

JOHNSON HOUSE
75/79 PARK ST,
CAMBERLEY, SURREY, GU15 3PN
☎ (0276) 20446

KINGSTON

KINGSTON — KRK 1

A hardware repeat key for the PET number/cursor pad — a boon to the busy programmer and the ambitious games programme writer. Aided by the detailed instruction programme the average PET owner can upgrade his machine in a couple of minutes without fear of a fatal 'no-no'. **£17.50**

KINGSTON — KRK 2

Initially the KRK 2 was conceived as a definitive full keyboard repeat key. However, Kingston ingenuity has optimized on their patented board accessing techniques to allow two invaluable features to be added:

The first, a warm keyboard reset from otherwise fatal crashes. The second, a selectable keyboard tone which allows touch entry at otherwise impossible speeds. We can say with confidence that this unit is an absolute must for any PET user who wants to get the best from his machine. **£35.00**

KINGSTON — KC 1

A totally new concept in PET's communication with the outside world. At long last the programmer is free from the limitations of the IEEE bus. INPUT, PRINT, LOAD and SAVE to an external RS232 device are now possible without recourse to ingenious/tedious software. A comprehensive on-board firmware package allows all manner of hitherto impossible functions to be achieved including keyboard selectable configuration with full modem control. **£135.00**

KINGSTON — KC 2

Having achieved one level of impossibilities, we knew someone would need more so here it is —

Simultaneous access to two RS232 serial devices or networks with all the features of the KC 1 and more besides. With this device we give PET users serial RS232 I/O capabilities, which the owners of much more expensive machines would envy. **£150.00**

KINGSTON — KSB 1

A twenty-way RS232 multiplexing/switching box with 'mind-blowing' potential — Applications of the unit are legion and range from simple networking through multiple disc sharing to multidevice complexes based on a single processor. **£350.00**

CMC ADA 1200

A low budget IEEE 488/RS232 unidirectional interface, with a proven record of reliability (Field failure rate better than ·1 percent). Since the unit is not addressable it is not recommended for use with the Commodore Disc. **£65.00**

CMC ADA 1400

An addressable IEEE 488/RS232 unidirectional interface, which is proving even more reliable than the ADA 1200 from which it was developed. While it was designed to offer only standard RS232 output it is sufficiently 'beefy' to cope with a number of less demanding current loop applications without modification. **£90.00**

CMC SADI

SADI — The microprocessor based serial and parallel interface for the Commodore PET. SADI allows you to connect your PET to parallel and serial printers, CRT's, modems, acoustic couplers, hard copy terminals and other computers. The serial and parallel ports are independent allowing the PET to communicate with both peripheral devices simultaneously or one at a time. In addition, the RS232 device can communicate with the parallel device. Special features for the PET interface include:

- Conversion to true ASCII both in and out.
- Cursor controls and function characters specially printed.
- Selectable reversal of upper and lower case.
- PET IEEE connector for daisy chaining.
- Addressable — works with other devices.

Special features for the serial interface include:

- Baud rate selectable from 75 to 192000.
- Half a full duplex.
- 32 character buffer.
- X-ON, X-OFF automatically sent.
- Selectable carriage return delay.

Special features for the parallel interface include:

- Data Strobe — either polarity.
- Device ready — either polarity.

Complete with power supply, PET IEEE cable, RS232 connector, parallel port connector and case. **£175.00**

CMC AIM 161

A low budget IEEE 488 16-channel analogue to digital convertor for the competent programmer who wants to 'do his own thing', With a 5·12 volt reference voltage the unit is normally accurate to better than ·5%. **£90.00**

CMC PETSET

An AIM 161 specially configured for plug-in and switch-on use by the less technically graced user. The unit has a number of helpful extras including an input connector board allowing simple screw connection to the outside world. **£135.00**

CMC APPLESET

Similar to the PETSET, saving that the unit is configured for use with the APPLE. **£135.00**

CMC TANDYSET

Similar to the PETSET saving that the unit is configured for the TANDY TRS80. **£135.00**

CMC XPANDR 1

Analogue to digital conversion of up to 128 channels can be achieved by simply connecting as many 16-channel AIM 161 units as you need through this smart board. **£40.00**

TNW Corporation

TNW 2000

With over 2,000 units sold, this IEEE 488/RS232 interface can truly be said to be tried and tested. Features include the conversion of both PET and true ASCII, daisy chaining and full address selection.

Standard RS232.	**£135.00**
Current Loop.	**£150.00**

TNW 3000

A bi-ported, bi-directional IEEE 488/RS232 interface offering everything the discriminating programmer could ask for. Features include independent crystal controlled Baud rate on both ports and fully implemented RS232 with extensive control line options allowing responsive throttling. **£220.00**

SSM

SSM — A10

Two powerful APPLE interface boards in one:

The first an RS232 serial with three handshaking lines (RTS, CTS and DCD), rotary switch selection of nine standard baud rates from 110 to 19200, including 134·5 for selectrics and the modes of serial communication under software control.

The second a double bi-directional parallel with four additional interrupt and handshaking lines, and interface configuration under software control. **£105.00**

NOTES

1. Every Kingston product is carefully burned in and tested before dispatch.
2. Kingston's guarantee, warrantee and service undertakings are probably the best in the business — If you would like to see what real customer concern is all about, then send for a copy of our standard Guarantee Form!
3. All prices quoted by Kingston are inclusive of packaging and shipping, but do not include V.A.T. — Please add 15% V.A.T. to any order.
4. We have a number of new and exciting products 'in the pipeline' including:
   (a) A family of rugged, low budget EPROM programmers and duplicators.
   (b) A number of new cost effective printers, including daisywheels and single and double pass (better quality) matrix.
   (c) A low cost TRS expansion.
   (d) A flexible/expandable industrial control system.
   (e) Emergency standby power units, ranging from a ·5 KVA baby to a 9·5 KVA mainline system.

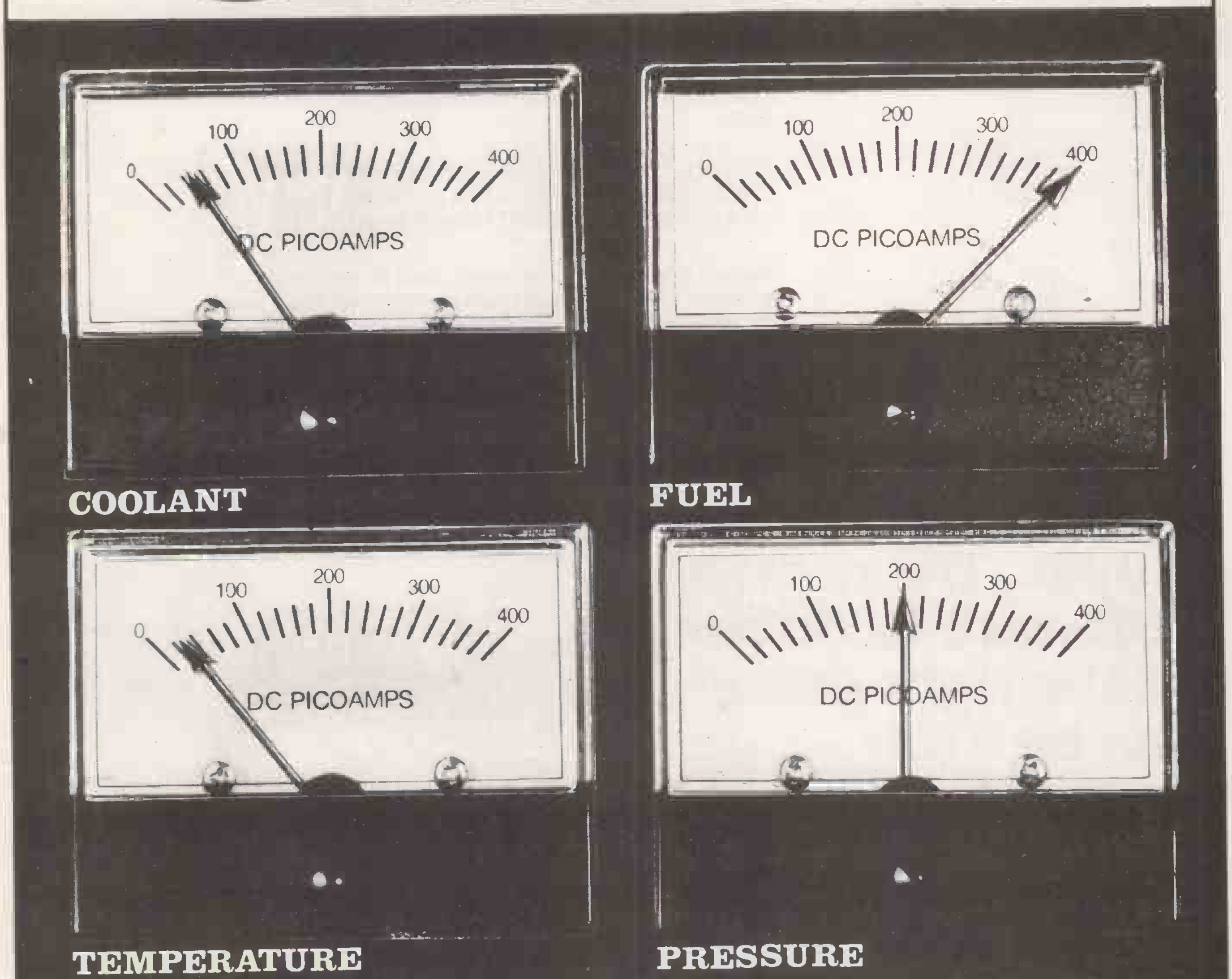
If you have an interest in any of these items, give us a call. As you might expect from a company which prides itself in being different, we maintain an engineer on call eighteen hours a day, seven days a week to help you.

KINGSTON COMPUTERS LTD

Scarborough House, Scarborough Road, Bridlington. Telephone 0262 73036


NOW THEY TELL ME !
KINGSTON CHRONICLE
KINGSTON PERIPHERALS MAKE MICROS' MIGHTY MICE !

Are you in Control?



WE CAN PUT YOU THERE!

We have experience in Advanced interfacing for micro-mainframe connection, control instrumentation and communications.

For further information please contact Jeff Orr or Graham Knott on 051 933 5511
Stack Computer Services Ltd, 290/298 Derby Road, Bootle, Liverpool 20.

STACK COMPUTER SERVICES

• Circle No. 118

Computer Gamble?

Visit Cambridge Computer Store and load the dice in your own favour! We have one of the biggest selections of micro-computers and peripherals in the country and the expertise to help you choose the right system. Most of the equipment listed below you can see on demonstration and buy off the shelf:

TANDY TRS 80 • APPLE • PET • HORIZON
CROMEMCO • COMPUKIT • ACORN • INFOTON
LEAR-SIEGLER • CENTRONICS • ANADEX

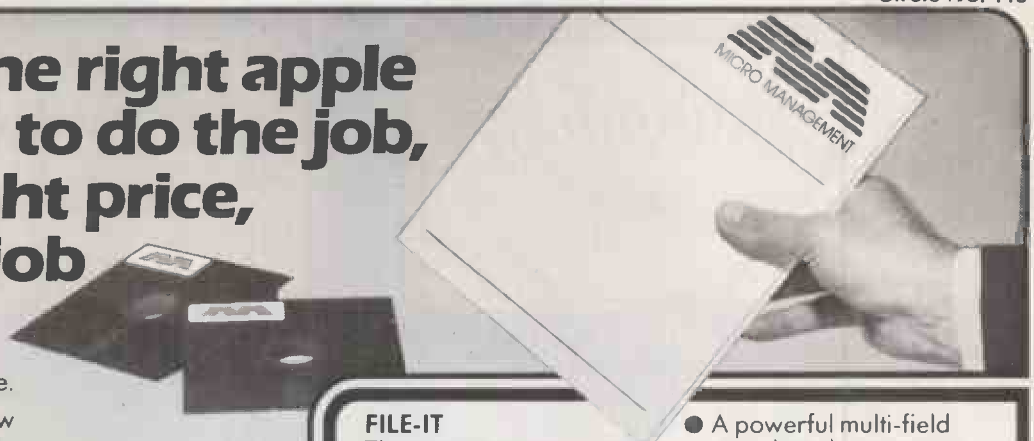
Back-up this impressive range with truly professional standards of advice and after-sales support and you'll take the gamble out of computer selection.

Cambridge Computer Store

1 Emmanuel Street, Cambridge CB1 1NE
Telephone (0223) 65334/68155

• Circle No. 119

Buying the right apple software to do the job, at the right price, can be a job in itself!



But it doesn't have to be.

Micro Management now have available a comprehensive range of quality software for business and commercial applications. Each package is user-tested before being released, and when released, carries our own guarantee. Software of such a high standard at a realistic price is hard to find, so end your search by asking for Micro Management software.

Micro Management software is available from your nearest dealer, or direct from us. We also offer a tailor-made service to suit your company's individual requirements.

FILE-IT
The Micro Management filing system offers the following facilities and benefits.

- A unique and fast user-orientated system
- Easily understood format
- No programming knowledge needed
- Ideal for staff, service or contract records
- A powerful multi-field search and compare facility
- 20 system files, with up to 1,000 records on each
- Up to 50 items on each record
- 10 field conditions
- Supports seven disk drives
- Complete with comprehensive manual

• £69 incl. p&p (ex VAT)

MICRO MANAGEMENT

13–15 Connaught Avenue, Frinton-on-Sea, Essex. Tel: Frinton 4592

Bringing the benefits of computer technology to the smaller business

• Circle No. 120

STACK

COMPUTER SERVICES LIMITED

WHAT LOGS, ANALYSES, PLOTS, PRINTS AND CONTROLS ???

APPLE II

All over Britain Apple II's are logging, controlling and analysing data for forward -looking research groups in industry and education
Apple provides a sensible solution to the headaches of data capture and analysis. Standard cards exist for 16 channel (8 bit or 12 bit) A/D conversion, parallel input/output, 3¾ digit analogue B.C.D., synchronous and asynchronous serial RS232 IEEE-488, D/A conversion....................
Apple will take data from B.C.D. instrumentation, strain gauges, thermocouples, spectrometers, gas chromatographs, diffraction gauges, pressure sensors, electronic balances etc.
The Apple's unique peripheral structure makes custom interfacing easy.
Powerful system firmware (including U.C.S.D. Pascal) means your application is up and running efficiently.
Interested?? call **Paul Fullwood or Carl Philips on 051 933 5511.**

SILENTYPE

The sensational new printer for Apple II.

* 80 characters per line.
* 8½" wide thermal paper.
* Full high resolution graphics at 60 dots Inch.
* Apple intelligent interface.
* 96 characters ASCII set, compatible with Pascal system.
* 40 characters per second.
* Microprocessor controlled.
* Bi-directional look ahead printing.
* Quiet operation.
* No external power supplies.
* Only two diven parts.
* High reliability.
* Clear 5 x 7 characters.
* Portable 12" W x 10" D x 2¾" H weighs 816lbs

2K Bytes of system firmware control operation of the Silentype providing a wide range of operating modes:

TEXT PRINTING Modes:
Computer output to screen and printer
Computer output to screen only
Computer output to printer only
Transfer text on screen to printer (ie emulates screen printer)

Formats:
Programmable page length
Programmable left margin
Programmable right margin
Programmable line length
Tabulation up to 80 columns

HIGH RES GRAPHIC SCREEN PRINTING Modes:
Uni-directional or bi-directional
High res page 1 or 2
Chart recorder mode (line feed suppression)

Formats:
Reverse or normal image
Optional 90% rotation of screen
Optional two-times screen size
Programmable left margin

SILENTYPE

Nett	VAT	Total
340.00	51.00	**391.00**

APPLE INTERFACE

Nett	VAT	Total
50.00	7.50	**57.50**

80ft paper roll

Nett	VAT	Total
2.25	0.34	**2.59**

THE LANGUAGE SYSTEM

Apple computer's innovative answer to the twin problems of software development and ROM obsolescence.

* 16K Write-protectable RAM on plug-in card gives all the advantages of ROM while allowing a choice of languages - Pascal, Applesoft, Integer Basic, assembler and forthcoming languages from Apple.
* Appropriate compiler/interpreter loaded into expansion RAM on switch on.
* Expands Apple RAM to 64K.
* Maintains compatibility with existing software.
* Gives Euro-plus owners access to the wealth of software, written for Integer Basic and programmers aid.
* Comes complete - 7 manuals, 6 disks, language card, replacement Roms, I.C. extractor.
*Full U.C.S.D. Pascal implementation compatible with Wirth's standard pascal.
*Provides mini-computer like operating system with full screen editor, filer, compiler, p-code interpreter, macro-assembler, demonstration programmes.
*Disk capacity (under Pascal) enlarged to 143K per disk.
* Fully compatible with external terminal.
* 80 character/line with horizontal scrolling.
* Apple oriented extensions allow direct control of keyboard, paddles, loudspeaker, cassette inputs, TTL in, TTL out.
* Turtlegraphics extensions provide the easiest way to use Apple's high resolution graphics.
* Highspeed powerful firmware graphics system.
* INIT, PENCOLOR, TURN, TURNTO, MOVE, TEXT, GRAF, DRAWBLOCK commands.
* Intrisics WCHAR, WSTRING provide software character generator - easy method of labelling axis, graphics and mixing upper/lower case and user defined graphics on the high-res screen.

APPLE LANGUAGE SYSTEM

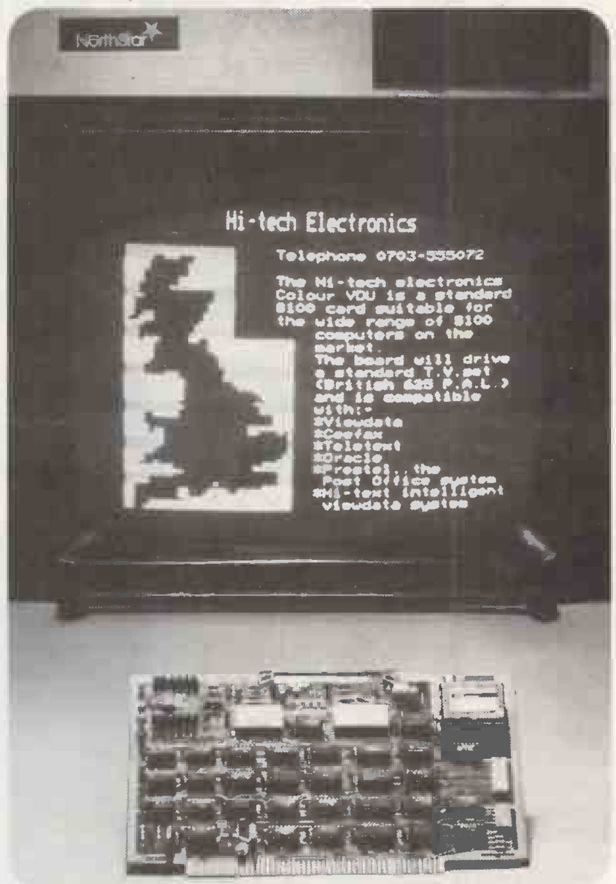
Nett	VAT	Total
299.00	44.85	**343.85**

New Peripherals??? If its for the Apple, exists and works, we already have it!

Stack-Apple experts in the North-West. 290/298 Derby Road, Bootle, Liverpool 20. Telephone 051-933 5511.

• Circle No. 121

IN-HOUSE VIEW DATA SYSTEM



Full specification colour viewdata system, compatible with Ceefax, Prestel etc. Implemented on Cromenco, North Star or an existing S100 machine. Uses unmodified tv. Single or multi-user, up to 11,000 frames stored. Intelligent 'soft-key' frame-editing. Modem/autodialler will allow interface to Prestel, the Post Office Viewdata system, or other distant viewdata bank.

Prices from £800 to £15,000

hi-tech electronics

1 Richmond Gardens, Highfield Southampton SO2 1RY
Telephone (0703)555072

• Circle No. 129

MICROSPEECH

Does your computer speak to you? 'WEHL IHT KAAN DOO WIHTH MEE!'

Features

- Single PCB plugs directly into an SWPTc 6800 bus.
- 9 parameter vocal tract model.
- Realtime software converts any stored phonetic code to speech.
- Computer Games.
- External input for special musical effects.
- Adds speech output to existing BASIC programs.

Microspeech package

- Speech synthesizer board (*assembled & tested*).
- MSP2 Software on floppy disc or cassette.
- Hardware & Software manual.
- Speaking BASIC software option.

Make your computer talk

Just by entering phonetic text (as in the sentence at the top of the page). Microspeech with the MSP2 software can make your computer speak. MSP2 uses only 4K of memory. Every extra 1K of buffer space can store 90 seconds of speech.

It speaks for itself

TIM ORR DESIGN CONSULTANT
55 Drive Mansions, Fulham Road, London, SW6

COSTRONICS ELECTRONICS
13 Pield Heath Avenue, Hillingdon, Middlesex

• Circle No. 130

Happy Memories

4116	200ns	£4.50	4116	150ns	£5.50
2114	200ns	£4.75	2114	450ns	£4.25
2708	450ns	£4.95	2716	5 volt	£16.95
21L02	450ns	85p	21L02	250ns	£1.25

VERBATIM mini discs soft sectored — with FREE library case £19.95 per ten

SALE

We're moving shortly to new premises and don't want to carry much.
Bargains from Sat. 26th April
All prices include VAT.
30p postage on orders below £10.
Access & Barclaycard.
All orders to:
Dept. PC

19 Bevois Valley Road, Southampton, Hants. SO2 0JP
Tel: (0703) 39267

• Circle No. 131

TERODEC

Central Data

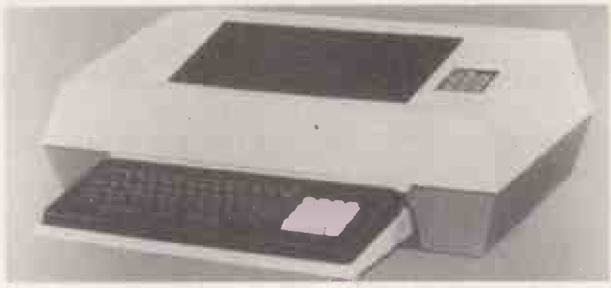
New RAM Prices.

Frm The Dynamic Memory Company.

● Deselectable in 2K increments — the deselect allows 2K areas of memory to be switched off to avoid memory overlap ● Z-80 and 8080 compatible at both 2 MHz and 4 MHz ● Fully socketed — allows the user to expand the board ● Power saving Dynamic RAM with invisible refresh ● Plug selectable addressing ● S-100 compatible ● Reliable — one year guarantee.

16 — £205	**32K — £270**
48K — £335	**64K — £400**

4 MHz Boards at £5/16K additional



DECISION DATA PRINTERS

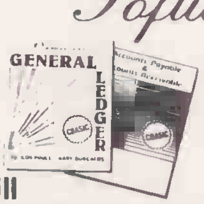
Bidirectional Printer with microprocessor versatility.

- Baud rate switch selectable.
- Variable character size and density.
- Quick change cartridge ribbon.
- Robust 7 × 9 dot matrix print head.
- Bidirectional paper movement.
- Table top design.
- Microprocessor controlled.
- Quiet operation.
- Horizontal and vertical tabs.
- Graphics capability.
- Self test.
- KSR and RO models.
- 150 character/sec.
- Easy serviceability.
- Bi-directional printing for high throughput.
- Industry standard RS232C and Centronix parallel interfaces.

3241 150cps 132 col RS232C RO	**£1450.00**
6541 150cps 132col RS232C KSR	**£1575.00**
Centronics Interface	**££75.00**

Software

TERODEC
ANNOUNCE
BUSINESS SOFTWARE
from A. Osborne/MCGraw-Hill



Here, at last, is low-cost business software complete and ready to run on many of today's inexpensive microcomputers. The programs are written in CBASIC version 2, a popular commercial BASIC for 8080/Z80 microcomputers which use a CP/M operating system.

The documentation includes a complete operators manual, with screen display formats and sample reports. And there is more: file descriptions and layouts, an explanation of pertinent CBASIC features, suggestions on how to change the programs, and program and data file installation instructions. In addition, the source listings themselves are thoroughly documented with in-line remarks.

ACCOUNTS PAYABLE & ACCOUNTS RECEIVABLE — CBASIC

Features Include:

- accounts payable check printing with invoice detail
- accounts payable invoice aging
- automatic postings to general ledger
- accounts receivable progress billing
- accounts receivable partial invoice payments
- accounts receivable customer statements

GENERAL LEDGER — CBASIC

Features Include:

- accumulation of postings from accounts payable and receivable
- trial balance
- income and expense statement
- balance sheet
- cash journal

PAYROLL WITH COST ACCOUNTING — CBASIC

Features Include:

- Interactive data entry with easy correction of data entry errors
- Monthly, quarterly, and yearly cumulative totals for each employee
- Summaries of the current year's paychecks for each employee
- Job costing (labor distribution) with cumulative totals and overhead calculations
- Flexible deduction schedule for every employee
- Check printing with full deduction and pay detail
- 16 different reports

Each package **£150** — Documentation only **12**
Programs require CBASIC-2

TERODEC sell these programs because we use them in our own business. They're on line now, working for us and others around the country.

OTHER APPLICATION PACKAGES

INVENTORY I — Gives a detailed listing of items in inventory and itemizes all goods sold from inventory, including which sales person sold what, when it was sold and for how much . . . recaps on one sheet this same inventory activity information . . . investigates and changes inventory on request . . . prints list of items to be reordered . . . provides profit analysis comparing sales personnel and/or various products. Requires CBASIC **£300/£25**

INVENTORY II — Two programs combine to offer support to the retailer or manufacturer. 'Build', 'Buy' and 'Cost' commands display information for review and analysis. Inventory alarm levels and cash flow plotting are but a few features. Requires UCSD PASCAL **£250/£10**

ANALYST DATA-BASE — Customised data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval and update facility makes information management easy. Sophisticated report generator provides customised reports using selected records with multiple level break-points for summarisation. Requires CBASIC-2, 80 × 24 VDU, printer and 48K system. **£150/15**

WORDSTAR — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, centre and underline. User can print one document whilst simultaneously editing a second. Edit facilities include global search and replace, read/write to other text files, block move etc. Requires VDU with addressable cursor positioning. **£255/£25**

HIGH LEVEL LANGUAGES

CBASIC-2 — A very powerful pseudo-compiler which has been used to great success in many business applications. Low cost and high performance together with minimal memory requirements dictate consideration of CBASIC for a run time basic only or for new design compatability.

CIS Cobol — Version 3	**£295/£25**
Version 4	**£395/£25**
Disc Extended Basic	**£155/£15**
Fortran-80	**£205/£15**

OPERATING SYSTEMS	
CP/M Ver 1.4	**£85/£15**
CP/M Ver 2.0	**£170/25**
MPM	**£200/£30**

TERODEC SYSTEMS LTD
16-17 College Place,
Southampton, Hants.
Tel: (0703) 39511-5

TERODEC
(MICROSYSTEMS) LTD
17 The Gallop, Yateley,
Camberley, Surrey.
Tel: (0252) 874790
(0344) 51160

All information is correct at the time of going to press. Prices exclude VAT and delivery.

• Circle No. 135

The perfect match
Low cost, high performance micro terminals

MODEL 730
Miniprinter £555

The Model 730 dot matrix printer is a high-quality printer ideally suited for microcomputer applications. It has been designed for small business users who look at their printer as a reliable provider of hard copy information. The Model 730 is ideal for these applications because it prints quickly at 100 c.p.s., is easy to operate, and offers the convenience of handling three different kinds of paper: cut sheets, paper rolls, or fan-folded (such as pre-printed forms).

The 730 can handle any of those three paper forms interchangeably – without adjustments – producing an original and up to two clear carbons.

Its 80 column line length matches most standard VDU formats, and its compressed print mode allows 132 column printing on 8" wide paper. The 7 x 7 matrix assures excellent print quality even with 3 part forms. Full upper and lower case 96 character ASCII set is standard.

MODEL 1420
Video terminal £680

The H1420 is a new low-cost video terminal designed to support small business systems using both data and word processing software.

It features a typewriter-style keyboard arrangement with both upper and lower case, making it suitable for fast and accurate entry with minimal operator training. Also included is a separate numeric keypad to make numeric entry faster, easier and less prone to error. Among other important features are cursor control keys, typematic and an alternate function keypad. Characters are displayed using a crisp 7 x 9 matrix on a 24 x 80 character screen in high and low intensity, blink or non-display (zero intensity).

The H1420 is an economy terminal with all the features needed to support a variety of microcomputer applications and human engineering design for adaptability and reduced operator fatigue.

To RAIR Limited 30-32 Neal Street, London WC2H 9PS
Telephone: 01-836 4663. Telex: 298452.

Name
Position
Company
Address
Telephone number

I wish to order MODEL 730 ☐ MODEL 1420 ☐ COMBO ☐
Please send more information ☐

RAIR

COMBO PRICE
Buy both terminals for a total price of
£1099

• Circle No. 138

THE EXIDY PROFESSIONALS

offer

LOWER PRICES

Exidy Sorcerer	16K	£749
	32K	£799
	48K	£849

NEW PRODUCTS

315K. Single Disc Drive £599
This connects directly to the Sorcerer — it does not require the S100 expansion unit.
315K Add-on Drive £450

SELECTED SYSTEMS FROM OUR RANGE

SYSTEM 1
Full professional System
48K Computer
Quality green phosphor monitor
Ricoh Dairywheel Printer
Twin 315K Disc Drives
Word Processor
CP/M, Basic
£3650

SYSTEM 2
Single Disc System
32K Computer
Quality green phosphor monitor
Microline matrix printer
Single 315K Disc Drive
Word processor
CP/M, Basic
£2200

SYSTEM 3
Cassette-Based System
16K Computer
10" professional monitor
Microline matrix printer
Word processor ROM-PAL
Basic ROM-PAL
£1450

RICOH RP-40 DAISY WHEEL PRINTER

We use this in our systems for really high quality word processing work. We are also able to supply it alone at a remarkably low cost. It is supplied complete with friction feed and interface for the amazing price of: £1450.00

PRICE INCLUDES Choice of interfaces: Centronics, PET or TRS-80
OPTIONS INCLUDE Tractor feed. Single sheet feeder. RS-232 version. Choice of 10 and 12 pitch fonts.

THE MICROLINE 80 PRINTER

This advanced design printer leaves other more expensive matrix printers way behind. It is compact and quiet. It has friction and pin feed. It has standard, condensed and double width print. The quality of both printer and print are extremely high. All this and more, yet the cost is only: — £499.00

**All above prices exclude VAT.

Optional tractor. Centronics interface standard, others available.

SOFTWARE — THE KEY TO SUCCESS

Any system large or small requires software. We can now offer OVER 200 PROGRAMS for the Sorcerer, ranging from full business systems to cassette-based games and operating aids. Please send large SAE and we will send you free details of all of these programs.

All of the above products and services are available from these two Exidy professionals:

BASIC COMPUTING
Oakworth Road,
Keighley, W. Yorks. BD22 7LA.
Tel: 0535-65094 — Mike Collier

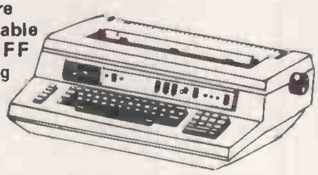
MICROPUTE
9 Prestbury Road,
Macclesfield, Cheshire SK10 1AU.
Tel: 0625-612759/612818 — Don Cooper

• Circle No. 143

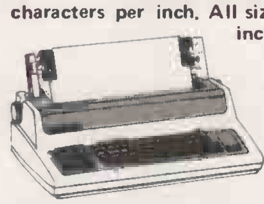
The Rohan Computing Collection.....

Rohan computing, in addition to their normal software and systems consultancy services, now offer the following range of computer equipment for sale. As far as possible Rohan computing try to hold these items in stock ready for immediate delivery. Nationwide on site maintenance for all Rohan computing equipment.

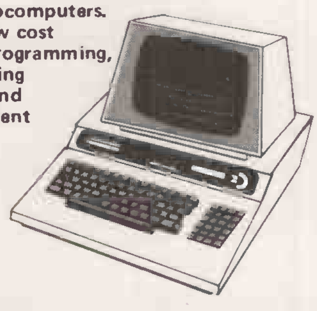
Qume The Qume is ideal as a general purpose printer or for adding word processing facilities to an existing microcomputer. Print only and keyboard versions available. The keyboard version can double as a spare typewriter. RS232 interface adaptable for the PET, APPLE, etc. XON/XOFF protocol available. Word processing package/driver available for CP/M based systems. Other versions in preparation.



digital Digital Decwriter IV. The best desk top matrix printing terminal available. Typewriter styling. 10,12,13.2,16.5 characters per inch. All sizes very legible. 2,3,4,6,8,12 lines per inch. Optional tractor feed and numeric keypad. RS 232 interface.



PET Commodore PET microcomputers. The PET is the ideal low cost computer for teaching yourself programming, educational use and time consuming calculations in science, industry and commerce. Graphic display excellent for histograms etc.
*8k PET with integral cassette and minikeyboard
*16 & 32k PET's with full sized professional keyboards.
*2022 matrix printers
*2040 floppy disc units.



CIFER Cifer 2600 Series VDU's. Superbly engineered and made in Britain. *12 inch screen.
*7 x 11 character matrix
*9 x 12 matrix for graphic characters
*62 or 100 key detachable keyboards
*Printer port
* VT52 emulation
*Line drawing set

RAIR Blackbox, Teletype 43s, Tally high speed matrix printers also available.

Rohan

Phone Richard on SOUTHAM (092681) 3541 for prices and delivery.
Rohan Computing, B.A.S.S. (Engineers) Sales Limited, Kineton Road, Southam, Warwickshire CV33 ODQ

• Circle No. 144

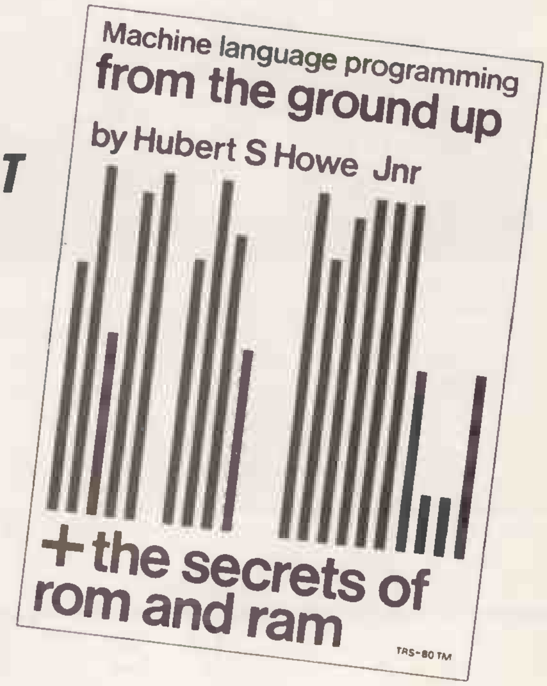
INNOVATIVE

TRS-80 SOFTWARE

FROM THE PROFESSIONALS

MACHINE CODE FROM A PROGRAMMER'S VIEWPOINT

- **HOW TO M/C PROGRAM**
- **ROM CALLS LISTED**
- **RAM LEVEL 2 USAGE**
- **DISKS EXPLAINED**



A book written by a well known programmer for people who not only want to learn machine code programming but who also want to use their knowledge in practical programming applications - from the ground up. Learning the Z-80 mnemonics, register handling and so on is important but what is essential is to be able to call the dozens of subroutines in Level 2 ROM, how to make use of the ROM user addresses in RAM and to know how the disk directories work. To learn your machine code programming from a book which does not contain this information is akin to driving a car without knowing the route you wish to take - it can be done but it is much easier knowing where you are going and how to get there !

Hubert Howe's book is written in easy to understand language and in a clear and logical manner. Two-thirds of the book is devoted to actual applications and examples. It assumes that the reader has no knowledge of the subject. If you can use Basic, you will understand this book.

£ 8.50

Plus 50p P & P.

Send large SAE (27p) for our current catalogue of TRS-80 software. Add £1.85 for a binder

A.J.HARDING (MOLIMERX)

28 COLLINGTON AVENUE, BEXHILL-ON-SEA, E.SUSSEX. TEL: (0424) 220391

TELEX 86736 SOTEX G FOR A. J. HARDING

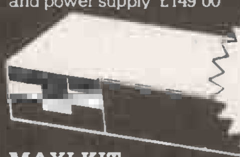
BARCLAYCARD VISA

• Circle No. 145

OFF THE SHELF AVAILABILITY FROM COMPUTER CENTRE

KIT PACKAGES

MINI KIT
The lowest priced CP/MZ80 Micro in UK Add your power and terminal Minifloppy 16KB RAM, Z80, CTC, serial + parallel I/O, S100 motherboard, connectors, manuals, CP/M system Free basic and Algol
Optional two drive case illustrated and power supply £149 00



£800

MAXI KIT
8" drive, CP/M disc operating system, 16K bytes, Z80, serial and parallel I/O, S100 motherboard, connectors and cables

£911

Optional power supply kit. £77.00

THE MEGABOX

MEGABOX - S
Twin 8" single sided drives plus Power Supply
Unit in an attractive box.
* Up to two megabytes
* Attractive 3 U case
* Fan cooling
* Mains switch

£913

MEGABOX - D
Twin 8" double sided drives plus Power Supply
Unit in an attractive box **£1090.00p**

8 INCH DRIVE

SCHUGART COMPATIBLE
Single/dual density
8" disc drive
Assembled and guaranteed

£350

Double sided version £450

MINI FLOPPY

Double/single density hard or soft sector, used for TRS80, North Star etc Assembled and guaranteed

£175

TRS 80 EXPANSION

DISC DRIVE
5¼" disc drive + power supply in attractive case

£199

PRICE LIST

	KIT	ASSEM
OEM PACKAGED SYSTEMS		
OEM1 Z80, 32KB, 1SER, 1PAR 2 x ¼ MEG Disks		1970.00
OEM2 Z80, 48KB, 1SER, 1PAR 2 x ½ MEG Disks		2270.00
OEM3 4MHz, 64KB, 2SER, 1PAR 2 x 1 MEG Disks		3570.00
DISC DRIVES		
SA400 mini floppy disc drive		175.00
DRI 7100 8 inch drive (single sided)		350.00
DRI 7200 8 inch drive (double sided)		450.00
VDU'S		
Pentland (full spec)		590.00
PRINTERS		
DRI 6320 (140 cps Max) 132 chts, Tractor Feed		1500.00
ANADEX 8000		499.00
SOFTWARE		
CP/M operating system + 6 manuals + basic E		70.00
Library index (33 volumes available)		2.80
Library copies on 8 inch media		4.40
Library copies on 8 inch media (10 or more)		3.40
Microsoft BASIC		193.00
Microsoft FORTRAN		267.00
Micro focus compact COBOL		376.00
Micro focus forms		75.00
UCSD PASCAL		193.00
Microsoft BASIC compiler		211.00
WORDSTAR		193.00
MPU	**KIT**	**ASSEM**
CB2 Z80A 1EEE S100	112.00	136.00
IDS Z80A CPU BOARD		115.00
SBC 100 Z80 + serial + parallel	155.00	197.00
SBC 200	182.00	242.00
DISC CONTROLLERS		
Tarbell single density	132.00	188.00
Tarbell double density	188.00	244.00
Versafloppy 1 single density	135.00	190.00
Versafloppy 2 double density	184.00	241.00
Nat Mux double density		215.00
Tarbell Cassette Interface		104.00
MEMORY		
8K bytes Econoram 2 (4MHz) static ram	84.00	100.00
16K bytes Econoram 4 (4MHz) static ram	145.00	178.00
24K bytes static	214.00	259.00
32K bytes static ram	302.00	349.00
Expandoram 2 (Dynamic) 64K population	663.00	713.00
Expandoram 1 (Dynamic) 64K population	366.00	416.00
I/O		
2SIO (2 serial full hand shaking uarts)	105.00	136.00
IO4 2 serial/parallel	86.00	129.00
SPECIAL BOARDS		
VDB-8024 (80 chts x 24 lines) video	194.00	263.00
PB1 2716/2708 eprom programmer	78.00	122.00
Memtech 3MHz floating point board		280.00
Prototype board		16.60
2708 prom board (ex proms)	52.00	63.00
VB1 16/32x64 video	78.00	107.00
MT3 11 slot motherboard		21.00
S100 extender + logic probe		31.20

Dealer, Educational and Quantity Discount Available.

OEM RANGE

FROM UNDER £2000

- ☐ **Up to 2 Megabytes of floppy disc storage**
- ☐ **High speed Z80 micro**
- ☐ **Up to 64K bytes fast ram storage**
- ☐ **High level operating system (supports Cobol, Fortran, APL, Basic, Pascal, Wordstar)**
- ☐ **2 drive minimum system under £2000**

Available off the shelf in an attractive case, the Computer Centre OEM 2 provides a powerful main frame computer

System builders are free to add peripherals to suit the final applications The operating system provided with the OEM's is a powerful upward compatible extension to CP/M and will support up to 128 mega byte disc storage

A 10 mega byte fixed disc is already planned and should be available as an extra during 1980

Another remarkable extension to the OEM range is the availability of the multi terminal operating system But with hardware costs as low as the OEM, the market for sharing the system is likely to be small!!!

OEM's are invited to write or call for details

NEW PRODUCTS

Now available from stock, new plug in card cards to enable Tandy owners to run CP/M and/or two 8" disc drives

Full range of power supplies, Firmware, Connectors and IC's

All advertied items generally in stock. Cash with order ensures same day despatch. Add 2% postage and 15% VAT to advertised prices. I enclose cheque for £ ....

Send ....

Send: ☐Catalogue (please tick)

Name ....

Address ....

COMPUTER CENTRE

THE DISCOUNT COMPUTER STORE

9 De la Beche Street, Swansea, SA1 3EX. Tel: 0792 460023 Telex: 48638

• Circle No. 149

CRA
COMPUTER RETAILERS ASSOCIATION

Buy with confidence from the specialists

HB COMPUTERS

A personal computer that opens the world of programming to your own fresh ideas!

CRT Display
This unit is equipped with a 25 cm (10") monochrome CRT for up to 1,000 letters (40 letters × 25 lines). Processing results can be displayed on the CRT, and it is possible to program and edit (addition, deletion, etc.) while watching the operation for confirmation.

Built-In Clock and Sound Circuits
Clock circuit: time is displayed according to program.
Sound circuit: 3-octave sound signals for aural confirmation according to program.

78 Keys
ASCII standard. Graphic symbols. Alphabet (capital and small letters).

SHARP M2-80K

HB COMPUTERS LTD

22 NEWLAND STREET, KETTERING, NORTHANTS.
Tel. (0536) 83922 & 520910 Telex 341297

• Circle No. 150

MICROCOMPUTER SHOPPING MADE SIMPLE

The Slough Microshop is the Thames Valley Specialist in microcomputer systems — for business, professional or personal use. Our services include:

* TAILORMADE OR PACKAGED SOFTWARE
* COMPLETE HARDWARE MAINTENANCE SERVICE
* FULL DEMONSTRATION EQUIPMENT

We are the officially approved stockist for
COMMODORE PET
EXIDY SORCERER
NORTH STAR HORIZON
APPLE II
IMS 5000/8000
EQUINOX 300

Ask for a demonstration. Phone or call into the Slough Microshop showroom — where microcomputer shopping is made simple.

THE SLOUGH MICROSHOP

120 High Street Slough Berkshire
Telephone: Slough 72470 or 22855

• Circle No. 151

You stand out in a crowd – and we know it.

Your business is not exactly the same as any other and neither are its problems. Any solutions are probably unique and must be tailored exactly for you.

You know your business better than anyone else and any system designed should use your knowledge. The micro-computer specialist should show you how to use the computer to meet your business requirements.

You should be able to get the micro-computer which best suits your business. It should be chosen after your requirements are specified.

You and your staff have a right to know all about YOUR system, including helping to program it if you want to. Training is your right – not an additional service.

If microcomputers cannot satisfy your business needs, you want to know – you don't want false promises.

67 Nova Road, Croydon, Surrey CR0 2TN.
Telephone: 01-688 6013

MIKE ROSE MICROS

• Circle No. 152

A.M. **TASK FORCE** LTD.

Computer Career Professionals.
Register yourself on our micro-computer for a new permanent job or contract in U.K., Europe or U.S.A.

All levels of staff required. We provide advice and assistance to contractors and career guidance to permanent candidates.

2C Southchurch Rd., Southend-On-Sea, Essex 0702-615551 Talk to John or Tony	44 Kingsway, Stoke-on-Trent, Staffs. 0782-410217 Talk to Chris or Derek

OUR REPUTATION TELLS ALL

• Circle No. 154

STOP PRESS!!!

TO ALL APPLE II AND ITT 2020 DISTRIBUTORS AND DEALERS

"THE BIGGEST AND THE BEST RANGE OF SOFTWARE AVAILABLE IN THE U.K. TODAY"

Following the success of our first Software Catalogue, Systematics Software Catalogue No. 2 is now available, free of charge on application, and contains many more prograoms'.

*Double headed disk drives (232K each) now available.

**12" Green screen video monitors now available.

For further details, please contact:
Britt-Marie on Basildon (0268) 284601

SYSTEMATICS INTERNATIONAL LTD
Essex House,
Cherrydown,
Basildon,
Essex

• Circle No. 155

apple computer
Sales and Service

MICROWARE COMPUTERS LTD. OF HULL

APPLE II PLUS

Apple 16K Computer	695.00
Apple 32K Computer	764.00
Apple 48K Computer	833.00
Eurocolour Card	79.00
Disc Drive with Controller	349.00
Disc Drive Only	299.00
VHF Modulator (for T.V. output)	14.00
High Speed Serial Interface	113.00
Parallel Interface	104.00
Firmware Card	116.00
Integer Card	116.00
Centronics Card	130.00
Communications Card	130.00
Clock/Calendar Card	128.00
Pascal Language System	299.00
Data Acquisition Card	180.00
Music Synthesiser Card	180.00
9" Black & White Video Monitor	127.00
12" Black & White Video Monitor	187.00
PRINTERS	
Anadex DP8000	575.00
Pet Interface for DP8000	45.00
Teletype 43	945.00
Decwriter 4 (LA34)	995.00
Qume Sprint 5 (Daisy Wheel) complete	2,497.00

COMMODORE

CBM 2001 8K Pet	550.00
CBM 3016 16K Pet	675.00
CBM 3032 32K Pet	795.00
CBM 3022 Printer, 80 column tractor feed	645.00
CBM 3040 floppy disc unit	795.00
IEEE to IEEE cable	25.00
IEEE to Pet cable	20.00
C2N external cassette	55.00
PETSOFT STOCKISTS	
12 minute blank cassettes (per 10)	5.00
5in. floppy discs (Apple & Pet per 10)	30.00
8in. floppy discs (Microstar per 10)	50.00

Microware Computers
1133 HESSLE HIGH ROAD HULL HU4 6SB
Telephone (0482) 562107

MICROSTAR 45+

(Multi-user, Multi-task)	
64K, 1.2 megabyte	4,950.00
64K, 2.4 m.byte	5,650.00
Upgrade, 1.2 to 2.4 m.b	1,250.00
Add on 2.4 m.b.	3,400.00
20 m.b. hard disc	4,950.00
VDU We Recommend	
Hazeltine 1500	785.00
CABLES (RS232)	
VDU Connector	21.00
Printer connector	21.00
MICROSTAR SOFTWRE	
CPM (gives access to Assembler & Basic-E)	180.00
Flexitex word processing	350.00
Stock control	600.00
Sales ledger	750.00
Cobol (under CPM)	350.00
Fortran (under CPM)	275.00
Mailing list	200.00

ALL PRICES EXCLUDE VAT @15%, UNLESS OTHERWISE STATED

• Circle No. 156

24 TUNE DOOR CHIMES

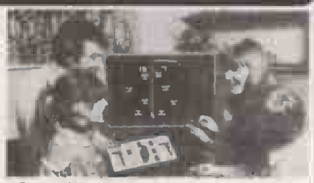
DOOR TUNES £17.13 + VAT

Waddington's Videomaster announce a doorbell that doesn't go Brrringgg, Ding Dong or Bzzzzzz. Instead it plays 24 different classical and popular tunes. It will play the tune you select for your mood, the season or the visitor you are expecting to call. Door tunes is not only great fun and a wonderful ice breaker, but is also very functionally and beautifully designed to enhance your home. There is something for Christmas, something for your continental visitors or your relations from the states, and even something for the Queen. Door tunes is easy to install and has separate controls for volume, tone and tempo.

T.V. GAMES

PROGRAMMABLE £29.50 + VAT.
COLOUR CARTRIDGE T.V. GAME.

The TV game can be compared to an audio cassette deck and is programmed to play a multitude of different games in COLOUR, using various plug-in cartridges. At long last a TV game is available which will keep pace with improving technology by allowing you to extend your library of games with the purchase of additional cartridges as new games are developed. Each cartridge contains up to ten different action games and the first cartridge containing ten sports games is included free with the console. Other cartridges are currently available to enable you to play such games as Grand Prix Motor Racing, Super Wipeout and Stunt Rider. Further cartridges are to be released later this year, including Tank Battle, Hunt the Sub and Target. The console comes complete with two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons. Other features include several difficulty option switches, automatic on screen digital scoring and colour coding on scores and balls. Lifelike sounds are transmitted through the TV's speaker, simulating the actual game being played.
Manufactured by Waddington's Videomaster and guaranteed for one year.



EXTRA CARTRIDGES

ROAD RACE – £8.87 + VAT.
Grand Prix motor racing with gear changes, crash noises

SUPER WIPEOUT – £9.17 + VAT.
10 different games of blasting obstacles off the screen.

STUNT RIDER – £12.16 + VAT.
Motorcycle speed trials, jumping obstacles, leaping various rows of up to 24 buses etc.

NON PROGRAMMABLE TV GAMES

6 Game – **COLOURSCORE II – £13.50 + VAT.**

10 Game **COLOUR SPORTSWORLD £22.50 + VAT.**

CHESS COMPUTERS

STAR CHESS – £85.65 + VAT
PLAY CHESS AGAINST YOUR PARTNER.

using your own TV to display the board and pieces. Star Chess is a new absorbing game for two players, which will interest and excite all ages. The unit plugs into the aerial socket of your TV set and displays the board and pieces in full colour for black and white on your TV screen. Based on the moves of chess. It adds even more excitement and interest to the game. For those who have never played, Star Chess is a novel introduction to the classic game of chess. For the experienced chess player, there are whole new dimensions of unpredictability and chance added to the strategy of the game. Not only can pieces be taken in conventional chess type moves, but each piece can also exchange rocket fire with its opponents. The unit comes complete with a free 18V mains adaptor, full instructions and twelve months guarantee.

CHESS CHALLENGER £85.65 + VAT
PLAY CHESS AGAINST THE COMPUTER.

The stylish, compact, portable console can be set to play at seven different levels of ability from beginner to expert including "Mate in two" and "Chess by mail". The computer will only make responses which obey international chess rules. Castling, en passant, and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given problem from magazines or newspapers or alternatively establish your own board position and watch the computer react. The positions of all pieces can be verified by using the computer memory recall button.
Price includes unit with wood grained housing, and Staunton design chess pieces. Computer plays black or white and against itself and comes complete with a mains adaptor and 12 months guarantee.

OTHER CHESS COMPUTERS IN OUR RANGE INCLUDE
CHESS CHAMPION – 6 LEVELS £47.39 + VAT
CHESS CHALLENGER – 10 LEVELS – £138.70 + VAT.
BORIS – MULTI-LEVEL TALKING DISPLAY £163.64 + VAT.

ELECTRONIC CHESS BOARD TUTOR £17.17 inc. VAT.

A special bulk purchase of these amazing chess teaching machines enables us to offer them at only £19.75 less than half recommended retail price. The electronic chess tutor is a simple battery operated machine that can actually teach anyone to play chess and improve their game right up to championship level. This machine is not only for total beginners but also for established players wanting to play better chess. Unit contains the electronic chessboard with 32 chess pieces, a 64 page explanatory booklet and a set of 32 progressive programme cards including 6 beginners cards, 16 check mate positions, 9 miniature games, 5 openings, 3 end games, 28 chess problems and 2 master games.

DRAUGHTS COMPUTERS

CHECKER CHALLENGER 2 LEVELS £43.00 + VAT.
4 LEVELS £78.00 + VAT.

The draughts computer enables you to sharpen your skills, improve your game, and play whenever you want. The computer incorporates a sophisticated, reliable, decision-making microprocessor as its brain. Its high level of thinking ability enables it to respond with its best counter moves like a skilled human opponent. You can select offence or defence and change playing difficulty levels at any time. Positions can be verified by computer memory recall. Machine does not permit illegal moves and can solve set problems. Computer comes complete with instructions, mains adaptor and twelve months guarantee.

PLAY DRAUGHTS/CHECKERS AGAINST THE COMPUTER

FOR FREE BROCHURES – SEND S.A.E

For FREE illustrated brochures and reviews on TV and chess games please send a stamped addressed envelope, and state which particular games you require information on.
Callers welcome at our shop in Welling – demonstrations daily – open from 9am-5.30pm Mon-Sat (9am-1pm Wed).
To order by telephone please quote your name, address and Access/Barclaycard number.
Postage and Packing FREE

AJD DIRECT SUPPLIES LIMITED, Dept. **P.C.6** 102 Bellegrove Road, Welling Kent DA16 3QD. Tel: 01-303 9145 (Day) 01-850 8652 (Evenings)

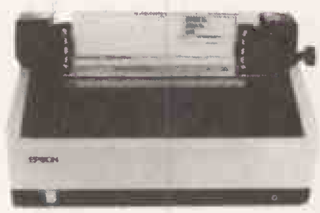
• **Circle No. 162**

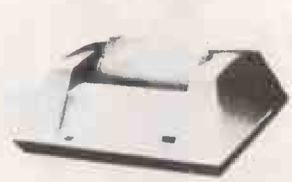
PRINTER SUPERMARKET

RICOH RP-1600 DAISY WHEEL PRINTER £1250
60 Characters per second print speed the fastest currently available. Options; serial interfaced £60, PET inter face £65, Apple interface £75.

OKI MICROLINE 80/132 £495
The printer you can live with!!!! The quietest dot matrix available. Options: PET, Apple and serial.

EPSON TX-80 £395
Dot-matrix printer with Pet graphics Interface: Centronics parallel, options: PET, Apple and serial.





ANADEX DP-8000 NEW LOW PRICE £475
Fast 112 Characters per second. Both RS-232, and Centronics parallel interfaces built in.

SUPER BRAIN COMPLETE COMPUTER £1875
CPM Operating System. — Word processing & Accounts packages available.

MISCELLANEOUS

FLOPPY DISCS.	
8" BASF — BOX OF 10 DOUBLE-DENSITY SINGLE SIDED	£30
5" BASF DOUBLE DENSITY — SINGLE SIDED	£25
FANFOLD LISTING PAPER — 11" × 9.5" 2000 SHEETS	£14
FANFOLD 2 PLY, 11" × 8" — 1000 SHEETS	£12
SELF ADHESIVE MAILNG LABELS 2000 ON FANFOLD PAPER	£12
INVOICE/ORDER FORMS, 4 PART BOX OF 500	£19
ANTI GLARE SCREEN FOR TRS80	£10
PRINTERS RIBBONS ANADEX, RICOH, OKI	P.O.A.

Prices quoted above do not include VAT

Phone or call in for further details or demonstrations.
DEALER INQUIRIES INVITED

LONDON COMPUTER STORE
43 GRAFTON WAY, OFF TOTTENHAM CT. RD
LONDON W.1. TEL: 01-388 5721
open 11-7 Mon-Fri 11-4 Sats.

• **Circle No. 163**

'NOT AN EXPENSIVE TOY'

System M-One Model 1 £5995

You know that a small computer could help streamline your business but, faced by the myriad machines and manufacturers' claims and counter claims concerning hobby computers to expensive mainframes, you're beginning to think it's safer to stick with your current methods.

LSI is offering a simple solution.

As a UK manufacturer of the comprehensive range of System M-One business computers, LSI provide a complete service from one source: advice, installation, programs, training and maintenance, so that your computer can grow with your business.

With over 300 installations in the UK alone, why not find out more about LSI Computers and how they can help you?

LSI COMPUTERS **Business Systems**

Copse Road, St. Johns, Woking, Surrey GU34 1SX
Telephone: Woking (04862) 23411 Telex: 85952

Please send me full details of System M-One, today!

I am interested in
- ☐ Accounts
- ☐ Payroll
- ☐ Invoices
- ☐ Order Processing
- ☐ Stock control
- ☐ Other

Name ____________

Position ____________

Company ____________

Address ____________

Tel. ____________

PC6

• Circle No. 164

ITT 2020 (16K) £645

send cheque payable to Guestel Ltd. 7 day delivery (16K—£759, 32K—£833, 48K—£906. Inc VAT&PP)

WORD PROCESSING FOR ITT/APPLE

The unique Guestel 360 letter writer combining text editing facilities with advanced mailing list and associated attributes file. All in machine code. The best letter writer available today at only — £230 complete with plug in lower case board. £190 for those people who already have an LCB. A complete system ready to use, including Daisy-wheel printer, twin discs, etc. Unbeatable at £3430.

GRAPHICS TABLET

Complete and ready to use with ITT operating program. Includes RS232 Interface and pen stylus. **£895.00**

PLUG IN LOWER CASE BOARD

Increase the capability of your ITT 2020 to include lower case flashing and normal characters. **£45.00**

PROFESSIONAL KEYBOARD

Very high quality 128 Ascii set keyboard, 8 extra keys. **£145** in kit form to fit into your ITT/APPLE.

All prices ex. VAT & PP.

Guestel Limited, Refuge House,
2-4 Henry St., Bath, BA1 1JT. Tel: (0225) 65379.

• Circle No. 165

ELECTRONICS FOR THE 80s

The Department of Electronic and Communications Engineering is planning some new full-time and part-time courses, commencing October 1980.

These have been designed to take account of recent advances in digital and software techniques, and emphasis is placed on these during all the courses.

BSc(Hons) in Electronic and Communications Engineering

a novel degree course designed to prepare engineers for the demands of the eighties and nineties. Entrance qualifications — two good 'A' level passes in Maths and Physics, or equivalents.

Higher Diploma (TEC) in Electronics and Communications Engineering

a full-time two year course stressing the practical applications of electronic engineering, especially microprocessor technology. Entrance qualifications — a good 'A' level pass or TEC Diploma or Certificate in appropriate subjects.

Higher Certificate (TEC)

is a part-time course following similar lines to the HD (TEC). Entrance qualifications — TEC Certificate in appropriate subjects.

Both TEC courses are of a unit structure, and all three courses aim to produce engineers for industry. Some industrial training is included in the HD (TEC).

Details from Secretary, Department of Electronic and Communications Engineering, Polytechnic of North London, Holloway Road, London N7 8DB. Tel: 01-607 2789 ext 2161.

The Polytechnic of North London

• Circle No. 166

CHROMASONIC electronics

56 FORTIS GREEN ROAD MUSWELL HILL LONDON N10 3HN
TELEPHONE 01-883 3705 01-883 2289

your soundest connection in the world of components

Demonstration At Our Shop (enter through stationers)

NOW AVAILABLE

Low cost computer in kit form

UK101

NO EXTRA NEEDED
SIMPLY HIT
'RETURN' AND GO

As seen in
P.E.
August to November '79

Kit price
only **£199** + VAT

EXTRA MEMORY
8 × 2114
only
£32.00 + VAT

INCLUDED FREE
Sample tape with extended machine code moditor and disassembler

Price includes RF modulator and and supply
ABSOLUTELY NO EXTRAS NEEDED

Also available ready assembled, tested and ready to go only **£249** + VAT

Build, understand, and program your own computer for only a small outlay

AVAILABLE SOON

COLOUR ADD-ON CARD

Enables you to choose your foreground, the background colour anywhere on the screen.
Flash any character on the screen at will. Full documentation and parts in kit form. Phone for details.

UK101
CASE
£17.50 + VAT
P&P £1.30

STOP PRESS

The latest edition of our 'STOP PRESS' is now available, and contains an up-to-date price list showing all the items that we stock.
Just send an S.A.E. or phone for your FREE copy.

• Circle No. 167

PETAID

EVERY PET SHOULD HAVE ONE!

OFFICIALLY APPROVED BY COMMODORE

PETAID **EVERY** PET SHOULD HAVE ONE!

PURPOSE: Provides the complete basic structure for file and screen creation and subsequent Insert, Amend, Delete, Display, Search and Print.

BENEFITS: Simple commands, no need for programming knowledge. Create your own screen and file layouts. Files up in hours. Highly structured in Basic. Simple appendment of further basic code for maths and specialised prints, well documented to allow the user to modify the program. Standard variables used, can halve the time for systems development. Common structure for ease of subsequent support. A very powerful STAND ALONE file create and retrieval system. The create file program can be used many times for various files. Further compatible utilities to be available.

VERSIONS AVAILABLE: Tape Files £52.95, Sequential Disk £150.65, Random Access Commodore Disk and Computhink 400K £208.15, Computhink 800K £231.15, Indexed Access Method Commodore Disk (Alpha Key Field) £288.65, Extract & Sort on Random Access or IAM Files £87.40.
All prices include V.A.T., Package and Postage.

PRINTERS SUPPORTED: Commodore, Anadex, Qume, Teletype 43.

FEATURES, The user may:
Define their own screen and file formats. Multiple disks per file. Very powerful search routine on any field and any content. Up to 50 separate search criteria or multiple simulataneous searches. Unlimited number of fields per record. PETAID programs within same Version are compatible with all PETAID created files of that version. Tape to Disk conversion utility as an extra.

PACKAGES: ALL PACKAGES REQUIRE: 32K PET, COMMODORE DISK & PRINTER

INCOMPLETE RECORD SYSTEM PETAID Based
Provides user specified Account Numbers, Titles and Final Account formats. Common input for new or carry forward clients. Up to 2300 Nominal Account Numbers. Unlimited transactions.
Incomplete £750 Final Accounts £350

BANK & RECONCILIATION PETAID Based
Bank Accounting System, automatic facility for standing orders and direct debits. Reminder for charges and interest. 2000 Transactions per Bank Account. £100

ESTATE AGENTS PACKAGE PETAID Based
Property and Applicants registers for speedy selection of properties or Applicants. 325 Applicants or Properties per disk. £250

MAILING SYSTEM PETAID Based
A complete Mailing Suite, labels, lists, multiple labels. Labels selective based on interest groups, etc. £100

BOND & PENSION CALCULATIONS
Allows the Broker or Agent to use the PET as a selling AID to Demonstrate Bond & Pension and Insurance Quotations. £100

QUOTE PROCESSOR PETAID Based
Word Processor in Basic with Mathematics for wordy and complex quotation production. 150 Paragraphs of 10 lines each with price field per line. £120

GENERAL ACCOUNTING PACKAGE PETAID Based
Open item Sales, Purchase, Nominal, Rechargeable Costs, error and status checking (back up forced). One posting routine for all transactions. 4000 Accounts and 18400 live transactions. £600

OTHER PROGRAMS
STOCK £100, BLOCK COPY (Bad Blocks Omitted) £25, DIARY PLANNER £100, DOUBLE PRECISION MATHS (M/C Code) £50.

SOFTWARE SUPPORT SYSTEM
Stage One Software offers a special support and reporting system to enable the users of our Software to get the very best support and advice on how to gain maximum benefit from our packages. Enquiries will be actioned promptly to provide a first class service which has so far been lacking in the Microcomputer industry.

Adda Computers
LONDON W5 2NH
Tel: 01 579 5845

Advanced Management Systems Ltd
LONDON EC2Y 9AA
Tel: 01 638 9319
01 606 4975

Alpha Business Systems
HERTFORD
Tel 0992 57423

Amplicon Micro Systems Ltd
BRIGHTON
Tel: 0273 562613

Business Electronics
SOUTHAMPTON
Tel: 0703 738248

Computer Services Midlands Ltd
BIRMINGHAM B23 6QX
Tel: 021 382 4171

Catlands Computers Ltd
CHESHIRE
Tel: 0625 527255

D.A.M.s Office Equipment Ltd
LIVERPOOL
Tel. 051 227 3301

G M Marketing
ANDOVER, Hants
Tel: 026 471 410

J.A.O. Integrated Services Ltd
PLYMOUTH
Tel: 0752 62616

Jeffrey Martin Computer Services Ltd
NEWQUAY
Tel: 063 73 2863

Malard Services (Fylde) Ltd
POULTON LE FYLDE, Lancs
Tel: 0253 823654

Metyclean Ltd
LONDON SW1E 5JL
Tel 01 828 2511

Microware Computers Ltd
HULL HU4 6SB
Tel: 0482 5627107

Milequip Ltd
GLOUCESTERSHIRE
Tel: 059 451 624

M M S
BEDFORD
Tel 0234 40602

R.P.L. Microsystems
DOUGLAS, I O M.
Tel: 0624 4247

RUF Computers (UK) Ltd
BURGESS HILL, Sussex
Tel: 04446 45211

Sheffield Computer Centre
SHEFFIELD
Tel: 0742 53519

Slough Microshop
SLOUGH
Tel: 0753 72470

Software Development Services Ltd
DUBLIN 4
Tel: Dublin 685755

Tekdata
STOKE ON TRENT ST6 4PA
Tel: 0782 813631

T & V Johnson (Microcomputers)
CAMBERLEY, Surrey
Tel: 0276 62506

Thistle Computers
ORKNEY KW15 1HQ
Tel: 0856 3140

R Ward & Son
GATESHEAD, Tyne & Wear
Tel: 0632 605915

Walters Computers Systems Ltd
STOURBRIDGE, W Midlands
Tel. 0562 885937

Microputers Ltd
KENDAL, Cumbria
Tel: 096 62 4101

MAIL ORDER Written orders with cheque or Access/Visa No. to:

STAGE ONE SOFTWARE 6 Criterion Arcade, Old Christchurch Road, Bournemouth. 23570

BARCLAYCARD VISA
Buy it with Access

Please supply: ITEM .... QUANTITY ....

AMOUNT £ .... CHEQUE NO. ....

Name ....

Address .... ACCESS/VISA NO. ....

• Circle No. 168

PADMEDE

Our first Apple hardware sales were made over two years ago, and we have recently successfully released our proven, reliable . . .

APPLE/ITT 2020 Business Software

PADMEDE COMPUTER SERVICES
112/116 HIGH STREET, ODIHAM, HANTS
PHONE ODIHAM (025-671) 2434

We are currently looking for more wanting to market our software at the following prices.-

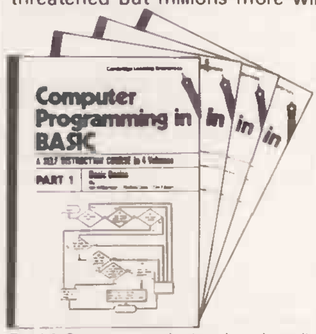
	£
SALES LEDGER	300
NOMINAL LEDGER	450
INSURANCE BROKER SYSTEM	400
TIME & COST RECORDING	300
PURCHASE LEDGER	300
INCOMPLETE RECORDS ACCOUNTING	450
JOB COSTING	300
STOCK CONTROL	300

Comprehensive packages with user manuals, program, data and example diskettes.

• Circle No. 169

CAMBRIDGE LEARNING ENTERPRISES — Self Instruction Courses

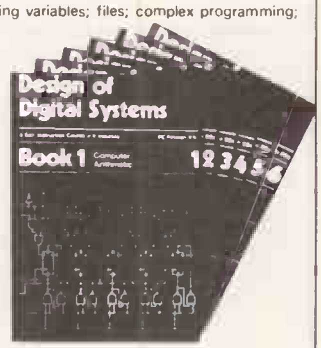
Microcomputers are coming - ride the wave! Learn to program. Millions of jobs are threatened but millions more will be created. Learn BASIC- the language of the small computer and the most easy-to-learn computer language in widespread use. Teach yourself with a course which takes you from complete ignorance step-by-step to real proficiency with a unique style of graded hints. In 60 straightforward lessons you will learn the five essentials of programming: problem definition, flowcharting, coding the program, debugging, clear documentation.



Book1 Computers and what they do well; READ, DATA, PRINT, powers, brackets, variable names; LET; errors; coding simple programs.
Book 2 High and low level languages; flowcharting; functions; REM and documentation; INPUT, IF....THEN, GO TO; limitations of computers, problemn definition.
Book 3 Compilers and interpreters; loops, FOR....NEXT, RESTORE; debugging; arrays; bubble sorting; TAB.
Book 4 Advanced BASIC; subroutines; string variables; files; complex programming; examples; glossary.

Understand Digital Electronics

Written for the student or enthusiast, this course is packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra to memories, counters and simple arithmetic circuits and finally to an understanding of the design and operation of calculators and computers.



Book 1 Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems.
Book 2 OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; karnaugh mapping; three state and wired logic.
Book 3 Half adders and full adders; subtractors; serial and parallel adders; processors and ALU's; multiplication and division systems.
Book 4 Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive—OR feedback counters; ROMS and RAMS.
Book 5 Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding.
Book 6 CPU; memory organisation; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming, assemblers; computers; executive programs; operating systems.

GUARANTEE - No risk to you
If you are not completely satisfied your money will be refunded, without question, on return of the books in good condition.

Please send me:-
...**Computer Programming in BASIC (4 books) @ £7.50**
...**Design of Digital Systems (6 books) @ £11.50**
All prices include worldwide surface mailing costs (airmail extra)
IF YOUR ORDER EXCEEDS £18 DEDUCT £2
I enclose a cheque/P.O. payable to Cambridge Learning Enterprises for £..........
or please charge my Access/Barclaycard/Diners Club/American Express.
Signed..........
account no ....
Telephone orders from credit holders accepted on 0480-67446 (ansaphone). Overseas customers (inc. Eire) send a bank draft in sterling on a London bank, or quote credit card and number.

Name..........

Address..........

Cambridge Learning Enterprises, Unit P1, Rivermill Site, FREEPOST, St. Ives, Huntingdon, Cambs PE17 4BR England.
Proprietors: Drayridge Ltd., address as above. Reg. in Eng. No. 1328762.

• Circle No. 170

What will you do with 12-year-old programmers when they reach 16?

Any microcomputer is a major investment for an educational establishment. Many potential users feel that a BASIC only computer is ample for their needs. That may be fine today, but with computer education starting so early you may in a surprisingly short time find you want more than current implementations of BASIC.

The 380Z is a computer that can grow to match your needs.

In the design of the 380Z our target user is the graduate research scientist. This ensures that the expandability and versatility needed tomorrow has been provided for in the computer you buy now.

Might you want to add disc storage in the next few years?

If you do:

Given good hardware, software availability completely determines the flexibility and usefulness of your system. There is absolutely no question that a Z80 based micro-computer which uses the industry-standard CP/M* disk operating system has several times more software on the market available to it than non CP/M computers.

Today you can purchase a mature CP/M BASIC, FORTRAN, COBOL or Text Processor for the 380Z. Soon there will be CP/M Pascal and Database Management systems.

CP/M software is several years ahead of software available for non CP/M family machines.

If you don't:

Remember that professionals writing packages for your cassette system will themselves often use a disk 380Z, and the power of their tools will influence what they produce.

For many people a disk machine is too expensive – but at least the 380Z approach will allow your students to advance.

380Z BASIC is not frozen in ROM. An enhanced BASIC could be loaded in mid 1980 and a BASIC with structured features sometime later.

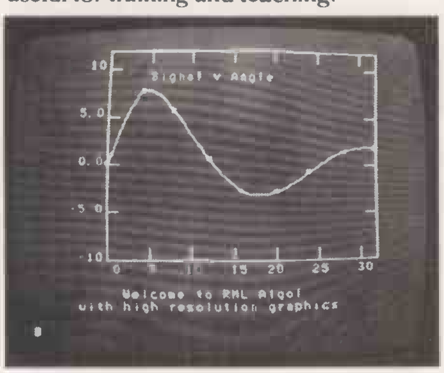
On the 380Z the memory used by a BASIC interpreter can also be used for other software.

Does our research-oriented design pay off in classroom hardware?

Our scientific graphics was produced for the professional user. Interest in it for classroom use has been surprising.

The 380Z has the best graphics now available on a microcomputer, allowing multiple resolutions, multiple paging, fading and accurate control over colour. All these features help bring excitement to efforts in computer assisted learning.

Our standard machine comes with low resolution graphics and support for this from BASIC allows you to plot a point directly with a plot command – useful for training and teaching.



It is worth remembering too that neither our low resolution graphics nor our optional scientific (high resolution) graphics has any limiting effect on your memory usage, and in both you can

freely mix upper and lower case text and diagrams.

Mains noise can cause system crashes which result in loss of programs and data. All current 380Zs include a mains filter which significantly reduces the chances of this happening.

Don't buy a 380Z on patriotic grounds.

Please only buy it if you would have bought it anyway. But remember, because it is designed and manufactured here you are bound to have better access to us for influence and help than if we were on the other side of an ocean.

Prices range from a 16K cassette 380Z @ £897 to a 56K Dual Full Floppy Disk 380Z @ £3322.

LOWER COSTS

Three things have happened which make it easier to buy a 380Z.

ONE: From 1st November 1979 most prices have been reduced.

TWO: Schools and some colleges can now get a 5% discount on computer orders.

THREE: A new Local Authority quantity discount scheme has been introduced to make it easier for more users to benefit from quantity purchasing.

Please contact the Sales Office for details.

RESEARCH MACHINES

RESEARCH MACHINES Ltd,
P.O. Box 75, Mill Street, Oxford, England.
Telephone: Oxford (0865) 49791/2/3.
Please send for full sales information.
Prices do not include shipping costs or VAT @ 15%.

* Trademark, Digital Research.

• Circle No. 171

Heritage and future

ALL THOSE WHO WORK with personal computers owe a huge debt to the many thousands of people who went before and broke the ground. Things we take for granted — the organisation of a machine into processor and memory, the machine code instructions which the processor executes, assemblers, high-level languages, operating systems — those are all things which have absorbed millions of man-hours of work. Many mistakes have been made — and corrected — and we have the benefits of them.

However, with this inheritance of powerful techniques is an inheritance of points of view which is not so helpful. Because most of today's experts in computing owe their expertise to working with large machines, we tend to take for granted that their problems are our problems, and what is worse, that they know more about our solutions than we do.

The two points of view collide most visibly over the question of language. Which high-level language ought micro-computers to run? The accepted wisdom says that a language should be block-structured — that is, it does not define variables outside the bit of program in which they are used. It should be recursive — that is, one ought to be able to write procedures which call themselves.

It ought to support advanced data structures. It ought to be written so that its lay-out shows its function. Basic, the language which most micro users write, is dismissed on all these grounds. The debate rages about what language should replace it, and those who like Pascal will point to it as fulfilling all these conditions.

I am not at all sure that the correct questions are being asked. If you have to write a program 30,000 lines long, you do, indeed, tend to run out of variable names. You do not want a variable used in a subroutine at the front re-emerging disastrously in one at the back. It makes things much simpler if you can define the region in which variables exist.

Yet the longest program one could fit into a micro is about 5,000 lines, and the great majority of useful programs are far shorter than that. Block structuring solves a problem that does not really concern us.

Recursiveness is very pretty, but there are few mathematical problems it solves, and when it does, it's slow and greedy on memory. It is fortunate that most of the time it's a solution looking for a problem.

Again, if embarking on a huge program which will take several people several years to write, it may well save a good deal of time to be able to define individual data structures. Programs for micros are not like that. By the time you have become used to the special data structure for one program, you have finished and are about to start something totally different.

Finally, program-structure and lay-out. I find that for my simple needs, a program consisting of many Basic subroutines is easy to understand and debug. Each subroutine is prefaced with a little note which explains the variables it uses and what it returns. Each has one entry point and one exit. It may not be elegant but it certainly works. Do we really need more?

A further hidden factor which confuses the discussion is that the mainframe industry tends to think in terms of teams of programmers. Many of their problems are caused by the need to co-ordinate the activities of bored, rebellious and possibly rather uninformed people. As has been pointed out in these pages before, that is not at all the case in our business.

We have programmers who are highly motivated and who, presumably, hold everything they need in their heads. The contrast was highlighted for me by a young friend who wrote 5,000 lines of debugged machine code in two weeks. Contrast that with the industry standard of five lines a day, or 70 in two weeks.

If publishers had to employ teams of writers to produce books, one would expect them to become bogged-down in problems of co-ordination and compatibility. When it comes to the writing of dictionaries and encyclopedias they do and this kind of publishing is very specialised. It is unfortunate for us that computer traditions have grown-up round writing that kind of program when what we should be considering is much more like a novel.

That difference in aim has an effect on the language problem. We need something which enables easy movement — to try this idea and that. We do not need a language which enforces rigidity, which demands time spent in defining things which might soon be changed. We need a language which will interpret for development and compile for action. It needs, ideally, to be as flexible as human language.

I write with some feeling here, because I started recently to wrestle with Pascal, gave up after a week and went back to assembler. It was, in comparison, much easier. In contrast with Basic, Pascal was a penance.

It seems clear that the road forward is through improvements in Basic. I look forward to trying the Microsoft version 5 which will either interpret or compile, and will link to bits written in machine code, Fortran or Cobol. Basic would benefit from some more developments — named subroutine calls, pointers, dynamically-allocated variables and dynamically-defined arrays.

We can live without them. The proof is that plenty of people are writing big, useful programs in Basic and making adequate livings from them.

That micros have put computing back 15 years is a complaint one hears frequently. It is true, and there is little point pretending it has not happened. In comparison with today's mainframes or even minis, many of the things we can do are pathetically limited, but the quantity of useful work which can be done is vastly increased. Instead of computing power being localised in a few, highly-expensive spots, it has now spread over a wider area.

It needs to be primitive because it has to be used by newcomers. It will no doubt develop and the branch which has been spliced into the tree of computer development 15 years ago will grow in its own way. There is no reason why it should take the same course as the main stem. We have to make up our minds about our own future. If we want something which makes the mainframe industry laugh we shouldn't mind.

It is too easy to be intimidated by professionals who argue from the wrong premisses to wrong, but authoritative-sounding, conclusions. If the future of the micro is with a kind of super-Basic, they'll just have to tolerate it.

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.

Answering criticism

THE CRITICISM of the Sinclair ZX-80 in April Printout seems to be unduly harsh. The correction of its price from £100 to £180 is misleading; the cost of the TV and cassette recorder constitute the bulk of the difference and are items which a great many people own already. Moreover, anyone who can afford £100 for a micro is even more likely to have the tape recorder and TV already.

The upper RAM limit of 16Kbytes is listed as a disadvantage — is it really? Sinclair claims that RAM is used ×4 more efficiently which is equivalent to 64Kbytes — few people will need more than that and few micros can cope with more.

The lack of discs on the ZX-80 is more serious, but anyone prepared to spend several hundred pounds on a good disc system would normally be looking for a more expensive computer in the first place.

According to the article, the machine's lack of logs, sines and so on, means that "it cannot be regarded as an up-market calculator". Is it meant to be one? For anyone planning to buy a micro for use as a scientific calculator, the ZX-80 is not a good choice. On the other hand, if he wants to write programs, it has one or two useful features that many £15 calculators do not — like Basic.

Finally, would someone like to explain why, if the article is correct in saying that one cannot gain access to the processor to write machine code, the ZX-80 has a USR function "causing jump to a user's machine language subroutine"?

Brian Medley,
Leeds.

● One can enter machine code with POKE and call it by USR. However, it is an awkward way of working. If machine code writing is to be at all productive, one needs an assembler and a proper monitor for debugging. Since the ZX-80 is aimed ostensibly at the beginner, it seems odd to make things so difficult for him.

ZX-80 capabilities

I WAS interested to read your column on the Sinclair ZX-80 — *Practical Computing*, April — having studied in detail the ZX-80 manual, my conclusion also was that the machine would provide a simple introduction to programming and probably be capable of a variety of simple games.

I feel, however, a few points should be clarified. Firstly, the ZX-80 Basic is an all-integer Basic, which means that any decimal calculation — not just logs or sines — requires remarkable programming and considerable skill.

I must pre-empt the possible reaction from Sinclair on this point by acknowledging that the manual does contain a routine to divide one integer by another and output a result to a few decimal places.

I am more concerned, however, with calculations involving two decimal numbers of any size. They must involve the user in programming his own floating-point software package — a very complex and store-consuming business.

Secondly, as I read it, the RAM is 1K, expandable to 4K, not 4K expandable to 16K as stated. The misunderstanding probably arises from the assertion that 1K RAM on the ZX-80 is worth 4K anywhere else.

G K Blackwell,
South Brent,
Devon.

Short record

IN THE Feedback pages of your excellent magazine, much space has been devoted to the subject of holo-alphabetic sentences — sentences which contain all 26 letters of the alphabet.

In the twentieth edition of the *Guinness Book of Records* is the following entry under Words, shortest holo-alphabetic sentence: The contrived headline describing the annoyance of an eccentric in finding inscriptions on the side of a fjord in a rounded valley as "Cwm fjord-bank glyphs vext quiz" represents the ultimate in containing all 26 letters in 26 letters.

Peter Ansell,
Cambridge.

QWERTY query

I AM surprised and delighted that QWERTY query in January, 1980, has produced so much correspondence, but I would like to point out my original letter does state short sentences. Anyone with enough vocabulary can write a sentence containing all the letters if they make it long enough.

The best English example I have been given is in 29 letters: quick blowing zephyrs vex daft Jim. Nobody has yet offered the solution to whether Sir Isaac Pitman or Lewis Carroll is the father of the 'quick brown fox'.

I would like to thank Jones and Frogg — Feedback, March, 1980 — for the only foreign one I possess, but what is 'le bicles'? Nobody seems to know.

Finally, I might add to Roger Standing's letter in Feedback, April, 1980, that we are trying to form the one-word compound German noun, which contains all 26 letters.

Larry Mascall,
Berkely,
Gloucestershire.

East Anglian users

A FEW friends and I have recently started a computer user group to cater for both amateurs and professionals in East Anglia. Anyone interested should telephone Norwich 402311 or send a SAE to me.

Jan Rejzl,
128 Templemere,
Sprowston Road,
Norwich NR3 4EQ.

Ninth Basic

IN REFERENCE to my article, Eight Basics for Nascom, which appeared in the April 1980 issue of *Practical Computing*, I have since received a copy of the new XTAL Electronic XTAL Basic 2.2.

It is a much-enhanced version of their XTAL Basic 2.1 — the version described in the review — and is now the only Basic sold by XTAL. In addition to a number of new commands and a superlative piece of documentation, it includes the ability to define your own reserved words directly, driving machine code routines in such a way to allow you to create a totally individual Basic to your own specifications.

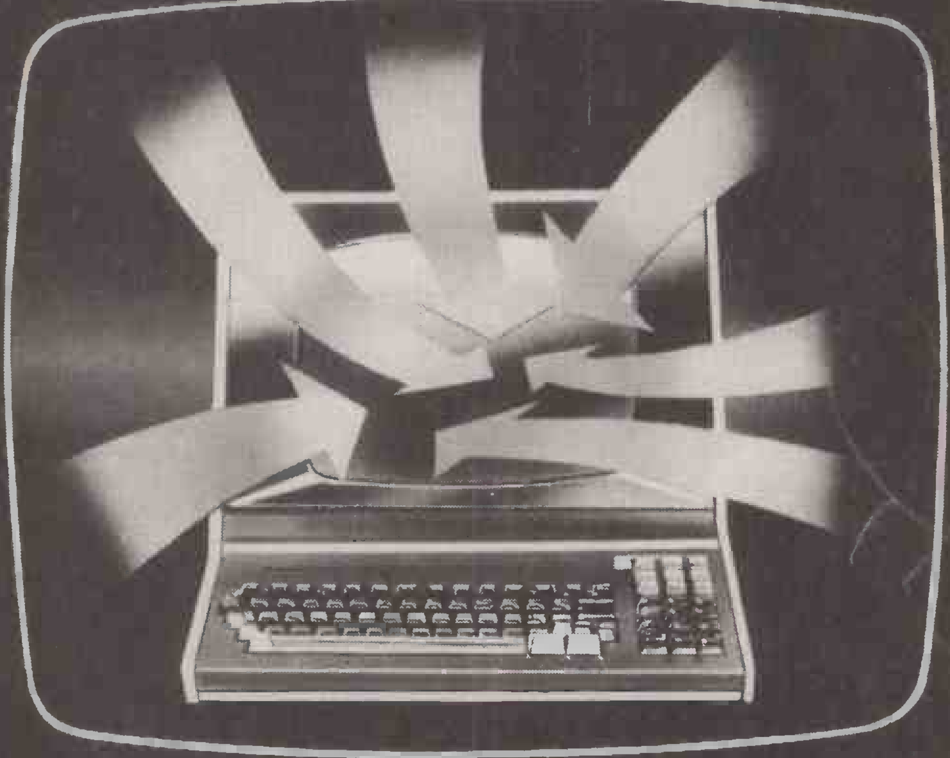
Nick Laurie,
Langport,
Somerset.

Library software

WE HAVE been commissioned recently by the British Library to compile a directory of microcomputer software suitable for library and information use. While we realise that there is little software written expressly with the library and information market in mind, our initial work shows that many commercially-available packages can be adapted for our purposes.

The problem is discovering the existence of such packages in the first place. We are reasonably confident about gaining information on the more obvious software, but the possibility exists that a less-

(continued on page 52)



BENEFIT INSTANTLY FROM YOUR APPLE II

Customer records – Direct mail – Membership lists – Subscription files – Inventory data – Employee records – Rental contracts.

TRENDISK/1 is an all purpose data handling package which is easy to use without being laborious and verbose. **Trendisk/1** enables you to benefit immediately from your new micro and – **WITH NO PROGRAMMING EXPERTISE:**

- Define new files and specify what data is to be held in each record
- Add records to the file
- Delete or amend existing records
- Reference records using any item of data
- Search for records with parameters such as 'SIZE greater than 12 and COLOUR = RED and PRICE is less than £20.00'
- Browse through the file record-by-record printing selected details
- List information from the file
- Generate reports
- Print address labels
- Analyse/Adjust numerical data
- Resequence the file using any item.
- Use of standard file formats makes development of 'add-on' programs easy.

Trendisk/1 runs on Apples with 32K of RAM (48K with Applesoft in RAM) with at least one diskette drive. The package supports Centronics-compatible printers using the parallel interface card.

Diskette – Five Programs Only **£75.00** (incl. VAT)

Send now for your **free** Personal Computer Data Card!

For our 24 hour telephone ordering service call 0423 711878, or complete the coupon:

Name ______
Address ______

Please send me Trendisk/1 at £75.00 incl. VAT
Please send me your product catalogue ☐ (tick)
Please send me a Data Card ☐

Signature ______

☐ ☐ CHEQUE ☐ (tick)

Credit Card No ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Send to: Microtrend Ltd.,
P.O.Box 51, Pateley Bridge,
Harrogate, North Yorkshire HG3 5DP

PC6

microtrend

• Circle No. 173

(continued from page 50)
well-known package might escape our net.

For that reason, would anyone, i.e., OEM, software house, user group etc., with a potentially-relevant applications package contact us?

The only incentive I can offer, is the possibility of some free publicity. It might be worth considering that the libraries and information units of this country do form a sizeable, and hitherto largely-untapped, market.

Microcomputers have penetrated this market, but only to a very small extent — one of the stumbling blocks is a lack of knowledge about available software.

Bob Winfield,
Aslib,
London WC1.

Inspiration

THE SIGHT of the 10-move win against the Microchess program on level 8 in your April, 1980, issue inspired us to do some work on the machine, and produced a seven-move defeat.

White		Pet (black)	
1 E2-E4		E7-E5	
2 D1-F3		D8-F6	
3 F1-C4		F6-E7	?
4 D2-D4	Pawn sacrifice	E5-D4	accepted
5 C1-G5	Bishop sacrifice	E7-G5	accepted
6 F3-F7	Pawn regained	E8-D8	
7 F7-F8	Bishop regained	You win	

At least it occupies less space.

A D Mitchell and Ashton Delauncy,
Sittingbourne,
Kent.

Chess problems

I HAD problems with Maurice Fozzard's chess game in *Practical Computing*, February, 1980. However many times I re-set the chessboard, I could not make Pet respond with G8-F6 on the first move. Only after playing the first move would it proceed with the game as written.

Peter Jenning's Microchess 2.0 is receiving a good hiding now. Does anyone know of another Microchess program for Pet or in 6502 code? If so, let's hear about it. Thank you for a very fine magazine.

B N Bidgood,
Manor Park,
London E12.

Hi-fi interface

I RECALL reading somewhere, not in a specialist computing journal, that in the future we may see home computers linked closely with not only TV systems but also with stereo equipment, especially once digital recordings have become widespread.

Nowhere, however, have I seen mention of this in a computing journal, neither in an article or in advertisements placed by the manufacturers or retailers of small computers.

It would seem that some simple moves might be made now, especially as I feel many may share interests in both hi-fi and computing. Mention is often made of using home computers to store and retrieve recipes — perhaps to convince wives of the value of their husbands' hobby — but I suspect a greater potential might lie in cataloguing music collections, on disc or tape, especially the latter if many home recordings are made.

It is not a simple task, without a computer, to keep in touch with a large, and perhaps changing collection, and some real benefit could, therefore, arise from such a system. Later the concept might be extended to direct retrieval of a recording on receipt of the appropriate command. I would be interested in any comment on these ideas.

P F Fagan,
Brunssum,
The Netherlands.

In West Sussex

A MICROCOMPUTER club has recently been formed in Crawley, West Sussex. The club is open to anyone interested in personal computing, with or without their own computing facilities.

It is the intention that meetings be held weekly, with the publication of a monthly or bi-monthly newsletter containing system ideas and suggestions and relevant technical information. Those interested are welcome to contact me.

J Fieldhouse,
18 Seaford Road,
Broadfield,
Crawley,
West Sussex.

Game-playing

IN RESPONSE to George Blank's article in April on game-playing, may I add that many of those programs do not tackle their instruction sheet properly? For example, in Zombie, published by you a few months ago, you are forced to wait about 30 seconds for the instructions to appear, which, when they do, vanish before you have had time to glance at them.

A time loop could be added, of course, but would it not be simpler to have them printed-out before the computer started its preparations, so we could read while we wait?

Richard Develey,
Horsham,
Sussex.

Sharp reminder

I HAVE bought a Sharp MZ80-K with 22K user RAM, after close evaluation of its competitors on performance and price.

I intend to form a London and south-east Sharp MZ80-K user group to enable all members to exchange ideas, software, etc. Anyone interested should telephone me in the evening on Hornchurch (STD 04024) 42905. Affiliation of the group to other user groups will be considered later depending on the response from members.

Joe Seet,
Hornchurch,
Essex.

Program Power

IT HAS been apparent for some time that there has been a lack of software for Nascom 1 and 2. We are certain that a substantial number of near-professional standard programs have been written, but knowledge of them probably remains with the author or his local Nascom club. Not least among the reasons will be the variety of monitors which have been available at one time or another.

To remedy the situation, Program Power has been established to act as a form of program exchange. We will undertake to make programs available nationally to owners of Nascoms, at a price which will enable us to pay reasonable royalties to the authors.

We hope this will generate the enthusiasm to finish those brilliant ideas which are almost saleable programs and perhaps create a few more original thoughts. We shall be concentrating on 8K Basic and machine code programs.

Any authors of Basic programs written for TRS-80, Pet or other micros who could provide listings for conversion to Nascom should also contact us.

R G Simpson,
Program Power,
5, Wensley Road,
Leeds LS7 2LX.

Open to cheating

CONGRATULATIONS on Maze Runner in *Practical Computing* April, 1980. However, I felt the author laid a challenge in saying that a routine to check that all Xs have been removed would slow the game too much. The game is wide open to cheating as written.

A line to achieve the result is:

```
275 Q1=PEEK (15425) : Q2=PEEK (15486) ;
Q3=PEEK (15841) : Q4=PEEK (16318) :
IFQ1ANDQ2ANDQ3ANDQ4<>88THEN380
```

Line 340 becomes redundant so delete it. An alternative is to insert the routine at line say 345, change 340 to read after 'THEN' 345 instead of 380. Update your instructions to suit.

Bugs and typographical errors are:

```
Line
450   IF S(W)>S(I) THEN W=I
620   SET(X,0) : SET(X,47)
710   T=T+1 : IF T=40 THEN RETURN
```

Keep up the good work.

A K Waller,
Moseley,
Birmingham.

Schools given Apples worth £30,000

APPLE microcomputers worth £30,000 have been given to specially-selected schools by the U.K. Apple importer and distributor, Microsense Ltd. The schools were selected in co-operation with Mini and Microcomputers in Secondary Education (MUSE).

Seven schools which have already received the systems include those for the blind, handicapped and deaf as well as primary and secondary schools.

MUSE intends to ensure that the Apples are used to develop software which will help other schools starting their own micro projects. At the presentation of the valuable equipment, Mike Brewer, the chairman of Microsense, said that the equipment was being donated in an effort to increase public awareness of Apple computers.

The gifts should also provide more opportunity for the development of educational software. Half of the money has been advanced by Microsense and the rest by Apple Inc, the U.S. manufacturers of the computers.

John Coll, MUSE chairman, explained that the schools had been selected on the basis of letting as many people as possible benefit from the gift.

He went on to reveal that the £30,000 would pay for 12 systems, one of which would be kept for the MUSE librarian to develop a program library for Apples. Apart from the seven already allocated, four systems will be held by MUSE for short-term loans to schools for special projects and weekend courses. A full set of peripherals will also be kept by MUSE.

Microsense has followed its gift with a special offer of 25 percent off the basic price of an Apple system for any school.

A folder with details of the offer has been sent to 36,000 schools in the U.K.

Good home needed for PDP-15

BIRKBECK College, London, has a PDP-15 which it wants to donate in July or August. A good educational home could have it for nothing, but they would have to pay for moving and be prepared to spend about £5,000 a year on maintenance. It uses the DECTape operating system. Write to Mick Farmer, Department of Computer Science, Birkbeck College, 12 Gower Street, London W1.

Home computer which talks

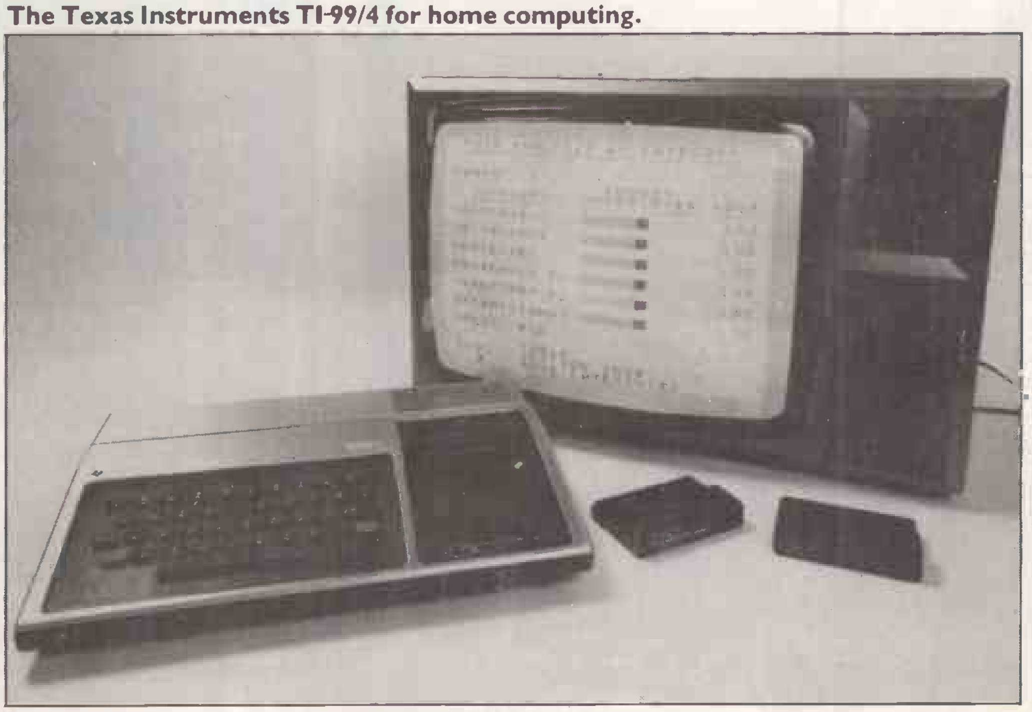
A HOME computer which talks is how Texas Instruments plans to market the TI-99/4, now available at more than 20 distributors in the U.K. Texas Instruments hopes to break into new sectors of the market with a sustained advertising campaign.

Built round the TI-16-bit 9900 chip, the computer consists of a console with 16K of RAM, a sound generator, full-colour graphics and an optional speech synthesiser. As yet the system is compatible only with the U.S. television standards so the price of nearly £1,000 includes a new 14in.-colour monitor. Texas Instruments consumer division general manager, Ian Davies, claims: "There is a certain utility in this. When people buy the system they will also be buying a second colour TV set".

The computer is supplied with a range of plug-in firmware modules, each with 30K of ROM, including programs for chess, grammar for children and a household finance package. A software module which will use the speech synthesiser to teach children how to read is still in the prototype stage.

For the home programmer the TI-99/4 has Basic in 14K of ROM. An RS232 adaptor is available as an accessory and floppy disc drives should be on the market later this summer.

The Texas Instruments TI-99/4 for home computing.



Best-selling software

THE FORCE behind Petsoft, Applied Computer Techniques, is diversifying into software for the Apple II microcomputer. The new company, Appleware, has been launched with a catalogue of 75 established best sellers such as the Personal Software VisiCalc.

Appleware will charge £125 for this program; the popular Apple Data Base will retail at £23.50. The new company intends to develop some of its own business packages. The existing Petsoft network of distributors will be used, along with all the Apple dealers.

Disc covers

IF YOU have ever felt unhappy about the idea of sending your discs through the post, to *Practical Computing,* for example, a Coventry company, Swan Packaging, has produced a simple idea to protect them. It will supply Discpacs in two sizes, for 8in. and 5¼in. discs. The Discpac is supplied flat but folds easily and quickly to make a firm postal package which will protect up to six discs. The 8in. packs sell at £44 for 250 with discounts for cash on delivery and larger orders. The 5¼in. packs start at £28 for 250. Swan recommends that all discs are wrapped in metal foil before posting.

Simple, but effective

A NEW product consisting of a sheet of card, a sheet of paper and a plastic folder is now available. Sounds simple and it is.

The paper is marked with a grid corresponding with the POKE numbers for the Pet memory display locations. The grid can be used for planning complicated graphics before any figures are entered into memory.

The pack is provided with a water-based, felt-tipped pen so that marks on the plastic can be wiped away. The grids are only available for the Pet but others are expected to follow soon. Details: Impex Enterprises, 12 Wallscourt Road, Filton, Bristol, BS12 7NS.

THE LATEST offering from Centronics is the Model 737 matrix printer. It was designed for the microcomputer-based small business system market and offers high-quality print. It also has new features such as the ability to print subscripts and superscripts. Price £650 Centronics, Burgess Hill (04446) 45011.

Survey shows satisfaction

THE CONTROL Data Institute has conducted a survey of the 2,000 people from its computer-operating, programming and engineering courses.

From almost 500 replies, CDI learnt that 97 percent are still working in the computer industry and more than 90 percent are satisfied with their career progression.

The responses show that while 50 percent of the programmers have remained in the same position, 25 percent have advanced to programmer/analyst or senior-programmer level, while one had become a dp supervisor within a year of completing the course.

The survey also showed that a successful career in computing does not require any particular background — 33 percent of programmers are from clerical jobs and 19 percent had backgrounds in manual work.

Special prize for inventiveness

THE WINNERS of the British microprocessor competition — *Practical Computing*, December, 1979 — have been announced by Sir Keith Joseph, the Secretary of State for Industry. The competition was sponsored jointly by the National Research and Development Corporation (NRDC) and the National Computing Centre (NCC).

The competition attracted more than 200 entries, with 125 of those in the main category of working models. The first prize went to Sinar Agritec, of Egham, Surrey, for a small, portable meter to measure the moisture content of grain.

Although all of the prizes were awarded for applications involving microprocessors, only one centred on a microcomputer. An entry from Graeme Harker and Anthony McKay of the Royal Grammar School, Newcastle-upon-Tyne, won a special prize of £500 for inventive flair.

Using a standard 32K Pet, they developed a system for controlling the stage lighting for their school's drama society. The software, written in machine code by Anthony McKay, allows all the lighting sequences for a performance to be programmed, enabling the operator to develop lighting routines which would previously have been physically impossible.

The lighting control system, which has already won the BBC Young Scientist of the Year Award, is now attracting the attention of several companies aware of its commercial potential.

In his speech, Sir Keith Joseph stressed that the Government supported the expenditure of tax payers' money for educational programmes to educate the public about future technologies, but that industry should be left to develop by itself. He said that he would like to phase out Government support for the micro industry were it not for the discouragement of enterprise by the last Labour government.

Wang system

THE RAPIDLY-GROWING U.S. mini-manufacturer Wang is to release a new bottom-of-the-line system with an integral Winchester disc for $12,000.

Programmer-time savings

SAVINGS of up to one-third of programmer-time are claimed by Phipps Associates for a new software product for the Panasonic JD range. The product is issued in permanent ROM-form for writing directly in the processor.

John Phipps, who founded his company recently, explains that the VDU monitor software handles all operator communications with the machine and checks all data keyed by the operator before passing control to the applications program. In doing so, it provides a simulated protected field capability for the visual display unit.

The package is compatible with CP/M or the Basic operating system. Phipps Associates is based in Epsom, Surrey. Tel: (78) 212 15.

CAP Microproducts, the micro software arm of CAP-CPP, has signed Distributed Data Processing as its first vendor of MicroCobol for the Panasonic JD range.

This latest vendor agreement follows the recently-announced agency deal with Comart to market MicroCobol on the Cromemco System 3 and brings to 16 the total number of systems on which MicroCobol has been implemented. These include the PDP-11, the Sord 223 and the Triton 3.

Free maintenance service

ONE OF the most common complaints *Practical Computing* receives is about the cost and quality of the maintenance service offered by microcomputer dealers, so it was with a certain amount of scepticism that we investigated a note which claimed that a group called Alpha Research has departments in computer software, electronic equipment, meterology, botanical surveys, library research and any others you care to name. The note continued: "Just in case you are worried about the cost, don't. There isn't any charge".

We discovered that members of Alpha Research work and study in each of the areas listed and, in a philanthropic gesture, decided to use their spare time applying their skills for free. One of the experts, Lee Cooke summarises their computer experience as Pet, Basic and Machine Code; Z-80 mainframe computer, Crememco control Basic; Compukit UK101, Basic and machine code; and Apple II and Basic only.

Their offer is to help anyone who really needs it. Contact Lee Cooke, Alpha Research Group, Worthing, Sussex. Tel: (0903) 41633.

Software company based on years of study

THE MARKET for good software for the more popular microcomputers is now strongly established. Whereas a few months ago companies talked of making long-term investments in the market to mark their territories, big money is now being spent in the expectation of a tidy profit in months rather than years.

A company has been formed to produce microcomputer software with the backing of a massive Dutch insurance group and the experience and contacts of the well-known computer consultant, David Hebditch. The new company, Microtrend International, has more than 125 programs for the Pet, Apple, TRS-80 and CP/M-based micros and by the end of the year nearly twice that number should be available.

The Dutch insurance group, Centraal Beheer, has funded the operation through its larger computer bureau subsidiary, CSR. CSR studied the mini, and now the micro market, for seven years before making its move. The first decision for the company was to find and hire a competent external advisor and according to Harry Costa, the new company director of research, CSR spotted David Hebditch speaking at a conference. The company followed him through seminars and conferences for nearly three years before deciding that he could be approached.

The final decision to finance the software company was taken slightly more than 18 months ago. The launch has been delayed deliberately until a viable product line could be presented to the public.

All the software will be produced by Microtrend Ltd, in the U.K., while the worldwide distribution and marketing of the line will be handled by Microtrend International in Amsterdam.

Nascom word-processing package

A WORD-processing package, Naspen, has been introduced for the Nascom 1 and 2 microcomputers. It is available in two versions: VS.1 for Nas-Sys monitors and VT.2 for Nasbug T4 — it is not suitable for Nasbug T2 and B-Bug.

The package should be used with 16K of RAM but 8K can be used provided the pointer to the top of RAM is altered. All the commands are direct-acting and single-character. Nascom Microcomputers Ltd, 92 Broad Street, Chesham, Buckinghamshire.

IBM stand-alone

IBM HAS launched its 5120 stand-alone computer at £5,577, £2,773 less than its nearest counterpart, the IBM 5110. It includes a screen, keyboard and two diskette drives.

New graphics board

R-SQUARED LTD, specialists in systems based on the Vector Graphics microcomputer now has a new high-resolution graphics board available. Intended for use with the Vector Graphics high-speed 8K RAM memory board, it is S-100-bus-compatible and can be used in any S-100 bus microcomputer with room for expansion boards. The board operates in digital output or 16-level, grey-scale modes. R-Squared is based in Crowborough, Sussex. Tel: (08926) 61587.

Geest family

GEEST MICRO Systems has launched a family of microcomputers based on the TI 16-bit micros — the TI 9900 and the 990/5, with one set of accounting, stock-control and payroll packages and another for civil and structural engineers. Each system has 64K RAM and the top of the range can take up to 200MB of hard-disc storage.

U.K. factory for Puma robot

CONSPICUOUSLY missing from the electronics revolution so far are not devices and applications, but large numbers of good, old-fashioned entrepreneurs with the self-confidence and drive to get things done. Jo Engelberger, president of Unimation, the U.S. robot manufacturer, reminds one irresistibly of those dynamic American millionaires immortalised by PG Wodehouse: "Men who think on their feet and do it now".

Unimation recently announced its intention to establish a U.K. factory for its Puma industrial robot, backed by £420,000 from the NRDC and £240,000 from the Department of Industry, and sited in Telford, Shropshire. The decision to build the factory should mean about 100 new jobs in Telford by 1983.

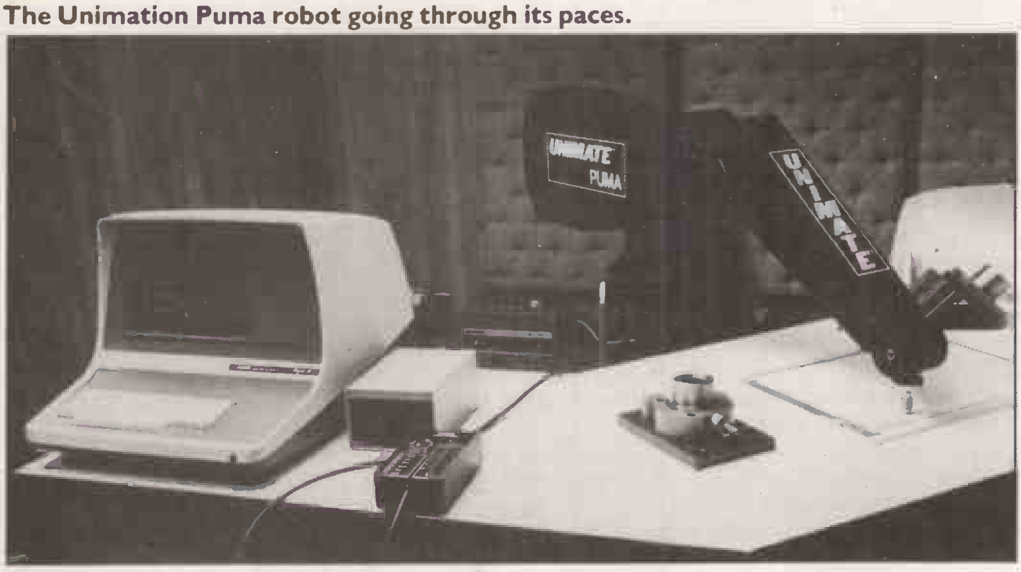
The new venture is only the second robot manufacturing unit in the U.K. The NRDC says that it is anxious to invest in U.K. companies wanting to manufacture robots and design and build associated systems.

Jo Engelberger lists 10 problems which need quick and economic solutions: rudimentary vision, tactile sensing for orientation, hand-to-hand co-ordination, computer-directed appendage trajectories, mobility, compactness, energy-conserving musculature, general-purpose hands, voice communications, and inherent safety.

The main resistance to the use of Robots in the U.K. has been, according to Engelberger, not from the unions but from managements who, he believes, have gone into negotiations with the unions whispering robots as a way of frightening them.

He believes that this pump-priming investment from the NRDC and the DoI will prove a considerable stimulus for developing software to control Unimation robots.

The Unimation Puma robot going through its paces.



Oddpod
— a revolutionary new pocket aid.

Overall size: 170mm x 90mm x 40mm

Oddpod will amaze you. It's the only hand-held language translator that really cares about language subtlety. And it can also be a lot more – a First Aid Guide, a Cocktail Recipe, a Telephone Directory, or anything else its unique 'Ami' Memory System is programmed to store, including customised data.

But until the new programs and customising facilities are finally ready, DDP offer you Oddpod as simply the best hand-held translator that money can buy. Now available in this country after great success in America, Oddpod is worked by 'Ami' micro-chip capsules. Each capsule you buy clips inside Oddpod together with a basic English capsule to allow a maximum of two languages to be cross-translated against English. Using a combination of keys and a phrase index printed on the back of Oddpod, you can quickly display translated words and sentences on Oddpod's screen. But such is Oddpod's respect for language complexity that multiple meanings and misspellings can be clarified and whole word categories can be sequentially displayed for inspection and learning.

Price: £130

inc. vat, p & p, operating instructions and two micro-capsules (English plus one other)

Please tick relevant box to indicate language capsules required: (Three or more capsules £14.50 each inc. VAT & p & p)
☐ French, ☐ German, ☐ Italian, ☐ Spanish, ☐ Japanese, ☐ Phonetic (Pronunciation)

Boris
– a fiendish chess opponent.

Overall Size: 220mm x 220mm x 50mm approx.

Boris will test you. And humiliate you. And improve you. Boris is the chess computer that allows no quarter as you pit your wits against its super-rational micro-circuits and its time-related thresholds of difficulty! It's compact enough to travel with you, but big enough to always be the supreme test of any player.

Price: £76

inc. VAT p & p, operating instructions and clear plastic cover, for board (not shown).

DDP Mail Order
– a smart way of getting either

To get either Oddpod or Boris, simply complete the details above and below and post us back this advertisement.

Please send me: .... (qty) Oddpod Language Translator(s)
.... (qty) Ami Language Capsule(s) as indicated above.
.... (qty) Boris Chess Game(s)

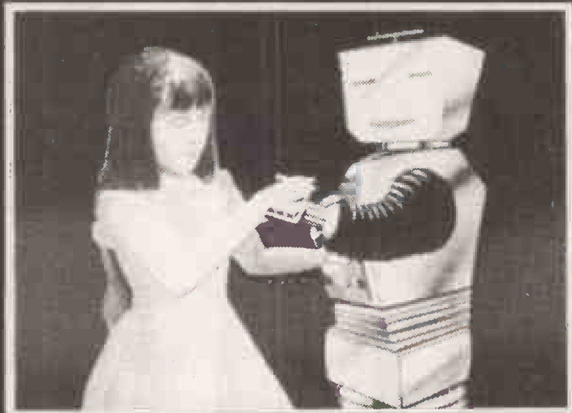
I enclose a cheque for/wish my Access, Barclaycard, American Express, Diners Club Account to be debited with (delete as appropriate) the total sum of £.................. as full payment and understand that I am to allow 21 days for delivery.

Name .... Address ....
Post Code .... Tel. No. ....
Credit Card Account No. .... Signature ....

Distributed Data Processing Ltd.
Mail Order Dept., 17 Nobel Square, Basildon, Essex SS13 1DD
Tel. Basildon (0268) 727563

• Circle No. 177

DR. PLAYGOOD
FOR PET, APPLE, TRS-80



Introduced by Tom O'Ton, Microtrend's friendly robot, this imaginative and entertaining implementation of four traditional games is ideal for 4-8 year olds. Full use is made of sound and graphics capabilities and success is liberally rewarded by the friendly animated robot.

Package includes:

- OXO Noughts and Crosses – win the best of five games and receive a stunning trophy of gold!
- Hunt the HURKLE using the keyboard (or game controls) but watch out for those sneaky snappers!
- Keep death off micros with our constructive version of hangman – WORDS!
- GUESS numbers or letters, the nearer you get, the more fun things become. Designed to improve recognition of numbers, letters and words.

FOUR SUPER PROGRAMS FOR ONLY £9.95 (incl. VAT)

OTHER ENTERTAINING SOFTWARE INCLUDES:

PET 8K		
HURKLE v SNAPPER	FOUR PROGRAMS	£9.95
GAMBLER'S WORLD/1	FOUR PROGRAMS	£9.95
BRAINTEASERS/2	THREE PROGRAMS	£9.95
APPLE II 16K		
BRAINTEASERS/1	FOUR PROGRAMS	£9.95
TRS-80 LEVEL II 16K		
REVERSI	(OTHELLO)	£9.95
GAMBLERS WORLD/2	FOUR PROGRAMS	£9.95

For our 24 hour telephone ordering service call 0423 711878, or complete the coupon:

Name ____________________
Address ____________________

Please send me ____________ At £ ______
for the ____________________ system.
Please send me your product catalogue ☐ (tick)

Total £ ________ Signature ____________

☐ ☐ CHEQUE ☐ (tick)

Credit Card No ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Send to: Microtrend Ltd.,
P.O.Box 51, Pateley Bridge,
Harrogate, North Yorkshire HG3 5DP

PC

• Circle No. 178

AT LAST!

Appleware

The best of British and American APPLE SOFTWARE

ACT Appleware brings you 70 classic programs from the worlds leading suppliers of Apple software. Many have already become best sellers in America. So send today for a free copy of the most exciting Apple software catalogue ever. We promise to keep you on the mailing list.

Appleware is backed by the resources of the ACT Group, Britains leading computing company. Contributing software houses include Programma International, Personal Software, Automated Simulations, Speakeasy Software and P.D.I.

Disk programs include:

Applepie Text Editor £30
Alien Invaders £8
Apple Database £23.50
Talking Disk (Speech Synthesis) £14.95
Apple FORTH £39.95
Assembler/Editor (in machine code) £45

Try them at your Apple Dealer. Also available by mail order direct from ACT Appleware.

Send a free catalogue to

Name ....

Address ....

.... Post code ....

I have an ☐ Apple II ☐ ITT2020 ☐ No Apple

Appleware

Radclyffe House, 66/68 Hagley Road, Edgbaston, Birmingham B16 8PF
Telephone 021-455 8585 Telex 339396

• Circle No. 179

• Circle No. 180 ▶


Can your business, research project or teaching laboratory be made more efficient? Yes. Today's users demand complete, high performance micro computer systems. Expandable to meet future needs and with software capable of immediate application.
The North Star Horizon is the answer. A cleverly balanced configuration: Z80A processor with 12 slot S100 chassis, one parallel and two serial interface ports. Now with double or quad capacity too.
The compact design gives you value for money and economy of space. The Horizon will not break your bank or your desk top.
Quick delivery and nationwide service are only part of the attraction. Add to this the wealth of software available, including the well known CP/M, and you can see why the Horizon has already sold in thousands.
The reason for its success is simple.
The North Star Horizon reflects your needs.
NorthStar
For technical specification and details of your nearest dealer contact Britain's leading North Star Supplier.
comart
PO Box 2, St. Neots, Cambridgeshire.
Tel: (0480) 215005. Telex: 32514.
COMART G.
North Star Horizon
reflects a new age in computing

Moving data at a snail's pace because you're floppy bound?

At last, a fast mass disk storage system for your micro-computer. The new CORVUS 10 megabyte hard disk lets your programs run faster and access more data than ever previously possible.

"How do I use it?"

If you have an Apple[1] Tandy,[2] North Star[3] or LSI-11 system, you can just plug in and go, just like any of your other peripherals. All the interfaces have been designed and tested to work with your existing software, all of which means that there is no new disk operating system to learn. Your programs will run virtually without modification!

"What about back-up copies?"

The unique Corvus MIRROR system allows you to dump onto any video tape recorder. Data is transferred at 1Mb per minute. Advanced error checking algorithms ensure a truly secure system.

"Just how fast is it?"

Normally your disk accessing speed will be about 20 times quicker than with using floppies.

"Fixed disks are bulky though aren't they?"

Not this one. New technology has provided 10 million bytes of storage space in less than two-thirds of a cubic foot of space!

REMEMBER: ALL EXISTING APPLICATIONS WILL RUN WITH LITTLE OR NO MODIFICATION.

The Sales Ledger that was just too large for the floppy system can now be handled with ease. The sorting of 10,000 names and addresses is possible in a short space of time. Stock Control of large inventories can be handled quickly and efficiently.

The serious business user cannot afford to be without one!

1 Pascal and DOS versions
2 TRS-80
3-or any other S100 bus micro

Corvus disk with interface	**£3500**
Corvus add on disk	**£2500**
MIRROR interface	**£500**

CORVUS SYSTEMS, Inc.

Keen Computers

Exclusive distributor. Retail enquiries welcome.

Keen Computers
5b the Poultry, Nottingham
tel: 0602 583254
telex: 37297 (keenco)

MEMBER CRA COMPUTER RETAILERS ASSOCIATION

Panasonic JD-700U heads Japanese challenge

by Vincent Tseng

THE JAPANESE challenge in the field of very large scale integration (VLSI) microelectronics has been in the news a good deal recently. The Panasonic 700 is part of the first wave of newly-announced and exhibited Japanese microcomputers. Now that major Japanese companies have entered the microcomputer market, how does a machine like the Panasonic compare to the already-available U.S. and British machines? Japanese products have an enviable reputation of offering very good value for money with high reliability. Does this new challenger in the microcomputer market continue in the same tradition?

Attractive package

The Panasonic JD-700U computer is a desk-top-type computer with a 12in. screen, full alpha-numeric keyboard and two mini-floppy disc drives all built into an attractive package. It is, however, reasonably large, occupying an area of about 2ft. × 2ft. and is heavy at around 66lb.

The machine is based not on some new Japanese VLSI technology but on the U.S. Intel 8085A at 2MHz, with 64Kbytes of dynamic RAM on the version under review. The keyboard includes the alphanumerics in the QWERTY lay-out, separate numeric keys, cursor control keys and some 21 special-function keys. The computer has, unusually, three serial ports claimed to be standard RS232C types. There are no convenient parallel I/O ports.

Delivered with the machine were two mini diskettes labelled respectively CP/M and Basic, along with a manual for each. There were at first sight, no instructions for setting-up, but it seemed simple enough; just plug-in the mains plug and switch-on at the power switch at the front of the machine. Being the cautious type, I ensured that there were no diskettes in the drives on powering-on.

Signs of life showed in the fan, and the LED indicating access on the disc drives lit on drive one, two and then one again, with the usual drive active sounds. Then a message which read "SET DISKETTE" appeared on the screen, the access light on, drive 1 remained on but there were no more sounds than the fan.

Hitting keys on the keyboard at this stage, including control-C, had absolutely no effect. The mini diskette, with the required operating system, CP/M, was inserted into drive 1, and within a few seconds the system was active with the usual CP/M prompt of "A " on the screen, but surprisingly the normal announcement message of CP/M and the version number was not there.

Mention of the version number, 1.4, was eventually found in the manual, toward the back, on some of the listings of routines, and in section 10 which showed the differences between versions 1.3 and 1.4. Using DDT and displaying sections of memory, DDT announced itself as "DDT VERS 1.4" and a copyright message for Digital Research was found in memory at 100H.

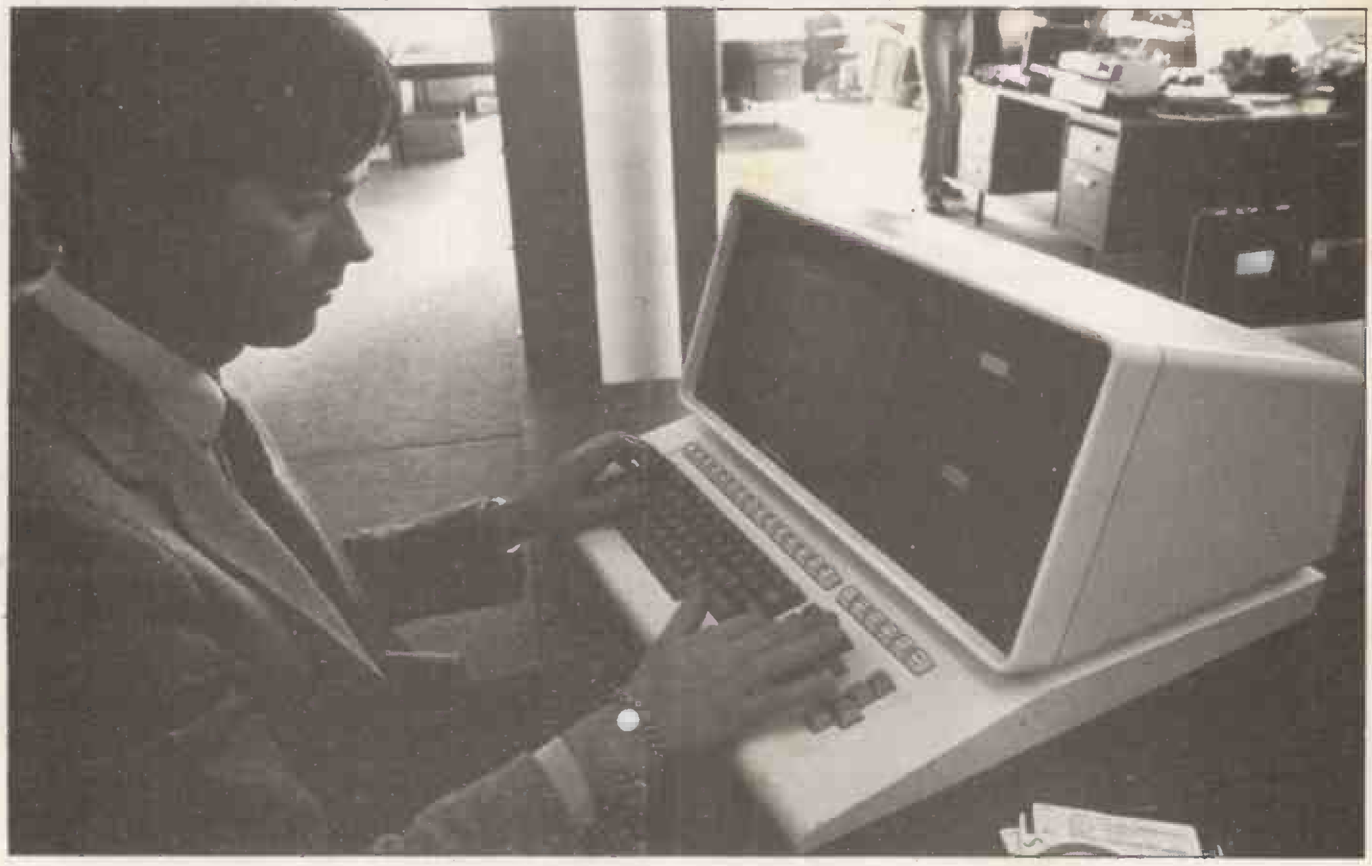
Basic disc

The Basic disc was inserted into drive two and a CP/M DIRectory executed for drive two, or B:, but showed nothing. Worried that a corrupted or blank Basic disc had been delivered, a STAT command was tried for drive two — this time there were three large files shown but the file names were jibberish.

In case the Basic did not work under

(continued on next page)

Ian Patterson of APT Computers Systems, London, demonstrating the Panasonic JD - 700U



(continued from previous page)
CP/M, the Basic disc was booted-up on the system by inserting the disc and powering-on and this time Basic Rev. 5.0 (Matsushita Version) by Microsoft announced itself on the screen.

The 12in. screen used green phosphor, and displayed both upper- and lower-case characters with very good clarity and definition right across the screen and into the corners where there was a slight deterioration.

There was a slight, but noticeable tremor in the image displayed. 80 characters × 24 lines in a claimed 12 × 7 dot-matrix format were capable of being displayed. The relatively large dot matrix in a 14 × 10 field accounts for the high legibility and definition of the characters as well as allowing true descenders in lower-case alphabetics.

The phosphor of the screen had rather long persistence, particularly noticeable in low ambient light conditions. When scrolling the screen, for example, the previous lines take discernable time to fade away, making the screen unpleasant to view when characters are changing.

Lower-case

When switched on, the keyboard is initialised to lower-cased alphabetics. To obtain the upper-case, one needs to use the shift key as on a normal typewriter, or the shift-lock key. The shift-lock key is of the non-latching type, so that the only indication that it has been activated is the response to keys hit displayed on the screen.

Unlike typical terminal or VDU keyboards, the shift-lock key words as a normal mechanical typewriter. When activated, all keys hit generate the characters shown on the upper symbols of the keys. On most terminals, the shift-lock is, in fact, a capitals lock key for alphabetics only, so that when the top row of combined numerical and punctuations keys are used, they still generate numerics. To access the punctuations, one uses the shift key, which when released does not affect the capitals lock key.

The shift-lock key on the Panasonic 700 is de-activated when the shift-key is used — again, as on a mechanical typewriter. There may be contention that this is a sensible system as it is adapted more easily by an accomplished typist of the typewriter variety, but may confuse people more used to terminals and VDUs.

I certainly found it frustrating, even though I am used to both typewriters and VDUs. I think it must be the fact that there is no indication that the shift-lock key has been activated, and that the shift key can de-activate it with no indication, other than responses to keys hit.

One grows used to seeing lower-case commands when entered from the keyboard. Both CP/M and Basic will accept those as if they were indistinguishable from upper-case.

One annoying feature is that the often-used DELete key is an upper symbol combined with an underline dash. That means that DELete has to be used with shift or when the shift-lock key is activated. Also control lower-case "c" is not recognised by this particular version of CP/M, and only an upper-case control-C will cause a re-boot.

CP/M is a well-known operating system for 8080-, 8085- and Z-80-based machines — see Rair Black Box review, *Practical Computing*, November, 1979. It was developed by the U.S. company, Digital Research. It worked reasonably well on the Panasonic and the only problem I encountered was that on one diskette, after formatting it and using the ERA B:*.* command to ensure all files were deleted from it, I was still unable to write or transfer any files to it.

Summary specifications

CPU —	8085A
Clock rate —	2 MHz
Memory —	32K or 64K (delivered) bytes of 4116 dynamic RAM. 2K of 2716 EPROM for boot-strap. 2K of 2114 static RAM for screen.
Mass storage —	2 × mini-floppy disc drives claimed Shugart-compatibility storage 60Kbytes under CP/M and 70Kbytes under Basic.
Screen —	12in. green P39 phosphor, displaying 80 characters × 24 lines of 7 × 12 matrix in 10 × 14 field.
Keyboard —	94 keys with alpha-numerics in QWERTY lay-out. Operation similar to mechanical typewriter. Separate numeric keys, cursor-control keys and 21 special-function keys PF1-15, PE1-6.
I/O —	3 × serial I/O RS232C-type, no convenient parallel I/O.
Software —	2 separate operating systems CP/M 1.4 or Basic.

CP/M indicated that the directory was full on that disc which resisted numerous attempts to write to it despite formatting, erasing and using SYSGEN — initialising as system disc.

That disc was later capable of being written to under Basic and, having been formatted and erased under Basic, was capable of being written by CP/M after the usual format and erase. The problem remains a mystery and may suggest an undiscovered bug in either the operating system or the machine.

It was not surprising to find that the version of Basic interpreter was by Microsoft. The Basic diskette, however, was not compatible with the operating system CP/M. It had, in fact, its own stand-alone operating system and was capable of booting-up on its own.

It has all the usual language features as found in the more usual Microsoft Basic (Rev. 5.0). Good string-handling functions, transcendental functions, as well as the TRON and TROFF commands to give debugging facilities.

There were extra commands for the Basic operating system, such as MOUNTing and REMOVE discs, and an executable file of "UTY" — utility routines — which had functions for formatting, initialising and clearing discs. The MOUNT and REMOVE commands were to allow access to the discs and to remove the access when necessary.

It was essential to execute the REMOVE command before removing any disc, to avoid the risk of corrupting the allocation, or directory, information, and losing further access to data stored on that disc.

That was very inconvenient — it is all too easy to forget to use the REMOVE command before removing or changing the disc, with disastrous consequences to both the removed and the newly-inserted discs. The allocation information is stored and updated in memory and is, therefore, not correct for the newly-inserted disc and can cause total loss of information.

That was not a feature I liked, and it cannot be recommended for anything but non-serious use, as it is too prone to operating errors, with the accompanying loss of data.

Having also tested Microsoft Basic Revs. 4 and 5 before, I was surprised to find the timings for the benchmark programs to be very slow, in the region of twice as long as the timings for the Rair Black Box — also 8085A. It probably was due to the fact that this version of Basic also contained the operating system and the slower clock rate for the 8085A — the maximum clock rate for the 8085A is 3MHz.

Special function

A feature which I liked was the provision of special-function keys. There was a row of keys along the top of the keyboard arranged in two groups, labelled PF 1 to 15 and PE 1 to 6, making 21 in all. The PF keys worked under the Basic where they had the same effect as the execution of a Basic command-statement line, and any statement line was assignable to any key — they are user-programmable.

That was useful, as often-used commands can be assigned to a PF key and called-up by a single key-stroke. Those keys are initialised to certain useful functions on booting-up the Basic system and are listed in the Basic manual.

I did not find mention of the PE keys in the manual except for PE1 under the EDIT command where it was used as control—[to end an insertion. Attempts were made to find out the characters generated by the PE keys by writing a short routine in Basic using INPUT and PRINT, but to no avail.

The special function keys did not appear to operate under CP/M which was a pity. There were also cursor control keys on the keyboard and although they could move the cursor around under both Basic and CP/M, there was no screen editing as with Nascom 2 — *Practical Computing* April, 1980 — and, therefore, they were of no operational value under the two systems.

The capacity of the inbuilt, twin, mini-floppy disc drive was very low as the recording format was single-density. That gives only about 60Kbytes storage per drive under CP/M. The specifications in the OEM manual claims 70Kbytes.

This limited storage tends to make business use difficult but not impossible. Serious consideration should be given by the manufacturer to upgrading the recording format to double-density, if not to double-sided — neither is offered as options at the moment.

Good access

Access into the computer was good, the logic was contained on one single, but large, circuit board, accessed from the bottom. All components were soldered directly to the board, including all the LSI 40-pin chips. That is not a good thing for easy servicing, unless total board exchange servicing was envisaged. Most of the components were from Intel, Texas Instruments and Motorola.

Almost all the RAMs were of Japanese manufacture, though. The 4116s, dynamic RAMs for the computer memory and the 2Kbytes of static 2114 for the screen memory, bore the Mitsubishi trademark and the three 8251 USARTs were by NEC, a second source for Intel.

Despite 64Kbytes of RAM, addresses above F800H were not accessible, tested under CP/M DDT, and showed that there was a wrap-around of addresses every 100H bytes and the character generator ROM resided in that region.

The disc drives, claimed to be Shugart SA104-compatible, had the National symbol and the keyboard PCB looked as though it was of Japanese manufacture.

Two manuals were supplied with the machine, for CP/M and Basic. The Basic manual gives operating instructions for setting-up but it does not mention that this was a version which included a self-standing operating system.

The manual was very much like the standard Microsoft Basic manuals — the information is there but you have to look for it and know what to look for.

The CP/M manual was the standard from Digital Research, brief and useful for reference.

Background

The Matsushita Electric company was founded in 1918 and has since grown to be the largest corporation in Japan and one of the largest in the world. Turnover last year exceeded £4,400 million. There are more than 110,000 employees, producing 10,000 different products and manufacturing most of the components. Panasonic is part of the corporation.

Teletronics in the U.K. won the distributorship for Matsushita office products when there was a clear division between office and consumer electronics. Now, as the two markets have started to overlap, Matsushita has bought Teletronics and changed its name to Panasonic Business Equipment (U.K.) Ltd. The address and telephone number are 9 Connaught St, London W2, 01-262 3121.

Panasonic intends to concentrate its efforts on the smaller end of the business computer market and the JD-700U reflects this aim. Rather than announce and develop entirely new systems, the company hopes to improve progressively the Panasonic range. The next major announcement expected will be a new version in the JD range with an integral Winchester technology hard disc and a single floppy drive.

Conclusions

- **Particular shortcomings were in the long persistence of the phosphor of the screen, the non-terminal operation of the keyboard with no indication of the activation of the shift-lock key.**
- **Of more serious nature was the low capacity of the mini-floppy discs, common to all mini-floppies recording on single-density, and not peculiar to the Panasonic.**
- **The awkward operating procedures in Basic were too prone to dangerous errors.**
- **The question remains, why did they not use the usual CP/M-compatible Basic from Microsoft, instead of having two operating systems?**
- **My disappointment may have been caused by unduly-high expectations about the quality of the Japanese challenge in the microcomputer market.**
- **It has attractive packaging, programmable special functions keys and the Japanese reputation for high reliability.**
- **The machine reviewed costs in the region of £4,000.**

VisiCalc

VisiCalc is a general-purpose modelling system written by Dan Bricklin and Bob Frankston of Software Arts Inc, Massachusetts, and designed to run on Apple II or ITT 2020 with a minimum configuration of 32K RAM, a floppy disc or tape and a printer.

DUBBED THE 'Electronic Sheet' by its authors, VisiCalc has gone on sale in the U.K. as a financial-modelling system. At £100 the system will, we expect, find many users in the fields of engineering and science, education and statistics as well as in finance and marketing. In fact, in any field where tabular reports of rows and columns of calculated numbers are used, VisiCalc will be a very powerful tool.

It has the added attraction that no knowledge of programming languages is required — though, a knowledge of Basic further extends its capabilities. To extend the machine to its full requires some study, but most should be able to use it with a few hours' practice and soon after will be able to produce working models.

Addressed array

Simply speaking, VisiCalc allows the user to build a set of calculations within a table — an addressed array — having a maximum width of 63 columns by a maximum length of 254 rows. At each address in the table — accessed by a row and column co-ordinate — the user may enter a value or a formula telling the system what relationship that value has to any other value in the array.

The screen acts as a window on the sheet or table and can be moved around easily to illustrate values and their formulae in any part of the table.

VisiCalc is geared to answer the 'what if' question so often asked of employees and usually requiring an answer five minutes ago. Once a basic model is established in memory, values may be plugged-in at any point and re-calculation occurs, or calculation rules can easily be altered with the same instantaneous result. Once written, models may be stored on cassette tape or floppy disc and recalled at will.

When loaded, VisiCalc initialises an array for the user and displays the top left-hand side of the table through the 'window' or screen shown above. The highlighted top row shows the column

by Mike McDonald

labels A, B, C and so on. The first column indicates the row numbers 1, 2, 3, up to 20.

The balance of the table, although not displayed, is out to the right of that portion shown for a total of 63 positions. Labelling of the columns is alphabetic — A to Z, AA to AZ and then BA up to BK. The row numbers continue downwards to 254.

The user has four key motions of up, down, left and right to move the cursor, displayed above as a white bar at position A1, round the table to any co-ordinate. At the top of the display are three lines of information. The top line tells the user the current cursor address and the nature of the data in that field or any formulae which apply.

The next line down is used to display command options and sub-options, and the third line, blank as above, is the edit line where all keyed transactions are displayed and edited before being committed to the table. Anything typed in the edit line is assumed to apply to the field in which the cursor is positioned in the table, figure 5.

Each table position or address may be accessed either by physically moving the cursor via key-strokes to that location, or by using one of the many commands consisting of a 'GOTO CO-ORD' by entering an address, i.e., B5 on the edit line.

The cursor then moves automatically to that location on the screen. If an address is outside the currently-displayed fields, the window scrolls to portray that region of the table in which the address resides.

Once the cursor is at the desired position, the user may enter information into that field. Our first working example is a very simple three-line model to calculate a gross margin from sales and costs figures entered.

With the cursor at A1 we simply type the word SALES. VisiCalc determines whether input is descriptive, numeric, calculative, or whether it is a command by examining the first character entered.

Alphabetic entry is taken as descriptive, numeric as a value. A '±' or '@' sign is calculative and '/' is a command request. The word SALES appears as typed on the edit line and RETURN places it in field A1 on our table.

Error correction

We then right-cursor to position B1 and enter the number 100. At the point of entry on the edit line, the user has the opportunity to back-space and correct any errors. On entering a RETURN or cursor movement, the value is accepted and transposed to the table. We cursor-down to positions A2 and B2 and enter the word COSTS and the value 60.

At A3, we enter GROSS and cursor-right to B3. Here we need a formula to subtract values B2 from B1. There are two ways to do this: either the formula

+B1—B2 may be keyed directly on the edit line or, after entering a '+', the cursor may be moved up to position B1.

As it is moved through B2, '+B2' appears on the edit line and is replaced by '+B1' when the cursor is moved-up again. A '—' keyed now fixes this value on the edit line and the cursor leaps back to position B3. The edit line now displays '+B1—'. An upward cursor movement brings it to rest on address B2 and 'B2' is tagged on to the end of the formula. The process is completed by hitting return; the cursor leaps back to B3, the value 40 appears under the cursor and the top line of the screen displays B3 (V) +B1—B2 — figure 1. That may sound long-winded but it illustrates that formulae may be built-up on a simple relational basis by using cursor movements instead of keyed values.

As each calculation is built-up, VisiCalc calculates the result automatically, although it may be suppressed if required. Once this simple model is set-up, the cursor may be moved to positions B1 or B2 and a new value entered. As each value is changed, the software notes the change on the top line and re-calculates the result at B3.

The cursor is moved through each field on the screen and its characteristics are displayed on the top line showing its location, nature — i.e., V for value or L for label — format if numeric, and value or applicable formula, figure 1.

Accounting rules

The accounting rules have now been established for the first column of our model. The next step is to duplicate it across the sheet to allow for, say, six months of data, i.e., six columns. To repeat previous transactions would have been tedious and time-consuming. VisiCalc solves this problem with a Replicate command.

Replicate is accessed by entering a '/R' and requests a source range of rows of columns and a target range. Once entered, it displays the value or formula to be transferred, offering the option of making the formula relative to each column / row.

Commands and their sub-options

Only the first character of each command is entered.
/Blank — blanks the current cursor address.
/Clear — clears all values, formulae, and labels from memory. Requires confirmation Y or N? before execution.
/Delete — deletes either Row where cursor resides or Column where cursor resides.
/Format — formats current field to;
- Default — resets all formats to that set under /Global command of each individual field.
- General — sets current field to free format.
- Integer — sets current field to integer value.
- $ — sets current field to decimal 2 places.
- Right — right justifies label string at current field.
- Left — left justifies label string at current field.
- * — causes graphical representation of value in *s.

/Global — options include;
- Format — as stated but applied globally.
- Column — column width setting, value entered.
- Recalc — A or M? sets re-calculation to automatic or manual.
- Reval — R or C? sets evaluation order by row or column.

/Insert — R or C? inserts a row or column at current cursor position.
/Move — From and To? moves row or column to any other position in the table.
/Print — To? prints selected array from table starting from current cursor position to entered address.
/Replicate — Source : Target? Relative & No Change? duplicates formulae across rows and columns and alters source expression to become relative at each new address.
/Storage — Load disc file, offers display of existing files
- Save file to disc, entry of filename.
- Delete disc file, entry of filename.
- Initialise new disc
- Write file to cassette
- Read file from cassette

/Titles — Horizontal, fixes horizontal title in place against scrolling at current cursor position. Vertical, fixes vertical title in place against scrolling at current cursor position. Both, as for both horizontal and vertical. None, cancels any existing title option.
/Version — displays current version title of software package.
/Window — Horizontal, splits screen into two sections with a horizontal divider showing column letters.
- Vertical, splits screen into two sections with a vertical divider showing line numbers.
- 1, returns screen to single-window format.
- Simult, permits simultaneous scrolling of screen in both windows of split-screen formats.
- Unsych, turns-off synchronised scrolling in split-screen mode.

It would be pointless duplicating the formula +B1—B2 in every position. By requesting relative option, VisiCalc then places a formula in each position, altering the column label, i.e., at C3 ÷+C1—2, D3 ÷+D1—D2 and so on. Our transaction takes the following keyed format:
/R
SOURCE RANGE?
B3...B3:
TARGET RANGE?
B4...F4
B1—B2 RELATIVE OR NO) CHANGE?

When we have done this, we are able to move the cursor to each position of sales and costs data and enter values. On each entry, VisiCalc produces the correct result on the third line. Equally we could use the /Replicate command to reproduce the values at B1 and B2 all the way down the line to avoid unnecessary keying effort.

A simple formula at C1 of +B1*1.1 would cause the sales figure in column B to be increased by 10 percent and placed in column C1. That could also be replicated down the line causing a single entry at B1 to be increased by 10 percent for each period.

The /Replicate command is undoubtedly VisiCalc's most powerful command and saves considerable time when we start to work with more complex models.

Screen limitation

One limitation of the Apple system is the 40-character screen width. VisiCalc does scroll, but titles down the left-hand column A or in row 1 can disappear from the edge of the screen when scrolling occurs and often the user will need to examine one portion of his model and the bottom line or totals column simultan-

(continued on next page)

Figure 1.

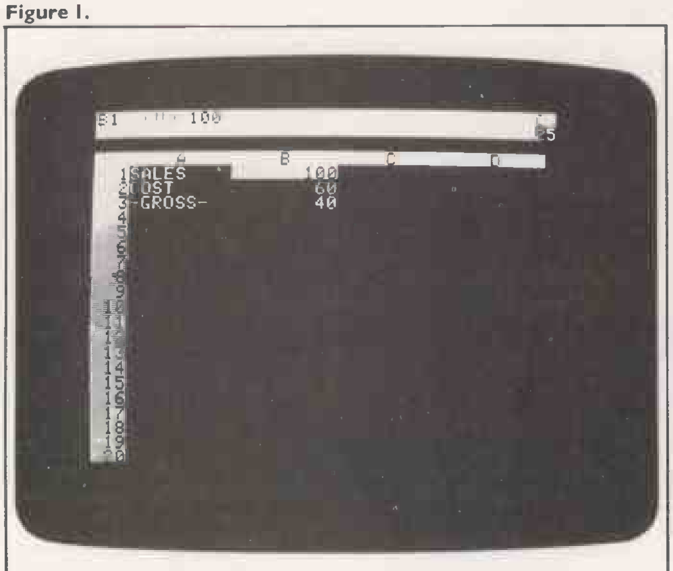
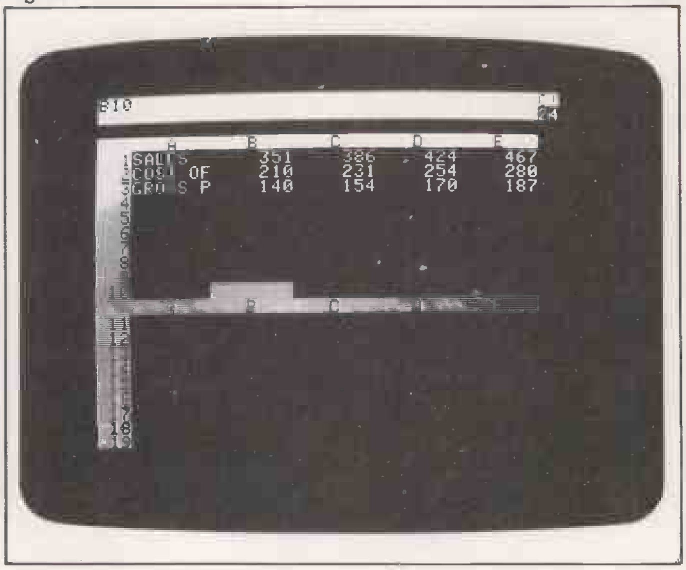


Figure 2.



(continued from previous page)

eously either in development or running phase.

The program caters for this in several ways — see figures 2 and 3. The default column width is set to nine characters on starting-up. That may be reduced Globally with a /Global command. Reducing the global column width to seven characters allows us to display columns A to E in the previous example.

The Global command applies to all fields in the table but merely reduces the information displayed without affecting the accuracy of the number.

The window may be split into two discrete windows either horizontally or vertically to duplicate row numbers or column letters. Cursor movement and scrolling in each side of the display are independent of the other half. The split will occur wherever the cursor is positioned on the screen, and is actioned with a /Window command with options of H for horizontal or V for vertical splitting.

Simultaneous

Thus if we were to calculate a total in column G, we could display columns A to D on the left side of the screen and G on the right side. All amendments to data on the left are rippled through to the right as re-calculation occurs.

For very large models, scrolling may be geared so that both sides move simultaneously, displaying columns or rows remote from each other — figure 4.

To avoid losing line names or column headings when scrolling, a /Title command allows the user to fix such fields on either a horizontal or vertical axis or both. Any scrolling will not affect these lines until the /Title option is cleared.

Each data field may have one of several formats. /Format may be used when keying data into addresses to set the display of numbers to integer, decimal fixed two places, or free format.

Free format is not justified and will use scientific notation on large numbers, i.e., 1,000,000 ; 10E5. Text or label fields may be right- or left-justified individually. The format of the whole screen may be affected from the /Global command with the /Format as a sub-option.

Therefore, selecting integer format while developing an application combined with a narrow column width allowed us to display up to 12 columns at once. They were later expanded to the correct width and format.

Once a model has been set-up the user may save it away on a disc or tape. The functions accessible through the /Storage command are:

Save — saves all entries, titles and window settings currently in force to floppy diskette.
Write — as for 1, but to cassette.
Load — loads saved models from diskette and re-instates them as saved.
Read — as for 4, but from cassette.
Delete — deletes specified file from disc with a Y or N confirmation request.
Initialise — formats a blank diskette for use by VisiCalc.

VisiCalc saves models under user-nominated file names and stores them on disc or tape as text — ASCII — files. When loading back into the system, the software asks the user for the file name to be loaded and the user may cursor — through displayed entries on the disc to select one.

File names may be up to 30 characters in length. Models are loaded to memory exactly as they were last accessed, including cursor positions, permitting development work to continue with minimum fuss.

Calculation rules or formulae entered against each field are entered as normal algebraic expressions with the usual operator notation of ½ — / * and either field addresses as the operands or numeric constants.

Two unusual features built into the formula entry procedure are: When a formula of, say, +A1/B2, has been entered, the user may key a '!'. VisiCalc will retrieve the numeric values at positions A1 and B2 automatically and evaluate the expression, replacing the formula with its numeric result; using the same formula +A1/B2, an entry of '#' will cause VisiCalc to replace the last address (B2) by the numeric value currently at address B2.

Those facilities offer the user a useful debug or substitution method when building complex expressions.

On entering a formula for a field or altering a value in a field, VisiCalc re-calculates the whole sheet automatically to reflect the changes. That may be suppressed by switching-off the option and entering a '!' when re-calculation is required. The program also has a number of built-in routines that may be used in formulae:

@SUM(RANGE) — computes the sum of the values in the range.
@MIN(range) — computes the minimum value in the range.
@MAX(range) — computes the maximum in the range.
@COUNT(range) — returns the number of non-zero entries in the range.
@AVERAGE(range) — calculates the average of the non-blank entries in the range.
@NPV(dis, range) — calculates the Nett Present Value of the cash flows in the range, discounted at the rate specified by dis.
@LOOKUP(v,range) — compares value v to the values in the range and places cursor or calculation in the next logical position.
@NA — results in a 'Not Available' value which makes all expressions using the value NA.
@ERROR — results in an error value which makes all related values equal error.
@PI — results in 3.1415926536.
@ABS(v) — produces an absolute value of v.
@INT(v) — results in an integer value of v.

Maths functions

The following maths functions are also available and are self-explanatory;

@EXP(v) @SQRT(v) @LN(v)
@LOG10(v) @SIN(v) @COS(v)
@TAN(v) @ASIN(v) @ACOS(v)
@ATAN(v)

The range value may consist of row or column addresses entered as a range or individual values. The user may define the

Figure 3.

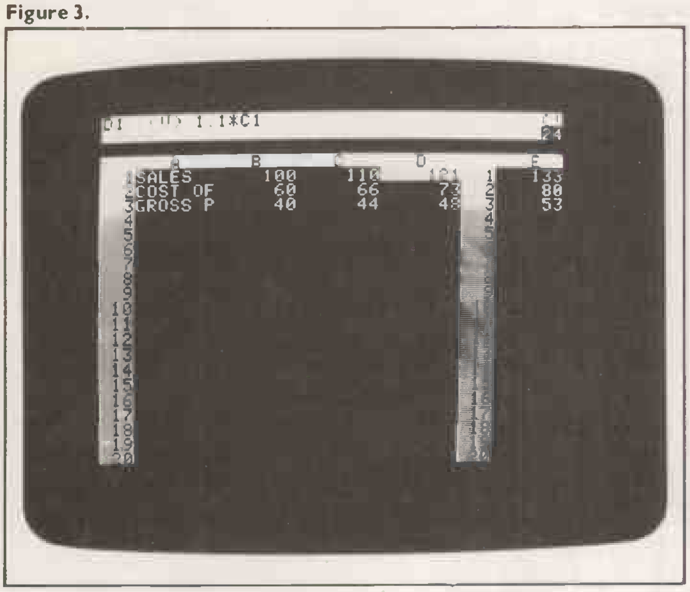
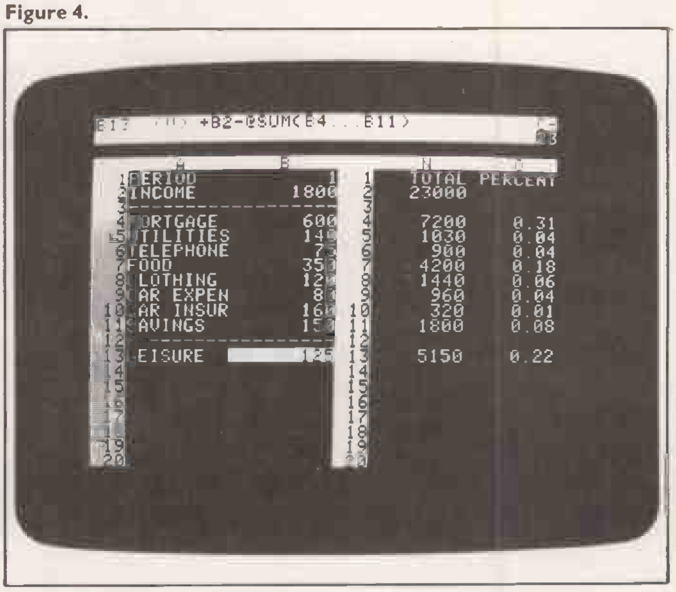


Figure 4.



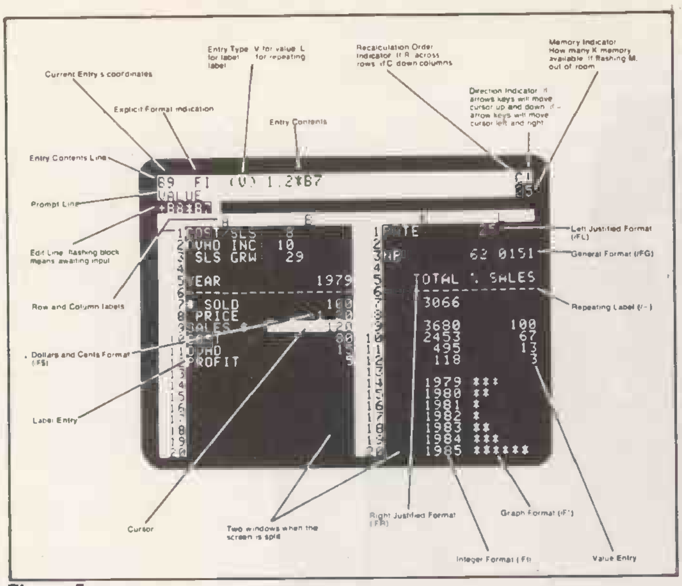


Figure 5.

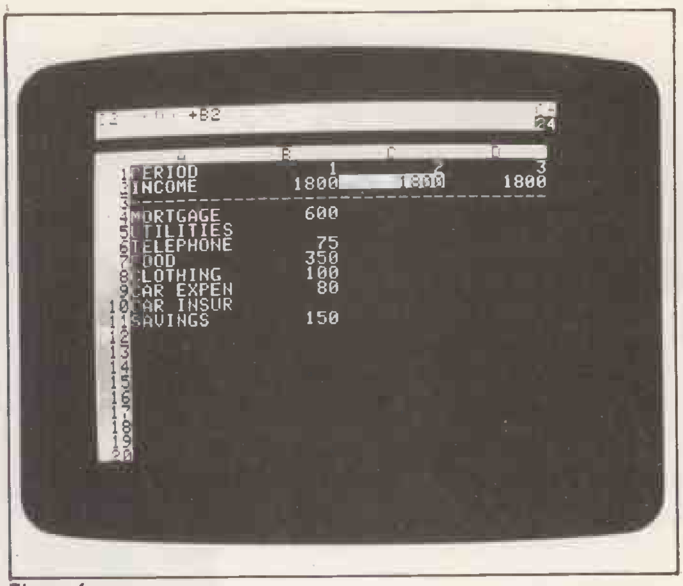


Figure 6.

order of calculation in terms of columns of rows, i.e., the default is calculated down each column, starting at column A. Calculations may be formed so that evaluation is by row across the screen.

Unlike other programming languages, VisiCalc evaluates formulae from left to right rather than in order of priority. Brackets may be used to nest calculations, but will not force the order of evaluation.

Three simple edit functions are provided to modify models or amend them at a later date to include new additions or deletions: /Delete — Row or Column must be specified; once this is done, a deletion occurs at the point where the cursor is resting. Any subsequent rows or columns are brought forward to replace deleted member. /Insert — as for Insert, a row or column is added and the balance re-shuffled to accommodate the change. /Move — requires the user to cursor from source to destination or simply to enter the appropriate addresses for either row or column adjustments.

The software package has a /Print feature designed to produce a hard-copy listing of the sheet. The print facility is simple to use and the only options are the nomination of the top-left-hand and bottom-right-hand corners of the array to be printed.

Flexibility

That allows a certain flexibility in producing reports. The image printed will duplicate exactly the data displayed on the screen. We felt it would be useful if the print routine allowed the user to print-out the related formulae for each screen address, as there appears to be no way to obtain it in hard-copy form.

Also lacking was the facility to add any additional headings or frills to the report. The fact that each model and its current logged values are stored as text information on the diskette does mean that Basic users can access the files from user-written programs to produce tailored reports. Otherwise VisiCalc is not specifically geared to produce special reports. One sub-option within the /Print command, is the ability to create a print file on diskette.

One of the features of the format command is the ability to represent integer numbers by a row of asterisks corresponding to the size of the number. It means that with careful modelling we were able to produce reasonably good bar charts from column-oriented data, i.e.,

A	B	C
No	FUNCTION I	FUNCTION II
1	@	@@@@@@@@@@ @@@@@@@@@
2	@@	@@@@@@@@@@ @@@@@
3	@@@	@@@@@@@@@@ @@
4	@@@@	@@@@@@@@@
5	@@@@@	@@@@@
6	@@@@@@	@@@
7	@@@@@@@	@@
8	@@@@@@@@	@

With expanded column format and the print option, we were able to obtain good plots on the printer of various functions, and formulae.

Documentation

The standard of documentation for VisiCalc is good. The user manual is bound in a neat A5 ring binder which includes the master software floppy diskette and a reference card with most options indicated.

The manual is more of a training aid than a reference text and certainly leads the user through the features of the package with ease. There are very good sections on obtaining the best results from the software and facilities.

There is also a user registration card for the purposes of software updates and news. Another section describes the VisiCalc dynamic memory allocation method. It simply means that as memory is used and released, the software expands the dimensions of the memory used automatically or contracts upon deletion of rows or columns.

Core is allocated according to the size of the current array. If a bottom right-hand co-ordinate is addressed, VisiCalc pre-allocates room for the values which may well occupy any intermediate positions.

On the top-right-hand side of the display are two indicators. The very top corner will contain a C or an R to indicate the order of calculation through the model and flashes when the CPU is in mid-calculation. Below that is a two-digit memory-free indicator which updates itself constantly as the model is developed or modified.

The indicator flashes if the memory capacity is approached. Another nicety of the system is the correction against the re-set being pressed. Unfortunately, the Apple II re-set button cannot be disabled from the software. VisiCalc cannot recover from this fatal action but enters automatically the /Storage mode in the event that re-set is hit.

The user is also advised against making cyclic errors in addressing and designing models and advised how best to avoid such problems.

Conclusions

- **We found the VisiCalc to be a highly-professional software tool which caters for many possible users and errors.**
- **It is extremely versatile and very powerful for any application requiring tabular calculation.**
- **The documentation is very good and covers all aspects a user is likely to encounter.**
- **The program may be used on a very simple or very complex level to produce highly satisfactory results.**
- **It is unfortunate that the Apple display is limited, but every possible facility has been provided to help the user overcome this handicap.**
- **VisiCalc is loaded as a machine code routine and occupies 26K of RAM, including DOS.**
- **We were unable to find any bugs in the program or to crash the system.**

Off-line

I GROANED. Pat had just made the most stupid move. "Mate in one", I said quietly and shut my thoughts so that he couldn't metaplex my opinion.

"What"?

"You're about to put yourself in check from my bishop", I explained and moved to take his rook. "And my rook. Checkmate".

"Oh damn".

I felt charitable. "Do you want to go back and restore the queens to their original places"?

"No", he grumbled, becoming petulant.

Outside the wind screamed. It was already up to three hundred kilometres an hour. I'd retracted all the antennae on the landers and lowered the floors as far as they would go but I still felt we'd both soon be torn off our feet. "Sounds like a demented banshee", I muttered.

My companion didn't answer. He had problems and I'd tried to protect him as much as I could. But it was the sand. In spite of all the protective shields and masks, it continued to blast through everything and coat the old respiratory valves.

"Mike, what's a banshee"? he queried suddenly.

"I meant the wind". Why did he have to ask such idiotic questions? How was I to know? It was just a word I'd heard sometime in the past, used by the others when we'd first landed on this wretched planet. And that had been a long time ago.

Miserably I stared at the space between the VDUs on the two consoles in my cabin. There was nothing else to look at. Outside was a solid wall of sand and I knew the wind might go on for another month or more.

Or it might stop as suddenly as it had started.

Since the breakdown of the long-range detector, and because of Pat's worsening condition, we couldn't find out what was going on above the crater in which we'd taken shelter. At least, not as quickly as I'd have liked. Pat couldn't move about much now and there was little point in my going anywhere without him. For one thing, there wasn't anywhere to go. If it wasn't sand, it was rock, and if it wasn't rock, it was ice, with crevasses and canyons that yawned sometimes for more than a hundred kilometres, and we weren't stable enough to caterpillar-out of those any more.

A few times we scoured down a gully 20,000 kilometres long, right to the equator. We had gone all round the northern hemisphere sampling soil and setting-up experiments of various kinds. But now we had to stay near the pole because my companion couldn't travel and we needed water if we were to survive and continue our job. I supposed the expedition was important, but I was heartily sick of it, and of continual chess games.

It was nearing nightfall when the wind dropped abruptly and I glimpsed a patch of mauve sky between the last flying sand particles. Fed up with playing chess, I shifted about to get more comfortable. Then something happened which froze me

by Caith Gill

to my seat. The hatch to the cabin had opened without my conscious control.

"Checkmate"! Pat shouted in elation at the same moment. Then he gave a gasp. "Mike, the hatch".

There was a flurry of sand and something heaved itself inside.

"What the hell have you let in"?

I was too amazed to do anything. "I don't know. I didn't let it in". I stared at the creature. It was tall, almost reaching the ceiling. On an impulse, I glanced at the calendar on the wall by the table. The oddly-shaped figure in the picture was faded, but I fancied there was a resemblance.

At fancy, however, the similarity stopped. The animal that had walked in front of me had a smooth white skin with a smear of red dust on its feet. It tilted itself from side to side and I guessed that the black slit at the top was a sensory organ — an eye probably.

"Then how did it get in"? Pat snapped. "And are you just going to let it wander all over our experiments"?

Without thinking, I slammed the hatch shut.

"That was a stupid thing to do. Now it can't get out, you fool".

But the intruder showed no sign of alarm — merely of curiosity.

"Mike", Pat whispered with surprising calmness, "we're not supposed to pick up aliens. It's part of every basic instruction that we don't interfere. Contamination, remember".

That jolted me into a response. "You choose some bright times to throw basic instructions at me". I grated. Then I burst into an uncontrollable laugh. "What the hell do you think we've been doing all these years then, if not examining and cataloguing alien life forms? This is the chance —".

"Yes but it's different from anything else we've found. It isn't exactly microscopic, is it? So what the devil are you going to do about it"?

"Report it to base"?

I wasn't happy. In the early days of the expedition I used to work by the book, reporting every detail. But I'd wised up since then. After all, we didn't know what they did with our reports and frequently the subsequent demands hadn't been to our advantage. Even less, since Pat's illness had developed. So now we just went on gathering data and I sent off a report intermittently, when I felt like it. This seemed to give them too much to think about and they hadn't bothered us for ages.

With growing apprehension I watched the creature walk over to the row of potted plants above Pat's VDU. "It seems able to detect the plants, but doesn't pay the slightest attention to us".

"Then do something, for God's sake". Pat was almost squeaking with rage. He could become irritated over the tiniest thing, without having aliens prodding at his beloved plants and the other experiments he'd set up.

I made a hurried scan of the immediate vicinity outside but couldn't find anything else like the animal that had appeared so miraculously in my cabin. "Where has it come from, that's what I want to know? The planet's atmosphere shouldn't be able to support anything this size".

"Mike"! My companion was becoming exasperated. He moved, the lander's body lurching upwards out of the sand drift as he did so.

Even though the creature was in my cabin, the floor shifted and I watched in horror as it grabbed at the table for support. "Don't do that". I hissed. "You could harm it, even kill it".

(continued on next page)

"We're not supposed to pick up aliens. It's part of every basic instruction that we don't. Contamination, remember".

(continued from previous page)

"Maybe that's what we should do".

"Are you mad".

But there wasn't a wrinkle in the white skin of the animal and it seemed unperturbed after the initial shock.

"Do you think it can hear us"? said Pat, regaining his composure.

He was so damned unpredictable.

"Well it doesn't seem able to see us properly, so presumably it can't hear us either", I answered. Then an idea occurred to me.

Before I could go on, the alien suddenly lifted its hands and removed the ball it had on top. Underneath was another ball for all that I could see covered with cilia-like growths similar to the flagella on

Pat was becoming hysterical.

some of the protozoa we had examined from a dig under the glacier. I felt a rush of excitement.

"No wonder we've never come across this thing before". Its action had just confirmed my tentative idea. "It's wearing protective gear of some sort so it doesn't live on this planet. That means it must be intelligent, otherwise how could it have got here"?

"That makes matters even worse. You should never have allowed it to get near us, let along into your cabin. You realise it could kill all my plants"?

"Your plants, what about —"?

"That's what I mean. It's a hazard to us, and to everything we're doing. You must get rid of it. Or I will".

The creature spun round. With a shock, I realised I was looking at a head and face. Pat was becoming hysterical.

"Wait", I cautioned.

It slipped out of its synthi-skin protective gear, which crumpled on the floor around its ankles. The pale flesh so revealed had a warm translucency and the curvature of the upright spine was highlit by the same flagella as on the head, but minute and golden.

It was the same creature as depicted on the calendar — *Playboy* nineteen-something-or-other, it said.

I stared as it sat down comfortably in the moulded chair, its hands hesitant, then caressing the keys.

To my astonishment it logged on. A vague but pleasant memory stirred. It had been a long time since I'd had to answer visually. "THIS IS MARTIAN IN-DEPTH KIRLIAN ELUCIDATOR", I printed up on the screen, "MIKE FOR SHORT".

The corners of the protozoan mouth turned up slightly. We've found you at last". The creature tapped easily on the keys. "Well Mike, we can now return you two ancient mariners home to Earth, update you, and put you back on-line".

Now you can control your business for less than £2,500.

This could be your best investment opportunity yet. A complete computerised business system, including a Floppy Disk Unit, high-speed Printer and *Britain's best selling microcomputer* – the Commodore PET. All for under £2,500.

First Class Programs

A comprehensive range of first class programs is offered by *Commodore 'Business Software' Dealers.* These are available on disk from £50-£500. And they cover such applications as *Business Information, Stock Control, Word Processing, Payroll, Accounting* and *Mailing Systems*.

Service and Support

With over 10,000 PET computers installed in the UK, dealer support is growing fast. A nationwide network of 90 official *Commodore 'Business Software' Dealers* ensures that service and technical facilities are close to every PET user. Our dealers can even offer you a 24 hour on-site maintenance agreement.

Training and Instruction

The PET Business System is self-contained and simple to use. Should you require personalised programs or extensive installation training this can be arranged with your *Commodore 'Business Software' Dealer* who can also give details of official *Commodore Training Courses.* These include intensive 2 & 3 day workshops to train you to write your own programs.

For full details about the Commodore PET Business System, Training Courses, Programs, *and 'Business Software' Dealers*, simply fill in the coupon and post today.

To: Commodore Information Centre, 360 Euston Road, London NW1 3BL.

Please send me details of the PET Computer Business Systems.

Name ____________________

Position ____________________

Company ____________________

Address ____________________

____________________ Tel. No. ____________

If you have a particular application in mind please specify:

____

____

____

P.C.B.6

commodore

We made small computers big business.

• Circle No. 184

Time and money saved with electronic solution

Every day, millions of newspapers and magazines are distributed around the U.K. to more than 35,000 newsagents. Each has to judge his own market and keep close track of any change in demand. In these two reports, Duncan Scot looks at a wholesale newsagent in Peterborough, who supplies to more than 130 newsagents, and at a retail newsagent in Wisbech, Cambridgeshire. Both proved ideal applications for the microcomputer.

NEWSPAPERS HAVE always excited interest — the masses read them as avidly as MPs and governments and are ready to be swayed by arguments exploring new fringes of ignorance. The Sunday newspapers are perhaps the most potent. During the week there is never enough time to devote to the kind of news they provide, but on Sunday we receive a full-frontage blast of pre-packaged culture as the supplements eat-up the hours before lunch.

Authoritative

Their authority gives them a certain fascination, but there is as much drudgery in the newspaper business as any other and as the papers roll hot off the presses, the teams of packers and drivers work to send their editions on trains round the country where distributors are waiting to continue the process through the night.

The first editions of the Sunday newspapers are printed by early Saturday evening. They then enter a complex distribution network which has to deliver copies as far afield as Mallaig and Padstow at the same time as the last editions are being dropped by van in London. Special British Rail trains, shared by all the papers, rush each edition to local distribution centres around the country. The system has hardly changed since the war.

As the *Times* and the *Daily Mirror* would testify, new technology has never been readily accepted into the world of newspapers except perhaps in the provinces, which is where we discovered a local distributor using a microcomputer to speed the news to our breakfast tables.

Desmond Westrope owns and runs a Sunday newspaper wholesale business in Peterborough, Cambridgeshire, where, every Sunday morning, he and his team of drivers and packers, deliver to all the newsagents within a 20-mile radius. From the time the first-edition train pulls in at 1.30am, until well after the crack of dawn, more than 130 newsagents are supplied with their weekly orders.

Q/SC		Q/SC
0/8	SUNDAY MAIL	0/8
2/9	SUNDAY POST	2/9
6/0	NEWS OF THE WORLD	0/0
12/22	SUNDAY EXPRESS	0/22
13/16	SUNDAY MIRROR	1/16
13/9	SUNDAY PEOPLE	1/9
6/0	SUNDAY TELEGRAPH	0/0
4/10	SUNDAY OBSERVER	4/10
8/11	SUNDAY TIMES	2/11
0/22	WEEKEND	0/22

Franchises

It takes time to establish oneself in this business. When Westrope inherited the business from his father there were three major competitors in the area, and he had the franchise for only a few of the national papers. Over the years, he has managed to pick-up all the franchises and gain the trust of the newsagents, which may prefer small independent wholesalers.

There is no question of having to work for only one day a week. The 15 van drivers are all subcontracted and spend the rest of the week working for WH Smith & Sons. In the meantime, Westrope, and his son David, catch up on the rest of the business.

"On Mondays and Tuesdays my son drives round all the newsagents and collects the returns — the unsold papers — and sorts all the stops — changes in orders — while I update the accounts", he explains. "Then on Wednesdays the Sunday magazines start to arrive".

The *Sunday Times* and the *Sunday Telegraph* prepare their magazines several weeks in advance, share the same printers and use the same transporters to deliver the magazines around the country, in time for sorting and delivery during the rest of the week.

The exception to this is the *Observer,* which is printed in Bristol. "They don't have enough print capacity", continues Westrope. "So they try and print the whole of their *Sunday Plus* section earlier in the week". But in practice things can go wrong and it can arrive anytime between Thursday and Saturday, leaving little time to sort and deliver before Sunday.

"The sooner we can send all the supplements to the newsagents, the more time they have to sort them for their customers before the Sunday rush, and the more time we have to catch up with our accounts and make sure that our packing lists are right".

Before the special train arrives early on Sunday morning each of the newsagents

W. H. WESTROPE LIMITED
SUNDAY WHOLESALERS
56 NEW ROAD
PETERBOROUGH ALSO AT: LOVE LANE, WISBECH

TEL 62892 2336

VAT REGD NO 284 6748 12

INVOICE/STATEMENT

BOX NO. 15 17/02/80

PETERBOROUGH

	Q	SC	EXTRAS	RETAIL	TOTAL
SUNDAY MAIL		8		0.14	1.12
SUNDAY POST	2	9		0.12	7.08
NEWS OF THE WORLD	6			0.16	24.00
SUNDAY EXPRESS	12	22		0.18	57.96
SUNDAY MIRROR	13	16		0.16	54.56
SUNDAY PEOPLE	13	9		0.16	53.44
SUNDAY TELEGRAPH	6			0.18	28.08
SUNDAY OBSERVER	4	10		0.20	22.00
SUNDAY TIMES	8	11		0.22	37.62
WEEKEND		22		0.14	3.08
GROSS TOTAL					288.94
DISCOUNT					77.14
NET TOTAL					211.80
CREDITS					5.30
BAL. FWD.					404.72
TOTAL BAL O/S					611.22

in the area has a packing list written out in his name. It sound like a simple, if not tedious, task but the printing industry uses some unusual ways of counting.

Newspapers are counted in units called quires packed into bundles; the number of quires in each bundle varies depending on the newspaper. To add to the confusion, each newspaper thinks that a quire is a different number of newspapers. For example, the *Sunday Times* has 20 newspapers to a quire, the *Sunday Telegraph* 26, and some of the others 25. So drawing-up a packing list can involve considerable calculation.

If one newsagent would like an order including 341 *Sunday Mirrors,* the order would be marked as 13/6 which means 13 quires and six additional single copies. There are 12 quires to each bundle for the *Sunday Mirror,* so the packer has to take one bundle, one quire and 16 single copies. With 10 newspapers to be sorted for more than 130 newsagents, and with different orders every week, the paperwork involved can be daunting.

The accounting is no easier, as Westrope explains: "Each of the newspapers offers a different discount to the wholesaler and to the retailer. Every week I have to go through every single newsagent and every single newspaper to calculate the amount of money taken and who will have what share. There is a good deal of work involved".

Paperwork

With the passing of his middle years and his business still continuing to grow, Westrope has begun to feel the strain of all his work. About two years ago, still unwilling to hire full-time staff, he decided he had had enough. "I really felt", he explains, "that I was becoming desk-bound with all the accounts, paperwork and invoicing and that I was not spending enough time out and seeing our customers, which is where our business is. You have to keep in contact.

"It was taking me nearly two days every week to look after the accounts and to make sure that they went out on time, and this was before I could even start thinking about the packing lists and everything else, like the VAT forms and paying the van-drivers".

Potential

Realising the potential for computers, but unsure of where to look, he turned to a bureaux service in Nottingham which offered him a reasonably efficient but costly service with a terminal in his office at the back of his home. "I was wary of them from the start", he explains. "I wanted to have everything under my own control here and, of course, it is quite expensive compared to buying your own system, but I didn't know that then. I was also unhappy about the lack of flexibility.

"It was a real nuisance to have any of the details altered week by week and we could work only during office hours. When you work for yourself you sometimes like to work in the evening, especially when some of your work is in the middle of the night".

Convinced he could find a better system somewhere in Norfolk, he started looking at computers at stationery exhibitions: "I met a man in Birmingham who tried to sell me a Pet but he knew next to nothing about the system and we would have been in a real mess if anything had gone wrong. We would have had to pay for someone to come from miles away and they would have been busy charging us £16 per hour for the travelling time before they started to find out what was going wrong".

Towards the end of 1979 he attended a local office equipment exhibition and met the team of a local microcomputer systems house. "I explained the problem to them and they took away some samples of my work from the agency and said they would have a go at writing a program".

Within a few weeks Westrope tried a program, accepted it, with a few minor alterations, and transferred his business to it without the customary trial period, showing apparently more faith in the system than the programmers themselves.

"The whole system was up and running within a few days. I got my son's fiancée to come in, as a touch-typist, and enter all the details of my business which then went straight into the system".

Matrix printer

The system is based on the Exidy Sorcerer with two mini-floppy drives built into the VDU and an Anadex matrix printer. According to Westrope it has been a real boon and for £4,500, well worth the investment. "I can now do all the work in a few hours each week. I just update all the information on Tuesday afternoon, once my son has all the returns sorted. So I am saving two days a week when I can deal with everything else, or just relax".

The operation of the system is simple and requires no specialist skills. When the program disc is loaded, the following choice of operations is displayed:

1 Add customer to file.
2 Display customer information.

(continued on page 75)

Your Commodore PET System

The Commodore PET is Britain's best selling microcomputer and the most popular choice in every field:–

✻ In Education for teaching Computer Science and as a teaching aid for other subjects.

✻ In Science and Engineering for solving problems and for monitoring laboratory equipment.

✻ In Business the PET system can be put to a wide range of functions including Payroll, Accounting, Statistical Analysis, Stock Control and Word Processing.

Not least of its attractions is the price of a PET – from £550 for a self contained unit, to under £2,500 for the complete system including Floppy Disk Unit and high-speed Printer. Ask your nearest Commodore dealer below for details about Commodore hardware, software and training courses.

Our Dealer* Network

LONDON

Capital Computer Systems, W1. 637 5551
ACE (by Top TV Ltd), SW1. 730 1795
Micro Computer Centre, SW14. 876 6609
Logic Box Ltd, SW1. 222 1122
Sumlock Bondain Ltd, EC1. 250 0505
Da Vinci Computers Ltd, NW4. 202 9630
L & J Computers, NW9. 204 7525
Adda Computers, W5. 579 5845
CSS Business Equipment Ltd, E8. 254 9293
Advanced Management, EC2. 638 9319
Metyclean Ltd, SW1. 828 2511
Microcomputation, Southgate. 882 5104
T.L.C. World Trading Ltd, WC2. 839 3894

HOME COUNTIES

Orchard Electronics Ltd, OXON, 0491 35529
D. L. Chittenden Ltd, CHESHAM, 4441
J. R. Ward Computers Ltd, MILTON KEYNES, 562850
Dataview Ltd, COLCHESTER, 78811
South East Computers Ltd, HASTINGS, 426844
Symtec Systems Ltd, SOUTHAMPTON, 38868
Alphascan Ltd, BANBURY, 75606
Super-vision, SOUTHAMPTON, 774023
Millhouse Designs Ltd, ALTON, (042) 050374
Micro Facilities Ltd, MIDDX, 979 4546
DDM, BRENTWOOD, 230480
Stuart R. Dean Ltd, SOUTHEND, 62707
Alpha Business Systems, HERTFORD, 57423
HSV Microcomputers, BASINGSTOKE, 62444
HSV Microcomputers, SOUTHAMPTON, 22131
RUF Computers (UK), BURGESS HILL, 45211
Wego Computers Ltd, CATERHAM, 49235
T. & V. Johnson, CAMBERLEY, 62506
T. & V. Johnson, OXFORD, 721461
Petalect Electronic Services Ltd, WOKING, 23637/21776
Business Electronics, SOUTHAMPTON, 738248
Amplicon Micro Systems Ltd, BRIGHTON, 562163
Bromwall Data Services Ltd, HATFIELD, 60980/64840
MMS Computer Systems, BEDFORD, 40601
Isher-Woods, LUTON, 416202
Sumlock Bondain, NORWICH, 26259
CSE (Computers), READING, 61492
Oxford Computer Systems, WOODSTOCK, 811976

MIDLANDS & STH. HUMBERSIDE

Taylor Wilson Systems Ltd, KNOWLE, 6192
Betos (Systems) Ltd. NOTTINGHAM 48106
Holbrook Business Systems, DERBY, 368088
Lowe Electronics Limited, MATLOCK, 2817
Davidson-Richards Ltd, DERBY, 366803/4
Arden Data Processing, LEICESTER, 22255
Tekdata Ltd, STOKE-ON-TRENT, 813631
C.S.M. Computer Systems, BIRMINGHAM, 360 6264
Business & Leisure Microcomputers, KENILWORTH, 512127
Caddis Computer Systems Ltd, HINCKLEY, 613544
Allen Computers, GRIMSBY, 40568
CPS (Data Systems) Ltd, BIRMINGHAM, 707 3866
Camden Electronics, BIRMINGHAM, 773 8240
Cliffstock (Computer Systems) Ltd, WOLVERHAMPTON, 24221

YORKSHIRE & NTH. HUMBERSIDE

Microprocessor Services, HULL, 0482 23146
Microware Computers, HULL, 562107
Computer Workshop, LEEDS, 788466
Hallam Computer Systems Ltd, SHEFFIELD, 663125
Ackroyd Typewriters Ltd, BRADFORD, 31835
Datron Micro Centre, SHEFFIELD, 585490
Yorkshire Electronics Service Ltd, MORLEY, 522181
Sheffield Computer Centre, SHEFFIELD, 53519

NORTH EAST

Dyson Instruments, DURHAM, 66937
Currie & Maughan, GATESHEAD, 774540
Wards Office Supplies, GATESHEAD, 605915
Tripont Associated Systems, SUNDERLAND, 73310
Newcastle Computer Services, NEWCASTLE UPON TYNE, (0632) 615325

SOUTH WALES & WEST COUNTRY

Computer and Design, BROADSTONE, 0202 697341
A. C. Systems, EXETER, 71718
Computer Supplies (Swansea), SWANSEA, 290047
Sigma Systems Ltd, CARDIFF, 21515
Devon Computers, PAIGNTON, 526303
Bristol Computer Centre, BRISTOL, 23430
J. A. D. Integrated Services, PLYMOUTH, 62616
Sumlock Tabdown Ltd, BRISTOL, 26685
Radan Computational Ltd, BATH, 318483
T. & V. Johnson Ltd, BRISTOL, 422061

NORTH WEST & NORTH WALES

B. & B. Computers Ltd, BOLTON, 26644
Megapalm Ltd, CARNFORTH, 3801
Tharstern Ltd, BURNLEY, 38481
Fylde Business Machines Ltd, PRESTON, 731901
Preston Computer Centre, PRESTON, 57684
RPL Microsystems, DOUGLAS, 4247/8

LIVERPOOL

Microdigital, LIVERPOOL, 227 2535
Rockliff Brothers Ltd, LIVERPOOL, 521 5830

MANCHESTER

Cytek (UK) Ltd, MANCHESTER, 832 7604
Executive Reprographic Ltd, MANCHESTER, 228 1637
Sumlock Manchester Ltd, DEANSGATE, (0618) 834 4233
Computer Workshop, MANCHESTER, 832 2269
Professional Computer Services Ltd, OLDHAM, 061-624 4065
D. Kipping Ltd, SALFORD, 834 6367
Catlands Computers Ltd, 0625 527166

SCOTLAND

Microcentre, EDINBURGH, 225 2022
Thistle Computers, KIRKWALL, 3140
McAllister Business Equipment, EDINBURGH, 336 2402

IRELAND

Softech Ltd, DUBLIN, 784739
Medical and Scientific, LISBURN, 77533

*This is a list of dealers participating in associated advertising and not a full list.

commodore

We made small computers big business.

Commodore Information Centre, 360 Euston Road, NW1 3BL. 01-388 5702

• Circle No. 185

(continued from page 73)

3 To amend customer details.
4 To delete a customer.
5 To update an order.
6 To produce packing lists.
7 To produce invoices.
8 To enter payments, credits and extras.
9 To access publications file.
10 To stop.

New details

The publications file has to be altered only rarely, when the list of Sunday newspapers changes or, for example, one of them goes on strike for a long period. On most Tuesday afternoons, Westrope chooses option number eight to feed in the details of any cheques he has received, and the value of the returns from each customer from the previous Sunday.

The invoices will then be produced automatically when he accesses number seven. Later in the week he can update his order — five — and then at the last minute, print-out his packing lists using six.

He is still very cautious of the computer and is careful not to expect too much of it. He certainly has no plans to use his Sorcerer to teach himself Basic or to write some of his own programs although, in a curious way, he seems to resent some of the mystique which has grown around computing. Some of this resentment stems from the fact, from the time of his first flirtations with computing, that he could never be sure that he had negotiated a good deal.

"It is worse than showing your books to your accountant", he says. "They say that have to know every intimate detail of your business and a good deal of it could be terribly useful to a competitor.

Real trust

"You have to find someone you can really trust, firstly because they get to know all about your business and secondly, if the system they sell you breaks down, you'll be putting your business at risk". Perhaps as the months roll by he will become more inquisitive about this box in his back room which magically saves him so much money.

Final link in distribution chain handled by micro

THE RETAIL NEWSAGENT is the final link in the distribution chain, although the sale of newspapers is seldom sufficient to keep a shop in business. At Poyser Printers, in the centre of Wisbech, Cambridgeshire, a small Fen town, daily newspapers play only a small role among nearly 1,000 other lines of stock. Poyser is unusual only in that it has recently transferred the business on to a microcomputer.

Stationer

The shop is really a small commercial stationer which has expanded over the years to include a printing works. The proprietor, Allen Snowden, bought the company from the Poyser family shortly after the war.

As the business has grown, so has the amount of paperwork. The purchase ledgers, the sales ledgers, VAT and the payroll occupy almost the bulk of every working day, especially with so many lines of stock. "The buying of stock is a skillful operation", explains Snowden, "and you have to give yourself enough time to make sure that you are buying all the correct things. For example, we normally sell very few ring-pull binders and I keep very few in stock. With the steel strike, I thought that there would either be a shortage or that their prices would rise because the major part of their cost lies in the steel. So I ordered a number of them. You have to think ahead in this business".

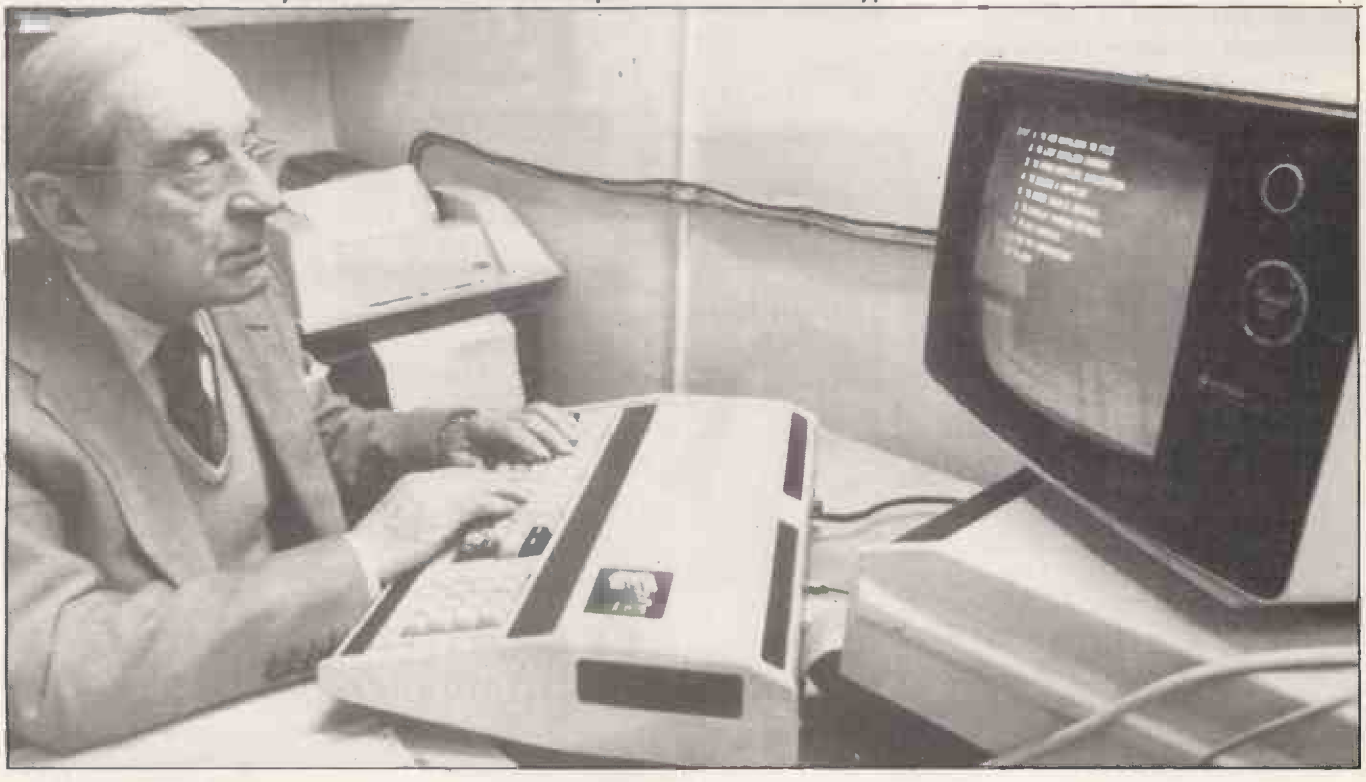
Accounts

The printing works developed more by chance. As three of his older workers retired, Snowden decided that it was time to invest in a small offset machine and some camera equipment. "To our surprise, the whole business took-off as we discovered that we could do virtually anything.

"While the printing works were just starting, we were very short of staff. I had

(continued on page 77)

Allen Snowden at the keyboard: "It would be much quicker if I could touch-type".



"If you want what's best for your PET, choose Commodore software."

Kit Spencer
General Manager,
of Commodore Systems
360 Euston Road
London NW1 3BL

The Commodore PET is Britain's best selling micro-computer, with over 18,000 already installed in a wide range of fields, including Education, Business, Science and Industry.

This has led to a tremendous demand for high quality software.

And Commodore has met this demand by producing a first class range of programs, now available from the nationwide network of Commodore Dealers.

Commodore's support also includes training courses, a Users' Newsletter and Official Approval for compatible products of other manufacturers who reach agreed standards.

COMMODORE PETPACKS

Over 50 Petpacks of programs are available (mainly on cassette) from Commodore Dealers.

These cover such popular titles as Strathclyde Tutorial, Statistics pack 1, Assembler Development System, Stock Market Trends and the Treasure Trove Collection of game packs. Plus the new Arcade Supergame Series including *"INVADERS"* – quick to learn but difficult to master and already a No 1 favourite. Prices range from £5-£50.

TRAINING COURSES AND SEMINARS

PET systems are simple to use and any normal advice or assistance you may need can be obtained from Commodore Dealers.

On the other hand, for rapid training on a basic or advanced level, you will certainly be interested in Commodore's intensive 2- and 3-day residential courses. We also run one day general appreciation seminars.

PET USERS' NEWSLETTER

This is Commodore's official method of sharing new information and ideas between the many thousands of PET users. The newsletter is published regularly and for an annual subscription of £10 you can start receiving copies now.

Look out for this sign. It tells you that compatible products of other manufacturers have met with our standards of approval.

OFFICIALLY APPROVED BY COMMODORE

BUSINESS SOFTWARE PROGRAMS ON DISK

Commodore's Floppy Disk Unit and high-speed Printer, combine with PET to form a complete system (ideal for running a business) for under £2,500.

Commodore also produce a range of business software application packages on disk. They were created by leading experts specifically for the PET business system. Here is our current range:–

NEW COMACCOUNTS PROGRAM – £650 +VAT

This puts complete financial control at your fingertips, with immediate access to current and trial balances. It is an integrated accounting system with up to 650 Sales Accounts, 650 Purchase Accounts and 400 Nominal Accounts.

NEW computerised diary – COMPLANNER £50 +VAT

Business Information – COMBIS £150 +VAT
Stock Control – COMSTOCK £150 +VAT
Word Processor – COMWORDPRO II + III £75 +VAT & £150 +VAT
Payroll – £150 +VAT

(Tick the appropriate boxes)

To: Commodore Information Centre, 360 Euston Road, London NW1 3BL. 01-388 5702

I am a PET owner ☐ Please put me in touch with my nearest dealer ☐
Please send me details of: Commodore PET Software ☐
Training Courses & Seminars ☐ I would like to receive the Users' Newsletter and enclose £10 annual subscription ☐

Name ______________________
Address ______________________
____
______________________ Tel. No. ______________

PCS6

commodore

We made small computers big business.

• Circle No. 186

(continued from page 75)
one of the workers, Mike, doing all the accounts for me and in a moment of weakness, I offered to do them for a few weeks while they caught up with all their orders. I was also slightly worried about the number of discounts I was losing through settling our accounts late. If you time all your payments correctly you can save up to £100 every week".

He thought that it would be a matter of weeks before he could pass the accounts back to Mike, but as Mike became busier, so Snowden found himself spending more and more of his working time at his desk, getting further and further behind: "It is a time-consuming task. We work out our total sales from the till total every day, and then at the end of the week we calculate the amount which has to go on VAT. It is only maps and newspapers which are zero-rated. We have to place all our orders on Monday and Tuesday.

"I think it was last July, and I was becoming really fed-up and edgy, when my assistant, Mrs Robinson, told me about her son who was starting a micro-computer systems house in the area.

Systems house

"I knew nothing about computers. Some of our invoices were computerised but I didn't really think about it, and there is another company in Wisbech which went on to computers and, as a result, had to close for weeks. Its machine cost more than £30,000 so I put the whole idea out of my mind. Then I was told I could have a complete system for £3,000".

According to Snowden, there was a massive communication gap when he first started to talk to the systems house. Although he knew his own business, it was quite hard trying to describe it effectively enough for a good business program. Despite a few hiccups and alterations to the program the system was running before the Christmas-rush period. As yet, only half of the business — the purchase ledger — has been computerised but it is certainly saving him a good deal of time.

As with Desmond Westrope's system, there is a simple menu choice, allowing little chance for mistakes.

1 Add supplier to file.
2 To list suppliers.
3 To amend suppliers information.
4 To delete a supplier.
5 To enter invoice details.
6 To display invoice details.
7 To pay invoices.
8 For VAT information.
0 To stop.

The system runs on an Exidy Sorcerer with two Shugart mini-floppy disc drives and a small TV monitor.

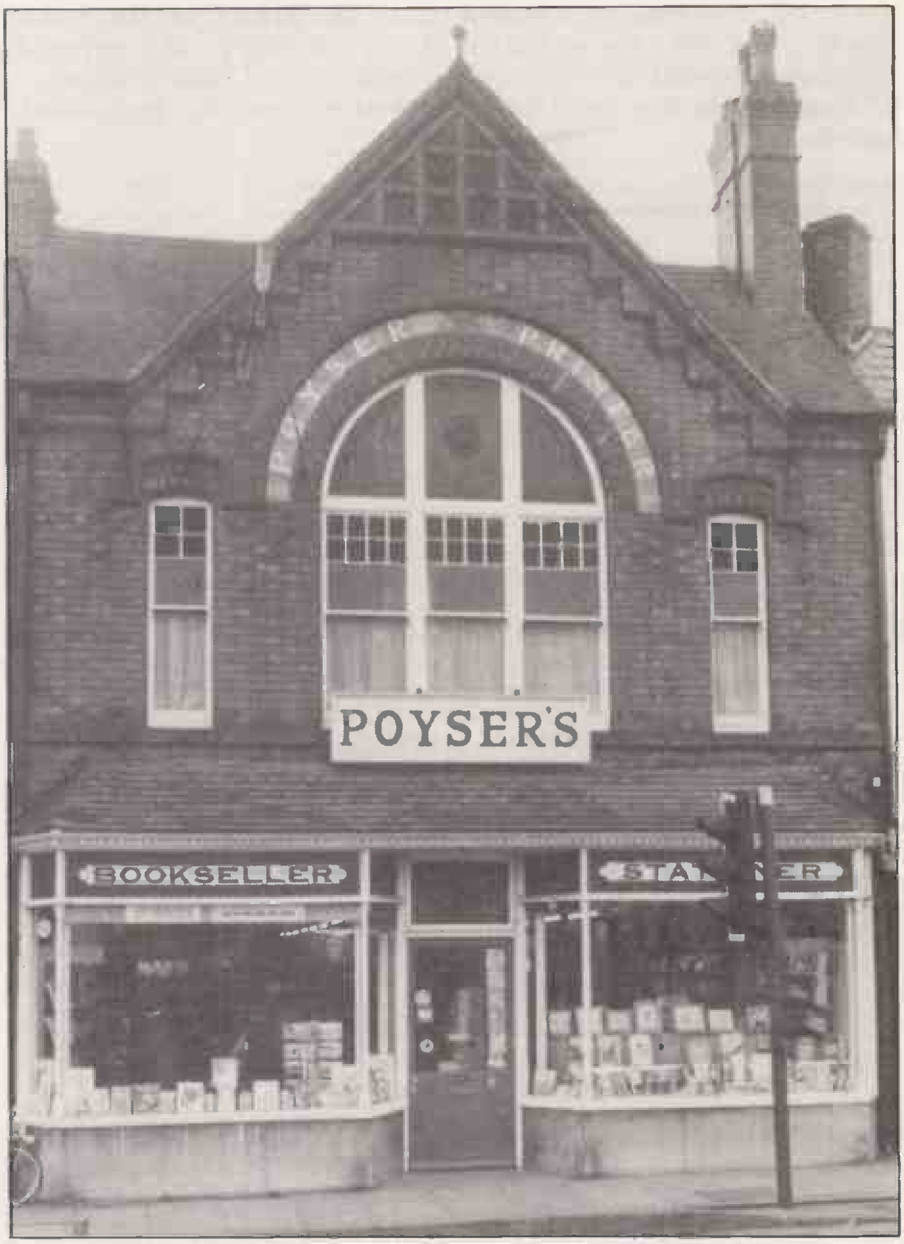
"I'm only just beginning to be used to it", says Snowden. "It would be much quicker if I could touch-type. All the same, I managed to put all the January invoices in on one day. It is funny how, even when you are saving a lot of time, even the smallest delay in the program can be really irritating, so I have asked for one or two improvements in the program.

"Otherwise it seems to be working very well. I am now up to date with all the discounts and I have to spend far less time on it. The first real test will be at the end of the financial year when we have to add-up all the total balances. I am looking forward to see how much time that will save".

Mrs Robinson, as the original enthusiast behind the system, is clearer and more ambitious about its future potential. She envisages a day when the computer will control all the stock, enabling her to be more effective with the sales representatives who always call.

Other businesses in the town have yet to be convinced by the idea. Some of them have wondered how Snowden can find the time to watch television during the day. "Most of the other shops round here", he explains, "belong to the old brigade and it would be impossible to pursuade them to change their ways and buy a computer. There is one chap who is so overworked that I am convinced he will not make it to the end of the year.

"It often amazes me. A businessman will happily go out and buy the latest Jaguar, which he doesn't really need, but tell him that the latest calculator will cost him £35 and he will run a mile".



Confidence

It does seem, however, that small businesses are, at last, beginning to realise some of the benefits which small computers can bring as confidence in this new-fangled technology grows. Both Westrope and Snowden still seem very wary of their computers, perhaps because so much of their business depends on the machines operating without the slightest hitch and also because their systems are so new. It is obviously not necessary for every businessman to be able to write his own programs but it could help them if they knew how their system worked and how to understand their programs.

Little doubt is well on

In the curious way in which Prestel has grown as the U.K. viewdata service, the speed of its development and general availability depend on the mutual confidence of three groups — the Post Office, the information providers, and the equipment manufacturers.

by Peter Sommer

THE commitment-measuring probes were gathering data all over the exhibition halls and conference suites at Viewdata 80.

The following questions were at the back of everyone's mind:

- The Post Office — how effective was its simultaneous publicity campaign going to prove? Now that it had stated its plans up to March, 1981, what rate of expansion did it forecast after that? Could it answer foreign criticism that Prestel lacked sophistication compared to its rivals?
- The information providers — how long could they continue without the certain prospect of a market? What kind of mood were they in? Were some IPs re-defining their objectives towards the more immediately-lucrative business at the expense of residential users?
- The manufacturers — were the household names prepared to make a serious commitment towards mass production? What prices were they asking for viewdata receivers now — and what would they be asking in 18 months? Could the small, inventive companies offering specialised services afford to continue much longer in the expectation of a bright tomorrow, or were high interest charges going to finish some of them?
- Was the concept of publicly-accessible viewdata to be diverted into a series of private systems — add-ons to the mainframes of large corporations and used chiefly as a semi-interactive device for disseminating internal company information?

The difficulties in measuring commitment were well-known to the multi-faceted industry before Viewdata 80 started and as a result many people knew they had to rely on subjective judgments.

The hidden drama of the show was supplied by Ayr Viewdata whose stand sported a viewdata add-on which it claimed could be delivered at £90 in quantities of 1,000-off. In terms of a High Street price, it would cost £120-£130 or a rental of 50p-75p a week. The arrival of the device is 18 months to two years ahead of all forecasts.

The big manufacturers have tended to concentrate on complete sets, partly because they believed the Post Office might sponsor its own adapter — the Post Office announced in February that it would leave such a development to private enterprise — and partly because of difficulty in achieving adequate quality through an RF modulator.

Ayr seems to have solved the difficulties; in the conditions of the exhibition viewing, the image, even with difficult yellows and greens, seemed steady and solid. Laurence Cook of Technalogics, who designed the device, says that a high proportion of the component cost was in the heavily-filtered modulator.

The Post Office has already revealed the plans for opening computer centres until 1986. The plans are arranged so that firm commitments need be entered only six months ahead of demand — growth from now on will be demand-orientated.

The main technical announcement was the unveiling of Picture Prestel and dynamically-re-definable character sets (DRCS). Many of the newer viewdata systems — the Japanese Captain, the Canadian Telidon, the U.S. Knight-Ridder Viewtron, and the French Didon/Antiope all offer an apparently more-sophisticated set of images.

Historically, the Prestel image, the first of its kind, is limited by a number of considerations. Graphics resolution depends on the amount of memory in the receiver and ROMs and RAMs were not always as inexpensive as they are now. Compatibility with broadcast teletext standards was, and is, considered important. The Post Office had been saying constantly that the important feature of viewdata was not its ultimate sophistication — full-colour, high-resolution digitised maps are not the least achievement of VDU technology — but that standards become universally accepted, inexpensive and easy to use.

New solution

Picture Prestel is clearly a whole leap forward. As a result of comparision techniques, it lacks the final degree of detail of present-day broadcast TV standards, but it is more than acceptable as a catalogue-type illustration. In the current format, the picture uses about one-ninth of the screen area, saving considerably on loading-down times.

The picture appears line by line in a vertical scan, but a progressive build-up mode may be adopted in the future. The picture store requires 24K. DRCS is a means of extending the graphics capability to include foreign fonts, and totally new shapes so that such items as circuit diagrams and simple maps can be produced. The traditional way of increasing the graphics capability of a VDU is by increasing the size of the ROM character generator.

The Post Office solution is to use a RAM, which accepts a series of instructions to cover the required graphics set before the processor as a whole is loaded-up with the instructions for display. The RAM is held while the particular graphics set is needed and is then emptied until a fresh set is loaded in later. It is a solution to almost any display problem.

The last element in the Post Office offering was its publicity — which must be counted a bit success. Boase Massimi Pollitt created the five spots for the middle of *News at Ten* which worked

The Sony viewdata monitor with video graphic printer.

that Prestel its way

well. At Wembley, in addition to the Post Office stands, the Great Hall was used for a series of specialist shows, the biggest of which was Fanfare for Prestel, which featured Alex Reid, the now-departing director of Prestel, jumping on a giant keypad to activate the world's largest Prestel set — courtesy of a giant TV projector. Reid is very different from most managers of national utilities and obviously enjoys showbusiness. An unforgettable performance.

There has been little discussion of viewdata at Parliamentary level in the U.K. and, unlike the situation in France and Japan, there is no central backing. The biggest threat to British viewdata-type standards is from the decision of the French to make viewdata available to their population as part of the process which will computerise the French telephone directory and make it available at an alphanumeric terminal by every telephone.

Large range

There is a large range of viewdata receivers at the £900 mark and many well-known rental companies are offering deals, but if there's a hesitant member of the partnership it is BREMA, the manufacturer's trade association. Its representative at the press conference was Lord Thorneycroft.

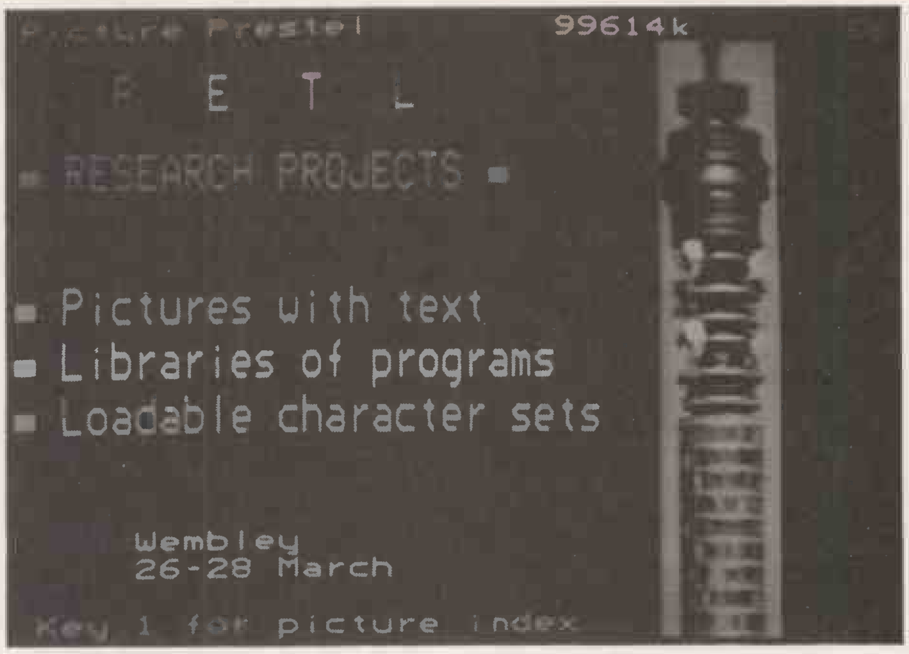
The Japanese are not yet allowed to sell their viewdata equipment in the U.K. but Sony, which had a tentative presence at the Professional Viewdata Show in September, 1979, has clearly invested in more models since then.

For those who believe that the path of mass acceptance will be via public access coin-op terminals, a rival to the Cherry/ISE pioneer from Bell Fruit was a pleasing sight.

It contains a video-recorder and when not being used as a viewdata terminal, it plays tapes of video advertisements.

Sharing a stand were the Owl Appletel, now with full Post Office approval, and the Prestel version of the Acorn. Both companies reported good business. In another part of the exhibition the Luxor ABC80 was also in viewdata mode. The experimental ITT 2020 arrangement was also on display but there are no immediate plans to develop it into a saleable commodity.

All of these units need appropriate software and the designers will have to decide whether they are going for an IP market — with one set of sophisticated requirements — or users — for whom auto-indexing is the main need, followed by word-search of specific pages.



There is now an Appletel users' club which exists via the *Practical Computing* database—*Practical Computing* *45631, Appletel users' club *456318.

The two micros built round viewdata, the TECS and ISE Sparrow, were also on display. Technalogics has recently received funding from the National Enterprise Board and has been developing its software. It has also been mounting a telesoftware experiment with Oracle, the IBA teletext service.

For would-be constructors, two new chips in particular should be noted. Firstly, Mullard, whose viewdata module has been looking increasingly cluttered compared to the General Instruments version, is to make available at the end of the year a brand new LSI, code-named Lucy. At the exhibition, it showed it behind closed doors, but a specification sheet (SAA5070) shows it has a very wide range of facilities on-board, and just as the teletext character generator has been seized on by home computer enthusiasts, so will this one be. GI had 264 command infra-red transmitter and receiver — in fact the receiver chip contains 32 channels of DC control for various TV functions. The chip is ideal for those who dislike ribbon connectors between keyboard and processor.

Many companies were offering intelligent IP terminals. They all had, more-or-less, the same functions borrowed from word-processing programs and none was clearly superior to the others, though if prizes are to be awarded, the Telemachus TM3 seemed to be the most complete and Hi-tech had hooked-up a digitiser pad which simplifies graphics. You are given a series of inkwells for colours and for contiguous or continuous mode. The main difficulty in use is that the coarseness of the teletext graphic set — which does not have diagonals — makes horizontal or vertical lines difficult to implement unless they are precisely parallel to the VDU window's sides.

The BBC Ceefax and IBA Oracle services were present. Oracle has been able to extend its graphics set without losing compatibility with existing requirements. The technique used is similar, but not identical to, the Post Office solution to the same problem. It was also showing its telesoftware, which has not been seen a great deal because of the rareness of the processor involved — a Signetics 2560. John Hedger of London Weekend Television spoke enthusiastically of the possibilities of broadcast telesoftware but at the moment it is just an interesting experiment.

Agreement needed

CAP was demonstrating its viewdata version of telesoftware. What is needed now is agreement as to protocols and standards. There appears to be a certain resentment at the way CAP is attempting to link telesoftware to its own proprietary portable language MicroCobol.

Viewdata 80 gave a splendid opportunity to view a number of foreign systems. In addition to displays from Prestel close-relatives in Germany, the Netherlands and Switzerland, the first live demonstrations of the French systems attracted a great deal of interest. The French had pulled the plug on a British Prestel show in their country, and a day before Wembley, the British did the same to them.

The result was an agreement that no restrictions would be placed on either country to the others' demonstrations. The Japanese Captain system has very appealing graphics. In the conference rooms, there was a good deal of argument over relative standards.

Most participants felt extremely optimistic about the rapid acceptance of viewdata.

Problems of poor resolution overcome with ingenuity

Gary Marshall outlines some ideas for producing displays on a memory-mapped screen and delves into methods which draw lines and create mobile displays.

COMPUTER GRAPHICS may be obtained with the use of straighforward programming techniques on personal computers such as the Pet and Apple. With these, and similar systems, the display screen is memory-mapped — a particular symbol appears at a given position on the screen when the appropriate number is stored in the appropriate memory location. Displays obtained in this way tend to lack resolution, but with the aid of some ingenuity, this shortcoming can be largely overcome.

Same principles

To illustrate and explain some of the techniques of computer graphics in a concrete way, let us consider how graphics are obtained when programming the Pet in Basic. The same principles apply when any similar system is used. The Pet screen provides 25 rows, each with 40 character positions, so that the screen is divided into 25 × 40 = 1,000 positions.

We can identify any screen position by giving its row and column, thus obtaining a pair of values we can call its co-ordinates. The co-ordinates of the screen position in row I and column J are written (I, J) and, in particular, the co-ordinates at the top left-hand corner of the screen, in the first row and the first column, are (1, 1) while those of the bottom right-hand corner, in the last row and the last column, are (25, 40).

Each screen position corresponds to a location in the memory — the top-left screen position is mapped to the location with address 32768, the location with co-ordinates (1, 2) to location 32769 and so on to the bottom-right corner, which is mapped to 33767. In general, the screen location with co-ordinates (I, J) is mapped to location 32768 + 40(1 — 1) + (J — 1) which is illustrated by figure 1.

Codes used by the Pet

When given the instruction PRINT ASC("A"), the Pet prints the code for the character A, which is 65. Most confusingly, codes obtained in this way are not necessarily the ones used in POKE instructions. To obtain the code for a character as used with POKE, place the character in the top-left corner of the screen and give the instruction

PRINT PEEK(32768)

The number printed is the code for that character as used in the POKE instruction.

Table 1.

The memory locations are 8-bit words, and so can contain any of 2^8 = 256 different 8-bit patterns.

When programming in Basic, a character can be displayed on the screen by using the POKE instruction. The instruction

POKE 32768,42

causes the binary representation of the number 42 — that is 00101010 — to be stored in location 32768. Now that location is mapped to the top left-hand corner of the screen, so that in this position the character *, whose code is 42, is displayed.

Thus the instruction POKE 32768,42 causes a star to appear in the top-left corner of the screen. A procedure for making the Pet give the code of any symbol is shown in the table 1.

To determine what is displayed at a particular screen position, we can use the PEEK instruction. The instruction

X = PEEK (32808)

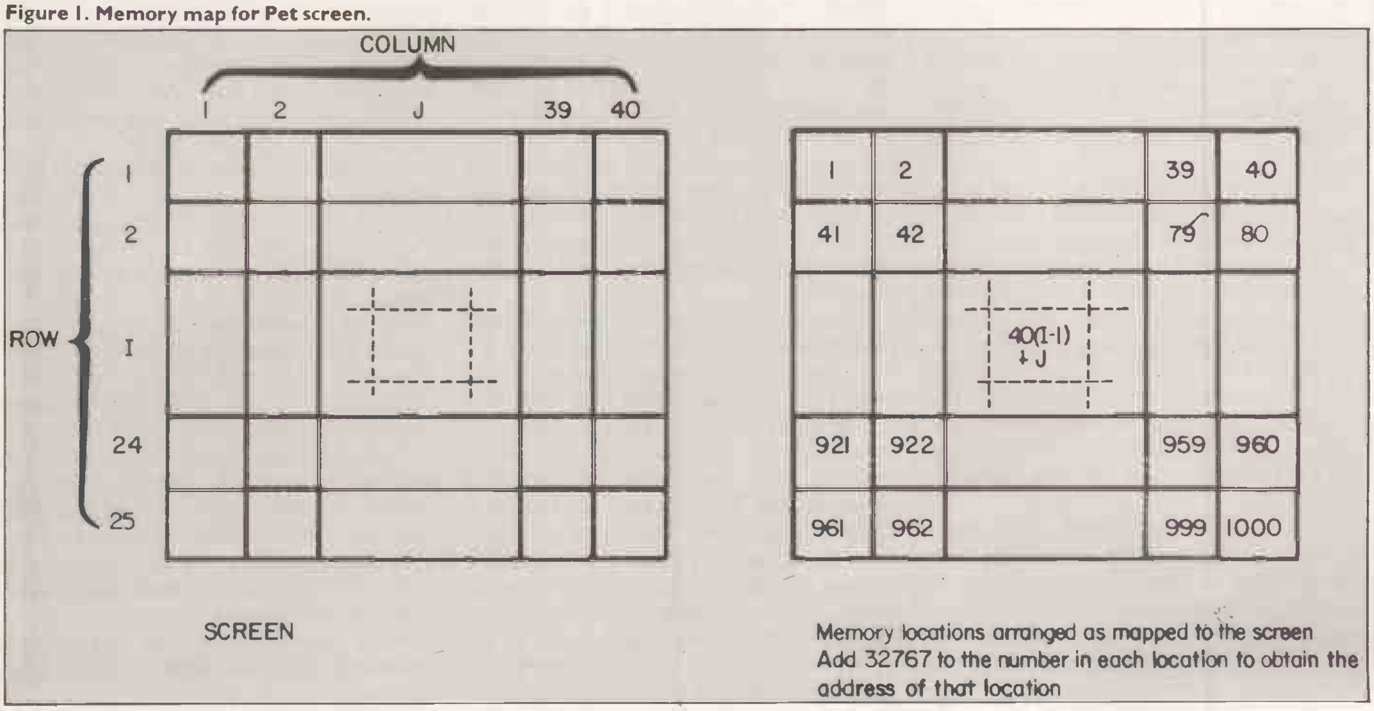
causes location 32808 to be examined (PEEKed) and the value of its contents be assigned to the variable X. Location 32808 is mapped to screen position (2, 1), so that when the instruction has been executed, X contains the value of the code for the symbol at the beginning of the second line.

Machine code

The PEEK and POKE instructions enable us to do things in a high-level language which are usually only possible in a low-level one. To illustrate this, the assembly code to perform these computations is now given.

To simpify the explanations, the

Figure 1. Memory map for Pet screen.



accumulator can be regarded as a special location for the use of low-level programs. The assembly equivalent to POKE 32768,42 is

LDA # 42, load the accumulator with the number 42

STA 32768, store the accumulator contents in 32768

The assembly code equivalent to X = PEEK (32768) is

LDA 32768, load the accumulator with the contents of 32768

STA X, store the accumulator contents in the location assigned to X

We can now move symbols round the screen, taking the first small step towards the production of animated graphics. For example, those instructions move a symbol from the top-left to the bottom-right of the screen:

```
10 X = PEEK (32768),   find symbol at
                               top-left
20 POKE 32768,32,      blank it out
30 POKE 33767,X,       put symbol at
                       bottom-right
```

Generalisation

A straightforward generalisation of the program causes a symbol initially at the top-left of the screen to flit back and forth between top-left and bottom-right. The new program is

```
10 X = PEEK (32768)
20 POKE 32768,32
30 POKE 33767,X
40 POKE 33767,32
50 POKE 32768,X
60 GOTO 20
```

If this causes movement that is too fast to appreciate, the program can be slowed by introducing delays, thus

```
35 FOR I = 1 TO 100: NEXTI
55 FOR I = 1 TO 100: NEXTI
```

When writing programs to produce complex animated graphics, it is seldom necessary to slow the program. The more usual requirement is to increase its speed. Unfortunately, it isn't so easy to speed a reasonably efficient Basic program as it is to slow it down. The ultimate solution to the speed problem may well be to program in assembly code.

Simple figures

We can design a simple line-plotting program and use it to produce simple figures composed entirely of lines. For the sake of simplicity, our program will produce only straight lines which are horizontal, vertical or diagonal. That is particularly convenient because there are symbols available for constructing lines in those directions.

We shall design a Basic subroutine which draws a straight line on the screen automatically, given the screen co-ordinates of the beginning and end of the line, provided the line is in one of the specified directions. The initial flowchart for the line-drawing subroutine, which requires the start and end co-ordinates of the line to be provided is given in figure 3.

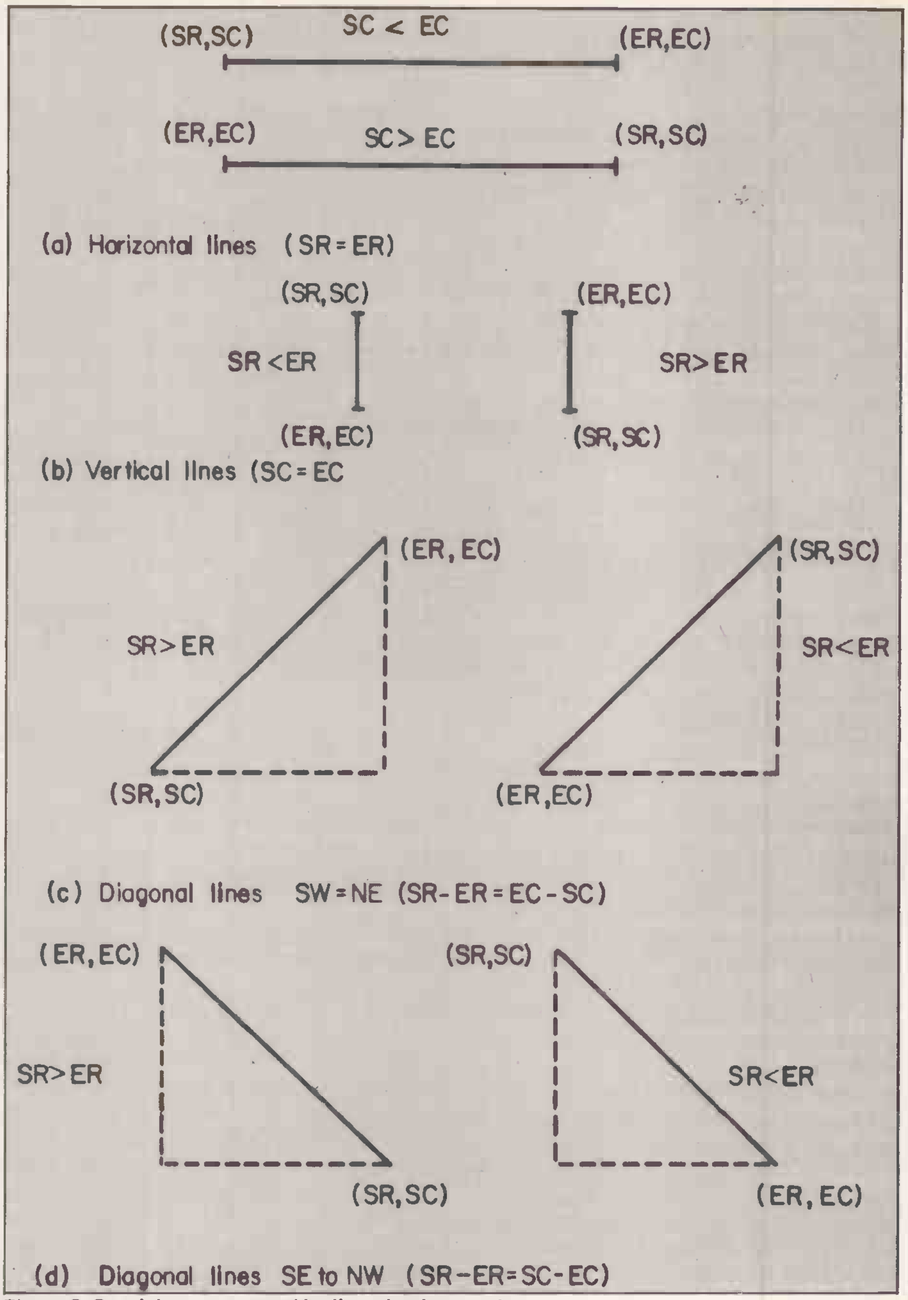


Figure 2. Special cases covered by line-plotting routine.

The subroutine, expecting the co-ordinates of the beginning of the line to be held in SR and SC as (SR, SC) and the co-ordinates of the end of the line to be held in ER and EC as (ER, EC), is

```
500 INC = 1: SL = 32767 + 40*(SR-1)
      + SC
510 IF SR = ER GOTO 600
520 IF SC = EC GOTO 700
530 IF SR-ER = EC-SC GOTO 800
540 IF SR-ER = SC-EC GOTO 900
550 PRINT "LINE NOT IN A REQUIRED
      DIRECTION"
560 RETURN
600 IF SC>EC THEN INC = -1
610 FOR I = O TO EC-SC STEP INC
620 POKE SL + I, 67
630 NEXTI
640 RETURN
700 IF SR>ER THEN INC = -1
700 FOR I = O TO ER-SR STEP INC
720 POKE SL + 40*I, 66
730 NEXTI
740 RETURN
800 IF SR>ER THEN INC = -1
810 FOR I = O TO ER-SR STEP INC
820 POKE SL + 39*I, 78
830 NEXTI
840 RETURN
900 IF SR>ER THEN INC = -1
910 FOR I = O TO ER-SR STEP INC
920 POKE SL + 41*I, 77
930 NEXTI
940 RETURN
```

Figure 2 shows all the cases to be considered by the plotting routine. The subroutine follows the flowchart more or less accurately. It can be compressed at the expense of some legiblity to:

```
500 INC = 1: SL = 32767 + 40*(SR-1)
      + SC
510 J = 1: K = 1: R = ER-SR
520 IF SR = ER THEN R = EC-SC:
      X = 67: J = 0: GOTO 570
530 IF SC = EC THEN X = 66: K = 0:
      GOTO 570
540 IF SR-ER = EC-SC THEN X = 78:
      K = -1: GOTO 570
550 IF SR-ER = SC-EC THEN X = 77:
      GOTO 570
560 PRINT "HLINE NOT IN A
      REQUIRED DIRECTION": RETURN
570 IF R>O THEN INC = -1
```

(continued on next page)

(continued from previous page)

```
580 FOR Z = O TO R STEP INC
590 POKE SL + (40*J + K)*Z, X
600 NEXTZ
610 RETURN
```

We can write a general program for drawing figures composed of straight lines. The program accepts the value of N, the number of lines in the figure, and then accepts the co-ordinates of the beginning and end of each line, storing them in the arrays called SX, SY, EX and EY. It then calls the subroutine to draw each line in turn. The input data required to draw the square illustrated in figure 4 is

```
N = 4 (Number of lines)
SX(1) = 10, SY(1) = 10 (Start of first line)
EX(1) = 10, EY(1) = 20 (End of first line)
SX(2) = 10, SY(2) = 20 (Start of second line)
EX(2) = 20, EY(2) = 20 (End of second line)
SX(3) = 20, SY(3) = 20 (Start of third line)
EX(3) = 20, EY(3) = 10 (End of third line)
SX(4) = 20, SY(4) = 10 (Start of fourth line)
EX(4) = 10, EY(4) = 10 (End of fourth line)
```

Because the figure is continuous, the end of one line is the same as the beginning of the next one. The program is:

```
10 PRINT "ENTER NUMBER OF
   LINES";: INPUT N
20 DIM SX(N), SY(N), EX(N), EY(N)
30 FOR I = 1 TO N
40 PRINT "ENTER START
   CO-ORDINATES OF LINE"; I
50 INPUT SX(I), SY(I)
60 PRINT "ENTER END
   COORDINATES OF LINE"; I
70 INPUT EX(I), EY(I)
80 NEXTI
90 FOR I = 1 TO N
100 SR = SX(I): SC = SY(I)
110 ER = EX(I): EC = EY(I)
120 GOSUB 500
130 NEXTI
```

Note that only lines in the required directions can be drawn, and that an attempt to draw one in another direction results in the line not being drawn and a message produced at the top of the screen. The plot of the square is, literally, a little rough at the corners, but this can be amended, if required, with a little ingenuity.

Having drawn a figure, it is useful to be able to transform it. It is particularly useful with representations of three-dimensional objects in giving different views of them. Useful transformations include magnification, translation, rotation and combinations of these. Our primitive plotting system is not at all suitable for dealing with rotation, since, as an example, it can only display the square, whose plotting we described, after rotation through 45 degrees or multiples of 45 degrees. Translation of that square, by five columns to the right and five lines upwards, to produce a plot similar to that shown in figure 5, can be produced by adding those lines to the program for plotting the square itself.

```
140 FOR I = 1 TO N
150 SR = SX(I)-5: SC = SY(I)+5
160 ER = EX(I)-5: EC = EY(I)+5
170 GOSUB 500
180 NEXTI
```

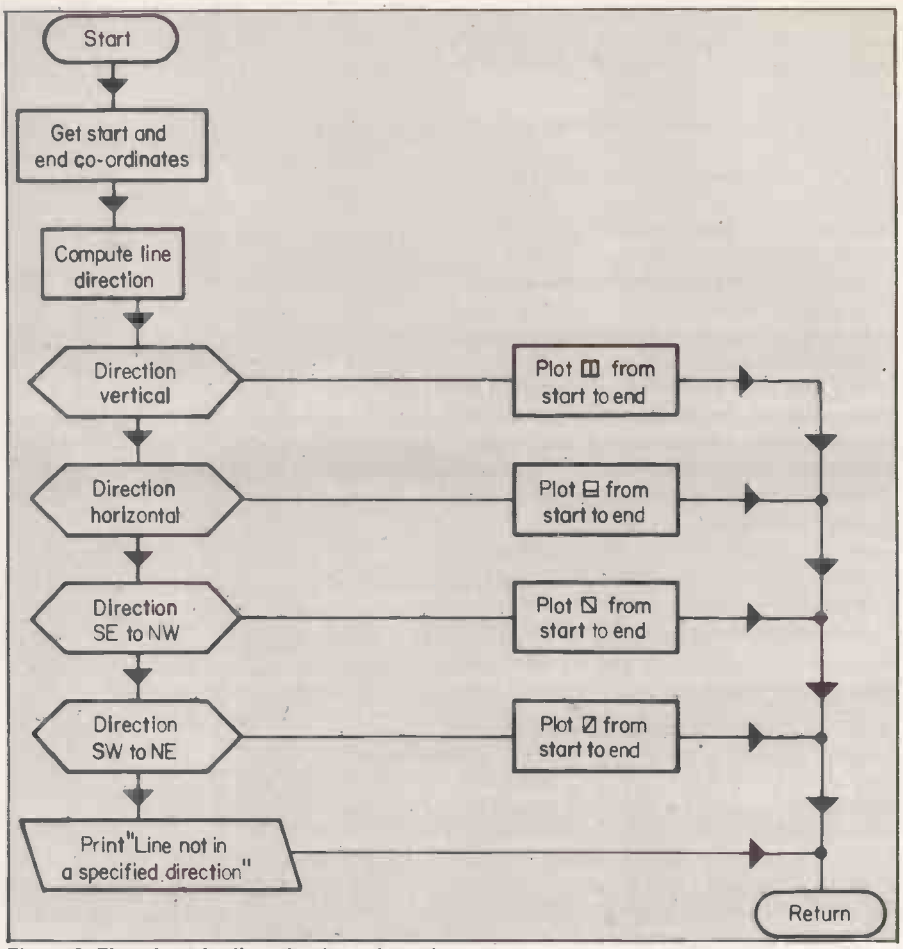


Figure 3. Flowchart for line-plotting subroutine.

Conclusions

- **If a subroutine for plotting lines is available, it can be used for producing figures composed of lines and for displaying the results of transforming such figures.**
- **The introductory ideas can be extended, with the aid of more sophisticated programming techniques than those used here, to produce animated graphics, displays for video games, general plotting routines for straight and curved lines, drawings of objects consisting of any straight and curved lines, perspective views of three-dimensional objects and displays of transformed objects.**

Figure 4. Plot of a square.

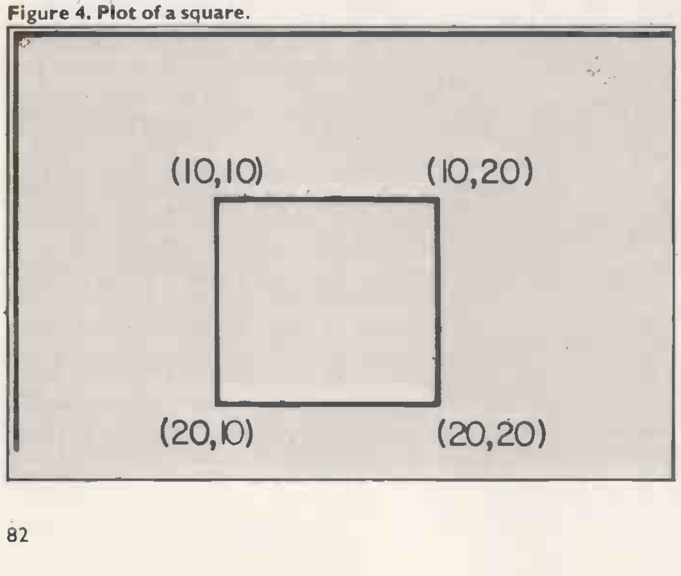
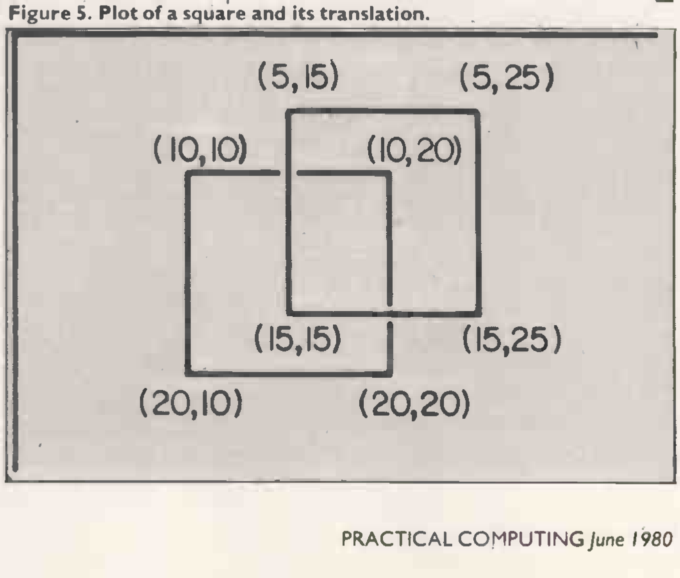


Figure 5. Plot of a square and its translation.



Gourmet Goodie

Super software from the world's leading microsoftware supplier.

Software with Manual / Manual Alone

DIGITAL RESEARCH

☐ Ⓜ **CP/M* FDOS** — Diskette Operating System complete with Text Editor. Assembler. Debugger. File Manager and system utilities. Available for wide variety of disk system including North Star, Helios II. Micropolis, ICOM (all systems) and Altair. Supports computers such as Sorcerer, Horizon, Cromemco, Ohio Scientific, RAIR Black Box, Research Machines, Dynabybe, etc. .... £75/£15

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

☐ **MP/M** .... £195/£25

☐ **MAC** — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) .... £55/£10

☐ **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

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

☐ Ⓛ **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

EIDOS SYSTEMS

☐ Ⓛ **KISS** — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80 etc .... £190/£15

☐ Ⓛ **KBASIC** — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS REL as described above, and a sample mail list program. ..... £295/£25
To licensed users of Microsoft BASIC-80 (M BASIC) .. £215/£25

MICROPRO

☐ Ⓛ **SUPER-SORT 1** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! .... £125/£15

☐ Ⓛ **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

☐ Ⓛ **WORD-STAR** — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center, underscore and PRINT. Edit facilities include global search and replace, read/write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning ..... £255/£15

☐ Ⓛ Ⓜ **WORD-STAR/MAIL-MERGE** — NEW above with option for production mailing of personalis[NEW]cuments with mail list from Datastar or NAD .... £315/£15

☐ Ⓛ Ⓜ **DATASTAR** — Professional forms control entry and display system for key-to-disk data capture. Menu driven with built-in learning aids. Input field verification by length, mask, attribute (i.e. uppercase, lowercase, nume[NEW] auto dup., etc.). Built-in arithmetic capabilities using ke[NEW] data, constants and derived values. Visual feedback for ease of forms design. Files compatible with all CP/M-MP/M supported languages. Requires 32K CP/M .... £195/£25

Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model 1 computers.

Software with Manual / Manual Alone

GRAFFCOM

☐ Ⓛ **PAYROLL** — Designed in conjunction with the spec for PAYE routines by HMI Taxes. Processes up to 250 employees on weekly or monthly basis. Can handle cash, cheque or bank transfer payments plus total tracking of all year to date figures. Prints emp master, payroll log, payslips and bank giros. Requires CBASIC-2 .... £475/£15

☐ Ⓛ **COMPANY SALES** — Performs sales accounting function. Controls payments of invoices and prints sales ledger and aged debtors report. Suitable for any accounting period. Comprehensive VAT control and analysis of all sales invoices. Requires CBASIC-2 .... £425/£15

☐ Ⓛ **COMPANY PURCHASES** — Performs purchase accounting function. Controls invoices, credit & debit notes. Prints purchase ledger, aged creditors report and payment advices. Comprehensive VAT control and analysis of all purchases, Interfaces with the ADD system. Requires CBASIC-2 .... £425/£15

☐ Ⓛ **GENERAL ACCOUNTING** — Produces Nominal Ledger, Trial Balance, P/L and Balance Sheet. Define your own coding system. Interactive data entry plus optional data capture from Company Sales and Company Purchases. Requires CBASIC-2 .... £375/£15

☐ Ⓛ **STOCK CONTROL**
Maintains stock records, monitors stock levels to ensure optimum stock holding. Details include stock desc., product code, unit, unit price, quantity on hand on order/minimum. Stock analysis reports can be weekly, monthly, quarterly etc. Interfaces with Order Entry Invoicing system. Requires CBASIC-2 .... £325/£15

☐ Ⓛ **ORDER ENTRY & INVOICING**
Performs order entry and invoicing function. Handles invoices for services and consumable items, part orders and part quantities. Sales Analysis report shows sales movemets and trends for user-defined period Interfaces with Stock Control. ADD and Company Sales systems. Requires CBASIC-2 .... £325/£15

☐ Ⓛ **ADD** — Complete control of all your names & addresses including suppliers, clients, enquiries etc. Assign your own coding system and select all output via the report generator. Will print anything from mailing labels to directories. Requires CBASIC-2 .... £225/£12

☐ Ⓛ **COMPLETE ACCOUNTING PACKAGE** — Combined Company Sales, Company Purchases, General Accounting, and ADD systems .... £950/£45

☐ Ⓛ **SALES ORDER PROCESSING PACKAGE** — Combined Stock Control, Order Entry and Invoicing and ADD systems .... £550/£30

STRUCTURED SYSTEMS GROUP

☐ **ANALYST** — Customised data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval and update facility makes information management easy. Sophisticated report generator provides customised reports using selected records with multiple level breakpoints for summarisation. Requires CBASIC-2, 24 x 80 CRT, printer and 48K system .... £125/£10

☐ **LETTERIGHT** — Program to create edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 .... £105/£15

☐ **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 .... £45/£12

☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. Parameter file created optionally with interactive program which requires CBASIC-2. Parameter file may be generated with CP/M assembler utility .... £50/£12

SOFTWARE SYSTEMS

☐ Ⓜ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables etc. .... £75/£10

MICRO FOCUS

☐ Ⓛ **STANDARD CIS COBOL** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive dubug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... £400/£25

☐ Ⓛ **FORMS 2** — CRT screen editor. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. Output is COBOL data descriptions for copying into CIS COBOL programs. No programming experience needed. Output program directly compiled by CIS COBOL (standard) .... £100/£12

OTHER

☐ **HDBS** — Hierarchical Data Base System. CODASYL orientated with FILEs, SETs, RECORDs and ITEMs which are all user defined. ADD, DELETE, UPDATE[NEW]EARCH, and TRAVERSE commands supported. SET ord[NEW]g is sorted, FIFO, LIFO, next to prior. One to many set rela[NEW]onship supported. Read/Write protection at the FILE level. Support FILEs which extend over multiple floppy or hard disk devices.

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

• Circle No. 188

Software for most popular 8080/Z80 computer disk systems including

NORTH STAR HORIZON, VECTOR MZ, OHIO SCIENTIFIC, CROMEMCO, PROCESSOR TECHNOLOGY, RAIR BLACK BOX, DYNABYTE, SD SYSTEMS, RESEARCH MACHINES, ALTAIR, EXIDY SORCERER, IMSAI, HEATH, and 8" IBM formats

Software with Manual / Manual Alone

☐ **MDBS** — Micro Data Base System. Full network data base with all features of HDBS plus multi-level Read/Write protection for FILE, SET, RECORD and ITEM. Explicit representation of one to one SET relationships. Supports multiple owner and multiple record types within SETs. HDBS files are fully compatible. **NEW**

☐ **MDBS-DRS** — MDBS with Dynamic Restructuring System option which allows altering MDBS data bases when new ITEMs, RECORDs, or SETs are needed without changing existing data.
HDBS-Z80 version ... £135/£25
MDBS Z80 version ... £395/£25
MDBS-DRS-Z80 version ... £455/£25 **NEW**
8080 Version available at £45 extra

Z80 version requires 20K RAM. 8080 version requires 24K RAM. (Memory requirements are additional to CP/M and application program.)

When ordering HDBS or MDBS please specify if the version required is for 1) Microsoft L80 i.e. FORTRAN-80, COBOL-80, BASIC COMPILER, 2) MBASIC 4, XX, or 3) BASIC-80 5.0.

☐ (L) **PASCAL/M** — Compiler generates P code from extended language implementation of standard PASCAL. Supports overlay structure through additional procedures and the SEGMENT procedure type. Provides convenient string handling capability with the added variable type STRING. Untyped files allow memory image I/O. Requires 56K CP/M ... £195/£20 **NEW**

☐ **PASCAL/Z** — Z80 native code PASCAL compiler. Produces optimised portable reentrant code. All interfacing to CP/M is through the support library. The package includes compiler companion macro assembler and source for the library. Requires 56K and Z80 CPU. Version 2 includes all of Jensen/Wirth except variant records ... £155/£15

Version 3 Upgrade with variant records and strings expected 2/80 ... £205/£15

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

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

☐ (M) **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

☐ (M) **WHITESMITHS' C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Compiler output in A-Natural source. Supplied with A-Natural. Requires 60K CP/M ... £325/£20

☐ (M) **POLYVUE/80** — Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual ... £70/£12

☐ (M) **POLYTEXT/80** — Text formatter for word processing applications. Justifies and paginates source text files. Will generate form letters with custom fields and conditional processing. Suport for Daisy Wheel printers includes variable pitch justification and motion optimization ... £45/£10

☐ (L) **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

☐ (M) **Z80 Development Package** — Consists of (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, DDT or SID facilities ... £50/£12

☐ (M) **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

☐ (M) **DISILOG** — As Distel to Zilog Mostek mnemonic files. Runs on Z80 only ... £35/£7

☐ (M) **TEXTWRITER III** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertion. Ideal for contracts manuals. etc. ... £75/£3

Software with Manual / Manual Alone

☐ (M) **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 **NEW**

☐ **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 **NEW**

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

☐ **WHATSIT?** — Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast resonse. Requires CBASIC ... £70/£15

☐ **XYBASIC** Interative Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in integer, Extended and ROMable versions.
Integer Disk or Integer ROMable ... £165/£15
Extended Disk or Extended ROMable ... £215/£15

☐ **SMAL/80** Structured Macro Assembley Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs ... £40/£10

☐ (M) **SELECTOR III-C2** — Data Base Processor to create and maintain multi Key data bases. Prints formatted, sorted reports with numerical summaries or mailing labels. Comes with sample applications including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC Version 2. Supplied in source code. ... £185/£12

☐ **CPM/374X 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

☐ (M) **BASIC UTILITY DISK** — Consists of (1) CRUNCH-14 Compacting utility to reduce the size and increase the speed of programs in Microsoft Basic and TRS-80 Basic. (2) DPFUN — Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation ... £30/£10

☐ (M) **THE STRING BIT** — Fortran character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source ... £30/£10

☐ (M) **BSTAM** — Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansions to send *.COM, etc. 9600 baud with wire, 300 baud with phone connection. Both ends need one. Standard and M versions can talk to one another ... £75/£5

MICRO DATA BASE SYSTEMS

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

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

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

☐ (M) **CBS** — Configurable Business System is a comprehensive set of programs for defining custom data files and application systems without using programming language such as BASIC, FORTRAN, etc. Multiple key fields for each data file are supported. Set-up program customizes system to user's CRT and printer. Provides fast and easy interactive data entry and retrieval with transaction processing. Report generator program does complex calculations with stored and derived data, record selection with multiple criteria, and custom formats. Sample inventory and mailing list systems included. No support language required ... £185/15 **NEW**

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

Add VAT to orders for software (not manuals alone) Add 50p per item postage and packing (minimum £1)

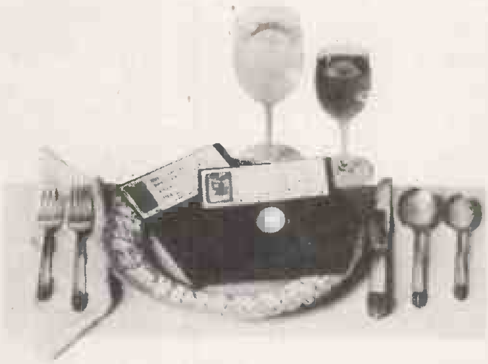
All orders must be prepaid (except COD or credit card) Make cheques POs etc payable to Lifeboat Associates.

Manual costs are deductable from subsequent software purchase

*CP M is a trademark of Digital Research
**Z80 is a trademark of Zilog Inc.
The Software Supermarket is a trademark of Lifeboat Associates.

EFFECTIVE MARCH 1980

• Circle No. 189



Disabled and administration share the rewards

In an era of shrinking health-care budgets, the inexpensive micro has an important role to play in cost-effective administrative and educational work. Martin Hayman visited Jonathan Seagrave of the London Borough of Hillingdon to discover exactly what applications have been found for the versatile machine.

IT WAS NOT to combat the current cash squeeze on social services that research officer Jonathan Seagrave first decided to use a micro for administrative purposes at the London Borough of Hillingdon's vast modern civic centre.

One reason was, in fact, more practical — he and his wife Gillian won an Apple in the *Practical Computing* competition in February, 1979. After assiduous work with this machine, it soon became apparent that there was a strong case for a departmental micro — the computerisation of the social services' referral system this year was a major step forward.

Information

The purpose of the referral system is to provide senior management with details of what kinds of people visited the department for social work help, the kinds of problems they faced and, in broad terms, what kind of help they had been given. "Such information is essential for the rational allocation of resources and manpower and sheds light on changing social trends and the ways we should respond to them", says Seagrave.

When using a micro was proposed, there was the possibility of using a mainframe computer which Hillingdon shares with Hackney, Tower Hamlets and Haringey. After five years of discussion, that system seems only now to be making worthwhile progress, and Seagrave admits he was relieved not to be compelled to use it. It would have cost his department £25,000 a year and would have been an albatross.

"Our viewpoint then was that a good, limited manual system which worked was better than a sophisticated computer system that didn't", he says. Indeed, his department's needs are relatively simple. Most of the client files which Seagrave's department handles are quite small, there are only a few in each category, and they may not need to be accessed more frequently than twice a year.

"If you can put all your details into one index card box, it is probably not even worth using a micro", he says. "But with more than 4,000, or if you need frequent access, it probably is worth it. It's a question of access time". That was the vital factor with the Borough's mainframe, which is dedicated to other tasks during the normal working day and would not have been available for social services use before 5pm.

As senior research officer, Seagrave's role was to see that summary sheets from the four area teams who dealt with clients — mostly disabled and handicapped people — were collated and produced as a quarterly quick summary sheet for senior management. They were made subsequently into a detailed annual report providing cross-tabulations in detail.

Details were previously compiled on a multi-part form, coded and collated manually — hence the boxes, which appear on almost any form you may fill in, which read forbiddingly "For office use only".

Efficiency

Three years ago, Seagrave's colleague, Sheila Noble, revised this form and tightened the definitions. That, he says, made the system more efficient. The next stage was to computerise the data tabulated. "All those boxes were an obvious target", he says. "It was a management information system, but it was not time-critical. It was a good area for experiment".

Earlier experience with computers included a simulation program written by a disabled programmer, Christine Simpson, for the Open University Hewlett-Packard in its own brand of Basic. Although the Open University was very co-operative, telephone time for the project still amounted to £350.

Seagrave had looked round the micro market for a while, after this the department funded a week's hire of an Apple for evaluation: "It's clear that you can't

(continued on next page)

Christine Simpson is one of the handicapped programmers who works for and benefits from Hillingdon social service policy.

(continued from previous page)

really learn about these machines without spending a fair amount of time working with them", he says.

Though the primary intention was to explore a range of possible applications, it quickly emerged that the machine would prove itself best on the referral statistics.

At the same time, the department had been waiting for the Manpower Services Commission for a grant under the Special Temporary Employment Programme (STEP). Happily, it arrived at the same time as the micro, so with funds to employ five handicapped people, Seagrave was able to take on wheelchair-bound Christine Simpson as a programmer working from home.

It was Simpson who told him about the British Computer Society's specialist group for the disabled, and put him in touch with other disabled programmers who were eager for work.

It was this aspect of programming which led to further explorations of the micro for educational and training use for the disabled.

Since the arrival of the departmental machine in January, 1979, a second programmer under the STEP scheme, Sheila Butcher, has been taken on, and it was she who devised most of the material for mentally-handicapped teenagers in the Borough's adult training centre.

That work, which is still under development, derived, at least in part, from Mrs Seagrave's "flower-power" program, which uses the Apple colour display to draw a flower. The flower is a very pleasing display; could it not be used as a kind of visual reward when severely speech-handicapped children or young adults gave the correct response?

Giant step

One of the problems of training people with severe speech defects is to elicit a consistent response; if an inarticulate sound can be interpreted consistently as yes or no, it is already a giant step forward in the patient's relations with the external world.

The Apple speech board offers the possibility of recognising acceptable utterances and rewarding the patient by drawing a flower. The problem is one of editing — clearly the teacher has to decide what is, or is not, an acceptable utterance and so program the machine.

That would represent perhaps two days' work by someone who really knows the innards of the Apple. "What it needs is someone to write a utility program to edit the utterances, someone who can happily dig around in Hex which I don't do happily", says Jonathan Seagrave. "I'm not a very good programmer, I'm afraid".

There is a further problem, the familiar one of lack of funds. The Department of Health and Social Security has assigned practically no money to micro applications for the disabled, and does not seem interested in doing so. So far only hearing disability applications have been granted any funds.

So this aspect, at least, remains for further exploration as time and money permit. For the present, Seagrave's main drive is to computerise the administration of the local adult training centres. Briefly, the role of such centres is to employ disabled people in light industrial work for which they are paid a nominal sum — the maximum permitted before the wage starts to affect disability benefit is a meagre £4 a week.

The "employees" also pay dinner money throughout the week which also goes into the training centre accounts. So it may be seen that although the sums involved are small, the complexity of the system approaches that of a normal commercial payroll program.

Challenge

In introducing the micro, Seagrave is aware that he is challenging an existing clerical system which works well. To their credit, the staff involved were quick to see the point that the micro would free them from administrative work and permit their time to be used more effectively for the primary purpose of caring for the patients.

Doubtless, it also helped that they are involved in the discussions at all stages, and, in fact, helped choose the equipment. They eventually plumped for a thermal printer with its advantage of quietness.

Seagrave admits that this is now moving towards the sharper end of the business and says that he will be considering commercial software. This application is clearly more time-critical than the original research applications and he may well commission a program if no suitable tender turns up. He has been looking round the cottage software market.

He has done a great deal of his own leg-work to popularise the micro — either his own or the department's — and, in general, has had a good response, both from handicapped people, children or adults, for the educational applications, and from his lords and masters for the administrative applications. "If you can be seen to use the machine effectively", he told me, "there's plenty of support".

The referral program certainly seems to be working well. After a few tests and amendments — mainly to facilitate a restart after a break in keying-in — it is in regular use and takes about half the time of the old manual compilation system. More important, the data is all on file for further analysis. He now intends to prepare a general-purpose analysis program for ready analysis of cross tables.

He does concede that, were he to start again, he might have considered modifying a commercial data management package, but these were not available at the start of the scheme. Yet the home-made program has made it possible to include input and consistency checks which would in any case have required custom programming, even if they were patched on to a package.

They include range checks on data input and a sequence check on the serial numbers. Against this, he opted not to verify data input, since the application can tolerate occasional errors without disaster.

In the future, he is very keen to modify the referral program so that one of the department's most severely-handicapped clients, a teenager with no speech and limited movement, can do some of the key punching. From the programming angle this represents no problem. The program is working and there is already a set of switches wired up to the Apple game socket which the youth can use.

The difficulty lies in page-turning the forms. To overcome this, the forms may be changed to make them suitable for mechanical feed, and a page-turner may have to be wired-up from the Apple. The volume of work is quite modest but the youth probably will not be able to do all the keying-in. Other attenders of the day centres may contribute — keyboard work is very suitable for handicapped people, as Derek Nicholson's organisation, Emphatic, has shown.

New possibilities

What the micro does is to extend the possibilities further, to those who can't use a keyboard directly. The only other organisation making progress in this area, to Seagrave's knowledge, is the Spastic Society Professional Workshop under Peter Deakin, where there is also an emphasis on higher levels of skill and word-processing.

Seagrave contrasts his own department's modestly-funded work with the grandiose computer projects undertaken by local authorities only a few years ago.

Gateshead in Tear and Wear, for example, which won the British Computer Society Social Benefit Award recently, spent over seven man-years of programmers' time alone developing its system and now hopes, with ICL, to sell it to other local authorities. Yet before that, in 1973/4, East Sussex had produced a similarly elaborate terminal-based system — also presumably very costly, and also for an ICL machine.

At least he is making progress, even if it demands a high level of personal commitment and a great deal of work — and he does have the backing of his colleagues and the higher authorities. "It is a great pity", he says, "that central government, particularly the DHSS, takes so little interest in this kind of application for clients, even though it can enable the most severely handicapped to do productive work, and, more generally, increase administrative efficiency — achievements that one would have thought warranted energetic support".

Planning techniques find optimal routes

Although robotics and artificial intelligence can be treated as two entirely separate disciplines, there is a good deal of interaction between them. Mark Witkowski looks at the impact of artificial intelligence techniques on robotics.

THERE ARE many possible reasons for applying artificial intelligence techniques to robotics. One is to gain a better understanding of the essential nature of intelligence — why some computations seem clever and worthy of further investigation and others do not, even though they appear more complicated.

Another is to discover new ways of manipulating data which are easier and more natural to write, which increase the efficiency or the applicability of an algorithm to a particular problem. Artificial intelligence has always been something of an assortment of ideas about perception, problem solving, abstraction, generalisation, skilled action, description, language, learning and memory and so on.

The tendency is to investigate those areas in isolation, even though the crudest definition of intelligence would indicate that it is not only the possession of these faculties but their interaction which is of significance.

At the moment, no robot possesses all those faculties but there are a handful which each demonstrate at least one or two to a significant extent.

Fortunately, it is not necessary for a robot to be very intelligent for it to tell us something useful about robot control. The ideas generated in research will slowly find their way to the shop floor and industrial robotics. It is, after all, easier to find a specific solution to a problem once a method of finding solutions in that area is understood.

Construction

Edinburgh University's Freddy system was programmed to construct small wooden toys from their component parts — Ambler et al. (1975) and Barrow and Crawford (1972). Were it not for the fact that this system could start from a situation in which the parts were tipped in a heap on the workbench before assembly commenced, the problem would have been relatively easy.

Furthermore, the algorithm was sufficiently robust to allow the initial pile to contain parts for more than one model of the same or different types, and totally extraneous parts which had to be identified and discarded.

Freddy was a five-degree-of-freedom manipulator in which the gripper could be lowered and raised on a gantry, rotated and closed. X and Y translation of the objects was achieved by moving the workbench. A small vice was fitted to the bench into which objects could be clamped during assembly.

Sensing was provided in the form of proprioceptive co-ordinate feedback, two television cameras, one looking obliquely at the table, the other directly downwards. The gripper was fitted with tactile and force sensing.

The complete assembly process was not totally autonomous — the operator was

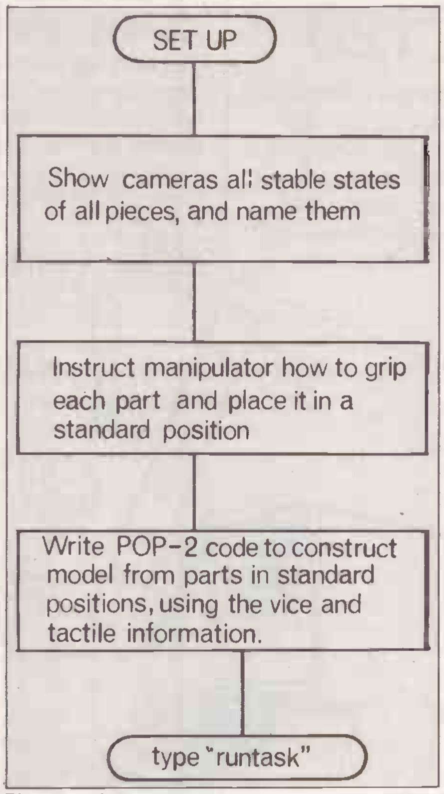


Figure 1. Operator actions.

required to do several things before the robot could be left to assemble models from piles of parts. The automatic part of the program proceeded in two stages.

In the first, parts were isolated from the piles, identified and laid-out in standard locations. This kit of parts would then be assembled using hand-coded routines.

The user had to do three separate programming or teaching operations before the robot was ready to go — figure 1. First, each part of each of the models had to be shown to the system in each of its stable states — the ways it would come to rest if dropped on the table.

That might be repeated several times so that the program could build-up an internal description or representation of the part so that it could be recognised and identified later using only incoming visual sensory data.

Next, the user had to instruct the robot, using a keypad, how to pick-up, rotate and finally deposit in a standard position for assembly each of the parts used in the models. The user had to write some POP-2 code to take the parts from their standard positions and construct the model using the vice to clamp the pieces and tactile sensing to do any close insertion assembly.

POP-2 is the Edinburgh artificial intelligence programming language and not a specific assembly language like WAVE or AL — Burstall, Collins and Popplestone (1971).

Figure 2 shows the automatic part of Freddy's operation — a loop which can be cycled forever. Each time, the most useful operation which can be done in completing the model is executed first. So if everything is complete, the program finishes 1.

Standard

If all the parts required for the model are in their standard positions, the model is assembled, using the pre-defined code, 2. If this was not the case, the cameras are used to explore the table-top. A potential item is a bright region on the dark background — 3.

Once a bright region is located, it must be visually analysed. It will either be a useful item, a piece of the model still needed for the process to continue, in which case it is moved to its standard position — 4.

It could be part of the model but one which duplicates a part already in its standard position, and it must be put to one side — 5.

If there are no regions that can be identified as useful items, the robot sets about the smallest region as a heap — 6. The tactic used is to divide the heap into its individual pieces so they may be identified. The first strategy is to locate visually a protusion from the side of the heap and attempt to pick it up and place it in a clear area for identification.

If for some reason this fails for all the visible protusions, a second tactic is then employed to separate the heap.

The gripper is lowered on to the heap until it touches, thereby defining its height. Then an attempt is made to grab at the heap, first halfway up and then, if that fails to isolate a single item, at the base.

In the case of a particularly entangled heap, a final attempt is made by ploughing the hand through its centre just above table level. That procedure is not entirely desirable as it causes significant disruption of the work-table lay-out. If the heap is still unrecognisable, it might as well be disposed of — 8.

That portion of Freddy's algorithm is characterised by a number of very useful ideas. First of all, extensive use is made of both visual and tactile feedback and there are many error recovery modes. Everything is checked periodically to make sure it has not moved and that the computer's internal description of the world matches the sensory data — 7.

Most of all, it is very persistent due to the structure of the main control loop — figure 2 — and will work away at objects and heaps until they succumb.

There are also checks to ensure that the proposed action is still applicable. For instance, just before smashing a heap, it checks that the heap is not really a recognisable object which slipped-through. The assembly routines are not as robust. It is the user's responsibility to include such checks as he or she feels appropriate, and if those tests are not made, the assembly may fail in an unexpected way.

Obviously the tactic actions of the lay-out algorithms are related closely to the types of item they manipulate. The vision routines depend on the objects being lighter in colour than the background, and the objects must be grippable by the hand.

Sensors monitor continually for the unexpected and error recovery was included at many levels. However, there was very little planning involved, actions being made in response to some immediate need. Problem solving and planning is an area where artificial intelligence can really help robotics.

Maze running

Of particular interest to anyone who may be entering the micromouse maze-running competition is the question posed by the exploration and learning of a maze.

The classic method of traversing a maze from some entrance to an exit is to keep touching either the left- or the right-hand wall until the exit is found. That would work for the maze shown in figure 3. You may note, however, that following the right-hand wall leads to the exit a good deal sooner than following the left.

It is, of course, entirely arbitary as to which handedness is to be more efficient. Without knowing something further about the maze, there is no way of telling.

There is, in fact, a particularly nasty catch to the follow-the-wall algorithm — it works only if both start and finish are on an infinite face, that they are joined by a continuous wall.

There is no problem with figure 3 as they are both on the outside wall. Unfortunately, the micromouse competition rules clearly state that the finish will be in the centre of the maze, and so there can be no assumption that the algorithm will terminate.

It is also pointless to take turnings at random, since this would give very slow progress through the maze. It would be worse to change walls at arbitary times. A systematic search of the maze is required. This will not help much for a single timed run but will be very valuable if the maze runner has a second chance.

Tarry's algorithm is useful — Berge (1962). It states that one should never go in the same direction twice along any one edge, nor take the edge from a junction by which one arrived unless no other choice is available. Figure 4 shows the maze in figure 3, depicted in the form of a graph.

Each square in the maze at which a decision can be made is represented by one of the lettered notes, A to N, dead-ends are shown by 'X'. Arcs joining the nodes show the distance between junctions.

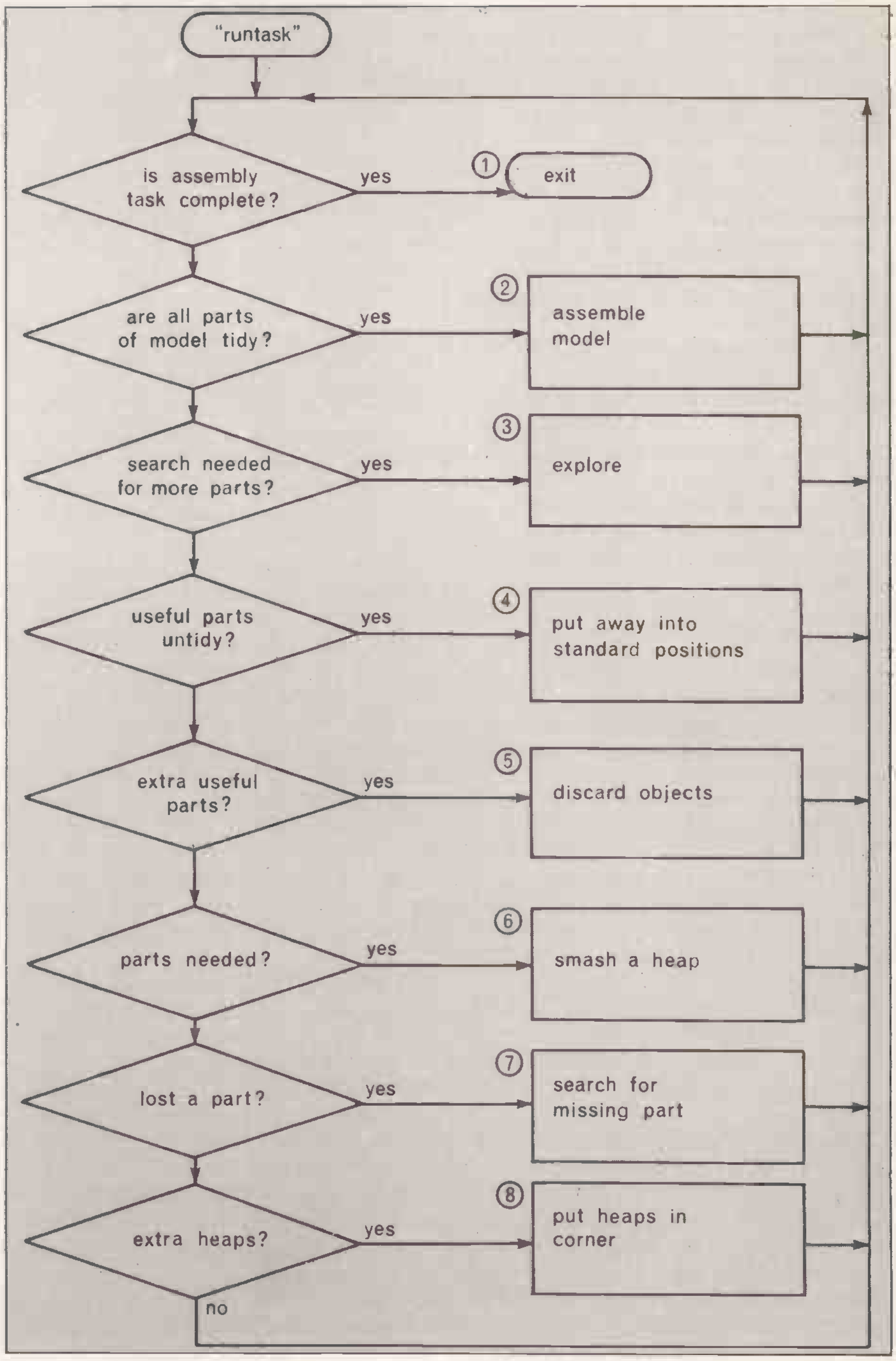
Clearly, with a graph like this, one could explore the maze and choose an optimum route without moving at all. By looking at either the ground plan or the graph, any particular route can be investigated. Following the right-hand wall leads to the exit via:

START(1), A(1), B(1), Xb(1) dead-end so back to B(5), D(3), H(3), M(2), N(2), back to N(5) and then EXIT, for a total of 26 moves.

Following the left-hand wall is altogether worse:

(continued on next page)

Figure 2. Lay-out algorithm.



(continued from previous page)

START(1), A(3), C(4), F(3), Xf(3), F(1), I(1), J(1), K(2), Xkl(2), K(3), Xkr(3), K(1), J(3), L(3), Xl(3), L(3), E(2), G(3), H(3), M(2), Xm(2), M(2), N(5), EXIT, for a total of 64 moves with six dead-ends visited.

The best strategy is to travel through each tunnel and visit each junction in turn, but re-tracing one's steps as little as possible and remembering the internode distance. That must be methodical and some variant of Tarry's algorithm could well be used.

The mouse must first have some way of remembering each of the junctions, probably as an X-Y co-ordinate and then start exploring the maze. As an example, one might turn left unless that tunnel had already been mapped. So from the start there is no choice but to visit A, and the left-most exit goes to C, and thence to F.

F's left-most exit leads to the dead-end Xf, there is no choice but to turn back to F. The current left-most exit from F leads to I, which visits Xi and then J, which visits K, Xkl and Xkr, showing that the node K is itself a dead-end.

Back to J, L and Xl, to E, G, H, M, Xm and back to M, left to N and left again to the EXIT. As our purpose is to explore the maze, not leave it, the exit is treated as a dead-end and we turn back to N, Xn and M. H, D, B, Xb back to B and then A, which takes us back to the start.

With the graph safely in computer store, it is possible to plan a route to the exit in the least possible moves, START, A, B, D, H, M, N and EXIT, a total of 20. A complete exploration of the maze takes 132 moves, on the 14 × 14 ft. maze there is about 700 feet of track, and somewhat more than 600 possible nodes, each with a maximum of four exits, assuming no diagonals.

Exploration

To explore the maze in 10 minutes, the mouse's speed would have to be in excess of 14 in. per second. Open spaces should be traversed as they could represent a considerable shortcut.

The graph representation is particularly useful in this case as it is suited ideally to list processing languages, — Foster (1967) — such as Lisp, which is available on at least three microprocessors, the 6800 — Van der Wateren (1978) — the 6502 — Gardner (1979) and the Z-80 (Softwarehouse).

A further advantage is that artificial intelligence has given rise to a great many algorithms for searching graph structures of this form to find an optimal path through them.

They can be elegant, quick, efficient, exhaustive or heuristicly-driven, according to taste — Nilsson (1971). Each algorithm is favoured in subtle ways by the exact design of the maze.

So with luck and a turbo-charged mouse — in the final analysis there is little substitute for well-directed brute force — a winner will actually reach the exit. Also see Allen and Allen (1979) and Stanfield (1979).

Maze running is a special case of a more general navigational problem that is solved by planning techniques. A mobile robot must operate in the passages and spaces between obstacles without hitting them. Even if the vehicle has an accurate picture of its own position, either by dead-reckoning or some navigational aid, and that of the obstacles it has to avoid, it must still plan a route from its current position to its destination.

In a warehouse, algorithms akin to those used for the maze may suffice with the vehicle running in the middle of the passageway. Any obstacle detected by its sensors would cause the vehicle to plan a new route round it. Presumably, when two such vehicles meet, being too stupid to go round one another, they would both turn, plan a new route and, doubtless, meet somewhere else.

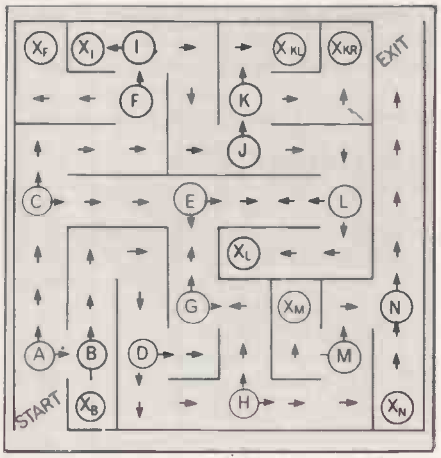


Figure 3. A maze.

Figure 5 shows an open-plan robot environment, bounded by walls but containing a few — five in this case, A to E — square obstacles. The problem is to plan a route from the start position, at the bottom, to the goal position at the top, avoiding all the obstacles, but obeying some shortest path criterion.

Normally, that would be the shortest total distance but in a robot suffering navigational error while turning, the straightest path may be preferable. If computer time was at a premium the first path found, of the several possible, may be chosen or the best path found after a fixed number of seconds.

Assuming that the positions of the objects are known, there are a number of algorithms for planning a route through the robot's environment. Clearly, a good deal of geometry is going to be involved, and hence a good deal of computation.

Any technique which keeps this at a minimum will be welcome. The map could be stored as a topological, graphical representation, perhaps in a two-dimensional array. Each element in the array would correspond directly to a co-ordinate in real space.

For large areas, particularly if there are only a few objects, that will be very cumbersome. Saving only the corner points of the objects would be far more efficient. In planning a minimal route it is desirable to pass by the objects as closely as possible to avoid travelling excess distance.

Computation can be further reduced by treating the robot as a point and by expanding each of the objects it must avoid by an amount equivalent to the radius of a circle which just surrounds the robot.

The result of this expansion is shown in figure 5. Clearly, if a point can navigate round those obstacles, the robot can move around the originals.

The next stage is to build a graph of all the points visible from the current position, and then all the points visible from those new places, and so on. A corner is visible from the current position if a line can be drawn to it without crossing any line which represents the face of an object, i.e., 1.3-1.4.

That could be rather time-consuming even though the routine to test if one line crosses another is minimal. Time could be saved by noting that a good deal of the robot world is invisible from any point as it is occluded by other obstacles. Figure 6 shows such a graph.

There is no need to join nodes at the same depth, 1.n or 2.n and so on, since it is pointless going somewhere in two stages when it is possible to arrive there by a straight line. Each of the arcs shows the length of the line between the two points in question. The underlined number beside each node is the distance which has been travelled to reach it.

Deeper nodes

Where two routes pass through the same point, only the shorter is used to compute distances to the deeper nodes. Eventually, the goal point is reached, or there are no more nodes to expand as the goal was unobtainable anyway.

The distance and route to be taken is now obtained easily from the graph. Searching the graph can proceed in a number of ways. First a breadth search, in which all the first-level nodes are expanded, 1.n, followed by all the second-level nodes, 2.n, then successively deeper nodes.

Searching in this way, the goal node to be found first is 1.6 — 2.4 — Goal, 179. The search would have to proceed to the fifth level to obtain the best route. When there are a large number of nodes, richly interconnected, the search space can become massive in a combination of explosion. However, the combinatorial explosion does not sound the death knell of artificial intelligence problem solvers.

The perfect search strategy is to know some heuristic measure which indicates the most advantageous arc of the many possible. Heuristics are often referred to as rules-of-thumb, extra knowledge or understanding about the problem domain.

A perfect heuristic would lead to a total depth first search, in which one particular successor to a node, rather than its neighbours, is expanded. That would lead directly to the goal.

In reality, a heuristic measure only indicates which of the nodes it might be best to explore. If the search leads to a terminal node, dead-end or one known not to be useful, the search must back-up to a previous node and follow another promising series of arcs.

Possible heuristic measures for searching figure 6 might include expanding the node which has the shortest route back to the start point, or expanding arcs that represent directions that most directly point to the goal position.

Using the co-ordinates of the points, the optimal path START — 1.3 — 2.2 — 3.2 — 4.1 — GOAL can be converted into a LOGO program, which could drive a turtle:

```
TO GOTOGOAL
10 RIGHT 39        (turn 39 degrees right)
20 FORWARD 41      (go 41 units forward)
30 LEFT 41
40 FORWARD 36
50 LEFT 70
60 FORWARD 27
70 RIGHT 24
80 FORWARD 36
90 LEFT 15
100 FORWARD 22
110 END
```

The more general case where the objects to be circumnavigated are not squares but arbitrarily-shaped is nothing like as straightforward. This simple edge expansion is not optimal. In fact, the robot could have squeezed between blocks A and B of figure 5 and if the block had been rounded at the corners to the robot's radius, the solution path would have been totally different. Further details of these algorithms may be found in Lozano-Pérez and Wesley (1979).

Planning and problem solving can be used in generating higher-level, more descriptive plans than those purely for navigation or maze-running. The Shakey robot project at the Stanford Research Institute (SRI) used a problem solver (STRIPS — Stanford Research Institute Problem Solver) to tackle chain of action tasks — Fikes and Nilsson (1971).

Figure 7 shows a typical Shakey environment. A suite of rooms connected by doors to an adjoining corridor contains the robot and a selection of boxes.

The robot can make actions within this world by applying any one of a number of different operators, such as 'goto', 'pushto' or 'gothrudoor'. Whenever there is more than one possible operator, several difficulties arise during planning which were not noticeable with the maze and navigation examples.

Before, only the robot or micromouse changed position. There were no other effects and it was assumed that whenever the robot moved it is no longer where it was and has arrived at its destination.

Environment

During STRIPS planning, even though nothing in the real environment is moved, when it plans to move an object or the robot, the old information in the database about that thing must be removed and replaced with updated information about its new status.

So each time a new node is added to the problem graph by planning to apply an operator, a new version of all the axioms must be generated. That is the essence of the frame-problem: every time you plan an action, the next stage in your plan must assume the world has been changed as a consequence of previous actions.

STRIPS deals with that by having a delete and add list for each of the operators which can be used. The delete list specifies which of the current world model axioms will no longer be true of the world if that operator were to be applied; the add list specifies the axioms which would have to be added after it was used.

A further complication is that operators may only be used if certain conditions are true of the world. The robot may not, for instance, push a box unless it is already next to it. Thus the operator:

gotol(m)

in which the robot moves to place 'm' has the pre-condition:

(∃x) [INROOM(ROBOT,x) ∧ LOCINROOM(m,x)]

which states that the robot and the proposed new place for it must both be in the same room. The delete list:

ATROBOT($), NEXTTO(ROBOT,$)

tells the system that wherever '$' the robot was, and whatever it was next to, it will no longer be there after the operator goto(m) is used. The add list:

ATROBOT(m)

is the new information the model requires; the robot will be at 'm'. The operator goto2(m) moves the robot next to the item 'm', which could be, for example, a box or doorpost. Gothrudoor(k,l,m) causes the robot to go through door 'k' from room 'l' into room 'm' and it has the preconditions:

NEXTTO(ROBOT,k) ∧ CONNECTS(k,l,m) ∧ INROOM(ROBOT,l)

The robot must be beside the door 'k'; 'k' must connect room 'l' to room 'm' and the robot must be in room 'l'. The delete list is:

ATROBOT($), NEXTTO(ROBOT,$), INROOM(ROBOT,$)

stating that the robot is neither where it was, next to what it was nor in the same room as before.

The add list simply states that the robot is in the new room:

INROOM(ROBOT,m)

A goal for the robot to achieve, a task or problem to be solved is also couched

(continued on next page)

Figure 4. Graphic representation of maze in figure 3.

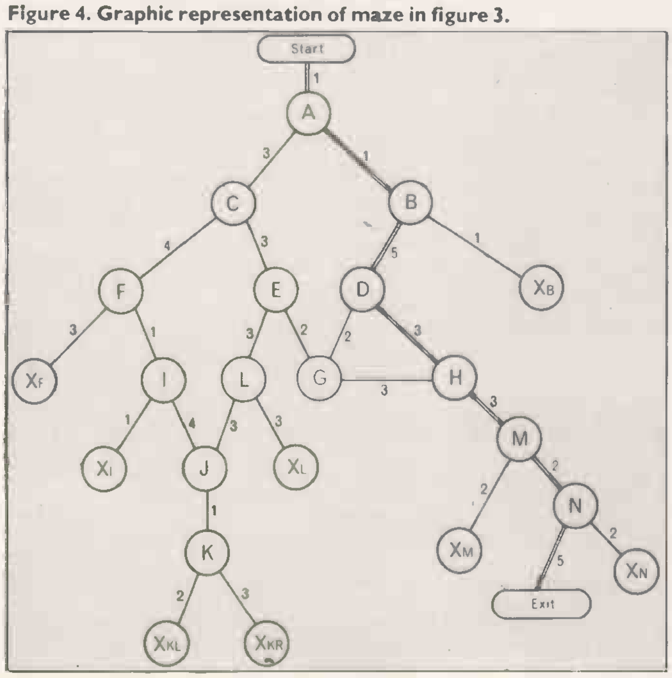
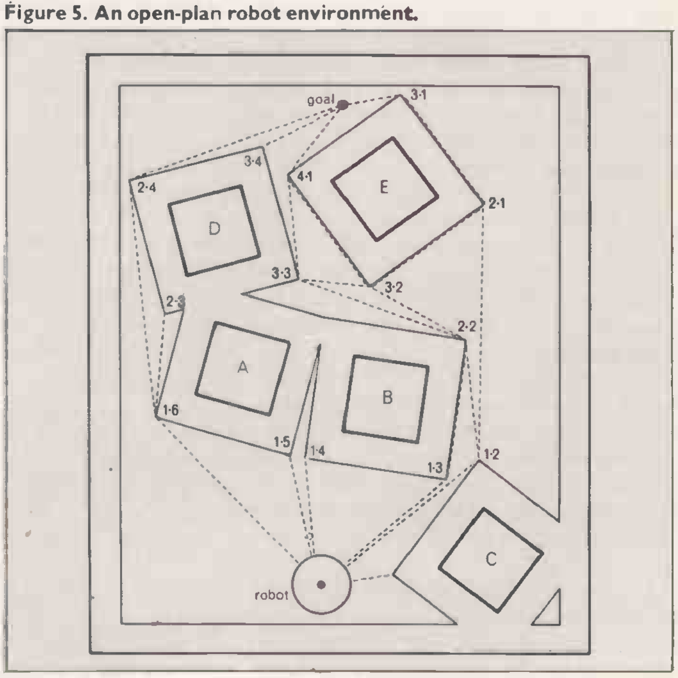


Figure 5. An open-plan robot environment.



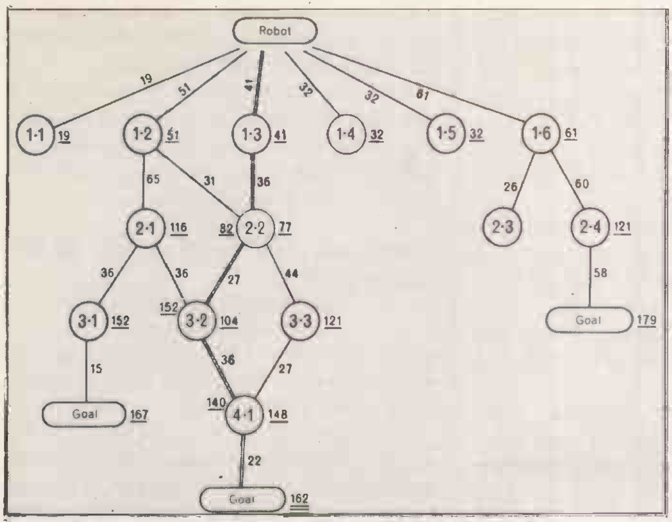


Figure 6. Graph of navigation problem posed in figure 5.

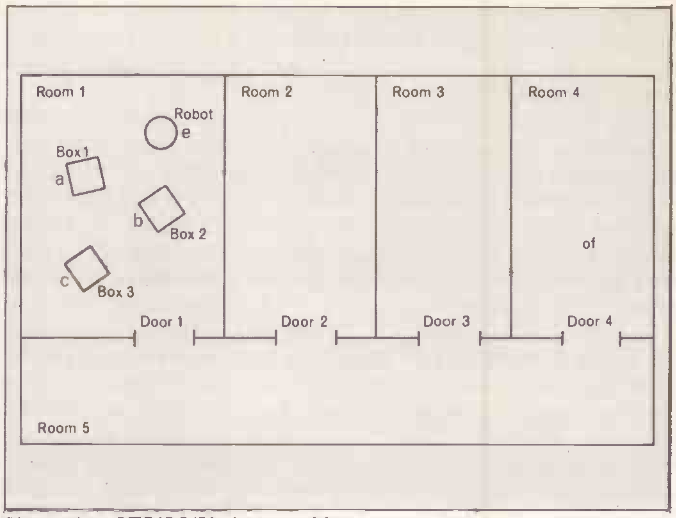


Figure 7. A STRIPS/Shakey world.

(continued from previous page)

in terms of a logic well-formed formula (wff):

NEXTTO(BOX1,BOX2)∧NEXTTO(BOX2, BOX3)

place box 1 next to box 2 and box 2 next to box 3. Group all three boxes together. The problem solver proceeds by trying to show that the goal wff follows logically from the axioms describing the world and actions by the process of resolution. Strictly speaking, it does exactly the opposite of that — Nilsson (1971) and Kowalski (1979).

Almost as a by-product of that proof the operator list is generated:

goto2(BOX2), pusto(BOX2,BOX1),
goto2(BOX2), pusto(BOX3,BOX2)

or the goal wff:

ATROBOT(f) gives:
goto2(DOOR1), gothrudoor (DOOR1, ROOM1, ROOM5),
goto2(DOOR4), gothrudoor (DOOR4, ROOM4,ROOM4),
goto1(f)

The system is clearly far more powerful than either of the previous 'planners'. Interesting environments can be described, many operators can be used to plan complex sequences of actions. Even though not English, the goals can be requested in a reasonably clear, and very unambiguous manner.

All is not wonderful, however, as a great deal of computation goes into generating a STRIPS plan. The wff format must be translated into its equivalent clause form, Nilsson (1971), updating the frame as a major task, as is the process of resolution itself.

A heuristic used to guide the problem search is that of goal difference. An operator is chosen which is likely to reduce the differences between the current state of the world and the required goal state. Fortunately, this information is provided almost directly in the form of each operator's add list.

In general, it takes considerably longer to generate even those short plans of actions than it takes for the robot to execute them. To overcome that to a certain extent, the designers added a facility to store portions of plans made to solve problems, so that they could be recalled and used *en bloc* — Fikes, Hart and Nilsson (1972a) — and also to generalise their stored plans so that they would be applicable as widely as possible.

Furthermore, they looked at the problems introduced by a second active unit in the environment, a second robot, which would change the world without updating the database axioms of the other — Fikes, Hart and Nilsson (1972b).

The lower levels of the Shakey system used a form of route planning similar to the one described earlier. Hardware checks, co-ordinate verification and error recovery, along with many other aspects are all integral in a project of this nature. Some idea of the scope of the Shakey project might be gained from Raphael (1976) or Raphael et al. (1971).

A number of other robot planning systems have been devised which do not involve robots, but simulate their actions on computer terminals. Among them are Doran's pleasure-seeking automaton, Doran (1968), Fahlman's BUILD system, Fahlman (1974), in which a simulated arm would build complex structures of blocks, requiring considerable planning ability.

It is interesting to note that in saving the effort of programming a robot arm, 80 percent of the programming effort in the system went on the simulation of the environment which included the effects of gravity and over-balancing. There was no attempt to model arm trajectories; blocks just disappeared and re-appeared where they were wanted.

References

Allan S and Allan S A (1979). Simple maze traversal algorithms. Byte 4-6, June 1979, pp. 36-46.

Ambler A P, Barrow H G, Brown C M, Burstall R M and Popplestone (1975). A versatile system for computer-controlled assembly. Artificial Intelligence 6-2, Summer 1975, pp. 129-156.

Barrow H G and Crawford G F (1972). The Mark 1.5 Edinburgh robot facility. Machine Intelligence 7 pp.465-480. Meltzer B and Michie D (eds.). Edinburgh University Press. ISBN 0-85224-234-4.

Berge G (1962). The theory of graphs. Great Britain: Methuen & Co.

Burstall R M, Collins J S and Popplestone R J (1971). Programming in POP-2. The Edinburgh University Press. ISBN 0-85224-197-6.

Doran J E (1968) Experiments with the pleasure-seeking automaton. Machine Intelligence 3 pp. 195-216. Michie D (ed.). The Edinburgh University Press. Congress 67-13648.

Fahlman S E (1974) A planning system for robot construction tasks. Artificial Intelligence 5-1, Spring 1974, pp. 1-49.

Fikes R E, Hart P E and Nilsson N J, (1972a), Learning and executing generalised robot plans. Artificial Intelligence 3-4, Winter 1972, pp. 251-288.

Fikes R E, Hart P E and Nilsson N J (1972b). Some new directions in robot problem solving. Machine Intelligence 7 pp. 405-430. Meltzer B. and Michie D. (eds.). Edinburgh University Press. ISBN 0-85224-234-4.

Fikes R E and Nilsson N J (1971). STRIPS: A new approach to the application of theorem proving to problem solving. Artificial Intelligence 2-3/4, Winter 1971, pp. 189-208.

Foster J M (1967). List processing. London/New York: Macdonald/Elsevier Computer Monographs. SBN 356-02225-0.

Gardner M (1979). The thinking computers language. Practical Computing 2-10, October 1979, pp. 82-84.

Kowalski R (1979). Logic for problem solving. New York: North Holland, Computer Science library, artificial intelligence series (Nilsson N J (ed.)). ISBN 0-444-00365-7.

Lozano-Pérez T and Wesley M A (1979). An algorithm for planning collision-free paths among polyhedral obstacles. Communications of the ACM 22-10 (October 1979) pp. 560-570.

Nilsson N J (1971). Problem solving methods for artificial intelligence. New York: McGraw-Hill Book Co., Computer science series. Congress: 74-136181.

Raphael B (1976). The thinking computer. San Francisco: W H Freeman & Co. ISBN 0-7167-0733-3.

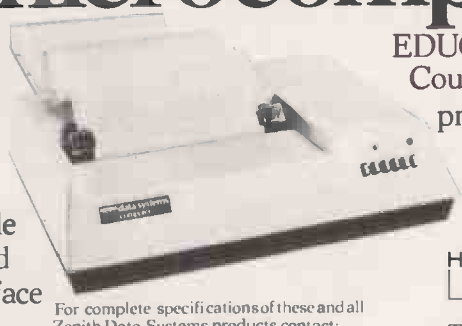
Raphael B, Chaitian L J, Duda R O, Fikes R E, Hart P E and Nilsson N J (1971). Research and applications — artificial intelligence. Semi-annual progress report 7/10/70 to 31/3/71 prepared for NASA, office of advanced research and technology research division.

Stanfield D E (1979). My computer runs mazes. Byte 4-6 (June 1979) pp. 86-99.

Van der Wateren F (1978). Lisp 1.5 programmers' manual. Software documentation.

Van der Wateren F — Lisp for the M6800 in: Dr Dobb's Journal of Computer Calisthenics and Orthodontia No. 28 pp. 24-25.

Winograd (1972). Understanding natural language. Edinburgh University Press ISBM 0-85224-227-1.



Servos are inexpensive and easy to build

The design of a simple, low-cost robot arm poses many problems. Principal among them is the choice of motive power devices. Nick Hampshire reports on electric motors and their use as computer-controlled servo mechanisms.

THE RANGE of motive unit types — i.e., muscle — is extensive, ranging from hydraulic rams to stepper motors. The majority of these devices are neither inexpensive nor simple in construction, system-design or use.

Of all the options, electric motors, either stepper or DC, are best suited to low-cost simple construction. We have looked at stepper motors in some detail in previous articles *Practical Computing*, April and May, 1979. In this article we shall not concern ourselves with them — our topic is DC motor servo mechanisms and how to interface them to a computer.

Motor control systems fall into one of two categories — open-loop and closed-loop control. Open-loop control is used in most stepper-motor systems; the controlling device counts the number of steps to determine the position of the rotor.

In an open-loop system, there is no feedback from a position-sensing device to the controlling device. Open-loop control is usually satisfactory with a stepper motor. However, if the motor misses a step because the torque is temporarily inadequate, the controlling device will not be aware that it has happened and cumulative errors will result.

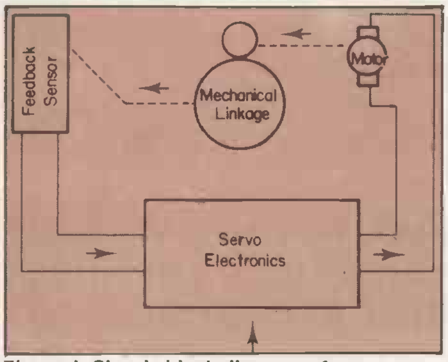


Figure 1. Simple block diagram of servo.

In a closed-loop control system a sensory device is attached to the motor's rotor. This sensory device is read by the controlling device every time there is an output to the motor, thereby checking that the position of the rotor is correct. By using feedback in a closed-loop control system, accurate positioning can be achieved without cumulative errors, even when using a device as difficult to control as a DC motor.

Sensory or feedback devices can take a wide variety of forms depending on the application and on whether the rotation of the rotor, either forwards or backwards — usually after being geared-down — is fixed or free.

The commonest form of servo motor — familiar to users of radio control models — is a servo mechanism with a fixed limit to its rotation, usually 180 degrees. The position-sensing device used for feedback in such devices is a potentiometer, see figure 1. The servo electronics usually uses a method known as digital proportional control.

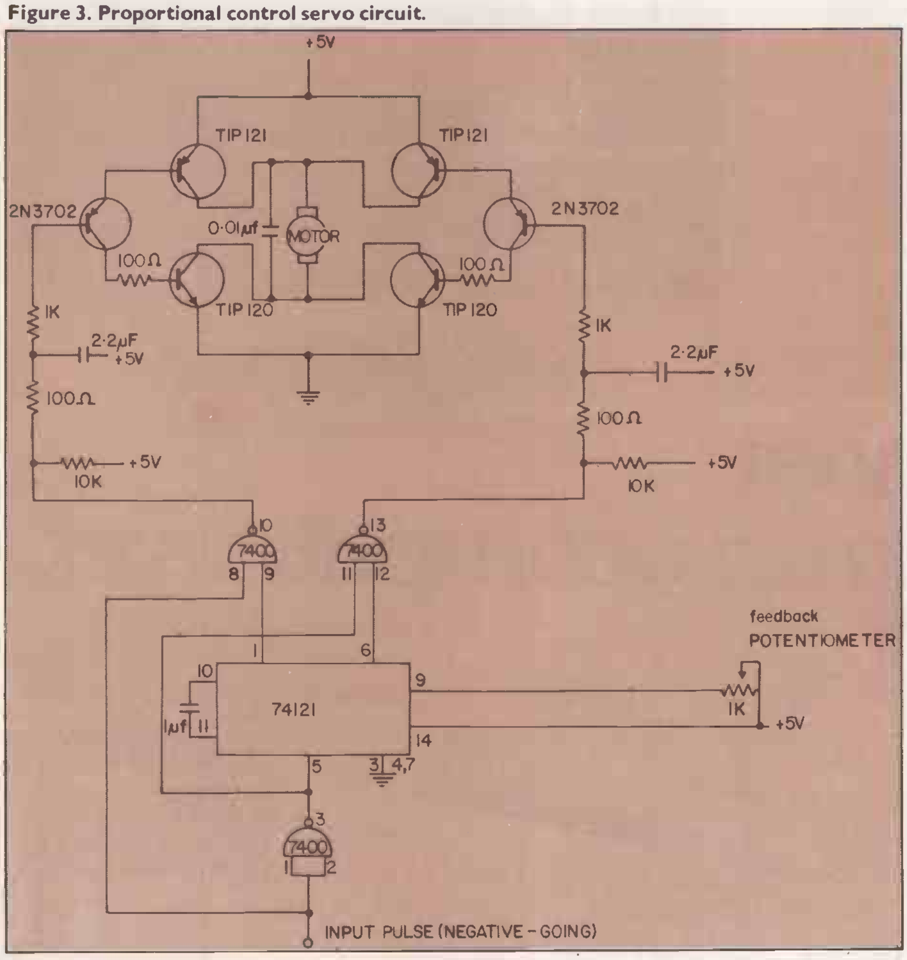
With that method, the input from the computer or controlling device is a digital pulse of carefully-controlled width, see figure 2. An internal pulse is generated by the control electronics. Its width depends on the position of the feedback potentiometer. The width of the internal pulse is compared to the width of the input pulse. If they match, no current goes to the motor. If they do not match, current is fed to the motor, which rotates the potentiometer in the appropriate direction via the gear chain.

Figure 2. Waveform of input.

As the position of the feedback potentiometer changes, so does the width of the internal pulse. Eventually, the internal and input pulse widths will match and current will cease to be fed to the motor. If the motor overshoots the correct position, the control electronics will sense it and reverse the polarity of the motor to bring it back to the correct position.

Similarly, if an external force is applied to the motor shaft, rotating it away from the desired position, the electronics will sense it and restore the rotor to its correct position. By feeding a sequence of such pulses into the servo electronics, the motor can be made to track the varying

Figure 3. Proportional control servo circuit.



pulse width. The model aircraft servo is an ideal low-cost, about £12, device for anyone wishing to experiment with computer control of servo mechanisms. Those devices are very small — less than 35 c.c. — and weigh about 50gm. Despite their size, they deliver a healthy torque as a result of gearing — about 40 oz. in. — though unfortunately this is not sufficient for use in robot arm.

They can be used in a wide range of applications from the control of valves to the construction of a simple plotter. Just three wires lead from the servo, two are for the motor power supply (200mA at 5V) and the third is the pulse input line. These servos typically expect pulse widths of between 1 and 3 milliseconds.

The pulse can be either positive- or negative-going depending on the make of servo. The pulses should be repeated every 15 to 20 milliseconds, though the frequency of repetition is not critical.

Waveforms

The servo will take about one second to move from one extreme to another and interfacing one to a computer is thus simply a matter of using a timing-loop within a program of programmable timers within an I/O chip to generate a waveform like that in figure 2.

The variable section of the pulse width is about one millisecond; with a processor clock at 1MHz, the maximum positional accuracy using a programmable timer — 16 bit — and a 180-degree maximum servo rotation is .18 degrees, i.e., 1/1000 of the arc of rotation.

That is only a theoretical accuracy, though, since it assumes true linearity of the feedback potentiometer which in practice probably has a five percent variability plus the assumption that there is no backlash in the gear chain.

Proportional control servo electronics are quite simple. An example is shown in figure 3. The circuit consists of three parts, the servo amplifier, the servo drive and the servo unit. The servo amplifier consists of a 74121 monostable to generate the internal pulse and a pulse-length comparator circuit.

The monostable is triggered by the leading edge of the input pulse. The width of the monostable output pulse is proportional to the resistance of the feedback potentiometer which is the resistance component of the RC timing circuit of the monostable. The comparator circuit consists of three Nand gates.

Two outputs

The circuit has two outputs; one drives the motor forwards via the servo drive circuit, the other drives it backwards. The choice depends on whether the input pulse is shorter than the internal pulse or longer.

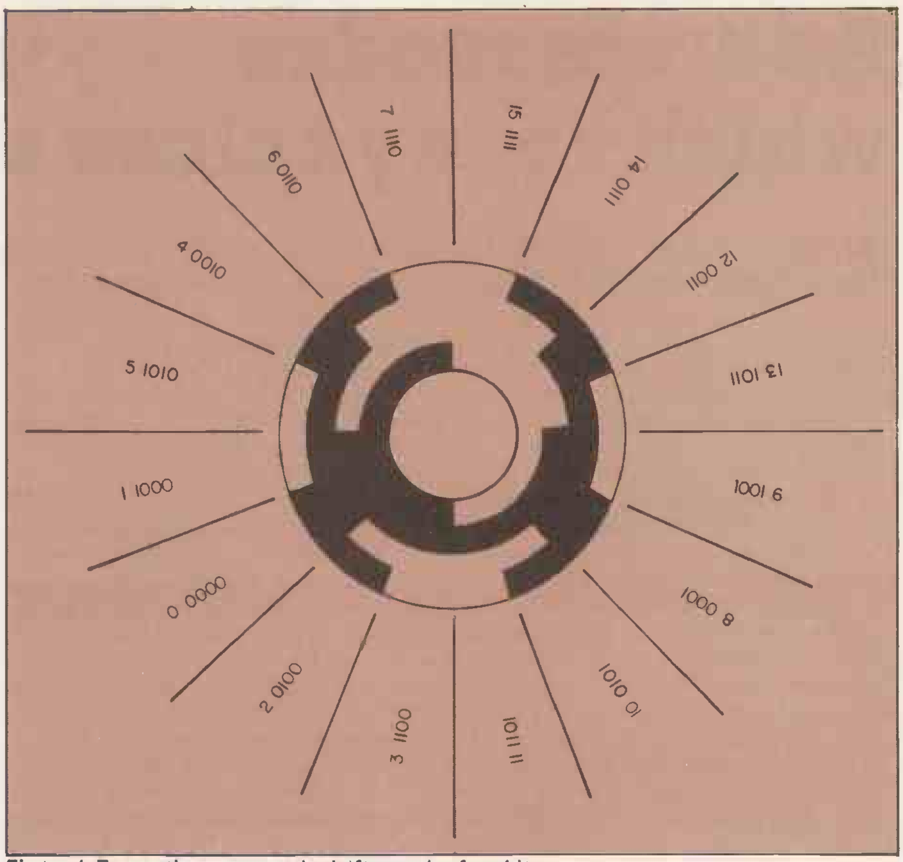
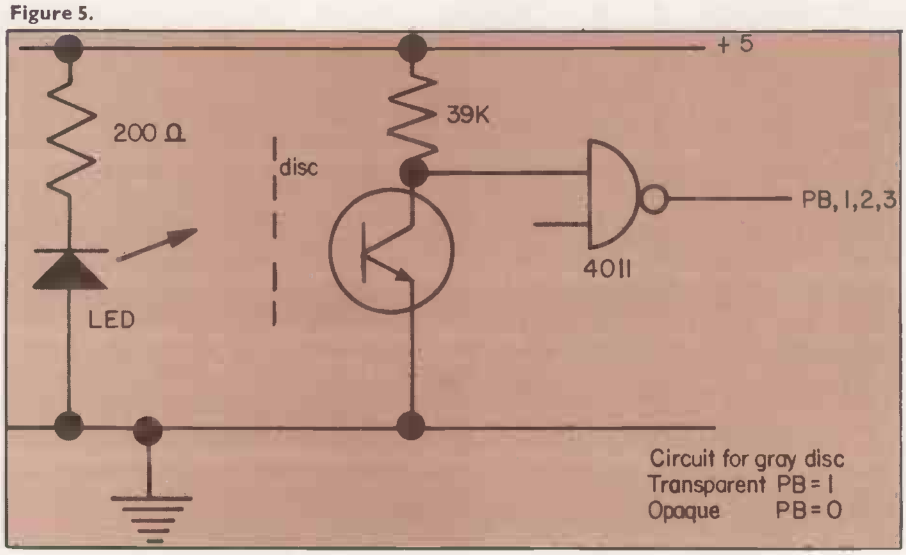


Figure 4. Excess three-gray code shaft encoder four-bit.

Figure 5.



The servo drive is a fairly standard bridge circuit for directional control of DC motors. The power transistors will drive the average small motor and have a power rating of several amps. The servo unit consists simply of the motor, the feedback potentiometer and the mechanical linkage between them.

Servo mechanisms need not be confined to the use of motors or limited to rotations of 180 degrees. Depending on the gearing, the output of a rotary servo motor could be tens or even hundreds of turns between the two extremes of motion. A rack and pinion mechanism will convert the rotary motion of an electric motor into linear motion, with a linear potentiometer as the feedback device.

The only feedback device considered so far in this article is the potentiometer. In applications requiring high precision, such devices are not accurate enough. One of the commonest replacements for a potentiometer feedback is optical encoding. It involves attaching an optical encoding disc to the motor driveshaft, either before or after gearing. Figure 4 shows such a disc.

The encoding disc is read by an array of photodiodes to detect the transmission of light through the disc from an LED on the other side. As the disc rotates, the coded output from each of the photodiodes changes and can be read by the computer controlling the motor.

This system is more accurate and a further advantage over the potentiometer is that it permits free rotation.

Address modes — vital topic which repays close study

Generally, the more ways that a computer can address data, the more flexible it is. This month, David Peckett describes different types of addressing and looks at what the 6502 and 8080A offer.

AN IMPORTANT aspect of any computer program is that instructions can exist in various forms, depending on how data is to be accessed and where it is to go. You will recall that a microcomputer instruction can be one, two or three bytes long. The first byte is always an opcode, defining what the micro is to do. There may also be a 1- or 2-byte operand, defining what or where the computer is to do it to.

Many instructions such as the one to load the accumulator, can exist in several forms, depending on their addressing mode. For example, in the 6502 we have already met:

LDA #data and LDA address

The first, an immediate load, has two bytes, with the second being the data to be loaded. The second version uses two bytes to define the address, and is thus a 3-byte operation. The two forms of the instruction have opcodes $A9_{16}$ and AD_{16} respectively to define the two operations.

Implied addressing is the simplest form. It is used where the instruction defines all we need to know about the data, what is to be done to it and where it's going to be done. With micros, it is inevitably a single-byte instruction, and examples are:

6502: CLC; DEX; TAY
8080A: INX rp; DAA; MOV r_1,r_2

Immediate addressing. An instruction using immediate addressing provides the data it will manipulate as an operand. Any 6502 assembly language instruction using immediate addressing contains a "#", while the 8080A uses special mnemonics. Examples are:

6502: LDA #data; ADC #data; SBC #data
8080A: MVI r,data; SUI data; LXI H,data

The data field can be either data or a label defined as a given value. The instructions can be two or three bytes long, depending on how much data is involved. For instance, "LDA data" needs two bytes, as it loads a single byte into the accumulator. On the other hand, since "LXI H,data" loads 16 bits into (H,L), it is three bytes long.

Direct addressing. In direct addressing, the operand field of the instruction contains the address where the data is to go or is to be found. Since both these micros use 16-bit addressing, the instruction always has three bytes. Examples are:

6502: LDA ADDRS1; STA $ABCD; ADC $1000
8080A: LDA $ABCD; STA ADDRS1; LHLD $1000

The address field can be either the address itself, or a label representing the address. The important point is that the address is defined explicitly.

A sub-form of direct addressing is called page-O addressing. In this mode, the high byte of the address is always set to zero, and the instruction provides only the low byte. It, thus, accesses the 256 memory locations from 0000_{16} to $00FF_{16}$. The advantage is that only one byte is needed to form the address, giving 2-byte instructions which take up less space and run faster. It is best to try to use this form whenever you can. The 8080A does not have page-0 addressing, but the 6502 can apply it to almost any instruction which has a direct addressing form, e.g.,

STA $20; ADC $15

If the numerical address field is FF_{16} or less, the assembler will use page-0 addressing automatically. Labels can be defined as being on page-0.

Indexed addressing. It often happens that we have a long list of items, in continuous memory, which we must process identically. The obvious way is to use a loop, but how do we arrive at each item in turn? One solution is indexed addressing.

In this form, the instruction provides a base address (BA), which is modified by adding the contents of an index register (IR). The operation is then performed on the address defined by the sum of the base address and the index register (BA + IR).

If you are told someone lives in the third house after the one with the green door, that is indexed addressing. I hope it is clear how indexed addressing is used to go through a list of items.

A fixed base address is used in a loop; on each pass through the loop, the index register is either decremented or incremented. Either way, each item is handled in turn.

Our two micros have different

Table 1. 6502 addressing options

Mnem.	Implied	Direct	Page-0	Immed	Index,X	Index,Y	Indir,X	Indir,Y	P-O,I'x,X	P-O,I'x,Y	Indir	R'tive
ADC		*	*	*	*	*	*	*	*			
AND		*	*	*	*	*	*	*	*			
BCC												*
BCS												*
BEQ												*
BMI												*
BNE												*
BPL												*
BVC												*
BVS												*
CLC	*											
CLD	*											
CLI	*											
CLV	*											
CMP		*	*	*	*	*	*	*	*			
CPX		*	*	*								
CPY		*	*	*								
DEC		*	*		*				*			
DEX	*											
DEY	*											
INC		*	*		*				*			
INX	*											
INY	*											
JMP		*									*	
LDA		*	*	*	*	*	*	*	*			
LDX		*	*	*		*				*		
LDY		*	*	*	*				*			
NOP	*											
SBC		*	*	*	*	*	*	*	*			
SEC	*											
SED	*											
SEI	*											
STA		*	*		*	*	*	*	*			
STX		*	*							*		
STY		*	*						*			
TAX	*											
TAY	*											
TXA	*											
TYA	*											

approaches to indexed addressing. The 6502 uses the pure technique I have described, modifying a base address by the contents of either X or Y. The data in the index register is treated as an unsigned binary number. Typical indexed instructions are:

LDA ADDRS3,X; STA $1000,Y;
ADC $FF10,X

The 8080A does not have the full indexing capability of the 6502. As we have seen, the register pairs (RPs) (B,C) and (D,E) can be used as indices to load and store the accumulator. Furthermore, the RP (H,L) gives access to the memory location "M", which can be used in any appropriate instruction. Examples are:

MOV A,M; ADD M; STAX B

However, the 8080A does not have special instructions to calculate (BA + IR) swiftly like the 6502. In most cases, that is not important, since indexing is used normally to step along a list from one end. It can, nevertheless, lead to complicated programming.

Indirect addressing. Absolute addressing forms such as direct addressing and variations such as indexed addressing are fine if the data is always placed in rigorously-defined areas of memory. It is not necessarily possible, however, as in many cases, the memory allocations must vary throughout a program, being defined by what the program has done.

Thus the program must calculate where the data is, and then pass that address to another program segment. It does this by indirect addressing, which uses reserved memory locations to show the position of other data.

The basic instruction has the form:

Opcode	Address

Table 2. 6502 assembly language formats. The table uses a hypothetical mnemonic, since no real operation uses all the possible modes.

Addressing Mode	Format	Remarks
Implied	OPN	No operand field
Direct	OPN addr	16-bit address
Page-0	OPN addr	8-bit address
Immediate	OPN #data	
Indexed	OPN addr,X/Y	16-bit address, X or Y possible
Page-0, Indexed	OPN addr,X/Y	8-bit address, X or Y possible
Indexed Indirect	OPN (addr,X)	8-bit address
Indirect Indexed	OPN (addr),Y	8-bit address
Indirect	JMP (addr)	JMP only, 16-bit address
Relative	OPN displace't	Branches only

Table 3. This month's instructions.

Operation	6502 Mnem.	6502 Flags	6502 Effect	8080A Mnem.	8080A Flags	8080A Effect
16-bit addition of RP to (H,L)	—			DAD rp	C	H,L = H,L + RP
Compare to Accum	CMP o	N,Z,C	Set flags for: (A-d/(a))	CMP r	All	Set flags for: (A-r)
Compare to X	CPX o	N,Z,C	Set flags for: (X-d/(a))	—		
Compare to Y	CPY o	N,Z,C	Set flags for: (Y-d/(a))	—		
Compare Immed to Accum	—			CPI d	All	Set flags for: (A-d)

Notes:
"a" = Address — defined by the program
"d" = Data — defined by the program
"o" = Operand — can be an address or data
"r" = Any 8080A register, including M
"rp" = Any 8080A register pair
"d/(a)" = Data, or the contents of the address defined by "a".

The data stored at the address is used, however, to form another address, which defines the data to be manipulated. In other words, an indirectly-addressed instruction defines an address where a pointer to the data can be found. Since addresses need two bytes, the address in the operand contains the low byte of the pointer and the next byte gives the pointer's high byte.

Figure 1 shows the process diagrammatically for an ideal micro — not the 6502 or 8080A. Initially, the instruction is "Load A (Ind) abcd". Address "abcd" contains "rs", and "abcd + 1" contains "pq". The indirect address gives a pointer to "pqrs". Location "pqrs" contains 10_{16} which is the data loaded into A.

In principle, in-directions can be nested, but that can become complicated. In-direction is like saying: "If you ask at the house with the green door, they'll tell you where I live".

I used an idealised example because neither of the two micros provides true indirect addressing. The 6502 uses a very limited form, while the 8080A needs several lines of code to obtain the full effect. That is the price you pay to squeeze a CPU on to a single piece of silicon.

Relative addressing. We met relative addressing last month, in the shape of the 6502 branch instructions. We can see that it is a variation of indexed addressing, with the displacement field being used to modify the base address represented by the PC. The 6502 uses this mode for conditional branches only, while the 8080A does not have relative addressing at all.

Further addressing modes. We have now covered the common addressing modes which micros, or for that matter any computers, use. If we want, however, to do something far more complicated, we can have compound modes such as indirect indexed or indexed indirect. The 6502, in fact, gives such facilities, but the 8080A doesn't really try.

The 6502 has a remarkably wide range of addressing modes for a microprocessor. In the descriptions of the difference basic modes, I outlined some of its options. The micro also provides a number of sub-modes which we have not yet examined.

What, precisely, are the 6502 addressing modes? Obviously, some instructions use implied addressing which normally excludes them from any other mode — there are exceptions, but we have not encountered them yet. Also, many instructions have an immediate form; this mode has no variations. Relative addressing is used only for the branches, and the branches use only relative addressing. Again, there is no need to go further. Direct addressing is perfectly straightforward.

The indexed and indirect modes, however, are rather complex, and we'll look at these in more detail.

6502 indexed addressing. Remember, a

(continued on page 101)

ACT THE ADVANCED DISK UNIT

It turns your Pet into a business system

Supports a wealth of Business Systems

Sales Ledger/Purchase Ledger
Powerful packages integrated to Nominal Ledger and Analysis.

Nominal Ledger
Up to 2,500 active postings a month; on-screen enquiries; month-end trial balance.

Analysis Package
Sales performance by territory; calculation of commissions; analysis of purchases.

Stock Control
Parameter driven; on-line enquiries; comprehensive range of reports.

Invoicing
Parameter driven; invoices tailored to user requirements; automatic typing.

Pagemate™ Database
Sophisticated report generating package; for work in progress, direct mail etc.

Wordcraft™ Simply the ultimate word processor for the PET.

+ A FULL RANGE OF PETSOFT PROGRAMS.
ALL AVAILABLE FROM ACT's PET BUSINESS COLLECTION.

Advanced Disk Hardware

1 Ultra fast-loads and auto verifies a 32K program in 5 seconds from a cold start.
2 Up to 800 Kbytes on-line— dual density double sided.
3 Powerful Disk Operating System— 9 additional commands and 7 extra disk instructions to the PET's own Basic.
4 Compatible with 16K and 32K new ROM PETS.
5 Random and sequential file access and support.
6 Comprehensive manual and utility disk.
7 Languages—Microsoft Basic, 6502 Assembler, Forth, Fifth, Pilot and Cesil.

400 Kbyte Disk Unit £895.

800 Kbyte Disk Unit £1,145.

PET is the trademark of Commodore. Prices exclude VAT and are correct at time of going to press.

ACT MICROSYSTEMS

ACT (COMPUTERS) LTD.
Radclyffe House, 66-68 Hagley Road, Edgbaston, Birmingham B16 8PF.
Tel: 021-455-8686. Telex: 339396.

ACT TOTAL COMPUTING

ACT (COMPUTERS) LTD. Radclyffe House, 66-68 Hagley Road, Edgbaston, Birmingham B16 8PF. Tel: 021-455-8686. Telex: 339396.

Please rush me details of: ☐ The advanced ACT disk unit. ☐ The Petsoft catalogue. ☐ The PET business system collection.

Name:
Company:
Address:
Tel. No:

A

• Circle No. 193

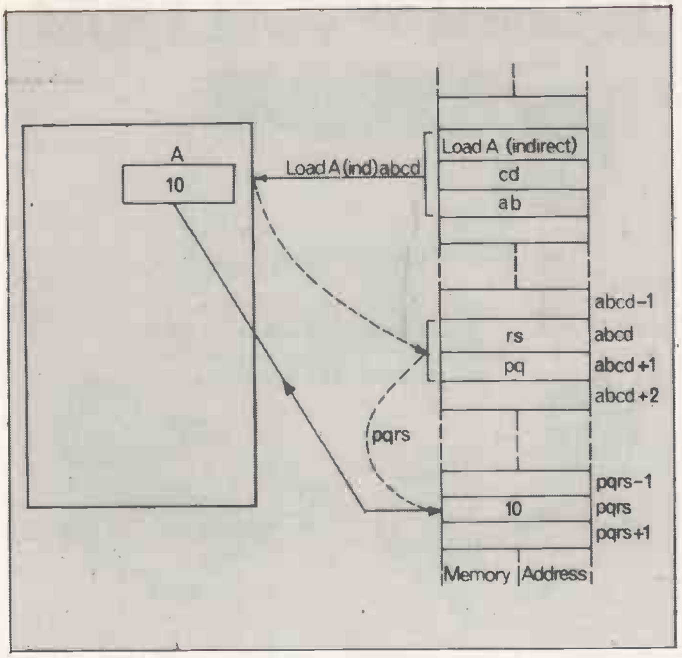


Figure 1.

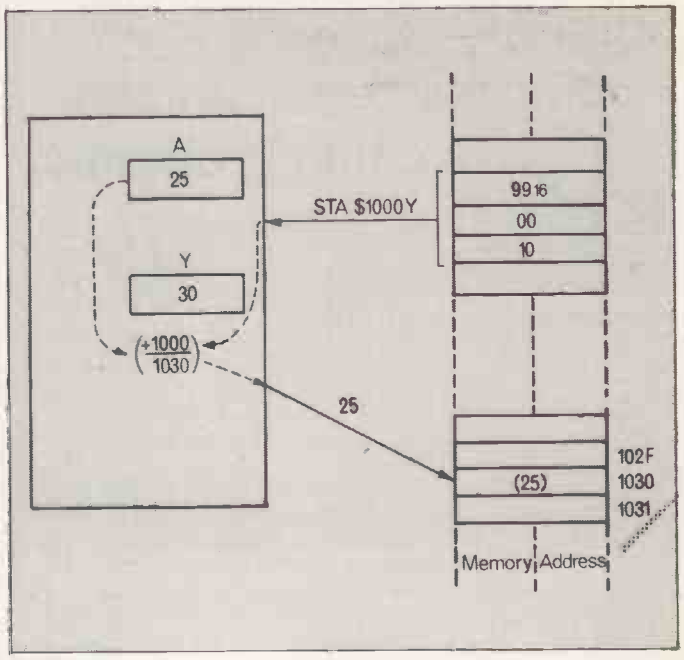


Figure 2.

(continued from page 99)

micro using indexed addressing goes to the address defined by the sum of the operand and the index register. The 6502 has two forms of indexed addressing — absolute and page-0. To make things more complicated, it doesn't use the two index registers, X and Y, in the same way.

Normally, if indexed addressing is possible, you can always use the "Absolute,X" mode. Also, if you can use "Absolute,X", you can also use "Page-0,X". However, some instructions, such as "STY", allow only the "Page-0,X" form.

The opportunities for using Y are more limited. About half the instructions which allow "Absolute,X" also allow "Absolute,Y". However, only two instructions have a "Page-0,Y" mode — these are "STX" and "LDX".

As an example of indexed addressing, look at figure 2. Suppose that X contains 30_{16}, "STA \$1000,X" will store the contents of the accumulator at address 1030_{16}.

Remember that the lack of a page-0 mode does not stop you indexing from this page. It only means that you must use two bytes to define the base address, rather than the single byte of a page-0 instruction. An assembler will take care of all that for you, anyway.

Generally you must be careful to use a valid form of indexed addressing. Your assembler will tell you if you make a mistake, but it is less frustrating to be right first time. Either way, since X and Y are only eight bits long, we can only index through a list of 256 items or less.

6502 indirect addressing. The 6502 has only one instruction using the pure indirect form which I described — that is "JMP". It is possible to write a program which computes a jump address dynamically, which it then uses via an indirect "JMP".

I do not recommend that you use it. A "computed GOTO", which it amounts to, is totally alien to any concept of maintainable software. It makes it almost impossible to find program bugs, and any future modifications to the software are a challenge, to say the least.

The normal indirect modes of the 6502 are indexed indirect and indirect indexed. They use the X and Y registers respectively as indices, and can be combined only with page-0 addresses.

Indexed indirect. In this mode, the contents of X are added to the operand to form a new page-0 address. The contents of this address are then used as a pointer to the target address. Figure 3 shows the technique.

In the example, the instruction is "LDA (\$1A,X)", and the index register contains 10_{16}. Initially, the micro loads the base address and adds X to obtain the address of the pointer — $2A_{16}$. This address contains "rs" and the next byte ($2B_{16}$) contains "pq". These are taken together to make the target address "pqrs", and the data in it is loaded into A.

The technique sounds long-winded but it is a useful way of handling a list of pointers. The pointer number can be defined by X, and found by indexing from a base address. As an analogy: "Go to the third house after the one with the green door, and they'll tell you where I live".

Beware, this mode only works on page-0, and any carry from the addition of the base and X is ignored. Thus, "LDA (\$AB,X)", when X contains 71_{16}, moves the pointer from $001C_{16}$, and not $011C_{16}$. It is easy to corrupt data if you misuse this mode.

Indirect indexed. It is, roughly, the opposite of indexed indirect. Again, it uses addresses on page-0, but Y is used for the indexing. The address defined by the instruction gives a pointer. The value of this pointer is then indexed.

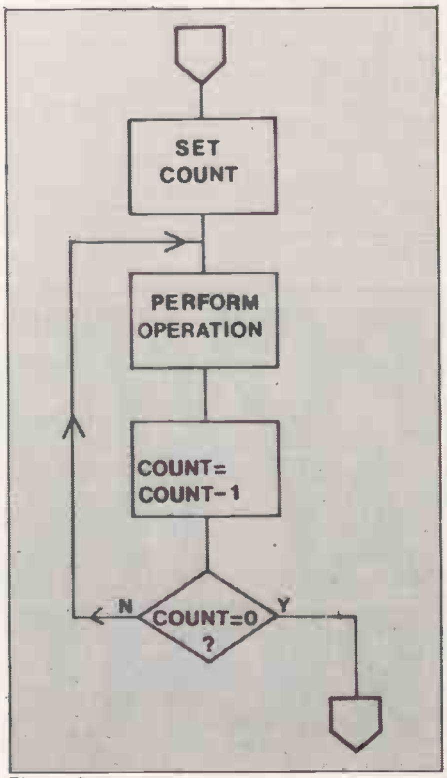


Figure 5a.

The process is shown in figure 4. The instruction is "LDA (\$10), Y"; the micro goes to addresses 0010 to 0011, and extracts a pointer to address 1234_{16}. It is then indexed by Y, which contains 10_{16}, and the data at 1244_{16} is loaded.

"Go to the house with the green door — they'll tell you the street in which I live. My house is the third one along".

Like the indexed indirect mode, the base address can only be on page-0. Of the 2 compound forms, indirect indexed is probably the more useful. It allows the base address of a variable-length list of data to be placed in a fixed location; the micro can then index its way along the list.

(continued on page 103)

LEICESTER

computer centre limited

present

2 exciting programs

tridee An exciting new addition to your Pascal library – enables you to create 3D graphics, viewable from any angle and distance. As easy to use as Turtlegraphics. Procedures include Ortho, Perspec, Rotate, View, Move to-3, View-from.

Complete with comprehensive instructions £49.95 + VAT

Animations and Simulations for Education

Ready made programs bring life to your demonstrations using the HGR facility of the Apple computer to illustrate points covered in lectures in elementary algebra and statistics.

Program includes:

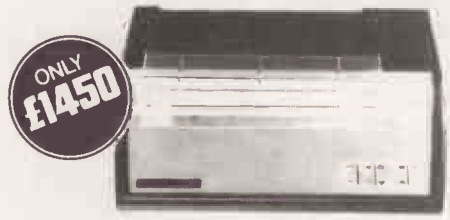
CAPILLARY FLOW – Poseuilles equation with animation.
EXPONENTIAL PLOTTER – Plots curves of exponential growth and decay, colour coded.
RADIOACTIVE DECAY – Simulates radioactive decay, shows how half life is always constant.
THE GENERATION GAME! – Simulates growth in real time of a bacterial population, with histogram.
DERIVATIVES – Shows how delta y/delta x can be approximated as closely as desired to d y/d x.
QUADRATURE – Trapezoidal and Simpsons rule, with graphics.
NON-LINEAR PLOTS – Shows how non-linear relations (e.g. y = x , y = exp(x),) may be linearised.
CORRELATION – Shows the linear regression and values for various sets of data.
RESIDUALS – Animation to show that as a line is moved in space, the 'least-squares' fit does minimise the SSR.
ROUNDING ERROR – Histograms to show distribution of rounding error for n (specified) value.
NORMAL ERROR – As above, for gaussian distribution.
FOURIER ANALYSIS – Computes the fourier coefficients (both sine & cosine series) for an input data set, prints them and then:
1) permits a reconstruction of the original function to be computed and displayed in graphics using *any* defined number of coefficients
2) displays a histogram of the magnitude of the coefficients.
LISSAJOU'S FIGURES – Simulates the movement of a swinging pendulum attached to the bob of another pendulum, swinging in planes at right angles to one another. Amplitudes and frequencies may be chosen and the resulting patterns are traced across the screen.

Complete with instructions £29.95 + VAT

LEICESTER COMPUTER CENTRE LIMITED
109 QUEENS ROAD, LEICESTER LE2 1TT. Tel 0533 708483

• Circle No. 194

A CHAMPION TRIO



Model 810 Receive-Only Printer
Reliable 150 cps printer for your mini or micro system. Multi copy capability. 9 x 7 print head.

LA 34 DEC writer IV Teleprinter
30 cps, full 128 ASCII character set. 9 x 7 print head. For desk-top use.

Teletype Model 43
30 cps. 132 character line. Exceptionally reliable. Accepts 11" x 8½" paper size.

Quote code PCM11

Stag Terminals Limited
30 Church Road Teddington
Middlesex TW11 8PB
Tel. 01-943 0777
01-977 7749/8363

Stag

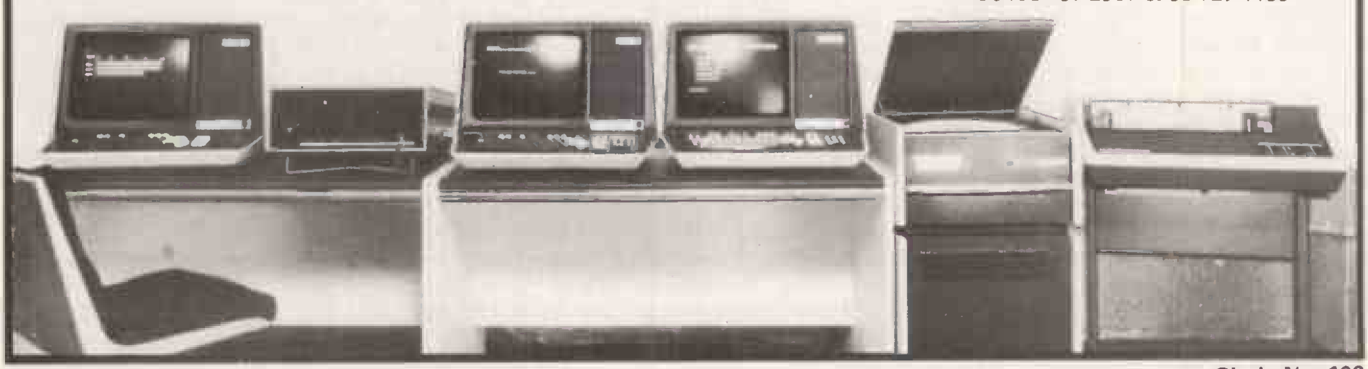
• Circle No. 195

POWERFUL MICROS AT THE RIGHT PRICE

- Multi-User ● Multi-Tasking
- Multi-Language ● Hard Disc Storage ● Word Processing
- Priced from under £5000

Languages supported include – Basic, Cobol, Fortran.
OEM, Educational and Dealer enquiries invited

EQUINOX
COMPUTER SYSTEMS LIMITED
Kleeman House, 16 Anning Street
New Inn Yard, London EC2A 3HB
Tel: 01-739 2387 & 01-729 4460



• Circle No. 196

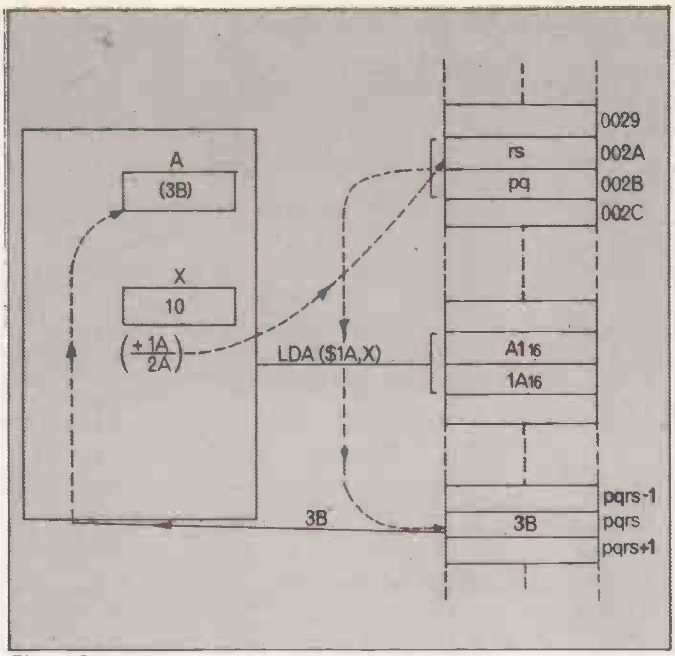


Figure 3.

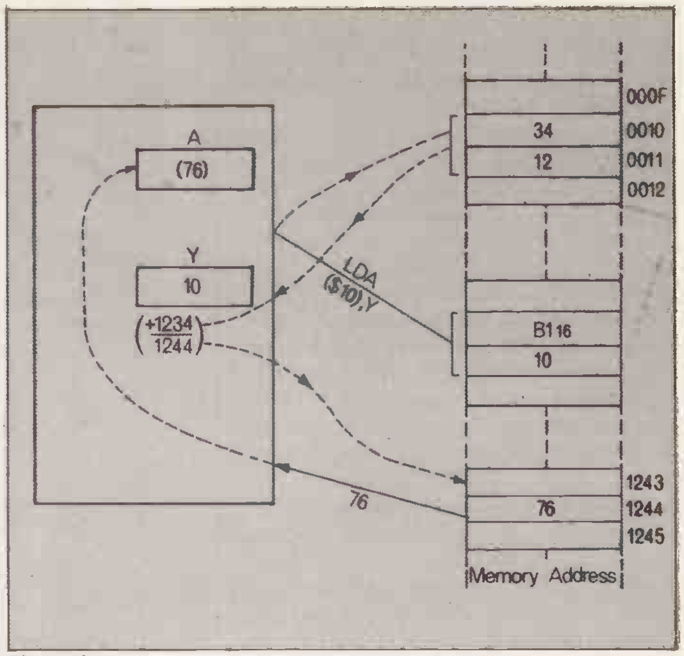


Figure 4.

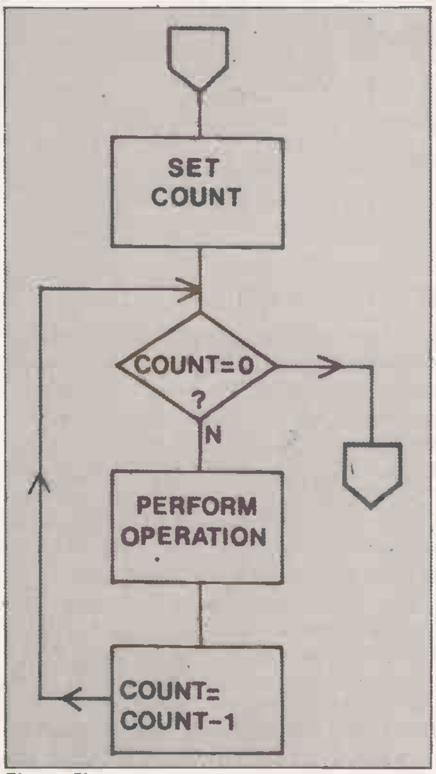


Figure 5b.

(continued from page 101)

The mode is thus very useful for passing lists of data from one program segment to another. Obviously, we can index directly only along a list of 256 or less items. If the list is longer, and it may very well be. We must increment the high byte of the pointer, thus adding 256 to it, every 256 iterations.

6502 addressing options. Table 1 lists all the 6502 instructions we have met so far, and shows which addressing modes each of them can use.

The 8080A has fewer addressing modes than the 6502. It is limited to direct and immediate modes, plus the indexed/implied hybrids provided by the three RPs.

Another major difference between the two micros is in the construction of their assembly-language mnemonics. The 6502 uses a basic mnemonic, e.g., LDA, and uses the operand field to define the precise mode. The 8080A, on the other hand, uses different mnemonics for each mode. For example, "MVI A,data", "LDA address" and "MOV A,M" are, respectively, the immediate, direct and indexed accumulator load instructions.

Although the 8080A instructions allow only those three basic addressing modes, it is, however, possible to combine instructions to obtain the effect of more. Indirect addressing is reasonably easy. If the pointer is stored in locations "IND" and IND + 1", "LHLD IND" will put it into (H,L). We thus generate an indirect pointer to M. For instance, to load A direct from "IND":

```
LHLD IND ;H,L CONTAINS POINTER
MOV A,M ;INDIRECT LOAD
```

Obviously, this needs two instructions.

For true indexed loading, we need to use a second RP, e.g., (D,E), as the index. We also need the instruction "DAD rp". That instruction performs a 16-bit addition of the data in the given RP and (H,L), and puts the result into (H,L). We can then use a program segment like:

```
LXI   H,BASE ;SET BASE ADDRESS
DAD   D      ;CALCULATE OFFSET
MOV   A,M    ;INDEXED LOAD
```

It's also possible to generate the compound modes which the 6502 uses. We can achieve an indirectly-indexed, i.e., indexing after indirection, instruction easily. For instance, the equivalent to "LDA (IND),Y", where Y contains 10_{16}, is:

```
LHLD  IND    ;LOAD BASE POINTER
LXI   D,$10  ;SET UP INDEX
DAD   D      ;(H,L) CONTAINS
              (IND + 10)
MOV   A,M    ;INDIRECT INDEXED
              LOAD
```

Alternatively, for an indexed indirect, i.e., where the address of the pointer is indexed, instruction, equivalent to "LDA (BASE,X)" when X contains $2A_{16}$:

```
LXI   H,BASE ;SET UP BASE POINTER
LXI   D,$2A  ;SET UP INDEX
DAD   D      ;INDEX POINTER
              ADDRESS
MOV   D,M    ;D HOLDS POINTER LSBS
INX   H      ;POINT TO POINTER
              MSBS
MOV   H,M    ;H HOLDS MSBS
MOV   L,D    ;(H,L) NOW HOLDS
              POINTER
MOV   A,M    ;INDEXED INDIRECT
              LOAD
```

It is clumsy, but it gives the desired effect.

Normally, however, we increment the index one step at a time from zero, and we do not need those complex constructions. In fact, what we are trying to do is to make the 8080A emulate a 6502. There are much better ways of achieving the proper effect with an 8080A, using all its registers. Occasionally, we might want to translate 6502 code into 8080A code, but it's best to understand first what the program is trying to do.

So, a single 6502 instruction can be in any one of up to eight different modes, all using the same basic mnemonic. Each mode, however, generates a different opcode — if it didn't, the micro would not know what to do. Yet how does the assembler produce the opcodes? The problem doesn't arise with an 8080A, because each mnemonic has only one meaning, but with the 6502 it is not so clear.

In fact, the assembler looks at the whole instruction, and not just the mnemonic. The operand field has a format for each mode which the assembler recognises and generates the appropriate opcode. We have already seen some of the formats, but, for reference, the full range of conventions is shown in table 2. Be warned — these are the normal 6502 conventions, and the ones I shall be

(continued on next page)

(continued from previous page)

using in this series, but I do not guarantee that your assembler will use them. Please check first.

We have covered a good deal of new material, so I don't intend to introduce many new instructions. I've described the 8080A "DAD rp" and there is no other instruction which will be useful at this stage.

Last month, we had to compare two numbers to find the larger — we subtracted one from the other to solve the problem. Since it is a very common requirement for a program to have to compare two numbers, both our micros provide special instructions to simplify the task.

The instructions are shown in table 3, and are effectively identical for the two machines. The micro subtracts the indicated data from the contents of the accumulator — or X or Y in the 6502 — and sets the flags accordingly. The result of the subtraction is not stored, however, and no registers are altered.

There are six possible relationships between the two numbers; if we are testing A against data of value "p", they are:

$A<p$; $A\leq p$; $A = p$; $A\geq p$; $A>p$; $A \neq p$

By suitable tests of the Carry and Zero flags, we can make conditional jumps based on any of these six relationships. For example, we could have:

	6502		8080A	
A<p	BCC	LESS	JC	LESS
A = p	BEQ	EQUAL	JZ	EQUAL
A>p	BEQ	NOTGT	JZ	NOTGT
	BCS	MORE	JNC	MORE
NOTGT...............			NOTGT..........	

Notice the different treatment of the carries because of the two ways in which the micros show a borrow. In the last example, we have to separate the equal case, because a simple no borrow would mean equal or greater.

The comparison instructions are particularly useful on two occasions: If we have to iterate through a loop until something happens, and don't know how long it will take; if a loop can occur for a pre-determined number of times which may include zero. The loop flowchart we used last month, figure 5a, gives one pass through the loop even if "COUNT" is initially zero. By re-arranging the test, we can avoid this happening, figure 5b. The second flowchart gives a completely universal loop; however, the first type will run slightly faster.

We shall now look at two short programs which employ some of the facilities I've outlined. The first inputs an undefined number of bytes until it reads a terminator. The second transfers a block of data from one area of memory to another.

Input routine. Very often, a program must read in a string of data and store it in a defined area. We do not know how long the string will be, but its last character is pre-defined, e.g., a "*". Further, the bytes may arrive asynchronously, and the program has to monitor a status bit which shows when data is ready. This bit is the MSB of a status word, "STATUS".

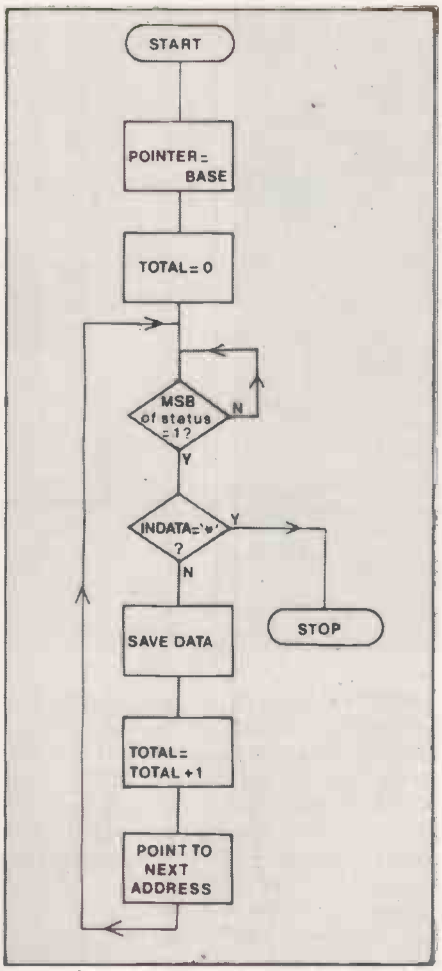


Figure 6.

Figure 6 is the flowchart for such a routine. It uses indirect addressing to point to where each byte is to go. The program also keeps track of how many bytes are received — there may be more than 255. The final "*" is not saved. The 6502 and 8080A programs are given in figures 7a and 7b respectively.

6502 program. First of all, the program sets the storage pointer at address "POINT", and clears the two bytes needed for "TOTAL". In the main loop, we monitor "STATUS", looping round-and-round until the MSB equals "1". The input data is read, and the routine uses a "CMP" to test it.

We save the input byte, using indirect addressing. The program has to use indexed indirect, but, with X set to zero, it is equivalent to pure Indirect.

The pointer and total are then incremented, remembering to test for a carry from the low to the high byte, and the program goes back to wait for another byte.

8080A program. The 8080A program is similar, but shows the value of being able to manipulate 16 bits directly. It uses (D,E) and (H,L) to contain the pointer and total respectively. (B,C) is set to the address of the data input port to speed reading input data.

```
;6502 INPUT ROUTINE
;
;SET UP POINTER AND COUNTER
       LDA  #BASELO     ;LSBS OF BASE
       STA  POINT
       LDA  #BASEHI     ;MSBS OF BASE
       STA  POINT+1
       LDA  #0
       STA  TOTAL       ;LSBS OF TOTAL
       STA  TOTAL+1     ;MSBS OF TOTAL
       TAX              ;SET X TO 0
;MONITOR INPUT STATUS
INPUT  LDA  STATUS
       BPL  INPUT       ;MSB=1?
;MSB SET - READ BYTE
       LDA  INDATA
       CMP  #'*         ;* IS END OF SEQUENCE CODE
       BEQ  END         ;FINISHED?
;VALID DATA WAS INPUT - SAVE IT
       STA  (POINT,X)   ;INDIRECT SAVE
       INC  TOTAL       ;TOTAL=TOTAL+1
       BNC  NOCRRY      ;INCREMENT "TOTAL" MSBS?
       INC  TOTAL+1     ;YES
NOCRRY INC  POINT       ;POINT TO NEXT STORAGE ADDRESS
       BNC  INPUT       ;INCREMENT "POINT" MSBS?
       INC  POINT+1     ;YES
       JMP  INPUT       ;GO BACK FOR NEXT BYTE
;
END    NOP              ;FINISH INPUT
```

6502 input routine.

```
;8080A INPUT ROUTINE
;
;SET UP POINTER AND COUNTER
       LXI  H,BASE      ;(H,L) WILL BE POINTER
       LXI  D,0         ;(D,E) WILL SAVE TOTAL
       LXI  B,DATA      ;THIS WILL SPEED UP THE PROGRAM
;MONITOR INPUT STATUS
INPUT  LDA  STATUS      ;READ STATUS WORD
       CPI  0           ;THIS SETS THE FLAGS
       JP   INPUT       ;MSB=1?
;MSB SET - READ BYTE
       LDAX B           ;INPUT DATA
       CPI  '*          ;END OF SEQUENCE CODE
       JZ   END         ;FINISHED?
;VALID DATA READY - SAVE IT
       MOV  M,A         ;INDEXED SAVE
       INX  H           ;INCREMENT POINTER
       INX  D           ;INCREMENT COUNTER
       JMP  INPUT       ;BACK FOR NEXT WORD
;
;SAVE TOTAL
END    NOP              ;END OF INPUT
       MOV  H,D         ;COPY (D,E) IN (H,L)
       MOV  L,E         ;(THERE IS A BETTER WAY)
       SHLD TOTAL       ;SAVE TOTAL
;
;END OF SEGMENT
```

8080A input routine.

Since an 8080A "LDA" does not affect the flags, we must set them deliberately before we can test the MSB of "STATUS". "CPI O" is one way of doing this. Apart from the easier way of incrementing 16 bits, the main loop is almost identical to that of the 6502.

Finally, we save the total, having first moved it from (D,E) to (H,L). It would be advantageous if the 8080A allowed 16-bit direct movement between (B,C) and (D,E), and memory.

Block transfer routine. This is another common requirement. The number of bytes to be transferred can be anything from one to a little less than half of the available memory, and the total must therefore be defined by two bytes.

Because the 8080A makes it so much easier to handle 16-bit numbers than does the 6502, it is not really practical to have a common flowchart. Sometimes, flowcharts must reflect the target computer — more strictly, the target language.

The 6502 flowchart is figure 8a, and the 8080A is figure 8b. In both cases, the lowest address of the byte to be transferred is "FROM", and its destination starts at "TO". The number of bytes is given by "TOTAL"

6502 program. In the 6502 program, figure 9a, there are two data transfer

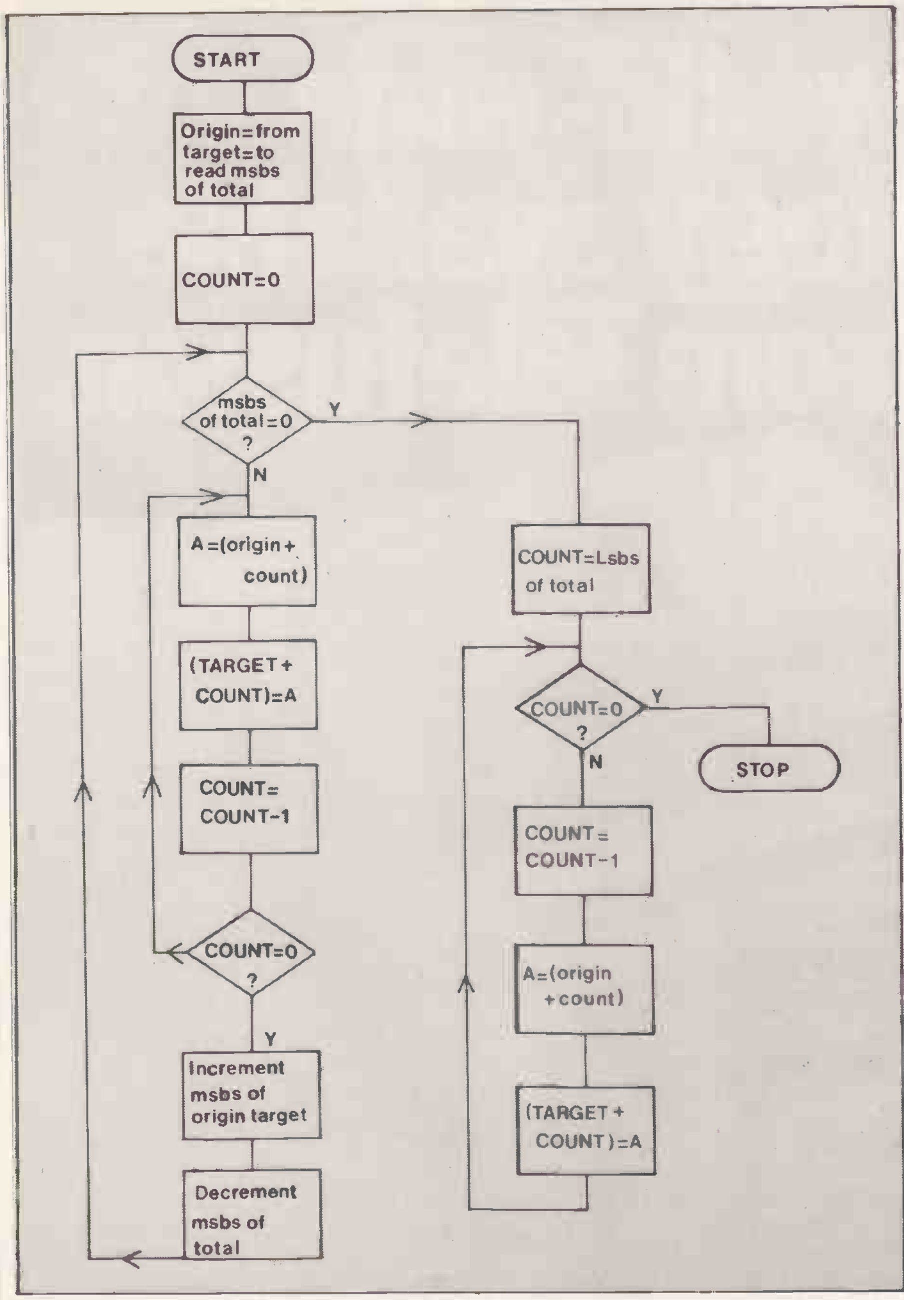


Figure 8a.

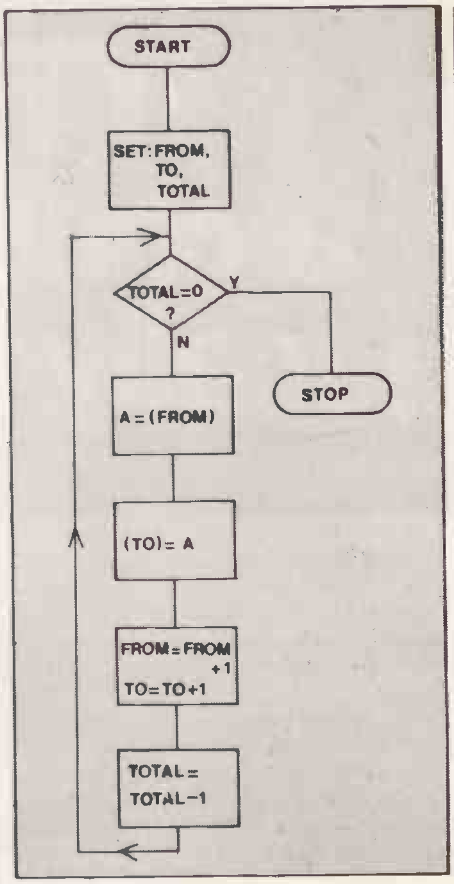


Figure 8b.

blocks. The first moves the number of 256-word blocks defined by the high byte of "TOTAL" which may be zero. At the end of each block, the high bytes of "FROM" and "TO" are incremented.

Note that we use indirect indexing to transfer each block without modifying the pointers within the loop. You may find the way of counting 256 iterations interesting — it is done by decrementing Y from O all the way back to O.

If you calculate, you'll find that this gives 256 passes through the loop before the test of Y finally sees zero. X is used to count the number of blocks.

Finally, the number of bytes defined by the low byte of "TOTAL" is moved. This time, we have to decrement Y before each data transfer. If we did not, there would be a one-byte gap between the last 256-byte block and the low-byte block. This technique lengthens the loop, as it demands a "TYA" to set the flags for every test we are undertaking.

8080A program. This program, figure 9b, is much simpler than that of 6502. (B,C) and (D,E) are used as 16-bit indices for the data transfer, and (H,L) contains the count. The only complication arises because we must test H and L separately, since "DCX H" does not affect any flags.

By checking L before H, we have to test H only once every 256 bytes. Obviously, this speeds the program.

I have not deliberately manipulated things so that the 8080A appears in a rosy light. The two programs show the massive advantages of being able to handle 16 bits of data at once, rather than being forced to work one byte at a time.

Here are a few problems: How do we multiply a binary number by four without making any additions? How do we multiply by 10, with only one addition? How could we combine H and L to test (H,L) for zero with a single instruction?

```
;6502 BLOCK TRANSFER ROUTINE
;
;SET UP POINTERS
        LDA  #FROMLO
        STA  ORIGIN
        LDA  #FROMHI
        STA  ORIGIN+1     ;"ORIGIN" HOLDS "FROM"
        LDA  #TOLOW
        STA  TARGET
        LDA  #TOHIGH
        STA  TARGET+1     ;"TARGET" HOLDS "TO"
        LDY  #0           ;USED AS POINTER
;SET UP NUMBER OF 256-BYTE WHOLE BLOCKS
        LDX  TOTLHI
        BEQ  REST         ;WHOLE BLOCKS ZERO?
;NO.  MOVE A 256-WORD BLOCK
NEXT1   LDA  (ORIGIN),Y ;USES INDIRECT INDEXED
        STA  (TARGET),Y ;ADDRESSING FOR TRANSFER
        DEY
        BNE  NEXT1        ;ANOTHER WORD?
;END OF BLOCK.  POINT TO NEXT
        INC  ORIGIN+1     ;INCREMENT THE MSBS
        INC  TARGET+1     ;OF BOTH POINTERS
;IS THERE ANOTHER WHOLE BLOCK?
        DEX               ;IF X=0,
        BNE  NEXT1        ;NO MORE BLOCKS
;MOVE THE REMAINING PART BLOCK
REST    LDY  TOTALO
        BEQ  END          ;ANY BYTES IN PART BLOCK?
;YES - CONTINUE
        DEY               ;SEE TEXT
NEXT2   LDA  (ORIGIN),Y ;INDIRECT INDEXED
        STA  (TARGET),Y ;ADDRESSING AGAIN
        TYA               ;SET FLAGS FOR Y
        BNE  NEXT2        ;ANOTHER WORD?
;
END     NOP               ;END OF ROUTINE
```

6502 block transfer routine.

8080A block transfer routine.j

```
;8080A BLOCK TRANSFER ROUTINE
;
;SET UP POINTERS
        LXI  B,FROM
        LXI  D,TO
        LXI  H,TOTAL
;CHECK FOR TOTAL = Ø
TEST    MVI  A,Ø            ;SET UP FOR TEST
        CMP  L              ;LSBS=Ø?
        JNZ  NOTØ
        CMP  H              ;MSBS=Ø?
        JZ   END
;(H,L) IS GREATER THAN ZERO
NOTØ    LDAX B              ;INDEXED MOVE
        STAX D              ;OF BYTE.
        INX  B              ;INCREMENT
        INX  D              ;POINTERS.
        DCX  H              ;DECREMENT COUNTER.
        JMP  TEST           ;SEE IF (H,L)=Ø
;
END     NOP                 ;END OF BLOCK TRANSFER
```

ITT world-wide technology available locally from Telefusion.

The famous ITT 2020 Micro Computer is now available nationwide from Telefusion. Ideal for most small and medium-sized businesses, it's one of the most versatile and cost-efficient computers you can buy. And now it's easily available from Telefusion and their agents.

The ITT 2020 can be teamed up with matching Floppy Disk Drive Unit and Serial Printer. In other words, it can be made into a complete data processing system.

Why not contact us or one of our dealers listed below for a complete demonstration. Alternatively, an 'on-site' demonstration can be arranged through our central Micro Computer Sales Office. Call Alan Webb, Bristol (0272) 211446.

ITT 2020 Micro Computer is a complete self-contained, ready-to-use computer. Standard features include: *PALSOFT and monitor in ROM. *Colour graphics. *Sockets for up to 48k bytes RAM. *Cassette interface. *Typewriter-style ASCII keyboard. *High-efficiency switching power supply and rugged structural foam case.

The ITT 2020 Micro Computer video display circuiting section displays memory as text, colour graphics or high resolution graphics – software selectable. Both graphics modes can be selected to include four lines of text at the bottom of the display area. In either graphics mode the user can select (under software control) one of two memory pages to be displayed.

See it for yourself, you'll be impressed.

Telefusion

Authorised Dealers: Demacan Ltd., 2 West Priory Close, Westbury on Trym, Bristol. Tel: 621920. Aries Business Machines, 21 Manor Walk, Thornbury, Bristol. Tel: 416189. Farmplan, Netherton Farm, Ross-on-Wye, Herefordshire. Tel: 4321. Ensign, 13-19 Milford Street, Swindon. Tel: 42615. Radan Computational Ltd., 19 Belmont, Bath. Tel: 318483. Data Lease Consultants, The Manor Court House, 9 Fore Street, Chard, Somerset. Tel: 5539. Guestel Ltd., Refuge House, 2-4 Henry Street, Bath. Tel: 65379. Brindiwell, 13 Brockridge Lane, Frampton Cotterell, Bristol. Tel: Winterbourne 774564. Data Link Micro Computer Systems, 10 Waring House, Redcliff Hill, Bristol. Tel: 213427. Dolphin Computer Sales Ltd., 17 Market Place, Tetbury, Glos. Tel: 53195. Data Wright Computer Services, 10 The Drive, Gosforth, Newcastle-upon-Tyne. Tel: 20946. Micro Business Centre, Castlebridge House, Lichfield Road, Wolverhampton. Tel: 732375/6/7. **Or contact the Commercial Sales Manager at Telefusion:** Dudley Street, Sedgley, West Midlands. Tel: 75961. Atlas Chambers, King Street, Leeds. Tel: 450453. 63 London Road, Norwich. Tel: 28441. 45 Church Road, Hove, Sussex. Tel: 723114. 61 Queens Square, Bristol. Tel: 211446. 35 Hoghton Street, Southport. Tel: 31030.

• Circle No. 197

Attack refuted

ROY WALDOCK, a programmer at Portsmouth Polytechnic, writes to complain about the attack on Apple users. The reason we have not contributed to your magazine, he writes, is that we don't have time to put pen to paper. I have torn myself away for a few minutes to offer Apple users a simple, but useful, program.

The program uses RWTS routine found in the new release of the operating system DOS 3.2. U.S. usage is well documented and so I will not explain its uses apart from saying it allows the user to read-from or write-to any track and sector on the disc.

Track 17 sector "O" contains a volume table of contents (VTOC). Within the sector there is a track-bit map which shows the status of all sectors on the disc. By loading this sector, it is possible to count the number of free sectors and, thus, the amount of free disc space.

When run, the program I have enclosed will give this information. The free-disc-space routine is written in assembler and is also included.

```
LIST
5    REM FREE SECTOR PROGRAM
10   GOSUB 1000: REM POKE FREE
     SECTOR ROUTINE
20   CALL 768
30   FS = 256 * PEEK (808) + PEEK (809)
40   V = PEEK (824)
50   TEXT:CALL — 936
60   UTAB 5: PRINT "DISK VOLUME ";V;"
     HAS ";FS;" FREE SECTORS"
70   PRINT : PRINT "THIS IS
     EQUIVALENT TO ";FS * 256/1024;"
     KILO-BYTES"
75   P = 100 — INT ((FS/455) * 100 + 0.5)
80   PRINT : PRINT "AND IS ";P;"%";"
     FULL"
90   END
1000 POKE 768,169: POKE 769,3: POKE
     770,160: POKE 771,42: POKE 772,32:
     POKE 773,217: POKE 774,3:
1010 POKE 775,169: POKE 776,0: POKE
     777,141: POKE 778,40: POKE 779,3:
     POKE 780,141: POKE 781,41:
1020 POKE 782,3: POKE 783,162: POKE
     784,187: POKE 785,189: POKE 786,68:
     POKE 787,32: POKE 788,160
1030 POKE 789,8: POKE 790,74: POKE
     791,144: POKE 792,8: POKE 793,238:
     POKE 794,41: POKE 795,3:
1040 POKE 796,208: POKE 797,3: POKE
     798,238: POKE 799,40: POKE 800,3:
     POKE 801,136: POKE 802,208:
1050 POKE 803,242: POKE 804,202: POKE
     805,208: POKE 806,234: POKE 807,96:
     POKE 808,0: POKE 809,0:
1060 POKE 810,1: POKE 811,96: POKE
     812,1: POKE 813,0: POKE 814,17:
     POKE 815,0: POKE 816,59:
1070 POKE 817,3: POKE 818,0: POKE
     819,32: POKE 820,0: POKE 821,0:
     POKE 822,1: POKE 823,0
1080 POKE 824,0: POKE 825,96: POKE
     826,1: POKE 827,0: POKE 828,1: POKE
     829,239: POKE 830,216
1090 RETURN
0010:       FREE DISC SPACE ROUTINE
0020:
0030:
0040: 0300                      ORG
      $0300
0050: 0300             RWTS     *
      $03D9
0060: 0300  A9  03              LDAIM
      $03         POINT TO IOB
```

This section is open to the Apple user. In every issue we hope to print ideas, hints and comments about the Apple and its suppliers. They must come from you, so write and tell us what you know.

```
0070: 0302  A0  2A      LDYIM   $2A
0080: 0304  20  D9  03          JSR
      RWTS      READ VTOC
0090: 0307  A9  00              LDAIM
      $00
0100: 0309  8D  28  03          STA
      HIGH
0110: 030C  8D  29  03          STA
      LOW
0120: 030F  A2  BB              LDXIM
      $BB
0130: 0311  BD  44  20  LOOP    LDAAX
      $2044
0140: 0314  A0  08      LDYIM   $08
0150: 0316  4A          AGAIN   LSRA
0160: 0317  90  08              BCC
      NOTFRE    INCREMENT COUNTER
                EVERY
                TIME WE GET A1 SINCE
                THIS INDICATES A
                FREE SECTOR
0170: 0319  EE  29  03          INC
      LOW
0180: 031C  D0  03      BNE     NOTFRE
0190: 031E  EE  28  03          INC
      HIGH
0200: 0321  88          NOTFRE  DAY
0210: 0322  D0  F2              BNE
      AGAIN
0220: 0324  CA                  DEX
0230: 0325  D0  EA              BNE
      LOOP
0240: 0327  60          RTS
0250: 0328  00          HIGH    =
      $00
0260: 0329  00          LOW     =
      $00
0270:
0280:
0290:       INPUT/OUTPUT BLOCK I.O.B.
0300:
0310:
0320: 032A  01          IOBST   =
      $01       TYPE INDICATOR
0330: 032B  60                  =
      $60       SLOT NUMBER *16
0340: 032C  01                  =
      $01       DRIVE NUMBER
0350: 032D  00                  =
      $00       EXPECTED VOLUME
                NUMBER
0360: 032E  11                  =
      $11       TRACK NO. OF VTOC
0370: 032F  00                  =
      $00       SECTOR NO. OF VTOC
0380: 0330  3B                  =
      $3B       LOW ORDER BYTE OF
                DCT
0390: 0331  03                  =
      $03       HIGH ORDER BYTE OF
                DCT
0440: 0332  00                  =
      $00       LOW ORDER BYTE OF
                BUFFER
0410: 0333  20                  =
      $20       HIGH ORDER BYTE OF
                BUFFER
0420: 0334  00                  =
      $00       UNUSED
0430: 0335  00                  =
      $00       UNUSED
0440: 0336  01                  =
      $01       COMMAND CODE 01 =
                READ
0450: 0337  00                  =
      $00       ERROR CODE
0460: 0338  00                  =
      $00       ACTUAL VOLUME
                NUMBER
0470: 0339  60                  =
      $60       PREVIOUS SLOT
                ACCESSED
0480: 033A  01                  =
      $01       PREVIOUS DRIVE
                ACCESSED
0490:
0500: DEVICE CHARACTERISTIC TABLE
      DCT
0510:
0520: 033B  00                  =
      $00       DEVICE TYPE
0530: 033C  01                  =
      $01       NUMBER OF PHASES
                PER TRACK
0540: 033D  EF                  =
      $EF       TIME COUNT
0550: 033E  D8                  =
      $D8       TIME COUNT
```

Refined method

TRY THIS on your Apple II; says Frank Atkinson of Gateshead, Tyne and Wear.

```
20 A = .99
30 B = .98
40 C = A-B
50 PRINT " C is "; C
```

When you RUN, you may be amazed to see 9.99999978E — 03. What has happened is that the simple statement was changed to binary, calculated and then re-translated from binary, with this horrible result.

'E', of course, is a mathematician's shorthand for ×10 to the power of, but that does not help — especially if you are planning to transfer a short number on to a text file of specified record length.

A crude method for a similar problem was included in my Make day number, published in *Practical Computing*, March, 1980. There, I divided seven and instead of subsequently multiplying by seven, I multiplied by eight. More recently, I found it preferable to add .01 and multiply by seven.

To return to the example, you can add, say, .0001, multiply by 100 and finally divide the result by 100. Better still, turn this into a function. So add these lines:

```
10 DEF FNA(A) = INT((A + .0001)*
   100)/100
60 PRINT " C IS NWO "; FNA(C)
```

and try RUNning it again.

Finally, you might be surprised by the result of applying this function to the following number. Enter.

```
70 D = — 2.98023224 E — 08
80 PRINT "D IS"; FNA(D)
```

Varied Pursuit

MY VERSION of Pursuit; Pursuit II, offers

(continued on next page)

(continued from previous page)

a degree of portability, amendability and variety, writes A Kowalski from Langley Mill, Nottinghamshire. The program has been kept simple and should be understood easily when the meaning of the variable names has been explained.

Note, the robbers' movement is independent and partly random. The attempt to escape is an illusion caused by the police pursuing. Because of that independance, the robbers' position may be controlled by keys or paddle controls — analogue inputs — or any other means available.

Speed relates closely to plotting definition and should be adjusted accordingly but is best kept below about 10. Even with the police speed lower than that of the robbers, a catch can often be made.

If the police speed is faster, they may overshoot and have to back-track. Interesting patterns can be formed by replacing line "90" with "90 HPLOT XC,YC TO XR,YR".

```
10  HOME:CX=3:SL=250
20  PI=3.14159:P2=PI/2
25  Z=0:XL=270:YL=159
30  VTAB 21
40  INPUT "ENTER COPS & ROBBERS SPEEDS ";SC,SR
50  HGR:HCOLOR=7:SX=Z
60  XC=7:YC=77
80  XR=197:YR=83
90  HPLOT XC,YC:HPLOT XR,YR
100 IF(ABS(XR-XC)+ABS(YR-YC))<CX GOTO 510
110 IF SX>SL GOTO 270
120 VR=VR+RND(SX)-0.5
130 XR=XR+COS(VR)*SR
140 IF(XR<Z OR XR>XL)THEN VR=VR+P2:GOTO 130
150 YR=YR+SIN(VR)*SR
160 IF(YR<Z OR YR>YL)THEN VR=VR+P2:GOTO 150
170 VC=ATN((YR-YC)/(XR-XC))
180 IF XC>XR THEN VC=VC+PI
190 XC=XC+COS(VC)*SC
200 IF XC<Z THEN XC=Z
210 IF XC>XL THEN XC=XL
220 YC=YC+SIN(VC)*SC
230 IF YC<Z THEN YC=Z
240 IF YC>YL THEN YC=YL
250 SX=SX+1
260 GOTO 90
270 RS$ =" ESCAPES"
275 HOME:VTAB 22:PRINT"THE VILLAIN ";RS$
280 PRINT"AT X=";INT(XR);" Y=";INT(YR);" STEPS=";SX
290 SX=Z
300 GOTO 30
310 RS$=" IS CAUGHT"
320 GOTO 275

      VARIABLES
COORDINATES-
XL. X LIMIT     YL. Y LIMIT
 MAY BE PRESET FOR ANY DESIRED WINDOW.
XC. X FOR COPS          YC. Y FOR COPS
XR. X FOR ROBBERS       YR. Y FOR ROBBERS
VECTORS-
VC. ANGLE IN RADIANS FOR COPS
VR. ANGLE IN RADIANS FOR ROBBERS
OTHERS-
CX, CATCH PROXIMITY preset to 3,may be raised or
    lowered for easier or harder catch,respectively
    Relates exactly to plotting definition.
SX, STEPS TAKEN COUNTER
SL, STEP LIMIT FOR VILLAIN TO ESCAPE
    Reducing or increasing gives shorter or
    longer game respectively.
RS$, RESULT OF CHASE
        OBJECTIVE OF GAME
To achieve the longest chase without letting the
 villain escape.
```

Fiendish plot

A PLOTTING program for Apple users from Q North, of Brighton, Sussex, plots a 3-D perspective view of a function, with hidden line removal. The function is typed in at line 1000, and always begins F= . . . The function shown is a good demonstration, but better ones can be found easily.

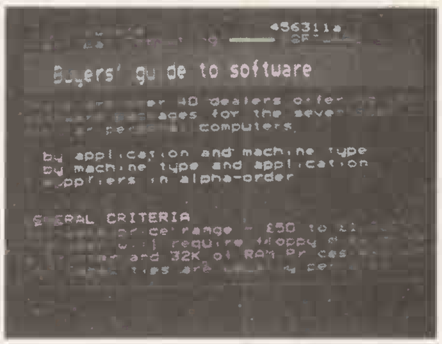
```
10 X0 =  - 1:X1 = 0:Y0 = 0:Y1 = 1

20 F0 =  - 1:F1 = 1
100  HGR : POKE  - 16302,0
110  FOR I = 0 TO 100 STEP 5:K =
     I
120  FOR J = 0 TO 160: GOSUB 500:
      NEXT
125  IF I = 100 THEN 150
130  FOR K = I + 1 TO I + 4: FOR
     J = 0 TO 160 STEP 8
140  GOSUB 500: NEXT : NEXT : NEXT

150 K = 0:J = 0: HCOLOR= 7: GOSUB
     505
160  HPLOT 10,91 TO 110,191 TO 27
     0,191
170 K = 100: GOSUB 505:J = 160: GOSUB
     505
180  STOP
500  HCOLOR= 0
505 Y = Y0 + (Y1 - Y0) * K / 100:
     X = X0 + (X1 - X0) * J / 160

510  GOSUB 1000:F = (F - F0) / (F
     1 - F0) * 89
513  IF F < 0 THEN F = 0
516  IF F > 89 THEN F = 89
520  HPLOT 10 + K + J,91 + K TO 1
     0 + K + J,91 + K - F: HCOLOR=
     7: HPLOT 10 + K + J,91 + K -
     F
530  RETURN
1000 F =  SIN (J * K / 200) / (K +
     .1): RETURN
```

Information exchange

WITH THE Apple computer now linked to Prestel by the Appletel system, it seems the logical step to start taking advantage of the exceptional facilities offered by Prestel for exchanging information between Apple users. *Practical Computing* has provided space on its Prestel pages for an Appletel users' club.

Even if you do not have an Appletel system or an Apple, the club pages will be of interest as they are aimed at all microcomputer users with access to Prestel, writes Mike Gardner, of Owl Computers, who developed Appletel and will edit the Appletel users' club pages.

The kind of item we want to include are

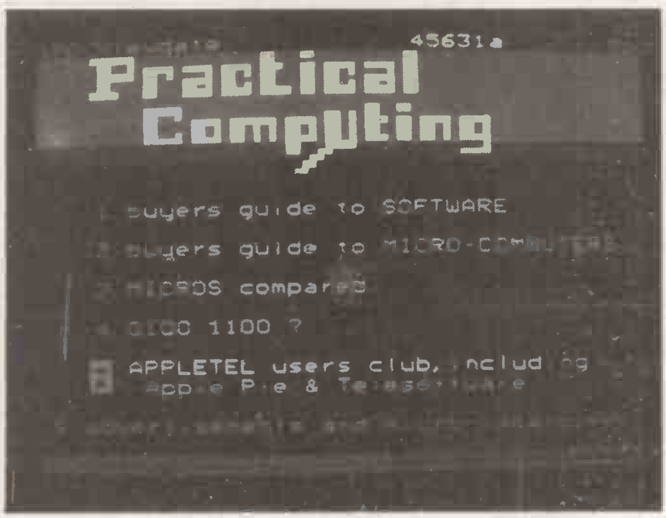


hints on the use of the Apple, software and hardware, news about applications for Apple, whether or not in conjunction with Prestel, and Apple programs and entertainment — Prestel games, quizzes.

Everything has to be contributed by you, so please write to me at *Practical Computing*.

The whole point of Prestel is to provide electronic communication, so there are exciting possible ways of using the Appletel users' club pages. Very soon it should be possible to input programs published on the pages into the Apple directly for execution — a real application of the telesoftware which everyone has been discussing.

What is more, we hope to be able to gather your contributions electronically — you type them on to a Prestel response frame and we edit them back on to Prestel. I'm sure there are more ingenious ways of using Prestel for an interactive users' club like this, so I shall wait for your suggestions.



30-32 Neal Street, London WC2H 9PS, Telephone 01-836 4663, Telex 298452

"My best Apple programs are on long-term deposit in the City... it pays rather well!"

We brought the first five Apples into the U.K. in November '77, with every penny we had. In November '79, we find several thousand throughout the country.
THANK YOU Apple owners.
Now we'd like to help you re-coup your investment by cataloguing and supporting the best Apple programs in the U.K. The Apple Software Bank is more like an old penny bank than a major clearing bank, but we know you'll help it grow. Telephone Stephen Derrick on 01-626-8121 to discuss your investment.
ATTENTION ALL Estate Agents, Employment Agencies, Yacht Brokers, Antique Dealers and Motor Traders.
Find out about *FINDER SOFTWARE!*

SOME BLUE CHIPS

TESKIM. This *ROM* will simulate the Tektronix 4010 family of graphics terminals. It's rather good!
UPPER LOWER CASE ADAPTOR A chip for the chap considering word processing.

NEW ISSUES

We are continually trying to bring the latest add-ons for your Apples. Please phone for the latest product information and data sheets.

NEW PRODUCTS

8" SHUGART DISKS giving 1.2 Megabytes A twin drive (with room for a third.) disk system with controller and software, give tremendous commercial possibilities. £2350 Excl. V.A.T.
WORD PROCESSOR. Ask about our Apple II Plus word processor package. Complete System with Diablo 1650 Daisy-Wheel Printer. £4250 Excl. V.A.T.
PERSONAL COMPUTER PRINTERS. Sensational 40 & 80 Character printer (graphics options) from £243 Excl. V.A.T. Interfaces for Apple, Pet & TRS 80. High quality silent printers. It's your choice!
A/D BOARD At last we have either an 8 bit or 12 bit A/D card for Apple. Excellent spec from £125 Excl. V.A.T.
APPLE PASCAL £296

Personal Computers Limited

194-200 Bishopsgate, London EC2M 4NR.

Let us advise you about *COLOUR DISPLAY* on your Apple. Contact Technical Services.

Idiosyncrasies

PETER ANTILL of Windsor, Berkshire, was most interested to read Tony Winter's explanation of the hardware idiosyncrasies of the Pet in Pet Corner, April, 1980. Faulty ends of files is a problem I have encountered and I am indebted to Winter for offering an answer, he writes.

His proposed solution, however, is suspect. I find the prospect of randomly-positioned blanks scattered throughout my data files alarming, to say the least.

A better solution is to test for the rogue carriage return when inputting the data. The following program demonstrates the method:

```
10 DIMA$(127):CR$=CHR$(13)
20 OPEN10,8,10,"1:TEST,S,W"
30 FORI=1TO127:A$(I)="AAA":PRINT#
   10,A$(I);CR$;:NEXT:CLOSE10
40 REM . . .INPUTANDTEST
50 OPEN10,8,10,"1:TEST,S,R"
60 GET#10, A$:IFASC(A$)=13THENK=
   1:GOTO80
70 INPUT#10,B$:K=ST:A$=A$+B$
80 IFK=0GOTO60
90 CLOSE10
```

The only limitation with this method is that the incoming data must be at least two characters long — a small price to pay for peace of mind.

In fact, I use a slightly-modified version:

```
60 GET#10,A$:IFASC(A$)<32THENK
   =1:GOTO80
```

I know the input data should be alphanumeric and the test ensures that no other rogues are involved.

High-resolution

JONATHAN DICK from Bristol has sent a program which enables you to plot high-resolution points on the Commodore 3022 printer. It divides one line into 480 discrete points which can be plotted individually.

The program consists of two subroutines, the first sets-up variables for the second to use. The second subroutine does the plotting. To communicate with it, the variables 'P' and 'M' are used.

'P' contains the number of the point to plot. If the number is more than 479, the subroutine sets variable 'OU' to one and control is passed to the main program. Variable 'M' contains instructions to be executed by the printer after plotting your point, e.g., if 'M' is a positive number the printer moves-down 'M' lines — the lines are set one dot apart.

If 'M' is a negative number the printer moves-up 'M' lines, if it can, since the number of lines it can move is controlled by a factor which is explained in the section on how the program works.

If 'M' is zero, the printer stays on the same line after plotting the point. You can change the line without plotting a point, by making 'P' a negative number, setting 'M' to the number you want and calling the subroutine.

The program employs the user-definable character which is available on the printer and the ability to vary the line-

feed distance. The characters on the printer are made of a seven by six dot matrix. With the user-definable character you can make any pattern in that matrix.

The program defines a two-dimensional string array called A$ which contains format information for all the possible single-dot patterns in the character — there are 42.

Using this array, it is possible to print any point in the dot matrix, e.g., if you wanted to plot the point 4,5 in the dot matrix, we send the string A$(4,5) to the printer through a special file. The dot at 4,5 then becomes the user-definable character.

When the program starts, a pointer is set to the top row of the user-definable character, and then a point or points can be plotted across the page on that line. When you move down a line the pointer is moved to the next row of the character.

The process continues until the seventh row where a carriage return and line feed is executed and the pointer set to the top of the character again. The line-feed distance is set so that the lines butt-up against each other.

That is the reason for the restriction on the number of lines you can move-up on the page. You can only move-up the software pointer, you cannot move the paper.

So if you are on row four of the character, you can move-up only four lines and if you are on row six you can move six. If you try to move too many lines, the subroutine sets variable 'ER' to 1 and control passes to the main program.

Using the program is very easy. The lines 10-30 in the listing are needed and must be used before any plotting. Line 10 opens two files to the printer.

Special file

The first is the special file for the user-definable character, while the second is the file for normal printing. Line 20 calls the first subroutine which sets-up the variable A$ with the format information in it.

This subroutine takes a few seconds to execute but it needs to be called only once before plotting. Line 30 sets the line-feed distance, although this could be incorporated into the set-up subroutine if desired.

Line 40 contains an example of the use of the actual plotting subroutine, it plots a sine curve. This program is able to plot more than one point per line as the user-definable character can, contrary to popular belief, be changed while still remaining on the same line. That is done by executing a 'CHR$(141)' which is the code for a carriage return with no line feed.

Righting wrongs

THE PET is very versatile and one of its great advantages lies in the fact that most commands can be abbreviated to two characters. One danger is that in a moment of forgetfulness you enter the abbreviated NEW for SAVE, write B P O'Hare and A S Goodenough, from Harrow, Middlesex.

However, all is not lost, as long as you are very careful, for NEW does not destroy a program — that could be done only by writing a "O" into every used memory location.

The pointers to the end of Basic are merely altered so that the Pet thinks it has nothing in memory, and all we have to do is restore the appropriate pointers.

Provided you have a Pet with the new ROM, and have read the machine language chapter of the user manual, you can do this by going into machine code and looking for three groups of zeros. The example should clarify the procedure.

Firstly, have a look at the machine language representation of the first few lines of Basic in the Pet immediately after powering-up. Use SYS1024 to enter the machine language monitor. The lines should be something like this:

```
SYS 1024
B*
   PC IRQ SR AC XR YR SP
.; 0401 E62E 32 04 5E 00 F8
.M 0401,0430
.; 0401 00 00 AA AA AA AA AA AA
.: 0409 AA AA AA AA AA AA AA AA
.: 0411 AA AA AA AA AA AA AA AA
.: 0419 AA AA AA AA AA AA AA AA
.: 0421 AA AA AA AA AA AA AA AA
.: 0429 AA AA AA AA AA AA AA AA
.M 0028,0030
.: 0028 01 04 03 04 03 04 03 04
.: 0030 00 40 FF 00 00 40 FF FF
```

Now type X to return to basic and enter the following program:

```
10 A=1
20 B=2
30 C=3
40 PRINT A,B,C
```

If you now repeat the above SYS commands, you should see:

```
SYS 1024
B*
   PC IRQ SR AC XR YR SP
.; 0401 E62E 32 04 5E 00 F8
.M 0401,0430
.: 0401 09 04 0A 00 41 B2 31 00
.: 0409 11 04 14 00 42 B2 32 00
.: 0411 19 04 1E 00 43 B2 33 00
.: 0419 24 04 28 00 99 41 2C 42
.: 0421 2C 43 00 00 00 AA AA AA
.: 0429 AA AA AA AA AA AA AA AA
.M 0028,0030
.: 0028 01 04 26 04 26 04 26 04
.: 0030 00 40 FF 00 00 40 FF FF
```

(continued on next page)

(continued from previous page)

Type X to return to Basic. If you now type NEW, two important pointers will be changed. Zeros will be written into locations 0401 and 0402, and locations 002A and 002B will become 03 and 04.

A LIST command will indicate that there is no program in the computer and you will still have the usual number of bytes available as there are normally immediately after powering-up.

So, how do you restore the program? The Basic program starts at locations 0401 and 0402, which contain the address of the second line of Basic, in Hex. In the program, the second line starts at 0409, the intervening code representing the Basic line 10, and it must be re-entered in two halves in reverse order, in locations 0401 and 0402. You must also tell the Pet where the variable table starts, and since that always follows the end of Basic, look for the group of three zeros which denotes this — it can be difficult to find in a long program.

The address you want is that of the following number, which in this case is 04 and 26, and these must be entered in locations 002A and 002B in reverse order.

Syntax error

Type X to return to Basic. You should find that you've found your program again. A similar problem can occur when you exit your program unexpectedly — perhaps by a syntax error. It is easy to correct the program, but you will lose all allocated variables. However, there is a way round the problem which is easy to demonstrate and which needs no manual changing of machine code. All you need do is follow a few instructions.

Enter and run the four-line program. Insert a colon instead of the comma after 'A' and RUN. All you will obtain is a '1' on the screen, plus 'SYNTAX ERROR IN LINE 40', although a direct enquiry will show that the three variables are still allocated correctly.

Clear the screen, type SYS 1024 to enter machine code, and call-up memory locations 0028 to 0030 — the start of the variable table — and return to Basic by typing X (Return).

```
SYS 1024
B*
   PC IRQ SR AC XR YR SP
.;  0401 E62E 32 04 5E 00 F8
.M 0028,0030
.:  0028 01 04 26 04 3B 04 3B 04
.:  0030 00 40 FF 00 00 40 28 FF
```

Now call up line 40, which will read 40 PRINT A:B,C, and correct it in the usual way. Type SYS 1024 again and you will be back in machine code. Take the cursor up the screen carefully until it is over line :0028 and hit return three times.

You will have re-set the pointers in the variable table and be back in Basic. However, be careful only to GOTO the corrected line to return to your program and do not use RUN as it clears all variables automatically.

The example is trivial, but it illustrates an important principle. It should be noted that the technique is for emergencies only, and can be used only when the corrected program is no longer than the original. For that reason, if not for the sake of legibility, it is often wise not to economise too much on spaces. Try GOTO 40 now and you will find you have the three variables again.

Machine code enthusiast

PET USERS who, like myself, are interested by machine code programming may wish to run their program from Basic using a RUN command and not a SYS, writes Kevin Jones from Lytham St Annes, Lancashire. If one lists Microchess, one finds,

```
10 SYS(1039)
```

which, of course, sets the program pointer at location 040F Hex. The codes, beginning at location 0400 for 1 SYS1037 which is slightly shorter, is: 0400 00 0B 04 01 00 9E 31 30 33 37 00 00 00 040D Machine language program starts here.

Of course, since a Basic program normally occupies locations 0400 upwards, it is possible only to use it for a complete program written in machine code, not a subroutine to be kept in the memory at the same time as a Basic program. The only other difference is that the byte on which the program ends must be RTS (op-code 60) and not BRK(code 00).

New facilities

A NUMBER of changes have been made to the Pet since it was first introduced slightly more than two years ago, writes Julian Allason, of Petsoft. Improved cassette player, revised ROMs and typewriter keyboard are some of the more notable improvements.

Frequently, it has been the success of individual entrepreneurs in marketing useful add-ons which has spurred Commodore to make the necessary design alterations. The large keyboard arrived only after an ex-Commodore employee, Bob Skyles, demonstrated the demand by selling hundreds of them himself.

The arrival of the 16K and 32K Pets was similarly preceded by the success of add-on memory purveyors like Small Systems Engineering and latterly, Plessey.

Looking at the growing list of accessories and peripherals, it is interesting to speculate on what Commodore will be including next. The most successful recent product has been the Programmers' Toolkit, and it would be surprising if several of its facilities did not find their way into the next revision of Basic.

Kingston Computers has been offering a hardware repeat keyboard which allows any character to be repeated if the key is depressed for a few moments. That would certainly be a useful facility to have as standard.

Perhaps the single, most-welcome addition to present capabilities of Pet is high-density graphics. At present, the highest resolution obtainable is 80 × 50 using the quarter character squares, although resolution of one-eighth character-width is possible in one direction only.

IJJ Design of Marlborough has been offering the spectacular MTU high-resolution graphics board for around £300. Now there is news of a British-developed high-density graphics board from HB Computers of Kettering which expect it to retail for less than £175.

Increased sales

It is said that when Personal Software introduced VisiCalc in the U.S., sales of Apples rose by 25 percent. Now a Pet version of VisiCalc has leapt the Atlantic. Dr Adam Osborne, not normally known for gushing praise, described VisiCalc as a work of art. Another U.S. reviewer called it the best piece of microcomputer software yet published.

The program acts almost as an extension of the computer's operating system, allowing the user to enter numbers, alphabetics and formulae on the keyboard. It is then possible to carry-out extremely complex calculations and projections quickly and easily.

Once the first projection is complete, the re-calculation feature allows one to ask: "What if that oscillation were damped by another 10 percent? What if sales drop 15 percent in September"? All figures affected by September sales are amended instantly.

VisiCalc is available on Commodore disc from most Pet dealers, price £125.

Several interesting new programs just released include an air-traffic-control simulation from Landsler Software on cassette at £5, the Commodore incomplete record accountancy package, and a 6502 Assembler programming tutorial from Petsoft priced at £25 on cassette or disc.

Simulation

I spent several nerve-wracking evenings on Petplan, the business simulation. The program was developed to run on main-frames several years ago by a specialist software house called Understanding Ltd, which recently converted it for the Pet.

Petplan simulates a manufacturing company, making Petals. Up to four players act as directors, hiring, firing, marketing and investing. Balance sheets, production and sales reports showing the effect of decisions taken, are generated. I managed to lose £7 million in my first year. Petplan costs £60 including a 50-page manual and a voice-guide on cassette and is available from most Commodore dealers.

A real must is the Pet Show at London's Café Royal on June 13-14. More than 50 suppliers of Pet goodies will be there. There may also be a chance to try out the new super Pets.

OUR SYSTEMS CAN GROW ON YOU

When you buy one of our low price microcomputer development systems you not only get a fully burnt-in and tested system designed and manufactured to industrial standards. You also get access to an ever-increasing range of software tools. And if you require a VDU or printer now or later, there is a selection of these and other peripherals from which to choose. So your system can grow and grow.

Our systems start to grow on you at £1525. This buys you a 32KB system with dual 5¼ inch double density floppy drives. At £1795 you can have a 48KB system or for £2665 one with the extra memory storage provided by dual 8 inch double density floppy drives. All the systems are based on the powerful Z80 microprocessor and S100 bus structure and can provide memory management. Cartridge disc drives are available providing up to 40MB of storage.

The prices include the CP/M operating system which has become the industry standard for microcomputers. Other software options are:

Operating Systems

● CP/M ● PASCAL ● CAP MICROCOBOL BOS
● Multi-User, Multi-Tasking Operating Systems

Languages

● C-BASIC COMPILER ● M-BASIC ● FORTRAN-80
● COBOL-80 ● PASCAL ● CIS-COBOL

There is also a word and text processing system available that is ideal for report writing.

You simply take your pick from the development software options. Or visit our London showroom and see the systems demonstrated.

SYSTEMS WITH CP/M		
	32KB + Dual 5¼ inch Floppies:	£1525
	48KB + Dual 5¼ inch Floppies:	£1795
	48KB + Dual 8 inch Floppies:	£2665

Prices exclude VAT.
Nationwide maintenance facilities available.

EQUINOX
COMPUTER SYSTEMS LTD.
Kleeman House, 16 Anning Street,
New Inn Yard, London EC2A 3HB
Tel: 01-739 2387/9 & 01-729 4460

• Circle No. 203

Increasing capabilities

I HAVE spent a great deal of time, with the aid of the T-Bug monitor program, investigating how the TRS-80 computes, writes J F Hancock of Bristol.

Page E/1 of the Level II manual lists the Basic keywords used in writing Basic programs, but as you have probably discovered many of them can be used only if you have a floppy disc system — they are reserved for use with Level II disc Basic. I hope to show how to use those reserved disc Basic words — and give them new meaning.

When the TRS-80 is switched-on, or re-set, it goes through its housekeeping routine. Part of that routine at 078D Hex, 1933 Dec, programs a section of reserved ram, 4152 to 41A5 Hex, 16722 to 16805 Decimal, with instructions for the words, reserved for disc Basic, giving them their meaning. When you do not have a disc system the instructions in Hex are for example

```
419A = C3 Jump to NN
419B = 2D LSB (Least significant byte of NN)
419C = 01 MSB (Most significant byte of NN)
```

That means jump to 012D Hex for your next instruction. The reserved word RSET goes to 419A Hex for its instruction. Type in RSET and enter — press enter — ? L3 ERROR is displayed. Now change those instructions by Poke statements,

```
419B = 19
419C = 1A
```

Now type Poke 16795,25: Poke 16796,26 and enter

```
419A = C3
419B = 19        Jump to 1A19 Hex
419C = 1A
```

Type RSET and enter and READY is now displayed. Not very useful — but you have given a new meaning to RSET.

For something more useful — a new meaning to the reserved words CLOSE and OPEN, it could be useful to CLOSE off a Basic program already in memory, to cload in another program without losing the first one. There is one stipulation — the program to be cloaded must have line numbers beginning with numbers greater than the last line number of the program already in memory.

To enable us to CLOSE or block-off an existing Basic program, it will help if we know how a Basic program is stored. The housekeeping routine of a Basic program is

```
42E9 = LSB of start of next Basic line
42EA = MSB of start of next Basic line
42EB = LSB of line number
42EC = MSB of line number
```

The last byte of your Basic program line is always ZERO. Type in this program line, 10 CLS and enter. Now if you peek at, or use a monitor program, you will see that

```
ADDRESS: HEX: DEC
42E9 = EF: 239 LSB of start of next Basic line
42EA = 42: 66 MSB of start of next Basic line
42EB = 0A: 10 LSB of Basic line number
42EC = 00: 0 MSB of Basic line number
42ED = 84: 132 CLS
42EE = 00: 0 last byte always zero
42EF  LSB of start of next Basic line goes here
42F0  MSB of start of next Basic line goes here
```

TANDY FORUM is devoted to the Tandy TRS-80. Sometimes we will use it to pass on news about the TRS-80 but, above all, it is for users, and would-be users, of the well-established model I and now the new model II. With your tips, queries, moans and comments, this page can become a market-place for TRS-80 information.

```
42F1  LSB of line number
42F2  MSB of line number
```

After switching-on, when your TRS-80 went through its "housekeeping" routine, it programmed

```
40A4 = E9 LSB of Basic program starting address
40A5 = 42 MSB of Basic program starting address
and
40F9 = EB LSB of address of first line number
40FA = 42 MSB of address of first line number
```

Now after entering the line: 10 CLS

```
40A4 = E9 LSB of address start of Basic program
40A5 = 42 MSB of address start of Basic program
but now
40F9 = F1 LSB of address for next line number
40FA = 42 MSB of address for next line number
```

I hope that you can now see why if you subtract two from the address contained in 40F9 and 40FA which is 42F1, —2 = 42EF and Poke it into 40A4 and 40A5 so that 40A4 = EF: 40A5 = 42, the TRS-80 will assume that your Basic program now starts at 42EE.

So do this, type in Poke 16548,239: Poke 16549,66 and enter. Now type LIST — nothing is listed. The line, 10 CLS, has to all intents and purposes, disappeared. 20 PRINT "THIS IS MY NEXT PROGRAM" and enter and LIST.

To open the Basic in memory so that line 10 CLS becomes available again, all that has to be done is to restore the original starting address in 40A4 and 40A5 Hex. So Poke 16548,233 Poke 16549,66 and enter and LIST.

10 CLS. 20 PRINT "THIS IS MY NEXT PROGRAM" and all is restored again.

A machine code routine to do this is

```
CLOSE
D9 — EXX — Save what Basic is doing
2A — LD HL,(NN)    H = contents of address
                   40FA
F9                 L = contents of address
                   40F9
40
2B — DEC HL        Subtract 2 from HL
2B DEC HL
22 — LD (NN),HL    Contents of L into 40A4
A4                 Contents of H into
40                 40A5
D9 EXX Back to what Basic was doing
C9 RETURN
OPEN
D9 — EXX
21 — LD HL, NN     L = E9
E9                 H = 42
42
22 — LD (NN),HL    L into 40A4
A4                 H into 40A5
40
D9 — EXX
C9 — RETURN
```

Change M/C to Decimal.

```
CLOSE = 217, 42, 249, 64, 43, 43, 34, 164, 64, 217, 201
OPEN = 217, 33, 233, 66, 34, 164, 64, 217, 201
```

Decide where to Poke it, so that CLOSE and OPEN can be instructed where to find their new meaning. Suppose you have 16K RAM and that your normally load KBFIX the key de-bounce routine.

```
CLOSE    from 7FB5 to 7FBF Hex
         from 32693 to 32703 Dec
OPEN     from 7FC0 to 7FC8 Hex
         from 32704 to 32712 Dec
WBFTX    from 7FC9 to 7FFF Hex
         from 32713 to 32767 Dec
```

CLOSE looks for instructions at 4185-4187 Hex
OPEN looks for instructions at 4179-417B Hex

Here is a Basic program:

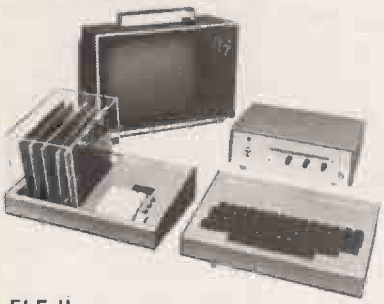
```
10 Poke 16774, 181: Poke 16775, 127: Rem
   Instruct CLOSE
20 Poke 16762, 192: Poke 16763, 127: Rem
   Instruct OPEN
30 FOR X = 32693 to 32712: READ A:Poke
   X, A: NEXT
40 DATA 217, 42, 249, 64, 43, 43, 34, 164, 64,
   217, 201: REM CLOSE
50 DATA 217, 33, 233, 66, 34, 164, 64, 217,
   201: REM OPEN
```

Once this program has been run, it can be deleted, but if you have to re-set the computer the Pokes in lines 10 and 20 will have to be done again. The machine code routines in high memory will stay unchanged.

Remember, whenever you use this program you must protect it in memory by answering MEMORY SIZE in the example with 32692.

ELF II

THE TRIED AND TESTED MICROCOMPUTER SYSTEM THAT EXPANDS TO MEET YOUR NEEDS



Computer Kit

STARTS AT **£59.95** + VAT

ELF II
BOARD WITH VIDEO OUTPUT
FEATURING THE RCA COSMAC 1802 cpu

STOP reading about computers and get your "hands on" an ELF II and Tom Pitman's short course. ELF II demonstrates all the 91 commands which an RCA 1802 can execute, and the short course speedily instructs you how to use them.

ELF II's VIDEO OUTPUT makes it unique among computers selling at such a modest price. The expanded ELF II is perfect for engineers, business, industry, scientific and educational purposes.

ELF II EXPANSION KITS

	Ex VAT
*Power Supply for ELF II	£5.00
*ELF II Deluxe Steel Cabinet (IBM Blue)	£22.00
*Giant Board Kit System/Monitor, Interface to cassette, RS232, TTY, Etc.	£28.00
*4K Static RAM board kits (requires expansion power supply)	£59.50
*Expansion power supply (required when adding 4K RAMs)	£25.00
*ASCII Keyboard Kits 96 printable characters, etc.	£39.95
*ASCII D/lux steel cab (IBM Blue)	£15.00
*Kings prototype board (build your own circuits)	£11.00
*86 pin Gold plated connectors, each	£3.75
*ELF Light pen writes/draws on TV screens	£7.50
*Video display board 32/64 characters by 16 lines on TV/monitor screens	£68.00
*ELF II Tiny basic on cassette	£9.75
ELF-BUG Monitor, powerful systems monitor/editor	11.50
*T.Pitmans short course in programming manual (nil VAT)	£4.00
*T.Pitmans short course on Tiny Basic manual (nil VAT)	£4.00
*RCA 1802 users manual (nil VAT)	£4.00
*On cassette, Text Editor, Assembler, Disassembler (each)	£14.50
Dual tape controller board	
RF Modulator	£2.75

ELF II BOARD

SPECIFICATION
*RCA 1802 8-bit microprocessor with 256 byte RAM expandable to 64K bytes
*RCA 1861 video IC to display program on TV screen via the RF Modulator
Single Board with Professional hex keyboard – fully decoded to eliminate the waste of memory for keyboard decoding circuits
Load, run and memory protect switches
16 Registers
Interrupt. DMA and ALU
Stable crystal clock
Built in power regulator
5 slot plug in expansion bus (less connectors)

BREAKTHROUGH We proudly announce the release of the first 1802 FULL BASIC, with a hardware floating point RPN MATH PACKAGE (requires 8k RAM). Also available for RCA VIP and other 1802 systems Board includes area for a ROM version. **£49.50** + VAT.

Pets Corner

LATEST PET's WITH LARGE KEYBOARD

8K	£475	AT DISCOUNT PRICES + VAT
16K	£575	
32K	£675	RRP £795 for 32K

BASE 2 PRINTER £450
PROGRAMMERS TOOLKIT, £45.
Full Range of Software Available

NEWTRONICS KEYBOARD TERMINAL

Kit **£114.20** + VAT

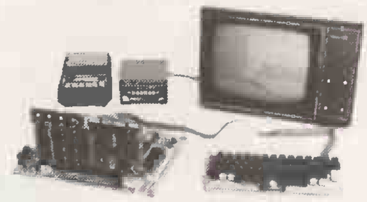
assembled and tested **£144.20** + VAT

Optional Extra Video Monitor **£79** + VAT

The Newtronics Keyboard Terminal is a low cost stand alone Video Terminal that operates quietly and maintenance free. It will allow you to display on a monitor 16 lines of 64 characters or 16 lines of 32 characters on a modified TV (RF Modulator required).
The characters can be any of the 96 ASC II alphanumerics and any of the 32 special characters, in addition to upper/lower case capability, it has scroll-up features and full X-Y cursor control. All that is required from your micro-computer is 300 baud RS232-C or 20ma loop serial data plus a power source of 8v DC and 6.3v AC. The steel cabinet is finished in IBM Blue-Black.

Explorer/85

Professional Computer Kit



ALL FOR **£295** + VAT

FEATURES INTEL 8085 cpu

FLEXIBILITY: Real flexibility at LAST
The EXPLORER/85 features the Intel 8085 cpu
100% compatible with all 8080A and 8085 software. Runs at 3MHz.
Mother Board (Level A) with 2 S-100 pads expandable to 6 (Level C).

MEMORY
2K Monitor ROM
4K WORKSPACE/USER RAM
1K Video RAM
8K Microsoft BASIC in ROM or Cassette

WITH ONBOARD S-100 EXPANSION

INTERFACES
STANDALONE FULL ASC11 Keyboard Terminal, 32/64 characters per RS-232/20Ma Loop. 4, 8bit: 1, 6 bit 1/0 ports, programmable 14 bit binary counter/timer. Direct interface for any S-100 Board.
FULL Buffering decoding for S-100 Bus pads, wait state generator for slow memory. Each stage has separate 5v 1A regulator for improved isolation and freedom from cross talk. P.S.U. requirements: 8v, 6.3v AC. Runs with North Star controller and Floppies/CPM. EXPLORER/85 is expandable to meet your own requirements with easy to obtain S-100 peripherals. EXPLORER/85 can be purchased in individual levels, kit form or wired and tested OR as a package deal as above.

NETRONICS S-100 DYNAMIC RAM BOARD

Netronics Solves the problems of Dynamic RAM with a state-of-the-Art chip from Intel that does it all. Intels single chip 64K dynamic RAM controller eliminates high current logic parts . . . delay lines . . . massive heatsinks . . . unreliable trick circuits.
We offer you: Hidden refresh . . . fast performance . . . low power consumption . . . latched data outputs . . . 200NS 4116 RAM's . . . onboard crystal . . . 8K bank selectable . . . fully socketed . . . solder mask on both sides of the board . . . designed for 8080, 8085, and Z80 bus signals . . . works in Explorer, Sol, Horizon, as well as all other well designed S100 computers.

	KIT	assembled, tested & burned in
16K	£149.00	£165.00
32K	£219.00	£234.00
48K	£289.00	£304.00
64K	£359.00	£429.00
16K expansion kits	£70.00	

SEND SAE FOR COMPREHENSIVE BROCHURE

Please add VAT to all prices (except manuals), P&P £2. Please make cheques and postal orders payable to NEWTRONICS or phone your order quoting BARCLAYCARD, ACCESS number.
We are now open for demonstrations and Sales, Monday-Saturday, 9.30 a.m.-6.30 p.m. Near Highgate Underground, on main A1 into London.

Newtronics
255 ARCHWAY ROAD, LONDON N. 6
TEL: 01-348 3325

• Circle No. 204

Word on legibility

A NOTE for Superboard II users from Alan Linton in Belfast — the closely-packed output of the Superboard can be made more legible by the command POKE 15,0. It causes output of two line-feeds instead of one when listing programs or executing print statements. The command POKE15,72 returns to normal.

Latest additions

WALTER WALLENBORN of the 6502 Club writes with a few points about additions to 6502 system. The Plessey Inpet has dropped another 10 percent in price, he writes, making it £224.10 plus VAT for 32K of fully-built and burnt-in RAM.

If you do not have a Pet, you will need a 74154 to decode the select lines but if you want to build your own, order with some friends directly from Strutt at its 100-off prices.

If you can obtain S-100 static-RAM cards at a reasonable price, these points should help to put it on to your system: LOW on SOUT (pin 45), R/$\overline{W}$ on SMEMR (pin 47), (R/$\overline{W}$ and Ø2) on PDBIN (pin 78), NOT ((NOT (R/$\overline{W}$)) AND Ø2) on $\overline{PWR}$ (pin 77) and, if you need it, NOT ($\overline{PWR}$) on MWRITE (pin 68).

When you plan on using only one card, you can manage with tying data inputs to outputs to data bus, but if you want more than one card, data inputs to S-100 need buffering from the data lines.

An easy way to interface to a centronics parallel-interface printer from a 6522 (VIA) is to connect the lines as follows:

CA1 — paper empty
PA7 — BUSY
PA6 to PA0 — DATA7 to DATA1
CA2 — DSTA (data strobe) on PET use CB2

I use the subroutine on the AIM. It takes an ASCII character in the A register and sends it to the printer, while checking paper empty and busy.

```
PRINT      STA  A001     ;Character to
                          PORT A
           LDA  A00D     ;Check IFR
                          for paper
                          empty
           BMI  PAPEMP   ;If empty
                          branch
BUSY       LDA  A001     ;Check BUSY
                          line
           BMI  BUSY     ;Loop until not
                          busy
STROBE     LDA  #$0D
           STA  A00C     ;CA2 LOW
           LDA  #$0F
           STA  A00C     ;CA2 HIGH
           RTS           ;RETURN
PAPEMP     LDA  #$07     ;ASCII BELL
                          CODE
           STA  A001     ;Character to
                          PORT A
           BNE  STROBE   ;Branch
                          always to
                          STROBE
;INITIALIZE Come here once before using
                          PRINT.
INIT       LDA  #$0F     ;The F is E to
                          set CA2
           STA  A00C     ;to a HIGH
                          and 1 to set
;CA1 sensitive to a LOW to HIGH transition
           LDA  #$7F     ;PA6 to PA0
                          set as outputs
           STA  A001     ;Set all
                          outputs to
                          HIGH
           STA  A00C     ;Then make
                          them outputs
;PA7 stays an input
```

THE 6502 SPECIAL is dedicated exclusively to the exchange of information between 6502 users. It is up to you, the reader, to help establish this page with your ideas, problems and guidance for other 6502 users. Please mark your letters 6502 Special. We pay £5 for each contribution published.

Mesmeric doodle

I HAVE been surprised and gratified by the response to my request for help in recording variables from the UK101 writes Reg Newman, from Chesham, Buckinghamshire. Great expertise has been shown in the varied solutions.

I have had calls and visits from friendly and enthusiastic helpers, who have answered not only my query but also have given me help in entering assembler language and have freely offered programs on which they must have spent much time and thought.

One in particular, an ingenious Basic editor, may inspire the production of a new ROM for UK101. Anyway, one's faith is restored, not only in human nature, but in the brain power available to help us out of the present slough — if only someone can harness it.

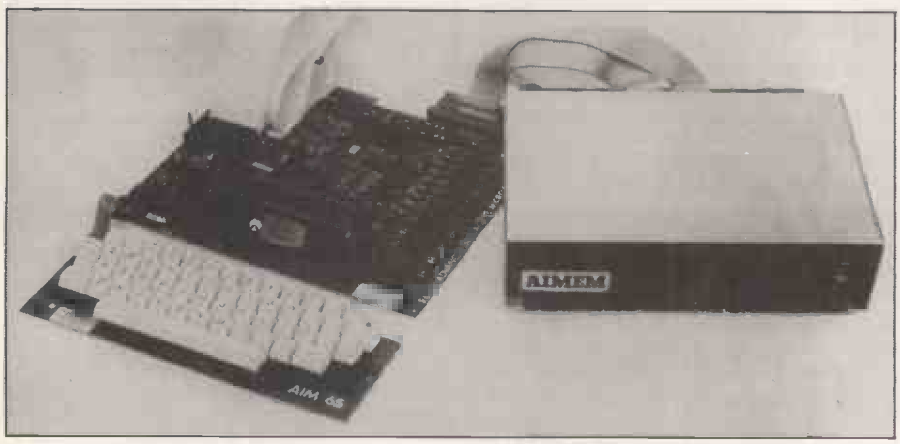
Could I venture another question; if one has a program, already resident, e.g., an editor, is there any possibility of loading from tape a further program without disturbing what is there already?

As an aid to thought, I find it helpful, and slightly mesmeric, to watch an ever-changing doodle-program. In the hope of starting a fashion, I offer a doodle which produces the effect of a mad town-planner. No doubt those with more experience can better this easily.

Mad Village Doodle. UK101 Microsoft Basic

```
1   A = 3: B = 14
4   FOR W = 53248 TO 54271
6   POKE W,189
8   NEXT W
10  N = INT(1024*RND(1))
20  M = 53248 + N
25  P = B + INT(A*RND(1))
30  IF RND(1)>.5 THEN POKE M,P
35  POKEM + 27,236
36  FOR K = M + 1 TO M + 10
37  POKE K,32
38  NEXT K
40  FOR D = 53248 TO 54248 STEP 63
45  POKE D + 32,189: POKE D + 33,32:
    LPOKE D + 34,32
47  POKE D + 35,32: POKE D + 36,32:
    POKE D + 37,189
50  K = INT(4*RND(1))
52  IF RND(1)<.3 THEN POKE
    (D + 33 + K),46
55  NEXT D
57  FOR R = 1 TO 400: NEXT R
60  IF RND(1)<.03 THEN 80
65  IF RND(1)  .2 THEN POKE M + 7,231
70  GOTO 10
80  POKE M + 3,227
90  POKE M + 4,187
100 POKE M + 5,187
110 POKE M + 6,228
120 POKE M + 17,14: POKE M + 18,15:
    POKE M + 19,15: POKE M + 20,14
140 GOTO 10
```

A new add-on memory for the AIM65, the AIMEM, includes 32Kbytes of memory in a self-contained unit with its own power supply. British-designed and built, the unit is available from Portable Microsystems Ltd for £335 + VAT. Tel: (0280) 702017. The memory can be connected to any system using the Motorola Exorcisor bus.



I/O port

AS THE Compukit lacks any parallel I/O facilities, Nigel Hepworth of 7 Greycourt Close, Idle, Bradford, Yorkshire, has written with news of a I/O port for the system.

The board allows 24 lines of I/O, programmable in groups of four. An on-board relay is fitted to allow the switching of up to 5W load. A 40-pin, on-board socket is also provided to allow further expansion. Prices, including VAT and P&P are kit £35 and built £40.

Tabular display

IT IS EASY to form a table by eye, so that the numbers in each row fit snugly under the column headings, with the decimal points aligned vertically, writes Ralph Turvey of Geneva in Switzerland. Programming a computer to do that neatly is more complicated. I offer a solution — one which uses the POS function, or a substitute.

Both the Pet and the Exidy Sorcerer have the POS function, and with its graphic capabilities, upper- and lower-case and 30×64 character screen, the Sorcerer can produce very professional-looking tabular displays. The coding is written for the Sorcerer, i.e., for 8K Microsoft Basic.

It is not necessary to set-out the date part of the program. This part should enable the user to input the number of rows in the table, R, and the number of columns, C. With the zero row and zero column left for subsequent use, the data, row-name and column-name arrays must then be dimensioned, sufficient string space having first been provided:

```
DIM D(R,C), RN$(R), CN$(C)
```

It will also be necessary to dimension two further arrays:

```
DIM PS(C), DS(C)
```

The program should now provide for user input of the data into the D array, either by row or by column, first obtaining user input of the row — side — headings, RN$( ), and of the column — top — headings, CN$( ). Note that "I" is used as row counter and "J" as column counter.

The final preliminary is the generation of two characters for drawing lines, using the method explained on page 88, *Practical Computing*, December, 1979. A centred single dot for horizontal lines and a double dot for vertical lines make lines which guide the eye without being too obtrusive and which intersect neatly. The necessary coding is:

```
FOR J = -512 TO -497
POKE J,0
NEXT J
POKE -512,16 : POKE -508,16 : POKE
-502,16
```

To provide a vertical line on the left margin of the table at TAB(LM), separating the row names from the numbers in the body of the table, it is necessary to calculate LM as the length of the longest row name plus one. That will enable the longest row name to be printed in columns 0 to LM-1, with a blank before the vertical line.

```
1000 LM=0
1010 FOR I = 1 TO R
1020 IF LEN(RN$(I)) > LM THEN LM =
     LEN(RN$(I))
1030 NEXT I
1040 LM = LM+1
```

The next step is to calculate the minimal necessary width of each column, J=1 TOC. This, denoted W, will equal whichever is greater — the length of the column name or the number of horizontal spaces required to accommodate the column of

IN DECEMBER 1979, we ran a special feature on the Exidy Sorcerer. We wrote that Exidy Sorcerer users seem to be neglected, partly because we seldom receive manuscripts. That no longer holds true. Rather than produce another special feature for the Sorcerer, we present a Sorcerer page — the Sorcerer's apprentice — and will pay our usual £5 for each item published.

figures when the decimal points in it are aligned vertically.

That number of spaces, which can be up to 14, equals (P). The largest number of digits before the decimal point, plus one for the initial blank or minus sign; plus (Q): one space for the decimal point, plus the largest number of digits after the decimal point. The necessary code is:

```
1050 SW = 0
1060 FOR J = 1 TO C
1070 P = 0 : Q = 0
1080 FOR I = 1 TO R
1090 U = D(I,J)
1100 V = LEN(STR$(INT(U))) + (ABS(U) <
     1)
1110 IF V > P THEN P = V
1120 V = LEN(STR$(U)) - V
1130 IF V > Q THEN Q = V
1140 NEXT I
1150 W = P + Q : V = LEN(CN$(J))
1160 IF W < V THEN DS(J) = P + (V-W)/2
     : W = V : GOTO 1200
1170 IF W > LEN(CN$(J)) THEN CN$(J) =
     " " + CN$(J)
1180 IF W > LEN(CN$(J)) THEN CN$(J) =
     CN$(J) + " " : GOTO 1170
1190 DS(J) = P
1200 SW = SW + W
1210 NEXT J
```

Line 1160 makes column width equal the length of the column name if this exceeds P+Q. If, on the other hand, the length of the column name falls short of P+Q, lines 1170-80 augment the column name with blanks to make it as long as P+Q.

Line 1160 or line 1190 store in the array DS( ) the distance inside the column J at which the decimal point should be placed so that the numbers in that column will have their decimal point centred under the middle of the column name and/or so that the numbers will fit inside the column.

Out of all the spaces in a line from 0 to 63, LM has now been allocated to row names and the vertical line separating them from the body fo the table. SW has been reserved for the C columns of data. Consequently, the remaining space per column is (63-LM-SW)/C.

If this is less than one, there can be no spaces between the columns, while if it is at least 3, three spaces can separate the columns with the vertical separating line in the central space.

Hence, after a Clear Screen command, the column headings can be printed as follows, using character 192 to provide the vertical line:

```
1220 PRINT CHR$(12)
1230 SP = (63-LM-SW)/C
1240 IF SP < 1 THEN PRINT, "Insufficient
     space" : STOP
1250 PRINT TAB(LM); CHR$(192);
1260 FOR J = 1 TO C
1270 DS(J) = DS(J) + POS(X)
1280 IF SP > = 3 THEN PRINT " ";
1290 PRINT CN$(J);
1300 IF SP > = 3 THEN PRINT " ";
1310 PS(J) = POS(X)
1320 PRINT CHR$(192);
1330 NEXT J
1340 PRINT
```

Line 1270 puts the appropriate location for the decimal point in column J into DS(J), while line 1310 records in PS(J) the location of the vertical dividing line following column J. To do this in a Basic without the POS function, it would be necessary to calculate these locations. For example, PS(1) would be LM + LEN(CN$(1)) + 1 with SP < 3, and would be two greater than this with SP > = 3.

A horizontal line now needs to be drawn and the rest of the table printed. Thus the line-drawing subroutine could be:

```
2000 FOR J = 0 TO PS(C)
2010 PRINT CHR$(193);
2020 NEXT J
2030 PRINT : RETURN
```

Using this subroutine, the rest of the coding is then:

```
1350 GOSUB 2000
1360 FOR I = 1 TO R
1370 PRINT RN$(I);
1380 PRINT TAB(LM); CHR$(192);
1390 FOR J = 1 TO C : U = D(I,J)
1400 PRINT TAB(DS(J)-LEN(STR$(INT
     (U)))-ABS(U) < 1));U;
1410 IF POS(X) < = PS(J) THEN PRINT
     TAB(PS(J)); CHR$(192);
1420 NEXT J
1430 PRINT
1440 IF R < 14 THEN GOSUB 2000
1450 NEXT I
1460 PRINT CHR$(17) : INPUT X$
```

The last line tucks the cursor away in the top left-hand corner and stops the program until you want to continue.

MEET THE FAMILY

. . . THERE MUST BE ONE HERE FOR YOU

The Exidy family is a sophisticated range of products designed to meet the ever increasing variety of computing needs including home and business uses, educational and laboratory applications, industrial process control, etc.
The Exidy range has been designed with built-in growth capacity to take the risk factor out of computer investment. The Sorcerer Computer now has a memory expansion capability from 8K up to 48K within its own cabinet, enabling the system to grow with your needs plus the ability to add many additional plug-in facilities such as disk drives, printers and pre-programmed ROM PAC's. All Exidy products are backed up by a 12 month warranty covering both parts and labour.
The Exidy Sorcerer provides a standard typewriter keyboard plus a 16 key numeric pad. Connections are provided for future expansion within the keyboard unit.
If you want an accounting machine, a word processor, or a program development system, the SORCERER offers all of these within the same unit.
The Word Processing ROM PAC allows you to create, edit, re-arrange and format text. The operator's work is displayed clearly on a screen—you can see the whole of an average business letter—correct mistakes—re-arrange it. Once perfected—press a key and the printer will type a perfect letter in record time—as many times as you like—no wasted letterheadings. Features include auto wraparound, dynamic curser control, variable line length, global search and replace, holding buffer for re-arrangement of text, right justification, line width and line to line spacing, underlining or boldfacing, text merging and a macro-facility permitting tasks such as formletter typing, multiple column printing or automatic forms entry.

Now contact your nearest dealer;

The NORTH
BASIC COMPUTING, Oakville, Oakworth Road, Keighley, W. Yorkshire. 0535 65094
E.S. MICROCOMPUTERS, 7 Berkeley Prec., Ecclesall Road, Sheffield S11 8PN. 0742 668767
GLYSTHYDON LTD., Nook Farm, Rake Lane, Warton, Preston, Lancs. 0772 633138
MAGNUM CONSULTANTS, 57 Fairburn Drive, Garforth, Leeds. 0532 867892
MICROPUTE, 7 Westbourne Grove, Manchester M20 8JA. 0625 612818
MICRODIGITAL, 25 Bruswick Street, Liverpool L2 0BJ. 051 227 2535
TW COMPUTERS LTD., 293 London Road, Hazel Grove, Stockport. 061 456 8187

MIDLANDS
M&R SYSTEMS, 20 Norwich Road, Wisbech, Cambs. 0945 5900
MIDLAND MICROS, 1 Cherry Wood Drive, Aspley, Nottingham. 0602 298 281
GRIFFIN & GEORGE, Birmingham, Manchester, London, Eastkilbride. 01 997 3344

LONDON and SOUTH EAST
E.M.G. MICROCOMPUTERS, 30 Heathfield Road, Croydon, Surrey CR0 1EU. 01 688 0088
HOME & BUSINESS COMPUTERS, 445 High Street North, Manor Park, London E12. 01 472 5107
MICROBITS, 34b London Road, Blackwater, Camberley, Surrey. 0276 34044
SLOUGH MICROSHOP, 120 High Street, Slough, Berks. 0753 22855
TVJ MICROCOMPUTERS, 165 London Road, Camberley, Surrey GU15 3JS. 0276 62506
C.C.S. MICROSALES, 7 The Arcase, Letchworth, Herts. N2 9EN. 046 26 73301
G.P.W. ELECTRONICS, 146a London Road, North End, Portsmouth, Hants. PO2 9DJ. 0705 693341
INFORMEX-LONDON LTD., 8-12 Lee High Road, London SE13. 01 318 4213
NIC, 61 Broad Lane, Tottenham, London N15. 01-808 0377

WALES and the WEST
TRYFAN COMPUTERS, 3 Switfts Blds, High Street, Bangor, Gwynedd LL57 1UW. 0248 52042
ELECTROPRINT, 5 Kingsdown Parade, Bristol BS6 5UD. 0272 292375
LIVEPORT DATA PRODUCTS, The Ivory Works, St. Ives, Cornwall. 0736 798157
TVJ MICROCOMPUTERS, 48 Gloucester Road, Bristol BS7 8BH. 0272 422061

Or send coupon for further information to:

SOLE DISTRIBUTORS
Geoff Wilkinson
LIVEPORT DATA PRODUCTS
The Ivory Works, St. Ives, Cornwall.

PLEASE SEND DETAILS OF THE EXIDY RANGE

NAME ______________________

ADDRESS ______________________

____

____

____

____

• Circle No. 209

Apple COS and the output bug

In the second part of his series on creating a cassette operating system for the Apple II, Hugh Dobbs discusses the output bug and how to deal with the problems it causes.

AT THIS stage, we must consider all the possible kinds of output which COS may be expected to handle, if it is to be able to emulate DOS approximately. Output may be:

- Keyboard, or other input, echo in command mode in any language.
- Keyboard echo in a Basic INPUT or equivalent.
- Keyboard echo in a new mode which will allow one to MAKE files manually.
- Program output addressed to COS, i.e., following 'retn CTRL-D'.
- General program output, including output from ASSeMbler and from monitor routines.

The necessary actions are display, unless suppressed by some new mode of NOMON and/or EXEC, filed already in input buffer, on 'retn', and check for COS commands. Display unless (READ and NOMON I); do not file. Display; file; check for terminator, e.g., CTRL- . Display unless NOMON C; file in input buffer; on 'retn', check for COS commands. Display unless (WRITE and NOMON O); file if WRITE.

Command mode

We need flags to control all this. First, we use one byte of storage to show which mode of operation is involved: MAKE, normal command mode, CTRL-D output, WRITE, READ, normal input, normal output which account for seven of the eight bits.

Next, we need one byte to show which NOMON conditions apply, if any. Note that NOMON C affects only CTRL-D output, I affects READ and O affects WRITE. All we have to do is align the appropriate bits in the two locations, do a logical AND, and the result will decide whether or not anything will appear on the screen. We can even add the facility, offered by Superboard, of suppressing all printout without any further effort.

Set all eight bits in the NOMON flag, supposing that we always have at least one bit set in OMODE. We need one more bit of storage — a flag to show whether the previous character output was 'retn'. We also need a few bytes of RAM for temporary storage and for file pointers, and also for the input/output vectors if COS is to be ROMable. They will all fit in the margins of page 2 of video RAM.

I am assigning the following storage locations, for the present:

878: INPUT FLAG will be used by the input 'bug'; bit 7 shows READ mode and bit 6 shows EXEC mode.
879: Operating MODE Bits: M, W, R, C-D, command, —, —, —.
87A: NOMON Bits: —, 0, I, C, —, —, —, —.
87B: CRLAST flag Low bit is 1 if 'retn' last, otherwise Ø for all.
979: File Pointer Low address byte.
97A: File Pointer High address byte.
97F: File Pointer (high) MAXimum value allowed without error.
9F9: X value IN (restore on exit).
9FB: Y value IN (restore on exit).

Entry points

The COS entry points are stored at 87C to 87F, and the exit vectors, initially to the monitor, are stored at 8FC to 8FF. Since all these are in the margins of text page 2, that page should be prepared. If you had the forethought to save the prepared page along with the beginnings of COS itself, using

*800.EFFW Write text page 2 and COS-so-far to tape, with HELP you can now Read it in again thus:

*800.EFFR

Otherwise, you can either repeat the preparations now, or continue and sort out the rest later. The I/O vectors can be inserted from monitor:

*87C:FØ ØC 1B ØC

*8FB:4C FØ FD 1B FD note that 4C is JMP absolute.

Then switch to ASSeMbler:

```
*F666G ASM
!978:STY FFFF; FPL/FPH Write to FILE
   subroutine.
!     JMP D85; CONTD No room to finish in
   this margin.
!9F8:LDX#FF; XIN Exit, restoring X and Y.
!     LDY#FF; YIN
!     RTS
```

Note that if there is a semicolon following an assembler statement, any further text on that line is ignored — unless overwritten by the assembler output. In practice, it allows about six characters of comment at the end of a line, like ....LDA (35),Y or ...JMP (8FE) — but don't try to use the last position on a line, if you want readable results.

Locations 979/97A/9F9/9FB, which are set to FF at present, will change to more usual values when COS is running; do not be tempted to use

!978:STY ØØØØ

because the intelligent miniassembler will assume that you want zero-page addressing and so you will obtain the wrong opcode.

What we have so far is two non-

ROMable subroutines. Now we need some revisions in the initiation stage and the input 'bug', for which I will give a full listing here rather than patch the old version. We can then move on to the main work of this section, the output 'bug'.

```
!C00:LDX #4; INIT version 2
!     LDA 35,X ; LOOP pick up I/O vector
!     CMP 87B,X is it COS address?
!     BEQ C11 ; TO SKIP if so don't switch
!     STA 8FB,X store as COS exit
!     LDA 87B,X pick up COS entry address
!     STA 35,X and store as I/O vector
!     DEX ; SKIP next location
!     BNE C02 ; TOLOOP
!SC14:EA EA EA EA EA EA use fake monitor
  to put in six NOPs
!C1A:RTS ; END INIT
!     PHA ; INBUG
!     LDA #20
!     BIT 878 ; INFLAG note changed address
!     BMI C27 ; TOREAD stub
!     BVS C27 ; TOEXEC sub
!     BNE C27 ; TO???? spare stub
!     PLA
!     JMP (8FE) ; TOKEYIN note changed
  address
```

The revised version of INIT avoids the problem, found in the previous version, of disabling all I/O — and everything else — if called twice. Yet it will not re-attach itself to the monitor if it is used, for instance, with a printer. There is an easy but messy solution to it, but I hope to produce something more artistic and, in the meantime, this version works. Now for the output 'bug'.

```
!CF0:STY9FB ; YIN OUTBUG 8 Jan. '80
!     STX 9F9 ; XIN
!     TAY save character in Y register
!     LDA 879 ; OMODE what are we doing?
!     BMI D34 ; TODISP skip tests if it is
  make
!     TAX save OMODE in X register
!     LSR 87B ; CRLAST clear CRLAST into
  carry flag
!     BCC D2D; TOCRTES
```

If the last character was not a 'retn', perhaps this one is. If it was, we have to check for a CTRL-D, program output addressed to COS, or for a prompt — keyboard command mode — or for another 'retn'. At this point, the line above the ASM prompt (!) should read

```
0D00— 90 2B BCC S0D2D TOCRTES now
  type on:
!     CPY #84 ; CTRLD?
!     BNE D25 ; TOPRTES if not, prompt ?
!     LDY #A0 ; SPACE replace char. by
  space
!     LDA #2 ; INBUF file in input buffer:
  page 2
!     STA 97A ; FPH set file pointer
!     STA 97F ; FPMAX no overflow
  allowed
!     LDA #0
!     STA 979 ; FPL start of page 2
!     LDX #10 ; ISCD flag CTRL-D output
!     STX 879 ; SOMD set Operating
  MODE;
```

note that as before this is also saved in X.

```
!     LDA #40
!     AND 878 ; INFLAG
!     STA 878 ; INFLAG
```

Both CTRL-D output and a return to command mode will cancel a file READ and WRITE, but will not cancel EXEC if that is operating. That is compatible with DOS.

```
!     TXA return OMODE to A
!     BNE D34 ; TOPRINT? forced (X is not
  zero)
!     CPY 33; PRTES
```

Location 33H holds the current prompt, so this will work with any language.

```
!     BNE D2D ; TO CRTES if not, 'retn' ?
!     LDX #8 ; ISPR flag keyboard
  command
!     BNE D17 ; TOSOMD
```

Set OMODE, INFLAG, and branch to PRINT? as for CTRL-D. Forced.

```
!     CPY #8D ; CRTES
!     BNE D34 ; TOPRINT?
!     INC 87B ; CRLAST set flag to show
  'retn'.
```

The line above the prompt should now read

```
0D31— EE 7B 08 INC S087B CRLAST
```

A contains OMODE as does X, while Y holds the output character. If we BIT A with the NOMON flag, a zero result is obtained — the Z flag is set. If no bit in OMODE matches the corresponding bit in NOMON — that is, Z is not set if there is a '1' in the same position in each word. If that is the case, printout is to be suppressed.

```
!     BIT 87A; PRINT? 87A being NOMON
!     BNE D3E; TO FILE? suppress printout
!     TYA character to A
!     JSR 8FB; PRINTOUT see (*8FB....)
```

Note that the 6502 does not have JSR(8FC), though it does allow JMP(8FC) :::: JuMP to — the contents of 8FC and 8FD. That is a minor inconvenience.

```
!     TXA OMODE to A
!     AND #D0 ; FILE?
```

If it is MAKE, WRITE, or CTRL-D output, it is filed, otherwise not.

```
!     BEQ D45 ; TOCOS?
!     JSR 978 ; TOWFILE file it.
!     TXA OMODE to A
!     AND #18 ; COS?
```

If not keyboard command and not CTRL-D output, exit restoring A, X, Y.

```
!     BNE D4E ; TO CMD otherwise check
  for 'retn'
!     TYA ; EXIT character to A
!     JMP 9F8 ; EXIT2 see above, !9F8
!     LDA 87B ; CMD CRLAST to A
!     BEQ 4DA ; TOEXIT EXIT should be
  D4A!
```

We arrive at the command decoder which is reached only when a 'retn' is reached in keyboard command mode or in CTRL-D output. Thus a COS command issued while a program is running must be preceded by 'retn' CTRL-D and followed by 'retn'. That again is compatible with DOS 3.2.

```
!     LDY #FF —1; becomes 0 in a moment
!     LDX #0 ; XZERO point to start of
  input buffer
!     JSR D7C ; READON take non-space
  character from buffer
!     INY point to next char. in command
  table
!     CMP DA6,Y ; TABLE do they match ?
!     BNE D6D ; TOWRONG if not ,
!     LDA DA7,Y pick up next char. in
```

(continued on next page)

(continued from previous page)

command table

```
!       BMI D57 ; TOREADON unless
 command is finished
```

All keyboard input, and all program output, will be in the form of ASCII code plus 8Ø H — that is, with the high bit set. The command table consists of commands in the same form, separated by single bytes with the high bit not set, and terminated by one Ø byte.

The byte following any command is a vector to the routine for handling that command, except that it must be shifted left, doubled, so that we can cover a whole page. With the high bit not set, it can point only to an address in the range 1 to 8Ø — actually in the range EØ1 to E8Ø — while doubling allows it to point to any odd location from EØ1 to EFF.

BMI branches if the N flag is set, that is, if the high bit of the byte loaded into A is set. Otherwise we have found a COS command — or possibly one shared with Basic, such as RUN — and all we have to do is jump to the appropriate routine. The line above the prompt should now read ØD63— 3Ø F2 BMI $ØD57 TOREADON ....

```
!       TAY ; FOUNDIT! save vector/2 in Y
!       LDA #E high byte of routine address
!       PHA push it
!       TYA restore vector/2
!       ASL convert to vector
!       PHA push low byte of r.a. minus 1
!       RTS jump to it via RTS
```

Since the program counter is incremented after an RTS, it is going to jump to ØEXX, where XX is one greater than the vector we calculated. That deals with the COS command, once we find one.

If there is a mismatch, the decoder must step over any remaining characters of the incorrect command in the table, and be ready to select the first character of the next possible command. If it has reached the end of the table, it must restore A, X, and Y, clear the OMODE flag to cancel either command mode — in case the mode changes — and return to the calling routine, transparently. Thus:

```
!       INY ; WRONG point to next char. in
 cmd table
!       LDA DA6,Y ; pick it up
!       BMI D6D ; TO WRONG loop if not
 finished command
!       BNE D55 ; TOXZERO test for next
 cmd if any
!       STA 879 ; OMODE clear command
 mode if not. (A is Ø).
!       LDA #8D restore A ('retn')
!       BNE D4B ; TOEXIT2 and X and Y,
 and exit to calling routine. Unconditional
 branch.
```

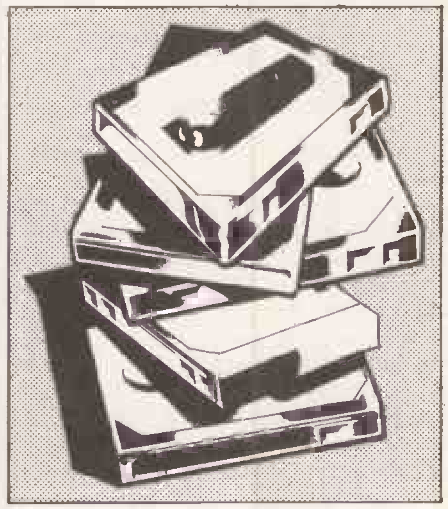
The last line should now read
ØD7A— DØ CF BNE $ØD4B TOEXIT2

Now we need a subroutine to read a non-space character from the input buffer. It is in fact identical to a subroutine used by ASM — but not, unfortunately, part of the monitor, so that it would only be available if on-board ROM is selected and, therefore, we have to include it here.

```
!       LDA 2ØØ,X; GETNSP take char. from
 in. buf.
!       INX point to next char.
!       CMP #AØ ; SPC? was it a space?
!       BEQ D7C ; TOGETNSP loop if so
!       RTS
```

There is another piece of unfinished business from the Write-to-FILE routine, which does not fit into the margins of text page 2 but is ROMable — which I am continuing here, temporarily:

```
!       INC 979 ; FPL WriteFileCONTd
!       BNE DA5 ; TORETURN same page,
 no overflow
!       INC 97A ; FPH next page if allowed
!       LDA 97F ; FPMAX what is limit of file
 space?
!       CMP 97A ; FPH have we passed the
 limit?
!       BCC DA5 ; TORETURN if not, carry
```



```
 on to next page
!       LDA #1
!       STA 879 ; OMODE
```

Clear MAKE, C-D, WRITE and indeed everything else; system mush crash 'safe' and give message of some kind to the operator.

```
!       JSR FF2D; TOPRERR monitor
 subroutine: 'ERR' and bell.
!       LDA CØØØ ; GETKEY wait for
 operator to respond
!       BPL D9D ; TOGETKEY loop until
 someone does
!       STA CØ1Ø clear keyboard strobe
!       RTS that should be DA5
```

That should cause the remaining output from an offending file-WRITEing program, for instance, to be dumped on to the screen rather than have it overwrite program space, variable space, or COS itself.

There is still one way in which this version of COS can be crashed — simply by holding down the space bar and the repeat key in command mode. That will fill the input buffer, 2ØØ to 2FF H, with spaces, ring the bell in between the last eight or so, print a backslash, and then a return.

COS will then scan the input buffer for possible commands, but since there is nothing there but spaces, it will go into an infinite loop — D7C to D83. Hit re-set and re-start COS, for now. This will be connected later.

Now we need a command table with at least one command in it; the obvious one, of course, is 'HELP', since we have already written the routine for that, i.e., to display text page 2. It is the first routine in page E, so HELP must be the last entry in the command table and must be preceded by a byte of 7F H or less, so that it will be read as a command, and followed by a 00 byte — end of table, and vector to HELP routine at 0E01.

The rest of the table should, for the moment, be filled with bytes of 80 H or more. Re-set to return to monitor, and:

DA6:AA First character in command table: ASCII '' with high bit set.
DA7<DA6.DF9M Copy ''s up as far as DFA inclusive.
*DFB: 08 C8 C5 CC D0 00 Vector for other 'command', HELP, end of table.

In case you missed the first part of this article, *Practical Computing*, May, I should explain that we had written a short routine, starting at E00 with a series of NOPs temporarily, which would display the second page of video RAM where we intend to put a list of COS commands with a short explanation of each, and return to the first page when you hit a key.

We have now overwritten the first byte of this with 00 (BRK), so the routine starts at E01 — where COS will jump to when we connect it and type 'HELP' (from any language). If you do not have the routine, you can add it from monitor by typing:

*E01: EA EA EA EA EA AD 51 C0
*:AD 55 C0 AD 00 C0 10 FB
*:AD 10 C0 AD 54 C0 4C 67 FD

Even if you have nothing very HELPful stored on page 2, you can still use it to test COS. Note the use of a colon with no address in front of it here. It allows one to continue inserting data where the previous line left off, so that 'AD 55 C0 ...' goes into D09 and following locations.

Transparent

We tested the HELP routine from monitor by *E00G and from Basic by CALL 3584; since E00 is now a BRK instruction, you can try *E01G or CALL 3585, as appropriate. Then connect COS by *C00 or CALL 3072, and check that it is transparent to normal monitor commands, Basic statements and program output, and to the ASseMbler.

If you are in the habit of using re-set to switch between languages, break it now. It will kill COS and will soon be unnecessary. CALL —151 from Basic, and use *C090 CTRL-B to reach Applesoft, rather than using the hardware switch, and instead of using re-set to escape from ASM, try !$FF69G.

Now, from monitor, try

*878.87B display INFLAG, OMODE, NOMON, CRLAST.

They were all 00 originally, and three should still be 00 — or maybe four. If you hit re-set and try again, OMODE should have changed to 08 to show that you were in command mode when COS was killed. Re-connect COS, switch to INTeger Basic, try

>10PRINT print a 'retn'
>20GOTO10
>RUN

and then re-set again, kill COS, and again do *878.87B. This time, OMODE should be 00 and CRLAST should be 01. If so, everything is working so far. Now the fateful moment, re-connect COS and type HELP — it doesn't matter which language you are in. Page 2 of text should appear, as before — but this is now due to COS and not to the use of a monitor Go or a Basic CALL.

Now hit any key — not re-set. The mystery bug strikes; page 1 appears for an instant, then page 2 returns and you can repeat this as often as you like. The only way out is re-set. Why does this happen, when *E01G works perfectly ?

The answer is, there is one more thing we should do when COS finds a command. Here is a clue:

*E18:6A change JMP GETLNZ to JMP GETLN

Exploration

Re-connect COS and try HELP again which works. Switch to INT.and check that HELP works there and that when page 1 returns you are really in command mode, for instance:

>HELP
>IS THIS BASIC?
***SYNTAX ERR
>10 PRINT"HELP"
>20 END
>RUN it does not work
HELP
>5PRINT"" put in a CTRL-D there
>RUN still does not work
HELP
>5PRINT""; CTRL-D in there again
>15PRINT"NO !" wait and see
>RUN it works
HELP
>IS THIS BASIC ? try it and see.
NO!

A little further exploration will show that a 'retn' is needed before the CTRL-D. One further problem — COS recognises two command modes: keyboard command, with a sequence of 'retn', prompt, HELP 'retn'; and CTRL-D output, with a sequence of 'retn' CTRL-D HELP 'retn'. Apparently, CTRL-D and prompt should be interchangeable, yet if you replace the CTRL-D by prompt thus:

>5PRINT" ";

and then RUNit, it does not work. Why not?

A few final things: return to monitor and try

*978.97F 8C FPL FPH 4C 85 0D 00 FPMAX

Three bytes should have changed.

*9F8.9FF A2 XIN A0 YIN 60 00 00 00

two changes.

You can save COS-so-far on tape by

*800.EFFW 800.EFFW

which will give two copies for safety.

BUYERS' GUIDE

Software

The Software Buyers' Guide is bigger and more comprehensive this month. The successful presentation used in the last guide has been retained but for easy reference, suppliers, applications and machine types are listed in alphabetical order. Application packages are listed by machine type, giving machine, company name, price and capacity.

The usual criteria have been applied. The minimum configuration is 32K of RAM, a disc and a printer; the price of the package must lie between £50 and £1,000; the companies listed are the source of the software or the main dealers in the U.K., and the capacity quoted is per disc or drive.

Machine types by main applications

Combined-Ledger/Stock/Invoicing

Machine type	Supplier Name	Price	Capacity
Commodore 3032	G W Computers Ltd	£275 - £575	1,000
Z-80/8080	Great Northern C S Ltd	£995	varies
Ohio Scientific	Microcomputer B M	£656	
Tandy TRS-80	Microcomputer Applications	£90 each	
Tandy TRS-80	T & V Johnson Ltd	£110	750 trans/disc
Commodore 3032	Bristol Software Factory	£300	1,000 A/Cs 6,000 trans
Apple II	Vlasak Electronics Ltd	£855	
CP/M North Star	Benchmark CS Ltd	£950	200 A/Cs 500 trans 300 ITM
Commodore 3032	Stage One Computers		
Commodore 3032	Commodore B M (U.K.) Ltd	£650	650 A/C/ledger
CP/M	Computastore Ltd	£1,000	
Tandy TRS-80	Mode Microcomputer Applications	£350	

General Ledger

Machine Type	Supplier Name	Price	Capacity
Z-80/8080	Great Northern C S Ltd	£275	varies
Tandy TRS-80	Tridata Micros Ltd	P.O.A.	to be linked to S/L P/L

Apple II	Computech Systems	£295	500 A/Cs 1,600 trans
Commodore 3032	HB Computers Ltd	£200	linked to S/L & P/L
Apple II	Vlasak Electronics Ltd	£225	200 A/Cs 1,000 trans
CP/M	Computastore Ltd	£500	999 A/Cs 99 centres 9 companies
CP/M	Comput-A-Crop	£400	
CP/M North Star	Benchmark CS Ltd	£250	500 A/Cs 5,700 trans
Apple II	Microdigital Ltd	£295	

Incomplete Records

Machine type	Supplier Name	Price	Capacity
CP/M	Profcomp Ltd	P.O.A.	2,000 entries
Commodore 3032	Micro Computation	£555	120 A/Cs 5,000 trans
Apple II/ITT 2	Padmede Computer Services	£450	900 A/Cs 2,000 trans/disc
Exidy Sorcerer	Basic Computing	£350	incl. Vasee also Micropute
Apple II	Personal Computers Ltd	£250	1,000 trans 2,600 A/Cs
Commodore 3032	Stage One Computers		

Job Costing/Billing

Machine type	Supplier Name	Price	Capacity
CP/M	Graffcom Systems Ltd		100 activity codes
Z-80/8080	Great Northern C S Ltd	£330	varies
Apple II/ITT2	Padmede Computer Services	£300	1,000 A/Cs 99 centres
Apple II/ITT 2	Padmede Computer Services	£300	150 A/Cs
Commodore 3032	Stage One Computers		

Mailing Systems

Machine type	Supplier Name	Price	Capacity
CP/M	Structured Systems Group	£50	varies
Apple II	Keen Computers Ltd	£300	500 addresses
Tandy TRS-80	T & V Johnson Ltd	P.O.A.	3,000 names/addresses
Z-80/8080	Micro Focus	£90	varies
CP/M	Graffcom Systems Ltd	£250	varies
Apple II/ITT 2	The Software House	£57	
Commodore 3032	Stage One Computers		
Apple/ITT 2020	Systematics Intl Ltd	£300	500 addresses

Payroll

Machine type	Supplier Name	Price	Capacity
Apple	Algobel Computers Ltd	£295	500 employees
Commodore 3032	Computastore Ltd	£200	275 employees
		£350	500 employees
CP/M	Graffcom Systems Ltd	£500	250 employees
Tandy TRS-80	Tridata Micros Ltd	£218	400 employees
Apple II/ITT 2	Computech Systems	£379	
Apple II/ITT 2	T W Computers Ltd	£145	
Commodore	Petsoft Ltd	£50	200 employees
Commodore 3032	Landsler Software	£95	250 employees
Commodore 3032	L & J Computers	£220	
Tandy TRS-80	3-Line Computing	£140	
Apple II/ITT 2	Hewport Ltd	£400 - £500	100 month 50 weekly
Apple II/ITT 2	Vlasak Electronics Ltd	£360	
CP/M	Comput-A-Crop	£450	
Apple II	Microdigital Ltd	£375	
Commodore 3032	Commodore B M (U.K.) Ltd	£150	200 employees
Apple/ITT 2020	Systematics International Ltd	£295	350 employees

Property Management

Machine type	Supplier Name	Price	Capacity
Z-80/8080	Graham Dorian Software	£325	varies
Apple II/ITT 2	Algobel Computers Ltd	£650	400 buildings 250 own 2,000 trans
CP/M	Algobel Computers Ltd	£650	2,000 trans

Purchase Ledger

Machine type	Supplier Name	Price	Capacity
CP/M	Structured Systems Group	£460	varies
Commodore 3032	Microact Ltd	£350	2,000 A/Cs 7,000 trans
Z-80/8080	Great Northern C S Ltd	£275	varies
Tandy TRS-80	Tridata Micros Ltd	£225	175 A/Cs 1,350 trans
Apple II	Vlasak Electronics Ltd	£315	200 A/Cs 1,000 trans
Apple II	Computech Systems	£295	500 A/Cs 1,600 trans
Commodore 3032	HB Computers Ltd	£350	800 A/Cs 4,000 trans
CP/M	Computastore Ltd	£400	500 A/Cs 3,100 trans
Apple II/ITT 2	Padmede Computer services	£300	900 A/Cs 4,500 trans/disc
Exidy Sorcerer	Basic Computing	£125	incl. Vasee also Micropute
CP/M	Comput-A-Crop	£400	500 A/Cs
CP/M North Star	Benchmark CS Ltd	£250	500 A/Cs 2,000 trans
Apple II	Microdigital Ltd	£295	
Commodore 3032	Act (Petsoft) Ltd	£120	200 A/Cs 700 trans

Records Management (DBMS)

Machine type	Supplier Name	Price	Capacity
Commodore 3032	Commodore B M (U.K.) Ltd	£150	650
Commodore Pet	Stage One Computers	£120 & £180	165K
Apple II/ITT 2	T & V Johnson Ltd	£95	112K per drive
Ohio Scientific	Microcomputer B M	£175	
Commodore 3032	Amplicon M S Ltd	£140	1,500 records
Tandy TRS-80	T & V Johnson Ltd	£200	
Z-80/8080	Structures Systems Group	£135	varies
Commodore 3032	Compsoft Ltd	£95 ea	170,600-5,000 records
Apple/ITT	The Software House	£140	
Commodore 3032	Microact Ltd		400K - 800K
Apple/ITT 2020	Systematics International Ltd	£72 & £175	
Apple/ITT 2020	Systematics International Ltd	£125	1,000 references

Sales Ledger

Machine type	Supplier Name	Price	Capacity
Commodore 3032	Microact Ltd	£350	2,000 A/Cs 7,000 trans
Z-80/8080	Great Northern C S Ltd	£275	varies
Tandy TRS-80	Tridata Micros Ltd	£225	175 A/Cs 1,350 trans
Apple II	Vlasak Electronics Ltd	£315	200 A/Cs 1,000 trans
Apple II	Computech Systems	£295	500 A/Cs 1,600 trans
Commodore 3032	HB Computers Ltd	£350	800 A/Cs 4,000 trans
CP/M	Computastore Ltd	£400	500 A/Cs 3,500 trans
Apple II/ITT 2	Padmede Computer Services	£300	900 A/Cs 4,500 trans/disc
Exidy Sorcerer	Basic Computing	£125	incl. Vasee also Micropute
CP/M North Star	Benchmark CS Ltd	£250	500 A/Cs 2,000 trans
Apple II	Microdigital Ltd	£295	
Commodore 3032	Act (Petsoft) Ltd	£120	200 A/Cs 700 trans

Stock Systems

Machine type	Supplier Name	Price	Capacity
Apple II/ITT 2	Microdigital Ltd	£225	625 items
CP/M	Graffcom Systems Ltd	£350	520 - 6,000 items
Z-80/8080	Great Northern C S Ltd	£275	varies
Tandy TRS-80	Tridata Micros Ltd	£200	630 items/disc
Commodore 3032	Commodore B M (U.K.) Ltd	£150	650
Commodore 3032	Bristol Software Factory	£300 - £360	2,300
Z-80/8080	Graham Dorian Software	£325	varies
Apple II/ITT 2	Vlasak Electronics Ltd	£285	
Commodore 3032	Petsoft Ltd	£50	2,000
Commodore 3032	L & J Computers	£120	3,400 items
Commodore 3032	Microact Ltd	£350	2,500 items 1,000 A/Cs
Tandy TRS-80	T & V Johnson Ltd	£115	1,000 items
Tandy TRS-80	T & V Johnson Ltd	£145	1,000 items/invoices
Commodore 3032	Aplicon M S Ltd	£750	500-600 items 255 A/Cs
Exidy Sorcerer	Basic Computing	£125	incl. Vasee also Micropute
Apple/ITT	The Software House	£80	
CP/M North Star	Benchmark CS Ltd	£450	1,000 items 750 trans
Commodore 3032	Stage One Computers		

Commodore 3032	Act (Petsoft) Ltd	£75	
Apple/ITT 2020	Systematics International Ltd	£500	200-2,500 items
Z-80/8080	Rogis Systems Ltd	£500	900 - 3,500 items

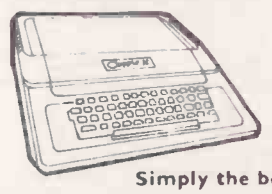
Word Processing

Machine type	Supplier Name	Price	Capacity
Commodore 3032	Commodore B M (U.K.) Ltd	£75 & £150	170 pages
Tandy TRS-80	T & V Johnson Ltd	£109	10,000 words
Ohio Scientific	Microcomputer B M	£116	
Apple II/ITT 2	Algobel Computers Ltd	£75	800 lines
Commodore 3032	Dataview Ltd	£159	
Commodore 3032	HB Computers Ltd	£70	39 A4 pages
Apple II/ITT 2	Vlasak Electronics Ltd	£120	
Z-80/8080	Structured Systems Group	£120	varies
Apple II	Personal Computers Ltd	£150	17 A4 pages
Commodore 3032	Stage One Computers		
Commodore 3032	Act (Petsoft) Ltd	£325	
CP/M	Computastore Ltd	£400	
Apple/ITT 2020	Systematics International Ltd	£75	

Applications by machine

Apple II/ITT 2020

Application	Supplier Name	Price	Capacity
Cash-flow/bank	Vlasak Electronics Ltd	£80	
Credit control	Microdigital Ltd	£130	
DBMS	The Software House	£140	
DBMS	T&V Johnson Ltd	£95	112K per drive
DBMS I & II	Systematics International Ltd	£75 & £175	
DBMS text files	Systematics International Ltd	£125	1,000 references
Estate agents' register	Vlasak Electronics Ltd	£120	
Estate agents' system	Systematics International Ltd	£850	
Financial planning	Systematics International Ltd	£295	
Incomplete records	Personal Computers Ltd	£250	1,000 trans 2,600 A/Cs
Incomplete records/ nominal ledger	Padmede Computer Services	£450	900 A/Cs 2,000 trans/D
Job costing	Padmede Computer Services	£300	1,000 A/Cs 99 centres
Job-T&M cost recording	Padmede Computer Services	£300	APCs
Ledger general	Computech Systems	£295	500 A/Cs 1,600 trans
Ledger general	Microdigital Ltd	£295	
Ledger general	Vlasak Electronics Ltd	£225	200 A/Cs 1,000 trans
Ledgers/general sales purchase	Vlasak Electronics Ltd	£855	
Ledger purchase	Computech Systems	£295	500 A/Cs 1,600 trans
Ledger purchase	Microdigital Ltd	£295	
Ledger purchase	Padmede Computer Services	£300	900 A/Cs 4,500 trans
Ledger purchase	Vlasak Electronics Ltd	£315	200 A/Cs 1,000 trans
Ledger sales	Computech Systems	£295	500 A/Cs 1,600 trans
Ledger sales	Microdigital Ltd	£295	
Ledger sales	Padmede Computer Services	£300	900 A/Cs 4,500 trans
Ledger sales	Vlasak Electronics Ltd	£315	200 A/Cs 1,000 trans
Letter writer	Vlasak Electronics Ltd	£80	
Mail system	The Software House	£57	
Mailing and letter writer	Keen Computers Ltd	£300	500 addresses
Mailing system	Systematics International Ltd	£300	500 addresses
Modelling (VisiCalc)	Microsense Computers Ltd	£95	
Payroll	Algobel Computers Ltd	£295	500 employees
Payroll	Computech Systems	£379	
Payroll	Hewport Ltd	£400 - £500	100 months 50 weekly
Payroll	Microdigital Ltd	£375	
Payroll	Systematics International Ltd	£295	350 employees
Payroll	TW Computers Ltd	£145	
Payroll	Vlasak Electronics Ltd	£360	
Property management	Algobel Computers Ltd	£650	400 buildings 250 own 20



Sales analysis	Microdigital Ltd	£200	500 A/Cs
Stock control	Microdigital Ltd	£225	625 items
Stock control	Systematics International Ltd	£500	200-2,500 items
Stock control	The Software House	£80	
Stock/purchase/order invoicing	Vlasak Electronics Ltd	£285	
Structural engineering design	James C Steadman	£200	
Word processing	Vlasak Electronics Ltd	£120	
Word processing	Algobel Computers Ltd	£75	800 lines
Word processing	Personal Computers Ltd	£150	17 A4 pages
Word processing	Systematics International Ltd	£75	

Commodore 3032

Application	Supplier Name	Price	Capacity
Appointments planner	Commodore B M (U.K.) Ltd	£50	200 entries
Building conversion	Micro Computation	£300 - £400	320 clauses
DBMS	Amplicon M S Ltd	£140	1500 records
DBMS	Commodore B M (U.K.) Ltd	£150	650
DBMS	Microact Ltd		400K-800K
DBMS MK I & II	Compsoft Ltd	£95 ea	17,600-5,000 records
DBMS sequential & random	Stage One Computers	£120 & £180	165K 165K
Hotel room system (INTG)	Landsler Software	£275	8X99 rooms for 400
Hotel system (+billing)	Landsler Software	£450	130 rooms
Incomplete records A/C	Micro Computation	£555	120 A/Cs 5,000 trans
Incomplete records	Stage One Computers		
Insurance brokers' system	Stage One Computers		
Insurance renewals	Stage One Computers		650 policies
Job/apartments planner	Stage One Computers		
Ledger general	HB Computers Ltd	£200	Linked to S/L & P/L
Ledger/general & purchase	Bristol Software Factory	£300	1,000 A/Cs 6,000 trans
Ledger purchase	ACT (Petsoft) Ltd	£120	200 A/Cs 700 trans
Ledger purchase	HB Computers Ltd	£350	800 A/Cs 4,000 trans
Ledger purchase	Microact Ltd	£350	2,000 A/Cs 7,000 trans
Ledger sales	ACT (Petsoft) Ltd	£120	200 A/Cs 700 trans
Ledger sales	HB Computers Ltd	£350	800 A/Cs 4,000 trans
Ledger sales	Microact Ltd	£350	2,000 A/Cs 7,000 trans
Ledger/sales, purchase & general	Commodore BM (U.K.) Ltd	£650	650 A/C ledgers
Ledgers/sales, purchase & general	Stage One Computers		
Ledgers/stock/ invoicing	GW Computers Ltd	£275 £575	1,000
Mailing system	Stage One Computers		
Ordercontrol	MMS Computer Systems	£250	3,600 orders
Payroll	Commodore BM (U.K.) Ltd	£150	200 employees
Payroll I & II	Computastore Ltd	£200 & £350	275 & 500 employees
Payroll	Landsler Software	£95	250 employees
Payroll	Petsoft Ltd	£50	200 employees
Payroll/invoicing	L&J Computers	£220	
Printers quote system	Microland	£175	
Stock control	Act (Petsoft) Ltd	£75	
Stock control	Amplicon MS Ltd	£750	500-600 items 255 A/Cs
Stock control	Commodore BM (U.K.) Ltd	£150	650 items
Stock control	Microact Ltd	£350	2,500 items 1,000 A/Cs
Stock control	Petsoft Ltd	£50	2,000 items
Stock control	Stage One Computers		
Stock control	Bristol Software Factory	£300 £360	2,300 items
Stock control	L&J Computers	£120	3,400 items
Window replacement	CSM Ltd	£500	

Word processing	Act (Petsoft) Ltd	£325	
Word processing	Dataview Ltd	£159	
Word processing	Stage One Computers		
Word processing	Commodore BM (U.K.) Ltd	£75 £150	170 pages
Word processing	HB Computers	£70	70
Work measurement	The Alphabet Company	£150	

CP/M

Application	Supplier Name	Price	Capacity
Hire purchase system	Graffcom Systems Ltd		varies
Incomplete records	Profcomp Ltd	P.O.A.	2,000 entries
Job-time recording	Graffcom Systems Ltd		100 activity codes
Ledger general	Benchmark CS Ltd	£250	500 A/Cs 5,700 trans
Ledger general	Comput-A-Crop	£400	
Ledger general	Computastore Ltd	£500	999 A/Cs 99 centres
Ledger purchase	Benchmark CS Ltd	£250	500 A/Cs 2,000 trans
Ledger purchase	Comput-A-Crop	£400	500 A/Cs
Ledger purchase	Computastore Ltd	£400	500 A/Cs 3,100 trans
Ledger purchase	Structured Systems Group	£460	varies
Ledger sales	Benchmark CS Ltd	£250	500 A/Cs 2,000 trans
Ledger sales	Computastore Ltd	£400	500 A/Cs 3,500 trans
Ledger/sales, & general	Computastore Ltd	£1,000	
Ledger/stock/ invoicing	Benchmark CS Ltd	£950	200 A/Cs 500 trans
Mail list system	Graffcom Systems Ltd	£250	varies
Mailing system	Structured Systems Group	£50	varies
Order entry & invoicing	Benchmark CS Ltd		
Order entry & invoicing	Graffcom Systems Ltd	£350	500-5,000 orders
Payroll	Comput-A-Crop	£450	
Payroll	Graffcom Systems Ltd	£500	250 employees
Property management	Algobel Computers Ltd	£650	2,000 trans
Purchasing system	Graffcom Systems Ltd	£450	540-7,000 invoices
Stock control	Graffcom Systems Ltd	£350	520-6,000 items
Stock/inventory control	Benchmark CS Ltd	£450	1,000 items 750 trans
Word processing	Computastore	£400	

Exidy Sorcerer

Application	Supplier Name	Price
Incomplete records	Basic Computing	£350
Ledger purcahse	Basic Computing	£125
Ledger sales	Basic Computing	£125
Stock recording	Basic Computing	£125

Ohio Scientific

Application	Supplier Name	Price
DBMS	Microcomputer BM	£175
Ledgers/stock/ invoicing	Microcomputer BM	£656
Word processing	Microcomputer BM	£116

Tandy TRS-80

Application	Supplier Name	Price	Capacity
DBMS	T&V Johnson Ltd	£200	
Invoicing	Tridata Micros Ltd	£75	Linked to stock SA
Ledger general	Tridata Micros Ltd	P.O.A.	Linked to S/L P/L
Ledgers/payroll various	Microcomputer Applications	£90 each	
Ledger purchase	Tridata Micros Ltd	£225	175 A/Cs 1,350 trans
Ledger sales	Tridata Micros Ltd	£225	175 A/Cs 1,350 trans
Ledgers/sales, purchase, general & invoice	Microcomputer Applications	£350	

SHOPWINDOW

Ledgers/stock invoicing	T&V Johnson Ltd	£110	750 trans/disc
Mailing system	T&V Johnson Ltd	P.O.A.	3,000 names/addresses
Payroll	3-Line Computing	£140	
Payroll	Tridata Micros Ltd	£218	400 employees
Stock control	T&V Johnson Ltd	£115	1,000 items
Stock control/ invoicing	T&V Johnson Ltd	£145	1,000 items/invoices
Stock control	Tridata Micros	£200	630 items/disc
Word processor (EP)	T&V Johnson Ltd	£109	10,000 words

Z-80/8080

Application	Supplier Name	Price	Capacity
Appointments system	Great Northern CS Ltd	£220 - £275	varies
DBMS	Structured Systems Group	£135	varies
Job/client	Great Northern CS Ltd	£330	varies
Ledger general	Great Northern CS Ltd	£275	varies
Ledgers/payroll	Great Northern CS Ltd	£995	varies
Ledger purchase	Great Northern CS Ltd	£275	varies
Ledger purchase	Great Northern CS Ltd	£275	varies
Mail list system	Micro Focus	£90	varies
Property management	Graham Dorian Software	£325	varies
Purchasing system (job)	Great Northern CS Ltd	£275	varies
Sales analysis (retail)	Great Northern CS Ltd	£325	varies
Stock control	Graham Dorian Software	£325	varies
Stock control	Rogis Systems Ltd	£500	varies
Stock control (retail)	Great Northern CS Ltd	£275	varies
Word processing	Structured Systems Group	£120	varies

Alphabetical list of suppliers

Supplier	Address	Sales contact
Act (Petsoft) Ltd 021-455-8585	Radclyffe House, 66-68 Hagley Road, Edgbaston, Birmingham.	Sales
Algobel Computers Ltd 021-233-2407	33 Cornwall Buildings, Newhall Street, Birmingham B3 3QR	Steven Linden
Amplicon M S Ltd 0273-562163	143A Ditchling Road, Brighton, Sussex BN1 6JA.	Jim Hicks
Basic Computing 0535-65094	Oakworth Road, Keighley, West Yorkshire BD22 7LA.	Mike Collier
Benchmark CS Ltd 0726-61000	Tremena Manor, Tremena Road, St Austell, Cornwall PL25 5QG.	S Willmott
Bristol Software Factory 0272-20801	Micro House, St Michael's Hill, Bristol BS2 8BS.	W J Kyle-Price
Commodore B M (U.K.) Ltd 0753-74111	818 Leigh Road Trading Estate, Slough, Berkshire.	Nick Green
Compsoft Ltd 2483-39665	Old Manor Lane, Chilworth, Guildford, Surrey.	Nick Horgan
Comput-A-Crop 01-771 0867	32 Whitworth Road, London SE25 6XH.	Jenny Wilson
Computastore Ltd 061-832-4761	16 John Dalton Street, Manchester M2 6HG.	David Nicholson
Computech Systems 01-794 0202	168 Finchley Road, London NW3.	Laurence Payne
CSM Ltd 021-382-4171	Refuge Assurance House, Sutton New Road, Erdington, Birmingham B23 6QX.	Peter Mart
Dataview Ltd Colchester 78811	Colchester, Essex.	P Handover
G W Computers Ltd 01-636 8210	89 Bedford Court Mansions, Bedford Avenue, London WC1.	Tony Winter

Graffcom Systems Ltd 01-734 8862	52 Shaftesbury Avenue, London W1V 6DE.	Barbara Castledine
Graham Dorian Software 01-379 7931	C/O Lifeboat Associates, 32 Neal Street, London WC2H 9PS.	John Clifford
Great Northern C S Ltd 0532-450667	15 Wellington Street, Leeds LS1 4DL.	P Clark
HB Computers Ltd 0536-83922 & 520910	22 Newland Street Kettering, Northamptonshire	Stuart Whittaker
Hewport Ltd 04254-77352	20 Cunningham Close, Ringwood, Hampshire BH24 1XW.	D N Rogers
James C Steadman 0903-814923	18 Manor Road, Upper Beeding, Steyning, Sussex BN4 3TJ.	James Steadman
Keen Computers Ltd 0602-583254	5B The Poultry, Nottingham.	Bob Ellis
L & J Computers 01-204 7525	3 Crundale Avenue, Kingsbury, London NW9 9PJ.	J Goodman
Landsler Software 01-399 2476/7	29A Tolworth Park Road, Surbiton, Surrey KT6 7RL.	E Landsler
3-Line Computing 0482-445496	36 Slough Road, Hull HUS 1QL.	Tim Hill
Micro Computation 01-882 5104	8 Station Parade, Southgate, London N14.	Graham Dicker
Micro Focus 01-379 7931	C/O Lifeboat Associates, 32 Neal Street, London WC2H 9PS.	Chris Barnes
Microact Ltd 021-455-8585	Radclyffe House, 66-68 Hagley Road, Edgbaston, Birmingham B16 8PF.	John Farthing
Microcomputer Applications 0734-470425	11 Riverside Court, Caversham, Reading RG4 8AL.	W S Jupp
Microdigital Ltd 051-227-2535	25 Brunswick Street, Liverpool, L2 0BJ.	Graham Jones
Microland 0723-70715	17 Victoria Road, Scarborough, N Yorks YO11 1SB.	Rick Holland
Micropute 0625-612818	Communique Place, 9 Presbury Place, Macclesfield, Cheshire.	Don Cooper
Microsense Computers Ltd 0442-41191/48151	Finway Road, Hemel Hempstead, Hertfordshire HP2 7PS.	D Page
MMS Computer Systems 0234-40601	26 Mill Street, Bedford.	D Nicholls
Padmede Computer Services 025-671 2434	112/116 High Street, Odiham, Basingstoke, Hampshire.	John Packwood
Personal Computers Ltd 01-626 8121/2/3	194-200 Bishopsgate London, EC4M 4NR.	Steve Derrick
Petsoft Ltd 021-455-8585	Radclyffe House, 66-68 Hagley Road, Edgaston, Birmingham B16 8PF.	Julian Allason
Profcomp Ltd 01-989 8177	107 George Lane, South Woodford, London E18 1AN.	Brian Whitcomb
Rogis Systems Ltd 0580-80310	Keeper's Lodge, Frittenden, Cranbrook, Kent.	Welby Everard
Stage One Computers 0202-23570	6 Criterion Arcade, Old Christchurch Road, Bournemouth, Hants.	N Hewitt
Structured Systems Group 01-379 7931	C/O Lifeboat Associates 32 Neal Street, London WC2H 9PS.	John Clifford
Systematics International Ltd 0268-284601	Essex House, Cherrydown, Basildon, Essex.	R Young
T & V Johnson Ltd 0276-62506	165 London Road, Camberley, Surrey GU15 3JS.	T Johnson
T W Computers Ltd 061-456-8187	293 London Road, Hazel Grove, Stockport, Cheshire.	G Thompson
The Alphabet Company 0304 617209	2 Whitefriars Way, Sandwich, Kent, CT13 9AD.	A L Minter
The Software House 01-637 1587	146 Oxford Street, London, W1.	Keith Jones
Tridata Micros Ltd 021-622-6085	Smithfield House, Digbeth, Birmingham B5 6BS.	A Plackowski
Vlasak Electronics Ltd 06284-74789	Thames Building, Dedmere Road, Marlow, Buckinghamshire SL7 1PB.	Paul Vlasak

SHOPWINDOW

MICRO ADS

are accepted from private readers only, pre-paid and in writing, 20p per word, minimum charge £2.

UK 101-BASED microcomputer built into video terminal. 11K user RAM, several games programs included. Tel: 01-688 8658 £355 or nearest offer.

COMPUTACASE. Flap-over style briefcase specially proportioned (16" × 12") to take computer print-out sheets. 3 compartments, quality lock and handle. Handmade from smooth black or chestnut hide. £34 + £1.50 P.&P. The Saddlers Shop, Caledonian Road, Wishaw, Scotland.

ITT 2020 16K Palsoft & Integer Basic. UHF Modulator. Games paddles. Lots of tapes. Full literature. Free disc controller (worth £43). Only three months old. Save over £100. First £595 secures. Tel: 0494 711431 Day, 024029 273 Evenings.

SORCERER 32K + TV Interface + Games cassette. Used only 10 hours £690. Will deliver. Tel: (0373) 4181.

PET 2001-8 Little used, perfect condition. Extensive Software. £500 o.n.o. West End (Southampton) 3493.

TANDY TRS-80 Radio Shack Level II For Sale. Comprises of V.D.U. 32K; D.O.S. 2.2 plus; 2 × disk drive; Tractor feed line printer; Quick printer and many extras. Will separate, £2750.00 o.n.o. Tel: 021-558 2468.

XTAL BASIC RENUMBER. Append to existing basic. No buffer required £4. Super Star Trek with animated torpedoes £5. J. H. Taylor, 4 East View Avenue, Cramlington Vill., Northumberland.

IMSAI 8080 Mainframe, CPU, F/panel etc (partial kit) £400; Thinker Toys S-100 'Switchboard' I/O (Kit) £108; Shugart SA400 Drive/Cabinet (mint) £190; Computalker S-100 Speech Synthesiser Board (new) and manuals/software (N/Star diskettes) £275. Other S-100 items to clear. Phone (evenings) Crawley 515201.

DOLA SOFTWARE UK 101 and ACORN programs. Subroutine library in Basic and Machine code for UK 101, Graphics and original games. Programs for Morse Code, Music and Teletype interface for Acorn. General hardware interfacing. S.A.E. for list. 117, Blenheim Road, Deal, Kent.

PET — 8K, New ROMS, big keyboard, green screen, cass, lots of progs. £400. Biggin Hill 71742 (Evenings).

TRS80 16K Level II with Library 100 £380. Star chess TV game £40 o.n.o. Brighton 593475.

250ns Low-Power 2114L-02 only £3.95. Phone St. Albans (56) 34629.

OSC-3C General purpose Oscilloscope with 10-1 probe. Hardly used, as new £70 ono. Also Intertube II VDU nearly new £400 ono. Creed Envoy ASR Printer V24 Interface ASCII upper/lower case, 8 hole punch and reader, real value for your money at £300. Ring 042-784 372.

FASTER TYPING ON COMPUKIT UK101. Basic Keywords in one touch. Control-I and INPUT appears on screen; Control-T for TAB(etc. Tape for £2.95 + S.A.E. A. R. Leader, Haileybury-B.Fr, Hartford, SG13 7NU.

Financial crisis forces sale; all new, full spec:— 2716,5V Eproms £20; 4116-2, £5. (Pembury) 0892-823133.

For Sale TI-59 calculator, print cradle, maths module. £225. Programming assistance possible. Phone Wolverhampton (0902) 780955.

PET 32K Business Computer compatible with either CBM or Computhink Disks, £690. Centronics Microprinter P1 (Suitable for Pet, Tandy etc) £210. Phone Liss 2512 Anytime.

'Understanding Wave Forms' Apple Self-Tutor Program with Hi-Res. Graphics for Apple plus. Two 16K. Programs. Cassette £3.90: Disc £5.50. E. Green, 550 Midgeland Road, Blackpool, Lancs.

ANADEX PRINTER FOR SALE, complete with Pet Interface. Surplus to requirements and absolutely good as new. £375. Tel: 01-952 8955.

TOMORROW TODAY
at Birmingham Computer Centre

3016, 3032, 3008 PETs
The reliable value for money system with after sales support, instruction and training facilities and a wide range of programmes.

3040 DUAL DRIVE FLOPPY DISC
The latest in disc technology. Low cost with reliable data transfer.

3022 PROFESSIONAL PRINTER
The high specification printer. Prints all PET characters onto paper and accepts labels, printed forms, cheques, etc.

Apple authorised distributors
The sophisticated quality system with a reputation for advanced design and innovation.

Camden Electronics,
First Floor,
462 Coventry Road,
Small Heath, Birmingham B10 0UG.
Telephone 021 773 8240
Open Mon.-Sat. 9.30-6.00 p.m.
A MEMBER OF THE COMPUTER RETAILERS ASSOCIATION

• Circle No. 254

THERE'S ONLY ONE COLOUR VDU BOARD FOR YOUR NASCOM

THE WT625 FROM WINCHESTER TECHNOLOGY

IT'S THE ONLY NASBUS COMPATIBLE COLOUR VDU BOARD THAT OFFERS ALL THESE FEATURES:

- 13 COLOURS
- VIEWDATA AND TELETEXT COMPATABILITY
- COLOUR GRAPHICS WITH A RESOLUTION OF 5760 PELS
- COLOUR ALPHANUMERICS
- FLASHING CHARACTERS
- SINGLE OR DOUBLE HEIGHT CHARACTERS

43 IC's, PAL ENCODER AND UHF MODULATOR ARE PACKED ONTO A SINGLE PCB MEASURING 8" × 8" WHICH PLUGS DIRECTLY INTO YOUR EXTENSION BOARD AND WE EVEN SUPPLY THE COAX CABLE TO CONNECT IT TO THE AERIAL SOCKET OF YOUR COLOUR TV.

DON'T GET YOUR FINGERS BURNT BUILDING A KIT, THE WT625 IS SUPPLIED FULLY ASSEMBLED AND TESTED.

WE WON'T LEAVE YOU HOLDING JUST A PIECE OF HARDWARE EITHER, THERE'S COMPREHENSIVE DOCUMENTATION, A FAULT FINDING GUIDE AND AN EFFICIENT AFTER SALES SERVICE. WE CAN ALSO SUPPLY YOU WITH 'GRAFFIC' AN OPTIONAL SOFTWARE PACKAGE TO HELP YOU WITH THE TRICKIER BITS OF GRAPHIC PROGRAMMING.

WT625 VDU BOARD £136 + VAT
GRAFFIC 2708 PROM £11 + VAT
MONEY BACK GUARANTEE
ORDERS OR FULL DETAILS FROM
WINCHESTER TECHNOLOGY LTD
PO BOX 26 EASTLEIGH, HANTS. SO5 5YY
TEL: 04215 66916

• Circle No. 255

Main London Sorcerer Stockists
EMG 01-688 0088

We are specialists in complete installations tailor made for your business requirements:

WORD PROCESSING SYSTEM	£1999
ESTATE AGENT SYSTEM	£2999
LEADS AND SALES SYSTEM	£2999
INSURANCE AGENT SYSTEM	£2999
AGENCY SYSTEM	£2999
COMPLETE BUSINESS SYSTEM	£3999

For the Sorcerer Specialist:
Sorcerer Systems Desk
Mains Stabilisation
Cooling Fan
Memory Upgrades
Servicing Undertaken
WP Correspondence Course
Link your Sorcerer to another Sorcerer
Link your Sorcerer to a Main Frame
Full software list on request

6 COPIES OF SOURCE MAGAZINE ONLY £5

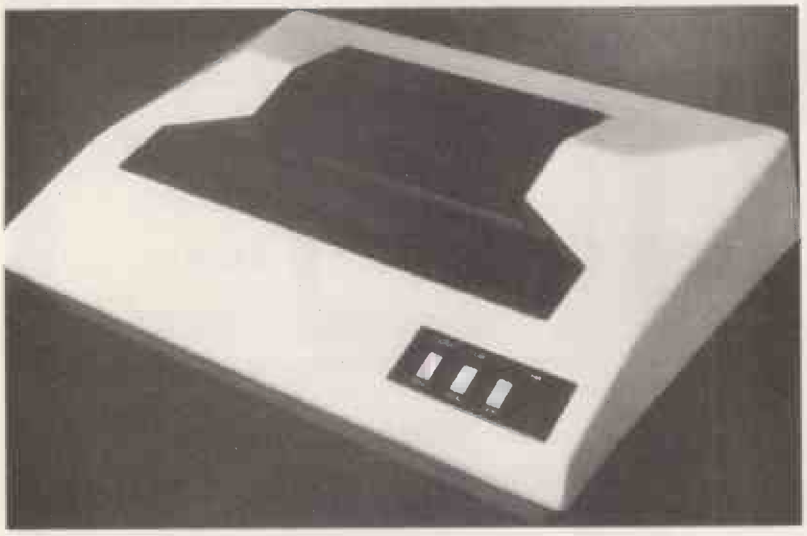
Write to Dept PC6, EMG Microcomputers Ltd, 30 Heathfield Road, Croydon, Surrey.

• Circle No. 256

THE NEW
DOLPHIN BD-80P

NOW AVAILABLE EX STOCK FROM

MICRO BITS



end user
£525

DEALER ENQUIRIES INVITED

125 CHARACTERS PER SECOND
80 CHARACTERS PER LINE
BI-DIRECTIONAL PRINTING
INTERNAL 9-LINE BUFFER

COMES COMPLETE WITH ANY ONE OF THREE PLUG IN INTERFACES.
1) RS 232C + 20mA CURRENT LOOP
2) IEEE for the PET
3) PARALLEL

The many advanced features are summarised in the following specification:

- 9 × 7 dot matrix
- 10 Characters per inch
- 6 lines per inch
- Full ASC II 96-Character set
- 750 Character buffer
- Continuous duty print head
- 64 Graphic Characters 11 × 7 matrix
- 10 user Definable Characters
- Double width characters
- 10 lines per second paper advance
- Adjustable sprocket feed
- Original and up to two copies
- Horizontal and vertical tabs
- Self test
- 132 characters per line optional
- Complies with V.D.E. 0875 electrical noise regulations to medical standards
- Quiet operation

MICRO BITS

CRAYWORTH (COMPUTER SERVICES) LTD
34b London Road
Blackwater Camberley
Surrey England
Tel: Camberley (0276) 34044
telex 858893
open Monday-Friday 9 a.m.-6 p.m.
Saturday by appointment only
Personal Callers Welcome.
Please phone first if you require a personal demonstration.

MICROCOMPUTER SYSTEMS & PERIPHERALS

ZILOG; CROMEMCO; NORTH-STAR; EXIDY.
Elbit, Lear-siegler & Hazeltine VDUs.
NEC Spinwriter printer.

Software and Consultancy.
We can offer a wide range of well proven software for our entire range of computers, from languages through to Commercial Accounting Systems, Payroll and Stock Control.
Full Consultancy, Programming and Prototype Hardware Design Facilities are our speciality.

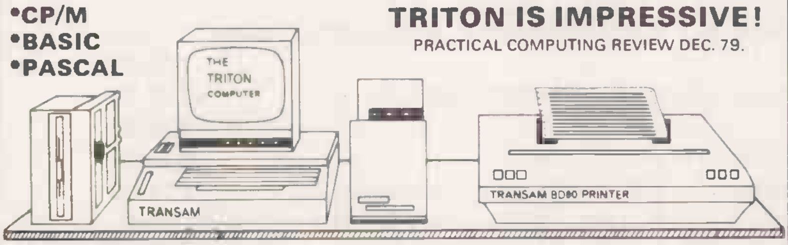
• Circle No. 257

TRANSAM

COMPONENTS AND SYSTEMS FROM TRANSAM COMPUTERS

- •CP/M
- •BASIC
- •PASCAL

TRITON IS IMPRESSIVE!
PRACTICAL COMPUTING REVIEW DEC. 79.



TRITON
COMPUTER SYSTEM.

Designed for ease of construction and flexibility. Kits come complete and all components and software are available separately. UK designed and supported. Fully documented hardware and software and a totally flexible approach to system building. Powerful and easy to use system monitors – a range of languages available. Firmware is Eprom based and upgrading from one level to the next is easy.

- L5.2 with 1.5k monitor 2.5k basic £294.00
- L7.2 with 2k mon 8k extended basic £409.00
- L8.2 4k ed/mon 20k res pascal £611.00
- L9.2 CP/M disc based system P.O.A.
- 8k ram card kit (21141) £97.00
- 8k eprom cards (EXCL 8 x 2708) £31.00
- Motherboard expansion 8 slot £50.00
- Trap-res assm/edit etc (8 x 2708) £80.00
- Transam BD80 bi-dir printer £595.00
- TVM 10 video monitor 9" £79.00
- Eprom prog (2708) kit £29.50

SEND FOR OUR CATALOGUE FOR FULL DETAILS OF TRITON FEATURES !

CP/M AVAILABLE NOW FOR TRITON

Disc operating system complete with text editor, assembler, debugger, system utilities and complete file management. Makes Triton fully CP/M compatible and able to run CP/M based software. Triton will support up to four 5¼ or 8" drives single or double density full CP/M software user group facilities available. SAE for details.
CP/M Disk + manuals (6) £75.00.

DISK DRIVES & POWER SUPPLIES

SHUGART

SA400 5¼" drive	£205.00
SA800 8" drive	£380.00
Power one quality power supplies	
CP249 1x5¼" PSU	£33.00
CP323 2x5¼" PSU	£60.00
CP205 1x8" PSU	£56.00
CP206 2x8" PSU	£76.00

TCL PASCAL – CP/M COMPATIBLE

A standard Pascal compiler available on a resident (20k) Eprom based configuration* or available to run under CP/M on 8" disc plus documentation. CP/M version £120.00.
*P.O.A. TCL Pascal Manual and specification £6.50.

FULL RANGE OF MICRO SUPPORT CHIPS – IN STOCK

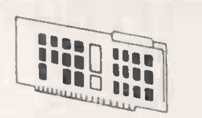
SN74LS00N	22	SN74LS54N	21	SN74LS138N	95	SN74LS195AN	.85	SN74LS325N	2.55	SUPPORT		RAMS	
SN74LS01N	22	SN74LS55N	21	SN74LS139N	95	SN74LS196N	1.20	SN74LS326N	2.55	8212	2.20	2101	2.32
SN74LS02N	26	SN74LS63N	1.50	SN74LS145N	1.20	SN74LS197N	1.20	SN74LS327N	2.55	8216	2.80	2102L4	1.20
SN74LS03N	26	SN74LS73N	35	SN74LS148N	1.75	SN74LS221N	1.25	SN74LS352N	1.35	8224	2.80	2111	2.32
SN74LS04N	26	SN74LS74N	40	SN74LS151N	85	SN74LS240N	2.20	SN74LS353N	1.50	3853(F8)	10.00	2112	2.48
SN74LS05N	26	SN74LS75N	46	SN74LS153N	60	SN74LS241N	1.90	SN74LS365N	65	8228	4.20	6810	4.00
SN74LS08N	20	SN74LS76N	35	SN74LS154N	1.60	SN74LS242N	1.90	SN74LS366N	65	8T26A	1.75	8154	11.50
SN74LS09N	22	SN74LS78N	35	SN74LS155N	1.25	SN74LS243N	1.95	SN74LS367N	65	8T28	1.90	2114L-450	5.50
SN74LS10N	18	SN74LS83AN	1.15	SN74LS156N	1.25	SN74LS244N	2.10	SN74LS368N	65	6522	8.75	2114L-250	7.60
SN74LS11N	26	SN74LS85N	1.10	SN74LS157N	60	SN74LS245N	3.60	SN74LS373N	1.75	8251	6.00	74C920	11.00
SN74LS12N	26	SN74LS86N	40	SN74LS158N	99	SN74LS247N	1.25	SN74LS374N	1.70	8253	11.00	74C921	11.00
SN74LS13N	65	SN74LS90N	65	SN74LS160N	1.15	SN74LS248N	1.95	SN74LS375N	72	8255	5.00	74C929	11.00
SN74LS14N	89	SN74LS91N	99	SN74LS161N	1.15	SN74LS249N	1.30	SN74LS377N	1.75	8257	£11.00	4027	6.00
SN74LS15N	26	SN74LS92N	90	SN74LS162N	1.15	SN74LS251N	1.45	SN74LS378N	1.32	8259	12.50	4044	7.00
SN74LS20N	20	SN74LS93BN	65	SN74LS163N	90	SN74LS253N	1.25	SN74LS379N	1.40	8155	12.50	4045	7.00
SN74LS21N	26	SN74LS95AN	1.20	SN74LS164N	1.50	SN74LS257N	1.40	SN74LS381N	3.65	6402	5.00	4060	7.00
SN74LS22N	26	SN74LS96N	1.75	SN74LS165N	1.70	SN74LS258N	95	SN74LS386N	57	6821P	4.50	2107	7.80
SN74LS26N	29	SN74LS107N	39	SN74LS166N	1.75	SN74LS259N	1.45	SN74LS390N	1.98	6850P	4.60	4116(58 for 8)	8.00
SN74LS27N	35	SN74LS109N	39	SN74LS168N	1.95	SN74LS260N	39	SN74LS393N	1.50	6852P	5.50	4118	20.00
SN74LS28N	35	SN74LS112N	39	SN74LS169N	1.95	SN74LS261N	3.50	SN74LS395N	1.80	AY.5.2376	11.50	Z80P10	8.00
SN74LS30N	25	SN74LS113N	44	SN74LS170N	2.50	SN74LS266N	39	SN74LS396N	1.70	MC14411	12.00	Z80CTC	8.00
SN74LS32N	27	SN74LS114N	44	SN74LS173N	2.20	SN74LS273N	1.85	SN74LS398N	2.75	M57109	12.43	Z80AP10	9.50
SN74LS33N	39	SN74LS122N	79	SN74LS174N	1.15	SN74LS279N	79	SN74LS399N	1.60	M57160	10.00	Z80ACTC	9.50
SN74LS37N	29	SN74LS123N	90	SN74LS175N	1.05	SN74LS280N	1.75	SN74LS424N	4.50	M57161	10.00	EPROMS	
SN74LS38N	29	SN74LS124N	1.50	SN74LS181N	2.75	SN74LS283N	1.80	SN74LS445N	1.25	TMS6011	5.00	1702	5.00
SN74LS40N	25	SN74LS125N	65	SN74LS190N	1.75	SN74LS290N	1.80	SN74LS447N	1.25	81LS95	1.80	5204	6.00
SN74LS42N	79	SN74LS126N	65	SN74LS191N	1.75	SN74LS293N	1.80	SN74LS490N	1.95	81LS96	1.80	2708	8.00
SN74LS47N	95	SN74LS132N	75	SN74LS192N	1.45	SN74LS295AN	2.20	SN74LS668N	95	81LS97	1.80	2516	25.00
SN74LS48N	95	SN74LS133N	39	SN74LS193N	1.75	SN74LS298N	2.20	SN74LS669N	95	81LS98	1.80	2532	50.00
SN74LS49N	1.09	SN74LS136N	40	SN74LS194AN	1.89	SN74LS324N	1.80	SN74LS670N	2.70				

DIL PLUG SOCKETS & SWITCHES

W/WRAP SKTS		DIL SKTS		DIL PLUGS		DIL SWITCHES	
8DIL	0.20	8DIL	0.14	14DIL	0.60	4DIL	1.20
14DIL	0.35	14DIL	0.15	16DIL	0.65	7DIL	1.75
16DIL	0.42	16DIL	0.17	SCOTCHFLEX		8DIL	1.80
18DIL	0.60	18DIL	0.24	14DIL	1.30	16w ZIF*	4.95
24DIL	0.52	20DIL	0.27	16DIL	1.50	24w ZIF*	6.20
28DIL	0.74	24DIL	0.30	24DIL	2.80		
40DIL	0.95	28DIL	0.36				
		48DIL	0.50				

*ZERO INSERTION FORCE

DOUBLE DENSITY S100 DISK CONTROLLER



Suitable for Triton, DPS-1 etc. Built and tested will drive Shugart compatible 8" or 5¼". Drives single or double sided. Uses the 1791 chip and CPU independent crystal.
Manual 50p + SAE. BOARD £195.00 + VAT

DPS.1 MAINFRAME – PASCAL SYSTEM

S100 to IEEE spec

Send 50p for our ITHACA catalogue.

DOUBLE DENSITY EP/M NOW AVAILABLE – CONTACT US FOR DETAILS

ITHACA

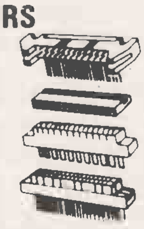
PASCAL/Z build your own Pascal Micro Development system. IEE-S100 bus system using DPS1 main-frame. Supports K2, ASSEMBLE/Z and PASCAL/Z on 8" disc. Complete system £2910.00.

S100 BOARDS

8k Static RAM board (450ns)	£99.00
8k Static RAM board (250ns)	£117.00
Z80 cpu board (2MHz)	£105.00
Z80 cpu board (4MHz)	£123.00
2708/27 16 EPROM board	£57.00
Prototype board (bare board)	£15.00
Video display board (64 x 16, 128U/L Ascu)	£108.75
Disc controller board	£131.25
K2 disc operating system	£45.00
ASSEMBLE/Z Macro Assm	£37.50
PASCAL/Z compiler	£205.00
PASCAL/Z CP/M	£235.00
16k Static RAM	£275.00

MULTIWAY CONNECTORS

INSULATION PIERCING		35/70	4.60
20 way plug	2.30	36/72	4.74
26 way plug	2.70	40/80	5.00
34 way plug	3.30	43/86	5.50
50 way plug	4.60	50/100	5.80
20 way skt	3.40	GOLD .156 PITCH	
26 way skt	4.00	6/12	1.25
34 way skt	4.80	10/20	1.50
30 way skt	6.00	12/24	2.00
EDGE CONN PCB		15/30	2.20
GOLD .1" PITCH		18/36	2.30
22/44	3.20	22/44	2.65
25/50	3.60	28/56	3.30
28/56	3.90	36/72	3.90
30/60	4.15	43/86	4.60

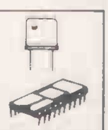


64 way DIN male 2.50
64 way DIN female 4.50

VISIT OUR SHOWROOM

WE ALSO STOCK:– a comprehensive range of books and magazines, VERO products including S100 and Eurocard and Wire Wrap equipment, Weller soldering equipment, Ribbon Cables, tools, tapes, diskettes, connectors and OK Tool range. Systems continuously on display in our showroom.

CRYSTALS					
		4MHz	2.10	F8(3850)	9.50
100k	3.00	4.43M	1.00	8080A	6.33
200k	3.70	5MHz	2.70	6809	24.00
1MHz	3.60	6MHz	2.70	Z80	8.00
1008k	3.50	7MHz	2.70	Z80A	15.00
1843k	3.00	7.168M	2.50	8085A	12.95
2MHz	1.50	8MHz	2.70	6502	8.00
2457k	3.05	10MHz	2.70	SCMP11	10.00
3276k	2.70	10.7M	2.70	6802	13.95



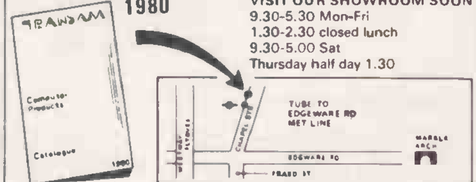
ALL PRICES
Exclude VAT & P/P

VAT 15% P. & P. 40p on small orders. For larger items please Tel. Telephone credit card orders accepted subject to £5 min. RAPID MAIL ORDER SERVICE

CATALOGUE

NEW A4 SIZED ONLY 50p & S.A.E.

1980



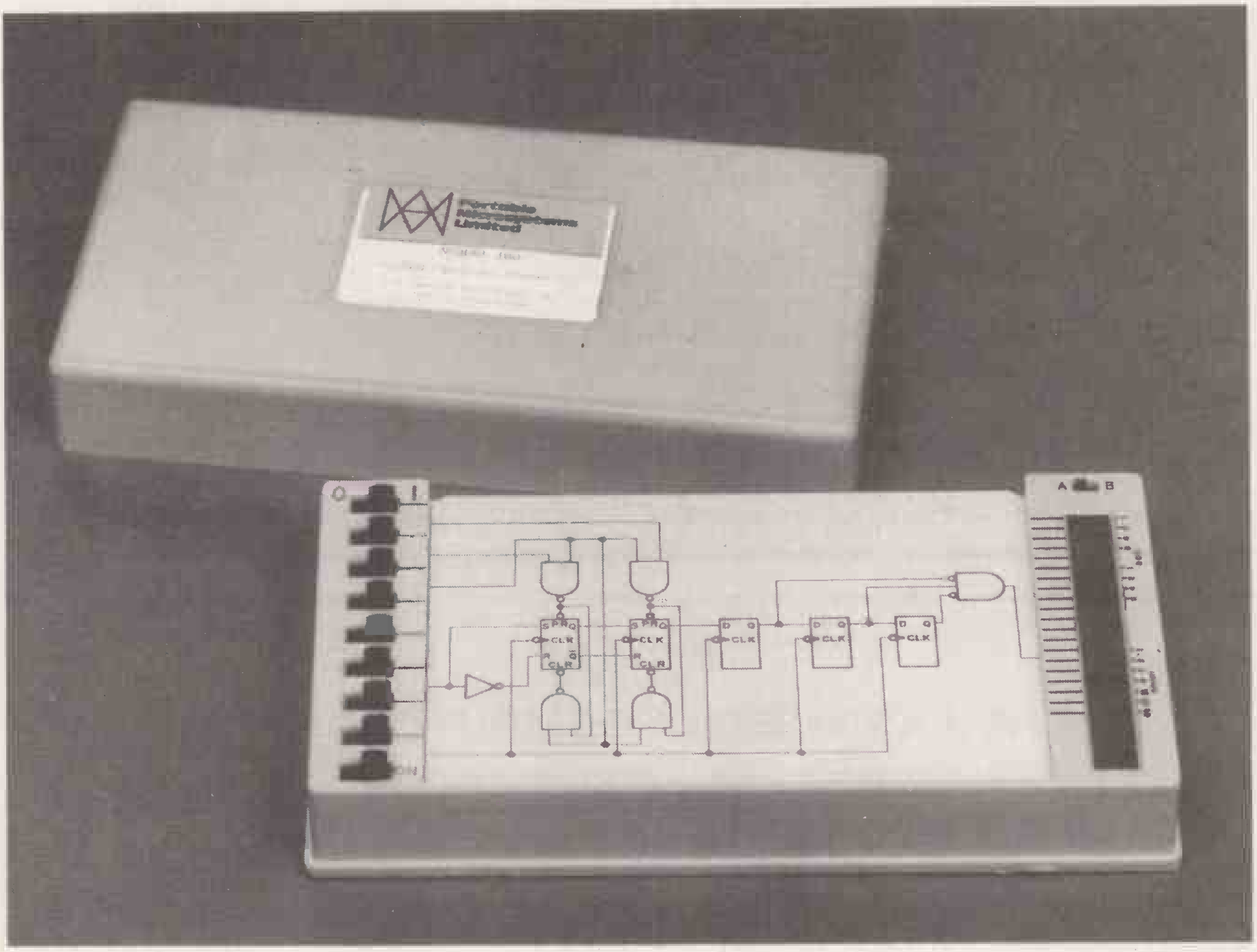
VISIT OUR SHOWROOM SOON
9.30-5.30 Mon-Fri
1.30-2.30 closed lunch
9.30-5.00 Sat
Thursday half day 1.30

TRANSAM COMPONENTS LTD, 12 CHAPEL STREET, LONDON NW1 Tel: 01-402 8137 Telex: 444898

• Circle No. 261

Portable Microsystems Limited

THE LOGICAL APPROACH TO DIGITAL LEARNING



THE ELT 100 FROM PORTABLE MICROSYSTEMS IS A REALLY SIMPLE LEARNING AID FOR THE HOBBYIST, STUDENT OR PROFESSIONAL. KEEP UP IN THE SILICON CHIP REVOLUTION WITH THE HELP OF THE ELT 100.

PRICE: £59.95 + V.A.T. + £2.50 p+p

DELIVERY: EX-STOCK

MAIL ORDER PRICE £71.82 inclusive

Note: Prices are subject to change without notice.

Forby House, 18 Market Place, Brackley, Northants NN13 5SF

Telephone Brackley (0280) 702017

Telex Micro 83147

• Circle No. 264

SOLVE YOUR BUSINESS PROBLEM WITH A MICROCOMPUTER

We have a variety of microcomputers and available software to suit most types and sizes of Business Applications.

At the lower end of the market is the popular TRS-80 (more than 100,000 sold last year). This is a reliable, effective and versatile business microcomputer. Processing speeds and disk storage are more than sufficient for many business applications.

The word processing (using **THE ELECTRIC PENCIL**, is excellent. We also distribute the **TRIDATA** range of business packages (software written by professionals).

WHY PAY MORE?, if the **TRS-80** will do the job.

But if you require a machine with extra capacity, we have suitable systems available.

We would be pleased to discuss your particular requirements with you.

Katanna Management Services Ltd

kms

(In association with S. J. Trott Ltd.)
22 Roughtons,
Galleywood,
Chelmsford,
Essex, CM2 8PF
TEL: (0245) 76127

(member of the computer retailers' association) (TRS-80 is a TANDY' trademark)

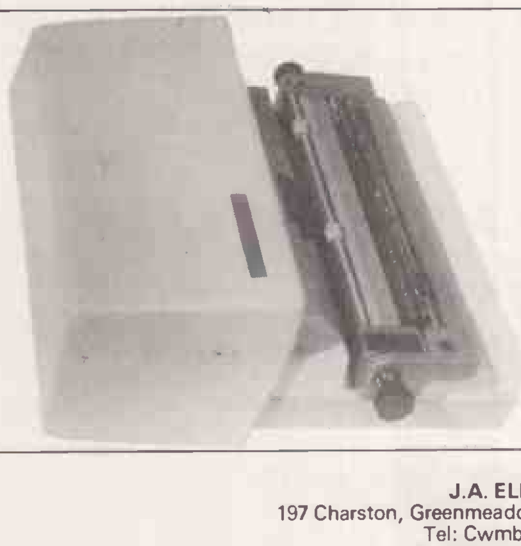
• Circle No. 265

NEW

THE J.A.100 SERIES COMPUTERWRITER

A new reliable 10 c.p.s. computerwriter that attaches to your electric typewriter keyboard enabling you to produce good quality hard copy from your microprocessor based computer system, providing you with an excellent computer controlled typewriter for use in a wide variety of computing applications, including special reports, invoices and letters in a wide range of typestyles when used on a golfball typewriter.
It's what your computers and typewriters have been waiting for.
All models complete with interface.

J.A.100 ADD-Vantage Receive Only Model	£310.00
J.A.101 Send/Receive Model	£395.00
J.A.102 Dictaphone/Cassette Operated Model	£375.00



J.A. ELECTRONICS
197 Charston, Greenmeadow, Cwmbran, Gwent NP44 4LD
Tel: Cwmbran 06333 60606
All prices quoted exclude V.A.T.

• Circle No. 266

DATALINK

Microcomputer Systems Limited

Systems software for business, industrial and scientific applications

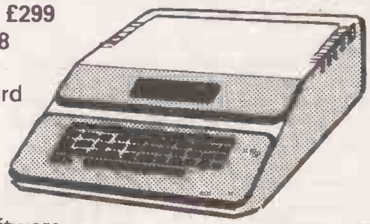
From the Micro City of the Future . . .

image data

Made in Bristol

Systems from **£1932**

APPLE/ITT 2020

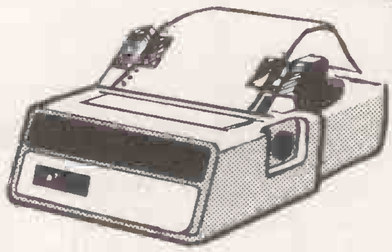


Apple II Plus 16K (B&W) **£695**
ITT 2020 16K (colour) **£867**
Disk Drive with Controller **£349**
Pascal Language System **£299**
Auto Start ROM Pack **£38**
16K Add-ons **£69**
Alf Music Synthesiser Card **£180**
Little Genius Tutorials Basic and Advanced **£40** each Etc., Etc.,
Full range of business software

SOFTWARE

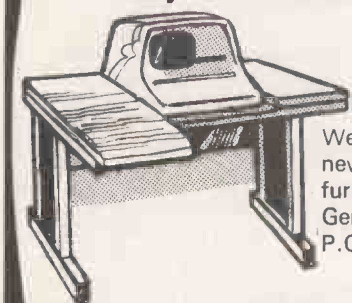
We have second-to-none programming facilities, both in-house and through an associated Company: Management Services and Systems Ltd.
All our programs are **original** and fully guaranteed. E.G. Mailing List **£50** Stock Control **£200** Integrated Accounts Package **£800** (Sales/Purchase/Nominal Ledgers/Invoicer) Critical Path Analysis POA; Contract Estimating POA Programs are written for both the Apple and Image Data systems. They can be tailored to meet a customer's particular requirements.

Printers



Centronics 779
Tractor feed **£875**
Printerm 879 80 col. **£695**
Printerm 879 80/132 col. **£745**
Microhush **£266**
TTY 43 Pin or Friction feed **£860**
Paper Tiger **£585** Qume Sprint 5 **£2115**
Graphics PT **£699**

Systems Furniture



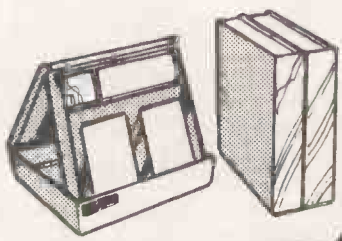
* STOP PRESS

We now have available an exciting new range of GESIKA systems furniture specially imported from Germany by BEAM
P.O.A.

ALL PRICES QUOTED EX VAT

Computer Stationery and Accessories

9½" Plain Listing Paper (per 2000 sheets) **£16.00**
Microhush Thermal Paper (2 rolls) **£4.00**
Customised Computer Stationery (Invoices/Statements/etc) P.O.A.
BASF 5¼" Diskettes **£2.50**
BASF 8" Diskettes **£3.00**
Library Cases for 5¼" **£3.00**
Library Cases for 8" **£3.50**
Diskette Tray with lockable lid for 5¼" **£16.00**
Diskette Tray with lockable lid for 8" **£22.00**
Diskette Head Cleaners **£13.00**
Dust Covers **£9.95**

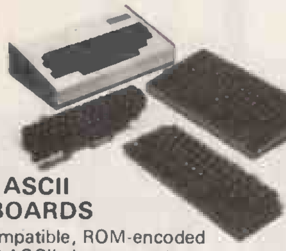


We also stock an extremely comprehensive range of computer books

DATALINK 10 Waring House, Redcliffe Hill, Bristol BS16TB
Telephone: Bristol (0272) 213427

• Circle No. 267

SAVE £££'s ON TOP QUALITY FULLY GUARANTEED SECOND USER EQUIPMENT



NEW ASCII KEYBOARDS
TTL compatible, ROM-encoded
Full 128 ASCII character set
Range of spares and accessories
Prices from £45.00
Send for full leaflet/price list.

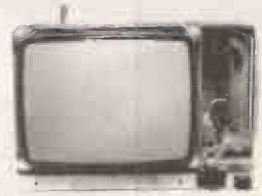
HAZELTINE H1000 VDU
12 lines by 80 character display. Upper case ASCII 110/300 baud (higher speeds optional). RS 232 Interface
NOW ONLY £225.00 (mail order total £280.00)

NEWSHUGART FLOPPYDISC DRIVES
SA 400 Minifloppy
110/220 KB capacity
Power + 5VDC + 12VDC
£195.00 (mail order total £234.00)

SA 800 8in. floppy 40/800 KB capacity + 24VDC + 5VDC − 5VDC £395.00 (mail order total £468.00)

BALL MIRATEL MONITOR
9in. Diagonal TV monitor complete with high and low voltage power supplies and attractive moulded plastic case with ample space for keyboard. Requires separate horizontal and vertical sync. input. £95.00 (mail order total £123.00)

TELETYPE ASR 33
10 cps, upper case ASCII 74-column friction feed platen Paper Tape Punch & reader Choice of Interface (20 mA or RS232) £650.00 (pedestal £30 extra) (Acoustic cover £25 extra)



EMI 15/3A TV MONITOR
15in. Diagonal TV Monitor complete With high and low voltage power supplies. Accepts composite or separate video input. Dimensions 12in.H × 18¾W × 16½D.Wt.22kg. BRAND NEW SURPLUS. £100.00 (mail order total £138.00)

Electronic Brokers

49/53 Pancras Road London NW1 2QB Tel: 01-837 7781. Telex 298694

All items are refurbished second-user equipment unless otherwise stated. All prices subject to VAT.

A copy of our trading conditions can be supplied on request.

• Circle No. 268

Speed separates the computers from the toys . . .

Ohio Scientific's small computers are *fast* — the standard benchmark tests prove it. Even at 1MHz the Challenger 2's BASIC is faster than Commodore's Pet® and Apple Corps' Apple® — Tandy's TRS-80® isn't even in the running. And at 2MHz, the Challenger 2 and new Challenger 4 colour system leave all other 'comparable' systems far behind.

Speed

The following benchmark test speaks for itself!

	Pet®	Apple®	C2 (1MHz)	C2 (2MHz)
BM1	1.7	1.3	*1.4*	**0.7**
BM2	9.9	8.5	*7.8*	**3.9**
BM3	18.4	16.0	*15.0*	**7.5**
BM4	20.4	17.8	*16.5*	**8.3**
BM5	21.7	19.1	*17.8*	**8.9**
BM6	32.5	28.6	*27.0*	**13.5**
BM7	50.9	44.8	*39.5*	**19.8**
BM8	12.3	10.7	*7.5*	**3.8**

Standard *PCW* benchmark tests, as published in *Personal Computer World*'s review of the Challenger 2 (April '80 issue). Reproduced (with thanks) by courtesy of the staff of *PCW*.

Expandability

All Ohio Scientific systems are designed for real expandability — memory, I/O, discs. For example, the C2/C4 series are the only personal computers designed to handle networking and hard-disc expansion up to 300 *megabytes on-line!*

Flexibility

The C2/C4 series is supported by a very wide range of expansion units, most of which plug straight into the integral backplane. In addition, the new 16-pin I/O bus range of boards makes interfacing with the real world simpler and cheaper — industrial grade flexibility at personal user prices!

C2-4P with two slots free for expansion **£349**
2MHz option for C2 (standard on C4) .... add **£5**
C4 with PAL colour, new 16-pin I/O system **£425**

The superior Superboard

Mutek offer their own version of the Superboard: the cased C1 modified in both hardware and firmware to run at 2MHz and with a true 32×48 display — takes the Superboard right out of the 'toy computing' class!

Standard C1 8K RAM, 1MHz, 25×25 display **£220**
Enhanced C1 8K RAM, 2MHz, 32×48 display **£255**
Upgrade for existing Superboard/C1 systems to Mutek's enhanced specification (ask for details) **£40**

All prices quoted exclude VAT.

Mutek — *real* computing. . . .for less than you expect

Mutek — the independent OSI specialists — Quarry Hill, Box, Wilts. Telephone: Bath (0225) 743289

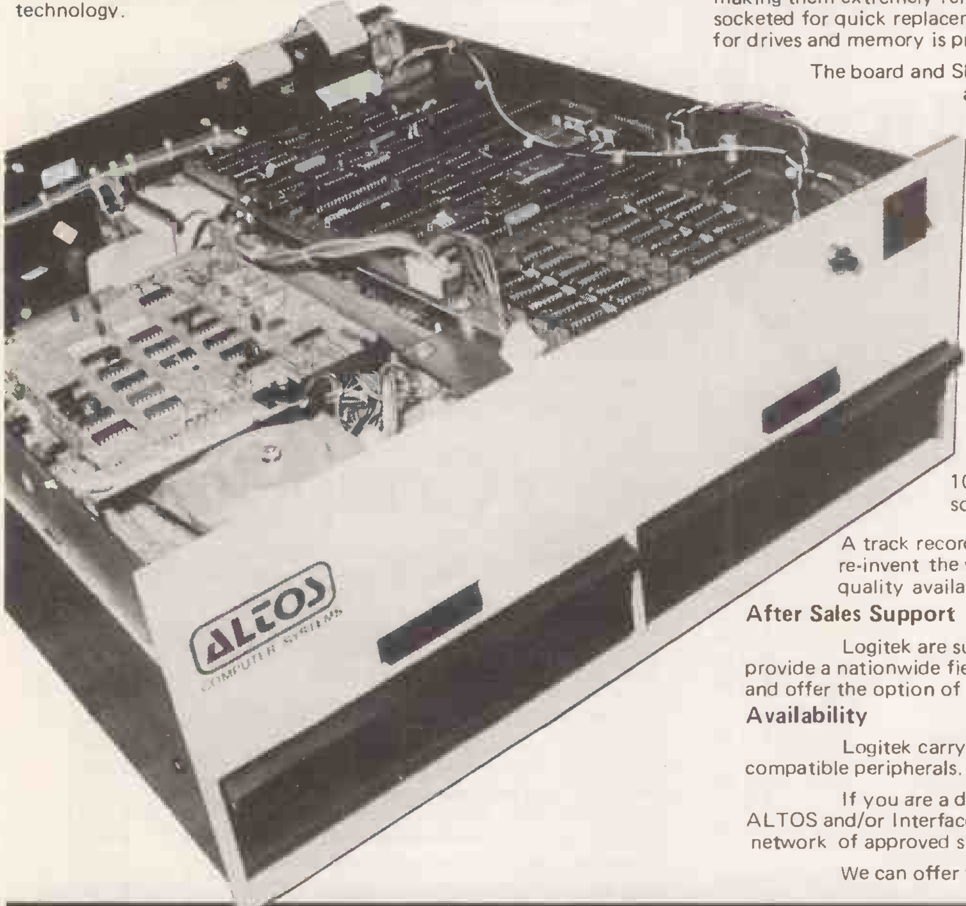
• Circle No. 269

ALTOS

The ALTOS ACS 8000 range of business/scientific micro computers creates a new standard in quality and reliability in high technology micro computers.

High Technology

Floppy Disk System The ACS 8000 single board Z80 floppy disk based micro computer utilises the ultra reliable Shugart 8 inch, IBM compatible, disc drives, double density — single sided, and providing 1 M. byte of data storage. Featuring the ultimate in high technology hardware: a fast 4 MHz.Z80CPU, 65 kilobytes of 16 K dynamic RAM, 1 kiloybte of 2708 EPROM, an AMD 9511 floating point processor (OPTIONAL) a Western Digital floppy disc controller, a Z80 direct memory access (OPTIONAL), Z80 parallel and serial I/O two serial RS232 ports, 1 parallel port) and a Z80 CTC Programmable Counter/Timer (real time clock). In essence, the best in integrated circuit technology.



Hard Disk/Multi User Systems The Winchester hard disk/multi user systems are now available supporting up to 4 simultaneous users and providing a maximum of 58 Megabytes of hard disk data storage.

The systems are truly flexible and allow expansion of the ALTOS floppy disk system to keep pace with the users requirements.

Still single board, features include * a high speed I/O section with up to six serial ports and one 8 bit Parallel port
*up to 208K of on board RAM.
*High speed (4 MHZ) D.M.A. control as standard.

Yes, mini power and at micro cost too.

Built-in Reliability

The ACS 8000 range are true single board micro computers making them extremely reliable and maintainable. All electronics are socketed for quick replacement. Complete diagnostic utility software for drives and memory is provided.

The board and Shugart floppy disk drives are easily accessible and can be removed in less than ten minutes.

Quality Software

Unlimited versatility. The ACS 8000 range support the widely accepted CP/M and MP/M operating systems plus basic (Microsoft and CBasic), Cobol, Pascal, and Fortran IV. All available now.

Logitek in conjunction with its own microsoftware house, Interface Software Ltd. of Camberley are able to supply a wide range of proven 'off the shelf' business software including general accounting, word processing, stock control, mailing list etc.

There are already over 1000 micro computer installations using this software.

A track record which we consider speaks for itself. Why re-invent the wheel' when there is standard software of this quality available now?

After Sales Support

Logitek are supported by DDT Maintenance Ltd. who provide a nationwide field maintenance service for ALTOS products and offer the option of maintenance contracts.

Availability

Logitek carry deep shelf stocks of ALTOS hardware and compatible peripherals.

If you are a dealer who may be interested in promoting ALTOS and/or Interface Software by joining the fast growing network of approved suppliers, contact Logitek.

We can offer you something rather special now.

Approved Dealers

SCOTLAND: Aethrotol Consultancy Services, Tel: 041-641-7758/9. Robox Ltd., Tel: 041-221-5401. Peter MacNaughton and Associates, Tel: 073-888-267.
NORTH EAST AND YORKSHIRE: Shermac Computers, Ltd., Tel: 0632-837405. Monitor (Data Processing) Ltd., Tel: 0423-60670. Metrodata, Tel: 0532-623788.
Derwent Electronics Ltd., Tel: 0904-53990. Sheffield Computer Centre, Tel: 0742-53519. NORTH WEST: Computer Business Systems, Tel: 0253-730033.
Minicom Business Machines, Tel: Kirkham 686617. B & B Computers Ltd., Tel: Bolton 26644. Kewill Systems Ltd., Tel: 0706-44337.
MIDLANDS: East Midlands Computer Services, Tel: 0602 267079. Evans Jackson, Tel: 0522-30371. Microspecific, Tel: 0572-2528.
Saba Computer Systems Ltd., Tel; 021-643-2021. CLE-COM, Tel: 021-444-3618 or 021-472-8233. SOUTH WEST: Validata Services, Tel: 0225-705957.
Opco Ltd., Tel: 0285-75225. BEDFORD: Starwest Computer Services, Tel: 0234-57135.
SOUTH EAST INCL. LONDON: Boyd Microsystems Ltd., Tel: 01-950-0303. Computer Systems Analysis, Tel: 02813-85389. Silicon Chip, Tel: 0753-70639.
Micro Market, Tel: 01-979-9824. Systematika, Tel: 01-485-3634. Logic Box, Ltd Tel: 01-222-1122. Profac Computer Services Ltd., Tel: 0276-25247.
Kewill Systems Ltd., Tel: 09322-22448. Action Computer Services Ltd., Tel: 01-502-1311. EAST ANGLIA: Proloc Computer Services Ltd., Tel: 0502-714038.
SOUTH: Software Development Services, Tel: 0962-68956. Wendmore Management Services Ltd., Tel: 04895-6318.
CHANNEL ISLANDS: Jersey European Airways, Tel: 0534-44171.

LOGITEK

LOGITEK, E.I.C. Electronics Ltd. All enquiries to: Portland St. Chorley, Lancs. Tel: 02572-66803
also at: 30 Kelvin Ave., Hillington Industrial Estate, Glasgow, G52 4LH.

• Circle No. 270

The New SHARP MZ-80K
From £520 plus VAT

Please telephone for demonstrations (Our premises or yours)

PET HIRE

From £4.25 per day

10% discount on all PETSOFT products
Please add 50p p&p to your order
send large SAE for PETSOFT Catalogue

All prices subject to VAT.
Send Cheque/P.O. with orders to:

ESSEX COMPUTER SERVICES

10 Grafton Road, Canvey Island,
Essex, SS8 7BT.
Tel. Canvey Island (03743) 61663

• Circle No. 275

MINSTER MICRO SYSTEMS

FOR APPLE & MICROSTAR COMPUTERS
We are MAPCON consultants and can solve your software problems.

APPLE II
Payroll
Stock Recording
Order Processing
Sales Ledger
Purchase Ledger

INTERFACES
16 Chan. AtoD
Relay Switching
D to A

MICROSTAR
Payroll
Sales Ledger
Invoicing
Purchase Ledger
General Ledger
Stock Control
Job Costing
Word Processing

Special packages written to order

apple computer

MINSTER MICRO SYSTEM LIMITED,
88 CHRISTCHURCH RD,
RINGWOOD,
HANTS.
TEL: (04254) 4751

• Circle No. 276

ARE YOU ILL-TREATING YOUR PET?

IS YOUR PET TIRED, LISTLESS & IRRITABLE ?

THEN FEED IT MORE NOURISHING SOFTWARE
FROM THE NEW

Softcentre

RANGE

DOZENS OF EXCITING, INTERESTING & EDUCATIONAL PROGRAMS, MOST WITH SUPERB GRAPHICS & MANY WRITTEN BY JIM BUTTERFIELD

GAMES = BUSINESS = EDUCATION
SCIENTIFIC & UTILITY

SEND STAMP FOR CATALOGUE TO DISTRIBUTORS

OPTELCO **26 ALBANY ROAD**
RAYLEIGH ESSEX

(FREE VOUCHER WORTH £2 WITH CATALOGUE)

****

AREA AGENCIES & OVERSEAS DISTRIBUTORS INVITED

****

PROGRAMMERS! HAVE YOU WRITTEN REALLY ORIGINAL PROGRAMS OF OUTSTANDING QUALITY ? WE PAY GOOD ROYALTIES FOR THE RIGHT MATERIAL - SEND CASSETTE FOR ASSESSMENT AND YOU WILL RECEIVE ANY OFFER WITHIN A WEEK !

****

P.S. LOTS OF SOUND & PRINTER PROGRAMS IN THE RANGE

S Software for TRS80®

ACCEL Compiler for TRS80 BASIC — Speeds execution of correct Level 2, BASIC programs by compiling the common statements to Z80 machine-code.
- Develop and debug normally.
- Compile for production work.

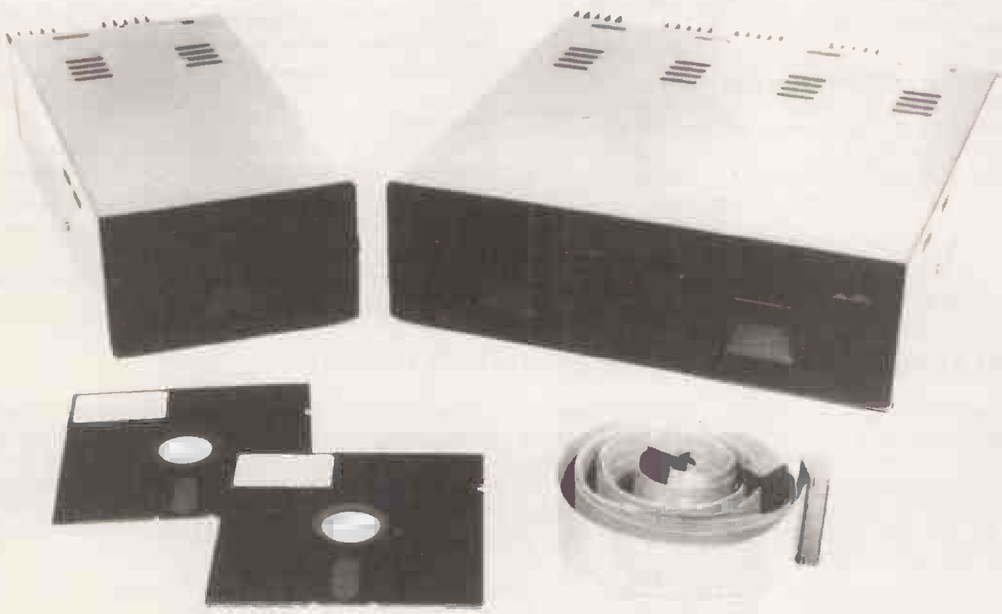
ACCEL (16K)	**Great value at**	**£19.95**
DLOAD	Load program segments	£4.95
ZBUG	Debug Z80 programs	£11.95
TSAVE	Prepare system tapes	£4.95
RENUM	Renumber BASIC programs	£5.95
FGRAF	Fast Graphics	£4.95
XREF	Program cross-reference	£5.95
SDUMP	Symbolic dump	£2.95
LIFE	(16K) 48 x 64	£3.00
USRN	Multiple USR calls	£2.95

Southern Software programs are self-relocating, load-anywhere, machine-code, well documented. They run in 4K Level 2, unless otherwise stated.

SOUTHERN SOFTWARE PO Box 39, Eastleigh, Hants. SO5 5WQ

• Circle No. 277

Floppy Disk Systems AT LOW COST



SINGLE DISK UNITS 40 Tracks • £250 77 Tracks • £345

DUAL DISK UNITS 40 Tracks • £440 77 Tracks • £645

✱ from CUMANA LTD ✱

The high quality and very reliable TEAC 40 track FD-50A and 77 track FD-50C 5¼ inch Mini Floppy Disk Drives packaged in single Disk and Dual Disk configurations with integral mains power supply unit.

* Both FD-50A and FD-50C are Shugart SA400 interface compatible.
* FD-50A has 40 tracks giving 125K Bytes unformatted capacity.
* FD-50C has 77 tracks giving 240K Bytes unformatted capacity.
* Both models can be used in double density recording mode.
* Daisy Chain up to 4 drives on your computer system.
* Directly compatible with TRS 80, SWTP, Heathkit, Superbrain, Video Genie, etc. etc.
* Japanese quality and reliability.
* 220-240v 50 HZ mains power unit.
* Warranty and service back up from Cumana.

* * * * * * *

DEALER ENQUIRIES WELCOMED

Please add VAT to all prices. Delivery at cost will be advised at time of order.

Cheques payable to: CUMANA LTD.,
35 WALNUT TREE CLOSE,
GUILDFORD, SURREY. GU1 4UN
TEL: (0483) 503121
TELEX: 859680 (INPUT G)

AVAILABLE SOON
ADD-ON DISKS FOR APPLE II AND ITT 2020
£259

• Circle No. 278

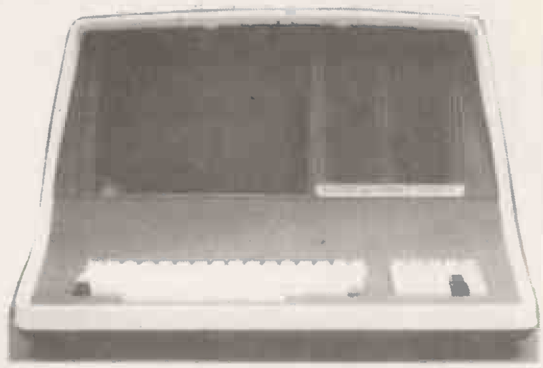
TERODEC
IS READY WITH SYSTEMS

INTERTEC SUPERBRAIN

More than an intelligent terminal the SuperBrain user gets exceptional computing power at low price.

- 32Kbytes of RAM (expandable to 64K).
- Dual double density mini floppies (320Kbytes).
- Dual 4MHz Z-80 CPU's.
- 80 × 25 High quality 12" display.
- Full ASCII keyboard.
- CP/M operating system.
- Dual synchronous/asynchronous RS232C ports.
- Interfaces to most printers.
- Wide range of standard software (FORTRAN, BASIC, CBASIC-2, COBOL, PASCAL, Sales Ledger, Bought Ledger, Nominal Ledger, Stock Control, IBM 3780/2780/3270 Emulation and more).
- Attractive integral desk top design.

SuperBrain with 64K £1950.00



DELTA DPS 64/1

Professional computing system with all the features necessary for the business or scientific user.

- 64Kbytes of 4MHz RAM, operating without wait states.
- Dual double density single sided 8" drives (1 Mbyte).
- Disc storage expandable to four 8" double sided double density drives (4 Mbytes), fixed and cartridge drives.
- CP/M1.4 standard (CP/M2.0 option).
- Expandable to multi-user (CP/M2.0 with MPM).
- RAM expandable to 512KBytes multiuser.
- Large range of standard Compilers, Interpreters, Assemblers and Applications Packages available.
- TV1912 80 × 24 VDU as standard.
- Interfaces to most VDUs and printers. £3099.00

DPS 64/2 the same spec as DPS 64/1 with 2 Mbytes of disk storage (2 double sided double density drives) £3404.00

TERODEC TMZ-80 Range

Microcomputers with unrivalled flexibility to solve your business computing problems.

- Choice of operating systems — CP/M1.4 or CP/M2.0.
- Interfaces to most VDU's, line, dotmatrix, daisywheel printers and modems.
- 64Kbytes of RAM as standard (512Kbytes multiuser).
- Single or multiprocessor.
- 1-4Mbytes floppy disk storage.
- Fixed or cartridge disks.
- 4MHz Z-80 CPU.
- Installation and commissioning.
- Full range of VDU's and printers.
- Single or multi-user.
- Nationwide maintenance.
- Comprehensive range of compilers interpreters assemblers and applications packages.
- Attractively styled workstation.

TMZ-80-1 1Mbyte 64K with VDU CP/M1.4 and workstation	**£3995.00**
TMZ-80-2 2Mbyte 64K with VDU CP/M1.4 and workstation	**£4295.00**
TMZ-80-2 4Mbyte 64K with VDU CP/M1.4 and workstation	**£5595.00**

TERODEC are the sole U.K. distributor for DELTA PRODUCTS and CENTRAL DATA CORPORATION.

OEM AND Dealer Enquiries Invited

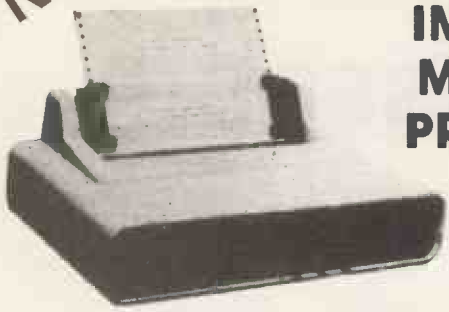
TERODEC (MICROSYSTEMS) LTD
17 The Gallop, Yateley,
Camberley, Surrey.
Tel: (0252) 874790
(0344) 51160

All information is correct at the time of going to press. Prices exclude VAT and unless stated delivery.

• Circle No. 280

NEW!

MPI MODEL 88T IMPACT MATRIX PRINTER



£535 + VAT

The first of a series of new, full-capability, low cost, high performance printers designed by MPI to meet the requirements of the general use computer market – hobbyist or professional.

SPECIFICATIONS

- Impact Bidirectional
- 7×7 Dot Matrix
- 100 Characters Per Second
- 80, 96 and 132 Column
- 10 Lines Per Second
- Tractor and Friction Feed
- Normal Paper: Roll, Fan-fold or Cut Sheets
- 115/230 VAC ±10%, 50/60 Hz.
- 96 ASCII Upper and Lower
- RS232C; 20 ma. Current Loop
- 110-1200 BAUD
- 2 Line Buffer; 1 or 2 K Optional
- Centronics Parallel
- 41×27×16 cm; 7 Kg.

SIGMA (U.K.) is the U.K. distributor for **MPI** and seeks dealers nationwide.

SIGMA (U.K.)
UNIT 2
106-120 GARRATT LANE
LONDON SW18

THE FIRST MICROCOMPUTER WHOLESALER

Σ Sigma (UK)

We offer products from many manufacturers including:

Altos	Houston Inst.	N.E.C.
Base 2	Impact Data	North Star
Centronics	Industrial Micro	Ohio Scientific
Century Data	Integral Data	PerSci
Control Data	Intertec	Qume
Dyna Byte	Konan	Soroc
Exidy	LRC Eaton	Televideo
Hazeltine	Micro Peripherals	Texas Instruments

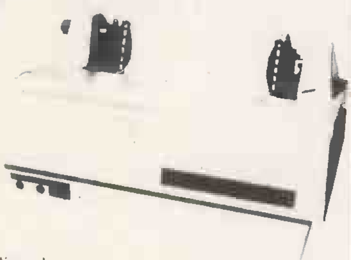
SIGMA (U.K.)
UNIT 2
106-120 GARRATT LANE
LONDON SW18

Telephone: 01-870 4524 Telex: 8954572 HOMLIV

IMPACT DATA MODEL 801

THE HEAVY DUTY WORKHORSE AT THE AFFORDABLE PRICE.

£695 + VAT



- 7 × 7 Impact Dot Matrix
- 132 CPS (max.)
- 96 Character Upper/Lower ASCII
- 8.0 in (20.3 cm) Line Length
- 80 or 96 Columns
- 6 LPI Line Spacing
- Tractor or Friction Feed
- 127 Character Buffer – 2 K Optional
- Feed at 50 LPM Printing – 560 LPM Slewing
- Continuous Loop Ribbon with Re-inking Roller – 5 Million Character Life
- Paper is Standard Fan-fold, Multi-copy Computer Forms up to 9-5/8" (24.45 cm)
- 8-bit Parallel (Centronics Compatible), RS232 or 20 ma. Current Loop Interfaces, 110/1200 BAUD, Switch Selectable
- 115 VAC, 3A, 60 Hz. or 220 VAC, 1.5A, 50 Hz.
- 12"H × 18"W × 14"D (30 × 45 × 35 cm)

High Quality • High Technology • Low Price

Substantial Dealer/Distributor Discounts Available

SIGMA (U.K.)
UNIT 2
106-120 GARRATT LANE
LONDON
SW18

NEW

LRC EATON MODEL 7000+ IMPACT PRINTER

£250 + VAT

- Simple Design
- Simple Maintenance
- Simple Interfacing to:
  - Apple
  - Pet
  - TRS-80
  - Exidy
  - OSI

  and many other personal computers

The 7000+ was designed to provide the personal computer user with an inexpensive, yet reliable printer. Take a look – you won't regret it!

SPECIFICATIONS

- Impact Unidirectional
- 1.25 LPS 50 CPS
- 40 or 64 Column
- 5 × 7 Dot Matrix
- Standard Paper Rolls
- 100 Million Character Printhead Life (minimum)
- 6 LPI Line Spacing

Substantial Dealer Discounts are Available.

OEM inquiries are invited. Please contact.

SIGMA (U.K.)
UNIT 2
106-120 GARRATT LANE
LONDON SW18

• Circle No. 282

APPLE/I.T.T. USERS

8" DISK DRIVES

½ OR 1 MEGABYTE ON-LINE

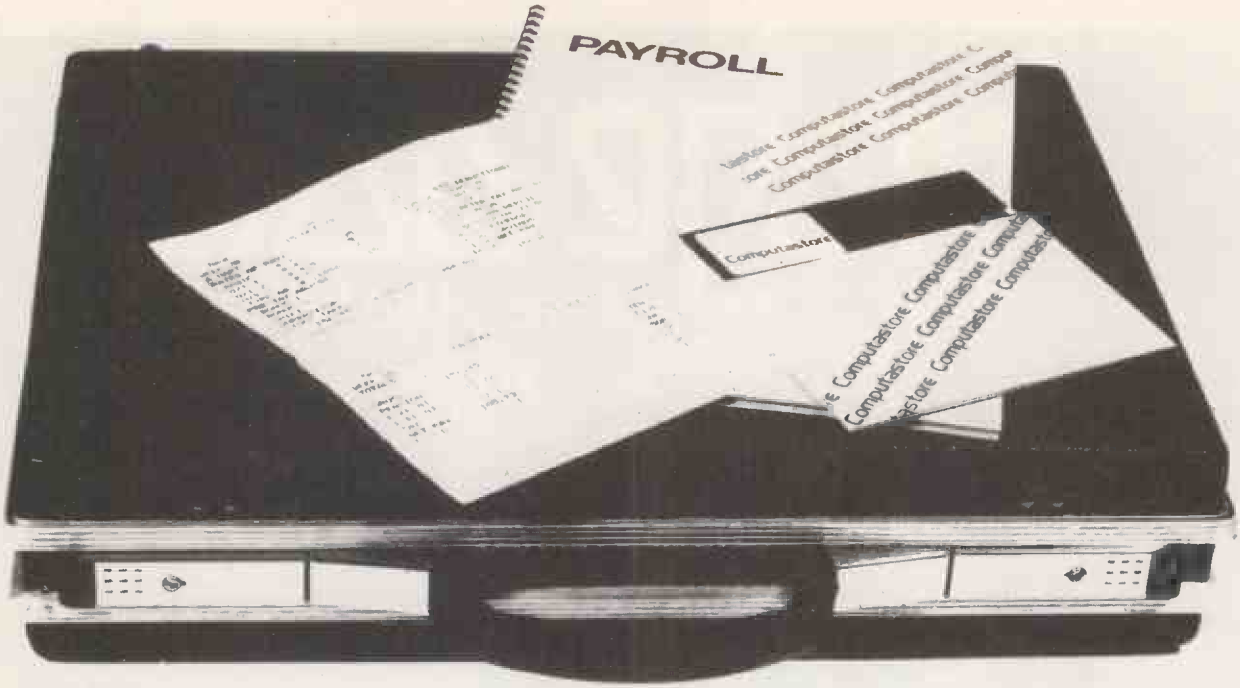
Available either as

1. Complete System from **£1100** + V.A.T.
2. Controller only from **£215** + V.A.T.

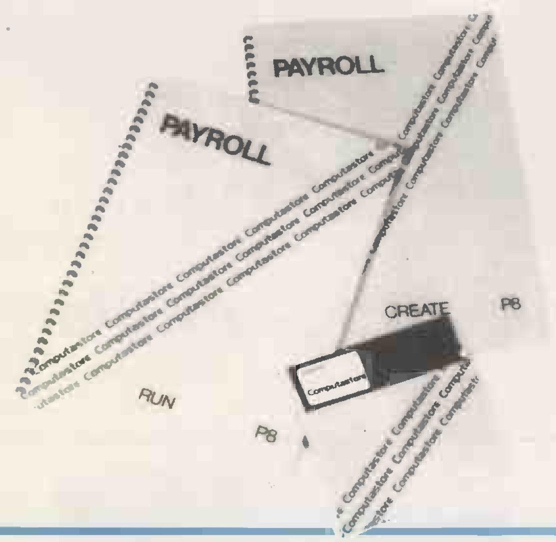
FARMPLAN/SVA

Netherton
Ross-on-Wye
Herefordshire
Tel: 0989 4321

• Circle No. 283



IN A CLASS OF IT'S OWN SUPERPAY FROM COMPUTASTORE



Unrivalled for speed and accuracy our new Superpay Payroll Program guarantees the PET user all the advantages of precise full payroll computing.

1. Unique Screen Layouts
2. Easily understood duplicate payslips
3. Payroll master file reporting and departmental analysis
4. Credit Transfer payments and coin analysis
5. Automatic Year-End analysis
6. Security and confidentiality
7. Reliable updating service for rate changes

The main features of Superpay are also incorporated into the Standard Disk and Cassette Options.

Professional standards and software support of the highest order are **guaranteed features** on all Computastore programs.

Other packages for the PET Series Microcomputers include:

PETE — turns PET into an intelligent RS232 terminal

ASSEMBLER — fast assembly up to 500 lines per minute

DISASSEMBLER — with powerful pattern search facility

KEYBOARD — permits program & data entry from remote keyboard

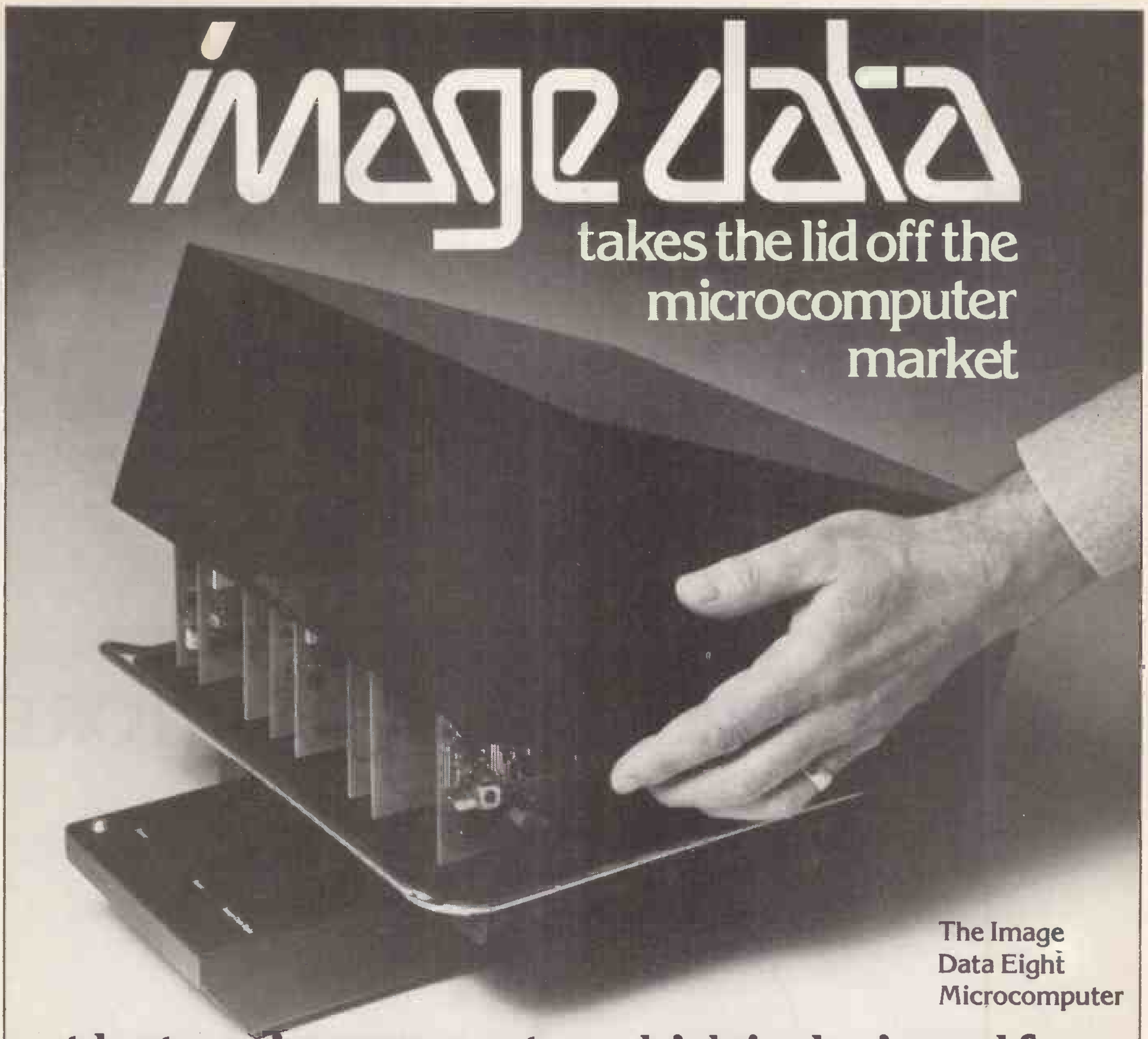
Computastore

Software that means business

Ask your local PET dealer or Computastore for a demonstration

COMPUTASTORE Ltd., 16 John Dalton Street, Manchester M2 6HG. Tel: 061-832 4761

• Circle No. 284



at last a microcomputer which is designed for good looks, ease of access and expandability.

Equally suited to applications in Commerce, Education and Industry, as a dedicated, development or control system.

★ 19" rack mount version
★ International third party maintenance support
★ Full range of supporting peripherals
★ Comprehensive system and application software

image data

Image Data Products Limited
1-4 Portland Square,
Bristol BS2 8RR.
Telephone: 0272 40248/9
Telex: 449752 Chacom G
(Prefix all messages 'Image')

• Circle No. 285

WHY BUY A MICRO-COMPUTER FROM

PETALECT ELECTRONIC SERVICING LTD.

BECAUSE

1) Established company trading since 1971
2) Electronic servicing is our speciality
3) We have in-house programmers/systems analysts
4) We have our own service engineers
5) We will demonstrate the PET at your premises
6) We can customise the PET to your requirements
7) We can arrange finance
8) We offer, after the three-month warranty, a service contract from £69.50
9) You benefit from our experience of having sold over 450 micro-computers to industrial, educational and business, personal users.
10) We specialise in programs and interfaces for weighing applications for average weight control and counting etc.

All 'PETS' sold with a Basic Tutorial Tape

£47.00 + VAT
8K £550.00 + VAT
16K £675.00 + VAT
32K £795.00 + VAT

New Large
Keyboard 'PETS'
Now in Stock

In our showroom we sell
Books, Programs, etc.

Also available:

24K Memory Expansion Boards (disk-compatible), only £320 + VAT
PET-compatible : dual floppy disk unit with advanced operating system, only £840 + VAT
Large Extension Keyboard for the PET £89.50 + VAT
Telephone for complete system prices : Wide Range of Printers Available

If you require any more information or demonstration regarding the PET 2001/8 or any associated equipment, programs, etc., please contact our Marketing Department.
All correspondence to Portugal Road.

PETALECT ELECTRONIC SERVICES LTD
33/35 Portugal Road,
Woking,
Surrey.
Tel. Woking 69032/68497

Shop at:
PETALECT
Chertsey Road,
Woking,
Surrey.
Tel. Woking 21776/23637

• **Circle No. 286**

• Circle No. 288

June

●2 **Microprocessor appreciation.** Venue: London. The course explains what affects microprocessors have on companies and products and is designed for those who are involved with systems or products which could usefully incorporate a microprocessor. Fee: £90 + VAT. Contact: Bleasdale Computer Systems Ltd, 7 Church Path, Merton Park, London SW19. Tel: 01-828.6661.

●2-3 **Microcomputers in education.** Venue: Cavendish Conference Centre, London. The course is of special significance to decision makers in education and presents a complete and concise survey of the most significant developments in this area. Fee: £166.75. Contact: European Study Conferences Ltd, Kirby House, 31 High East, Uppingham, Rutland, Leicester LE15 9PY. Tel: (057 282) 2711.

●2-3 **Production control systems: analysis and design.** Venue: London. Designed for systems staff requiring specialist knowledge in the business principles and design considerations of manufacturing systems. On completion, the participant should have a clear understanding of manufacturing and production control and the design considerations necessary to develop successful production requirement planning systems. Fee: £270 + VAT. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berkshire SL6 1LD. Tel: (0628) 39101.

● 2-3 **Second international microcomputers in education congress.** Venue: Cavendish Conference Centre, London. Presents complete and concise survey of the most significant developments in education. Fee: £166.75. Contact: European Study Conferences Ltd, Kirby House, 31 High Street East, Uppingham, Rutland, Leics. LE15 9PY. Tel: (057 282) 2711.

●2-4 **Database machines.** Venue: London. An opportunity to learn about the possibilities and implications of this radically different approach to database management from one of the world's leading experts, Bruce Berra. Fee: £395. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berkshire SL6 1LD. Tel: (0628) 39101.

●2-4 **Microprocessor workshop.** Venue: Birmingham. Designed for engineers with little or no knowledge of microprocessors. The course is based on the AIM65 board and introduces all aspects of software development by practical programming sessions. Fee: £195 + VAT. Contact: Microsystems Consultants Ltd, PO Box 65, Camberley, Surrey GU15 1QN. Tel: (0276) 27417.

●3-4 **Managing the development of microprocessor-based systems.** Venue: London. The course is designed to give participants a good understanding of microprocessors and of managing the development of microprocessor-based systems. Fee: £180 + VAT. Contact: Bleasdale Computer Systems Ltd, 7 Church Path, Merton Park, London SW19. Tel: 01-828 6661.

●3-6 **Distributed processing systems.** Venue: London. Gives introduction to the tools, techniques, requirements, and benefits of distributed processing. Designed for management, programming and engineering staff who are involved in the selection, installation and management of distributed processing systems. Fee: £470 + VAT. Contact: ICSP U.K., Pebblecoombe, Tadworth, Surrey, KT20 7PA. Tel: (03723) 79211.

●4-5 **Requirements planning systems: analysis and design.** Venue: London. Explains the materials and inventory management business environment and covers techniques for designing computer-based systems to meet typical application requirements. Fee: £270 + VAT. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berkshire, SL6 1LD. Tel: (0628) 39101.

●5-6 **Introduction to database for programmers. Venue:** London. Covers database concepts, DBMS methods, and practical aspects of program development in a database environment. Designed for programmers and team leaders about to encounter database. Fee: £135 + VAT. Contact: The Registrar, LBMS Ltd, 22 Newman Street, London W1P 3HB. Tel: 01-637 9699.

●5-6 **Microprocessor project leadership.** Venue: London. Designed for engineers with sound experience of microprocessors. It will give them the skills necessary to lead a team of engineers who are developing a microprocessor-based system. Fee: £180 + VAT. Contact: Bleasdale Computer Systems Ltd, 7 Church Path, Merton Park, London SW19. Tel: 01-828 6661.

●5-6 & 19-20 **Introduction to microprocessing.** Venue: Bedford. Introductory course on microprocessors using the TMS 9900. Designed for engineers and technicians, non-technical high-level language programmers, technical authors and engineering managers. Fee: £95 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford MK1 7PA. Tel: (0234) 67466. Extn 3718.

●9-13 **Fundamentals of microprocessors — 8080/5/6** course. Venue: London. Starting from basic principles, the operation of microprocessors and the components which are required to build a system are considered. Gives participants opportunity to develop simple programs. Fee: £300 + VAT. Contact: Bleasdale Computer Systems Ltd, 7 Church Path, Merton Park, London SW19. Tel: 01-828 6661.

●9-13 **Introduction to the design of microprocessor-based systems.** Venue: Cambridge. The course gives the basic techniques necessary for the design of microprocessor-based systems by lectures and hands-on practical design work. Designed for engineers with little or no microprocessor experience, programmers, project leaders and managers. Fee: £240 + VAT. Contact: Cambridge Micro Computers Ltd, Cambridge Science Park, Milton Rd, Cambridge, CB4 4BN. Tel: (0223) 314666.

●9-13 **Microelectronics for non-electronic engineers.** Venue: London. Designed for engineers with no previous experience of microprocessors who are faced with the problem of designing microprocessors into their products. Fee: £300 + VAT. Contact: Bleasdale Computer Systems Ltd, 7 Church Path, Merton Park, London SW19. Tel: 01-828 6661.

●10-12 **Advanced microprocessor design techniques for engineers.** Venue: London. Designed for engineers with a good understanding of microprocessor system design. Fee: £240 + VAT. Contact: The Course Registrar, Ganymede Division, SIA Ltd, 23 Lower Belgrave Street, London SW1W 0NW. Tel: 01-730 8171.

10-13 **Project management and control.** Venue: London. Provides information on techniques, documentation, and a project control system. Fee: £245 + VAT. Contact: LBMS Ltd, 22 Newman Street, London W1P 3HB. Tel: 01-637 9699.

11-13 **Advanced microprocessor prototyping laboratory (AMPL).** Venue: Bedford. Designed for technicians and engineers who can write 9900 assembly language programs and can use the FS 990/4 development system. Fee: £250 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford MK1 7PA. Tel: (0234) 67466. Extn. 3718.

13-14 **Commodore Pet Show.** Venue: Café Royal, London. A range of approved Pet products will be demonstrated on more than 50 stands. In addition, Commodore Business Systems will exhibit a wide range of Pet system configurations and software and staff will be available for discussion with users and buyers. Fee: £1. Contact: Iona Uhl, Business Image, Baroness International, 1-3 Old Compton Street, London W1V 5PH. Tel: 01-734 2907.

16 **Introduction to Micro-APL.** Venue: Mollington Banastre Hotel, Chester. Fee: £75. Contact: Course secretary, Alan Pearman Ltd, Freepost, Chester CH3 5YZ. Tel: (0244) 46024.

16-20 **Practical microprocessor course for beginners.** Venue: London. Designed for engineers who need experience in handling a microcomputer. No electronic experience is assumed. Fee: £400 + VAT. Contact: Course Registrar, Ganymede Division, SIA Ltd, 23 Lower Belgrave Street, London SW1W 0NW. Tel: 01-730 8171.

16-20 **Advanced program and data design technology.** Venue: London. Designed for analysts, designers, programmers and software managers and other data processing decision makers. £565 + VAT. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berkshire SL6 1LD. Tel: (0628) 39101.

16-27 **Designing systems with microprocessors: 6800 course.** Venue: London. Designed for engineers with a knowledge of microprocessors and how they work. Covers designing and producing highly-reliable, microprocessor-based systems. Particular emphasis is placed on the design and development of structured software. Fee: £590 + VAT. Contact: Bleasdale Computer Systems Ltd, 7 Church Path, Merton Park, London SW19. Tel: 01-828 6661.

17 **Should we be using a computer?** Venue: London. Half-day seminar designed to give practical help, beginning with what to computerise and whether to computerise at all. The speakers from ICFC consultants will also give guide-lines for dealing with the computer industry and its salesman. Fee: £27.60. Contact: Miss C A Measures, London Chamber of Commerce and Industry, 69 Cannon Street, London, EC4 5AB. Tel: 01-248 4444.

17-19 **APL for analysts.** Venue: Mollington Banastre Hotel, Chester. Fee: £150. Contact: Course secretary, Alan Pearman, Ltd, Freepost, Chester CH3 5YZ. Tel: (0244) 46024.

17-20 **Trouble-shooting microprocessors.** Venue: London. This course combines lectures and hands-on workshops to provide the practical knowledge needed to trouble-shoot microprocessor-based systems. Fee: £540 + VAT. Contact: ICSP U.K., Pebblecoombe, Tadworth, Surrey, KT20 7PA. Tel: (03723) 79211.

18 **An introduction to microelectronics for managers and senior engineers.** Venue: London. Discusses the practicalities of introducing the technology of microelectronics into a company, in either its process or its products. Fee: £90 + VAT. Contact: Course Registrar, Ganymede Division, SIA Ltd, 23 Lower Belgrave Street, London SW1W 0NW. Tel: 01-730 8171.

18 **Practical introduction to microcomputers.** Venue: Cambridge. Covers the basics of microprocessors and how to use them with hands-on training using the SGS-Ates Nanocomputer. Fee: £50 + VAT — if you buy a Nanocomputer, the course is free. Contact: Cambridge Micro Computers Ltd, Cambridge Science Park, Milton Road, Cambridge CB4 4BN. Tel: (0223) 314666.

18-19 **Ifan 3 conference.** Venue: London. Institution of Electrical Engineers, Savoy Place, London WC2. The conference is to present the result of a three-year research program into current standardisation practice. Fee: £100. Contact: The Secretary, British Standards Society, BSI, 2 Park Street, London W1A 2BS.

18-20 **Minicomputers — distributed and stand-alone systems.** Venue: London. Describes the uses of minicomputers in systems, with emphasis on throughput and data-processing capabilities. Designed for systems designers, and managers; also useful for non-dp staff familiar with the basics of computing. Fee: £190 + VAT. Contact: The Registrar, Learmonth & Burchett, Management Systems Ltd, 22 Newman Street, London W1P 3HB. Tel: 01-637 9699.

20 **Advanced APL.** Venue: Mollington Banastre Hotel, Chester. Fee: £75. Contact: Course registrar, Alan Pearman Ltd, Freepost, Chester CH3 5YZ. Tel: (0244) 46024.

23-25 **World computing services industry congress II.** Venue: San Francisco, U.S.A. Contact: Thomas M Driscoll, 4400 Connecticut Avenue, N W Washgton DC 20008.

23-27 **Financial modelling in APL.** Venue: Mollington Banastre Hotel, Chester. Fee: £245. Contact: Course secretary, Alan Pearman Ltd, Freepost, Chester CH3 5YZ. Tel: (0244) 46024.

24-27 **Pascal — hands-on workshop.** Venue: London. Provides a systematic introduction to Pascal. Designed for engineers, scientists, programmers, analysts and managers who plan to use Pascal for the development of systems and applications software. Fee: £540 + VAT. Contact: ICSP U.K., Pebblecoombe, Tadworth, Surrey, KT20 7PA. Tel: (03723) 79211.

24-27 **Computer communication networks.** Venue: London. Provides comprehensive, state-of-the-art foundation in computer communication network concepts, technology and implementation. Emphasis is on the practical aspects of network design, interfacing, protocols and packet switching. Fee: £470 + VAT. Contact: ICSP U.K., Pebblecoombe, Tadworth, Surrey KT20 7PA. Tel: (03723) 79211.

25-27 **Pascal language programming.** Venue: Bedford. For system designers, project engineers and programmers who need to learn Pascal. Fee: £250 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford MK1 7PA. Tel: (0234) 67466. Extn. 3718.

26-27 **Inspection method for software insurance.** Venue: London. This course explains the IBM-developed inspection method for software insurance. On completion, the participant should understand how to apply the techniques of the inspection method to software and related aspects of system development, and achieve greater cost-effectiveness in the activities of dp and dp-orientated departments. Fee: £310 + VAT. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berkshire SL6 1LD. Tel: (0628) 39101.

28-29 **Programming in Basic.** Venue: Hallam Tower Hotel, Sheffield. Designed for those who possess or are considering using a microcomputer or minicomputer in their business and wish to learn how to write programs using the Basic programming language. Fee: £125. Contact: Dean Consultancy Ltd, 45 Canterbury Avenue, Sheffield S10 3RU. Tel: (0742) 303054.

A PRACTICAL GLOSSARY

Continuing the terminological gamut with T

Teletype
Used loosely for any keyboard/printer terminal. In fact, it's a registered trademark for an AT&T subsidiary, Teletype Corp, whose terminals dominated computing in the 1960s and early 1970s.

Their operating characteristics were widely copied, and their specification became a *de facto* standard for low-cost input-output devices — even when VDUs started becoming inexpensive and common in the second half of the 1970s. The simplest and most inexpensive VDU terminals still feature Teletype-compatibility.

Meanwhile, Teletype is still among the big boys in the business, notably through its good Teletype 43 — a 30 cps printer terminal.

Teletypewriter
See teleprinter.

Telex
A world-wide subscriber network for teleprinters. It is often a feasible alternative to data links using telephone lines — you can send and receive messages on both kinds of service, but the Telex is cheaper and simpler, though slower.

Terminal
Specifically, it is the end of a communications link, defined more helpfully by one dictionary as the point at which a user communicates directly with a computer. So, in theory, the keyboard and screen on a TRS-80 or a Pet are terminals.

In practice, you would be better off thinking of a basic unit comprising keyboard, screen, and/or printer connected to a computer by a cable and/or telephone line. That is the simplest terminal.

More clever are the so-called intelligent terminals. They incorporate a microprocessor and may give you local programming facilities — which means the terminal user can develop and run programs without communicating at all with the central computer. In that case, your terminal will probably have a cassette or floppy disc attached.

There are purpose-built industry-specific terminals which are really very complex. Banks and supermarkets, for instance, typically have whole terminal systems with the terminal involving several different types of device — special printers, cash registers, those hole-in-the-wall cash dispensers, various kinds of automatic credit-card checkers, and so on. All can be linked to a small mini or microcomputer which, in turn, passes the data collected to the central computer.

Text editor
A special program which allows input of alpha-numeric text and modification without necessarily your having to be aware of how and when it will be printed. The output side may be looked after by a second program called a print formatter. Together, the two programs constitute a word processor. On its own, a text editor is a dramatically useful tool for program entry and correction — it can greatly simplify the time-consuming chores.

Throughput
It is usually defined in some all-embracing fashion like the total useful information processed or communicated during a specified period by a machine, system or procedure, measured in some terms meaningful to the process under consideration.

For example, a payroll system may deal with 50 employee records per minute; you might deal with 5,000 inquiries from an information retrieval system.

Time-sharing
The method by which one computer can service several users more or less all at the same time. In fact, the computer services each user in sequence; its high speed makes it appear that the users are all handled simultaneously — whereas in reality each receives a few milliseconds of the computer's attention in turn.

Tiny Basic
A subset of Basic devised by designer of minicomputers, Tom Pitman. It allows only integer arithmetic and limited string operations, but the more useful Basic facilities are there. Tiny Basic fits into only 4Kbytes which makes it great for sub-£250 microcomputer kits like the Elf II.

TP
Teleprocessing — though sometimes it is known as transaction processing.

Track
The channel on a disc along which data is stored — also called a cylinder. The term is also used with mag tape to refer to the longitudinal paths on which bits can be placed, so nine-track tape can have up to nine bits in a character.

A character is read by picking up a particular combination of bits horizontally across the tape from whatever is in the nine channels at that position.

Transaction
This term is bandied about a good deal in business computing. A transaction is any event — like receiving a bill or despatching an order — which requires a record to be generated in the system.

You may encounter the impressive but ill-defined term transaction processing. Usually it means that each transaction is processed as it happens which makes transaction processing the opposite to batch processing in the commercial environment.

Transfer rate
The speed at which a footballer changes clubs. Also the rate at which data is transferred from a peripheral device to main memory. You will usually meet it in reference to cassette or floppy disc units.

The transfer rate quoted so blithely is the theoretical maximum. In practice, the performance will generally be constrained by many other factors. Transfer rate is usually given as characters, bits or bytes per second.

Transistor
You don't really need to know anything about them, but this electronic device is absolutely critical to the development and design of today's computers.

Transmit
To send information from one place to another via a data transmission circuit which usually means a telephone line.

Trap
A method of detecting program errors when illegal instructions are executed or illegal memory locations are accessed. Usually what happens is that the program branches briefly to a special subroutine when some unusual condition occurs during the running of a program.

The operating system may assume control automatically and correct the condition or note the cause of failure. Trapping is also a feature of certain diagnostic routines.

TRS-80
The world's second most popular personal computer is Tandy's little baby. It adopted a very different approach to the Commodore Pet, even though both use the same elements — keyboard, screen, cassette, graphics and Basic.

Tandy went for the Z-80 rather than the 6502 — Intel derivative versus Motorola parentage — opted for a real keyboard rather than the calculator-style keys on the Pet, and decided to sell three cable-connected boxes rather than one integrated unit.

As a result it's difficult to weigh these two similarly-priced computers against each other. Both manufacturers are now going for business versions of their computers — floppy disc systems at the £2,000-plus mark.

Truth table
You may find the term applied to a table describing a logic function by listing all possible combinations of input values and indicating all the logically true output values.

That is all associated with the heavy esoterica of Boolean arithmetic, so most of us can safety forget it.

TTL
Stands for transistor-transistor logic; it's one of the standard design approaches to semi-conductor integrated circuits. Standard TTL provides the lowest component cost of conventional logic.

It is relatively fast and is unsurpassed for a variety of functions but it has at least four disadvantages; high power dissipation, limited noise immunity, inadequate speed for some applications, and limited complexity.

All these only from HENRY'S

IN STOCK

FREE POWER SUPPLY

NASCOM-2 + FREE 16K RAM £295 + VAT P&P £1.50

NASCOM-2+FREE 16K RAM

Here's an offer you can't refuse:
Because of the lack of availability of MK 4118 RAMs, Nascom Microcomputers is supplying its Nascom 2 without the 8 spare 4118s but with a FREE 16K dynamic RAM board.

NASCOM–2 with 32K RAM £345 + VAT P&P 1.50

When the 4118s become available, Nascom 2 purchasers can have them at the special price of £80 + VAT for the 8K.

So, for £295 plus VAT this is what you get:

Buy British It's Best!!

MEMORY
- 16K RAM board (expandable to 32K).
- 8K Microsoft BASIC.
- 2K NAS-SYS 1 monitor
- 1K Video RAM.
- 1K Workspace/Scratchpad RAM.
- Main board sockets for the 8x4118s or 2708 EPROMS.

MICROPROCESSOR
- Z80A which will run at 4MHz but is selectable between 1/2/4 MHz.

HARDWARE
- Industrial standard 12" x 8" PCB, through hole plated, masked and screen printed. All bus lines are fully buffered on-board.

INTERFACES
- Licon 57 key solid state keyboard.
- Monitor/domestic TV interface.
- Kansas City cassette interface (300/1200 baud) or RS232/20mA teletype interface.

The Nascom 2 kit is supplied complete with construction article and extensive software manual for the monitor and BASIC.

No more slaving over a hot soldering iron – the Nascom 1 is now supplied BUILT! Britain's biggest small system is available fully constructed for you to slot into your own housing for the ridiculously low price of £175 plus VAT (kit price still only £165 plus VAT). EX-STOCK

nascom-1

12" x 8" PCB carrying 5LSI MOS ... 1K MOS memory packages ... There is on-board ... unmodulated ... The ... user RAM ... erating

With NAS-SYS SCOOP KIT NOW ONLY Less P10 £125 FULLY GUARANTEED

NEW NASCOM-1 BUILT £140 + VAT P&P 1.50

MEMORIES	£.p.
2114	4.00
8 FOR	30.00
4116	7.50
8 FOR	55.00
2708	7.50
4 FOR	28.00
4118	12.75
4 FOR	48.00
2716	22.00

EXPANSION NASCOM-1

*Expansion buffer board	£32.50
MEMORY KITS (inclusive all hardware)	
8K	£85
16K	£140
32K	£200
*I/O board with decoders and all hardware except ICS will accept up to 3 PIOs, 1 CTV and 1 UART	£35
NEW. T 4 operating system in (2) 2708 EPROMS UPWARDS COMPATIBLE FROM T2 and B-BUG	£25.00
NAS SYS 1. MONITOR	£25.00
Programming Manual	£4.50
*Power supply for up to 32K expansion Mk II	£24.50
*8A power supply for larger than 32K expansion	£60.00
*Expansion card frame	£29.50
EPROM programmer	£13.95
SMART-1	£74.95
Tiny Basic	£25.00
Super Tiny Basic (with editor and machine utility routined)	£35.00
Zeap assembler editor	£32.00
8K BASIC ROM	£40.00
Naspen Text Handler	£30.00
Disassembler	£9.95

NASCOM IMP £325 + VAT + P&P £2.50

NASCOM IMP PLAIN PAPER PRINTER

Fully built and housed in a stylish enclosure for just £325 plus 15% VAT. Interfaces with all micro computers. Deliveries Ex-Stock.

- Optional tractor feed.
- Baud rate from 110 to 9600
- External signal for optional synchronisation of baud

The Nascom IMP (Impact Matrix Printer) features are:
- 60 lines per minute
- 80 characters per line.
- Bi-directional printing.
- 10 line print buffer
- 96 character ASCII set (includes upper/lower case
- Automatic CR/LF.
- Accepts 8½" paper

FERRANTI COMPUTER KEYBOARDS

STURDY SOLID CASE

SIZE 14×6×3" SLOPING FRONT

60 Key ASCII Coded in steel case
Latched output complete with Plug & Cable with circuit to convert to T.T.L. levels.

In good condition at only **£25** + VAT P/P £2.50

HALF PRICE OFFER

80 column

CENTRONICS P1 PRINTER

EXCLUSIVE TO HENRY'S 50% OFF MAKER'S PRICE

- Software selectable 20, 40 and 80 column using 120mm aluminiumised paper. 1 roll supplied.
- 150 lines per minute.
- Centronics parallel data interface for Nascom, Tandy, etc.
- 240volt mains input.
- ASCII character set
- Paper feed, and on/off select switches
- Audible 'BELL' signal Weight 10lbs
- Size: 13" x 10½" x 4½" LIST PRICE £400
- New, boxed and fully guaranteed

Our Price £195.00
plus VAT post FREE

Spare paper £9 for 3 Rolls + VAT

Your London & National Nascom Distributor
Export Orders deduct VAT, but add 5% carriage
Official Export & Educational Orders welcome
Our Telex 262284 Mono Ref. 1400 Transonics

COMPUTER BROCHURE FREE — SEND 15p STAMP

HENRY'S
Computer Kit Division
404 Edgware Road, London, W2, England
01-402 6822

• Circle No. 290

Advertisement Index

8MHz Super Quality Modulators	£4.90
6MHz Standard Modulators	£2.90
C12 Computer Grade Cassettes	10 for £4.00
Super Multi-rail P.S.U. +5 −5 +12v	£29.50
ETI Breakout Game — Chip and PCB	£9.90
S100 Expansion Motherboard for Nascom I	£39.00
Anadex Printer Paper — 2000 sheets	£25.00
Floppy Disks 5¼" Hard & Soft Sectored	£3.50
Floppy Disk Library Case 5¼"	£3.50
Eprom Boards	£63.00
8K Static Ram Boards — S100	£110.00
Cartridges for Grandstand	£11.99
George Risk Ascii Keyboard	£39.00
Cartridges for Atari — Full Range in Stock	£13.90
Interface PET IEEE — Centronics Parallel Not decoded £49.00 Decoded	£77.00
Interface to Centronics parallel for TRS80	£75.00
Verocases for Nascom 1 & 2 etc.	£22.50
Keyboard Cases	£9.90
Electric Pencil for TRS80	£29.00

SPECIAL SCOOP

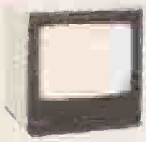
GET YOURSELF A PRINTER FOR YOUR PET AND SAVE A FORTUNE

only **£399** + VAT

Full Pet Graphics including cables. Ready to go.

EX-STOCK.

HITACHI PROFESSIONAL MONITORS



9" — **£129**
12" — **£199**

● **Reliability** Solid state circuitry using an IC and silicon transistors ensures high reliability. ● **500 lines horizontal resolution** Horizontal resolution in excess of 500 lines is achieved in picture center. ● **Stable picture** Even played back pictures of VTR can be displayed without jittering. ● **Looping video input** Video input can be looped through with built-in termination switch. ● **External sync operation** (available as option for U and C types) ● **Compact construction** Two monitors are mountable side by side in a standard 19-inch rack.

only **£356** + VAT

TRS80 LEVEL 2 16K

Fully converted to UK T.V. Standard. Comes complete with easy to follow manuals. UK Power Supply — Cassette Leads — Sample tapes. Special box to enable you to plug into your own TV. Recommended for first time-buyers. Just plug in and go. Full Range of Software Available

Model with numeric key pad £389 + VAT
4K Level I — machine only £251 + VAT

NEW REDUCED PRICES

8K **£449**
16K **£549** + VAT
32K **£649**

RRP £795 for 32K

The PEDIGREE PETS

Very popular for home & business use. 8K Microsoft Basic in ROM. 8K Pet 32K & 16K with new improved keyboard. All with green screen.

Extra cassette deck **£55** Full range of software available.

32K **£690** + VAT

48K **£790** + VAT

EXIDY SORCERER

RRP £859 for 32K

For Personal or Business Use.
32K or 48K memory. 8K Microsoft Basic in ROM. Dual Cassette I/O, RS232 I/O. Parallel I/O (Centronics). Expansion available through optional extra S100 Motherboard. 69 Key keyboard including 16 key numeric pad.

S100 EXPANSION — **£199**

NASCOM IMP PLAIN PAPER PRINTER

£325 NEW

Fully built and housed in a stylish enclosure for just **£325** plus VAT. Interfaces with all micro computers.

The Nascom IMP (Impact Matrix Printer) features are listed below:

● 60 lines per minute. ● 80 characters per line. ● Bi-directional printing. ● 10 line print buffer. ● Automatic CR/LF. ● 96 character ASCII set (including upper/lower case, $, #, £). ● Accepts 8½" paper (pressure feed). ● Accepts 9½" paper (tractor feed). ● Tractor/pressure feed. ● Baud rate from 110 to 9600. ● External signal for optional synchronisation of baud rate. ● Serial RS232 Interface with parallel option available soon.

only **£295** + VAT

TRS80 EXPANSION INTERFACE

32K

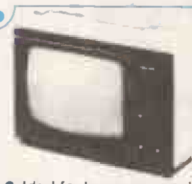
Expand your TRS80 by 32K.
32K Memory on board. Centronics parallel port. Disk controller card. Real time clock. Requires Level II Basic. Interface for 2 cassette decks, complete with power supply.

RRP £540

only **£499** + VAT

ANADEX DP8000

Super Quality — Low cost printer. Tractor Feed with full 96 ASCII character set. Accepts RS232C at band rates between 100 and 9600 and Parallel Bit data.
Attaches either directly or through interfaces to Pet, Apple, TRS80, Sorcerer, Nascom, Compukit etc.



video 100

12" BLACK & WHITE LOW COST VIDEO MONITOR

RRP £79

only **£69** + VAT

● Ideal for home, personal and business computer systems ● 12" diagonal video monitor ● Composite video input ● Composite video input ● Compatible with many computer systems ● Solid-state circuitry for a stable & sharp picture ● Video bandwidth - 12MHz + 3DB ● Input impedance -75 Ohms ● Resolution - 650 lines Minimum In Central 80% of CRT; 550 Lines Minimum beyond central 80%.

NASCOM-2 MICRO-COMPUTER

only **£295** + VAT

Your choice of freebies with every Nascom 2 purchased from us

either FREE POWER SUPPLY
OR FREE GRAPHICS ROM
OR FREE VERO CASE TO TAKE NASCOM 2

Microprocessors Z80A. 8 bit CPU. This will run at 4MHz but is selectable between 1/2/4 MHz. This CPU has now been generally accepted as the most powerful, 8 bit processor on the market.
INTERFACE
Keyboard New expanded 57 key Licon solid state keyboard especially built for Nascom. Uses standard Nascom, monitor controlled, decoding.
T.V. The Iv peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.
I.O. On-board UART (Int.6402) which provides serial handling for the on-board cassette interface or the RS232/20mA teletype interface.
The cassette interface is Kansas City standard at either 300 or 1200 baud. This is a link option on the NASCOM-2.
The RS232 and 20mA loop connector will interface directly into any standard teletype.
The input and output sides of the UART are independently switchable between any of the options — i.e. it is possible to house input on the cassette and output on the printer.
PIO There is also a totally uncommitted Parallel I/O (MK3881) giving 16, programmable, I/O lines. These are addressable as 2 x 8 bit ports with complete handshake controls.
Documentation Full construction article is provided for those who buy a kit and an extensive software manual is provided for the monitor and Basic.
Basic . The Nascom 2 contains a full 8K Microsoft Basic in one ROM chip with additional features like DEEK, DOKE, SET, RESET for simple programming.
With free 16K RAM board.

A PROFESSIONAL WORD PROCESSING SYSTEM AND IT'S A COMPUTER AS WELL.

ALL FOR ONLY **£3250** + VAT including Word Pro and Cables.

£790 + VAT

£1750 + VAT RRP £2200

PET 32K — This is the standard 32K Pet from Commodore. Reverse video and graphics allow the WordPro Package to give simple clear and easy to read displays.

2040 Disk Drives Twin disk drives allow large high speed storage for your letters, or paragraphs. Plugs in the back of the PET.

NEC Spinwriter NEC's high quality printer uses a print "thimble" that has less diameter and inertia than a daisy wheel, giving a quieter, faster, more reliable printer that can cope with plotting and printing (128 ASCII characters) with up to five copies, friction or tractor fed. The ribbon and thimble can be changed in seconds.
55 characters per second bidirectional printing — with red/black, bold, subscript, superscript, proportional spacing, tabbing, and much, much more.

WordPro II The heart of the system — consists of a ROM and diskette. The ROM is inserted into a space socket inside the Pet. One of the most versatile Word Processing Packages around.

All items sold separately.

● **Circle No. 309**

COMPUKIT UK101

EUROPE'S FASTEST SELLING ONE BOARD COMPUTER

★ 6502 based system — best value for money on the market. ★ Powerful 8K Basic — Fastest around ★ Full Qwerty Keyboard ★ 4K RAM Expandable to 8K on board. ★ Power supply and RF Modulator on board. ★ No Extras needed — Plug-in and go. ★ Kansas City Tape Interface on board. ★ Free Sampler Tape including powerful Dissassembler and Monitor with each Kit. ★ If you want to learn about Micros, but didn't know which machine to buy then **this is the machine for you.**

Build, Understand and Program your own Computer for only a small outlay.

KIT ONLY **£199** + VAT
NO EXTRAS NEEDED

AVAILABLE READY ASSEMBLED & TESTED
READY TO GO FOR **£249** + VAT

Specially designed case for Compukit in orange/black. With room for accessories. **£29.50** + VAT

6502 Assembler/Editor for Compukit £14·90 + VAT

The **Compukit UK101** comes in kit form with all the parts necessary to be up and working, supplied. No extras are needed. Ater plugging in just press the reset keys and the whole world of computing is at your fingertips. Should you wish to work in the machine code of the 6502 then just press the M key and the machine will be ready to execute your commands and programs. By pressing the C key the world of Basic is open to you.

This machine is ideal to the computing student or Maths student, ideal to teach your children arithmetic, and is also great fun to use.

Because of the enormous volume of users of this **kit** we are able to offer a **new reduced price** of **£199** + VAT

NEW MONITOR FOR COMPUKIT UK101 ● In 2K Eprom 2716
● Allows screen editing ● Saves data on tape
● Flashing cursor ● Text scrolls down **£22.00** + VAT

THE NEW TRS80 SURPRISE — MODEL II

Fast and expandable!
Model II operates at twice TRS-80's high speed.

In addition to either 32 or 64 thousand characters (bytes) of internal Random Access Memory, one built-in 8" floppy disk stores an additional one-half million bytes, including the Disk Operating System. And you can easily expand up to a four-disk system for up to two-million bytes of storage.

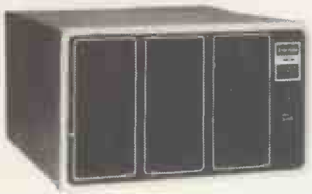
Model II features upper and *lower* case letters. Its built-in 12" high-resolution video monitor displays 24 lines of 80 normal characters. The profesional 76-key keyboard (with "calculator" keypad) includes advanced functions such as Control, Escape, Caps, Hold, Repeat. The keyboard is detachable and moveable for convenient data entry.

You get the enhanced Level III version of TRS-80's already-famous Level II BASIC language and "TRSDOS" operating system, automatically loaded in memory when you "power up." (About 24K of RAM is used by this software.)

Each time you power up, Model II thoroughly tests itself to insure proper operation. Your chosen program can appear immediately, without any Intermediate steps or questions to answer.

Versatility ... plug-in expandability
Built-in input/output capabilities include two RS-232C channels, and one Centronics parallel port. Future expansion is provided for through four plug-in slots for optional PC boards.

64K 1-Disk Model II **£2250.00** + VAT



1 DISK EXPANSION
Room for 3
500K per Drive gives total of 1.5M Byte — 1 Drive plus Cabinet **£799** + VAT

Just Plug In

WE ARE NOW EX-STOCK

Why do people buy more from COMPSHOP than anywhere else?

EXTENDED WARRANTY BY COMPUCARE

★ **LARGER STOCKS** — we hardly ever run out
★ **GOOD SERVICE** — we give extended warranties on all our products.
★ **EXCELLENT REPAIR SERVICE** — Through Compucare we repair and maintain most makes of personal computers.

LAST YEAR WE SUPPLIED TO THE PUBLIC — LARGE & SMALL
16,000 Television Games & 7,000 Computer Systems

NEW TV GAME BREAK OUT

Has got to be one of the world's greatest TV games. You really get hooked. As featured in ETI. Has also 4 other pinball games and lots of options. Good kit for up-grading old amusement games.

MINI KIT — PCB, sound & vision modulator, memory chip and de-code chip. Very simple to construct. £14.90 + VAT
OR PCB **£2.90** MAIN LSI **£8.50** Both plus VAT

THE ATARI VIDEO COMPUTER SYSTEM £99.00 + VAT

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty great Game Program™ cartridges!

Have fun while you sharpen your mental and physical coordination. You can play rousing, challenging, sophisticated video games, the games that made Atari famous.

You'll have thrill after thrill, whether you're in the thick of a dogfight, screeching around a racetrack, or dodging asteroids in an alien galaxy. With crisp bright colour (on colour TV) and incredible, true-to-life sound effects. With special circuits to protect your TV.

Cartridges now available All at **£13.90** each + VAT
Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, Hunt & Score*, Space War, Sky Diver, Air Sea Battle Codebreaker*, Miniature Golf.

Extra Paddle Controllers — **£14.90** + VAT
*Keyboard Controllers — **£16.90** + VAT

Please add VAT to all prices — Delivery at cost, will be advised at time of purchase. Please make cheques and postal orders payable to COMPSHOP LTD., or phone your order quoting BARCLAYCARD, ACCESS, DINERS CLUB or AMERICAN EXPRESS number.
CREDIT FACILITIES ARRANGED — send S.A.E. for application form.
14 Station Road, New Barnet, Hertfordshire, EN5 1QW Telex: 298755 TELCOM G
Telephone: 01-441 2922 (Sales) 01-449 6596
OPEN · 10 am · 7 pm — Monday to Saturday
Close to New Barnet BR Station — Moorgate Line.
✱ **NOW in IRELAND at:** 80 Marlborough St., Dublin 1. Tel: Dublin 749933

COMP SHOP LTD.
"Europes Largest Discount Personal Computer Store"

COMP COMPUTER COMPONENTS
(Part of the Compshop Ltd. Group)

At Intersystems, "dump" is an instruction.

Not a way of life.

(Or, when you're ready for IEEE S-100, will your computer be ready for you?)

We're about to be gadflies again.

While everyone's been busy trying to convince you that large buses housed in strong metal boxes will guarantee versatility and ward off obsolescence, we've been busy with something better. Solving the *real* problem with the first line of computer products *built from the ground up to conform to the new IEEE S-100 Bus Standard*. Offering you extra versatility in 8-bit applications today. And a full 16 bits tomorrow.

We call our new line Series II.™ And even if you don't need the full 24-bit address for up to 16 megabytes (!) of memory right now, they're something to think about. Because of all the performance, flexibility and economy they offer. Whether you're looking at a new mainframe, expanding your present one or upgrading your system with an eye to the future. (Series II boards are compatible with most existing S-100 systems and *all* IEEE S-100 Standard cards as other manufacturers get around to building them.)

Consider some of the features: Reliable operation to 4MHz and beyond. Full compatibility with 8- and 16-bit CPUs, peripherals and other devices. *Eight* levels of prioritized interrupts. Up to 16 individually-addressable DMA devices, with IEEE Standard overlapped operation. User-selectable functions addressed by DIP-switch or jumpers, eliminating soldering. And that's just for openers.

The best part is that all this heady stuff is available *now*! In our advanced processor—a full IEEE Bus Master featuring Memory Map™ addressing to a full megabyte. Our fast, flexible 16K Static RAM and 64K Dynamic RAM boards. An incredibly versatile and economical 2-serial, 4-parallel Multiple I/O board. 8-bit A/D-D/A converter. Our Double-Density High-Speed Disk Controller. And what is undoubtedly the most flexible front panel in the business. Everything you need for a complete IEEE S-100 system. Available separately, or all together in our new DPS-1 Mainframe!

Whatever your needs, why dump your money into obsolete products labelled "IEEE timing compatible" or other words people use to make up for a lack of product. See the future now, at your Intersystems dealer or call/write for our new catalog. We'll tell you all about Series II and the new IEEE S-100 Bus we helped pioneer. Because it doesn't make sense to buy yesterday's products when tomorrow's are already here.

InterSystems™

Ithaca Intersystems,
58 Crouch Hall Road,
London, N8 8HG. U.K.
Telephone: 01-341-2447/Telex: 299568