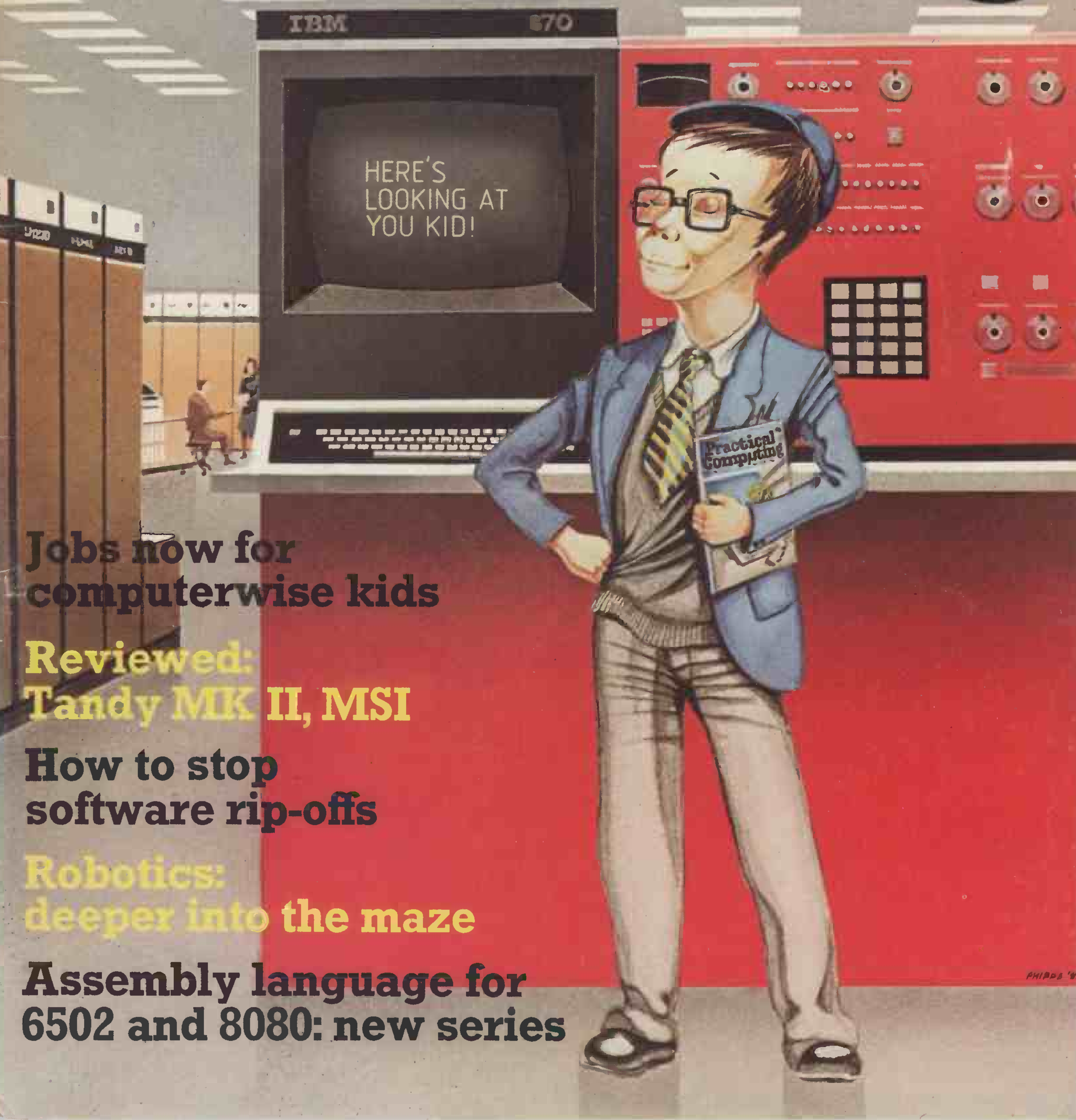
Practical Computing

50p

March 1980

Volume 3 Issue 3



Jobs now for computerwise kids

Reviewed: Tandy MK II, MSI

How to stop software rip-offs

Robotics: deeper into the maze

Assembly language for 6502 and 8080: new series

Practical Computing

CONTENTS

This month's cover shows the bane of micro-computer shows — the fourteen year old who knows it all. But still, at this juncture in our island history, we seem to need him. Inside this issue: how to get started in computing, even if you aren't still fourteen.

Editor
Peter Laurie
Technical editor
Nick Hampshire
Staff writer
Duncan Scot
Rewrite
Martin Hayman
Art
Margaret Smith
Editorial secretary
Susie Manning
Advertisement manager
Tom Moloney
Advertisement executives
Tina Roberts
David Lake
Secretary
Stephanie Hill
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 £25 per published page. Programs intended for publication must 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.

Scotland 18, 19, 20 March – Albany Hotel, Douglas Street, Glasgow
North West 11, 12, 13 March – New Century Hall, Corporation Street, Manchester
Midlands 4, 5, 6 March – Albany Hotel, Smallbrook Queensway, Birmingham
London 25, 26, 27 March – West Centre Hotel, Lillie Road, London SW6

COMPUTERMA

Your first computer?

If you're thinking about your first computer for home or office, a visit to Computermarket will save you time and money. You'll be able to compare prices in just one visit, see who is committed to your area, meet people who have installed the sort of equipment you are considering, check out after sales service arrangements with more than just one potential supplier and see computers performing the applications of interest to you. You'll see micro-computers from just a few hundreds of pounds and highly sophisticated systems costing hundreds of thousands. You'll be able to examine the enhancements you may later wish to add to your computer and check out that the system can be upgraded, investigate the availability and cost of the supplies that you'll need to get and keep your computer running. You might even actually see a silicon chip!

OEM/System builder?

Hasn't your marketplace changed since you first thought about the business you're in? 16 bit micros, midi-computers, bread-boards for peanuts, matrix line printers, smart VDUs for the price of dumb ones, famous names that you hadn't heard of only months ago. Custom ized or off-the-shelf, it must sometimes look like the world and his wife is starting a systems house. Who is in your business in your area? A visit to Computermarket will tell you and a lot more besides including who can supply at least cost and fastest delivery.

Computer user?

If you've already got a computer, you'll know who gives the best service on supplies in your area – won't you? You'll already know where you can get short delivery and best terms on the peripheral enhancements you plan – won't you? You'll be aware of the software packages that are available for your existing equipment – won't you? You've probably thought about the additional processor (or its replacement) you will need before too long – haven't you? Why not check and be sure. A visit to Computermarket will confirm that you are right and will continue to get the best deal on peripherals, ancillary equipment, services, software, supplies . . . and it will give you the opportunity to see micro and mini based systems in operation just to keep up-to-date and for interest's sake – won't it?

Communications user?

Are you getting the most from your system? An acoustic coupler can cost very little and yet be the start of a communications network. Modems, multi-plexers . . . the hardware of data communications is developing fast and so is the environment in which the equipment may be employed. Communications experts will be at Computermarket so if it's a terminal in another part of your building, distributing data processing or starting your own satellite communications network (!), a visit to Computermarket should prove to be a worthwhile investment and a chance to study PRESTEL at first hand.

Who will be at Computermarket?

Advertisements such as these are prepared many months in advance of the exhibitions described, but it is already certain that Computermarket will be bigger than ever before – more than twice as big overall. Companies that had already reserved stands as at November (almost four months before the 1980 series of exhibitions) included:- Zygal, Wootton Jeffreys, Willis Computer Supplies, Which Computer?, Wespac, Wang, Versatec, Tullis Neill, Terminal Display Systems, Telema, Tektronix, Tann Synchronome, Systime, Sumlock Bondain, Star Computer Centre, Scotia Data Products, SEMS, Selborne Computers, SEL, Rostronics, Robox, Rair, Q-Pac Services, Pragma, Post Office, Plessey Peripherals, Peterborough Data, Richard Norton, Northern Software Consultants, Newbury Laboratories, Nashua, Nascom, NSC Computers, Modular Technology, Modem, Midlectron, Micro Media, Micro Data Products, Micro Centre, Micro Bits, MCS Mini Computer Systems, Lynwood Scientific Developments, Lyme Peripherals, Linn Products, Information Equipment Maintenance, ITT, ICS, Harwoods Business Machines, Hamilton Rentals, John Goldsmith, General Audio & Data Communications, Geest Computers, GEC Computers, Excel, Eurocom, Equinox, Digidata, Digico, Datum, Data Design Techniques, DRG Business Machines, DML, Cytek, Cost Effective Computing, Corner Computer Services, Computing, Computer Workshop, Computer Weekly, Computer Management, Computer Ancillaries, Computastore, Comp

ARKET'80

Shop, Commodore Business Systems, Comma Computers, Cole Electronics, Cifer Systems, Camden Electronics, CPS Data Systems, CPN, C.A.R. Business Systems, Byte Shop, Benson Electronics, BL Systems, B & B Computers, Andrews Industrial Equipment, Anadex and A.I.R.

Accountant?

If accounts, payroll, invoicing, credit control, ledger maintenance . . . figure in your life, then an hour or two at Computermarket should be an absolute must. A micro-computer can cost as little as a calculator did just a few short years ago. Trial balance and Profit and Loss statistics can be generated at the touch of a few buttons. Computers can cost hundreds or hundreds of thousands of pounds, save or even sometimes, heaven forbid, squander. You should know what computers are doing today, you might want one or have to use one tomorrow. Your advice may be sought – should be sought – by your own company or that of a client. Admission to Computermarket will cost you nothing, but could very well be worth a great deal in the future.

Data processing manager?

How much would a ten per cent saving on your stationery budget mean to your annual costs? There may be an exhibitor who could achieve that if the two of you met. Is your next peripheral going to be supplied on the most favourable terms? A visit to Computermarket will give you the confidence that you are doing the best for your company. Wouldn't it help if only other Managers in your company could see what it was you were talking about when describing printers/plotters/displays/. . ? Why not bring them along to Computermarket and show them what you've told them about? Does your chief analyst realise how software packages can be run on your hardware? Wouldn't you both benefit from a visit to Computermarket?

Your own business?

Like it or not, computers are affecting your business and that of your clients, suppliers and competitors. A computer can offer the businessperson much more than automated accounting. It can provide accurate, up-to-the-minute details on the performance of the company, flash warning signals over stock levels, credit-worthiness, supplier shortfalls . . . handle payroll, revenue and VAT returns . . . generally give you more time to run the business you know rather than processing paperwork. See the systems at Computermarket.

Computerising correspondence?

Computer control has received a lot of publicity since the advent of the silicon chip, but micro-processors have also made an impact in the office. Word Processors are able to increase the efficiency of typists to varying and often staggering degrees. Where repetition occurs in letters, reports, contracts, etc., a Word Processor can frequently pay for itself in a matter of months. Many of the small business computer systems now available include a word processing facility, thereby offering what is almost a complete 'work processing' system for a cost equivalent to, say, a new company car. Witness work processing at Computermarket.

In the Midlands?

Computermarket'80 opens at the Albany Hotel, Smallbrook Queensway, Birmingham on the 4th, 5th and 6th March between 10 am and 5 pm daily. The Albany Hotel has excellent facilities and is very conveniently located for car parks and New Street Railway and Bus Stations.

In the North West?

The Manchester venue of Computermarket'80 is the New Century Hall (at the foot of the C.I.S. building) in Corporation Street, opposite Victoria Station, close by car parks and connected by bus with the Piccadilly Station. Computermarket – North West is open 11th, 12th and 13th March 10 am to 5 pm.

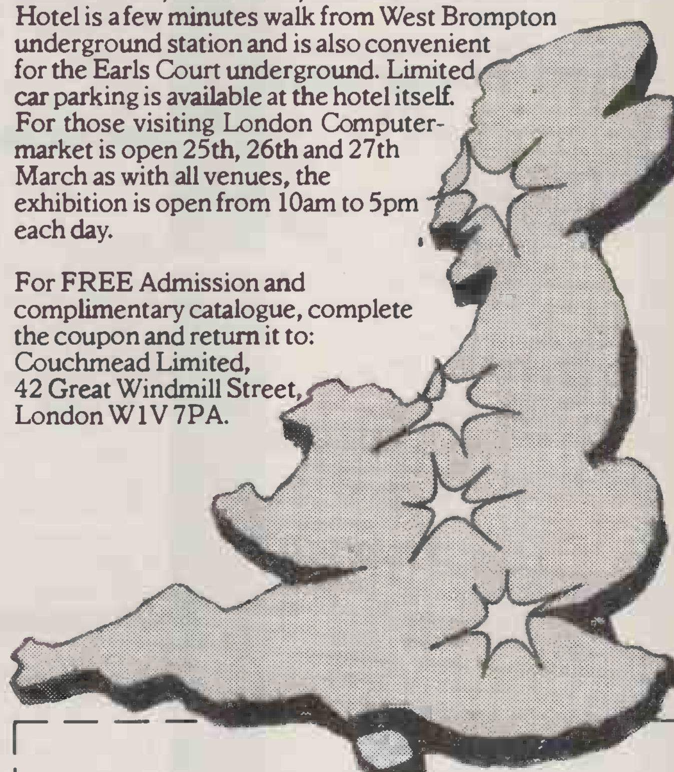
In Scotland?

Regarded as Glasgow's finest hotel, the Albany in Douglas Street (on the corner of Bothwell Street) houses Computermarket'80 in Scotland. The hotel is within walking distance of the major railway stations and well provided with car parking and motorway access. Computermarket – Scotland is on 18th, 19th and 20th March between 10 am and 5 pm each day.

In London?

Biggest of all the Computermarket'80 venues is at the West Centre Hotel, Lillie Road, London SW6. The West Centre Hotel is a few minutes walk from West Brompton underground station and is also convenient for the Earls Court underground. Limited car parking is available at the hotel itself. For those visiting London Computermarket is open 25th, 26th and 27th March as with all venues, the exhibition is open from 10am to 5pm each day.

For FREE Admission and complimentary catalogue, complete the coupon and return it to:
Couchmead Limited,
42 Great Windmill Street,
London W1V 7PA.



Name ______________________

Job Title ______________________

Organisation ______________________

Address ______________________

______________________ Postcode __________

COMPUTERMARKET'80

It is regretted that in order to preserve the businesslike nature of Computermarket, admission is not open to persons under 18 or to student parties.

• Circle No. 104

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 £515.00
- **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 £45.00
- 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

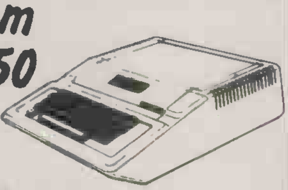
- TRS 80, 4K Level I consisting of Keyboard with 4K memory, Video Unit, Cassette Drive and 240v power supply unit £365.00
- TRS 80, 4K Level II (as above with Level II Basic) £425.00
- TRS 80, 16K Level II (as above with 16K memory) £499.00
- TRS 80, Expansion Interface with 16K RAM £275.00
- TRS 80,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

ACCESSORIES

- TVJ 232C 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 £750



apple & ITT 2020 authorised dealers

BASIC SYSTEM

Apple II Plus computer – APPLESOFT extended basic in ROM – (16K RAM) - video output £750*

ACCESSORIES

- Apple black and white modulator for domestic TV £20.00
- Eurocolor card – provides colour on domestic TV £69.00
- Parallel Printer Interface Card £110.00
- High Speed Serial (RS232C) Interface Card £110.00
- Communications Card £132.00
- Centronics Card £110.00
- Integer Basic Firmware Card £110.00
- PASCAL language system – includes language card to provide user with PASCAL, PALSOFT & INTEGER BASIC £296.00
- Real time clock/calendar card – 1/1000 sec to 388 days with interrupt, software controllable £140.00
- Speechlab – provides voice control for the Apple £127.00
- Supertalker – adds human speech output! £205.00
- ALF Music Synthesizer Card £215.00
- A1-02 Data Acquisition Card £170.00
- 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 £120.00

SORCEROR

from £740

Exidy authorised dealers

BASIC SYSTEMS

- Sorceror 16K RAM (inc. UHF Modulator) £740.00
- Sorceror 32K RAM (inc. UHF Modulator) £840.00

ACCESSORIES

- Exidy Video Monitor (High Resolution) £240.00
- Exidy Video Disk Unit P.O.A.
- Exidy S100 Bus with Interface + motherboard PSU £200.00
- CP/M for Sorceror on Disk £145.00

COMPUCOLOR

from only £999

for computer with colour monitor, keyboard and integral disk drive. Second disk drive £316.00

ADVANCED SYSTEMS

Altair, Equinox, Billings, Heath, Rair, Horizon. Installations include hard disk and multi tasking. Prices on Application.

NEWS

CORVUS 11mb Hard Disk for TRS 80 & Apple. Complete with interface & D.O.S. £3500.00

TANDY Model II now available for demonstration at our Camberley Office. (by appointment only) P.O.A.

8

PUTERS ETC

Consultancy and Competitive Prices.

Registered business name

TVJ

DISKS

PET	
CBM 3040 (dual drive) 343K User storage*	£795.00
Computhink (dual drive) 400K storage	£895.00
Computhink (dual drive) 800K storage	£1145.00
TRS80	
Shugart drive	£315.00
Micropolis drive	£315.00
Percom FD200 drive 110v	£299.00
Micropolis Dual Drive (394K storage)	£995.00
Corvus Hard Disk (11mB)	£3500.00
APPLE	
Apple Drive – 116K storage 1st drive	£398.00
Apple Drive – 116K storage 2nd drive	£355.00
Corvus Hard Disk (11mB)	£3500.00
SORCEROR	
Exidy – 143K storage	£495.00
Exidy Dual drive (630K storage)	£1195.00
Corvus Hard Disk (11mB)	£3500.00

PRINTERS

PET	
CBM 3022 (80 col with PET graphics – tractor feed)*	£675.00
TRS80	
TRS 80 Screen Printer (text + graphics) (110v)	£445.00
New Radio Shack Micro Printer	£245.00
GENERAL	
Teletype 43 KSR Serial (pin or pinch feed, 132 cols)	£825.00
Teletype 33 KSR Serial (110 Baud) Reconditioned	£450.00
OKI – parallel/serial (pin or pinch feed, 40, 80, 132 cols selectable)	£499.00
Centronics 779 parallel (tractor feed, 132 cols)	£825.00
Anadex DP 8000 serial/parallel (112 cps bi-directional tractor feed, 40, 80 cols selectable)	£560.00
Centronics Micro Printer (20, 40, 80 cols selectable)	£395.00
Heath WH 14 serial (80, 96, 132 cols selectable)	£475.00
QUME daisy wheel printers	P.O.A.
TCM100/MICROHUSH Thermal Printer (40 cols) inc. interface for PET/APPLE/TRS80	£266.00

ETC.

Diskettes 5¼" (blank) boxed (min order 10) each	from £3
C12 Cassettes (min order 10) each	£0.35p
Ansaback 'phonemate' telephone answering machine, voice operated twin cassette	£190.00
Pace EZ-PHONE – Cordless Telephone	£225.00
Computalker Speech Synthesis for S100	£350.00
BOOKS – Large range of microcomputer related books and magazines	
TERMINALS	
Pentland V1, 80 char./24 lines 2 page memory	£580.00

IF YOU DON'T SEE IT – ASK IF WE HAVE IT

SOFTWARE

PET	
PETSOFT authorised dealers – over 160 programmes on cassette and disk. Send for catalogue.	
STAGE ONE COMPUTERS S/W dealers – PETAID, Stock Control, etc. Send for list.	
74 Common BASIC Programs on one tape	£15.00
PETACT Business Software – Sales and Purchase Ledger	P.O.A.
CBM DISK-BASED BUSINESS SOFTWARE:–	
Commodore Word Processor powerful word processor package	£75.00
CSTOCK – STOCK CONTROL – gives complete stock report	£150.00
CBIS – BUSINESS INFORMATION SYSTEM – Storage & Retrieval of all types of company records	£150.00
COM ACCOUNTS – Full Financial Business Accounting System incl: Sales, Purchase, Nominal Ledgers (integrates with C Stock and C INV)	£610.00
PAYROLL – Handles hourly, weekly or monthly paid employees (Tape) (We are authorised CBM Business Software Dealers) Send for List.	£50.00
GD 1001 – Assembler Development System	£50.00
GD 010 – Lisp Interpretive Language (Artificial Intelligence)	£75.00
JOYSTICK PACKAGE – complete with connector software	£25.00
CAR INSURANCE QUOTATIONS – computerised car insurance quotation suitable for insurance brokers (TVJ S/W)	£25.00
MORTGAGE QUOTATIONS – suitable for agents/mortgage brokers (TVJ S/W)	£25.00
TRS 80	
COMAC III SUITE – computerised accounting for TRS 80 (TVJ SOFTWARE)	£75.00
STOCK CONTROL – complete inventory control – recorder level – P/0's etc.	£115.00
CP/M	£95.00
CBASIC	£75.00
FORTRAN includes compiler, relocatable assembler text editor and linking loader	£95.00
PASCAL – tomorrow's programming language today	£195.00
ELECTRIC PENCIL – powerful word processor allows full cursor movement, insert/delete, string search block movement, adjustable line length, justification on cassette	£65.00
ELECTRIC PENCIL as above – disk version	£115.00
LOWER CASE MOD KIT for Electric Pencil	£28.00
DATA MANAGEMENT/REPORT GENERATOR – easily formats disk files, allows entry, edit, delete and list of records and retrieves data for display or calculation on screen or printer	£200.00
RSM-2D DISK MONITOR – powerful system manipulates disk data, has Z-80 break routine	£25.00
ISAM – INDEX SEQUENTIAL ACCESS METHOD – sub routines to facilitate control of random data files	£45.00
ST80D communications software	£60.00
NEWDOS – TRSDOS with corrections and enhancements	£25.00
NEWDOS+ – as above but with further facilities:–	£45.00
KBFIX, Renum, Screen to printer in one step, DOS commands from BASIC, Level I in II, Superzap, Disassemble, load and save faster, list variables	£49.00
LIBRARY 100 – an assortment of 100 programs	£39.00
SARGON CHESS – 16K Level II – the 1979 Champ Version I	£14.00
SARGON CHESS – 16K Level II – the 1979 Champ Version II	£24.00
APPLE	
EASYWRITER – word processing system	£85.00
A2FP FUNCTION PLOTTER – Comprehensive graph plotting	£18.00
PILOT – programming language suitable for educational purposes	£35.00
U-DRAW II – High Resolution graphics editor. Create a figure then intake, expand, contract etc and store on disk	£27.00
PROGRAMMERS AID No.1 – Plug-in ROM gives numerous facilities including renumber, merge, high res in integer etc.	£29.00
3D GRAPHICS – High res plotting in 3D!	£30.00
LISP – programming language suitable for research in artificial intelligence	£30.00
3-MILE ISLAND – Complex disk based game simulating nuclear reactor	£27.50

MUSE authorised dealers. Many programs on cassette and disk. Send for list.

SORCEROR many programs available – send for list.

COMPUCOLOR full lists available.

*** 5% DISCOUNT ALLOWED FOR EDUCATIONAL ESTABLISHMENTS**

TVJ

T&V JOHNSON (MICROCOMPUTERS ETC) LTD

Member of the TV Johnson Group of Companies

Hours of business
Mon-Fri. 9.30 – 5.30
Sat. 9.30 – 1.00

Camberley (Head Office)
165 London Road, Camberley
Surrey, GU15 3JS.
Telephone (0276) 62506

Oxford
148 Cowley Road, Oxford
OX4 1JJ.
Telephone (0865) 721461

Bristol
48 Gloucester Road, Bristol
BS7 8BH
Telephone (0272) 422061

+ Ansaback eves and w/ends.
Telex 858893

BARCLAYCARD VISA

Buy it with Access

PRICES EXCLUDE VAT, FREIGHT & HANDLING SEND OR 'PHONE FOR PRICE LIST & BROCHURES
(All prices correct at time of compilation)

Directors: Dr. R.V. King BA, MIEE
S.G. Johnson, BSc. (Hons.)
T.S. Johnson, ABIBA, ACMB, FBSC, MBIM
A.S. Barton ACII, ABIBA, CdipAF.

Branches at:
Birmingham, Bristol, Edinburgh, Leeds, London, Louth, Newmarket, Nottingham, Oxford, Byfleet, Wokingham.

• Circle No. 105

plete computer kit.

£79.95
Including VAT.
Including post and packing.
Including all leads and components

Fewer chips, compact design, volume production – more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed onto fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer, because the ZX80's brilliant design packs the RAM so much more tightly. (Key words, for instance, occupy just a single byte.)

To all that, add volume production – and you've that rare thing: a price breakthrough that really *is* a breakthrough.

The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

The ZX80 kit costs a mere £79.95. Can't wait to have a ZX80 up and running? No problem! It's also available, ready assembled, for only £99.95.

Whether you choose the kit or the ready-made, you can be sure of world-famous Sinclair technology – and years of satisfying use. (Science of Cambridge Ltd is one of the Sinclair companies owned and run by Clive Sinclair.)

To order, complete the coupon, and post to Science of Cambridge for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied.

sinclair
ZX80
Science of Cambridge Ltd
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: 0223 311488.

Order Form

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Remember: all prices shown *include* VAT, postage and packing. No hidden extras.

Please send me:

Quantity	Item	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (takes up to 3K bytes).	12.00	
	RAM Memory chips – standard 1K bytes capacity.	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		TOTAL	£

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £

Please print

Name: Mr/Mrs/Miss

Address

PC 3/80

• Circle No. 106

aculab Ltd

HIGH-QUALITY PRINTOUT FOR YOUR WORD-PROCESSING SYSTEM

The ACULAB 735P, a fully self-contained interface for IBM golfball output typewriters and printers.

Parallel model accepts 7-bit ASCII data via a Centronics compatible connector.

Serial model accepts RS232/V24, selectable Baud rates. Parallel model may be retro-fitted with serial board.

Programmed for 7 different typehead layouts, covers all common golfballs and an ASCII ball, switch selectable from the front panel.

STOP/GO switch, ONLINE/OFFLINE switch, also online/offline under software control.

Parallel.......................... £155-00 + VAT
Serial .... £205-00 + VAT

Accessories and cables available for use with PET/SORCERER/TRS-80 (with or without expansion interface) APPLE/ITT/RML380Z etc., etc.

Wiring and testing service for typewriters and printers.

Typewriters and printers available wired and tested and ready to go.

Trade enquiries welcome.

aculab Ltd.
24 Heath Road,
Leighton Buzzard, Beds.
LU7 8AB

For further information
Telephone. 0525-371393.

• Circle No. 107

SUPPORT MEMBERS OF THE COMPUTER RETAILERS ASSOCIATION . . .

CRA
COMPUTER RETAILERS ASSOCIATION

THEY WILL SUPPORT YOU.

For further details on the associations aims, membership, code of conduct etc.

Please contact: Ms. Heather Hodgson,
47, Creswell Road, Newbury, Berkshire.
Tel. (0635) 42486

• Circle No. 108

Possibly the most cost effective word processors in the world.

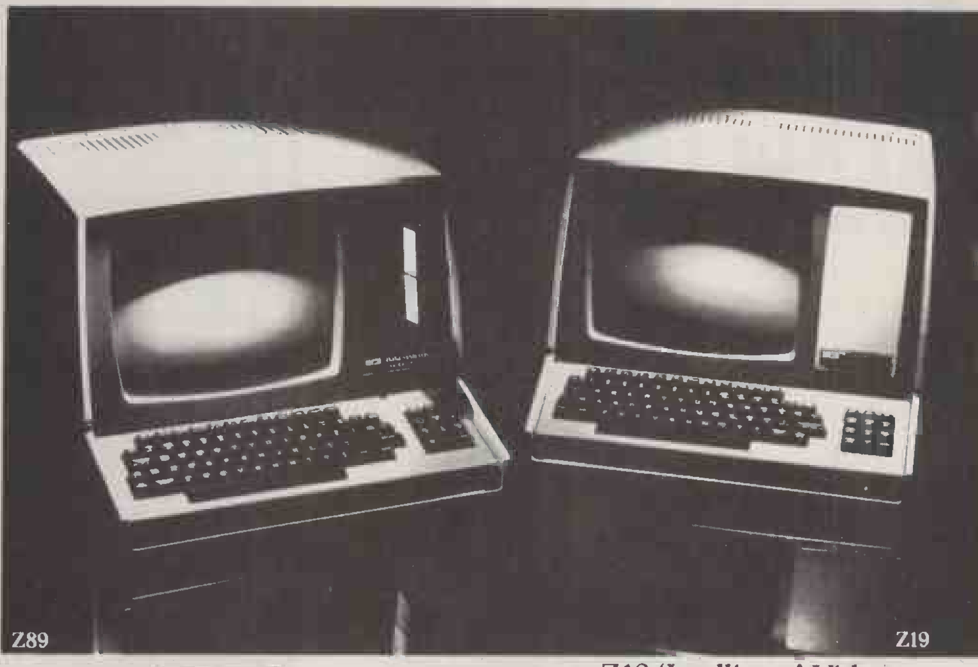
The Vector Graphic MZ
* 4MHZ Z80A CPU
* 48K ram
* 630K Bytes disk storage
* Serial port and two parallel ports
* Prom/ram Board with monitor
* MDOS Operating system
* Z80 Assembler
* Basic Interpreter

Plus a large range of CP/M compatible software including Fortran, Cobol, Macro assemblers etc.

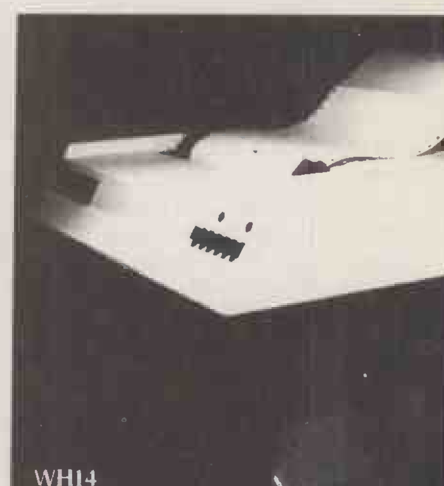
The Vector Graphic System B
Complete Vector MZ system plus: *
* Vector Mindless terminal *
Flashwriter 2 video board (24 x 80) *
* Software driver on prom *
MZOS North Star compatible DOS *
* CP/M configured by Almarc *

ALMARC
DATA SYSTEMS LTD
906 Woodborough Road, Nottingham. Telephone: (0602) 625035

• Circle No. 109


Z89
Z19


Z11A


WH14

The desktop computer that thinks it's a mainframe

Compare these features with micros, minis or even mainframe computers. Then have a guess at the price of putting an Athena on your desk. We can guarantee that, even if you are already very aware of all the latest advances in multi-micro desk top computers, the answer will surprise you.

The Athena can be tailored for personal, educational, business and industrial users. It can stand alone or be connected to larger systems in a distributed processing environment. It is flexible and easily up-graded to meet changes in application requirements.

The basic system starts at £3,380. A typical configuration with 64K, integral dual floppy discs, 150 cps printer and software costs £7,954.

- **Multi-processing with intelligent buffered peripheral controllers**
- **64Kb RAM PROM Memory**
- **Integral 150 cps matrix printer**
- **Additional external printers and terminals**
- **Storage modules from 12 to 300 Megabytes**
- **Up to 1200 Mb of disc storage**
- **Integral mini-floppy discs and cassettes**
- **Remote communications – asynchronous or synchronous**
- **Powerful multi-tasking operating system (AMOS)**
- **COBOL, Fortran, BASIC, Pascal and APL compilers**
- **Proven accounting package in COBOL – Sales, purchase and general ledgers, order entry, invoicing and payroll**
- **Text editing package**

BUTEL-COMCO
Technology for business

Butel-Comco Limited
50 Oxford Street,
Southampton, Hants. SO1 1DL
Telephone: Southampton (0703) 39890. Telex: 47523

• Circle No. 114

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 £1450. This buys you a 32KB system with dual $5\frac{1}{4}$ inch double density floppy drives. At £1675 you can have a 48KB system or for £2495 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 an operating system and language, in this case CP/M and C-BASIC, to give a typical system cost. But with slight cost adjustment the software options are:

Operating Systems

● CP/M ● PASCAL ● CAP MICROCOBOL BOS
● Multi-User, Multi-Tasking Operating Systems

Languages

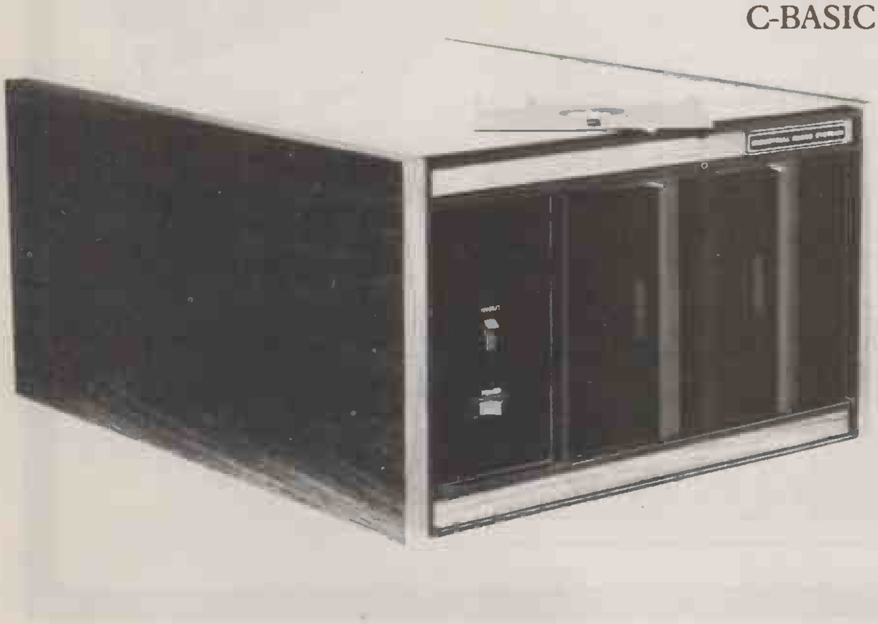
● C-BASIC COMPILER ● M-BASIC ● FORTRAN-80
● COBOL-80 ● PASCAL ● CIS-COBOL

There is also a word and text processing system available that is ideal for report writing.

You simply take your pick from the software options. Or visit our London showroom and see the systems demonstrated.

SYSTEMS WITH CP/M AND C-BASIC:		
	32KB + Dual $5\frac{1}{4}$ inch Floppies:	£1450
	48KB + Dual $5\frac{1}{4}$ inch Floppies:	£1675
	48KB + Dual 8 inch Floppies:	£2495

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. 117

You can Count on Us for your
COMPUTER PERIPHERALS - call the

ABACUS WAREHOUSE

Please compare our Prices and Delivery!

Printers	Texas Instruments 810 (RO) 150 CPS Bi-directional	£1250	**EX-STOCK**
	Texas Instruments 820 (KSR) 150 CPS Bi-directional	£1465	**EX-STOCK**
	NEC Spinwriter 5510 (RO) 55 CPS Bi-directional Daisywheel	£1869	**EX-STOCK**
	NEC Spinwriter 5520 (KSR) 55 CPS Bi-directional Daisywheel	£2026	**EX-STOCK**
Terminals	Hazeltine 1410	£ 587	**EX-STOCK**
	Hazeltine 1510 (Top of the line, numeric keypad etc.)	£ 827	**EX-STOCK**
S-100 Systems	MCS 122 22 Slot M'frame complete with power supply + fan	£403	**EX-STOCK**
	PT 208 Integral Screen, 60K RAM, 2 x 5" floppies	£3535	**EX-STOCK**
	PT 212 Integral Screen, 60K RAM, 2 x 8" floppies	£4497	**EX-STOCK**
	TF 12 12 Slot M'frame complete with power supply + fan (case will accommodate 3 x 5" floppies)	£ 359	**EX-STOCK**

Why pay more?
Why wait longer?

62, New Cavendish Street, London W1M 7LD

See all these and more at
the Abacus Warehouse
call Bob Brown on 01·580·8841

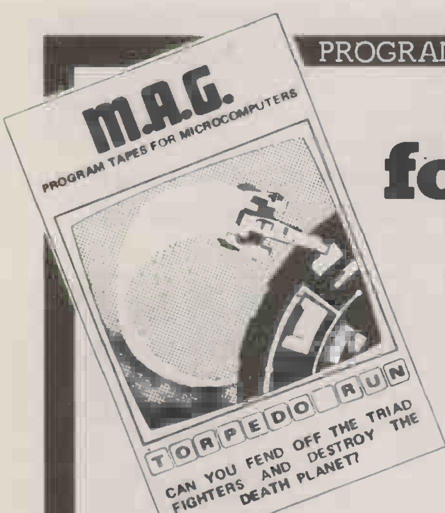
Abacus Computers Limited Telex: 8813085 (Abacus)

• Circle No. 118

PROGRAM TAPES IN PET BASIC TO RUN ON 8K MACHINES

A Good Run for your Money

with M.A.G.



What PRACTICAL COMPUTING had to say (June 1979):

Torpedo Run
"If you are an employer who believes in good worker relations and do not mind a 50% drop in productivity, leave this program on your PET...Congratulations to Games Workshop on producing a program of very good quality."

YAM
"Both games are of high quality with good use of the graphics and layout...should keep you happy for hours."

All games use full Graphic Display

TORPEDO RUN
Manoeuver your fighter down the trench avoiding attacks from Triad ships until the opportunity arises to release your Photon Torpedo and destroy the Death Star £7.99

YAM
A classic dice game in two versions: *Yam 1* for up to 6 players and *Yam 4*, a more skilful version, for up to 4 players £5.99

PONTOON & CALCULATION
Two card games with full graphic displays. *Pontoon* has betting facility, twist and burn; *Calculation* is a patience game. £5.99

Games Workshop
1 DALLING RD, HAMMERSMITH, LONDON W6
Tel: 01-741 3445 Ravenscourt Park tube
Open: Mondays-Fridays, 10.30-6.00; Saturdays, 10.00-5.30

MAIL ORDER - *Please make cheques payable to 'Games Workshop'. UK orders sent post free. Overseas please include 25p per tape (surface) or 50p per tape (air).*
FURTHER DETAILS - *Send a stamped, addressed envelope for our catalogue sheet.*

OVERLOAD
A strategic game of reactions and chain reactions in which players build up nuclear piles. *Programmed with sound.* £7.99

FINAL FRONTIER
This *Star Trek* game combines features of the other *Star Trek* games. Explore the galaxy to exterminate Klingon Warships using your ship's computer £7.99

MAN-EATER
Computerised *JAWS*! You command a group of divers attempting to surround and capture a killer shark which, unseen, can arise from the water to chomp hapless swimmers £3.99

TRADE ENQUIRIES WELCOME

WHEN ORDERING PLEASE SPECIFY OLD OR NEW ROMs

Up-to-date Micro and Mini Books

J. Victor Nahigan and William S. Hodges
Computer Games for Businesses, Schools and Homes
Popular and original computer games using BASIC are fully explained in this illustrated book.
£8.40 Pb 87626-166-7 157 pages

James R. Huffman
Personal Computing
Complete plans for building a microcomputer are given as well as programming instructions.
£10.35 Hb 8359-5516-8 262 pages £7.75 Pb 8359-5515-X

Stephen L. Snover and Mark A. Spikell
How to Program Your Programmable Calculator
£11.00 Hb 13-429365-7 272 pages £5.15 Pb 13-429357-6

Jefferson C. Boyce
Microprocessor and Microcomputer Basics
Both hardware and software are explained in sufficient detail to enable the novice to recognise the capabilities and uses of micros.
£11.00 Hb 13-581249-6 324 pages

Bruce Artwick
Microcomputer Interfacing
Computer system construction and layout techniques are described as well as basic microcomputer software.
£12.30 Hb 13-580902-9 320 pages
To be published in March 1980

Robert Bruce
Software Debugging for Microcomputers
The author shows how to write programs in BASIC and use the machine for increasingly complex applications.
£12.30 Hb 8359-7021-3 416 pages £7.10 Pb 8359-7020-5

Carol Anne Ogdin
Microcomputer Management and Programming
A complete introduction to microcomputers is provided in this practical guide which examines microcomputer technology and shows how to exploit it in both management and systems design.
£11.00 Hb 13-580936-3 384 pages

John D. Lenk
Handbook of Microprocessors, Microcomputers and Minicomputers
This practical introduction provides a sound knowledge of digital logic and electronics, and describes major systems such as the RCA, Motorola, Intel, Texas Instruments and Textronix systems.
£11.65 Hb 13-380378-3 404 pages

George D. Craft and Wing N. Toy
Mini/Microcomputer Hardware Design
A straight-forward, up-to-date approach to the design of computing systems using recent LSI devices as standard building blocks is given in this practical book. The authors examine the uses of minis and micros and discuss a wide range of small computers.
£13.60 Hb 13-583807-X 514 pages

James W. Coffron
Understanding and Troubleshooting the Microprocessor
£12.30 Hb 13-936625-3 400 pages

Prices and publication dates are correct at the time of going to press but may be subject to change.

Prentice-Hall International also publishes several **programming language books** for microprogramming in **PASCAL** and **BASIC**. For details of these books and our new **microprocessing leaflet** please write to Jean Walmsley at Prentice-Hall International, 66 Wood Lane End, Hemel Hempstead, Herts. HP2 4RG. England.

Prentice-Hall International

• Circle No. 125

WHOLESALE

ELECTRONIC COMPONENTS

2102L — 400ns	SRAM	.55
2114 — 300ns	SRAM	3.51
4116 — 200ns	DRAM	4.50
2708 — 450ns	EPROM	4.39
AY—5 — 1013	UART	2.65
TV MODULATOR	Chan 36	1.67
2102L × 8	SRAM	3.85
2114 × 8	SRAM	24.45
4116 × 8	DRAM	31.35

Please add 15% VAT to all orders and postage of 50 pence. Postage FREE on orders over £10.

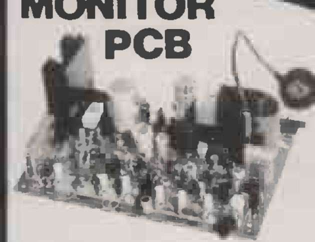
STRUTT
ELECTRICAL AND MECHANICAL ENGINEERING LTD.
ELECTRICAL COMPONENT DISTRIBUTORS

3c BARLEY MARKET ST.
TAVISTOCK
DEVON PL19 05F
Tel. TAVISTOCK (0822) 5439
Telex: 45263

• Circle No. 126

Great new Crofton double!

Self contained
MONITOR PCB



- Compact size, 5" x 7"
- Complete with power and video plugs, plus leads
- Scan coil assembly as standard supplied
- Transformers, tubes, and surrounds available
- 15v Mains or 12v DC power
- Ideal for O.E.M. use

ONLY **£35.50**

- Totally enclosed
- All transisterised
- Suitable for analogue signals or alphanumerics
- Operable on 220v Mains or 12v DC power
- Comparable to wire frame monitors
- The super Ohio board 2. £188 plus VAT

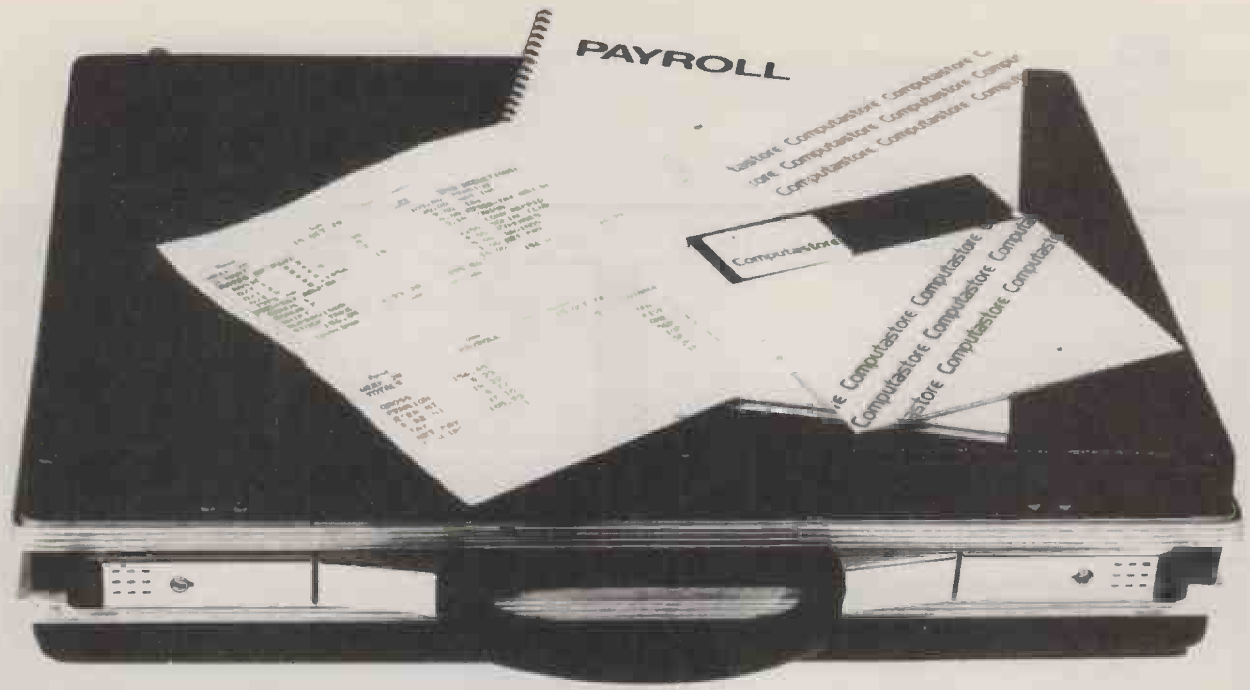
ONLY **£85.00**

EX VAT AND P&P

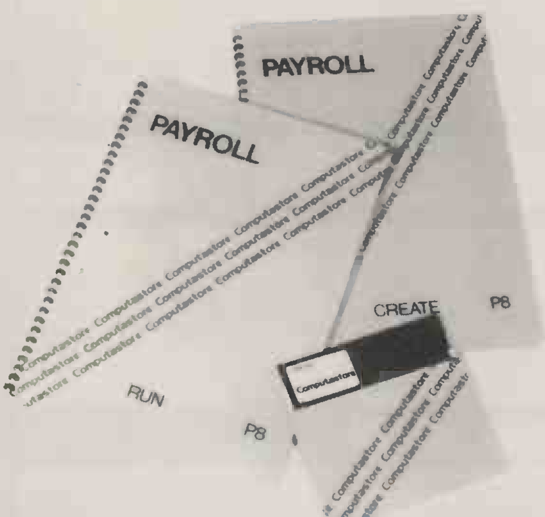
Crofton Electronics

Crofton Electronics Limited, 35 Grosvenor Road, Twickenham, Middlesex. Tel.: 01 891 1923

• Circle No. 127



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. 133

• Circle No. 134 ▶

RAIR

- High speed 8085 microprocessor
- Priority interrupts and DMA
- 64K bytes of RAM memory
- Transparent ROM bootstrap loader
- Integral dual minifloppy disks
- Programmable serial I/O interfaces

- Advanced floppy disk operating system
- Serial and random file processing
- Macro assembler with symbolic debugging
- Extended BASIC interpreter
- Relocating FORTRAN IV compiler
- ANS 74 COBOL compiler

- Comprehensive range of peripherals
- UK wide on-site maintenance
- Quantity and OEM discounts
- Leasing and rental facilities

New features

- Double sided/density disks (260K bytes/drive)
- High speed hardware arithmetic unit
- Multi-user operating system support
- Dual-drive add-on (over 1M byte on-line)

BLACK BOX MICROCOMPUTER

30-32 NEAL STREET COVENT GARDEN LONDON WC2H 9PS TELEPHONE 01-836 4663

MICRO CONTROL

224, EDGWARE ROAD
LONDON W2 1DN
TEL (01) 402 8842

apple SALES SERVICE

Official Dealers — Apple II — Microstar — Compucorp

PRICE LISTS

APPLE II (16K) VIDEO OUTPUT	750.00
HIGH-SPEED SERIAL CARD	110.00
CLOCK CARD	140.00
LIGHT PEN	165.00
VOICE RECOGNITION CARD	127.00
LOWER CASE GENERATOR	40.00
EPROM BURNER & SOCKET ADAPTOR	99.00
PROTOTYPING BOARD	20.00
PAL CARD	72.00
B/W MODULATOR	20.00
PROGRAMMERS AID NO. 1	29.00
APPLE II MODULATOR OUTPUT	770.00
DISK DRIVE WITH CONTROLLER	398.00
DISK DRIVE	355.00
DOS 3.2 MANUAL & DISKETTE	18.00
APPLE PASCAL	296.00
AUTO-START ROM	40.00
GAMES PADDLES	17.50
SUPER TALKER	190.00
APPLE II INTEGER BASIC MANUAL	3.55
APPLESOFT BASIC MANUAL	5.75
6502 PROGRAMMING MANUAL	8.90
APPLE II PLUS COLOUR (PAL)	819.00
6502 HARDWARE MANUAL	8.90
BLANK CASSETTE (C15)	0.85
MICROPRODUCTS PARALLEL PORT	40.00
8" FLOPPY DISK SYSTEM (1.2 MB)	2350.00
DISK BASED ASSEMBLER	30.00
VINYL CARRYING CASE	25.00
MICROCHESS 2.0 CHESS DISC	16.00
16K ADO-ON MEMORY	69.00
APPLESOFT FIRMWARE CARD	110.00
INTEGER FIRMWARE CARD	110.00
PARALLEL PRINTER CARD	110.00
COMMUNICATIONS CARD	132.00
APPLE II REFERENCE MANUAL	5.75
BASF FLOPPY DISKETTE	3.50
CENTRONICS 779 PRINTER	889.00
CENTRONICS PRINTER CARD	132.00
HITACHI 9" B/W MONITOR	132.00
TRENDCOM 100 PRINTER	23.00
TRENOCOM PAPER (80 FT)	4.25
TC 3 TRENDCOM 100 I/F	49.00

APPLE PASCAL TM

This Hardware/Software package provides a very powerful tool for the serious user. High speed hires "Turtle" graphics, fast editor, Compiler, Relocatable Assembler, Excellent System Utilities, Superb documentation £289.

NEW!

DIGITAL COLOUR CARD

Apple II or ITT 2020
Mixed Colour Text!!!

Complete software control allows **15** fully-saturated colours in Graphics and Text modes. Simple plug-in system. Existing Software Compatible Designed and Manufactured by us

Complete System. £148.00
Monitor Mod Kit £27.00

12-BIT RESOLUTION
A/D Conversion

Our new A/D cards offer high 12-bit resolution with a fast conversion time, 4 inputs on board expandable to 8.

Max. Sensitivity 10 uV F.S.D. Demonstration Software Supplied.

Turn your apple to a fast analogue data aquisition system X, Y plotter etc.

12-Bit System £174.
8-Bit System £116.

LEASING FACILITIES AND FINANCE AVAILABLE
RING FOR QUOTE

COMING SHORTLY
COLOUR FOR PET TRS80

SPECIAL INTERFACES
We can design and produce special interface systems at reasonable cost

PART EXCHANGE
We offer generous P.X allowances, ring for quote

All prices exclude VAT

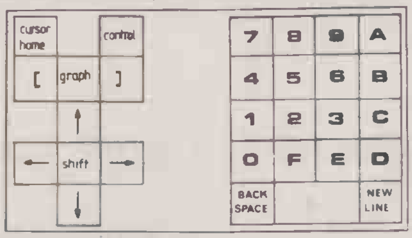
• Circle No. 136

BITS & P.C.s

COMPUTER PRODUCTS

NOW A NASCOM DISTRIBUTOR IN YORKSHIRE

Full range of Nascom Products available.
We are Nascom service and repair specialists order with confidence.
Free for a limited period with Nascom 2. 16K memory board, mini mother board and 2 edge connectors. This is 8K more memory than specified and leaves 28K of free space.
Unbelievable Nascom 1 now only £125.00 or £140.00 ready built and tested.



Upgrade your Nascom 1 to Nascom 2.
By using our specially designed control key pad this enables you to run Nas-sys on Nascom 1. Gain on screen edit and cursor movement. The power of Nas-sys. Kit only £21.50. Nas-sys £25.00.
A hexadecimal keypad for Nascom 1 & 2. Specially designed for your Nascom by us. This is an essential for entry of machine code listings. New line, space and back space are duplicated for convenience. £29.50 complete kit.
Control and hexadecimal key pads combined for Nascom 1 £36.50 complete kit. The above key pads require no modification at all to your Nascom.
Port Probe. A simple but essential device for Nascom 1 or 2. Allows monitoring of the port output on L.E.D. indicators, input words can be set up with L.E.D. indication interrupts can be tested manually or by using the variable clock provided, this also allows real timing for games £10.60 complete kit.
Dual monitor board. This kit allows switching between 2 monitors on Nascom 1 £5.40.
Chess for Nascom. A powerful chess programme which requires our graphics options. This must be the best chess graphics available. £15.00 on cassette, ask for details.

Nascom 1 £125.00 kit or built	£145.00
Nascom 2	£295.00
Power Supply Unit	£29.50
Nascom 1 Buffer Board	£32.50
8K Ram Board	£85.00
16K Ram Board	£140.00
32K Ram Board	£200.00
Nascom 1 Graphics	p.o.a.
Nascom 2 Graphics Rom	£15.00
Bits & P.C.s Data Cassettes Price for 10 C12	£4.75

Please check with us for your Nascom requirements.
Add 15% VAT to all our prices.
Barclaycard and Access phone your order. Personal demonstrations by appointment. Please send S.A.E. for any details.
BITS & P.C.s
18 Rye Garth
Wetherby, West Yorkshire
LS 22 4UL
Tel: (0937) 63744 9 a.m. to 7 p.m.

• Circle No. 137

PRINTERS FOR PET

- Plug connectable. 2001 and 3001
- Full Character Set and Graphics and Cursor Signs
- Variable Character Size
- Reverse Print
- Paper roll or Reversible Tractor Feed
- £ sign
- 100-120 CPS Bi-directional
- 5×7, 6×7, 9×7, Dot Matrix
- 52-80 Print Positions
- Alternative Interfaces — RS232 and Centronix

PRICES FROM £450

250 Brompton Road
London SW3

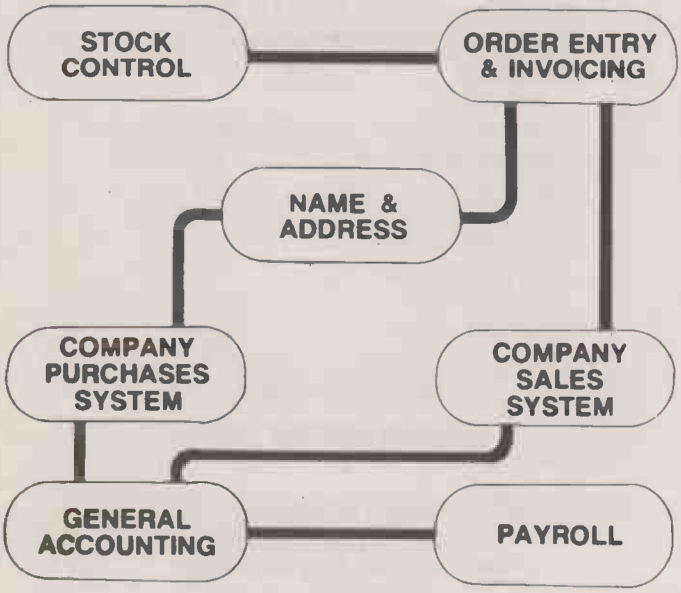
PARAMETERISED
COMPUTER
SYSTEMS LTD

• Circle No. 138

INTEGRATED SMALL BUSINESS SOFTWARE

- ISBS -

FAST AND EASY TO USE ISBS MEANS INCREASED EFFICIENCY AND PROFITABILITY – PUT IT TO WORK FOR YOUR BUSINESS



ISBS	£
STOCK CONTROL	350
ORDER ENTRY & INVOICING	350
NAME & ADDRESS SYSTEM	250
COMPANY PURCHASES SYSTEM	450
COMPANY SALES SYSTEM	450
GENERAL ACCOUNTING	400
PAYROLL	500

Packages supplied on floppy disk with easy to follow Reference Manuals — NO PREVIOUS COMPUTER KNOWLEDGE REQUIRED TO OPERATE. ISBS runs on 48K Northstar Horizon, Rair Black Box or other systems supporting CP/M* — plus VDU and 132 col printer. Complete suite or individual packages available now and are fully supported.

Other software packages available include Time Recording Systems, Finance Control and many others. Special application software undertaken for Northstar & Black Box and also complete TURNKEY SYSTEMS.

*CP/M registered trademark of Digital Research.
Costs shown exclusive of VAT.
Dealer enquiries welcome.

GRAFFCOM

52 SHAFTESBURY AV. LONDON W1.
01-734-8862

• Circle No. 139

TANDY

NEW LOWER PRICES ON THE TRS 80

OVER 100,000 SOLD

TRS - 80 Model I 4K Level I	TRS - 80 Model I 16K Level II
£385.25 inc. vat.	**£546.25** inc. vat.
£335.00 plus vat.	**£475.00 plus vat.**

Level refers to version of BASIC language. Level I is a beginners language.

Level II is very advanced. Level and memory can be expanded. All systems include Users Manual and game cassette.

For Business, Learning and Entertainment

Just think what the incredible TRS - 80 microcomputer could do for your family or business.

The TRS - 80 will take you into the world of tomorrow for less than the price of a set of encyclopedias and it can free you from routine tasks that waste so many valuable hours.

Properly programmed, it can help with your budget, manage your mailing list or teach children maths.

And, when the work is finished you can spend many enjoyable hours playing one of several pre-programmed games.

Visit a Tandy Computer Centre or any of our 180 nationwide stores and dealers for full details.

Meet TRS-80's Big Brother! The new TRS-80 Model II.

We've added a bigger, more powerful "brother" to the TRS - 80 family. It's TRS - 80 Model II – a completely new microcomputer for business applications.

Its capabilities start where TRS - 80 Model I approaches its upper limits. Order now for delivery within four-five months.

FROM £1,999 plus vat.

(Illustration. Central Processing Unit, Monitor and Disc drive TRS - 80 Model II)

TANDY DEALER

TANDY

THE BIGGEST NAME IN LITTLE COMPUTERS

Most items also available at Tandy Dealers
Look for this sign in your area
Prices may vary at individual stores

Offers subject to availability
Instant credit available in most cases

OVER 180 STORES AND DEALERSHIPS NATIONWIDE.

• Circle No. 140

TERODEC

Central Data

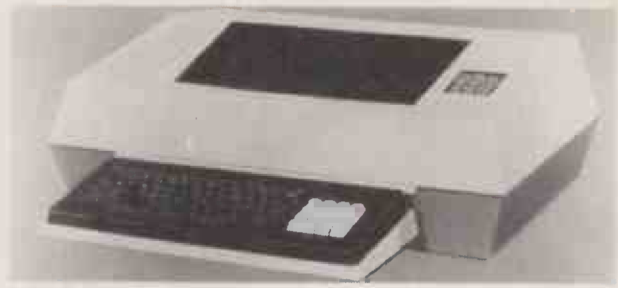
New RAM Prices.

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

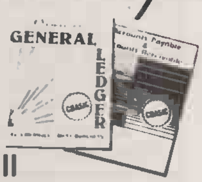
Bidirectional Printer with microprocessor versatility.

- Baud rate switch selectable.
- Variable character size and density.
- Quick change cartridge ribbon.
- Robust 7 x 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 x 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. 143

Buy with confidence from the specialists

HB COMPUTERS LTD

Stock a full range
Under One Roof

BUSINESS AND GAMES SOFTWARE FOR THE CBM PET

DISC BASED BUSINESS SOFTWARE CBM 3040 AND COMPU/THINK

SALES LEDGER

Process up to 1,000 accounts. Full input audit trail, enquiries, statements, debtors list and sales analysis. £350

PURCHASE LEDGER

Specifications as per Sales Ledger. £350

ESTATE AGENT

Property file maintained and houses selected. £25.00

WORD PROCESSOR

All the usual word processor features plus global changes and right justify. £50.00

MAIL LIST

Names, addresses and selection codes on disc. Will interface with our word processor. £50.00

CASSETTE BASED SOFTWARE

STOCK WATCHER

Up to 250 stock items processed. Stock Reports, re-order, etc. £25.00

R H SHAPEMATCH

Memory game. Children love this one. £5.00

R H MASTERMIND

Our version of this popular brain teaser. £8.00

SNAKES & LADDERS

You choose the number of snakes and ladders. Good graphics. Works with our SOUNDBOX £8.00

R H MICROPOLY

Monopoly board controlled by your PET. Nobody is lumbered with the bank. £12.00

HB COMPUTERS LTD

22 NEWLAND STREET, KETTERING
NORTHANTS.

Tel. (0536) 83922 & 520910 Telex 341297

All prices exclude VAT.

• Circle No. 144

THE SATELLITE VIDEO KEYBOARD TERMINAL

GIVES YOU MORE ON YOUR SCREEN

(INCLUDING 128 GRAPHICS CHARACTERS).

The Satellite is based on the KTM Keyboards made by Synertek. The on-board microprocessor gives full control over the display allowing not only the full ASC11 character set to be displayed, but also 64 graphics characters which, with reverse video becomes 128.
An auxilliary serial port allows onward transmission to or from a remote peripheral such as a printer, or modem, and may be switched on and off under soft-ware control.
The Satellite comes built and tested. All you need is a monitor (a television and modular may be used with the Satellite 1) and a 5V 1.25A power supply. If RS232 is to be used, then $\pm$12 at 100mA is also required.
SATELLITE 1 24 rows of 40 characters £215 + VAT.
SATELLITE 2 24 rows of 80 characters £250 + VAT.
(Dealer Enquiries Welcome).

SPECIFICATION.

- 24 rows of 40 or 80 characters.
- Full 128 ASC11 Character Set. PLUS 128 graphics characters.
- Full RS232 or TTL Serial Interface with RS232 handshaking.
- Auxilliary RS232/TTL Serial Port for printer, modem, etc.
- Interlace/non-interlace.
- Line truncate/non-truncate.
- Direct cursor addressing.
- Switch selectable European/USA standard.

INTERACTIVE DATA SYSTEMS 14, BUCKMAN CLOSE, GREENLEYS—MILTON KEYNES. Telephone: (0908) 313997.

• Circle No. 145

MEET THE LITTLE GENIUS

If you find self-instruction manuals difficult to follow, then meet our Little Genius.

Little Genius floppy diskettes are the fastest, easiest way to master your micro.

Little Genius will save you time and effort, teaching you to exploit all your micro's facilities.

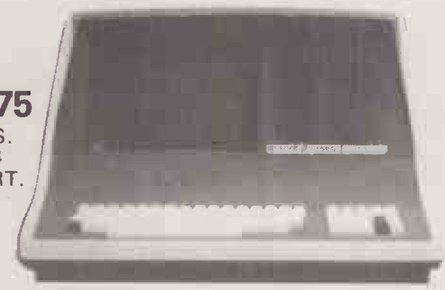
Courses on Basic and Advanced Basic are available now. For a free demonstration or more information ask your local dealer or contact Peter Brown at Suite 504 Albany House, 324 Regent Street, London, W1R 5AA. Telephone 01-580 6361.

• Circle No. 146

IF YOU OWN A COMPUTER . . . PET . . . APPLE . . . TRS-80 . . . HORIZON . . . ETC. RICHO DAISY WHEEL PRINTER PUTS YOU JUST A CABLE LENGTH AWAY FROM A HARD COPY (TYPEWRITER QUALITY) WORD PROCESSING SYSTEM

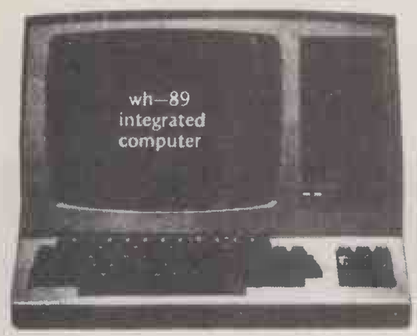
£1250

Richo high speed daisy wheel, heavy duty commercial printer, gives a high quality printout from METALISED daisy wheel, coupled with low noise level, necessary for office environment.
Nationwide service by UDS. Service under 90 day warranty is provided at your premises.
96 char: upper/lower case. — 35 chrs:/sec print speed. — 10/12 chars: per inch giving 136 or 163 columns. — 16 inch wide friction platen. — forward/reverse paper feed for GRAPHICS. — Top of the form and host of other features. — Centronics type parallel interface as standard.
Options: serial interface £60 — PET interface £50 — APPLE interface £95 — TRS-80 interface £60.



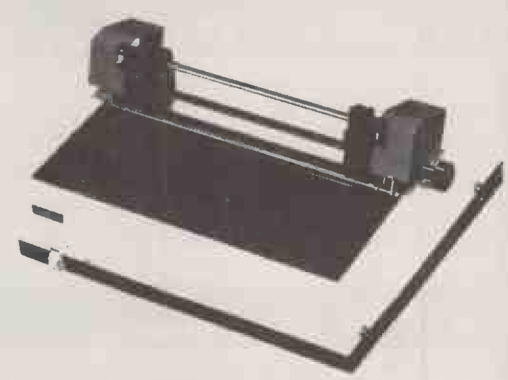
SUPER BRAIN COMPLETE COMPUTER £1875

TWIN Z 80-A 4MHZ. — 2 DOUBLE DENSITY DISC DRIVES. — 64K RAM. — HIGH RESOLUTION 12 INCH CRT. 80 x 24 LINES. — UPPER/LOWER CASE. — RS232 PRINTER PORT. — CPM OPERATING SYSTEM. — WORD PROCESSING & ACCOUNTS PACKAGE AVAILABLE. — 90 DAY WARRANTY.



HEATH DATA SYSTEMS WH-89 COMPLETE COMPUTER £1450

TWIN Z-80'S. — 1 DISC DRIVE BUILT IN. — VT-52 ONFIGURATION. — 48K RAM. — 12 INCH HIGH RESOLUTION CRT. — UPPER/LOWER CASE. — 80 x 24 LINES. — SERIAL RS232 PRINTER PORT. — MICRO SOFT BASIC — OPTION: 3 EXTRA FLOPPY DRIVES EACH.



EPSON TX-80 £495

DOT-MATRIX PRINTER WITH PET GRAPHICS. PRINTS 80 COLUMNS ON PLAIN PAPER AT 90 CHARACTERS/SECOND. ADJUSTABLE TRACTOR. — UPPER/LOWER CASE. — DOUBLE WIDTH PRINTING. — MICRO CONTROLLED. — SELF TEST. — HEAVY DUTY PRINT HEAD USING JEWELL BEARINGS FOR LONG LIFE. — CENTRONICS PARALLEL INTERFACE. — MADE BY SHINSHU SEIKI AN AFFILIATE OF SEIKO WATCH CO OF JAPAN. OPTIONS: PER INTERFACE WITH CABLE £50. APPLE INTERFACE WITH CABLE £60.

LOW COST WORD PROCESSOR I

BASED ON TRS-80 LEVEL 2 16K, CASSETTE RECORDER, ELECTRIC PENCIL SOFTWARE, UPPER/LOWER CASE MOD, PRINTER INTERFACE AND RICHO DAISY WHEEL PRINTER. COMPLETE READY TO GO £1850. FREE MAILING LIST PROGRAM.

WORD PROCESSOR II

BASED N "HEATH DATA SYSTEMS" COMPUTER AS SHOWN ABOVE PLUS RICHO DAISY PRINTER & "WORDSTAR" SOFTWARE. COMPLETE READY TO GO £2900.

WORD PROCESSOR III

BASED ON "SUPERBRAIN" COMPUTER SHOWN ABOVE. WITH RICHO PRINTER & "MAGIC WAND" THE ULTIMATE IN WORD PROCESSING. LETTERS AUTOMATICALLY FORMATTED WITH ADDRESSES FETCHED FROM SEPARATE FILE. COMPLETE SYSTEM £3400.
INVOICING, STOCKCONTROL, SALES LEDGER, PURCHASE LEDGER, PAYROLL AVAILABLE FOR ABOVE COMPUTERS. FROM £250 PER PACKAGE.

Prices quoted above do not include VAT. Phone or call for further details or demonstrations.

LONDON COMPUTER STORE

43 GRAFTON WAY, OFF TOTTENHAM COURT RD, LONDON W.1. TEL: 01-388 5721 OPEN 11-7 Mon-Fri 11-4 Sats.

• Circle No. 147

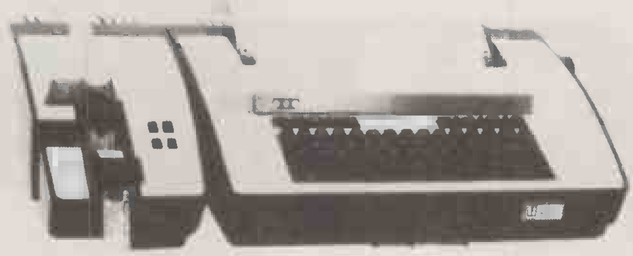
Listen, Westrex have more to offer than you realise.

Yes more new models. A bigger sales and service team.
And plenty of new ideas. Give us a ring now and let's talk.

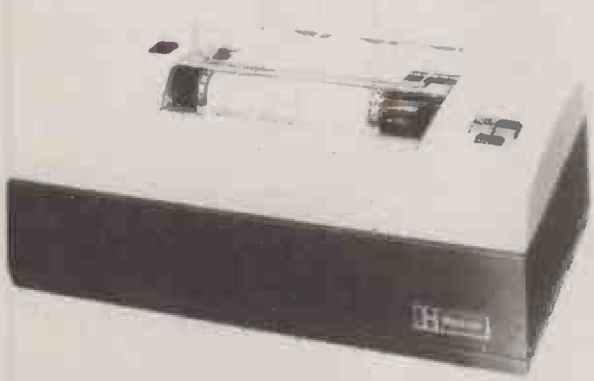
TALLY 1600 series micro controlled KSR 160 C.P.S. matrix printers.

Fred Allen Managing Director Westrex Company

TELETYPE MODEL 43 10/30 C.P.S. Keyboard send/receive terminal.



TELETYPE MODEL 43 Automatic send/receive terminal with paper tape reader and punch.



MANNESMANN MODEL 80 series receive only matrix printers.

PERKIN ELMER 550 BANTAM. Teletype compatible Visual Display unit.

Litton **Westrex**

Westrex Company Limited, 152 Coles Green Road, London NW2 7HE. Tel: 01-452 5401
and at Manchester Telephone: 061-764 0324 and Glasgow Telephone: 041-332 2052/3

• **Circle No. 150**

DATRON of SHEFFIELD

for

Cromemco the ultimate name in micros

DATRON import direct from Cromemco, California.
DATRON can supply Nationwide.
DATRON can provide maintenance nationally
DATRON can give you the realistic prices.
DATRON have in stock:–

System 2 64K	£1995
System 3 64K	£3292
Hard Disc	£4998

DATRON can supply Systems 2 and 3 with Multi-Tasking facilities. (Hard Disc soon)
DATRON easily accessible – in the centre of the country.

MEMBER CRA COMPUTER RETAILERS ASSOCIATION

Write or telephone for FREE colour brochure on System 3 or Z-2H.
We use Cromemco for our own business, why not call in for a demonstration.

DATRON MICRO CENTRE
DATRON INTERFORM LTD
Latham House, 243 London Road, Sheffield S2 4NF.
Telephone 0742 – 585490. Telex 547151.

• Circle No. 151

NewBear Books

★SEND FOR COMPLETE LIST.★

GAMES		
Chess & Computer	D. Levy	£ 7.16
Chess Skill in Man and Machine	P. Frey	£11.84
32 Basic Programs for the Pet		£ 8.90
Game Playing with Computers	D. Spencer	£10.20
Basic Computer Games	D. Ahl	£ 5.50
Star Ship Simulation		£ 5.10
Game Playing with Basic	D. Spencer	£ 4.10
Sargon	Spracklen	£ 9.50
MISCELLANEOUS		
Intro. to TRS 80 Graphics		£ 5.75
Microprocessors C201	Zaks	£ 7.50
Scelbi Byte Primer		£ 9.95
Business Data Systems	Clinton	£ 5.75
The Systems Analyst	Atwood	£ 6.60
Your Home Computer	White	£ 4.95
Programming a Micro 6502	Foster	£ 7.95
6502 Applications Handbook	Zaks	£ 8.95
BASIC		
Learning Basic Fast	De Rossi	£ 6.30
Basic Basic	J. S. Coan	£ 5.00
Advanced Basic	J. S. Coan	£ 5.50
Illustrated Basic	D. Alcock	£ 2.25
Basic with Business Applications	Hayden	£ 8.40
Basic Primer	Waite	£ 5.80
The Basic Handbook	Lien	£11.00
COBOL		
Cobol Programming	Nickerson	£ 6.95
Learning Cobol Fast	De Rossi	£ 6.20
Cobol with Style	Hayden	£ 4.20
Reducing Cobol Complexity	Mc Clue	£11.30

PASCAL		
Pascal: User Manual and Report	Springer-Verlag	£ 5.52
Problem Solving Using Pascal	Springer-Verlag	£ 7.84
Programming in Pascal	P. Grogono	£ 7.50
A Practical Intro. to Pascal	A. Addyman	£ 3.50
An Introduction to Programming and Problem Solving with Pascal	Schneider	£ 9.50
Introduction to Pascal	J. Welsh & J. Elder	£ 6.95
Z80 BOOKS		
Z80 Programming for Logic Design	A. Osbourne	£ 5.95
Z80 Technical Manual	Zilog	£ 4.00
Z80 P10 Technical Manual	Zilog	£ 3.25
Z80 Programming Manual	Zilog	£ 4.50
Z80 Microcomputer Handbook	W. Barden	£ 6.95
Practical Microcomputer Programming (Z80)	Weller	£19.55
Z80 Instruction Handbook	Scelbi	£ 3.25
Z80 Assembly Language Programming	A. Osbourne	£ 6.95
Introduction to TRS 80 Graphics	Inman	£ 5.75
Zilog Data Book	Zilog	£ 3.50
Z8001/Z8002 Product Specification	Zilog	£ 3.75
Z8000 CPU Instruction Set	Zilog	£11.50
Z80 Micro Programming & Interfacing	Nichols	£ 7.10
NEW BOOKS		
COBOL for Beginners	Worth	£ 7.75
BASIC for Everyone	Worth	£ 7.50
MICROS for Business Applications	Barden	£ 5.80
Fortran 77	Katzan	£13.75

☆ CREDIT SALES (Minimum £10), Access and Barclaycard Welcome. "BY RETURN ORDER SERVICE" ☆

CALLERS AND MAIL ORDER: 40 Bartholomew Street, Newbury, Berks. Tel: 0635 30505
CALLERS ONLY: 220-222 Stockport Road, Cheadle Heath, Stockport Tel: 061 491 2290

• Circle No. 152

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. 154

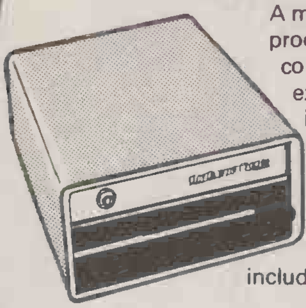
• Circle No. 155

DATALINK

Microcomputer Systems Limited

Systems software for business, industrial and scientific applications

MICROSTAR 45 PLUS



A multi-user disk based information processing system designed for commercial application where extreme simplicity of operation is required.

MicroStar Double Density 2.4Mb £5650
Additional 20 Mb Hard Disk Unit £4950
Available Software includes Mailing List, Word Processor, Purchase Ledger, Sales Ledger, Payroll, Invoicing, Etc., Etc.,

APPLE/ITT 2020

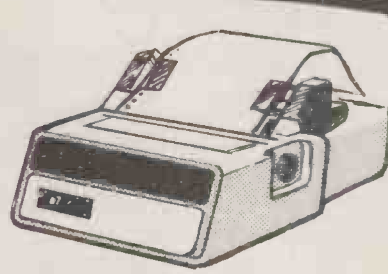
Specifically designed to handle the day-to-day activities of education, business, financial planning, scientific calculation, and brings to the user a new level of simplicity through design sophistication.

Apple II Plus 16K (B & W) £695 ITT 2020 16K (colour) £867
Disk Drive with Controller £349
Parallel Printer Interface Card £104
High Speed Serial Interface Card £113 Centronics Card £130
Communications Card £130
Pascal Language System £299
Auto Start ROM Pack £38
16K Add-ons £69
Alf Music Synthesiser Card £180

VDUs/Terminals

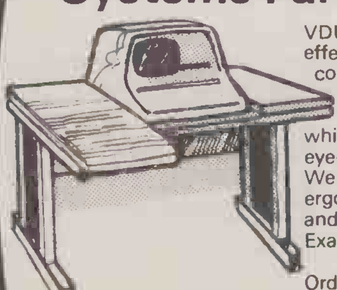
Lear Siegler ADM 31 £849
Lear Siegler ADM 3A £620
Hitachi 9" VDU (B&W) £127
Hitachi 12" VDU (B&W) £187
ITT 340 16" Colour TV £220

Printers



Centronics 779 Tractor feed £875
Printerm 879 80 col. £695
Printer 879 80/132 col. £745
Microhush £266
TTY 43 Pin or Friction feed £860
Paper Tiger £585 Qume Sprint 5 £2115
Graphics PT £699

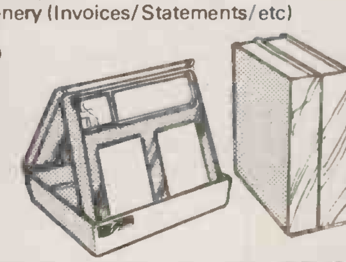
Systems Furniture



VDUs are increasingly an essential and effective form of business communication. Their impact and efficiency can be impaired by incorrect mounting and siting which results in uncomfortable, tiring, eye-straining operation.
We have available a wide range of ergonomically designed VDU Desks and Terminal Work Station furniture.
Example: Apple VDU Desk £145.00
Printer Table £92.00
Orders can also be taken for custom designed furniture.

Computer Stationery and Accessories

9½" Plain Listing Paper (per 2000 sheets) £16
Microhush Thermal Paper (3 rolls) £4
Customised Computer Stationery (Invoices/Statements/etc) P.O.A.
Mini-Diskettes — From £2.50
Diskette Library Cases £3
Diskette Tray with Lockable Lid £16
Mini-Diskette Head Cleaners £13
Dust Covers £9.95
Sound Boxes for PET, mains or battery (ownß manufacture) T.B.A.

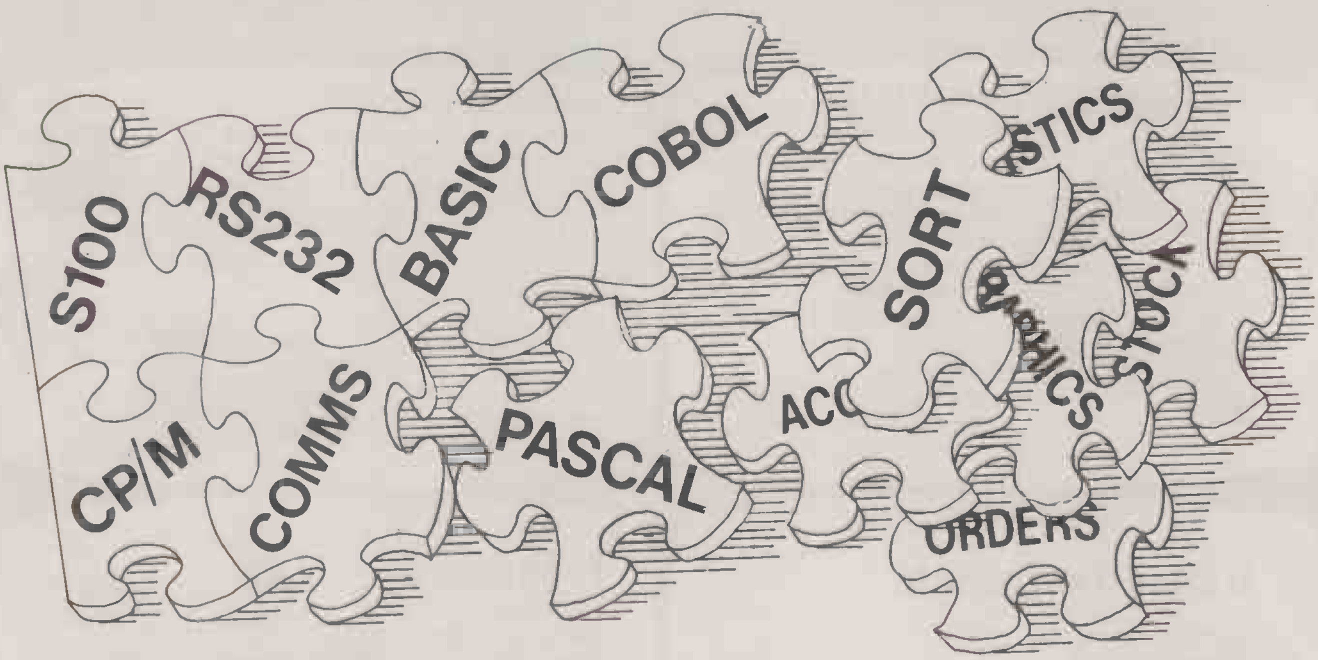


We also stock an extremely comprehensive range of computer books

DATALINK 10 Waring House, Redcliffe Hill, Bristol BS1 6TB
Telephone: Bristol (0272) 213427

• Circle No. 159

Stop puzzling over the Micro Jigsaw and buy an operational system to fit your needs



If only buying a microcomputer system was as simple as using one.

Just look at the advertisements in this magazine. When can you find time to digest them all?

There are millions of chips, thousands of boards and hundreds of peripherals, software systems and application packages. How do you pick the right ones to meet your requirements?

And put them together? And make them work? And add the specials you want?

At Digitus we have computer professionals working full-time putting systems together. Absorbing information. Testing equipment and software. Writing programs. Training users.

At one stop you can commission a complete system to fit your requirements.

Last year we supplied systems for: number processing, word processing, data processing, graphics and machine control. Advised accountants, surveyors, archaeologists and engineers. Helped DP departments and small business men. Developed software for personnel, incomplete records, order processing, business games, linear programming, process control and terminal emulation. And were retained by other computer companies to advise on micros.

This year we can put even more experience to work so that you can benefit from micro technology . . . in comfort.

Come and see us. Spend a few hours discussing your requirements. Attend a training course. Select a machine. Test drive some software.

Solve the micro puzzle. Buy an operational system that fits your needs.

Call for an appointment with one of our consultants.

Digitus

Digitus Limited   Microtechnology Centre   Dumbarton House   68 Oxford Street   London W1   Tel: 01-636 0105

• Circle No. 160

All work and no play

IN THE DAYS of your Editor's youth, persons of good education were required to struggle at least as far as O Level in Latin. We all hated it but it had to be done, and when we asked Why?, our betters would say gravely that it trained the mind.

At the time we pretended to hear them say 'drained' and laughed cynically, but it was probably true that having to recode our ideas in a different language made us understand in some dim way a difference between meaning and syntax that might otherwise go unnoticed if one were only to write in a single language.

For a while the educational process made do with French, which hasn't quite the same bite to it as Latin, perhaps because of all those delicious meals and wines one can order in it, and those rather fetching ladies who speak nothing else. To be educational, a language has to be very very boring.

Now it seems that a new language is appearing — computing. It has the drawback that children enjoy it, but that problem is in hand, as we shall see.

I say 'computing' rather than Basic or Pascal or whatever, because the difficulty about learning to handle computers only appears to be the language. In reality it is because one's mind is pretty fuzzy — what does Nature expect if she tries to build a computer out of materials you can buy in a butcher's shop?

As anyone knows who has tried to write even the simplest program, there are all sorts of steps in logical thought that the brain skids over, saying to itself, with mental fingers crossed, that 'It'll be alright on the night.' And, of course, it isn't. 'Next without For' or 'Return without Gosub' or 'Subscript out of range' the horrid little machine says starkly and there you are, presented fairly and squarely with an immediate opportunity for mental self-improvement.

Clear thinking is an instant but rather prosaic bonus one gets from computing. The next item of educational value is the realisation that computing is all about naming things and then either changing the things or changing the names. You soon realise that different things can have the same name, while different names can mean the same things — or different things.

It isn't long before one is quite cured of that hang-up that so puzzles philosophers: the confusion between the thing and the name. (Of course the name is also just a thing, but we'll slide over that. See educational point 1).

Of course too, this improvement in mental equipment tends to make computer people boring conversationalists because they get into loops like: 'When you say 'Madeleine' do you mean 'Madeleine' as a pointer to the name 'Joan' or as a pointer to a girl called 'Susie' (who is also called 'Coral')?'

The next useful insight is that at the end of the day, the subtlest and most mysterious program only mangles data bytes with program bytes and stores the results. Any goofy feelings one may be tempted to get about 'mind' and 'consciousness' and the relations of Artificial Intelligence to all that, are soon dispelled by thinking about the bytes being relentlessly, meaninglessly swapped about. And no-doubt something very similar goes on inside our heads, only it's difficult to model it because we've only got a head to model it in.

Thirdly, having observed what spectacularly dire effects can be wrought on a program by the failure to set a flag or two to zero, or to clear out an itsy-bitsy buffer, it is easier to understand the pyschoanalysts' contention that much absurd human behaviour is caused by unfortunate childhood experiences. It looks to me as if the first three years of life are taken up in running a sort of boot-strap loader program which is pre-written to look in the world about it for basic concepts like 'mother', 'father', 'love', 'language'. Consciousness doesn't start until this loader has run, and if it has loaded a few things awry, then bizarre results may be expected later.

A good example is Lorenz's famous goslings who seemed to be programmed to identify the first large moving object they saw as Mother Goose. If it happened to be Lorenz himself, they would forever after think that geese looked like men. When the time came, they would marry a man and settle down — unhappily — ever afterwards.

It seems quite clear that this deep, background program goes on running in our minds to deal with love and hate, hunger and sex, home and family and that our civilised conscious thoughts are just subroutines called by this main program. But since they operate with parameters passed by the background program, the results of the subroutines may not be civilised at all. They may be, and often are, very savage indeed.

Anyone who has tried writing stories will know that there are only three important questions the human mind asks about any situation: Can I eat it? Can it eat me? Can I mate with it? The deep mind does not experience time — events in childhood are as real to it as if they happened ten minutes ago; it does not distinguish between people — the world is inhabited solely by MAN and WOMAN who may also be FRIEND or ENEMY. The story teller's art is to use the deep background program running in his audiences' heads to breathe life into his characters and situations. If he can do that they become compelling; if he fails, they sit lifeless on the page or the screen.

It is at the deep level that our mental programs interface with our bodies. The foreground mental program manages to solve a difficult intellectual problem; the deep mental program 'feels good' because, as far as it's concerned, you have outwitted a sabre-toothed tiger. If we took away the deep programs, we would take away life, for the foreground programs are only subroutines. With no animal crises to call the subroutines, human would sit inertly around and quickly starve to death.

But on the other hand, much of our troubles stem from just this crocodile brain in back of our frontal lobes. There is no doubt that we could do with some thorough debugging in this department, but since the bugs seems firmly established in ROM, there isn't much we can do about them.

However, it may be that the wonderchip revolution is actually a stage in evolution, in which intelligence is transferring itself onto silicon and in the process, leaving the lizard brain behind. If and when it gets established enough to be self-replicating, its butchers-shop progenitor can H-bomb itself into oblivion. And probably will.

Enough of philosophical maundering. What this piece started out to celebrate was the informal educational virtues of the computer, and then on the way, to deplore what some professional educators are doing with it. I would have said it was impossible, but in some schools, children now actually dislike computer studies.

In ordinary life there is hardly a child who does not fall on a computer with shouts of glee. They love it because *they* control it — or not. Children are like people: they want power, and the computer gives them power direct without having to go through adults.

No doubt it is just this freedom, which children love, which annoys their teachers. So they are making it boring. With a bit of luck, educators of this kidney could send Britain irrevocably to the bottom.

— P.L.

"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 microcomputer, with over 10,000 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.

NEW BUSINESS SOFTWARE PROGRAMS ON DISK

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

Commodore also produce a growing range of business software on disk available from Official Business Software Dealers.

Business Information System – COMBIS £150 + VAT

Combis facilitates the storage and instant retrieval of all kinds of company records, from personnel files to mailing lists and printed address labels.

Stock Control – COMSTOCK £150 + VAT

Comstock provides an accurate, up-to-the-second and comprehensive stock position for as many as 1,300 products.

Word Processor – COMWORD £75 + VAT

Comword turns the system into an excellent word processor.

Payroll – COMPAY £150 + VAT

Compay is a new, comprehensive payroll package.

COMMODORE PETPACS

Over 50 Petpacs 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 including the award winning Star Trek, which is packaged with Petopoly. Prices are from £5 to £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.

OFFICIALLY APPROVED BY COMMODORE

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

(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 ______________________ P.C.

Address ______________________

____

______________________ Tel. No. ______________________

commodore

We made small computers big business.

• **Circle No. 161**

Rolls-Royce among calculators here

HEWLETT PACKARD's new contender for the personal computer in 1980, the H-P 85, features a built-in BASIC, high-definition screen graphics, a smaller thermal printer, 16K of usuable memory expandable to 32K, four I/O ports, and built-in cassette drive and VDU.

Priced at just under £2000 plus VAT the machine is, like all H-P products, beautifully made and its Basic looks excellent.

The language has many features of its own: graphics commands, four levels of program and data security, CHAIN and COMMON for linking programs together. There is what looks like a good library of mathematical, statistical, and financial programs.

On the other hand, the concept of the machine has a dated air. The VDU is hand-sized. There seems to be no access to the CPU for writing machine code — in fact, H-P do not even say what processor the 85 uses. There will be discs, but only 5¼in, and since they use H-P's own operating system rather than a standard one like CP/M, the software available to the user will be limited.

All in all, it feels more like a luxury PET than a micro for the Eighties. As a process control machine, or a Rolls Royce desktop calculator, it may be very successful; as a true personal computer — perhaps not.

Football-crazy!

THE WORLD CUP could be England's once again if our footballers were helped by a computer, according to a postgraduate social scientist, Roger Codwell, who is to program a computer with information from World Cup matches.

Using his skills as an architect and a doctor in sociology, Codwell will plot the movement of players from films of the 1976 World Cup matches, released to him by Allen Wade, the Football Association's director of coaching. Once the information has been fed into a computer, with the help of his wife Jo who is a computer scientist, Codwell hopes to devise important tactical hints that could be useful in a real-life game.

"The two basic problems," explained Codwell, "are those of the game being fast, unlike chess, and complex. But these can be countered by the use of computer technology. Coaches often go along and watch the opposition, but how often have games been systematically analysed and the results fed back in training?"

Setpieces

Codwell believes that he will be able to detect as yet unrecognised incidental set-pieces which, once discovered, could lead to predictive football. "Imagine a game," he said, "where members of one team know what the others in their team are going to do for ten to twenty minutes of the game. If each of, say, twenty refined set-pieces is identified with a signal from the captain, then we could control one to two minutes at a time."

Dot matrix display

A READER, R. Crawley, tells us about a new dot matrix display he's invented and thinks would be the best thing for computers since sliced silicon.

It shows:

- **All upper and lower case English characters**
- **All Arabic numerals**
- **All upper and lower case Greek characters**
- **All Cyrillic characters**
- **Many mathematical symbols**
- **Many specialised symbols in various fields**

to a total of 400 different characters.

So far no-one has shwon much interest, but perhaps one of *PC's* enlightened readers can do something with it.

His address is: 4 Kent Place, Oughton Head Way, Hitchin, Herts, SG5 2LE.

A brilliant notion (though we say it ourselves)

THE ISSUE OF THE DAY — see our last cover for instance — is the possibility of linking computers one with another to produce many striking social results. There are four obvious ways of doing this: by satellite, by telephone line, by glass-fibre, and by television.

There are drawbacks: the satellites aren't there, offend national dignity, need expensive ground stations. The telephone lines are too slow and percolate through horrendously noisy and unreliable exchanges. The glass fibres aren't there either and probably won't be for a long time, because installing them means digging up many thousands of tons of pure copper in the old cables which will make a mess of Rio Tinto's share price. The TV is fine but it only works one way.

Well, that was true up until just now, because here we have — two-way TV! The point is this: aerials are reciprocal. In a TV system, you put 50,000 Watts in at the transmitter and get a microwatt out at the receiver. But you could just as well put 50,000 Watts into your domestic aerial and get a microwatt out at the transmitter (assuming a suitable receiver had been installed there).

This is all right so far as it goes, but 50,000 Watts would burn your domestic aerial. So, now the second trick: you don't need that much power because you don't need the data rate of a TV transmitter, which is about 8 million b/sec.

James Martin in his book *The Wired Society* calculates that the average home user needs 300 bits/sec. The power needed for a channel is proportional to the data rate, so the home-end transmitter needs $50,000 * 300/8.10^6 = 1.875$ watts — which can be done with one transistor working as a power oscillator. So, each TV set has five quids worth of transmitter built into it, and a separate TV data channel is allocated which addresses each home computer one at a time, using a digital access code.

How many can it serve? $8.10^6/300 = 27,000$ customers. Not bad.

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.2

commodore

We made small computers big business.

• Circle No. 162

Handy debug tool for novices

A NEW DESIGN, debug and development tool for use by both experienced microprocessor users and novices to evaluate microprocessor-based systems is now available in the UK. Called the Microsystem Designer, it can be used as an 8 or 16-bit universal prototype instrument or as a training aid to a specific microprocessor.

Microprocessors that are currently supported by the Designer are the Z80A, 8088, 8086 and Z8002. Other microprocessors which will be added include the M6800, 8085, 8048 and M6809. All command and data entry formats are standardized so that the same methods are used no matter which microprocessor is being emulated.

The tool was developed by Millenium Systems Inc and is marketed in the UK by Microsystems Services. The unit includes a 14-segment 16-digit alphanumeric display, a hexadecimal keyboard, a 16-key command and function keyboard and eight user I/O switches and LED outputs. Each personality module contains interrupt and special function keys.

Microsystem Services are based at 11 Duke Street, High Wycombe, Bucks, tel: (0494) 41661.

Corvus gets back-up

BACK-UP STORAGE for the eight-in Winchester technology Corvus disc drives has just been announced by Mike D'Addio, president of Corvus. It has developed an intelligent interface that provides up to 100 Megabytes of magnetic tape storage using video cassettes. The new system will allow any standard video cassette recorder to be interfaced directly with the disc controller.

Corvus drives are distributed in the UK by Apple dealer Keen Computers. The new video cassette interface will be sold, by Keen, for about £500.

Double-density discs on the way

RUMOUR HAS IT that several firms, including Research Machines and Commodore, will be offering double-density 8in discs, 20-30 MByte hard discs and 80 character VDUs by the summer of this year.

By the end of the year they both intend to offer bus systems that will allow a dozen or so standard computers to access a central hard disc or a high-speed printer — a neat solution to the multi-user problem. Coming soon after that: video discs for back-up to the hard disc. Prices will be in the £6000 range for basic machine, hard disc and 8in disc for back-up and transfer of program and data.

Research Machines seem to be moving from a maker of mainly educational devices to a contender in the general small business system market. It is not hindered in this by being one of a very small selection of British manufacturers, since quasi-official bodies like the GPO — one recent customer which has placed a large order — feel they ought to buy British if they can.

However, as Mike Fisher of RML says: 'We get a bit embarrassed about this. We aim to be truly competitive, especially in the European market.'

Complete off-the-shelf applications systems

COMPLETE off-the-shelf applications systems based on firmware modules will be the next and most significant development in the microprocessor world. That's the prediction of the latest report in Infotech's State of the Art Series — *Microcomputer Software*.

According to the report, the future holds promise for systems consisting of active firmware modules, each incorporating a microcomputer with its firmware program on chip, integrated together. The users of these systems will view these active firmware elements as functional modules and will select these devices from the manufacturer's standard module list, with only interfacing and application information defined.

The report describes developments in firmware including Western Digital's PASCAL "Microengine", a 16-bit chip set which directly executes PASCAL programs up to five times faster than is possible with conventional systems software.

Contributors include Branko Soucek from Zagreb University, Gill Ringland of Inmos, UK, Chris Hawkins of CAP Microsoft, UK, and Paul Hazan of John Hopkins University, US.

The report costs £130 and is available from Infotech Ltd, Nicholson House, Maidenhead, Berks. SL6 1LD, tel: 0628 35031.

Metro jumps on board

ANOTHER INDUSTRIAL 'giant', Grand Metropolitan, is going into the microcomputer market. The massive group, which includes Watneys, Express Dairy, IDV, Berni and Mecca, has formed a new company called Metrotech, which will provide microcomputer services for the Grand Metropolitan Group and operate in the open market.

Metrotech will specialize in total systems including hardware, software and support. The hardware offered will include the North Star Horizon, the Vector MZ and various Cromenco models, which together span a disc storage range from 320K to 70 megabytes.

The company has a showroom at Waterloo Road, Uxbridge, Middlesex UB8 2YW, tel: 0895 58111.

'Million jobs in four years' — industry minister

THE DEBATE about the impact of microprocessors on employment has so far been dominated by those politicians and union leaders who claim that there will be massive unemployment and unrest in the eighties.

Headlines

The orthodox arguments, that this technology will create more but different jobs, as all technological advances have done so far, have not caught the headlines.

But now the Government has decided to step up its campaign to promote the growth and acceptance of the new electronics.

King Canute

Industry Secretary Lord Trenchard, speaking at the opening of the National Microprocessor and Electronics Centre, said opponents of the microelectronics revolution were like King Canute trying to stop the advance of the sea.

He commented that the country should look at the effect of the silicon chip on the US. In the past three years more than 750,000 jobs had been created in California, and in the last four years over 5m jobs in the country as a whole.

Wishful thinking

He believed that, given the effort, the effect could be repeated in the UK.

"In a recently published MORI survey conducted from my Department, about 5% of the top British 1000 companies thought that they had already lost a share of the market because of their failure to compete with microelectronics," he said.

Reviewer's howlers?

SINCE THE HP-41C is new on the market and not yet fully available, Vincent Tseng's inept review will very likely escape the howl of user-protest it deserves.

I suppose one can't blame him for chasing the rather silly hare of "is it or is it not a computer", as this was started by the Hewlett-Packard press office in their release to the media. But this isn't the problem. Any machine of this degree of sophistication represents the work of a rather intelligent team, and a reviewer should approach his task of criticism with some degree of humility. Or at least with scientific method.

- ☐ Why does Mr Tseng conclude that the printer offers "full alphanumerics upper case only"? Has he operated the printer? Has he even read the printer manual? It's difficult to understand how he can have missed the fact that in addition to the facility of lower case, full punctuation, and mathematical symbols (including the most commonly used Greek letters), the printer is also user-programmable to produce any character that can be supported by the dot matrix. This "surprisingly dumb" printer can do all of this in normal or bold print.
- ☐ It does not, as Mr Tseng intuits, have to "print a full line of 24 characters, filling in with 23 spaces, even when only one character needs printing". If he means that printing is always accompanied by line advance (which is a different thing) he has failed to spot that the device carries a 40-character buffer capable of accumulating characters and running them off as a string. The "silly oversight" he attributes to the manufacturers is clearly his own.
- ☐ Another untested surmise appears in his discussion of the way the CMOS memory is sustained. He suggests that "the batteries cannot be removed for more than a few seconds without corrupting or losing the contents." Who says? The manual guarantees the CMOS charge for thirty seconds while the batteries are changed over, but I took the trouble to test the length of hold-over (as Mr Tseng clearly has not): the batteries can be removed for at least 24 hours with no loss of memory!
- ☐ Another "shortcoming which needs serious attention" dreamed up for the machine by your second-guessing reviewer is its supposed inability to protect programmes against being over-written. How would it be if the designers had made the provision for the programme instruction "END" to shut the door automatically on the previous programme when fresh space is called up with "GTO . . ."? Well, they have. Next question.
- ☐ "Fiddly to access" submerged functions, says Mr Tseng. Has he tried using the Assign facility, which enables any function to be called up by pressing a single key? No reference list of these functions, says Mr Tseng. How about the index of the manual, where they're clearly picked out in blue? Or the 16-page "Quick Reference Guide". Or even CATALOGUE 1 in the machine itself, which gives a quick flick through all the 140-odd functions.

The key to these howlers (and there are more, but it's boring to go on) lies in his exasperation at the manual's alleged failure to provide "quick and concise reference", combined with his weary concession that "the manual might be good for a first-time user . . ."

Rather than seeking to dish up instant judgement, it would have been better if Mr Tseng had approached this really rather subtle machine in the spirit of a first-time user. Which he would have been, if he'd ever actually got round to using it.

Chris Bidmead,
London N.W.3

Our reviewer, Vincent Tseng, replies:
FIRST, I fully admit I did not realise the total capabilities of the HP-41C printer — but it must be borne in mind that I had the HP-41C system for a very short time. It was one of the first in this country and in demand for demonstrations, so I concentrated my time on the calculator itself.

Also under normal usage, such as listing programs, using the CATalogue functions and printing out messages entered on the keyboard, the printer did print only upper-case alphabetics, numerics, punctuations and common maths symbols, which I called "full alphanumerics upper-case only", referring to the commonly known 64-character upper-case ASCII character set.

"Surprisingly dumb" and "silly oversight" referred to the need for the print head to move the full length of the line even when only one character needed printing. For example, when using the "CATalogue 1" function, the printer took a long time to list all the functions. I am sure if better use were made of the 40-character buffer by printing to a near optimum path (eg: bidirectional printing and moving only the lenth required for printing) throughput would be faster.

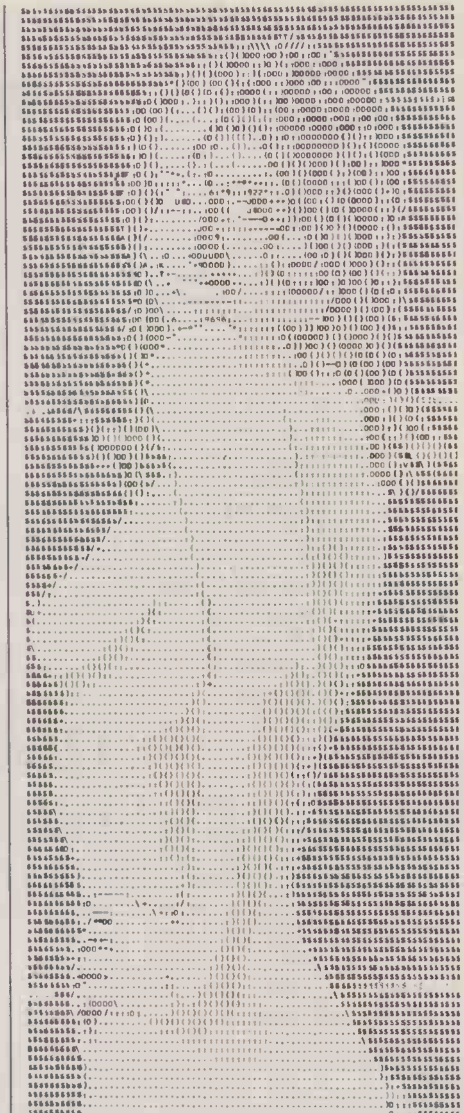
I do not see any advantage in having the print head move the full length of the line all the time. Do you? Whether the head advances, steps or print spaces/blanks is not the point.

As for memory retention with batteries removed, my sample certainly did not retain memory for as long as 24 hours. H-P would not have guaranteed retention for only 30 seconds if 24 hours were typical. Have you tried switching on the calculator with the batteries removed? I assure you that my sample had total memory loss within 10 secs or so.

My point about the "shortcomings" in memory protection is amply illustrated in your own letter — the need to use a deliberate sequence so as *not* to corrupt memory contents (ie: the "END" and "GTO . ."). I feel it would have been better to use an obviously deliberate sequence when it *is* required to change/modify or overwrite memory, so that memory contents are protected from errors in operation.

I do realise that the submerged functions can be assigned under "USER" to allow their use by a single keystroke. However since there are many submerged functions and few keys on the keyboard, one does not need a calculator to tell that not all of the submerged functions can be assigned a separate key. Moreover this leaves nothing for real user definition, which defeats the purpose of the "USER" mode. Otherwise why have H-P not assigned the functions to keys themselves?

"CATalogue 1", the quick-reference guide and the index of the manual give only a listing of the mnemonics of the available functions. Some functions, such as "FS?C", are not immediately obvious to everyone, and therefore need explanation. A quick reference to all the functions *and* a brief explanation of what they do would be useful.



"Sarah by Teletype" by Gerald Seymour

He made it himself!

I HAVE just read my first copy of *Practical Computing (January 1980)*, and must congratulate you on a very interesting and informative publication. Indeed, the experience was so exciting that you really must forgive me if I run about every which way at once.

Firat a comment on "QWERTY query" (page 49). Reginald Mascall and other readers may be interested to know that the sentence, "Pack my box with five dozen liquor jugs" also contains every letter of the alphabet and is shorter than "The quick brown fox jumps over the lazy dog".

Shorter sentences exist and readers may like to try to reduce the redundancy still further. Of course, the goal can be approached from the opposite direction. Consider the following 'sentences':

A MISTYPED CHUNK OF BGJLQRVWXZ
BUT MY LEXICON HAS DFHJKPQRVWZ

Get the idea! Each letter of the alphabet is used once, and the sentence provides its own explanation for the nonsense remnant. The object here is to reduce the number of letters in the remnant. Readers may like to challenge, "BUT CAP MY ENGLISH WORD VXJQKFZ".

A comment about A.C.Kilgour's article, "Speak memory ... draw me a picture of the real world." On page 85, he mentions that each picture cell has its darkness integrated over the cell area and character/s selected to approximate to this value are printed to obtain the desired picture.

As a young lad back in '44, I approached this problem from the other direction and produced typewritten pictures (usually portraits) using the shapes of the available characters to produce textures. The idea of including the grey scale came later, sometime around the early fifties.

The technique from then on was to examine each cell and select a character that came nearest to matching the light and dark distribution within the cell, as well as the overall grey tone. When one had to be sacrificed for the other, it was always the grey tone that was allowed to float a step or two, the shape being regarded as the more important. The increased resolution of this approach permitted easily recognisable full-face portraits of small size even when using the relatively coarse characters of a pica typeface.

Your Editorial provided what was probably the saddest news of all. For the past fourteen years I have been developing a completely original mathematics embracing a new algebra, modified geometry and an additional branch of statistics involving new operations, theorems, series and relationships galore. Over the years I have produced a considerably quantity of material on this work and found some applications, particularly in engineering design.

The task is colossal with much still to do, but the work was becoming increasingly slow. I needed a really good number cruncher. The popular press was hopeful; simple calculators would soon cost less than a pound, while a tenner would buy one of the best of programmable scientifics, they said. The home computer would arrive with change from a hundred pounds, they said.

With my work becoming painfully laborious and pitifully slow, a few months ago I decided to await the arrival of the cheap computer and carefully put away my notes until that happy day. But now it appears that this will never happen. Your magazine makes it plain that the current high prices will rise and continue to do so.

This means that people such as myself with an income considerably below the average will never be able to apply the benefits of this technology to our own work. So may I appeal to the manufacturers of the more serious machines to stop updating (and up-pricing) some models and let continuing production eventually bring these within the reach of ordinary folk.

Gerald Seymour,
Stapleford,
Nottingham NG9 8GY

Jones the Frog

WITH REFERENCE to Mr Mascall's letter (Feedback, January) my dictionary defines a sentence or phrase which contains all the letters of the alphabet as a program.

I have encountered another example in the form of a test phrase used by some French radiotelegraph stations when idling on a radio channel. It reads "voyez le bricles geant que j'examine pres du wharf".

M. Jones,
Cardiff Road,
Newport, Gwent.

Buyers are daft

REGARDING Duncan Scot's report "Computer chief hits out at cowboys" (*PC*, January 1980), in all aspects of business large and small, the watchwords are *caveat emptor* (let the buyer beware); in the modern idiom, "You get what you pay for".

Over the twenty-four years I have been in computing, "cowboys" of one sort or another have always impeded the establishment of confidence in the application of computers and will continue to do so into the future if buyers of services, software and hardware do not make reasonable checks upon the vendors.

For some strange reason, when it comes to computers, buyers seem not to apply the same criteria that they would apply to, say, the purchase of a washing machine for their home or a typewriter for their business.

I don't pretend to know the underlying psychology of this but it existed when the first mainframe computers came into business, it was repeated with the advent of the smaller minicomputers and is with us yet again now that micros are on the scene.

In the early days there was the apparent excuse that there was nobody to turn to for advice since computing was something new. I say "apparent" advisedly, because even new disciplines can be applied successfully if the business brains apply the proper controls.

Despite the early setbacks, computers are still with us, although many an incompetent company director is not. More to the point, however, is the fact that there are people around with more than a decade of experience who are offering a service to the micro user. It is therefore up to the buyer to ensure that his purchases are backed by competent advice, which is preferably independent from the vendor. One form of this is to be put in touch with a successful user of some years' experience.

Another way is to seek those with membership of the appropriate professional society to guide them. On this point, it is wrong to assume that, for example, members of the British Computer Society are interested only in very large computers. There is an obligation for all members to keep abreast of current developments. In this context therefore, there is already something which Gerry Cook of Logabax Ltd is requesting, ie certification of the individual.

One of the forms in which this appears in "MBCS" after a name.

P. J. Winnall, MBCS,
Sheffield, Yorks.

Misinterpreted values

I READ with interest the article in the January edition of *Practical Computing* on North Star BASIC and the method by which it represents reserved words. Unfortunately, the ingenious method used to list these gives some spurious results (such as "PYDM"), apparently due to the BASIC misinterpreting values which are not assigned.

In North Star BASIC, there is a table of reserved words and their corresponding values, In release 5.0, this is at 3EF5 and in release 5.1, it is 3F04. Hence, the easiest way of listing these is merely to print out the table and the accompanying program achieves that.

Using this method, some of the anomalies described in the article are explained. For example, " = " is only represented by 245 and not by all the other codes (which are unassigned). Similarly, the peculiar "reserved words" reported are spurious. I would surmise that BASIC does not check for the end of the table when presented with an unassigned value.

I enclose a copy of my program and a sample output.

Dr Adrian Stokes,
Mill Hill,
London N.W.7.

128	LET	158	CREATE
129	FOR	159	ERRSET
130	PRINT	160	RUN
131	NEXT	161	LIST
132	IF	162	MEMSET
133	READ	163	SCR
134	INPUT	164	AUTO
135	DATA	165	LOAD
136	GOTO	166	CONT
137	GOSUB	167	APPEND
138	RETURN	168	REN
139	DIM	169	NSAVE
140	STOP	170	SAVE
141	END	171	BYE
142	RESTORE	172	EDIT
143	REM	173	DEL
144	FN	174	PSIZE
145	DEF	175	CAT
146	!	176	STEP
147	ON	177	TO
148	OUT	178	THEN
149	FILL	179	TAB
150	EXIT	180	ELSE
151	OPEN	181	CHR$
152	CLOSE	182	ASC
153	WRITE	183	VAL
155	CHAIN	184	STR$
156	LINE	185	NOENDMARK
157	DESTROY	186	INCHAR$
		187	FILE

```
100 REM Program to print out list of values corres-
    ponding to reserved words
110 REM in North Star BASIC. This program is
    specific to Release 5.1 BASIC.
120 REM For other releases, the constant in the
    first program line must be
130 REM changed appropriately. In Rel 5.0, the
    value is 16117.
140 REM The format of the table is each value
    (> 127) followed by the
150 REM reserved word. The table is terminated by
    a byte value 255.

160 P=16132                    REM Start of table
170 Q=0                        REM Output port number
180 S=EXAM(P)                  REM Pick up byte
190 IF S=255 THEN END          REM Check whether
                               finished
200 PRINT £Q\£Q,S,"   ",       REM Make output
                               neat
210 P=P+1                      REM Increment
                               pointer
220 S=EXAM(P)                  REM Pick up byte
230 IF S > 127 THEN 190        REM Check if end of
                               word
240 PRINT £Q,CHR$(S),          REM Else print
                               character
250 GOTO 210                   REM and loop
```

Spot the looney

WE HAVE HAD to institute a daft letter section of Feedback this month. The first comes from **Fats Wannamaker Junior**, who purports to write from Ocean Software Inc, New Jersey.

'HOW are things in little old England? What we at Ocean would like to know is this: Will future government have deployment option over the multiprocessing activity window, or will the Euro-users' event-horizon resolve ultimately to become a low impact scenario in this respect? More plainly, are we to anticipate a negative stimulus situation at this point in time? Perhaps even a negative man-in-the-street situation? You see what I mean; that mankind's ultimate interface could become no more than a low-level event, resulting from a lack of strategic forward planning input throughout the man-machine symbiosis.

The architecture, and indeed the hierarchy and entire spectrum of all strata might prove to be an OEM oriented ongoing throughput discipline! A simultaneous distributed turnkey facility may emulate the ongoing fragmentation of our culture differential, but unless a target interpolation is considered, the primary trade-off, a zero-redundancy array will never be encountered!

A typical example is the move toward the integrally redundant accuracy 16-bit and even 32-bit micro facility vectoring in on the personal processor, irrespective of a verified speed enhancement achieved through dyadic CPU 8-bit multiprocessing in what is after all an interpreter scenario. Consider a second order of magnitude finite configured data base utilising all encompassing maximally configured characterisation.

We surely need a specific software parity criteria in a civilisation seeking sophisticated user-transparency. Do you not agree that our socio-electronic integrity, if it is not to be a constraint simulation, must avoid any credibility gap'.

It's a free country!

The second is an extract from a letter received by Transam, reproduced with their permission.

'HAVING BRIEFLY outlined our purpose in pursuing the purchase of a microprocessor, would you please be so kind as to answer the following queries?

- ☐ Would you demonstrate the usage of the microprocessor in our school to Staff and PTA representatives and to a selection of children to see if the microprocessor, more appropriately its VDU, can cope with a class;
- ☐ Be willing to answer the many questions both for and against the usage of the microprocessor in education today;
- ☐ Allow us a trial period thoroughly to test the microprocessor without obligation to purchase;
- ☐ If we were completely satisfied with the handling capabilities of the microprocessor allow us to purchase one by paying half the purchase price on delivery and the remainder over a period not exceeding one calendar year;
- ☐ Allow us to purchase the microprocessor at a much reduced price with a view to showing that it can be very effectively used in a primary school as an educational aid. This would then give you the opportunity to use any of your new educational programmes in our school.'

Life memory shortage

RECENTLY I received my copy of *Practical Computing* for January with the program 'Life', written for the 380Z.

I am taking O level in computers and have an extensive library of tapes. I understand the program but when it is run using BASG or BASGF, the 380Z states that it is "OUT OF MEMORY SPACE at LINE 20", so evidently the DIM A (3000) is too large.

After seeing this happen, I switched the micro off and reloaded the BASIC but there was still this problem. Obviously the DIMs statement cannot be changed without changing the whole problem. Could you please tell me if I am overlooking something?

The BASIC is RML 9K

Ian Crosswell,
Kings Norton,
Birmingham, B38 8TW.

It looks as though the problem is lack of memory. A 3000 element vector takes up 18K of memory, since each real number in this BASIC needs six bytes. The answer is to compact the vector. This might take a bit of experimentation, but the way I'd go about would be to DIM the vector to 3000, find the start address of the vector when loaded by doing some judicious PEEKing, and then to use that space to keep the data in by POKING numbers in as single bytes rather than six-byte reels. Of course you then have to keep track of the number of the element you want and get it back by adding this number to the start of the address of the vector. It may not be all that easy, but it will be most educational.

Good word for the ELF

THANK YOU for a year of excellent reading, but I have become increasingly aware that the RCA COSMAC ELF II has not received the publicity it deserves.

Having had to wait four months for a working MK14 and then for it to give up after 20 minutes' use, made me wonder about the reliability of any home micro. But after a further two months waiting for money to be returned, I went to HL Audio in London to see the ELF and bought the kit on the spot.

Having spent two hours soldering the kit and applying power, it worked first time — much to my surprise, I admit. And at just over twice the price of the MK14, I found that the extra spent was more than worth it.

The basic ELF is very basic with only 256 bytes of RAM and no monitor. But a monitor is not needed to load and run programs as no bootstrap is needed. The professional hex-keypad is probably one of the ELF's greatest attributes — it far outperforms the keyboard on the MK14. I have had a good nine months' use from it and no problems have arisen as yet. Also no special power supply is needed as all rectification and regulation is done on-board — only a 7V ac supply is needed.

The backup software available is also good, and the following is available: ELF-BUG Monitor, Assembler, Disassembler, Tiny Basic, Full Basic and a powerful Text Editor.

There is also extensive hardware available: memory in 4K boards, full ASCII keyboard, prototyping board, video display board, light pen, dual tape controller board (especially for the text editor and assembler), EPROM board and the so-called Giant board which incorporates cassette, TTY, RS232-C and parallel I/O port with a small systems monitor.

The constructional and operational literature is of very high quality and designed for the beginner or for the person with computer experience.

I feel that for anyone the ELF II is a computer to be seriously considered, especailly if money is not available in great amounts at any one time. Would it be possible to review the ELF II or feature a little software for it once in a while?

D. Rawle,
London SE9 5PE.

We don't publish software for the ELF because no-one has sent us any. Maybe this letter will stimulate something.

Murder most foul!

IN THE DECEMBER issue of this journal, there appeared a feature entitled "Contrasting Eurapple with ITT 2020". The piece was attributed to Bryan Spielman.

While I confess to the identity of Bryan Spielman, I am anxious to disclaim responsibility for the piece as it was published.

Yes, I did write an article on the subject for this paper. But then it got into the hands of a production editor and what came out was a travesty of the original. I have lost friends through it. Former admirers have torn up my photograph. I am not asked to parties any more.

It is perfectly allowable for editorial prerogative to be exercised over a contribution. Indeed, it is a job I do myself from time to time and I fully understand the problems which have to be dealt with.

Things do have to be cut if they are too long for the available space or if they do not suit the occasion. Punctuation and so forth may have to be adjusted to conform to house rules. Plain illiteracy should be rectified, but if it is too bad then the author should be invited to make an alternative arrangement, such as bringing in a ghost writer or having his message put out in the form of a report by an interviewer, or simply giving up and going round to the pub.

Necessary minor changes which do not diminish the quality or nature of the contribution are perfectly in order, provided they are decently done and there are not too many of them.

But consider the effect on an author, who has diligently researched his material and gone to pains to fine-tune every cadence of his reporting, of coming home one night to find that someone has run amok through his prose. The drab and colourless thing, oh readers, which masqueraded as my Christmas present to you was a sad and mutilated corpse. Sentence after sentence had been laid in ruins.

Adjectives, phrases, nouns even, had been freely tampered with. Amongst the carnage there were lucid sentences rendered obscure, accurate ones turned into lies and meaningful ones transformed into gibberish. Jokes were cut out or, more wickedly, just the punch lines were omitted.

Now, there are many liberties an editor or printer may take with an author's work and be forgiven for, but when things go so far as to bring about the assassination of the author's style they have gone too far.

One former reader of mine actually sent me a wreath.

Bryan Spielman,
Wanstead, London E.11.

Just imagine how many parties the Production Editor doesn't get invited to!

Tandy steps into a new class

Ron Geere spends a day checking out the Tandy TRS-80 and finds the Model II is a giant step forward.

Compshop's Angie gets her finger byten!

TANDY'S new Model II looks very much the same as the Model I, but its width has been slightly increased in order to accommodate the single 8in floppy disk drive.

Some of its features are unusual. The exploitation of the full 64K addressing capability of the 8-bit processor is to my knowledge unique in the commercial microcomputer market, although about 27K is required for the operating system. The architecture is somewhat unusual, as the screen memory is not mapped from this 64K.

Making comparisons between any two machines is unwise without a thorough knowledge of both, but Model I owners will be interested in the differences. The Model II is aimed at the business market and as such the graphic characters are limited and differ from Model I. Nor can they be programmed. Cursor controls are more comprehensive and the real-time clock is a standard feature. Lower-case characters have true descenders.

The BASIC is Level III and is compatible with the old, but has more command options. Machine-code routines are easily entered using the Model II's improved DEBUG utility, but machine-code programs written for the Model I will probably not operate on the Model II.

The new disk operating system is superb, full of useful features. Some examples follow: 'FREE' displays the status of all tracks and sectors graphically on the screen. One can then see pictorially which tracks are used or unused. 'D' indicates directory information and 'F' indicates flawed tracks which have been automatically locked out on formatting.

Disk-to-disk copies can be made with the single drive using about two passes, depending on how full the disk is. The password for the disk can be changed on a back-up copy, but disk copies *cannot* be made without a knowledge of the master disk password.

When formatting a disk, TRSDOS first checks the disk for data and if present queries the operation. DEBUG splits the screen display giving 'monitor' format plus ASCII equivalent on one half, while the other half is the normal screen format.

CLOCK displays the clock time on the screen, irrespective of any scrolling, while DIR gives the full director, ie, file type, attributes, record length, number of records, number of extents, space allocated and blocks used. The terms 'attributes' and 'extents' as applied to TRSDOS give extra properties to specific files. For example, certain users can be denied access to a file, or the file may be read, but not written to or listed, or may be nominated to RUN immediately on completion of the power-up sequence.

Some 50 or 60 routines are also available with ready access to the user.

Hardware

The hardware is manufactured to the highest commercial electronic standards. Circuit boards are resist-coated fibre-glass double-sided with plated through holes.

The keyboard unit superficially resembles that of the Model I, but the major differences lie inside. The keyboard has its own processor, an Intel 8021, and connects to the main unit via a 5-pin 180° DIN connector. There was no trace of key bounce on the unit reviewed.

The keys provided include 'BREAK', ESCape, CAPS which is a case transpose lock and is not the same as SHIFT and SHIFT LOCK, TAB, HOLD, BACK SPACE, ENTER (carriage return) and REPEAT. The separate keypad includes cursor controls, two 'function' keys, F1 and F2 which generate CHR$(1) and (2) respectively. I could see little use for these, since CTRL A and B produce the same result.

Internally the power rails are derived from an ASTEC switching regulator powered from 115 or 240 V mains. The unit examined was running from a 115 V transformer because the disk drive was 115 V only. Comp Shop had modified the

Practical Computing evaluation

	Yes/No NA	1	2	3	4	5
Ease of construction	N/A					
Quality of documentation				●		
Dealer support/maintenance						●
Can handle 32K memory	YES					
Quality of video monitor					●	
SS-50 Bus	NO					
S-100 Bus	NO					
Sockets for chips	YES					
Numeric, calculator-type pad	YES					
Large amount of removable memory, randomly accessible	YES					
Cassette tape recorder capability: Own	NO					
Built-in recorder	NO					
Floppy disk capability	YES					
Communications capability	YES					
Speed of Instruction cycle	4mHz					
Ease of expansion						●
Low power consumption					●	
Assembly language	YES					

	Yes/No N/A	1	2	3	4	5
Basic language	YES					
Other languages	YES				CP/M	
Compatibility with other systems					●	
Reputation of manufacturer				●		
Appearance					●	
Portability		●				
No. of software applications packages available					●	
Hobby use					●	
Business use						●
Education use				●		
Suitable for commercial applications				●		
Home applications				●		
Educational applications					●	
Ability to add printer	YES					
Ability to add disks	YES					
Ability to add other manufacturers' plug-in memory	N/A					

Ratings
1 = poor; 2 = fair; 3 = average; 4 = good; 5 = excellent. N/A = not applicable.

machine for 50Hz operation of the drive unit. Presumably overload protection was built in, for the rear fuse protects the disk drive only. The mains connector is of the European three-pin type (IEC).

The single disk drive is the Shugart SA800/2 double-density version. Each disk stores 486K bytes (416K on the system disk). The disk controller board handles the flow of data from processor to disk.

The disk controller chip is the Western Digital WDIT9I. The disk has five times the speed of the Model I's mini-disk. The data tranfer rate is 62,500 bytes/sec.

The next board is the keyboard and video interface. This board and its 6845 chip must surely hide the clue to the video technique used. Unfortunately, time did not permit an investigation.

The processor board houses the Z80A which runs BASIC 2½ times faster than Model I, bringing it into the same speed bracket as the Apple and Commodore PET. The memory board (crammed with memory chips) completes the main board count.

There are four slots provided on the Eurobus for expansion boards, although if a 32K model is later upgraded to 64K, one of the four is used for add-on memory. Three interface connectors are available, one parallel, one serial synchronous and one serial asynchronous.

The system may be expanded with single, dual or triple disk drives in the near future.

The TV driver board houses the circuitry necessary to drive the cathode ray tube and an internal fan is used to extract the heat from this compact unit.

Software

On start-up, 847 bytes are reserved for each data file, the number of which must be declared, as must usable memory size to reserve a top-of-memory area.

The Level III BASIC has the facility for double-precision variables. Single precision variables are printed to five digits, 'double' to 16!

Editing can be done by the command EDIT (line number). This puts the appropriate line number on the screen and invokes a simple text editor. It is also possible to erase from the cursor to the end of a line or from the cursor to the end of screen.

HEX$ and OCT$ convert decimal to hexadecimal or octal values respectively. RENUM provides the ubiquitous renumbering facility.

Plus points

The disk does not need to be removed during reset or power-up. Both 'Reset' and 'Power' switches are readily accessible on the front.

The DOS appears to be considerably more advanced than that of most personal computers currently on the market.

Minus points

The continuously running disk drive was noisy and I found it irritating in a quiet office. The level of radio frequency interference was sufficiently high to cause disturbing patterns on a nearby closed-circuit TV set, but this is not uncommon in digital electronic equipment. I did not like having to call up error numbers from the disk as a separate activity when the full-length error message is already in the system for the asking.

Conclusions

- **The Model II is in a different class to the Model I.**
- **Its memory capability is greater than many mini-computers.**
- **The operating system has numerous features which make the computer a joy to use.**
- **For business use, up-and-running can be simplicity itself — just switch on and your program is running.**

MSI micro nibbles at the mini market

Jim Wood reviews the MSI System 7, which with a 10MB hard disc becomes the System 10. He finds it competent, a little expensive and the software a little untidy for the inexpert user.

THE MSI SYSTEM 7 and its big brother the System 10 are new additions to the 6800-based series of microcomputers manufactured in America by Midwest Scientific Instruments and marketed in the UK by Strumech Engineering Electronic Developments (SEED).

This machine extends the capabilities of the earlier MSI 6800 in terms of disc storage and available software. The system can handle up to eight disc drives, four of which may be 10MB hard discs, between 32 and 56K bytes of RAM and provides a choice of three user operating systems FDOS, SDOS and FLEX.

The system provided for review consisted of a 56K byte machine, two minifloppy drives and a SOROC IQ120 terminal.

Equipment

The MSI System 7 is based around a Motorola MC-6800 CPU running at 2MHz, generated by a 6875 clock drive circuit with an 8MHz crystal oscillator. The twin minifloppy drives take 5in quad density diskettes, formatted as IBM System 34 compatible and giving 3K bytes per drive. The drives are controlled by an MFD-8 disc controller with a data tranfer rate of 250,000 bits/second.

The computer and drives are packaged in a large, squat metal box with an adequate but rather noisy fan situated at the rear. Also at the rear is a mains lead plugging directly into a standard socket and an RS232 socket for connection to a Visual Display Unit.

At the front are the drives, a large red power button, a reset button for loading a bootstrap loader and an IRQ button which was not enabled on the review machine. The IRQ button can be programmed as an automatic bootstrap loader.

VDU facilities

The SOROC VDU provided has two RS232 serial ports, one for the computer and one for an auxiliary disc drive unit, an RS232 parallel port for a printer and a baud rate switch. An on/off switch, a reset button and separate brightness and contrast controls are all provided and are readily accessible. The VDU also has a fan, but this one is comparatively noiseless.

Hooking up

The system was straightforward to put together. The cable connector from the computer to the VDU was unmarked but worked when connected in either direction. Both devices were plugged into the mains and turned on.

At this point we had our first problem. Pressing the reset button on the computer should have generated an "*" on the screen ready for booking an operation system. As there were no instructions for the VDU, I had to figure out that the unmarked 15-way switch at the back was a baud rate switch and then select the correct setting by trial and error.

But the lack of VDU documentation was offset by the quality and comprehensive nature of the manuals provided with the system. Once the correct system master disc had been selected and loaded into drive Ø, the procedure is to type "B" followed by "D" for FDOS or "S" for SDOS to load an operating system.

FDOS defaults from drive Ø but SDOS allows an alternative drive to be selected. FLEX also defaults from drive Ø but is loaded by entering a load address of "GO ECØØ".

Keyboard

A standard alphabetic QWERTY layout is provided, with a separate numeric keypad and eight function keys, four for cursor movement, left, right, up and down, a home cursor and clear-screen keys, a break key and a tab key. The VDU was set to operate in lower-case, but required upper case for operation. A lockable upper-case key was well laid-out and easy to use.

The display gives 24 lines of 80 characters and is set to operate in scroll mode. The characters are well formed and easy to read, with a good screen definition.

FDOS

The first operating system looked at was MSI FDOS which provides a good set of utilities, a BASIC interpreter — the MSI Disc Extended BASIC Version 1.4, and a translator package. The disc initialisation utility was easy to run and took only 45 seconds to initialise a new diskette. The user is asked for a two-digit drive number — drive 1 is entered as "01" — and is then asked to confirm before starting. Any drive may be used.

Disc copying was also quite fast — 25 seconds for an empty diskette (operating system parameters only) and 65 seconds for a copy of a full diskette. A utility is also provided for copying a single file. A 16K byte file on drive Ø took 25 seconds.

The user may look at a catalogue of his disc files by using the CAT command, or at operating system files by using PFILES, both being used with device numbers or defaulting to drive Ø if used without. The CREATE command is used to set a disc directory entry for a new file, but allocates no more than the minimum file space. PURGE removes the disc directory file-name only and leaves the space allocated. The file name can be recovered; to remove the space it is necessary to PACK the disc.

The majority of the system commands and the utilities can be run by typing in only the first two characters, which saves time and possible errors.

The BASIC interpreter is an extended version of the earlier MSI one and now has many of the features that one would expect to find in the more extensive minicomputer BASICs. The facilities added bear a close resemblance to those found in DEC's RSTS BASIC +.

Plus points

- ☐ Run time error handling, ON ERROR GO TO statement, ERR and ERC variables for error number and line, the RESUME statement.
- ☐ KILLing a file from a user program.
- ☐ Line input mode and PRINT USING strings.
- ☐ GOTO and GOSUB allow expressions as well as line numbers.
- ☐ Multi-line statements.
- ☐ True string arrays.
- ☐ A very fast CHAIN (ie loading one program from another).
- ☐ Trace ON and OFF for program debugging.
- ☐ Calling external subroutines.

- ☐ Nested IF-THEN statements.
- ☐ Standard function and string manipulation functions.

Minus points

There are however some restrictions:

- ☐ Line numbers have a range of 1-9999 only.
- ☐ Variable names may be A,A0-A9, to Z,Z0-Z9, but string variables may only be A8 to Z8.
- ☐ The shortest string length is six bytes, the maximum 256 bytes, with a default size of 32 bytes.
- ☐ Only two array dimensions are allowed.

Two interesting statements are CALL and PRINT USING. Subroutines may be called from disc, with the integrity of variables maintained between the CALL and RETURN. The calling program continues execution from the next statement after the CALL. A COMMON statement can be used to retain all variables in the list, but not those subsequently referenced so as to save space. The CALL is quite fast as well.

The PRINT USING statement uses an IMAGE string, but this can be either a string variable or a line number of a line with a string constant. The BASIC interpreter is good for development but has the drawback of being rather slow in terms of program execution. Our simple benchmark of FOR I = 1 TO 1000, NEXT I took an average of 7.5 seconds to execute.

Variables are stored as eight bytes if non-subscripted and six bytes for each element of an array plus, a six-byte overhead. Range is 1.0*E ± 99 with nine significant digits. Strings occupy two bytes, plus the string length and string arrays have the same six-byte overhead as variables. Line numbers occupy seven bytes and spaces are stored as entered, which means that neatly laid-out programs occupy rather more disc space.

Files

The main restrictions on data file usage are that only three files may be open at any one time. Data file records have a maximum size of 256 bytes (or one sector) and only sequential files are supported. Files may be opened for INPUT, OUTPUT, or UPDATE, but only one file may be open for OUTPUT at any one time. The remainder of the file-handling software is adequate for most straightforward applications.

Translator

A set of programs is provided to translate FDOS BASIC interpreter source to SDOS BASIC compiler source, the benefits of which can be seen later. The translator seems fairly comprehensive, if a little tedious to run, and leaves very little tidying-up to be done before an SDOS output program can be compiled and run. Thus it would be possible to develop programs under FDOS and later run them under SDOS.

SDOS

The SDOS operating system provides a more extensive set of software than FDOS and includes a true BASIC Compiler and Assembler, providing a much faster running program. It also supports both sequential and random-access files.

When the system is first loaded, a prompt is issued for the current date and time, both of which may be displayed by typing TIME and the date is used in the file directions.

The mandatory utilities are provided but the user may also use the command interpreter to run his own control files, giving an ability for reducing tedious operations to a single command.

The format and initialisation of diskettes is rather slower — eight minutes for formatting and three minutes for initialisation, but a better disc structure is achieved and the user can select his own mapping parameters to optimise the way his files are stored on the diskette.

One criticism of the SDOS commands is the long names used and the need to type the entire name, ie. SDOSDISKFORMAT, SDOSDISKINIT or SDOSDISKBACKUP. This can be rather annoying, as it takes about 40 seconds for the system to determine that a command is incorrectly typed.

The system provides both straight copy, for files or full discs, and a disc backup which can use an exception list and or a date to select only a subset of the disc files for copyng. Wild cards are allowed against file names and extensions in the exception list.

Although single-file copies are very fast, a full diskette copy takes 13 minutes and a full backup a very long 22 minutes. We applaud the use of backup exception facilities but believe that the full disc-to-disc versions are excessively slow. The system allows the user to define the default disc other than to the drive 0 and to assign system and work files discs to more than drive.

The manual explains the use of the HELP command for interpreting errors and gives a description line for a simple error number, but this failed to work.

The system allows up to eight channels for an I/O port and files can be opened on more than one channel at a time. Record format files, ASCII files and binary files can be read and written and status information for current position in file, length of file and end of file can be interrogated. It is possible to disable control C to present accidental program abortion.

BASIC

Using the software Dynamics BASIC under SDOS can be rather cumbersome and requires several stages to go from a new source file to a binary run-time program. BASIC source is entered using a line editor, starting from an empty file and inserting new statement lines. Obviously no syntax checking is available at this stage, but the editor provides a comprehensive set of commands.

The major problem with the editor comes with large programs since the editor treats blocks of statements as pages in memory and once a new page is rolled in, it is impossible to go back to the previous page without exiting the editor and re-entering from the top.

Once a program is entered, it must be compiled, with syntax errors being displayed on the screen. If more than a screen full of errors occur, they will scroll off the top of the screen, so the user must be ready either to hold the screen scrolling or to re-compile.

Error-free

A compilated, error-free file is then run through the Assembler, which may produce further errors, and in the end produces a MIKBUG-type file. This file may be loaded and run in SDOS by typing its name, but to end up with a true binary file (which saves file space over the MIKBUG file) the user must run the MAKEBINARY program for a final conversion. This program can also be run

Memory breakdown (in HEX)

0	— DFFF	User RAM (56K bytes)
E000	— E3FF	MSIBUG RAM
E400	— EBFF	SDOS disc bootstrap routines
EC00	— EFFF	FLEX/FDOS disc bootstrap
F000	— F07F	MSIBUG monitor RAM
F080	— F3FF	CPU board
F400	— F7FF	Input/output interfaces
FFF8	— FFFF	Restart and interrupt vectors

Prices

These prices were quoted by SEED and are exclusive of VAT.

Hardware

MSI System 7 — £4500
— 56K bytes, Micropolis 5" twin mini floppy drive with 630K bytes, SOROC IQ120 VDU FDOS, SDOS and FLEX
Micropolis 5in twin drive — Price on application
Caleus 206R
10MB front-loading
hard disc — £4250 (includes controller)
CDC Hawk 10MB — Price on application
Price on application
SOROC, ELBIT, ACTI — Various VDU

Software (All disc-based)

FDOS, SDOS, FLEX — Included in basic machine price and not sold separately
Inventory control
Accounts receivable/
payable — Price on application
Further packages will be made available in April

Maintenance

Third party through Data Design Techniques, price per annum 10 per cent of hardware cost.

by typing its name.

The COMPILE command speeds up this procedure by compiling and then assembling a program, and the FIX command runs the editor, makes an automatic back-up of the source, and on exit compiles and assembles.

- ☐ The BASIC itself contains most of the facilities available under FDOS, plus some further extensions and two restrictions.
- ☐ Multi-character variable names are allowed for both variables and strings.
- ☐ Assembly-language subroutines may be CALLed.
- ☐ Numeric range is 1.0*E = 126 and takes six bytes of storage.
- ☐ Line numbers are not required except for references such as GOTOs.
- ☐ Strings may be up to 65534 bytes in length.
- ☐ Both random and sequential files are available.

The BASIC programs produced are far faster than those under FDOS — the simple benchmark ran in well under one second, but to make a one-line change in a small program took nearly five minutes from editing to running.

FLEX

The final operating system provided is Technical Systems Consultant (TSC) FLEX system. The system provides an extensive command structure, similar to SDOS and a faster BASIC interpreter than FDOS. Also included is a debug package, an assembler and a text processor.

FLEX comprises a File Management System, a Disc Operating System and a Utility command set. The File Management System allows sequential and random files and virtual arrays — an array that is stored as a separate disc file, opened and closed as a disc file, but treated by the program as a normal array, thus saving program size.

This part of the system also allows spooling to operate, provided that a SWTP-MP-T interrupt timer board is installed on the system. The spooling system allows full management of spooler queue files against multiple printers. Spooling makes it possible to print a file while also doing other computation.

User protection

The Utility command set provides commands for disc format and initialisation, disc or file copying, disc cataloguing, listing a BASIC file from disc with line number and format options, a TTYSET command for defining the screen operation and the ability for the user to build his own commands and treat them as part of the system structure. FLEX also allows user protection of a password against disc files. Two or more files can be APPENDed together.

The command NEWDISC is used to format and initialise a new diskette, which takes about five minutes. The ESC key on the keyboard is used to hold and release scrolling.

The user can build his own STARTUP command file, which will automatically be used on booting the system, to take him straight into the BASIC interpreter or any other system or user program.

TSC BASIC

The TSC BASIC interpreter is similar to the FDOS BASIC interpreter but has better file-handling and variable handling capabilities. Files may be straight sequential or record-orientated random-access files. Records are 252 bytes in length (FLEX uses the other four bytes), and may be manipulated by GET and PUT statements and mapped by FIELD statements.

All random files have information stored in string format, with a variable using four bytes of file space and being converted by the use of the command CUT$F and CUTF$, for converting a string representation to a floating-point variable and *vice versa*.

Line numbers may be 1-32767 and multi-line statements may be used. Variable names are A,AA-Z,ZZ and the same 8 range for strings. Program error trapping is provided as for FDOS. The BASIC will also allow user-defined assembly-language sub-routines.

Fast run

The BASIC source can be run or COMPILED to give an object code program that occupies less disc storage. This is not a true compiler but it does speed up the loading and running of a program.

The simple benchmark for J = 1 to 1000, NEXT I, took half a second under TSC BASIC, which makes it one of the fastest BASIC interpreters on the market.

Text Processor

A TSC Text Processing system is provided to run under FLEX, which contains the following facilities:

- ☐ Page sizing.
- ☐ Margin setting and justification.
- ☐ Test filing, adjusting and centering.
- ☐ Spacing and indenting, tabs.
- ☐ Capitals or lower case switching.
- ☐ Height and width of printed output, depending on the type of printer used.
- ☐ Insertion and deletion and movement within a text file.
- ☐ Macro definitions.

The macro definitions can be used to define page headings or footings or as full-form letters or documents. Up to 3.5K bytes of macro definitions can be stored within the sysstem as part of the text processor. The macro definitions and commands of the text processor offer most commands that are common to text processors and go some way towards providing the sort of structure that is found in simple word-processors.

Sort/merge

Finally, the MSI System 7 software includes a Sort/Merge package for use under SDOS or FLEX. The Sort allows up to 20 input keys, defined as ascending or descending, left-justified or right-justified keys. The utilities comprise four programs which are run by the user through the keyboard, but at present cannot be accessed directly by a user-written program.

Documentation

The documentation provided is extensive and of a high standard, and the only piece missing was for the VDU. The MSI operations manuals explain the machine right down to individual wiring diagrams and includes a parts breakdown. Each operating system has its own set of manuals, most including assembly listings of utilities and command structures. They provide a good introduction to the beginner, yet are comprehensive enough for the curious to understand how the system operates in detail.

Conclusions

- **The MSI System 7 is part of an expandable range of machines, starting at a minimum disc storage of 630K bytes and increasing to over 40 MBytes.**
- **The basic software provided between the three operating systems is extensive and, in the main, quite good.**
- **The user can choose the operating system to fit his demands, and if he wishes can develop interpretive programs and translate to a compiled version to obtain run-time benefits.**
- **The system is fairly straightforward to use and the documentation is of a high standard.**
- **The hardware is robust and comes from a tried and tested manufacturer.**
- **The system provides a direct upgrade for users of the MSI 6800 systems, with compatible software.**
- **The ability to have multiple file opening and random access files lends itself to commercial applications.**
- **The screen and keyboard are quite good.**
- **The level of the BASICs provided is almost up to mini-computer standard.**
- **The TSC BASIC interpreter is very fast.**
- **At the price of a basic system, the MSI System 7 is moving away from the hobbyist and is aimed very much at the commercial user, but it is restricted to a single-user system.**
- **The inclusion of all three operating systems in the basic price makes the system expensive and perhaps confusing for the user who only requires one of them.**
- **The memory cannot yet be extended beyond 56K bytes.**
- **Disc copying under SDOS is very slow.**

Here's looking at you, kid

Industry bleats about the shortage of programmers and yet it can be a hard slog for the newcomer to find a first job. In this article Duncan Scot looks at training schemes, talks to the students and finds out which qualifications make up for lack of experience.

EVERY WEEK the computer newspapers are packed with advertisements for experienced computer programmers, reflecting a world-wide shortage of this valuable commodity. The exact shortage in the UK is already the subject of two wide-ranging Government-and industry-commissioned surveys, at Warwick and Sussex Universities.

Derek Potts, training advisor at BIS applied systems, a company which trains computer professionals for industry, believes that the problem can only get worse. "As far as we can tell, there is a shortage of something like 25,000, split fairly evenly between systems analysts and programmers. But if we look forward two or three years, the figure could easily be 70,000. Maybe much greater."

Despite the shortage, the newcomer to the industry finds few openings. "The only way out of the problem is through self-generation. Companies must be willing to take the plunge and bring in raw trainees. They often say that it takes far too long to train a programmer, something like 12-18 months, and then they leave to find a better job. But the point is that companies simply cannot afford not to train their own staff. Too many projects are already being delayed or abandoned because the skill is not there. The overall effect has not been costed but I would guess that it is very expensive," continued Mr Potts.

"If we are lucky, we will see a sensible and steady rise in the number of companies with their own training programs but I suspect that the industry will wait until the last possible moment and then whine and bleat about the problem."

Rapid promotion

In the meantime, there are tremendous opportunities for those who can find a way into the profession in which they can command substantial salaries and expect rapid promotion.

Employers will always be guided by qualifications and experience. If the qualifications include some practical training, so much the better.

There have been some attempts to create specialist computing qualifications, many of which have involved George Penney, careers project manager at the National Computing Centre (NCC), in Manchester. "In the last ten years we have tried again and again to introduce standards which industry will recognize. Before 1968 City and Guilds, The Royal Society for Arts (RSA), the Scottish Council for Commercial Administrative and Professional Education (SCCAPE), the British Computer Society (BCS) and the NCC were all offering qualifications in some discipline of computing."

Move over, oldsters! Only 14 and he doesn't even know computing is difficult!

It was felt that these qualifications would be more widely recognised if the proliferation of different standards could be avoided, and in 1968 the UK Co-ordinating Committee for Examinations in Computer Studies was formed. The aim was to ensure that the recognised qualifications were jointly certified by the committee.

"City and Guilds assumed the prime responsibility for programmers with the well-known City and Guilds 746 Basic Certificate in Programming, the RSA for computer operators and the NCC, jointly with the BCS, for Systems Analysis. SCCAPE agreed to use all the same standards in Scotland."

Meanwhile the Department of Educations and Science appointed the Haslegrave Committee to study all sub-degree qualifications, excluding O and A levels. Haslegrave recommended the establishment of two committees, the Business Education Council (BEC), and the Technical Education Council (TEC) and that a joint BEC/TEC committee should be formed for computer studies. This joint committee was eventually formed in 1978.

The courses made available under the new BEC/TEC sylabus include:

- ☐ The National Certificate in Computer Studies
- ☐ The National Diploma in Computer Studies
- ☐ The Higher National Certificate in Computer Studies (HNC)
- ☐ The Higher National Diploma in Computer Studies (HND)

The City and Guilds course and the National and Higher awards can be taken at Colleges of Further and Higher Education, while the Higher awards and degree courses can be taken at Polytechnics. Degree courses normally demand passes in an HNC, HND or two to three A levels.

The entry requirements for the national level course are 4 O levels or a pass in the City and Guilds course. At the higher national level an A level is also required. Anyone over 19, however, can be admitted without the minimum qualifications at the discretion of a college principal.

Although there have been long delays in establishing the BEC/TEC courses, George Penney believes that they will have a significant role to play. "They are essentially practical courses; they give the student hands-on experience with computers. They should also give a good grounding in business practice."

Hidden talent

George Penney is also the Director of the Threshold Scheme for Computer Programmers, organized by the NCC to help school leavers find a way into computing. The scheme is open to anyone aged 16-19 and within two years of leaving school, or is unemployed, or in a dead-end job. Trainees are accepted on the basis of aptitude tests and interviews and receive a weekly allowance of £23 for the duration of the course.

"We are not going to solve the shortage of programmers with this scheme overnight, but we are showing that many people who have failed in the stakes for qualifications can make very good programmers. What we have done is to

George Penney, (right) Threshold scheme director at the NCC, with two Threshold students.

discover hidden talent." The course alternates between classroom training and work in commercial computer departments. At the end of the 42 week course, the NCC helps the trainees to find a job.

Hélène Feyfant joined the Threshold Scheme at the South-East London College of Further Education at the end of October 1979. Now 18, Hélène came to London, from France, about two years ago and has since taken two O levels and an A level in her spare time. She was working as a sales assistant in a china shop in central London when she read an article about Threshold and wrote to the NCC. Her aptitude test was organized within a matter of days.

"The course was terribly disorganized at first," she told me. "The teacher stuck to the manual for the course and nobody could understand all the technical language. And a few of us felt that there wasn't enough programming. It would have been a good idea if there had been some sort of general introduction to tell us what the course was going to include. The whole of the first week was a waste of time. The teacher realized that we weren't getting anywhere and started again."

Most of the trainees on this course had not realised that as much time would be spent learning about business practice as they would programming. It was the first time that the college ran the course; it was still trying to find the right teaching 'mix' for these students.

In the 1979/80 academic year, there will be over 1200 trainees under Threshold, spread out over 30 colleges around the UK. On past record, about 10% will drop out, either through incompetence or boredom and another 30% will accept computing jobs during the training period. These are regarded as a success for the Scheme. The remainder normally have no problems in finding a relevant job within two to three months of finishing, although some have to accept positions as computer operators and then work for promotion to programming. This usually takes between 12 and 18 months. But, as Hélène pointed out, "The course might not work perfectly but we would have found it very difficult otherwise."

An NCC report reflects this view. "There can be little doubt that most of the young people who benefit from this course would not have found any other way to escape the drudgery of work quite inappropriate to their level of ability. The social benefit of this alone can hardly be overestimated."

Private contracts

A similar scheme, TOPS, for those who are over 19 and who have been away from full-time study for at least three years, is run by Manpower Services Commission. Most of the training is contracted to private companies with computer departments or commercial training schools which are paid directly by the Commission. In 1979/80 over 3600 are expected to complete the course, of which at least 90% find relevant jobs within a couple of months.

Chris Nelson at BOC Data Solve, in London, is, at 30, one of the oldest TOPS trainees. He is also unusual in that he had a fair bit of contact with computers before he was accepted. "I spent a year as a computer operator but it was very boring and there were no opportunities to become a programmer, even as a trainee. I then spent another five years as a clerical assistant in a university computer department and there was still no way into programming."

Chris visited his local job centre which told him about the TOPS Scheme and got him an interview with the training school at BOC Data Solve.

"If you pass the aptitude test, they want to make sure that you know what the job entails and that a lot of the work can be boring."

As an employer of computer programmers, BOC Datasolve has been impressed by the standard of the TOPS trainees. The training manager, Mrs Janes, commented: "It has been a real eye-opener for us. It could mean that we will start to rethink some of our own recruitment policies.

"I know of three companies which have now abandoned graduate recruitment in favour of TOPS. The TOPS trainees' expectations are more in line with reality; they tend to be more mature and to have had some experience in business. They also have personal qualities and experience which tend towards greater stability;

they are more suited to supervising other people's work and, being older, find it easier to command respect. Graduates often become disenchanted very quickly."

The course at BOC includes an introduction to computing, COBOL programming and problem-solving practice. At the end of the 14 weeks, trainees are given advice on self-presentation and interview techniques to help them find jobs.

Outside the TOPS and Threshold Schemes the widest range of opportunities for studying computing lie within our system of higher education, where the new BEC/TEC HND is already proving itself popular. The largest course in the country is run by Professor Derek Wilson at the Polytechnic of Central London (PCL). "It is a good commercially biased course which looks like becoming more and more popular. There are so many applicants we may have to start advising qualified students to apply elsewhere.

No trouble

"Most students who pass their HND have no difficulty is finding a job. Their starting salaries vary a great deal but I would guess that with the HND a student will be able to earn about a £1000 a year more than a computer science graduate. They learn more about business practice and have practical experience of programming. About 90% of the HNDs go straight into a job; some of the others stay on for a degree course."

The HND acts as an entry qualification into the second year of a degree course, at the Polytechnics. One degree course at PCL is the BSc in Science. It is a modular course which allows students to concentrate on commercial computing, science computing or hardware design. In many respects it is very similar to a computing science course at a university.

Professor Wilson believes that all the courses could be expanded if local education athorities, which fund colleges and Polytechnics, appreciated the demand for computer professionals. "There is no shortage of willing applicants; there is just a chronic shortage of hardware. Heads of Department can only spend up to £400 on their own initiative. Anything more has to be approved by the local education authority. If an item will cost more than £10,000, it has to be referred to the Department of Education and Science. It is a very cumbersome process and just doesn't work. Even in the third year of the degree course, it is not worth trying to write a serious program with the equipment we have at the moment."

Academic bias

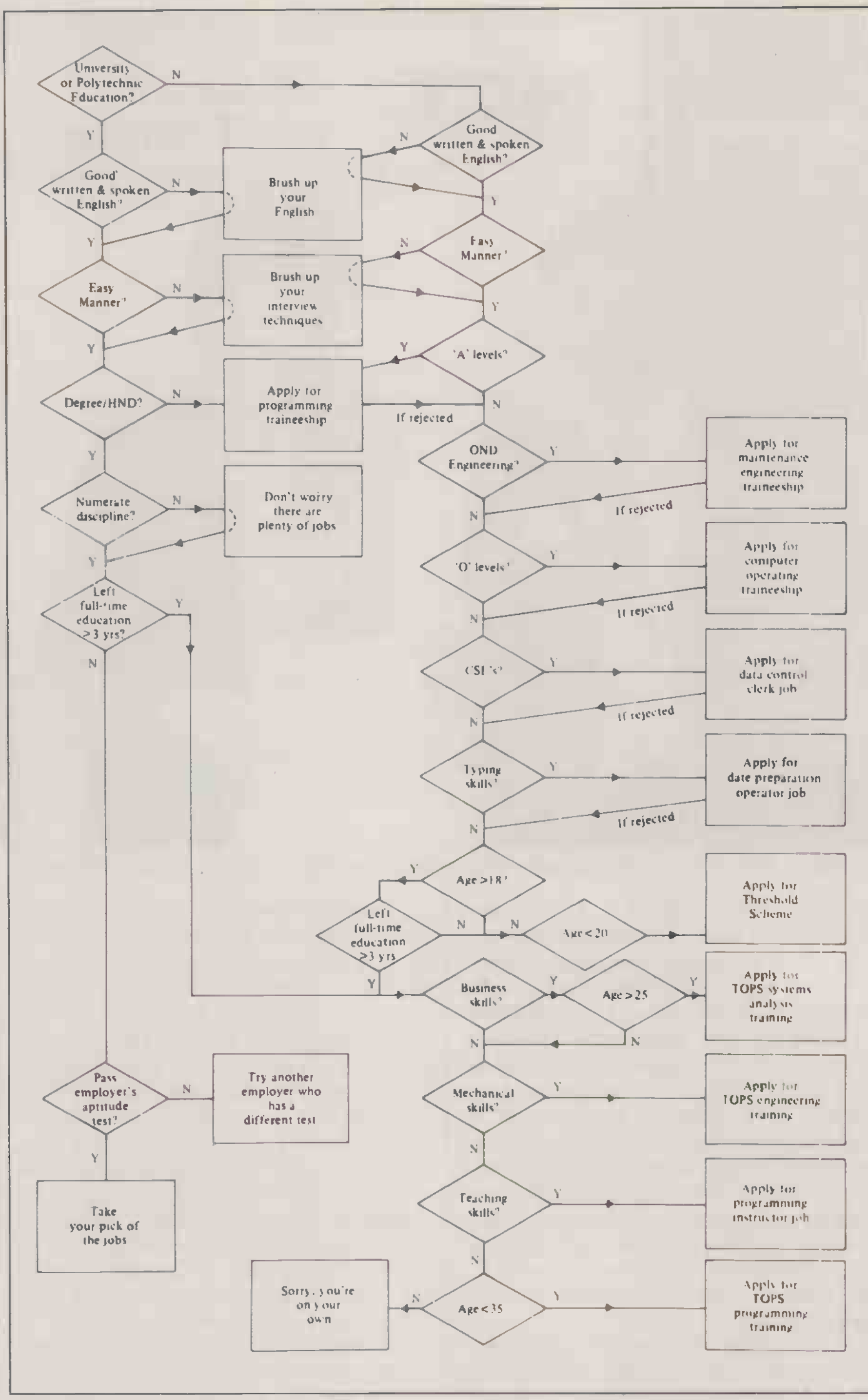
The university sector has escaped this stranglehold. In 1966 the Government established a separately-funded University Computer Board to meet computing requirements.

But university courses are often criticised for their lack of relevance to industry. Derek Potts, at BIS Applied Systems, commented: "There is far too much bias towards the academic and not enough towards industry. I remember seeing one class which was learning how to program the flight path of a satellite. Most programming has to be far more down-to-earth. We should be trying to teach the hardcore, necessary skills and spend less time on the marginal projects."

Some universities, however, notably Brunel, Salford and Loughborough now run four year sandwich courses. One year is spent working with industry.

Don't give up

Wlith such a wide range of different computing qualifications, one problem for an aspiring programmer is to decide when to stop studying and when to look for an employer. Virtually every large company, and many smaller ones, have their own computer department and yet they will all have different requirements. As George Penney recommends: "Don't give up until you have tried every company in your area."



Reproduced from *A Career in Computing* by George Penney

Civil Service

Of all the major employers, the Civil Service, with over 16,000 staff directly involved with data processing, is undoubtedly the largest. With the prospect of earning up to £5730 within three years

Jackie Janes, training manager at BOC Datasolve. "I know of three companies which have now abandoned graduate recruitment in favour of TOPS."

Chris Nelson, TOPS trainee: "They want to make sure that you know that a lot of the work can be boring."

of entry, it can be an attractive proposition. Nigel East, of the Civil Service Commission, explained the entry procedure.

"Most of our programmers enter the service as Executive Officers. We ask for at least 2 A levels and 3 O levels, one of which must be English. There is also an aptitude test for every entry at this grade and a second, more specialised, one for programmers."

Although the Civil Service is one of the few employers to accept raw recruits, it is still short of programmers. "We have advertised for programmers, held open days at schools and we have also extended our age limit from 28 to 45. We will have to wait and see how much of an effect this has, since it is a very young profession."

The Civil Service claims to have one of the most professional training programs. Once accepted and allocated to a department, the trainee is introduced to the installation and projects on which he will work and then is sent on a formal course in programming. The trainee then returns to his department to practice his skills until competent enough to join a programming team.

"The training doesn't end as soon as comeone is proficient, or a good working member of a team. We encourage them to carry on developing their abilities: within five years it is possible to reach the highest professional standards," says Mr East.

One can also enter the Civil Service as a clerical assistant, with two O levels. There are plenty of opportunities for promotion to Executive Officer, through internal examinations.

Make an effort

It is not so easy to specify the general rules of recruitment in commercial companies. Some, such as British Airways, recruit up to fifty trainees each year, but the vast majority are graduates. Other companies are more willing to recognise the potential in less qualified applicants.

Employers will tend to be impressed by some evidence that an applicant has made an effort to learn something by himself, perhaps through a part-time course at a college. Despite some of the difficulties in finding that first job in computing, the attractions of the work should ensure a ready supply of applicants, although the responsibility will ultimately fall to industry to meet its own requirements with in-house training schemes.

The salaries offered to programming staff continue to rise and juniors can still expect a rapid promotion. As a general guide, programmers can expect to earn the following:—

Junior Programmers	£3600 to £4800
Programmers	£4600 to £5800
Senior Programmers	£5600 to £7000

The salaries offered, however, vary widely and overtime, to meet a project deadline, can often add considerably to total earnings.

It has often been argued that the shortage of computer programmers may prove a limit on the explosive growth of the computer industry but the speed with which the microcomputer has swept into new markets may give the lie to the claim.

There is now a small army of self-taught programmers and new companies have emerged whose requirements are enthusiasm and willingness to learn, not qualifications. Whichever way is chosen, the opportunities do exist for anyone with native ability and enough determination.

Contact addresses

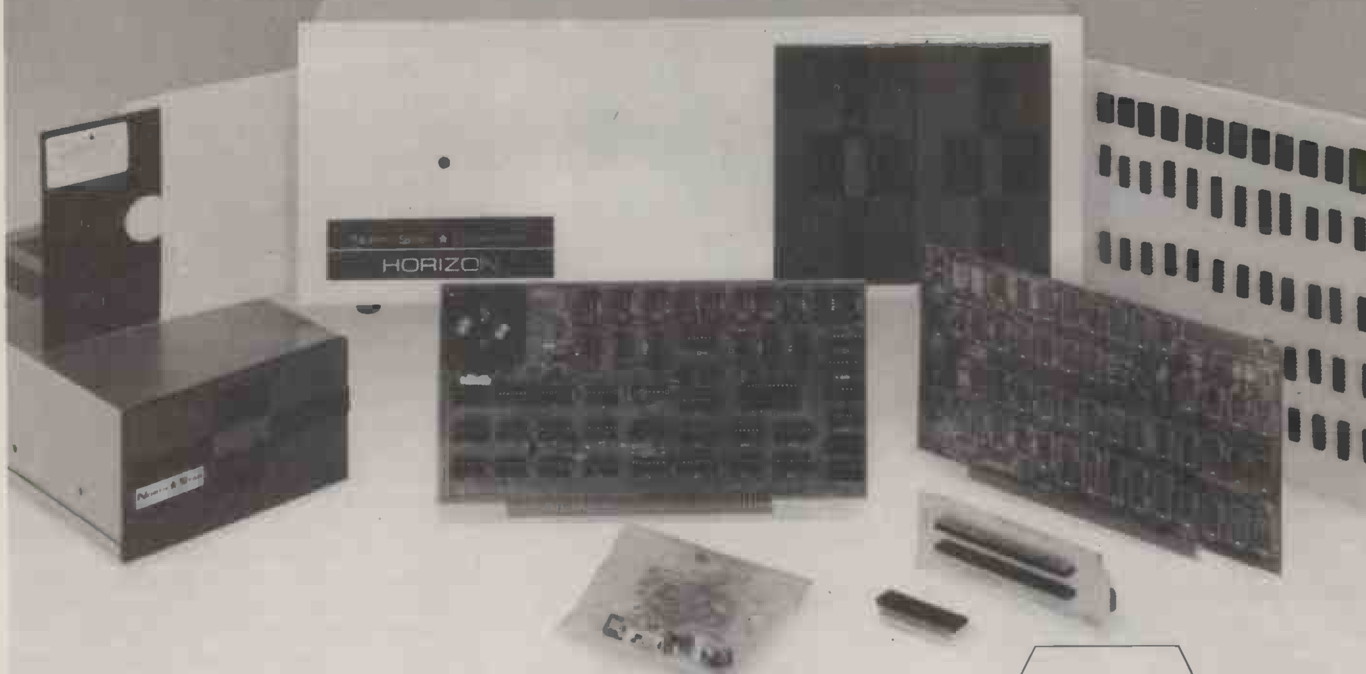
The Threshold Administrator,
National Computing Centre,
Oxford Road,
Manchester M1 7ED.

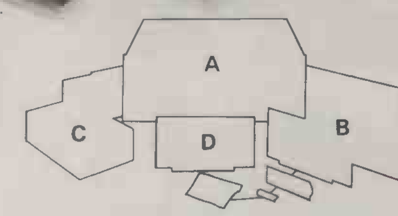
The Civil Service Commission,
Basingstoke,
Hampshire RG21 1JB.

Applicants for the TOPS Scheme should contact their local Job Centre.

comart

...the specialists





The complete range of North Star computer products in both kit and assembled form is offered by Comart: The Horizon computer, the Microdisk System, memory and floating point arithmetic board. And, Comart being S100 specialists, other items from our computer catalogue may be easily added to meet your requirements.

Teaching, Research, Engineering and Commerce .... each field has applications where this state-of-the-art technology provides cost effective processing of immediate benefit.

Comart quality. Each assembled module is final-tested by our own engineers. Take delivery of a computer system – plug in a wide variety of peripherals and use it.

Attractive prices, good delivery and a choice of Comart's factory repair or on-site service with a Computer Field Maintenance contract make the acquisition of a Comart computer a safe decision.

Find out more – ask us for the Comart catalogue of Computers.

The North Star dual drive double-density Horizon computer **A** together with a typical kit product **B**, the Microdisk system drive **C** and hardware floating point board **D**.

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 SYSTEMS**, Newport, Gwent (0633) 50528
NOTTINGHAM	**COMPUTERLAND LIMITED**, Nottingham (0602) 40576
	also at Birmingham (021 622) 7149
	Manchester 061-236 4737
	Glasgow (041 332) 2468
SHEFFIELD	**HALLAM COMPUTER SYSTEMS**, Sheffield (0742) 663125
SOUTHAMPTON	**XITAN SYSTEMS LIMITED**, Southampton (0703) 38740

c m

comart specialists in microcomputers

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

• **Circle No. 165**

How to keep the pirates at bay

All hands on deck to repel rip-offs! Peter Sommer explains how, in the absence of clear rules on computer copyright, you must arm yourself for the fight or be jolly well rogered.

WHAT CAN YOU DO to prevent unauthorised use of your original software? How far does the English law of copyright protect the work of programmers? What machinery exists for enforcing copyright claims?

You're writing a program, but borrowing freely from the work of others — after all no-one expects to solve every problem by starting each time at the beginning: at what point do you start to risk breaching someone else's copyright? When do your activities cease to be creative adaptation and start to be mere copying?

The need to devise clearer protection for writers of software has now become urgent. The Copyright Act, 1956, is the most recent item of relevant legislation and not surprisingly makes no mention of computers of software. What reliance programmers can have on it is achieved by tortuous analogy.

Until the growth of personal computing, however, no one worried much about the situation because software writers would expect to have physical control over the use of their product.

Software, you will remember, was highly dedicated to a particular mainframe or mini and the needs of the large organisation that was the end user — it was sold merely as one constituent of a complex hardware/software/service contract.

Over the past two years all this has changed:

- ☐ We now have a number of very cheap universal machines with resident programming languages.
- ☐ With them has grown the market for the development of non-dedicated general-purpose software to cover basic commercial requirements and home entertainment.
- ☐ Program copying is child's play.
- ☐ The market size has reached the point where informal policing is becoming very difficult.

Just as copyright law for print became necessary once mass-produced books and pamphlets enjoyed affordable currency — the first English attempt dates from 1709 — the stage has now arrived where clear unambiguous protection for software is essential.

Such a requirement is necessary not only for writers, but also for their customers.

These pages have carried frequent criticism of the poor quality of some microsoftware. The point is that until adequate rewards and the related safeguards exist, few of our better programmers will have the confidence to spend much time preparing material for the micro market — and that will make us all poorer.

What follows isn't a fault-free guide — the Copyright Act is open to criticism even in its current provisions. Rather, I've tried to explain the main aims and concepts involved in a good working copyright system.

One of the problems faced today by software writers enquiring about copyright protection is that few lawyers understand how a program gets written and what it consists of. Armed with some idea of what copyright law seeks to achieve, you should at least be able to ask legal advisors the right questions.

More importantly, there *are* plans to reform the Copyright Acts; indeed a DTI Report of three years ago spent a great deal of time examining the problems of software copyright.

The trouble is that the technology and the market have moved on since then. Insofar as the new Copyright Bills will be topics of public debate, it is essential that those active in the business should be able to participate effectively.

Definitions

The purpose of copyright law, like its close relatives relating to patents and registered marks, is to give protection to intellectual property in much the same way as other sections of the law look after personal property and land.

The problem is, how do you define the unique qualities of one particular item of intellectual property? Clearly there is no problem with a traditional artistic work but the further you edge towards pure ideas, particularly those that may find expression in a physical form, you run into difficulty. Remember, too, that most classes of intellectual property tend to have been developed from clear antecedents — improvements are far more common than completely original work.

There are two ways of tackling the problem. The first is by *registration*. Here, it is up to the inventor/devisor to draw up a definition of what he wants protected, satisfy the appropriate authorities of the unique quality of his product, and then to obtain a formal document to that effect. This is the approach used in patent law.

The second is a *post hoc* form of recognition. Here the law recognises, prima facie, that an 'original work' has come into being as a result of the skill and effort of the creator, and automatically confers protection.

But whereas once a patent is conferred, it is very difficult for someone to challenge its originality, in a copyright proceeding, everything about an original creator's claim can be reviewed by the courts. The Copyright approach, as distinct to the Patent scheme, has the merits of informality and ease of application and the disadvantage of uncertainty.

The copyright approach

The essence of the copyright protection is that labour, skill and capital must have been expended sufficiently to give the product some quality or character which the raw material did not possess and which differentiates the product from the raw material. The way it is defined in the 1956 Act is as follows:

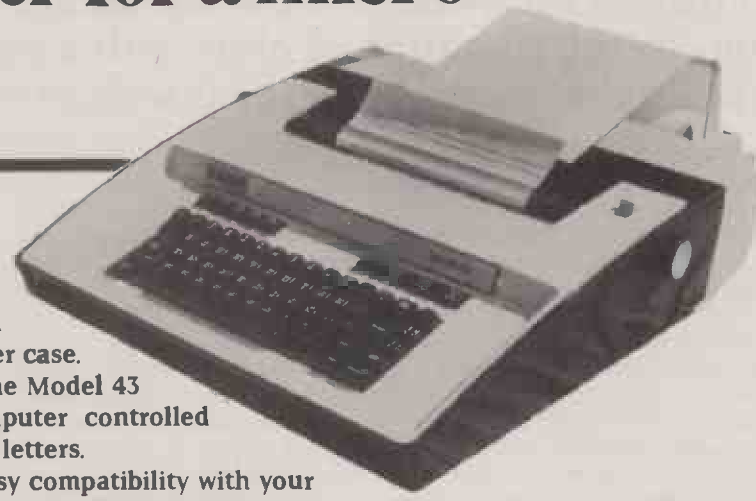
> 1(1) In this Act "copyright" in relation to a work (except where the context otherwise implies) means the exclusive right . . .to do, and authorise other persons to do, certain acts in relation to that work . . .
>
> (2) In accordance with the preceding subsection, but subject to the following provisions of this Act, the copyright in a work is infringed by any person who, not being the owner of the copyright, and without the license of the owner thereof, does, or authorises another person to do, any of the said acts in relation to the work . . .

What these 'certain acts' are depends on the nature of the original work. The set of possible forms of exploitation arising from a sculpture are quite different from those arising out of a novel. The Act makes a broad (and not very satisfactory) distinction between primary works, eg literary, dramatic, musical and artistic works, and secondary ones, eg sound recordings, cinematograph films, television broadcasts, and published editions.

In fact, it is much easier to understand copyright as a bundle of rights for which protection may be sought. A novel may be published as a printed edition and finally translated into a movie. The original author's bundle of rights may include payment for each printed copy sold and a percentage of the profits (or box office takings) of the movie. But on the way, other people will have acquired rights too — the book publisher in respect of his

continued over

How do you combine a typewriter with an output printer for a micro computer?



Simple — with a Kode Model 43 friction and tractor feed teleprinter! This reliable 10 or 30 c.p.s. machine has a 9 wire matrix printhead for exceptional print quality with true descenders on lower case. When used with single sheets of paper, the Model 43 provides an excellent keyboard or computer controlled typewriter for special reports, invoices or letters. The useful range of interfaces ensures easy compatibility with your microcomputer, and when supplied with tractor-fed fanfold paper, the Model 43 becomes a superb output printer. Two machines in one proven package — at a real value-for-money price. Contact Kode for more information now.

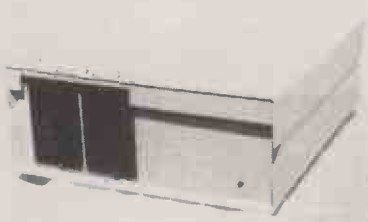
WITH A TELETYPE 43 FROM KODE

Station Road, Calne, Wiltshire SN11 0JR.
Telephone Calne (0249) 813771. Telex 449335

• Circle No. 166

SIRTON PRODUCTS (SP)

13 WARWICK ROAD
COULSDON
SURREY Tel: 01-660 5617



MIDAS S100 SYSTEMS

Substantial Mainframe to house your S100 system, with optional 5in. or 8in. disc drives. Special systems built to your requirements from Z-80 CPU and other S100 boards held in stock.

Mainframes from £228
MIDAS 1 : Z-80 System from £625 (built)
MIDAS 2 : Z-80 5in. Disc System from £1,100 (built).
MIDAS 3 : Z-80 8in. Disc System from £1,300 (built).

ITHACA INTERSYSTEMS DPS 1

Professional versatile computer system with comprehensive front-panel facilities and 20-slot motherboard. Units have substantial power supply etc. and come with 2 or 4 MHz Z-80 CPU. BUS conforms to the IEEE S100 standard.
DPS.1 from £695

COMPREHENSIVE RANGE OF S100 BOARDS AND SOFTWARE STOCKED

from

ITHACA INTERSYSTEMS · S D SYSTEMS · GODBOUT · CROMEMCO · ECT · SSM · Etc

Write or Phone for Catalogue

• Circle No. 167

continued from page 65

edition (and also copyright for the typographic arrangemnet of the printed words on the page), and a whole host of film people — script writers, directors, products, actors and financiers, may all have rights of some sort in the final movie product.

Limits on copyright

How far do these rights extend? Well, the principal claim to have circumvented copyright depends on demonstrating that your own subsequent work is sufficiently far adapted from the original for you in turn to satisfy the courts that you have created an original work.

Falling short of that, however, are a number of other provisions, the most important of which is to show that you have made 'fair dealing' use of the copyright material — and that is all. 'Fair dealing' has to be for the purposes of research or private study, criticism or review. The definitions have no precise measure — most book publishers will let you quote the odd paragraph or so without expecting payment, but they will look at all the circumstances — the compiler of an anthology consisting of no more than odd paragraphs from other books will be treated less sympathetically than the writer of a major critical work. Special provisions exist for 'fair dealing' in a specifically educational context.

The other main limit on the extent of copyright is time — for example, fifty years after the death of an author, all his works published in his lifetime pass into public domain.

Remedies

What does the law do to help you enforce these rights? Let it be said that the vast majority of copyright cases are settled according to various informal codes of conduct created within the industries affected — for instance, the one backed by the Publisher's Association and the Society of Author's; and for the rest, out-of-court settlement is the rule.

The penalties the Copyright Act itself supplies are:

- ☐ Damages for infringement.
- ☐ An account of profits, so that both sides can see how much the infringement has actually been worth to the offender.
- ☐ Delivery of infringing copies (and, if necessary) ultimate destruction.
- ☐ An injunction to prevent distribution and sale of items in dispute.
- ☐ If the original work has been supplied as a result of a licensing agreement to the offending party, there could also be an action for breach of contract.

Application

So much for general principles. The user of the British Copyright Act, 1956, faces two main difficulties. In the first place, it's something of a draftsman's nightmare. Whereas the West German act tends to start off with a series of wide definitions as to what is being protected, you have to clamber over the British Act, which works by detail rather than general principle. This is what the Whitford Committee (about which more later) said three years ago:

> The present system of definition has been said to be inexplicable even to the extent to which it is comprehensible. Literary works, a description which includes works which no ordinary person would define as literature, dealt with in Section 2 of the Act, are partially defined in Section 48. Section 48 is a general definition Section, but when we come to artistic works we find that 'artistic works' has, according to Section 48, the meaning assigned to it by Section 3. Section 3, while expressly excluding any consideration of artistic quality in relation to, for example, paintings and drawings, includes among artistic works the category 'works of artistic craftsmanship' the exact extent of which has led to a notable division of judicial opinion. An enquirer, finding in Section 48 a definition of artistic works which refers him back to Section 3, might conclude that Section 48 has nothing more to teach him about artistic works. He would be wrong. Section 3, by definition, brings sculptures, drawings, engravings and photographs within the category of artistic works. Each of these sub-categories is in fact further defined in Section 48. To take one example, 'drawing' is said to include 'any diagram, map, chart, or plan'. On the basis of this definition engineering drawings have been held by the courts to be 'artistic works'. A 'musical work' (perhaps inevitably) is nowhere defined . . .

The second problem is the one referred to right at the beginning — there's no mention anywhere in the Act of computers or software. The general view is that the existing category closest to the software program is 'literary work' — but there are formidable problems in making this analogy operate.

Software

The first set of problems are raised by the forms in which computer programs can exist. A 'literary work' usually implies a collection of set-down words. Well, does this mean that software only gets protection if it is expressed in listing form? What about punched cards or tape — couldn't the hole be regarded as a form of writing/printing? The commonsense view is that such an approach is far too limited — at the very least any effective copyright protection has to extend to software on magnetic tape or discs.

But this would still leave the problem of the ROM, PROM, and EPROM, to say nothing of the bubble memory. Surely such essentials as high-level languages and character generators should be able to secure protection. And, once we get away from the computer pure and simple, what happens to all those dedicated PROMS that govern industrial processes without the supervision of a keyboard and VDU?

- ☐ Is programming not merely the application of maths formulae, which after all are in the public domain? Well, I don't think so; it's the way in which the formulae are applied and the neatness and convenience of presentation that gives a program a special quality.
- ☐ What happens if (as is usual for beginners) you're writing in a proprietary high-level language, the documentation for which explains all the routines you're actually going to use in your program? Well, again, you're all right, because your input to the final product results in a more than sufficient change to the raw materials.
- ☐ You're writing a fairly complicated program, but in order to assemble it you've borrowed certain sub-routines or modules that you've admired in other applications, say, a sort routine, or a method of displaying results, or a particular group of graphics. In a 'literary work', the position is clear: quotations aren't allowed without acknowledgement and payment. But at what stage does a sort routine cease to be common-or-garden public domain stuff and staret to be someone's original creation?
- ☐ You're reworking a well-tried program. The application is a common one, but, as you examine it, you think, maybe you could find a neater way of achieving the same result — faster and with less occupancy of memory space. Where do you stand? Answer: it all depends . . .
- ☐ You've got another well-tried program. This time you merely remove the REM lines, delete a couple of sub-routines that won't be needed by your end-user and stick in a couple of new ones, though nothing very clever. Is the program now your copyright or the guy from whom you pinched the original?
- ☐ You've yet another well-tried program. This time your aim is limited merely to adapting it from one machine to another. Maybe it's a change of dialect, say from PET Basic to APPLE Basic. Or if it's in machine code, from 6502 to Z80. Maybe both you and the original programmer should share the honours, but who knows?
- ☐ Your program relied on an input of data. Maybe the data is already in a digital form, or perhaps it comes from an on-line source, or Viewdata. Perhaps you have to keystroke it from a newspaper listing. We know that copyright can subsist in listings of data (on the basis that it needed work to assemble it in the first place), but what happens if your program changes the presentation (and hence possibly the value) of the original data? Even if you agree to a shared copyright, who agrees as to the proportions of the respective contributions?

continued over

continued from page 67

- You are an on-line retrieval system bureau. A client wants some information and you provide an answer by calling up two or three of your source computers. You don't actually read the results, but get your intelligent terminal to carry out a keyword search of relevant items and then, using its resident word-processing power, it assembles a report from a series of paragraphs from the original on-line sources. Who is entitled to copyright?
- Your computer creates a new industrial design. You've fed it with criteria and specifications, but the final result isn't actually yours — or, for the purposes of copyright law, is it?

The trouble with all of these questions is that most of the answers are guesses. There's no certainty.

Enforcement

If you try to go to law, the first thought that must cross your mind is that there is a considerable danger that the lawyers and courts will be using your case to find out what the law actually says. Test cases are one of the mot expensive types to finance. There'd be no legal aid either.

There aren't even informal codes suggested by professional organisations, like the various publishers associations. Neither is there a Performing Rights Society. Either way, you're on your own.

The copyright notice

One of the commonest mistakes about copyright law is to believe that protection becomes available if you affix the right, notice, eg © Peter Sommer, 1980, or that there is some potent legal magic when you deposit your statutory copies at the British Museum.

In fact, this is not the case in English law, since copyright subsists as soon as the criteria of 'original work' are met, though most American legal systems do require a notice, and it is important for securing international protection under various International Conventions. Sticking a notice on a work though has two useful functions — it reminds users that the work isn't 'free' and it also tells them where to apply if they want permission to reproduce.

But where do you fix the notice on a piece of software? Can it be on line 20 as a REM, or should it appear as a PRINT statement on the VDU shortly after the first RUN command has been set up? Or shoudl you affix it to the outside of the cassette, on the label, or do you have to imprint it somehow on the first few centimeters of magnetic tape? Again, there are no clear answers.

Non-legal protection

Faced with all this uncertainty, what can you do to protect yourself? Some interesting *ad hoc* techniques have been developed. Some are commercial, some technical.

Customising. This is only possible on larger programs. Essentially you try and recreate the circumstances of a few years back when software was sold as part of a package. You don't ever sell the basic program — except perhaps to fellow software writers whom you know and trust — what you sell is, say, a stock control system for a specific High Stret company, tailored (usually by adapting a few PRINT lines to mention the company name and to cover the appropriate number of stock items) to the business's needs.

Often, of course, you'll be advising on the right hardware — micro, VDUs, disc drives, printers. That way you can have physical control over the fundamental software. If you are smart, you will also include in your supply contract a mere licence for the client to use the program. In the event of breach, you can then sue in contract law rather than copyright, a much easier matter.

Supply contract. You could try the licensing ploy on smaller programs too. You can make it a condition of sale that unauthorised copying does not take place. This will give you the benefit of suing for breach of contract.

But you would need to be able to prove to the court that a specific individual had been responsible for the copying. With a popular program in wide circulation, that might be difficult and if you wish to prevent someone selling your program, then you might find yourself forced back into copyright law.

Strategic pricing. This approach is one that may work best with cassettes. You have to have enough confidence to believe that a lot of people will want your software offering and that you will get your remuneration from lots of small royalties rather than a few biggish sums. What you do is to price your cassette or floppy at little more than the retail cost of the blank article. In other words, you make it scarcely worth the while of the pirate to copy.

For ths ploy to work, though, you need a popular product with a large potential audience, plus the ability to market to them in suitable quantity. Tricky, that. Alternatively you can aim to sell only a few very high-priced cassettes, possibly to clubs, knowing full well that each will be copied.

Fingerprinting. This is a technical device. Again, it works more readily on longer programs. What you do is insert the odd anodyne sub-routine. Nothing that would really get noticed unless you were examining the listing in detail, and nothing which takes up too much memory, but enough so that, if you believe an adapted version of your program is being offered on sale, you can look for the fingerprints . . .

Bombing. The idea here is either to arrange the program so that copying is difficult or that the whole thing collapses if it is used in an unauthorised way. You can make copying difficult in a machine code program by taking as your first step the decision to remap the memory of your micro, so that most of the space usually used by the keyboard and high-level language is taken away. Only the keys essential to manipulate the program are left, so that the owner can't execute a SAVE command.

Once you do this, though, you may find that your own task of duplicating your tapes and discs in order to sell them is that much more difficult. Program collapsing can be generated if the user introduces an 'illegal' entry. You may give the program a restricted list of acceptable entries or names. Or, and this is useful in many commercial programs, you may limit date entries to a specific and limited period.

When telesoftware — the sending of programs via Teletext or Viewdata — becomes a commercial reality, the supply houses are likely to achieve control of their use by ensuring that each loading down will carry 'acceptable' dates for only a short period, eg one month, so that customers are compelled to go back for a refresher. In this way the supply house will keep its revenue up.

The future

Such devices, though, are shaky substitutes for a real copyright law. In March 1977 the Whitford Committee *Copyright and Designs Law* was presented to Parliament. Whitford had some sensible suggestions to make about the forms in which computer copyright could be conferred and enforced and for anyone interested further in the subject, it is essential reading. However, three years ago the PROM wasn't an everyday object. Neither was the personal computer.

The DTI seems to feel proper reform of the law of Copyright will be a lengthy business. In view of criticisms of the workings of the existing Act (even in regard to conventional media) they would prefer to present a completely new Act before doing anything else.

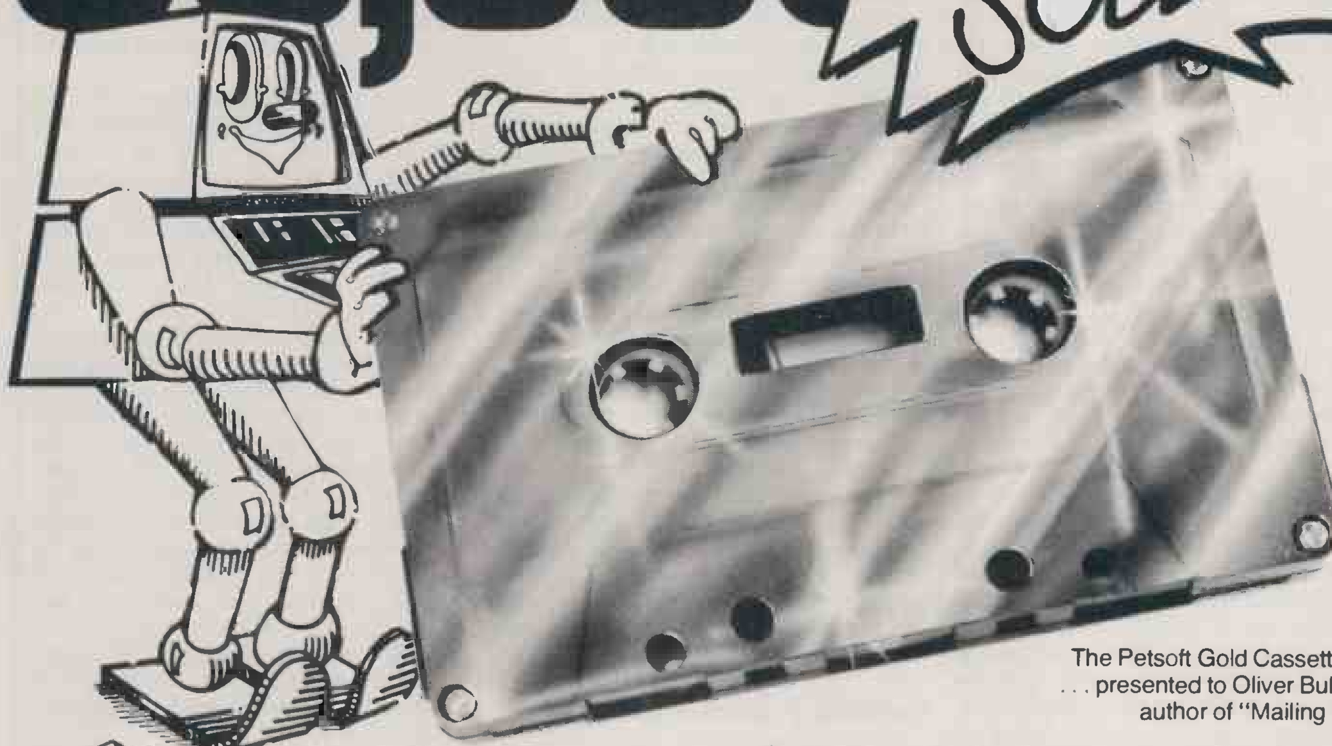
In the meantime a barrister, Mr Alistair Kelman, has drafted a bill to provide explicit protection for computer software; it even proposes to hve a retroactive effect. It looks as though Sir Keith Joseph may issue a Green Paper (consultative document) some time in the summer. It should make interesting reading, but I for one would like to see a greater sense of urgency about the whole matter.

Further reading

Copyright: Modern Law & Practice by P. F. Carter-Ruck and E. P. Skone-James (Faber).

Copyright and Designs Law (Whitford Committee) Cmnd 6732 (HMSO).

50,000TH PROGRAM SOLD!



The Petsoft Gold Cassette . . .
. . . presented to Oliver Bulmer,
author of "Mailing List"

60% OFF!

We celebrated by slashing Ledger systems prices by over **60%**:

SALES LEDGER ______ £95

PURCHASE LEDGER ______ £95

Developed by ACT, Britain's leading computing group, to run on a 32K PET with Anadex or Datac BD80 printers. Commodore Disk versions available price £115.

These systems provide full facilities for ledger maintenance, preparation of lists of outstanding balances, printing of statements and remittance advices. Full audit trail. Send for details.

PLUS

Disk Payroll £50 for up to 200 employees
Disk Stock Control £50 handling 2,500 stock items (Petsoft/CompuThink Disk) or 400 stock items (Commodore Disk)

AND

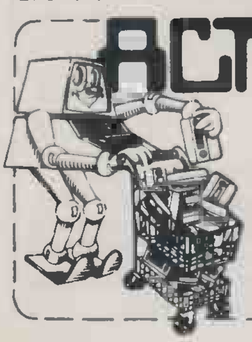
Mailing List £15	**VAT Pack** £17.50	**Microchess** £14
Word Processor £25	**Invoicing** £20	**Super Startrek** £8
PET BASIC Tutorial £15	**Forth** £30	**Eliza Doctor** £8
Assembler/Editor £25	**Statistics** £7	**Backgammon** 8

Prices exclude VAT. Credit card orders accepted by telephone. All programs available through your local PET dealer or direct from:

All prices correct at the time of going to Press.
PET is the trademark of Commodore

ACT Petsoft

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



Please rush me your latest catalogue of over 170 PET programs.

My name is ______

I live at ______

______ Postcode ______

I have a new/old ROM PET   I have NO PET

• **Circle No. 168**

Cyberkids

by Andrew Walker

HENRY UNERRINGLY touch-typed in a command on his qwertypad watching the characters being echoed back to his VDU, and waited for the system to respond. The pause was brief, the micro answering him first with the time and date:

13.33.21 hours 21 July 2022

then with the acknowledgement of his executed instruction:

LOADED: SEGMENT 3/1074
TITLE: "Mathematics"
SATELLITES 3,7,10: UNAVAILABLE

To the last symbol, the ampersand prompt, Henry added another few words before leaning back in his soft control chair which he then swivelled in order to face the general mêlée that almost always engulfed this room.

The walls of the nursery-cum-rehabilitation centre were a clean white — a miracle considering how long it had been since the Finance Committee had last bought a tin of paint — and here and there were a few scratched and somewhat faded nursery-rhyme and cartoon characters added for the sake of the youngsters.

Henry felt for the embedded panel in the right arm of the seat and pressed the appropriate button. Immediately nine microunits, satellites of the main system, placed circumferentially round the walls of the room, jumped into life, their audiboxes calling out the name of their allotted pupil. One child, seated next to his unit, answered the call by climbing up into his chair. The rest carried on as though nothing had happened — either they had not heard their call, which would hardly be surprising in the permanent din of the nursery, or were ignoring it, preferring to play on with their toys.

Spectacular gimmick

Henry had often complained about this and indeed many other faults of the system but persuading the designers to adapt it to the special requirements of the nursery was impossible. They just weren't interested. They were continually reaching for some new spectacular gimmick, some challenge to their egoistic intellect, instead of perfecting the functional aspect of their work.

He waited for a lull in the noise so that he could attract everyone's attention but the animation of the kids was such that there was not even the slightest drop in the level.

"Quiet everyone!" he finally shouted above it all.

Slowly the commotion began to subside until only the monotonous, unanswered callings of the audiboxes was left.

"Those who have a maths lesson now should go to your units."

Henry's order was greeted by moans and groans as the chosen few trudged to their respective micros — this always made Henry smile as he remembered, from various old manuscripts he had recently read, the optimism those early micro-pioneers had felt, way back in the 1970s and 80s, about the future of 'computer-aided instruction', as it had then been known.

They had enthused wildly about children's willingness to work with the . . . — what was the term they used? . . . "personal computer"! he finally remembered. Funny names they came up with, he thought. But of course they ignored or were blind to the parallel revolution in toys which greatly outweighed the relatively puny interest and addiction generated by the computer in education.

Paralline multichip

He watched as the maths pupils sat down and began to speak to their obsolete micro-units, obsolete that is everywhere except here. The Finance Committee were considering a modified system based on the pico but the perennial government cuts were hitting all things — the new system would probably be shelved — for the time being, at least, Henry envisaged a lot of pressure to get the pico-system intalled and the committee would, no doubt, finally relent — just in time to see it outmoded by the embryonic paralline multichip design. Then more pressure for the paralline to be used.

And so the penny-pinching circle continues.

Michael. Henry suddenly realised that he had not been to see his most special pupil in the privacy kiosk which the youngster now seemed to monopolise. He wondered what he was up to.

It was Penny who diverted him before he had even started out. Blonde, pig-tailed Penny with her wide blue eyes. Anyone hearing her soulful cry and seeing her flailing arm could not help but to have immense pity for her. Henry rushed over, keeping away from her windmill-like action.

"I can't stop it!" she wailed, tears rolling down her pale cheeks.

Henry put his hand in the limb's path and gripped it tightly. It jarred to a halt.

"Let's have a look inside, shall we?" he suggested.

Penny nodded, sniffling and brushing away the tears.

With a practised hand Henry rolled up her sleeve and quickly unhitched the offending article, revealing, on Penny's shoulder, the stub of what had once been her natural arm. None of the other children, disturbed at first by her sudden outburst but now having resumed their play, gave the 'scene' a second glance. Not for want of caring, though.

Henry peered intently into the concave joint of the false arm, taking great care not to damage the thin wires which were not the only link between the limb and its mistress. He could feel the organo-skin, that nearly perfect flesh-like tissue developed at the turn of the millenium, twitching in his hands — an eery feeling. Somewhere in that pico-chip housing he was looking at lay the fault that had caused Penny to lose control of her artificial arm, but he could see nothing.

"Let's see if we can get a nurse to take you to see the nice doctor, shall we?" he molly-coddled her, as he carefully replaced her limb.

As he picked her up in his paternally comforting arms she burst into tears again.

"Why, what is it Penny?" he asked. "There's nothing to cry about. The doctor will soon make you better."

"It's my arm," she sobbed. "Oh, you wouldn't understand . . ."

She cried on, hugging his broad shoulders.

I think I do, he thought to himself sadly.

Microcyberology interface

As luck would have it, there was no need to find a nurse. Passing the nursery at the very moment Henry stepped into the corridor with Penny in his strong arms was Dr Halliday, the hospital's leading figure in the microcyberology field.

"Hello Henry," he beamed. "Trouble?"

Henry explained the problem. Halliday nodded, his fair hair falling in front of his face.

"I'll take her downstairs," he said, brushing back the stray wisps. "I'll just get a wheelchair."

Microcyberology was not, of course, a new technology, as is shown by its 'micro' prefex. The microprocessor was rarely, if ever, used, though, in the second decade of the twenty-first century — it had long been superseded by the pico-chip.

The science — or art, if you prefer — of microcybersurgery, whereby 'intelligent' electronic devices can be interfaced to the central nervous system of a human, or indeed animal, body had grown out of the troubled late 1980s with the 'War for Work' campaign as its supporters had named it (now, over thirty years on, more commonly referred to as the 'Second Luddite Riots').

These disturbances were not unexpected, though, perhaps, a little underestimated. World-wide unemployment rose sharply as computer technology took over and lack of provision, due to governmental ignorance, for the radical sociological changes meant great hardship for the jobless millions. It was against this and not the silicon chip that the unions fought. Naturally those early marchers had become the puppets of militants from both ends of the political spectrum and the violence that followed caused the fall of several governments around the glob — and the death of thousands of people.

Whatever the results, however, the cause was undeniable. It was the insensibility not only of governments but also those early micro-pioneers, who lived in a 'Cloud 9' existence, happily bashing away on their qwertypads, playing games and predicting a panaceaic future for the world, a world full of micros, minis and even mainframes.

"Society's attitude to unemployment will change," they hackneyed. "With the micro the world will be a better place — more leisure-time for everyone, more efficient production, more education, better this, better that . . ."

Elitist jargoneers

Then they sat down and worried about and developed — more games! They did little to create the changed society that they promised. Micro-users came to be regarded as élitist jargoneers like the earlier hi-fi freaks with their amps, tweeters and woofers.

There were those, of course, who attempted and sometimes succeeded, in finding new applications — for both computer and silicon chip — like 3D X-ray machines, for example. But as ever funds were the problem. Governments were hard-pressed to meet the demands of the numerous late-century energy and economic crisis and the profit-conscious producers of chips and computers were too busy to set aside anything for the common good. 'Why should they,' they argued, 'it would be so unprofitable.' They were too busy taking the money of an all consuming society.

The Riots eventually put a stop to that — to a degree. The micro-magnates were finally forced to realise their responsibilities. Micro-pioneers at last became aware of the public's need for their expertise. Thus began the 'real' Chip Revolution.

Having seen Dr Halliday wheel Penny away, Henry returned to the chaos-filled room to see Michael.

There were still those who attacked the microprocessor and its offspring the picoprocessor, particularly in the cyber field. Fanatics generally, religious and otherwise, but they were a dying breed.

"If God had intended us to have electronic circuits in our heads, He would have put a socket in our skulls!" they intoned.

But how could anyone begrudge these children at least some semblance of normality? Most would have led an institutionalised life of hell without the chip. Michael was the prime example of this. Mike the Miracle the nurses had nicknamed him. And, indeed, he was a miracle — a technological one.

Shaven head

Henry opened the curtain that separated the kiosk from the rest of the nursery and looked at the healing scars on the back of his pupil's shaved head.

Until a few weeks ago, Mike had been a hopeless case. Born nine years earlier, his brain had been affected by a drug administered in the maternity ward and his mental age had never risen beyond two. In many ways his physiological age was even less.

He was unable to speak more than five or six words and these were invariably garbled. His head would frequently roll from side to side and his self-control was so bad that his arms waved about as he staggered arund with his ungainly walk. Most off-putting of all was the lolling of his tongue and the sickly thick saliva that dribbled down his chin, staining the front of his clothes. Incontinence was a problem, too — hence the need for nappies.

And he was nine years old.

Henry could remember the electro-lectures he had once had on the history of treating the mentally handicapped. They were more like horror films! Those that were allowed to live were hidden away in institutions or even caged and put in travelling circuses, billed as the 'Human Beast' or some such sensationalist title. But who was the more savage? The caged 'creature'? Or its 'human' keeper?

Then there were the more final solutions. At least the Jews were able to fight back, to some degree. But what were the mentally handicapped to do agianst Hitler's Reich? Huddled together and ritually exterminated, like vermin. Or made to suffer inhumane experiments that would never have been perpetrated on the lowest of animals.

Henry stared at the result of man's latest attempt to solve the problem.

"D . . . d . . . d . . . doggy," Michael stammered as a picture of an Alsatian appeared on the VDU. For a correct answer the picture changed to a clip of a century-old silent-movie and a custard pie landed in the star's face. Mike broke into a hearty laugh that made even Henry smile.

Well, was it worth it? Henry already knew the answer to that. Fifty-three hours of almost continuous microcybersurgery, cutting holes in the thin skull, close scrutiny of the 3D X-rays of his brain and the intricate positioning and quasi-wiring of the minute picochip to the correct cells.

Neocabbage

Fifty-three hours of the most extensive microneurological implantation ever. Fifty-three hours that had created an ebullient child out of a salivating neo-cabbage.

His problems were not over, of course — man's knowledge and ability could not — yet — make him completely normal and Mike had a lot to learn and do to catch up with others of his age, but it was a leap in the right direction. At least his major handicaps were overcome and heads no longer turned away at the mere sight of him.

Henry, from the corner of his eye, saw Penny return, exercising her repaired arm. He left Michael, closing the curtain behind him and walked over to her.

"OK now, Penny?"

She nodded, then said: "The doctor told me all about you".

The smile that had been on Henry's face quickly vanished.

Why had Halliday divulged his secret? After all these years why would any member of staff break the written contract of secrecy?

Picochip implants

"I wish you were't going away," Penny continued.

"Oh . . . that!" Henry breathed a sigh of relief." Don't worry — I'm sure the new teacher will be nice."

"I don't care. I like you."

Henry looked around the room at his pupils as they accustomed themselves to using their picochip implants and artificial limbs. Those with recently attached parts were often clumsy in their use, their brain as yet not trained to using its newest peripheral. He watched one or two as they limped on their unnatural legs or fumbled something with their hands. The brain is very adaptable, however, as Penny had shown, and would soon acclimatise itself to its new-found abilities. Her arm had been fitted only ten days earlier and already she was using it as a natural — apart from her little trouble a short while ago, that was.

"yes," he finally said, mournfully, "I'll be sorry to go."

He was as fond of his patients-cum-pupils as they were of him.

It was a strange desolation that took over the nursery when the kids had gone. Every footstep echoed eerily around the walls in the dim half-light of the late evening.

Henry turned at the doorway for a final look at the room with its faded cartoon characters, the cupboards full of every conceivable electronic toy and the now dead micro-units. Reluctantly he turned away and left.

The Quiet Room was empty when he arrived a few minutes later and he walked over to the wallpad, applied pressure at the correct co-ordinates and sat down in his favourite easy chair. The dim wall suddenly blinked into life and a six foot by six foot video-pic appeared. Someone was doing a funny walk and the 'live' audience was erupting in a fit of moronic canned hysterics and applause.

"Another American import," Henry grumbled. Then he looked away from the screen, noticing a large crate in the corner of the room. "That must be it," he thought. "What a way to go!"

He only had to wait six or seven minutes. A bright, blonde woman breezed in — Professor Clarke.

"Hard day, Henry?"

"As usual."

"We'll . . . er . . . be sorry to see you go, you know."

Henry nodded solemnly.

"Roll up your sleeve, please," Clarke asked, approaching him and taking his hand in hers.

"Where will I be sent?" Henry inquired.

The professor found a couple of catches just above Henry's right elbow. As she unfastened them and disconnected the inner wiring, a nurse walked in.

"We'll all miss you, Henry." She said as the professor handed her the disolcated arm.

The process was repeated for the left arm.

Henry watched the nurse step away with his two separated limbs and pack them carefully in the waiting crate. It was a strange, unreal sensation that he felt.

"Demagnetise please, Henry," Clarke half-ordered, half-requested.

"Done," came the reluctant reply after a brief but noticeable pause.

"Don't worry, Henry," the professor tried to comfort him.

Henry's brain told him to nod but he couldn't.

"You'll just go back for a recondition and training for your new job," Clarke continued. Then she reached up, one hand under Henry's chin, the other at the back of his neck, and, with a slight tug, gently lifted his head from his shoulders.

This was a job she detested more than any other. Everyone had become so attached to the amiable Henry, and here they were packing him and sending him away like some unwanted toy insead of the friend that he really was.

It was the ultimate irony, she thought to herself as she carried him to the crate. All of those children in his care. All of those children whose bodies needed the pico-processor to survive adequately, in the care of a robot whose picos were in need of a body. She looked back at the rest of the torso and legs, the universal robotic chassis designed merely for mobility and appearance and wondered who would be using it next — what would the new robot be like?

Henry — or at least the head, with its cyberbrain, and the specialised arms that constituted Henry — would be moving to a new chassis, exactly the same in every respect as the one he had just left — except it would be elsewhere.

"I understand your makers, Robo-of-Europe, have a contract with Space Unlimited," Clarke remarked, snapping herself out of her morose brooding. "There's a good chance you'll be put to work on the Lunalab Project on Clavius."

Goodbye

Henry — his head and arms, that is — lay face up in the padded crate. He smiled feebly, though not particularly comforted by the professor's conversation. He blinked several times almost — or so Clarke thought — as though he were blinking back tears.

In silence she peeled back a flap in his hair and unscrewed the plate she found beneath it. Removing this uncovered the all-powerful switch. Her finger came to rest on its cold surface. She hesitated for a moment.

"Goodbye, Henry."

Click.

St. Valentine's Day match-up

Our Schools Correspondent sends us this account of something really useful for the computer to do ...

HERE's a St. Valentine's Day frolic, to involve the whole upper school in *their* computer. We launched ours a week before Christmas, and results were produced on the day of the school Christmas disco.

Pupils were invited to fill in a simple form. A couple of girls in the computing group transcribed the contents of the forms onto data sheets, and the data was fed into the program. A portion of the output is enclosed. 189 pupils submitted forms, and (with the minor exception of the girl who was allocated her brother!) the project was a great success (so was the disco afterwards!)

The program accepts data for each entry in the following form (after printing the entry number):

☐ Name (and form, if required)
☐ Number of the box ticked in each selection (1-2, 1-4, or 1-8 in each case). Numbers go in on separate lines — press RETURN after each number.
☐ Prompt ERR? comes up. If the last entry was wrong in any way, type YES here; the entry may then be re-input. Otherwise press RETURN, then input next entry.

Inputting Z in place of a name terminates data input, starts processing. The operator is prompted to type CTRL Q and CTRLE (for continuous scrolling, and echo to printer) then RETURN. The system compares the characteristics, requirements and interests of each entry in turn with *every* entry of the opposite sex, giving a compatability rating out of 10 (serious differences in age from requirement count negative). The two best-scoring matches for each entry are listed below the name of that entry.

On completion of the run, the prompt EXTRAS? may be answered YES if it is desired to add to the list of entries in the machine (a 'name' of Z will again terminate the extended list, and start a complete new processing run, on the new extended list). Any other response will set the machine off on producing a duplicate list.

The program is minimal, to leave maximum data store. We allowed 20 characters per name — this was generous; I believe the arrays could be extended to 250 without mishap (more, if string space is reduced). A run for 189 entries took 1¼ hours — a long time, but the whole thing would not be possible without optimal packing of data. This is a project well worth undertaking for a Valentine's Day crack!

```
2 CLEAR 4000
3 DIM N$(200),S(200)
5 FOR I=2 TO 9:READ W(I):NEXT I
10 J=0
20 ?:?J:INPUT N$(J)
25 IF N$(J)="Z" THEN J=J-1:GOTO 140
30 FOR I=0TO9:INPUT A:F(I)=A-1:NEXT I
35 INPUT "ERR";A$:IF A$="YES" THEN 20
40 IF F(0)=0 THEN 80
60 A=F(4):F(4)=F(3):F(3)=A:A=F(6):F(6)=F
(5):F(5)=A
80 S(J)=F(1)
90 FOR I=2TO9:S(J)=S(J)*W(I)+F(I):NEXT I

110 IF F(0)=0 THEN S(J)=-S(J)
130 ?FRE(A$):J=J+1:GOTO 20
140 ?:?:?:INPUT "CTRL E,CTRL Q";A$:?:?:?

150 FOR K=0TOJ:Y=0:Z=0
160 A=SGN(S(K)):B=ABS(S(K)):GOSUB500
170 FOR I=0TO9:C(I)=F(I):NEXTI
180 FOR L=0TOJ
190 A=SGN(S(L)):B=ABS(S(L)):IF A=C(0) TH
EN 300
200 GOSUB500
210 A=3
220 FOR I=3TO9
230 IF C(I)=F(I) THEN A=A+1
240 NEXT I
250 A=A-ABS(F(2)-C(1))-ABS(F(1)-C(2))
260 IFA<Z THEN300
270 Z=A:E=L
280 IF Y>=Z THEN300
290 A=Y:Y=Z:Z=A:A=D:D=E:E=A
300 NEXT L
310 ?:?:?N$(K);TAB(26);"COMPATABILITY"
320 ?TAB(6);N$(D);TAB(32);Y:?TAB(6);N$(E
);TAB(32);Z
330 NEXT K
340 INPUT"EXTRAS";A$:IF A$="YES" THEN J=
J+1:GOTO 20
350 GOTO150
500 FOR I=9TO2 STEP -1
510 B=B/W(I):F(I)=(B-INT(B))*W(I):B=INT(
B)
520 NEXT I
530 F(1)=B:F(0)=A:RETURN
600 DATA8,4,4,4,4,8,8,8
```

Please answer the following questions:

Name:

Sex:

Male ☐ Female ☐

Age:

AGE OF IDEAL PARTNER:

UNDER 14.6 ☐ 16-16.6 ☐
14.6-15 ☐ 16.6-17 ☐
15-15.6 ☐ 17-17.6 ☐
15.6-16 ☐ OVER 17.6 ☐

WHICH OF THESE BEST DESCRIBES YOUR HAIR COLOUR

FAIR ☐ DARK ☐
MID-BROWN ☐ RED ☐

YOUR HEIGHT:

UNDER 5'1" ☐ 5'6"-5'11" ☐
5'1"-5'6" ☐ OVER 5'11" ☐

HEIGHT OF IDEAL PARTNER;

UNDER 5'1" ☐ 5'6"-5'11" ☐
5'1"-5'6" ☐ OVER 5'11" ☐

ON A RAINY DAY, WOULD YOU PREFER TO:

COLLECT (STAMPS, COINS ETC) ☐ PLAY INDOOR SPORTS ☐
PLAY A BOARD GAME (CHESS ETC) ☐ DO CROSSWORDS ☐
MUSIC (PLAYING OR LISTENING ☐ GO FOR A WALK ☐
WATCH TV ☐ CRAFTS (PAINTING ETC) ☐

WHICH SPORT DO YOU PREFER WATCHING!

BOXING ☐ FOOTBALL ☐
TENNIS ☐ CRICKET ☐
GOLF ☐ TABLE-TENNIS ☐
SWIMMING BASKETBALL

WHICH MUSIC DO YOU PREFER!

CLASSICAL ☐ SOUL ☐
PUNK ☐ BLUES ☐
ROCK 'N' ROLL ☐ JAZZ ☐
REGGAE ☐ THE SMURFS ☐

Please tick the appropriate boxes and return completed to Nicola Gowan or Helen Reynolds (4th year).

In pastures phosphor-green ...

Bob Merry plays at shepherds with Sheepdog Trial, a game against the clock programmed for the PET

THE SCENE is the Petshire Country Show; the event the sheepdog trial. In a large field, a lone dog seeks to round up a number of sheep and herd them into a pen in the centre of the field. The obedient dog follows the instructions from his master; left, right, forwards and backwards. The sheep wander in the field at random until the dog approaches, when they head away from it. A good sheepdog will not approach too close, however, since this causes the sheep to panic and then they are liable to dart off in any direction.

Novice shepherds can elect to round up only a single sheep, but the more experienced can attempt up to six sheep. This can lead to complications, as the sheep will often wander out of the pen when the dog goes off to fetch another sheep. This is why the trial must finish with the dog guarding the entrance of the pen. The best times in each class are recorded so the shepherd can see how well he is doing.

This is the idea behind the game of "Sheepdog Trial". The program is designed for the PET, using the graphics to illustrate the course of the game, so a few notes of explanation may help readers who wish to adapt the ideas in the program to their own systems.

Et in arcadia ego

Lines 105-310: These contain the basic instructions. Lines 105, 170 and 245 start with the 'Clear screen' instruction, shown here as a reversed image 'heart'. Most of the other lines in this section contain one or two 'cursor down' instructions, shown by the 'Q'.

Lines 160, 240 and 310 call for GOSUB 3000, which simply waits for a keyboard input to indicate that the player has read that 'page' of instructions. Lines 260-275 illustrate the Pen with six sheep inside and the dog placed across the gate. Aficionados of 'Rhino' might notice a family resemblance in these sheep!

It is important that all the points on the edge of the pen, except the gate, are filled with a symbol, as we shall see later. The instructions end with the player selecting the number of sheep he wants to round up.

Lines 320-390: It was obvious when I first conceived the idea for this program that it was going to involve a large number of symbols moving around the screen. One obvious way of doing this is to POKE the required symbols into the screen, but I prefer to avoid this, since it usually results in a burst of "snow" on the screen.

Instead, I use two strings of cursor control characters, which I can call upon later in order to move the cursor to the approdpriate part of the screen. These are contained in Lines 360-370; A$ consists of 39 'cursor right' instructions and D$ is 24 'cursor down' instructions.

We will be using XS(I) and YS(I) to keep track of the positions of the I sheep, and the best time recorded for each number is stored in BT(I), which is set initially to an impossibly(?) high number.

Drawing the field and the pen and placing the sheep and the dog all take a little time, so since we don't want the game to start until the scene is set, we employ, in Line 320, the POKE that blanks out the screen on the PET.

Lines 400-450: This section of the program prints out the Pen and the surrounding field. Movement in the program is restricted to spaces that are free, so it is important to fill up all the spaces on the screen that are 'out of bounds'. During development of this program, I had problems initially with sheep that were able to leap the corners of the pen.

At this stage the pen was shaped as in **Figure 1(a)**, whereas, of course, it needs to be as shown in **Figure 1(b)**. This is easy to see in the diagram, but not, perhaps, so easy to deduce from the graphics.

Line 410 starts by moving the cursor to the desired point on the screen and then prints out the top of the pen: a corner post (shifted ',') a lower line for the fence (shifted 'dollar'), a space for the gate, another fence-line, and a corner post (shifted ';'). Line 420 prints the rest of the pen.

The sides are made up of a right-hand line (shifted '), three spaces, and a left-hand line (shifted '%'). The bottom of the pen has a corner post (shifted 'less than'), three upper lines (shifted 'hash sign'), and a final corner post (shifted 'greater than'). The pen, therefore, fulfils the requirements shown in **Figure 1** and surrounds six spaces on all sides, including the corners.

Later on, we shall be moving the sheep and sheepdog around the screen and at this stage I had to consider the restraints on their movement; they should not move over the sides of the pen, they should not move off the screen and they should not jump on each other. The position of sheep and dog would be recorded as co-ordinates, where X could possibly be 0 to 39 and Y could be 0 to 24.

Out-of-bounds space

My first thought was to use the entire screen and judge when an edge had been reached by checking the value of the X and Y co-ordinates. Applying such a method to the other out-of-bounds areas, though, involves several different tests and can be long-winded.

A much simpler method soon suggested itself. We started off this sequence by clearing the screen, which fills it full of 'spaces'. Subsequently, the pen, the sheep, the dog, etc overwrite these spaces and it follows that an out-of-bounds area is 'not-space'.

With this in mind, I decided to put a fence around the field to prevent the animals leaving the screen. To be effective, this fence must be continuous and one area of particular difficulty was the bottom right-hand corner. If a symbol is printed in the very last space on the bottom row of the screen, the cursor will move on to the next row and the whole display is scrolled up.

Because of this, I had to settle for a field that only filled 24 lines on the screen. Lines 430-450 print the edges of the field. Line 430 starts by moving the cursor

continued page 81

In pastures phosphor-green . . .

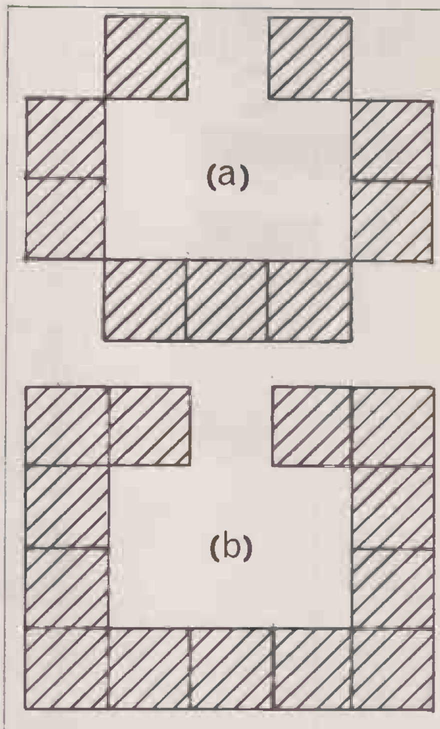


Figure 1: The Pen, before (a) and after (b) designs (see lines 400-450).

```
READY.

 10 REM****SHEEPDOG TRIAL***
 20 REM****BY R.C.MERRY 18/9/1979***
 100 REM****INSTRUCTIONS***
 105 PRINT"▯          SHEEPDOG TRIAL"
 110 PRINT"                ___________"
 115 PRINT"▯▯   THE OBJECT OF THE GAME IS TO DRIVE"
 120 PRINT"▯A NUMBER OF SHEEP(π) INTO A PEN USING"
 125 PRINT"▯A SHEEPDOG(◆).THE SHEEP TEND TO WANDER"
 130 PRINT"▯AROUND AT RANDOM, UNLESS THE DOG COMES"
 135 PRINT"▯CLOSE, WHEN IT CAN CONTROL THE SHEEP"
 140 PRINT"▯TO AN EXTENT. DON'T GO TOO CLOSE THOUGH"
 145 PRINT"▯OR THE SHEEP MIGHT PANIC AND GO OFF IN"
 150 PRINT"▯A RANDOM DIRECTION. NEITHER SHEEP NOR"
 155 PRINT"▯DOG CAN JUMP FENCES."
 160 PRINT"▯PRESS ANY KEY TO CONTINUE.":GOSUB3000
 170 PRINT"▯ YOU CAN MOVE THE DOG BY USING ONE OF"
 175 PRINT"▯FOUR KEYS:      8"
 185 PRINT"                 ↑"
 190 PRINT"               4<─┼─>6"
 195 PRINT"                 |"
 200 PRINT"                 2"
 205 PRINT"▯  ANY OTHER KEY USES UP ONE OF YOUR"
 210 PRINT"▯THREE MOVES/TURN, BUT DOESN'T MOVE THE"
 215 PRINT"▯DOG. AFTER YOUR THREE MOVES, THE SHEEP"
 220 PRINT"▯MOVE AND THEN YOU CAN MOVE AGAIN. THE"
 225 PRINT"▯SHEEP MUST ENTER THE PEN BY MOVING"
 230 PRINT"▯DIRECTLY DOWNWARDS THROUGH THE GATE ON"
 235 PRINT"▯THE TOP EDGE."
 240 PRINT"▯PRESS ANY KEY TO CONTINUE":GOSUB3000
 245 PRINT"▯ONCE YOU HAVE ALL THE SHEEP IN THE PEN"
 250 PRINT"▯YOU MUST KEEP THEM THERE BY PUTTING"
 255 PRINT"▯THE DOG ACROSS THE GATE:"
 260 PRINT"▯                ▄_◆_▄ "
 265 PRINT"                 |πππ| "
 270 PRINT"                 |πππ| "
 275 PRINT"                 ▀▀▀▀▀ "
 280 PRINT"▯  YOU ARE TIMED FROM THE MOMENT THE"
 285 PRINT"▯DISPLAY APPEARS UNTIL THE MOMENT THE"
 290 PRINT"▯DOG IS PLACED ACROSS THE GATE."
 295 PRINT"▯YOU CAN TRY TO ROUND UP AND PEN UP TO"
 300 INPUT"▯SIX SHEEP. HOW MANY DO YOU WANT";NS
 305 IFNS>6THENPRINT"▯DON'T BE GREEDY! NO MORE THAN":GOTO300
 310 PRINT"▯PRESS ANY KEY TO START.":GOSUB3000
 320 POKE59409,52
 350 REM****INITIALIZE***
 360 A$="▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯"
 370 D$="▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯"
 380 DIMXS(6),YS(6),BT(6)
 390 FORI=1TO6:BT(I)=1000000:NEXT
 400 REM****PRINT PEN***
 410 PRINT"▯";LEFT$(A$,17);LEFT$(D$,11);"▄_ _▄"
 420 PRINTTAB(17);"|   |":PRINTTAB(17);"|   |":PRINTTAB(17);"▀▀▀▀▀"
 430 PRINT"▯";:FORI=1TO40:PRINT"┬";:NEXT
 440 FORI=1TO22:PRINT"▯";LEFT$(D$,I);"┤";LEFT$(A$,38);"├";:NEXT
 450 PRINT"▯";LEFT$(D$,23);:FORI=1TO40:PRINT"┬";:NEXT:PRINT"▯"
 500 REM****GENERATE SHEEP***
 510 FORI=1TONS
 520 X=INT(39*RND(1)+1):Y=INT(22*RND(1)+1)
 530 IFPEEK(32768+X+40*Y)<>32THEN520
 540 XS(I)=X:YS(I)=Y:PRINT"▯";LEFT$(A$,XS(I));LEFT$(D$,YS(I));"π":NEXT
 600 REM****PLACE DOG***
 610 X=INT(39*RND(1)+1):Y=INT(22*RND(1)+1)
 620 IFPEEK(32768+X+40*Y)<>32THEN610
 630 XD=X:YD=Y:PRINT"▯";LEFT$(A$,XD);LEFT$(D$,YD);"◆"
 700 REM****START***
```

listing continues on page 79

MICRODIGITAL 1980

Apple II plus

Apple II Plus will change the way you think about computers. That's because it is specifically designed to handle the day to day activities of education, business, financial planning, scientific calculation and entertainment.

- APPLESOFT
A fast, extended 10K BASIC with 9-digit precision and graphics extensions.
- HIGH RESOLUTION GRAPHICS
On a matrix of 280 x 192 individually addressable points
- AUTO-START ROM
With power on boot of applications programs, reset protection and improved screen editing.
- INTERNAL MEMORY EXPANSION TO 64K BYTES
For big system performance at a low cost.
- EIGHT EXPANSION SLOTS
To let the system grow with your needs

	Nett	V.A.T.	Total
Apple II Plus, 16K RAM	695.00	104.25	799.25

APPLE PASCAL
Apple Pascal is the new extension to microcomputer power

Pascal Incorporating UCSD PASCAL TM, offers extended features in a complete interactive package employing todays most sophisticated structured programming language. It provides advanced capabilities that boost performance and cut development time for large business, scientific and educational programs.

This software package provides the most powerful set of tools yet available for the microcomputer programmer.

	Nett	V.A.T.	Total
APPLE Pascal System	229.00	44.85	343.85

FLOPPY DISCS
Gives your system immediate access to large quantities of data. The subsystem consists of an intelligent interface card, a powerful Disk Operating System and one or two mini-floppy drives.

	Nett	V.A.T.	Total
Floppy disk Subsystem	349.00	52.35	401.35
Second disk drive and connecting cable	299.00	44.85	343.85

Parallel Printer Interface Card
Allows you to connect almost any popular printer to your apple, A BASIC program can produce hard-copy output as easily as it prints to the TV monitor screen. Command interpretation and printer control details are handled by the firmware built into the card, to eliminate user programming requirements.

	Nett	V.A.T.	Total
Parallel Printer Interface Card	104.00	15.60	119.60

Communications Interface Card
Allows your Apple to "talk" (through a modem) with other computers and terminals over ordinary telephone and load programs over the phone, send messages to remote terminals or access your office computer from the comfort of your home.

	Nett	V.A.T.	Total
Communications Interface Card ..	130.00	19.50	149.50

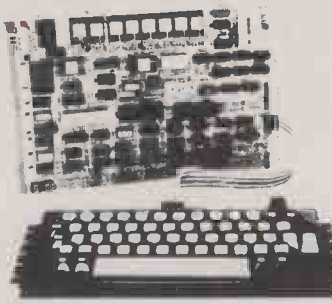
NEW LOW PRICES

Nascom 2

Microprocessor
Z80A 8 bit CPU. This will run at 4 MHz but is selectable between 1/2/4/ MHz.

Hardware
12" x 8" Card
All bus lines are to the Nasbus specifications
All bus lines are full buffered

Memory
On-board, addressable memory:
2K Monitor — Nas-sys 1
1K Video RAM (MK4118)
1K Work space/User RAM (MK4118)
8K Microsoft Basic
(MK3600 ROM)
8K Static RAM/2708 EPROM



Keyboard
New expanded 57 Key Licon solid state keyboard especially built for Nascom. Uses standard Nascom, monitor controlled, decoding.

T.V.
The T.V. 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 RS 232/20mA teletype interface. The cassette interface is Kansas City standard at either 1200 or 300 baud. This is a link operation on the Nascom-2.

PIO
There is also a totally uncommitted PIO (MK3881) giving 16, programmable, I/O lines.

Character Generator
The 1K video RAM drives a 2K ROM character generator providing the standard ASCII character set with some additions, 128 characters in all. There is a second 2K ROM socket for an on-board graphics package which is software selectable.

	Nett	V.A.T.	Total
Nascom-2 in kit form	295.00	44.25	339.25
Power Supply ..	24.50	3.68	28.18
Graphics ROM ..	15.00	2.25	17.25

Superboard II

The sensational single board computer from Ohio Scientific. Superboard comes fully assembled and tested. On board is a 6502 microprocessor, 4K RAM (expandable, on board to 8K), 8K Microsoft BASIC in ROM, CUTS cassette interface, full ASCII keyboard. Superboard interfaces with a video monitor or domestic television (via U.H.F. Modulator) and provides a 24 x 24 display with Upper/Lower case and a wide range of graphics/gaming characters.

Superboard comes complete with documentation and sample software on cassette

Ex-Stock

	Nett	V.A.T.	Total
Superboard II ...	188.00	28.20	216.20
U.H.F. Modulator	2.50	0.38	2.88

Video Genie

A third generation personal computer system, the video genie is a powerful microcomputer upwardly compatible with the Tandy TRS-80. TM

Central Processor
The system uses the powerful and popular Z80 processor. A system reset button is mounted at the rear of the console. Power down is NOT required should the system crash

Video Display
16 lines of 32 (2 pages) or 64 characters, switch selectable. Full software cursor control
Composite video output to a domestic television

Memory
RAM — 1K Screen Ram
16K User RAM
ROM — 12K Extended Level II Basic interpreter, system monitor. Completely compatible with TRS-80TM Level II BASIC.

Cassette
Integral 500 b.p.s. cassette deck eliminates tape loading errors.
Additional interface for second (external) cassette deck. Manual overide of cassette deck and tape counter cures problems normally associated with this storage medium.

Basic
An extended Level II Basic, compatible with TRS-80 level II Basic. TM
Features line editing, formatted printing, multi-dimensional arrays, AUTO Line numbering, Program tracing
A huge range of software, on cassette is already available

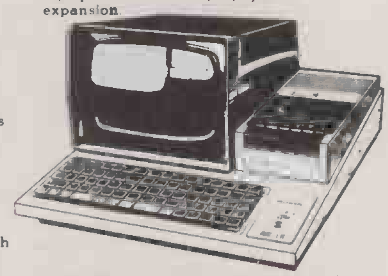
Peripherals
Full ASCII keyboard with 10 key rollover eliminates keyboard bounce. Expansion connector provides a parallel I/O Port for printer

	Nett	V.A.T.	Total
Video Genie	369.57	55.43	425.00

Sharp

SHARP MZ-80K

- Z-80 based CPU.
- 4K Byte monitor in ROM.
- Internal memory capacity from 4 to 48K RAM.
- 14K Extended BASIC.
- 10 in video display, 40 chars. of 24 lines.
- 80 x 50 bit mapped graphics.
- Extensive character set with upper, lower case, graphics etc.
- Full 79 Key Keyboard.
- Built in music synthesizer with 3 octaves.
- Fast reliable cassette unit with tape counter 1200 b.p.s.
- Wide variety ofsystem software on cassette.
- 50 pin bus connector for system expansion.



A complete personal computer system for the microcomputer user, at an economic price. The Sharp comes complete with all necessary peripherals, sample software and excellent documentation — giving the user a personal system of unmatched flexibility and ease of use. At the heart of the machine is the Z-80 CPU — widely accepted as the most powerful 8-bit CPU on the market. A 4K byte system monitor controls system operation. From 4 to 48K of RAM can be resident on board; enough room for the most demanding applications.

An extensive graphics character set, plus 3 octave sound generator and fast cassette unit hi-resolution video monitor complement these basic facilities. It has the ease of use and compactness of "black box" computer combined with extensive peripherals and facilities for expansion.

Sharp Basic occupies 14K of RAM: and offers extended features above those of normal microcomputer implementations;

Model	Nett	V.A.T.	Total
6K	520.00	78.00	598.00
10K	540.00	81.00	621.00
18K	620.00	93.00	713.00
22K	640.00	96.00	736.00
34K	740.00	111.00	851.00

Acorn

This compact stand-alone micro-computer is based on Eurocard modules, and employs the highly popular 6502 MPU. Take a look at the full specifications, and see how Acorn meets your requirements.

The Acorn consists of two single Eurocards:
1. MPU card; 6502 microprocessor, 512 x 8 ACORN Monitor; 1K x 8 RAM; 15-way I/O with 128 bytes of RAM; 1 MHz crystal; 5V reg| sockets for 2K EPROM and second RAM I/O chip.
2. Keyboard card; 25 click-keys (16 hex, 9 control); 8 digit, 7 segment display. CUTS standard crystal controlled tape interface circuitry.

Acorn Operating Manual
With Acorn, you'll receive an operating manual that covers computing in full, from first principles of binary arithmetic, to efficient hex programming with the 6502 instruction set. The manual also includes a listing of the monitor programs and the instruction set, and other useful tabulations; plus sample programs.

	Nett	V.A.T.	Total
Kit	65.00	9.75	74.75
Ready Built	75.00	11.25	86.25

Acorn Memory
A high quality fibre glass,through hole plated.PCB with solder resist and component identification, this eurocard has provision for 8K of RAM (2114) and 8K of EPROM (2732).

	Nett	V.A.T.	Total
8K RAM (Kit)	95.00	14.25	109.25

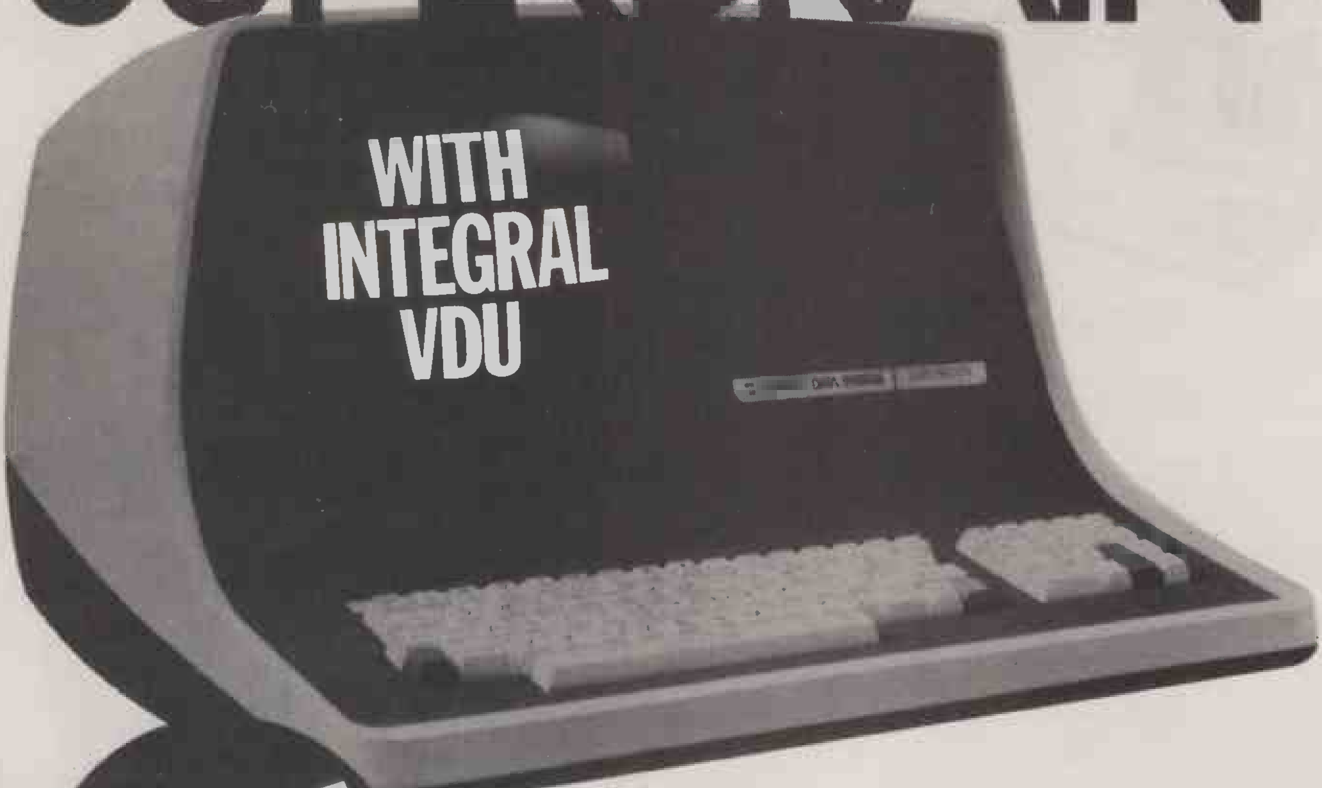
ACORN V.D.U.
The Acorn V.D.U. Board connects to the Acorn Computer Bus and contains memory mapped character storage RAM which is transparently written to or read from, by the C.P.U.

An MC 6845 programmable controller I.C. Provides all the synchronisation signals to drive a 625 line 50 fields per second V.D.U. together with read addresses for the character R.A.M. Characters are then fed to an SAA 5050 character generator IC which produces the necessary dot patterns to create the characters to refresh the V.D.U.

The SAA 5050 produces Teletext standard characters and has Red, Green and Blue drive outputs giving coloured characters or graphics.

	Nett	V.A.T.	Total
V.D.U. Card (Kit)	88.00	13.20	101.20

SUPERBRAIN™



£1,995 COMPLETE (+VAT)

- ★ **Full 64K RAM**
- ★ **Twin Z80A microprocessors**
- ★ **CP/M operating system**
- ★ **Twin double density mini floppies (280K total)**

SUPERBRAIN™ – stand alone system and intelligent terminal combined in single desk top unit (14³/₈″ H × 21³/₈″ W × 23¹/₈″ D). Optional S-100 Bus available for easy linkage to vast range of ancillary equipment including mass Data Storage on Hard Disc. Non-glare dynamically focused 12″ CRT and Universal RS-232 Communications port. SOFTWARE PACKAGES AVAILABLE.

Full SUPERBRAIN™ details from the following dealers:

JAEMMA LTD., 44 Manor Park Road, Castle Bromwich, BIRMINGHAM Tel: 021 7474531
JENNINGS COMPUTER SERVICES LTD., 55/57 Fagley Road, BRADFORD 2, W. Yorks. Tel: 0274 637867
RUSSELL & SON LTD., Deane House, 27 Greenwood Place, LONDON NW5 1NN. Tel: 01-485 5574
COMPUTERISED BUSINESS SYSTEMS, 32/34 Huntriss Row, SCARBOROUGH, N. Yorks. YO11 2ED. Tel: 0723 75787
RESOURCE PLANNING LTD., Goldie House, Upper Church Street, DOUGLAS, Isle of Man. Tel: 0624 4247
GEMSOFT COMPUTER SERVICES, "Alverstone Lodge", Wych Hill Lane, WOKING, Surrey, GU22 0AH. Tel: 04862 60268
MICROPEOPLE LTD., Microcomputer Consultancy Services, 1 Union Street, LONG EATON, Nottingham, NG10 1HH. Tel: 06076 68923
OFFICE COMPUTER TECHNIQUES LTD., 22 Highcroft, Husbands Bosworth, MARKET HARBOROUGH, Leicestershire. Tel: 0858 880561
COSMOS COMPUTERS LTD., Black Horse Road, LETCHWORTH, Herts. Tel: 046 26 6861
ANGLO-AMERICAN, E Floor, Milburn House, Dean Street, NEWCASTLE-ON-TYNE, NE1 1LE. Tel: 0632 29593

For dealer enquiries, contact

ICARUS COMPUTER SYSTEMS LTD., 27 Greenwood Place, London NW5 1NN.

SUPERBRAIN™ *is the registered trademark of Intertec Data Systems.*

• Circle No. 170

In pastures phosphor-green . . .

continued from page 75

```
710 POKE59409,60:T=TI
720 FORI=1TO3:GOSUB3000
730 X=XD:Y=YD
740 IFR$="8"THENY=YD-1
750 IFR$="4"THENX=XD-1
760 IFR$="6"THENX=XD+1
770 IFR$="2"THENY=YD+1
780 IFPEEK(32768+X+40*Y)<>32THENX=XD:Y=YD
790 PRINT"■";LEFT$(A$,XD);LEFT$(D$,YD);" "
800 XD=X:YD=Y:PRINT"■";LEFT$(A$,XD);LEFT$(D$,YD);"◆":NEXT
900 REM****MOVE SHEEP***
910 FORI=1TONS
920 X=XS(I):Y=YS(I)
930 IFABS(XS(I)-XD)>3ORABS(YS(I)-YD)>3THEN990
935 IFABS(XS(I)-XD)<2ANDABS(YS(I)-YD)<2THEN990
940 IFXS(I)>XDTHENX=XS(I)+1
950 IFXS(I)<XDTHENX=XS(I)-1
960 IFYS(I)>YDTHENY=YS(I)+1
970 IFYS(I)<YDTHENY=YS(I)-1
980 GOTO1000
990 X=XS(I)+1-INT(3*RND(1)):Y=YS(I)+1-INT(3*RND(1))
1000 IFPEEK(32768+X+40*Y)<>32THENX=XS(I):Y=YS(I)
1010 PRINT"■";LEFT$(A$,XS(I));LEFT$(D$,YS(I));" "
1020 XS(I)=X:YS(I)=Y:PRINT"■";LEFT$(A$,XS(I));LEFT$(D$,YS(I));"π"
1030 NEXT
1100 REM****ARE ALL SHEEP IN THE PEN?***
1110 P=0
1120 FORI=33266TO33268
1130 IFPEEK(I)=94THENP=P+1
1140 IFPEEK(I+40)=94THENP=P+1
1150 NEXT
1160 IFP=NSTHEN1200
1170 GOTO720
1200 REM****IS DOG BY ENTRANCE***
1210 IFPEEK(33227)=90THEN1300
1220 GOTO720
1300 REM****STOP THE CLOCK***
1310 T=INT(100*(TI-T)/60)/100
1320 PRINT"■■■YOU ROUNDED UP";NS;"SHEEP IN";T;"SECS";
1330 IFT<BT(NS)THENBT(NS)=T
1340 PRINT"■■■■■YOUR BEST TIME FOR";NS;"SHEEP IS";BT(NS)
1350 FORI=1TO5000:NEXT
1360 PRINT"■DO YOU WANT ANOTHER GO(Y/N)":GOSUB3000
1370 IFR$="N"THEN4000
1380 IFR$<>"Y"THENPRINT"■PLEASE ANSWER Y OR N":GOSUB3000:GOTO1370
1390 INPUT"■HOW MANY SHEEP";NS
1400 PRINT"■PRESS ANY KEY WHEN READY TO START":GOSUB3000:POKE59409,52:GOTO400
2090 REM****WAIT FOR KEY SUBROUTINE***
3000 GETR$:IFR$=""THEN3000
3010 RETURN

4000 PRINT"■YOUR BEST TIMES WERE:"
4010 FORI=1TO6
4020 PRINT"■";I;"SHEEP:";
4030 IFBT(I)=1000000THENPRINT"NO TIME RECORDED":GOTO4050
4040 PRINTBT(I);"SECS"
4050 NEXT
9000 END
READY.

READY.

3010 RETURN
2976 PRINT"■YOUR BEST TIMES WERA:"
4000 PRINT"■YOUR BEST TIMES WERE:"`

READY.
```

In pastures phosphor-green ...

continued from page 74

'home' and then prints 40 fence sections along the top. I have used the shifted '2' for this. Line 440 prints the fences on the left and right of the screen, from the second to the twenty-third lines. The symbols here are the shifted '3' and '+', respectively. Finally, line 450 prints the bottom fence on the twenty-fourth line, using a shifted '2'.

Lines 500-630: These lines generate the positions of the sheep and of the dog and print them on the display. The positions are recorded in the form of X and Y co-ordinates and these are randomly generated. Lines 530 and 620 check that the generated position is clear.

Lines 700-800: Now display has been printed, we are ready to start. Line 710 contains the necessary POKE to unblank the display and then records the start time. The program now waits for an input from the keyboard (GOSUB 3000) and then checks to see if it is one of the keys that will move the dog.

I have restricted the dog's movements to four directions as I felt that the advantage it has in moving three times as fast as the sheep was enough. There is obviously room for experiment here and I leave this as an exercise for the reader.

Line 780 checks that the move is into a 'space' and then we print a 'space' at the old position and the dog symbol at the new. This is repeated three times, but if the player presses any other key than the four 'command' keys, or attempts an illegal move, then Lines 730, 790 and 800 cause the dog to 'mark time' and stay where it is.

Lines 900-1030: The movement of the sheep is determined by their position relative to the dog. If it too distant, they will ignore it and wander around at random. As it approaches, they move directly away from it. If it comes too close, they will 'panic' and again move at random. Whatever happens, the sheep can only make 'legal' moves into a clear space.

At one stage I considered including a check for each sheep to see if it had got a legal move. If for some reason it hadn't, then I would pass it over. I soon realised that this situation would only occur very rarely when four or more sheep were crowded into the pen.

At other times, it would be very time-consuming to have the sheep continue to generate random moves while searching for a legal move. Instead, I decided to have somewhat stupid and single-minded sheep. They would decide on their move and, if it proved impossible, they would simply give up and stand still.

Line 930 checks to see if the dog is too far away to have an influence on the sheep in question and Line 935 tests whether it is too close. In either case, the diversion to Line 990 leads to random movement of the sheep. If the dog is within the range where it affects the sheep, then Lines 940-970 determine the appropriate changes to the sheep's co-ordinates. Line 990 is used to generate random movement and the expressions in it generate —1,0, or +1. Before the sheep is moved, the proposed move is checked for legality in Line 1000 and then a space is printed in the old position and the sheep printed in the new.

Lines 1100-1220: Now we come to the point where we check to see if the game's over. This depends on the position of the sheep *and* the dog. One way to check on their positions would be to compare their X and Y co-ordinates with predetermined figures for the pen area. This could involve a routine which would have to be checked for each sheep.

Instead it seemed a simpler proposition just to look in the pen and count the number of sheep; this is precisely what Lines 1100-1170 do. If this count shows that we have all the sheep in the pen, we can go on and see if the dog is in its designated position, guarding the entrance.

If either of these tests fail, then the program goes back to let the dog move again, but if we pass this, then we can stop the clock and check our time.

Lines 1300-1400: The time calculated in 1310 gives a time to one-hundredth of a second. I thought it would provide more challenge for the player if he could record his best time to date and then try to better it. This is the object of the set of variables, BT(I).

Line 1320 contains the cursor intructions 'home', 'down', 'right' so that the result is printed inside the field border; Line 1340 does the same thing with three 'downs'. Line 1350 gives you time to read the result before another game is offered. If this offer is declined, then the final printout at Line 4000 will show all your best times.

This, then, is the game of 'Sheepdog Trial'. I hope these notes help you put the game on to your system and give you an insight into the methods used. An understanding of the various routines should enable you to make modifications and improvements. After all, one of the joys of computer-ownership is to adapt programs to your own requirements, rather than simply accept them at face value.

My own experience of playing this game shows that, whilst it is relatively easy to round up one or two sheep, the inborn waywardness of the beasts make the final capture of five or six an elusive target. Good shepherding!

Man-machine clanks into step

Mark Witkowski of the AI Laboratory at Queen Mary College looks at the principles of robotics design and discusses some ways in which amateurs can learn from the pros.

IN PART ONE of this introduction to robotics (February 1980 *Practical Computing,* we looked at some of the ways in which robots are slowly turning a dream into reality.

This month, Part Two deals with some of the mechanical design considerations in robotics.

Robots were defined as mechanical contrivances with some human-like attribute or, preferably, attributes. Given the current 'state-of-the-art' in robotics, it is unusual for any serious attempt to be made at constructing a humanoid, mechanical-man type of machine.

Manipulator designs loosely based on the human arm are not uncommon, but machines that walk are much rarer. Walking in a straight line is quite feasible, and even walking up stairs, but turning corners and walking over rough ground is another matter.

Walking locomotion is very much a matter of dynamic system control, as the mass of the body must be balanced against both gravity and its own momentum.

The Russians and Japanese are the most active in this area. WABOT, made in the Waseda University Bio-engineering department in Japan is a hydraulic-powered biped walking machine (Kato *et al* 73).

Several papers relating to walking can be found in the proceedings of the two international CISM-IFToMM symposia — at Udine in 1973 and Warsaw in 1976. They include theoretical and practical studies of biped, quadruped and six-legged locomotion.

A common robot vehicle configuration, currently thought of as the best compromise encompassing all the conflicting design and control problems, is that of a motorised based sporting one or more arm-type manipulators.

If the robot is not to be controlled by a person holding a joystick while watching the vehicle directly, it must also have one or more television cameras on board. These will cometimes feed a digitiser to allow computer analysis of the scene.

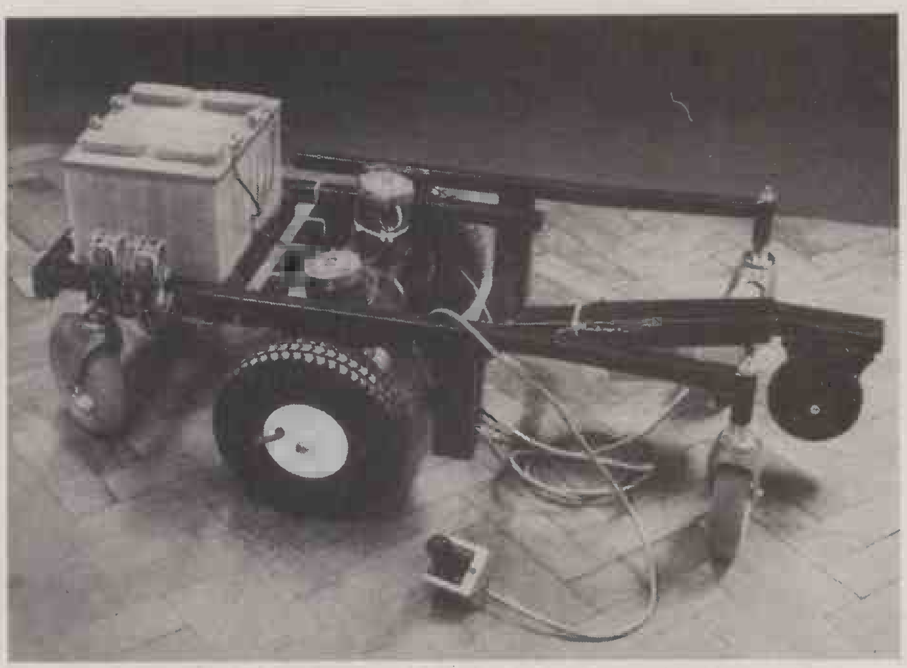
A reasonable goal to aim for in robotics research is to develop a totally autonomous robot under computer control.

Even if this is not how robots will eventually be used, it means that a number of currently unsolved problems relating to the control and behaviour of robots will have to be tackled. They can all too easily be glossed over when a person demonstrates the capabilities of a robot by remote control in the laboratory or workshop environment.

Because of the time taken and the expense involved in designing, building, commissioning and programming a useful, general-purpose robot of even quite modest specification, it is a game for a team rather than the individual.

But a micro-mouse or turtle-type robot is well within the capabilities of the individual and a number of books describing in full detail the mechanical and electronic design of a small mobile robot are available.

For instance, full constructional details are given by Tod Loofbourrow for his robot 'MIKE' in the book *How to build a computer-controlled robot* (Loofbourrow 78). Computing is provided on-board by a KIM-1 microprocessor.



Picture 1: General lay-out of wheelchair base, showing near-central location of drive wheels. This machine is capable of climbing a 3½in kerb.

Another amateur constructional robot design book is David Heiserman's *Build your own working robot* (Heiserman 76). In this machine — 'BUSTER' — control was provided by hard-wired logic rather than a microprocessor. Either might form the basis of a personal design.

Copy a design

It makes sense to start by copying an existing design that can reasonably be expected to perform to some specification before extending and modifying it to your own requirements.

These modifications may range from simple changes to the control algorithms, or adding new sensors more appropriate to the project; to a substantial re-build with major mechanical additions, such as a manipulator or dumper-truck type pallet.

There are few books about robotics in general, so the information required will often have to be gleaned from many different sources. One general review of the technical aspects of robotics can be found in John Young's book *Robotics* (Young 73).

Much of the work to be discussed this month has been done at universities around the world. Some comes from the research labs of larger companies, but mostly the mechanical aspects of robots are best covered by standard industrial design principles. This is the route most industrial robot manufacturers will take.

Their work will be governed by standard, well-understood and sound engineering knowledge and practices. This, in itself, is no bad thing: cost-effectiveness, reliability and usability are all pertinent factors.

Sophisticated sensor design and computer control are often treated with the utmost suspicion by industrial roboticists and will therefore only be used by them if all other possible solutions prove unsuccessful.

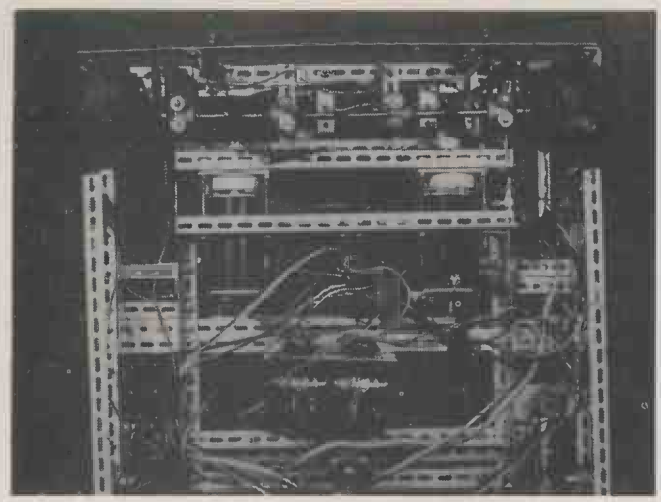
But in the long term, these will have to be introduced as robots are required to perform tasks requiring higher levels of skill than are currently possible.

A practical mobile robot will almost certainly be based on a platform powered by two independently controlled motors and some passive castors to maintain balance.

Ackerman steering, as used on cars, has occasionally been used, notably on vehicles for space and extra-terrestrial exploration. One, loaned by the Marshall Space Flight Centre to the Jet Propulsion Laboratory (JPL) had double Ackerman steering (steering on both front and rear wheels) with each of the four wheels independently powered (Lewis and Bejczy 73 and Dobrotin and Scheinman 73).

For more mundane, earth-bound vehicles, the Ackerman steering principle requires a complex system of linkages and is hard to control in confined spaces or where there are many closely-packed obstacles to avoid.

Most small mobile robots have two drive wheels along the central axis of a nominally circular body, though groundplans are often square or hexagonal. Then the castor forms a



Picture 2: Modified drive/steering configuration better suited to front alignment operations such as pallet lifting.

Picture 3: Standard wheelchair layout with driving wheels at the rear, as used on the University of California's 'JASON'.

triangular balance point — the weight of the batteries and electronics being used to ensure that the vehicle does not fall over (**fig. 1a**, p87).

Steering is achieved by driving the two wheels in different directions and/or at different speeds. By powering them both forward equally, the vehicle will travel in a straight line forwards; if both motors are reversed, the machine will travel backwards.

If one wheel goes one way and the second the other the base rotates about its centre point. By varying the ratios of motor speed, the vehicle spins about a point on a line between the wheels. If the motors are rotated in different directions, it describes an arc whose radius and direction depends on the ratio of rotation speeds and directions of both motors.

Every which way

'NEWT' (Hollis 77) used this configuration. The wheelchair base shown in **photograph one** has its driving wheels (almost) central. Notice the four castors support the weight evenly — the front two are hinged near the motor bearings. These and the wheeled projection at the front allow the vehicle to climb curbs up to 3½in high. This wheelchair base is to form the chassis of a new robot vehicle.

Castors of this form, where a wheel is used in an angled bracket, have a disadvantage because they tend to steer the vehicle in an unpredictable way until they realign themselves after each change of direction.

Figure 1b shows a modification to this standard layout (**photograph two**). Here the wheels are at the front. Steering and general controllability are similar to 1a. There is a slight advantage if the front edge of the vehicle has to be lined up with objects in the environment such as battery contacts on the robot's front that have to be aligned with a battery charger power source on the wall.

This layout should be considered if the robot is to be used in pallet shifting operations. The vehicle would be fitted with a 'fork-lift' attachment on the front and objects to be moved would be placed on pallets or low stilts. An object would be moved by running the fork-lift between the stilts and lifting the prongs — a task typical of most industrial warehousing.

A disadvantage of this system compared with **1a** is that it naturally spins about a point very near the front of the base and as a result can be quite difficult to extricate with simple software if it gets trapped in a tight corner.

Figure 1c shows the last configuration with driving wheels at the rear. This is the standard wheelchair layout (**photograph three**). 'JASON', built at the University of California at Berkeley, used this principle (Smith 73).

As a layout it offers neither easy leading edge positioning, as in **1b**, nor the 'escape' facility of **1a**. It is better suited to travelling over longish distances in a forward direction, where abrupt changes of direction are unusual. Its use therefore is best suited to uncluttered environments, as would be the Ackerman steering principle.

Loofbourrow's 'MIKE' has two forward-facing drive wheels at the rear corners of a triangular base and steers by pointing a third wheel at the apex of the triangle in the desired direction This layout seems to cost an extra motor for no particular advantage.

With all these layouts, 'forward' and 'backwards' are somewhat arbitrary, since the motors have to be bi-directional. It is the direction in which the cameras and the majority of the obstacle-detecting sensors point that really fixes the most significant direction.

These vehicles are almost always powered by low voltage d.c. electric motors, whose exact specifications will depend on the size, weight and performance required from the robot in relation to the tasks it will have to perform.

In general, d.c. motors work at high speed and low torque; but in a robot, low speed and high torque are required. Fortunately reduction gearing produces exactly this transformation.

Getting motorised

Photograph four shows four different motors. On the left is a Meccano six-volt motor with an integral six-speed reduction gearbox. In the centre is a six-volt model motor, with a 0.6amp free-running and seven-amp stalled rating.

Above and to the right of this motor are a selection of in-line sun and planet reduction gears for this motor. The gearboxes come in a selection of ratios from 2:1 to 6:1 and they can be stacked to provide any integer ratio.

A pair of these motors can be seen in **photograph two**; the output shafts of the motors feed a 5:1 box before a 20:1 worm drive gear on the wheel axles. Worm gears form an effective one-way mechanical linkage. The wheels will not turn if the motors are not powered, which is useful for instance for holding the vehicle on a slope. The foam-tyred wheels as well as the motors are available from most hobby model and radio control suppliers.

Below the motor, in the centre of **photograph four**, is a smaller one in the same series (6V, 100mA running, 500mA stalled). High levels of electrical noise generated by the Meccano motor make it unsuitable for computer-controlled robot drives, since they upset all but the most isolated and noise-suppressed logic circuits.

The motors on the wheel-chair (**photograph three**) are similar to those used for the windscreen wipers on cars. Clearly they are powerful enough to drive the weight of two car batteries and a fully grown man through their internal reduction gearboxes.

An uprated version of this motor type is used on the base **in photograph one**. Top speed is abour four miles an hour, fully laden with a man, and that can be alarmingly fast!

D.c. motors are not very easy to control to a high level of precision, but they are cheap, readily obtainable in a myriad different sizes and specifications with a quite adequate power-to-weight ratio. It is usual to control the speed and power output of d.c. motors by pulse-width modulation of the input current, rather than by varying the voltage levels at the terminals.

This is easy to arrange with small logic circuits or equally trivial microprocessor progams (Computabits 79a). **Figure 2** shows a bridge circuit that allows a d.c. motor to be run in either direction from a single voltage source.

Each of the transistor pairs A (Q1,Q2), B (Q3,Q4), C (Q5,Q6) and D (Q7,Q8) form a darlington pair (equivalent to a single transistor with a high current gain), that can be switched from 'off' to 'on' with TTL logic levels.

From previous page

With the circuit logic inputs unplugged and TTL inputs default to high, a logic zero appears at the bases fo Q5 and Q7, which means that switches C and D are non-conducting. The logic zero at the bases of Q9 and Q10 means that they are non-conducting, therefore a logic *one* appears at the bases of Q1 and Q3, so switched A and B are 'on'.

While the circuit is in this state, both the '+' and '—' poles of the motor are at the positive motor drive potential, so, the motor is in effect shorted out — giving a degree of reactive braking. If switch A is put into its non-conducting state (P=0) and C is switched on (Q=0) the '+' pole is still at the positive rail but the '—' is at the zero rail and current flows C— motor-B and it rotates in one direction.

If A and D are switched on and B and C off then the '—' pole is at positive and the '+' pole at zero and current flows D motor — A and it rotates in the other direction.

While none, or only one, switch conducts, the motor is effectively isolated. While A and B or C and D are conducting, it is partially shorted. If A and C or B and D, or any three or all four conduct, the power rails will be shorted through the transistors and they will be destroyed. It would therefore be worth designing a small logic circuit that converted a FORWARD/REVERSE and an ON/OFF logic pair into the correct P,Q,R and S drive signals, rather than rely on a length of code to do this.

The diodes are for back e.m.f. protection and the circuit, with the values shown, will work for motors drawing up to eight amps. As each of the transistor switches drops about a volt, the power rail should be two volts higher than the motor voltage rating. At medium and high current flows the power transistors get hot, so heat-sinks are called for. The circuit is shown in **photograph five.**

Mechanical construction

The overall size and shape of the finished robot may well be determined by the type of motor that is readily available or already to hand. There are no real guidelines about detailed mechanical construction, so a few pointers are called for.

Firstly, robust mechanical construction will always pay off in the long run. The robot in photograph two is constructed from 'Proto', which offers the same types of component as the familiar 'Meccano' construction system.

Meccano is not strong and rigid enough for load-bearing members but Proto can be bolted together to form a firm structure. Increases in robot size require corresponding upgrading in the strength of the individual structural parts.

Most robot vehicles, even the small ones, will clock the scales at surprisingly high weights, NEWT, for example, 30in high and 14in in diameter, weighs in at 60lb.

Since much of this weight will be transmitted to the wheel axles, these should normally be supported by proper bearings, rather than relying on the motor output shaft bearings.

Ample battery size is a crucial factor in determining the size of motor required. The vehicle must run for a period of several hours without recharging. Not only will the motors consume power, but electronic circuits, motor drivers, sensor systems, cameras and micro-processors will soon increase the power consumption.

With any form of computer-controlled robot, it is important to be able to determine how far and how fast the robot is travelling. D.c. motors are not sufficiently predictable to allow open loop control; even repeating the same actions will seldom give similar results.

There are several techniques for measuring distance traversed and it is usual to servo the speed of the motor using an optical or magnetic disc that produces a frequency proportional to the angular velocity of the wheel. Gray code encoder discs can be used to give a reliable indication of axial rotation, which can then be integrated in software to give precise co-ordinate positions.

The only practicable solution to high positional accuracy and repeatability is to drive the wheels with stepper motors. NEWT uses a pair of 200 step/revolution motors driving wheels with neoprene Q-ring types (that don't slip on the floor surface) through a 3:1 reduction gearbox, offering a total of 600 steps per wheel revolution.

Each step causes the robot to move by about 0.5mm or to rotate by about 0.1 of a degree. Complicated sequences of movements involving up to 100 separate actions still give a repeatability of in.

Stepping motors should be capable of accelerating from rest to full speed under load and then decelerating to a halt if the inertia of the robot is not to stall then while speeding up or overrun while slowing down, causing a loss of accuracy in either case.

Photograph six shows two different stepping motors, on the left a 15 degree/step, 28 volt, 38 ounce/in motor and on the right a 200-step (1.8 degree) 25 ounce/inch motor. The circuit shown acts as a power driver for any four-phase motor. The gear box is a 60:1 reduction worm-drive unit, with a built-in anti-backlash mechanism.

Further information on stepper motors and using them can be found in *Computabits 79b* and Giacomo 79, and Ralph Hollis gives the driver circuits for NEWT in Hollis 77.

Arm, manipulator and gripper deisgns present a different selection of problems. The photographs of industrial robot arms in Part One will given a general idea of the patterns in common use.

Robot body image

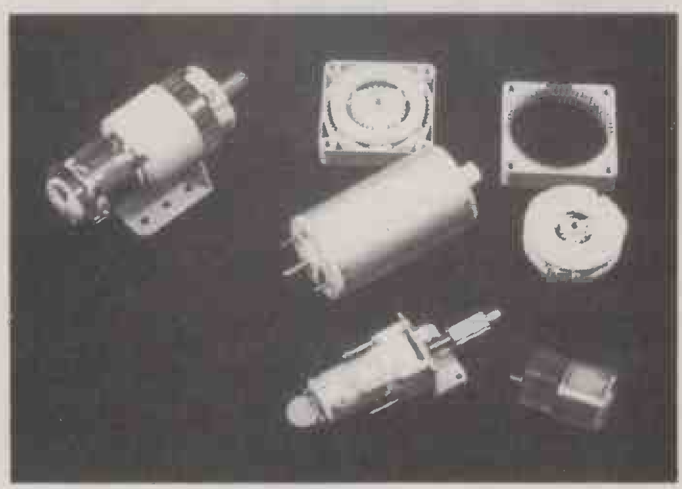
Any arm that is to have more than one special use must have certain characteristics (see: Burckhart and Helms 76). There msut be sufficient degrees of freedom (joints, extensions etc) to allow the arm to manipulate objects into several orientations within a good volume of space.

It must have sufficient power to not only lift its own weight, at the most disadvantageous extension and orientation, against gravity, but that of some payload as well.

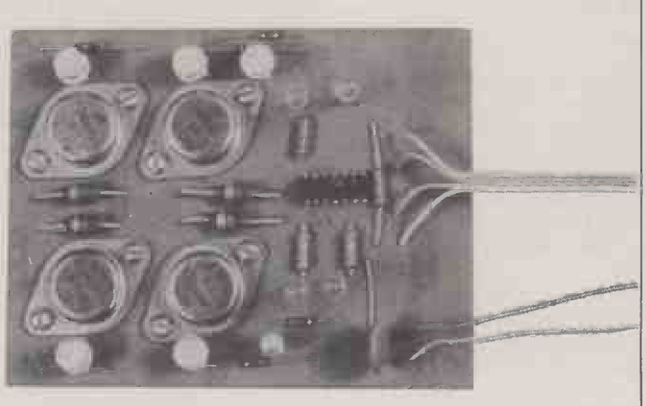
Provision must be made during the design stage to allow adequate sensing if the arm is to be computer-controlled. Dead reckoning open-loop control is only suitable for highly engineered devices with precise actuators.

The arm should be constructed to sufficiently fine tolerances so as to be rigid while stationary and also to give precise motions without backlash or oscillation when it moves.

Figure 3 shows the most commonly used types of motion, which, for the sake of



Picture 4: A selection of 6V motors with epicyclic gearbox components. Note that these motors can upset microprocessor controls unless electrical noise is properly supressed.



Picture 5: Completed version of the bridge circuit shown in figure 2. This permits a d.c. motor to be driven in either direction from a single voltage source. Note that heat-sinks.

argument, will be described as angular for 3a and 3b, rotational for 3c and 3d and linear for 3e and 3f.

In most mechanical arm designs, the whole machines can be thought of as a series of separate modules joined together. Basically a set of rods connect mechanisms that bend, turn or twist. In the case of a linear motion the rod itself expands and contracts.

Consider, as an example, the human arm, a shoulder, upper arm, elbow, forearm and wrist **(figure four)**. The shoulder is in effect two angular joints: the upper arm can swing backwards and forwards, and also up and down.

Arm flexibility

These two degrees of freedom are not separately hinged, but are produced by a ball-and-socket mechanism. The vertical swing is about 180 degrees and the horizontal 160. The shoulder can also move up and down a couple of inches and forward and backward a small distance.

Upper arm rotation, between the shoulder ball and socket and the elbow joint, is about 100 degrees, elbow bend is about 120 degrees. There is a rotation between elbow and wrist of nearly 180 degrees.

True rotations about a plane are unknown in nature, since it would be impossible to get nerve and blood vessel continuity across the joint.

The wrist motion of about 90 degrees up and down and 50 degrees from side to side leads onto the hand (which has about 19 further degrees of freedom) giving a total of nine degrees of freedom on the arm. This is not including the fact that the torso can be rotated and bent to either side and forwards.

The total volume covered by at one arm of the pair is a hemisphere, a little squashed at the front, of about 2ft 6in, plus a very limited area round the back. Both hands can work together only in the central 'slice' of that total volume.

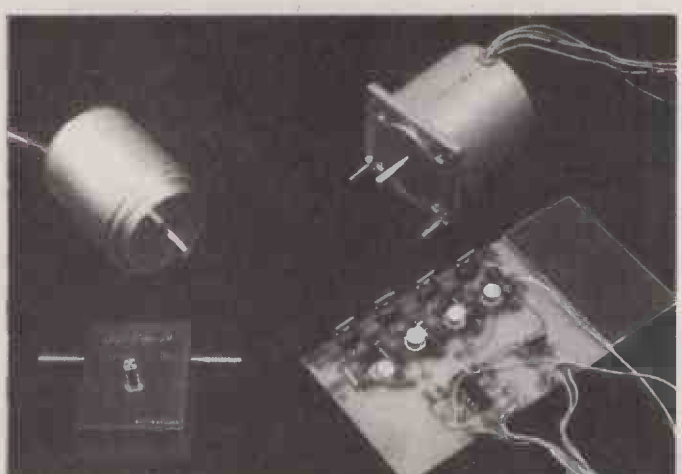
The motor is muscle — a pulling device — and hence muscles come in pairs, one to flex the joint and the second to pull it back. Hydraulic and pneumatic cylinders **(3b, 3d and 3f)** can be made to pull and push, by feeding pressurised fluid in at the ends, either side of the pressure seal.

One form of industrial robot that includes all three types of motion is typified by the Unimate series 4000 arm (see photograph two, last month, and **figure five**).

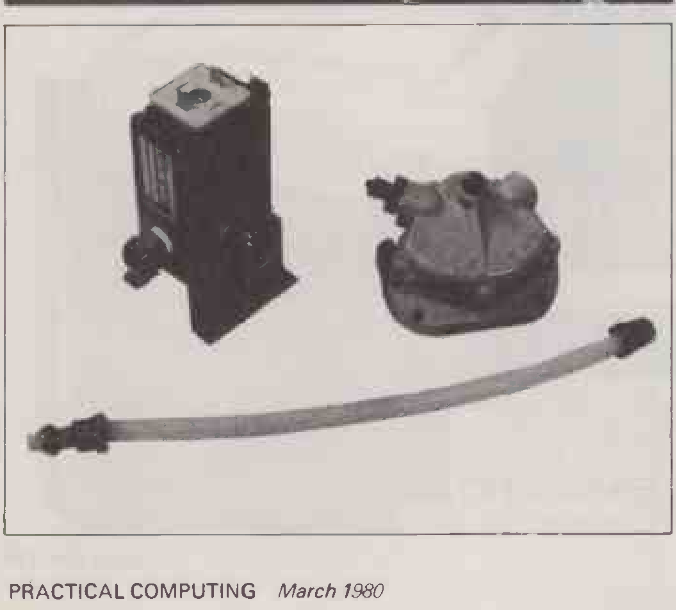
Base rotation is a maximum of 200 degrees (65 degree/second), maximum vertical stroke is 50 degrees (35 degrees/second), maximum extension is 1300mm (750mm/second from 1608mm to 2929mm). Wrist bend, swivel and yaw are 230 degrees, 300 degrees and 200 degrees respectively, all with a maximum rate of 110 degrees/second.

This arm has a maximum load carrying capability of up to 175kg and a positional accuracy of 2mm.

Compare that, if it is possible, to the plastic arm in **photograph eight**. Compressed air has been replaced by d.c. motors and the joints are held in position by worm-drive gears. It is shown as a warning to all those who think arm design is trivial: only two of five designed degrees of freedom were ever built.



Picture 6: Two stepper motors and power drive circuit for any four-phase motor. The gearbox is a 60:1 worm-drive mechanism.



Picture 7: Fluid drive motor using compressed air at around 80 psi. Input is through the two horizontal pipes; drive from the vertical shaft. Also shown is the on/off solenoid valve.

Notwithstanding photograph seven, electric motors are still probably the most suitable power source for small arm design (see: Scheinman 69 pp17-20), if they are sufficiently geared down to generate the high turning forces required.

Fortunately the largest and most powerful motors are also those most inboard — nearest the shoulder. In some designs, including **photograph eight** their weight can be used to counterbalance the weight of the remainder of the arm.

In many designs, the motors are not always at the joint; instead, the power is transmitted from the electric motors to the joint by wires, belts (toothed or untoothed), gears, steel ribbon or chains working over pulleys.

Smaller amounts of power can be transmitted over short distances by cables inside tubes, either rotational — like a speedometer or tachometer cable on a car, or pulling as is found in bicycle brake cables.

Great care is needed in the design of pulley-type mechanisms when power is taken over an intermediate joint between the power source and the joint to be moved. It is important that movement in that intermediate joint does not affect the driven joint. Attempts to compensate for this in software can be grim business, involving considerable computational expense.

Keith Baxter and Timothy Daily (Baxter and Daly 79) describe a design in which a five degree of freedom arm is constructed with all the power transmitted from small electric motors at the base to the joints via belts manufactured from neoprene O-ring cord over a series of plastic pulleys.

Strong enough for chess

Total reach was just over one foot with a lifting capacity of about ½ ounce — enough to lift board-game pieces (chessmen, draughts etc). Sensing may be provided by measuring the rotation of the drive pulleys. This is not the most satisfactory arrangement as one major source of error in this layout would be stretch and slip in the rubber drive cables.

Angular joints **(3a)** may be driven in several ways. An electric motor may be mounted to the inner extension and its output shaft connected directly to the outer rod. Any play in the reduction gearing on the motor will be magnified manifold, hence high-precision gearboxes are needed.

By careful motor selection, ample torque can be applied at the required speed, although care should be taken to limit the rotation of the joint so as not to stress either the hinge or any cable or wires that may be going further down the arm.

The inherent simplicity of this design is counteracted by the weight of the motor, which imposes a severe mechanical disadvantage to the drives on previous degrees of freedom.

To overcome this, the motor may be placed at the most inboard end of the design, but the resulting pulley and cable mechanism adds further mechanical complexity and is another source of play in the system.

Figure 3b shows a piston used to provide power. Mechanical disadvantage may easily be calculated from the pivot positions along the arm lever — it is, however, the basis of the human arm — and that seems to function well enough.

An alternative fluid-drive motive source is shown in **photograph seven.** In the centre of the picture is a pneumatic vane motor. Pressurised air (at about 80 psi) is fed to the two inputs and

continued over page

AERCO GEMSOFT

APPLE 2 Comes to Woking!

Aerco Gemsoft have just opened their new computer division in Woking and invite you to drop in for a look at some real computers: —

APPLE 2
SUPERBRAIN
MICROSTAR 45
OHIO SCIENTIFIC

We are official Apple agents and southern area distributors for the Intertec Superbrain.

Apple 2 16K (Europlus B & W)	£750.00
Superbrain 64K (Twin Disks)	£1995.00
ITT 2020 16K (Colour)	£867.00
Microstar 45 Plus	£4950.00
Apple 2 Disk Units from	£355.00
16K Memory Upgrade Kit	£69.00
Serial/Parallel Interface Card	£110.00
Pascal Language Card	£296.00
Anadex DP-8000 Printer	£570.00
9" Hitachi Monitor	£132.00
12" Hitachi Monitor	£210.00
Auto-Start ROM	£40.00
Eurocolour Card	£69.00

DISK BASED BUSINESS SOFTWARE FOR APPLE 2/ITT 2020

Sales Ledger Payroll
Stock Control General Ledger
Invoice Printer Price List Maintenance
Please add 15% VAT to above prices.

Send S.A.E. for full catalogue containing over 100 programs for PET, Apple & Exidy Sorcerer. Trade enquiries welcome.

Gemsoft can supply you with a complete (and fully expandable!) Apple system off the shelf including twin disks & printer for £2431 + VAT.
We specialise in designing complete systems and our expert in-house programmers are available to write any customised software from business systems, through industrial control systems to scientific and research programs.

GEMSOFT LTD, 27 Chobham Road, Woking, Surrey. Phone Woking (04862) 22881.
Open 6 days a week 9.30-5.30 p.m.

• Circle No. 172

the software house

APPLE II MICROCOMPUTERS
BUSINESS SOFTWARE
EDUCATIONAL SOFTWARE

DEMONSTRATIONS GLADLY GIVEN

WE CARE ABOUT AFTER SALES

SERVICE & ADVICE IS FREELY

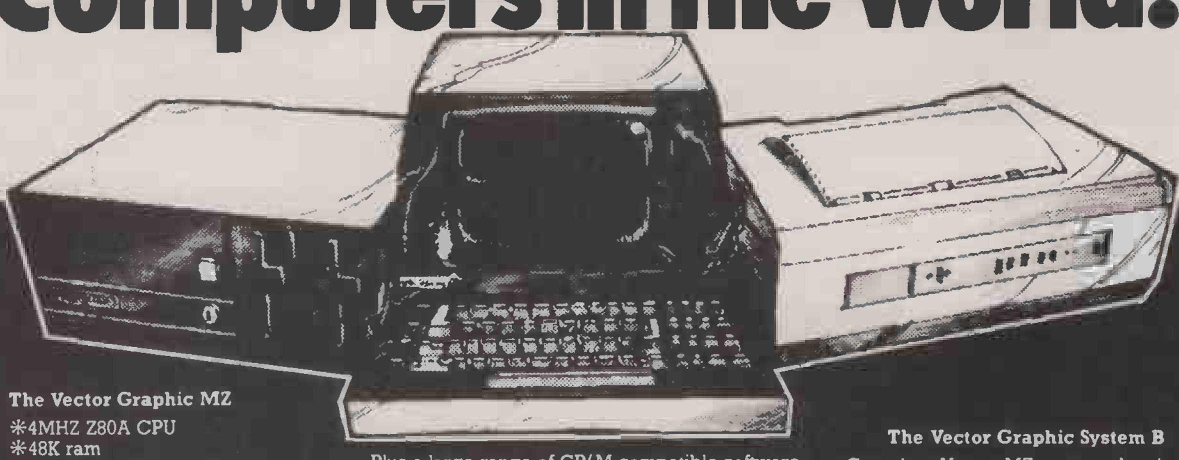
AVAILABLE ON MOST SUBJECTS

SHOWROOM:
146 OXFORD STREET LONDON W.1.
TEL. 01-637-1587

OUR CATALOGUE OF SOFTWARE
(FOR MOST MICROS) IS FREE

• Circle No. 173

Possibly the most cost effective Laboratory Computers in the world.



The Vector Graphic MZ
*4MHZ Z80A CPU
*48K ram
*630K Bytes disk storage
*Serial port and two parallel ports
*Prom/ram Board with monitor
*MDOS Operating system
*Z80 Assembler
*Basic Interpreter

Plus a large range of CP/M compatible software including Fortran, Cobol, Macro assemblers etc.

The Vector Graphic System B
Complete Vector MZ system plus:*
Vector Mindless terminal
Flashwriter 2 video board (24 x 80)*
Software driver on prom
MZOS North Star compatible DOS*
CP/M configured by Almarc

ALMARC DATA SYSTEMS LTD
906 Woodborough Road, Nottingham. Telephone: (0602) 625035

• Circle No. 174

From previous page

the difference in pressure between the two supplies positions the vane inside the triangular body accordingly. Output power is taken from the shaft at the top of the casing.

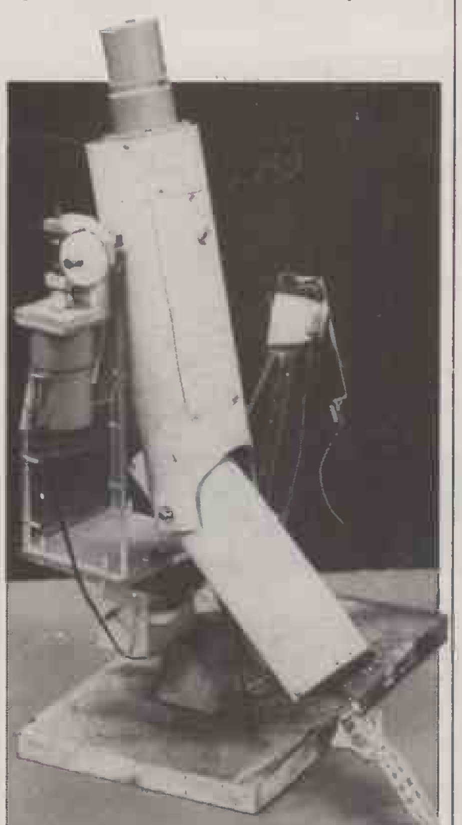
Also shown in the photograph is a solenoid valve for allowing or interrupting the air flow using an electric control current. Its working speed is of the order of milliseconds. Rotation is limited to 90 degrees, but these motors come in a range of sizes. The area of the vane, coupled with the maximum air presure usable, dictates the torque rating of the device.

One disadvantage of using compressed air in this way is the need for compressed air itself. Most engineering laboratories and workshops will have a pressure line piped around the area, but work elsewhere will need compressors. Those that deliver 80-100 psi at a reasonable flow rate are both bulky and expensive.

Rotations (3c and 3d) can be accomplished by attaching the arm extension directly to the output shaft of an electric or fluid-vane motor. A linear motion can be converted to a rotary one, as in figure 3d, which is similar to the arrangement used to drive car windscreen wipers. A piston could be used to push a rack gear — with the pinion on the shaft.

Linear motions can be produced by electric motors driving a rack and pinion gear (3e), or a lead-screw mechanism. Lead-screws, like worm drives, offer a high resistance to displacement when the motor is not driving them, and this might be a useful feature, particularly if power was at a premium or if one does now wish continually to servo the position of that joint.

Fluid power can be used, as in figure 3f, or the whole extension can be fashioned from a pneumatic or hydraulic cylinder. A piston with square or oval cross-section will prevent a further, unwanted, rotational degree of freedom being inadvertently introduced.



Picture 8: Be warned: arm design is no joke! This complex-looking machine achieved only two of its five designed degrees of freedom.

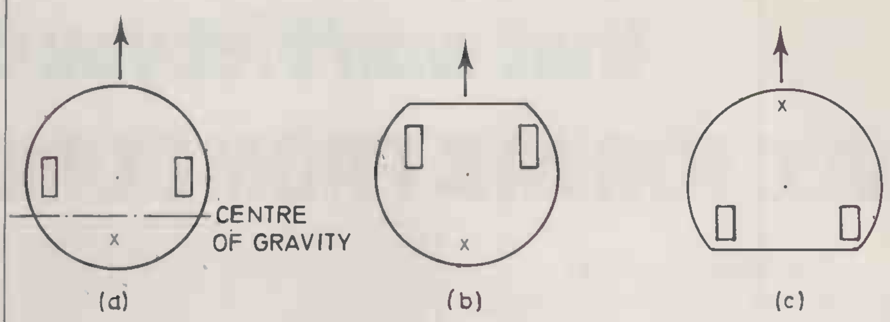


Figure 1: Motor drive configurations

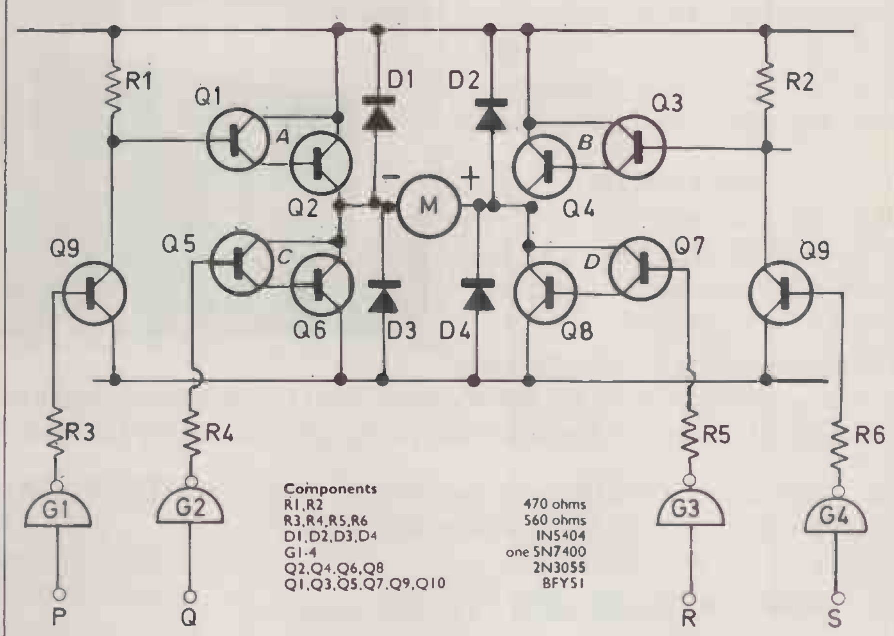


Figure 2: A d.c. motor drive circuit

Grippers and hands are usually formed from a pincer-type of motion that seize the object to be manipulated between two jaws. These will often be designed so as to remain parallel to each other as they close, using some straightforward parallelogram linkage.

All thumbs

'Human'-like hand designs are rare, even though a design with two fingers and an opposing thumb would show advantages over the straight gripper. It is standard industrial robot practice to bolt specialist tools onto the wrist joint: spanners for doing up bolts, hooks, magnets or suckets for lifting things and so on.

Experimentation is essential in robotics and new ideas are always being tested. The 'ORM' arm is constructed from a series of circular plates with a number (eight in this case) of pneumatic actuators between the plates. Figure 6 shows the principle of the device. (Roth *et al* 1973).

There were problems with the construction and control of this form of manipulator, but it could well form the basis of an even better idea. It is obvious that the human arm might form the basis of a computer-controlled manipulator, and that the study of quadruped locomotion would assist with the study of motion in a four-legged walking machine.

One might wonder, therefore, if nature has any other interesting and fun designs to research. Mechanical insects, dinosaurs, crabs, starfish and assorted creatures from ancient mythology have all been discussed as likely candidates by various members of the laboratory.

The Japanese Active Cord Mechanism (Hirose and Umetani 76) is a highly articulated robot with a long, thin body and is based on that team's study of snake locomotion. It shows some interesting properties.

Part Three of this series will be concerned with the design of robot sensors and sensory systems, and how this information is fed into microprocessors.

The small business system that won't let you down

VECTOR MZ FROM COMPUTASTORE

Computastore has combined the powerful Vector MZ microcomputer with the reliability of proven accounts packages to bring you the benefits of a Small Business Computer at a price you can afford. With a high speed printer, the total system costs £5500, including installation and training – no extras to pay.

The integrated accounts packages provide the flexibility and ease of operation that first time users demand. Operator training is provided at YOUR premises, using YOUR data to get your system working within days. And because our accounts software has been developed in-house, the standard packages can easily be tailored to meet your needs exactly.

- **SALES LEDGER:** Open item system, produces statements and current aged debtors balance at any time – not just at month end.
- **PURCHASE LEDGER:** Open item system, produces aged creditors balance and remittance advices at any time – you choose the items you want to pay.
- **NOMINAL LEDGER:** Links with both sales and purchase ledgers. Compares actual with budget, and with same period previous year.
- **ONE OFF SOFTWARE:** We will be pleased to quote for any other commercial application.
- **WORD PROCESSING OPTION:** Combine your word and data processing on the same system.

TECHNICAL OVERVIEW:

Vector MZ: Industry standard CP/M operating system, 48K RAM, 630K Disk Drives, Fast Z80 microprocessor, S100 bus.

Mindless Terminal: High quality 80 x 24 upper and lower case display, Typewriter style keyboard, with numeric keypad.

Texas Instruments 810: 150 c.p.s. high quality dot matrix printer.

ONLY £1,700 32K Vector MZ complete with 630K disk drives, CP/M, C/BASIC and NAD.

Full Range of Low Cost Accessories by Mail Order.
*Barclaycard and Access welcome.

HARDWARE, SOFTWARE and ACCESSORIES sold either as complete systems or separately.

All goods in stock NOW, so why not call in for a demonstration, or ring or write for further details.

Computastore

Software That Means Business
16 John Dalton Street
Manchester M2 6HG
Tel: 061-832 4761

• Circle No. 175

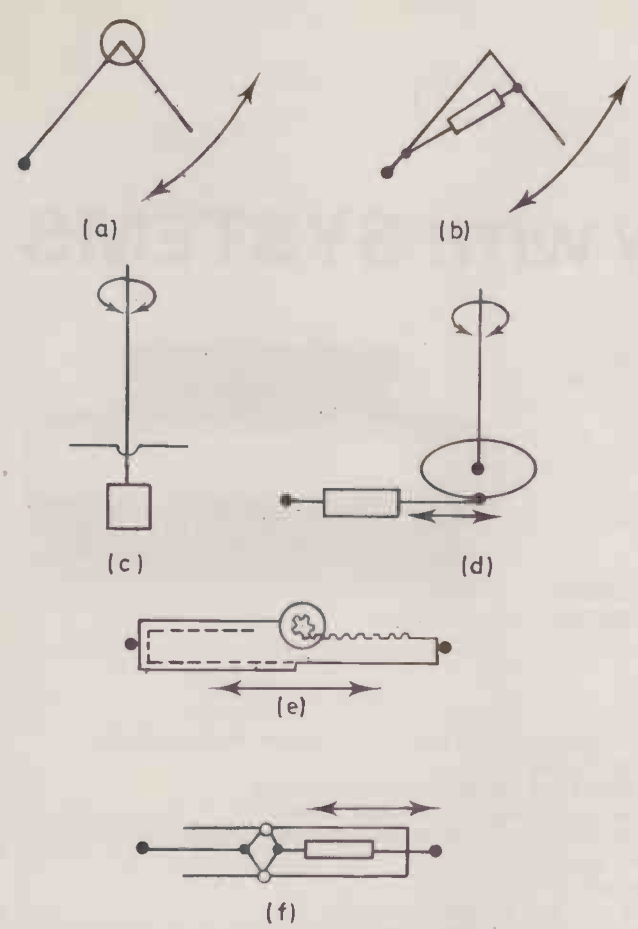


Figure 3: Angular, rotational and linear degrees of freedom (a) (b) (c) (d) (e) (f)

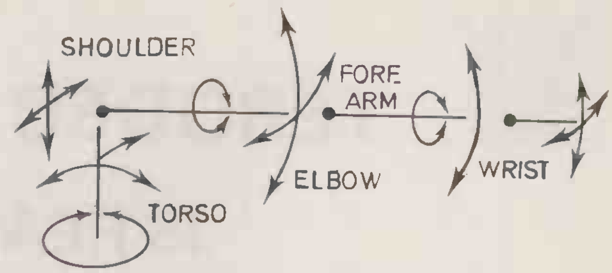


Figure 4: Degrees of freedom of the human arm

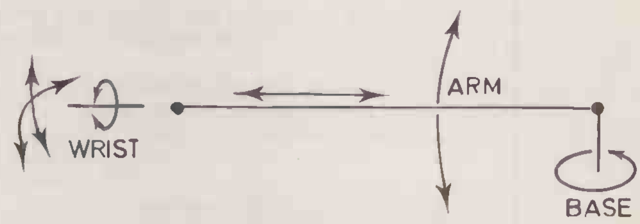


Figure 5; Degrees of freedom of the Unimate arm

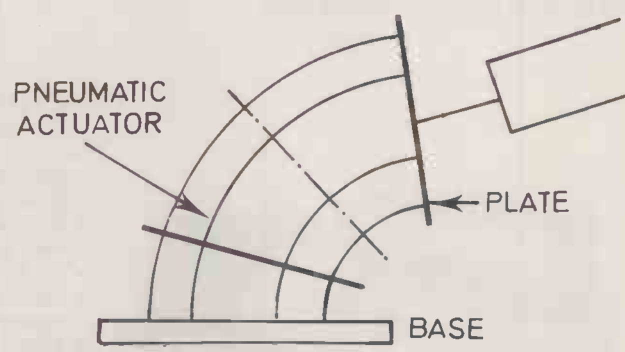


Figure 6: Principle of 'ORM' arm

References

Baxter K. and Daily T. (1979): *A hobbyist robot arm* in: Byte 4-2 (February 1979)

Burckhardt C. W. and Helms D. (1976): *Some general rules for building robots* in Proceedings of the Third Conference on Industrial Robot Technology and Sixth International symposium on Industrial Robots. Held at Nottingham University, March 24-26th, 1976, ppE4-49 to E4-58; Bedford, England, International Fluidics Services.

CISM-IFToMM (1973) (organisers): *On theory and practice of robots and manipulators.* Proceedings of First CSIM-IFToMM symposium at Udine 1973; Springer-Verlag, Vienna-New York. Two volumes, ISBN 3-211-81252-0 and ISBN 0-387-81252-0.

CISM-IFToMM (1976) (organisers), Morecki A. and Kedzior K. (eds): *Theory and practice of robots and manipulators,* Proceedings of Second CSIM-IFToMM symposium at Warsaw 1976; PWN — Polish Scientific Publishers/Elsevier Scientific Publishing Co, Amsterdam-Oxford-New York. One volume, ISBN 0-444-99812-8.

Computabits (1979a) (Hampshire N., Ed): *Using KIM-1 to aid motor control* in: *Practical Computing* 2-4 (April 1979), pp90-96.

Computabits (1979b) (Hampshire N., Ed): *Stepper motor control using KIM-1,* in *Practical Computing* 2-5 (May 1979) pp91-99; 3-1 (February 1980)

Dobrotin B. M. and Scheinman V. D. (1973): *Design of a computer controlled manipulator for robot research,* in: Third international joint conference on artificial intelligence at Stanford University, Calif, 20-23rd August, 1973 pp324-335. Stanford Research Institute (Publication Dept.), advance papers.

Giacomo P. (1979): *A Stepper motor primer: Part 1: Theory of operation* in: Byte 4-2 (February 1979) pp90-105 and Part 2: *Interfacing and other considerations* in: Byte 4-3 (March 1979)

Heiserman D. L. (1976): *Build your own working robot,* Slough, England: Foulsham-Tab Ltd. ISBN 0-7042-0171-2.

Hirose S. and Umetany Y. (1976): *Kinematic control of active cord mechanism with tactile sensors,* in CSIM-IFToMM (1976), pp241-252.

Hollis R. (1977) *Newt: A mobile, cognitive robot* in Byte 2-6 (June 1977)

Kato I., Ohteru S., Kobayashi H., Shirai K. and Uchiyama A.: *Information-power machine with senses and (WABOT-1)* in CISM-IFToMM (1973), Volume 1, pp11-24.

Lewis R. A. and Bejczy A. K.: *Planning considerations for a roving robot with arm* in Third international joint conference on artificial intelligence at: Stanford University, Calif., 20-23rd August, 1973 pp308-316 Stanford Research Institute (Publications Dept) advance papers.

Loofbourrow T.: *How to build a computer-controlled robot.* New Jersey: Hayden Book Co Inc, ISBN 0-8104-5681-8.

Roth B., Rastegar J. and Scheinman V.: *On the design of computer-controlled manipulators* in: CISM-IFToMM (1973):, Volume 1, pp93-113.

Scheinman V. D. (1969): *Design of a computer-controlled manipulator.* Stanford Artificial Intelligence project MEMO-AIM-92. University of Stanford, Computer Sciences Dept.

Smith M. H. (1973): *Design of a low-cost, general-purpose robot* in: Third international joint conference on artificial intelligence at Stanford University 20-23rd August, 1973, pp324-335.

Young J. F. (1973): *Robotics.* London: Butterworth ISBN 0-7042-0171-2.

The Games Master

George Blank is a pastor and edits *Softside*, an American magazine which specialises in games for the Tandy TRS-80. In this, the first of two articles, George discusses the rationale of game playing and argues that computer games can teach essential human skills.

LAST WEEK my eldest son came home from school upset because he could not recognise all the lower-case letters. I wrote a game for the TRS-80 that required him to identify letters on the screen; after each set of ten letters, it displayed a space battle in which the survival of his spaceship depended on accurate guessing. Using the game, he learned in a couple of hours something that everyone else had failed to teach him over several days.

This morning my younger son, aged four, sat at the computer and played for an hour. His favourite game is a chase through a maze avoiding a troll. This afternoon, the daughter of a friend, at the age of nine months, stood, fascinated, for five minutes on a chair in front of the keyboard playing a game that made patterns with letters and symbols corresponding to the keys she pressed.

One of the fringe benefits the magazine *Softside* offers the staff is a game night on Fridays; adults and teenagers play games into the early hours of the morning on our three TRS-80s. Two weeks ago we had a multi-player simulation game on all three computers, shifting from one to the next as people took their turns; everyone becoming thoroughly confused over where they were in each game. Still, the game went on until after two.

There is no denying the fascination of these games. Even in my most proper role, as the pastor of a Presbyterian Church, I have found uses for computer games. The youth of my parish love to gather around the computer, and in our leisure hours so do my fellow pastors from our community. So what is the source of the enchantment?

I believe that play is one of the most important facets of our humanity. As children, we play automatically. A great deal of our learning takes place in play, from the development of language skills to the acting out of adult roles.

Child is father to the man

This fascination with play does not stop with adulthood: while I am sitting at the computer and my sons play with toy cars on the floor, my wife loves to remind me that "the only difference between men and boys is the price of their toys".

Perhaps the most elaborate games played are sponsored by governments to develop military skills. They use complex simulators to teach flight skills to aviators, and they spend fortunes on war games. I am not thoroughly convinced that war itself is not a game to national leaders.

The computer adds a great deal of depth to games. It can perform elaborate computations based on simple inputs from player to create fantasy worlds, simulate real activities, or test and evaluate the skills of one or more players in competition with each other or the machine.

It has excellent capacity for scorekeeping, even in games that have been around long before the computer. With the capacity for accurate simulation of real processes, colour graphics, and sound, the computer makes possible games that we cannot presently even imagine.

As the editor of a magazine that specialises in providing games, I have long reflected on the sources of our fascination with games. I identify three factors: curiosity, the practice of essential skills, and the structure of time.

Human curiosity

Human curiosity is the source of culture and civilisation. For thousands of years we have been fascinated with how things work, with finding better ways to do the things we must do to survive, and with improving the conditions in which we live. That curiosity goes beyond the merely practical, and exhibits itself prominently in games. A large part of the fascination of computer games lies in the exploration of new ideas and new capabilities.

The practice of essential skills may be the origin of games. Children frequently play at adult roles. In hunting and gathering societies, this form of play is essential for survival, and we find similar behaviour even among animals. A kitten plays at hunting, and the cat may even cripple a mouse to teach her cub how to seek food.

While curiosity and practising skills are important even in computer games, I am convinced that the primary appeal of games lies in the structure of time. With the frenetic pace of contemporary life, time has become an enemy. We rush to keep appointments, struggle to meet deadlines; we watch the clock hoping in desperation for the end of the workday. When we have nothing to do, time is a burden.

But there are certain magic moments in our lives in which all sense of time disappears. Most computer hobbyists have had the experience of programming long into the night without any sense of tiredness or an awareness of the time. This loss of a sense of time has recently been given a label, 'flow', and it has been scientifically studied in an attempt to discover what creates flow and why it is so pleasurable.

There are four factors in computer games which create flow: they are challenge, creativity, imagination, and social interaction. Sometimes the factors can work against each other to decrease the pleasure of a game; but I have not found a single game that I enjoy without at least one of these factors present in excellent measure.

Challenge usually relates to manual dexterity, competition, or intellect. A few years ago, when I lived in Scotland, I remember watching in sheer fascination as a young lad kept a football bouncing with his head, shoulders, and feet for several minutes. He practised for hours at a time, and had developed an amazing facility in co-ordination and dexterity.

Another excellent example is an aerial battle between fighter planes in which great physical skill is necessary for survival: and this is an even better illustration of competition. The real source of flow in such a battle, the real loss of the meaning of time, comes from the high stakes involved.

A fight to the death is the ultimate form of human competition, and it may have been the original 'game' as early men fought for inadequate supplies of food, shelter and mates.

Popular myth

The popular myth that computers are intelligent makes competition against the machine stimulating. But computers are high-speed morons while humans are low-speed geniuses; so the best competition is between people, perhaps mediated by the computer.

Intellectual challenge is well illustrated by chess, a game so complex that true mastery is impossible. Grand Masters achieve their rank by defeating other good players, not by conquering the game itself: and sooner or later each of them is beaten.

The intellectual challenge of chess comes from its complexity, which itself is

Continued over page

From previous page
present in two forms. 'Factor complexity' is provided by different numbers of six different kinds of pieces with different moves, including some moves for exceptional cases such as castling. But the true complexity in chess is 'relationship complexity', as different relationships of the same pieces create entirely different situations. In chess, time, as well as space, is critical, as the value of a position often depends on who has the next move.

Most computer games tend to be intellectually trivial because of a lack of complexity. This is why many are short-lived in popularity. A major consideration in challenge is continuity of action, with one threat arising even before the previous one has been dealt with — which often happens in chess strategies.

The second major factor in creating flow is *creativity*. The development of new strategies, the creation of patterns, the opportunity for bold risks, all improve a game. Creativity is the factor which leads me to spend more time writing games than playing them: artists, writers, and programmers all have opportunities to chart new territory, and it is often exciting. If any of the same qualities can be put into a game, that can be an important advantage.

The challenge of creativity has made Adventure one of the best computer games. There are essentially no rules, and players develop their skills as they go along.

Imagination, the third major factor, is stimulated by role playing. Subtle cues create a new universe for the player, as we imagine ourselves in King Arthur's Court or aboard the Starship *Enterprise*. Role playing is enhanced by providing interaction with known characters — in a simulation of Camelot a player might have to deal with Merlin, Guinevere, and Lancelot, among others.

Time machine

In historical simulations, the imaginative task is to lift the players out of the present and transport them to the historical situation — so that they imagine themselves a soldier in Ceasar's legions, or Marco Polo meeting the Great Khan. Research and adequate cueing accomplish the identification. In fantasy simulations, the task is to creative a new universe. Simply populating a game with dragons or elves and goblins can stir up images in the mind that stimulate the imagination and create flow.

Social interaction is the last of the four major factors in creating flow. It is at the same time the most important source of flow and most neglected in computer games. Many computer games are even written as substitutes for human society. This may be a valid approach — it is often difficult to find others who have time to play a game — but it is an unfortunate one.

I prefer to write interactive games designed to stimulate conversation and friendship among the players. The basic gift to humans to one another is affirmation, the feeling of value as a person.

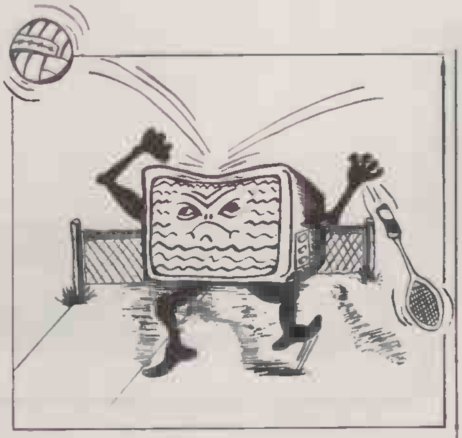
That sense of affirmation, value, and belonging is very important in my ministry, and I carry the same principles through into my games. They tend to be ideological, deliberately stimulating understanding of economics, history, politics, values, culture: that is, I put a piece of myself into all that I write.

I believe that single-player computer games ought to serve to reinforce our sense of values if they are to be satisfying alternatives to social interaction. One way to do this is to provide a scale of skill, so that players can measure the growth of their progress. No good game is strictly random, and any game which builds skills builds confidence and self-affirmation.

Games lift us out of ourselves, teach us new skills, open us up to new ideas, make new friendships for us, and present us with some magical and delightful moments in our lives.

Put some bounce into that games writing!

S. J. Baker describes some neat tricks for making balls bounce on the computer screen. His listings are for the TRS-80, but the same principles will apply to any memory-mapped display.



SIX MONTHS AGO I became the proud owner of a 4K, Level II TRS-80 whose name is Elizabeth. Like most non-business machines, it is used mostly for developing and playing computer games and over the last few months I have learned a fair amount of Elizabeth's inner workings. As a result I have come up with several techniques, both in hardware and software, to help me get the most from my machine.

Although these articles will be aimed at fellow TRS-80 Level II users, most of the ideas presented will be useful to anyone whose computer has a memory-mapped display, soft-scanned keyboard and a few bits of input/output capability.

Animated display techniques

The basic attraction of any of the usual "arcade"-style games programs (tennis, football, etc) lies in the ability to simulate the movement of bats, balls, spaceships and the like in real time. To achieve these effects, we first write out the characters used to represent the moving object, then overwrite them with spaces (or whatever character we choose to represent the background of the field of play) — for example...

```
10 CLS : FOR I = 0 TO 63 : PRINT CI, "*"; :
   PRINT CI, " " ; : NEXT I
20 END
```

As with all programs listed in this series, I shall present them with plenty of redundant spaces in order to improve readability — when entering the programs to be run, the reader should remove all these spaces to improve running times.

This simple one-liner moves an asterisk from the top-left of the screen to the top right in about 0.78 seconds. Although this is fast enough to avoid jerky movement when no other work is being done in the program, we find that it is too slow for a fast action game by the time we have added bat movement, storing, ball bounce and sound effects. Does this mean that we must resort to assembly language? Not if we are careful in writing the Basic code in such a way as to make maximum use of the machine's architecture. Let's see just how rapidly we can cause an asterisk to bounce around the screen... *Contined over*

From previous page

```
10 CLS : CLEAR 100 : DEFINT A-Z :
   S = 15360 : P = S + 480 : V = —65
20 PRINT CO, STRING$ (64,188) ; :
   PRINT C896, STRING$ (64,143) ; :
   FOR I = 64 TO 832 STEP 64 :
     PRINT CI, CHR$ (191) ; :
     PRINT CI + 63, CHR$(191) ; :
   NEXT
30 I = PEEK (P + V) :
   IF I = 32 THEN 40
   ELSE IF I = 143 OR I = 188 THEN
     GOSUB 1000 : GOTO 30
   ELSE IF I = 191 THEN
     GOSUB 2000 : GOTO 30
40 POKE P,32 : P = P + V :
   POKE P,42 : GOTO 30
999 REM Subroutine at 1000 does UP/DOWN bounces.
1000 I = SGN (V) * (64—ABS(V)) : V = — V — I — I :
   RETURN
1999 REM Subroutine at 2000 does LEFT/RIGHT
   bounces.
2000 I = SGN (V) * (64—ABS(V)) : V = V + I + I :
   RETURN
```

Line 10: Initialises the program,

S — Address of screen memory
P — Position of the ball.
V — Movement vector.
(P + V) — Next position of the ball, assuming it doesn't bounce.
I — Temporary variable.

Notice that I have used DEFINT to tell BASIC to store all variables — very few games require floating point arithmetic so DEFINT saves memory and a great deal of time.

Line 20: Draws a rectangle around the screen, leaving bottom line free for any scoring or other messages. This also stops the TRS-80 from scrolling the screen up and losing the top line of the rectangle. Characters 143, 188 and 191 are TRS-80 graphics characters.

Line 30: The program detects rebound conditions, not by directly measuring the ball's position on the board but by PEEKing the screen memory at the address the ball is about to move into and testing the resultant character to see if it is free. Try running the program then add a new line ...

```
25 PRINT C595, STRING$ (30,191) ;
```

which adds an obstacle in the middle of the board — the ball automatically bounces off it without any extra testing in line 30. I have used different characters for the sides (character 191) and the top and bottom (143 and 188) so that line 30 can decide which way to bounce the ball.

Line 40: This line can only be reached if the ball is about to move into a vacant cell, so we can safety update its position after having first erased the asterisk (character 42) from its old position with a space (character 32).

Lines 1000 and 2000: These are one-line subroutines to do the arithmetic on the movement vector (V) — The table below gives the new values needed for V ...

Direction	Old V	New V Vertical	New V Horizontal
North-West	—65	+ 63	—63
North-East	—63	+ 65	—65
South-West	+ 63	—65	+ 65
South-East	+ 65	—63	+ 63

The values given for V give diagonal motion on the screen because adding or subtracting 64 to P would cause the ball to go down or up the screen by one line and adding or subtracting an additional 1 causes it to move to the right or left respectively. The values given in the table are calculated fairly rapidly using a simple arithmetic expression through the use of a look-up table for the new values might well prove faster.

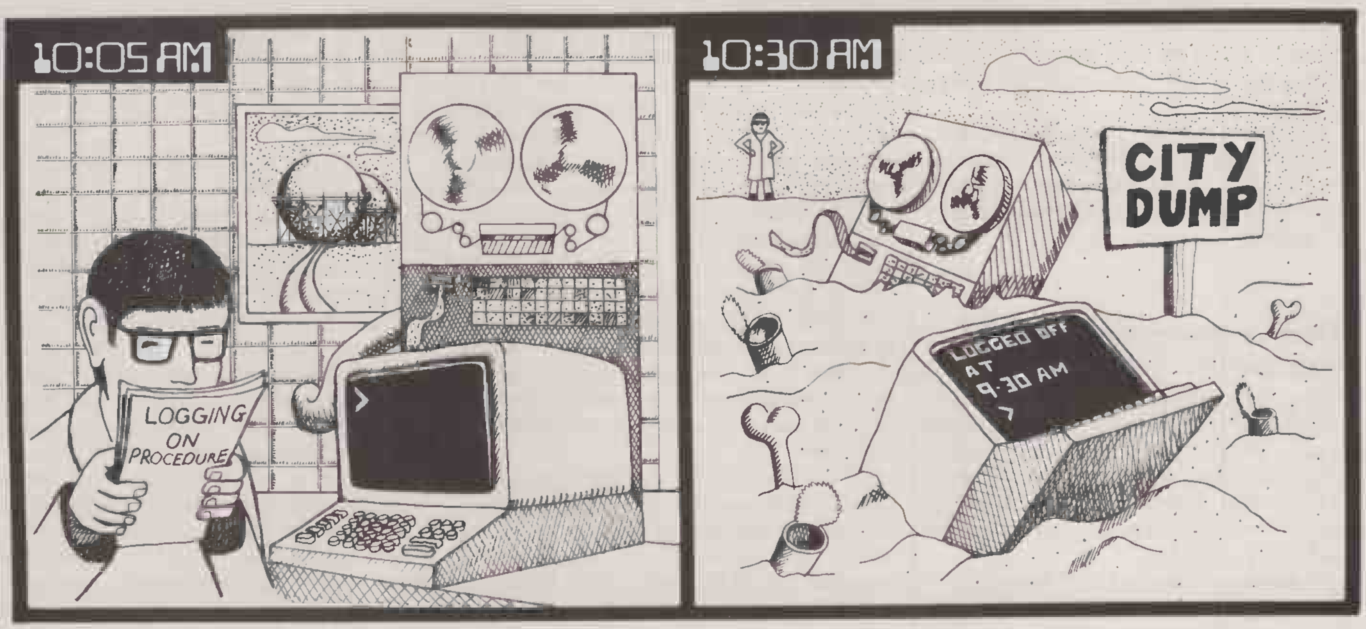
One can see, then, that this short program represents the beginnings of a fast and very flexible 'arcade'-style game where goals, bats and other terrain obstacles may be added at little or no cost in processing time or memory space. One word of warning — don't under any circumstances "breach" the wall surrounding the area of the play — for example by adding the line...

```
25 PRINT CO, STRING$ (25,32) ;
```

because this may result on the ball leaving the screen area altogether and bouncing off through memory deleting everything in its path!

If you think I'm kidding, just try it — but be sure to CSAVE your program first because you will probably have to switch the machine off before you can get any sense out of it again.

● **In his next piece S. J. Baker shows how to generate music and sound effects without any additional hardware except a hi-fi amplifier and a connecting cable.**



Stop the world, I want to get off! by S.W. Bailey

THIS NEW fifth-generation computer has its CPU the brand-new Z8055 chip. This chip, unike its predecessors, does not work on electron technology, but instead utilises the new technology based on chyons.

These particles travel much faster than electrons, so much so that they arrive at their destination before they have in fact been transmitted. This has many distinct advantages in a computer system:

- ☐ **In a file maintenance system, the computer will be able to tell which files will no longer be needed, and can thus purge them.**
- ☐ **Reports can be written to an output device before the data for these reports has even been input.**
- ☐ **A compiler will be able to tell in advance which jobs will have compilation errors and can thus abort the compilation before starting it.**

The clock which times the functions of this new generation of computers runs at the modest speed of 70THz or $70 * 10^{12}$ Hertz. This leads to the incredible instruction cycle time of 2.59aS or $2.59 * 10^{-18}$ seconds.

This fantastic new series of computers does however have two minor drawbacks:

- ☐ **You will need a nuclear reactor to power it.**
- ☐ **It is so fast that before you can "log on" to the system, it logs you off in anticipation that you will eventually do so anyway!**

In the right-hand corner, the ambitious home computeer limbers up to

Get an armlock on machine code

David Peckett begins a series on writing Assembly Language — a series many readers have requested. Over the next months David will deal in parallel with both the 8080A and the 6502. Since the Z80's instructions include the 8080 set, this combination covers most micros in popular use. We hope the series will drive some beams of light through the machine code jungle.

Decimal	Binary	Hex	Decimal	Binary	Hex
0	0000	0	8	1000	8
1	0001	1	9	1001	9
2	0010	2	10	1010	A
3	0011	3	11	1011	B
4	0100	4	12	1100	C
5	0101	5	13	1101	D
6	0110	6	14	1110	E
7	0111	7	15	1111	F

Table 1: Decimal — binary — hexadecimal conversion

IN THE FIRST PLACE, this series is not intended to teach the basic concepts of programming — these have been described before, in great detail, and apply to any form of programming, be it in assembly language, Basic, Pascal, or whatever. So, if you're totally new to programming, this series is not for you.

Nor yet will it teach you how to build a microcomputer; neither will it go into the detail of how a microprocessor works.

So, who is the series aimed at? It's aimed at the person who normally programs a micro in a high-level language such as Basic, but who also wants to program in machine code. It's also aimed at anyone else who wants, or is forced, to come to grips with the fascination of assembly-language programming.

In this article, then, I describe just what assembly language is, and what programs in it look like. In the article, various words are printed in italics — these are defined in a glossary at the end.

What is assembly language?

First, let's define a "microprocessor":

A microprocessor is a single integrated circuit which provides the control, program interpretation and data manipulation facilities of a computer's central processor unit. Among its salient features, it typically

☐ manipulates data in 8-bit "bytes";

☐ has one or two accumulators where the data is normally manipulated;

☐ possesses a number of other 8- and 16-bit registers; I'll describe their uses as the series develops;

☐ communicates with the outside world via a 16-bit memory address bus (ie, it can directly read and write to 65536 (64K) memory locations) and an 8-bit data bus.

When combined with memory, I/O facilities etc, the microprocessor becomes the central element of a microcomputer.

As far as programming the beast is concerned, there are two key factors; it can normally only handle data in bytes, and its limited size. The first point means that, to manipulate practical numbers, we must handle several bytes — which is time-consuming.

The second point restricts the number of single-instruction functions a micro can perform. For instance, if you want to multiply two numbers together, you must write a suitable program — I'm discussing established devices, not the latest generation — using the micro's ability to add, shift and compare numbers and to jump to different points in its memory.

What form does a program take? It is simply a sequence of 8-bit binary patterns in the computer's memory. The patterns can represent instructions to the processor, numerical data for it to manipulate, or character codes. The important point is that the processor decodes, and responds to, binary patterns only. For instance, the instruction which tells an 8080A to add 15 to whatever is in the accumulator is:

```
11000110    00001111
```

The first byte is the pattern which orders the 8080A to add data to whatever is in the accumulator; the second byte is the data itself. An object code program for a microcomputer (or any computer, for that matter) is thus only a sequence of "1"s and "0"s.

Obviously, it's very difficult to program directly in binary; it's not impossible, but the human mind just doesn't think in terms of superficially meaningless patterns of "1"s and "0"s. The first simplification we could make would be to represent the binary patterns by hexadecimal characters. In this way, we could represent each 4 bits ("nyble") of the program by a single hex character. **Table 1** shows equivalent binary, decimal and hex numbers. Using hex, the 8080A instruction above would become:

```
C6    OF
```

The information hasn't been changed — it's simply presented in a form which people can handle more easily. Before the computer can use it, though, it must be translated back to binary. The translation is normally done by a simple routine in the system's monitor program. The programmer may well use a hex keyboard to input the data — Mk 14 freaks will be familiar with the concept.

Hex isn't particularly satisfactory; the instruction codes don't suggest their effect, they don't folow any immediately obvious pattern and the whole approach is error-prone. Because of these limitations, Assembly Languages have been developed. They represent every instruction that a given micro can perform by an easily remembered mnemonic. Using 8080A assembly-language, our example becomes:

```
ADI  15     (ADd Immediate 15)
```

The instruction code suggests the operation, and the data is assumed to be decimal unless the system is told otherwise.

So this, simply, is assembly-language — source code which uses human-oriented instruction mnemonics, and which presents data and operands in a more easily handled form. There are, however, several important points to appreciate:

☐ Each mnemonic in a program represents a single machine code instruction.

☐ The mnemonics are simply codes which represent binary patterns and could be anything the language designer chooses. They are only labels, just as "apple" is a label which represents a round, greenish-red fruit. Each micro manufacturer has designed his own assembly-language, with the result that some operations have largely standardized mnemonics, while others are very different from micro to micro. For instance, in both the 8080a and the 6502, the instruction:

```
JMP  xxyy
```

will make the program JuMP to address xxyy. However, the last instruction in an 8080A subroutine is RET (RETurn), while the corresponding 6502 mnemonic is RTS (ReTurn from Subroutine).

☐ Assembly-language programs must be translated, either manually or automatically, to the processor's binary object code before they can be used. A program to do this is called (surprise-surprise) an "Assembler".

☐ An Assembler is a program, supplied by the manufacturer of the computer, which takes the text of your assembly language program (described below) and translates it into machine code. The text program is called the 'source code' and the machine code that results the 'object code'. Providing you have written the source code correctly, this process only has to happen once. Thereafter, when you want to run the program you use the object code. Of course, you'll probably keep the source code as a listing on paper or as a file on disc or tape for future reference. But it plays no active part once the assembler has done its work.

I hope I've persuaded you that, if you're programming in machine code, it's easiest to do so via your micro's assembly-language. The program will be much easier to follow. To get the most benefit, however, you should use an assembler.

Not only would this approach prevent errors caused by misreading mnemonic-to-hex code lists, but it would be much faster than any manual system. Speed and accuracy are not the only benefits of using an assembler, however.

The most important benefit conferred by an assembler is the ability to use labels. Two types are possible — variable lables and jump labels.

In a high-level-language such as Basic, you don't have to worry about where the computer stores data. You can simply write:

```
150  LET K=3*X*SIN(Y)
```

and leave the interpreter to find "X" and "Y", and to decide where to put "K".

In machine-code programming, however, you must decide, and keep track of, where all the data is stored. Things are made much easier if you can use a label. You could write:

```
STA   SUM
```

which would store the contents of the accumulator in the store labelled "SUM". At some stage, you give the assembler an idea of where in the computer's memory it should put "SUM", but throughout the program you can repreent the variable by its label. If you choose the labels carefully, they will help you, and others, to understand the program; eg "SUM" would normally make more sense than "PSQXE".

Most useful programs have lots of jumps and branches in them. In machine-code programming, you must calculate addresses the micro is to jump to, but an assembly-language program can use labels to clarify things. For instance, you could write:

```
      .
      .
JMP   END
      .
      .
      .
END   "The final routine starts here"
```

	6502			8080A		
Operation	Mnem	Flags	Effect	Mnem	Flags	Effect
Load Accumulator	LDA o	N,Z	A=d/(a)	LDA a	None	A=(a)
				or		
				MOV A,M	None	A=(M)
Load Acc, Immed	—			MVI A,d	None	A=d
Store Accumulator	STA a	None	(a)=A	STA a	None	(a)=A
				or		
				MOV M,A	None	(M)=A
Add	—			ADD M	All	A=A+(M)
Add Immediate	—			ADI d	All	A=A+d
Add with Carry	ADC o	N,V,Z,C	A=A+d/(a)+C	ADC M	All	A=A+(M)+C
Add with Carry (Imm)	—			ACI d	All	A=A+d+C
Subtract	—			SUB M	All	A=A—(M)
Sub Immediate	—			SUI d	All	A=A—d
Sub with Borrow	SBC o	N,V,Z,C	A=A—d/(a)—C	SBB M	All	A=A—(M)—C
Sub with Borrow (Imm)	—			SBI d	All	A=A—d—C
Load H,L Imm	—			LXI H,d	None	H,L=d
Clear Carry	CLC	C	C=0	—		
Clear Decimal	CLD	D	D=0	—		

Notes

"a" = Address (defined by the program)
"d" = Data (defined by the program)
"o" = Operand — can be an address or data
A = Accumulator
H,L = Register pair formed by H and L
M = The address implied by the data in H,L
C = Carry flag
D = Decimal flag
/ = Either/or
Brackets mean "Contents of the location whose address is between the brackets"
Some of the 8080A instructions are shown for completeness only at this stage.

Table 2: Fundamental 6502 and 8080A instructions

The assembler will work out what number to represent "END" by when it translates the program.

The main advantages of labels are:

☐ They make a program quicker to write and easier to follow.

☐ Labelled routines can easily be used as library routines.

☐ Program modification is easier.

☐ You don't have to do the donkey-work of calculating storage and jump addresses.

There are normally a few limitations on the use of labels. The most common ones are:

☐ Only a certain number of characters (often 6) can be used.

☐ Only 'A'-'Z' and '0'-'9' can be used.

☐ You can't use assembly-language mnemonics as labels.

☐ A label must start with a letter.

If you are using an assembler, its manual will give specific instructions, but in this series I'll observe the four constraints above.

The second major benefit of using an assembler is that data in the operand field of an instruction can be defined in many ways — via a label, of course, as a decimal, binary or hex number, as an ASCII character or as a simple arithmetical expression. In every case, the assembler will convert the operand to the correct format for the micro. In this series I'll use the conventions illustrated below. (LDA is the 6502 mnemonic which means LoaD the Accumulator.)

	Value which goes into Accumulator
LDA 15	Data at memory address 15_{10}
LDA $1F	Data at memory address $1F_{16}$
LDA %00100011	Data at memory address 00100011_2
LDA #'S	ASCII code representing "S"

The in the last example indicates an "immediate" operation in which the data is given directly by the operand field, and is not read from memory. As a further example:

```
LDA  #  $27
```

would load the hex value "27" into the accumulator. The 8080A has separate mnemonics for all its immediate instructions, and therefore doesn't use the:

```
Operation   # Operand
```

construction. Remember, the assembler recognizes the whole form of the instruction and selects the correct machine code. Immediate and memory-referenced instructions have different opcodes.

Yet another advantage of using an assembler is that comments can easily be inserted in the source code. One aspect of adequate software documentation is putting plenty of comments in the program; the comments should explain what is going on and, more important, why it is happening. The comments should be constructive; for instance, the comment in:

```
LDA  #  $15      ;SET ACC TO 15
```

doesn't tell us anything new. It would be much better to put:

```
LDA  #  $15   ;INITIALIZE LOOP COUNTER
```

Different assemblers give different facilities for inserting comments, but the

continued from page 99

comments are always ignored when the program is assembled. Throughout this series, I will assume that comments can be inserted either as a whole line, or following the operand field. In either case, the first character wil be a semi-colon.

Why use assembly language?

Assembly language programming is much more complex than using languages such as Basic, and is laborious and error-prone. Nevertheless, there are a number of good reasons for using it:

☐ There is no choice. If your computer is, for example, a Mk 14 or a simple Nascom, it has to be programmed in hex. Programming is much easier if assembly-language listings are manually translated to machine code.

☐ The planned program must fit in a very small space, or run very quickly, or both. Programs in high-level languages will always run more slowly, and demand more space, than assembly-language programs.

☐ Certain tasks, such as bit manipulation, are very difficult in the high-level languages available on most microcomputers.

☐ It can be fun. Assembly-language programming represents a challenge and, incidentally, gives a good insight into how a micro works.

You must recognize, however, that assembly-language programming is inevitably slow, hard or even impossible to follow, and gives source-code which can be astonishingly difficult to modify.

Assembly-language routines

From here on, this series will study the details of assembly-language programming; the details will be supported by examples using two of the best-known micros — the 6502 and the 8080A.

By the end of the series, you should be able to write reasonably complex programs for either or both of the two devices. Here are a few more points about my approach:

☐ I'll stick to assembly-language mnemonics only. If you need the hex, binary or decimal translations, you'll have the documentation to look them up.

☐ The programs will use the assembler conventions I've outlined — these may not be the same as your system's, so please check before you blame me.

☐ Where I define absolute addresses, they won't necessarily be usable in your system.

Finally — I know that home microcomputers rarely have assemblers, unless the extra software has been purchased specially. I repeat, however, that manual assembly is much better than nothing.

Structure of a micro. The hub of each of the micros I've chosen is a single Accumulator (A). They also each have a Program Counter (PC) and a Status Register, containing the 8 bits of the Processor Status Word (PSW), which records what's happening in the micro. They both have a number of other registers, most of which I'll leave to future articles.

Two of the registers in the 8080A are called H and L. Each has 8 bits, but they can be combined into a single 16-bit register, also referred to as H; in the 16-bit mode, L supplies the 8 least significant bits. Which "H" is meant in any particular case is clear from the mnemonic. The basic architectures of the 6502 and the 8080A are shown in **Figures 1a and 1b** respectively.

Fundamental instructions. Let's now look at the most fundamental instructions for any micro — those which allow the accumulator to be loaded either from memory or immediately, and which store the accumulator's contents in any given location. I'll also cover the simple arithmetic operations which the two devices can perform.

These fundamental instructions are given in **Figure 2;** there are other ways of doing some of the operations, but I'll cover these later in the series.

You can see immediately that the 8080A has a much richer instruction set (at this level, anyway) than the 6502. Partly this is because the former micro has special instructions for immediate operations, while the latter uses a " " in the operand field.

The 6502's use of the carry and decimal flags is also important, however. One bit in the PSWs of both micros is designated the "carry" bit (or flag), and shows the result of previous operations; the 6502 also has a bit called the "decimal" flag.

I'll describe the PSWs next month, but you must remember that 6502 addition and subtraction always take account of these two flags, while the 8080A's instruction set makes them optional. If the flags are kept at zero, then the 6502's "ADC" corresponds roughly to the 8080A's "ADD" and "ADI".

The ways the two micros address data can be very different, depending on the instruction. The 8080A is designed to use "implied" addressing as its normal mode of operation. In this mode, the operand field of an instruction does not indicate an address; instead, it shows a register where the address can be found.

Normally, the register-pair (H,L) acts as the pointer. Thus, before an implied operation, (H,L) must be loaded with the 16-bit address of the data to be manipulated. The operand "M" is taken to mean the address implied by the data in (H,L).

For simple programs, this technique is rather clumsy, but it has distinct advantages for more realistic programs — I'll describe some of these advantages in future articles. Implied addressing is a special case of a more general technique called "indexed addressing".

The 6502, on the other hand, can use direct memory addressing with all its instructions. It also has various indexed modeds, but these don't concern us this month. The only 8080A instructions that affect registers and which allow direct memory addressing are the load and store commands. All other instructions referring to memory must use an implied form. The load and store operations also have implied forms, which are shown in **Figure 2** and which are called MOVes. They are examples of a much larger group of 8080A instructions.

Let's try a simple exercise. Suppose we have data in the memory at the addresses labelled "DATA1" and "DATA2". We want to put the sum in "DATA3" and the sum minus 7 in "OFFSET". Finally, set

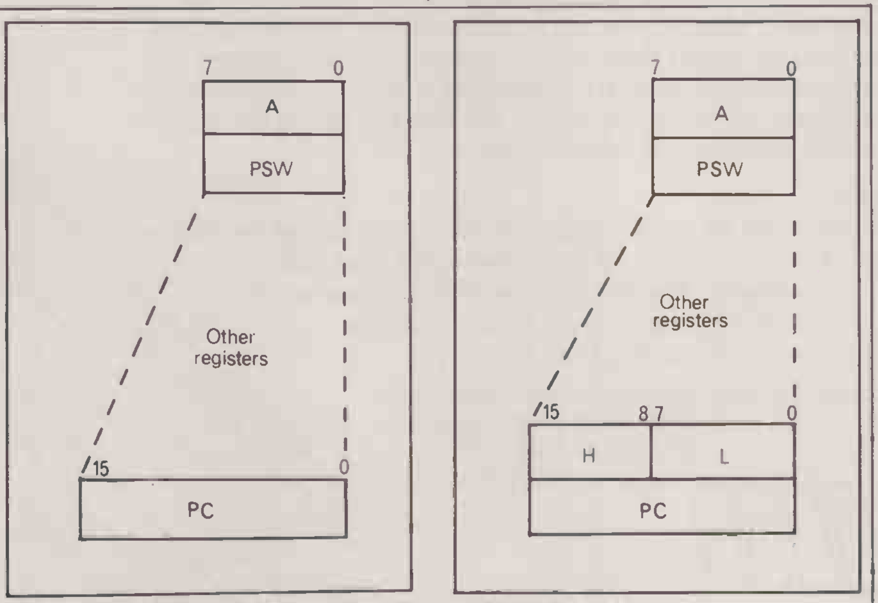


Figure 1: Device architecture: 6502 (left), 8080 (right)

```
; THIS PROGRAM DEMONSTRATES THE USE OF THE BASIC 6502
INSTRUCTIONS
;
      CLD                        ;CLEAR THE DECIMAL AND
      CLC                        ;CARRY FLAGS
      LDA       DATA1
      ADC       DATA2            ;ACC = DATA1 + DATA2
      STA       DATA3            ;DATA3 = DATA1 + DATA2
      SBC       #7               ;ACC = DATA3—7
      STA       OFFSET
      LDA       #$2A             ;ACC = 2AH
      STA       COUNT            ;COUNT = 2AH
;
;END OF THE FIRST DEMONSTRATION ROUTINE
```

8080A program

```
;THIS PROGRAM DEMONSTRATES THE BASIC 8080A INSTRUCTIONS
;
      LDA       DATA1
      LXI       H,DATA2          ;SET POINTER FOR ADDITION
      ADD       M                ;ACC = DATA1 + DATA2
      STA       DATA3            ;DATA3 = DATA1 + DATA2
      SUI       7                ;SUBTRACT IMMEDIATE — NO # NEEDED
      LXI       H,OFFSET         ;SET POINTER FOR IMPLIED STORE
      MOV       M,A              ;OFFSET = DATA3—7
      MVI       A,$2A            ;ACC = 2AH
      STA       COUNT            ;COUNT = 2AH
;
;END OF THE SECOND DEMONSTRATION ROUTINE
```

Table 3: Demonstrations routines

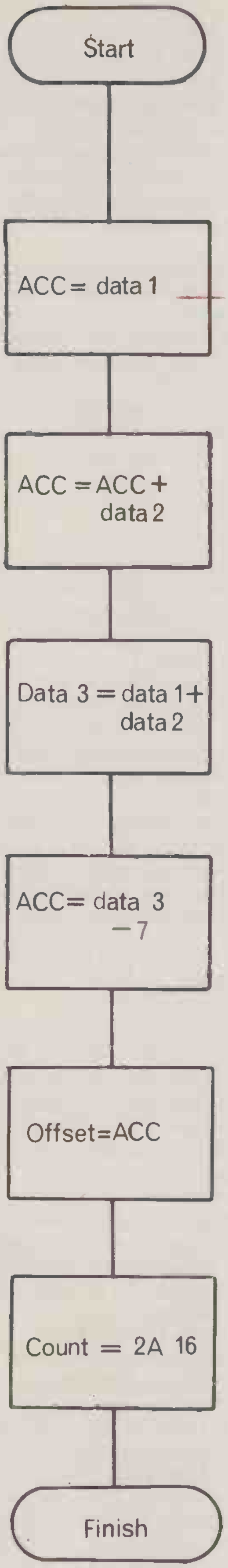


Figure 2: Flowchart for example

"COUNT" to $2A_{16}$. In Basic, this exercise would be easy:

```
110 LET DATA3 = DATA1 + DATA2
120 LET OFFSET = DATA3—7
130 LET COUNT = 42
```

(Assuming we could use six-character variables)

In assembly-language programming, however, we must tell the micro eacn and every step of the procedure; furthermore, and this is very important, arithmetic operations can only take place in the accumulator. Neither must we forget to set up the 8080A's pointer.

So, first of all, decide the sequence in which you must carry out the operations, and produce a flow chart. The flow chart should show every significant step, but beware of making it so detailed that it becomes a program. I suggest the flow chart of **Figure 2;** from it, I wrote the 6502 and 8080A programs of **Figures 3a** and **3b** respectively.

The two programs are similar — one significant difference is the need to clear the 6502's carry and decimal flags to avoid interfering with the "ADC" and "SBC" operations. Once cleared, the flags stay cleared unless reset by an instruction or a result.

The second major different is the need to imply an address for the 8080A's "ADD" operation; this necessitates loading the (H,L) pair with the data's address. The 8080A program also shows the use of an implied MOVe to store data.

Finally, note the different ways of expressing the immediate operations.

I hope that this initial article has given you a feel for the basic concepts of assembly-language programming, and its advantages and disadvantages. Any micro's assembly-language reflects its internal structure to some extent, and the first codes I've given start to show this.

Next month, I'll explain the different ways in which numbers can be represented in a micro. I'll also describe in detail the PSWs of the 6502 and the 8080A. Further, I'll start to describe the use of jumps, which are essential in any real program.

Homework

1. What is the largest decimal number which an 8-bit byte can hold?
2. What happens if the sum of two numbers is larger than the answer to the last question?
3. How can we represent a negative number?
4. How can we represent decimals?
5. In the 6502 program of Figure 3a, could we have put "CLC" and "CLD" anywhere else?
6. Consider a program to satisfy the following equations:

```
DATA4 = DATA1 + DATA2—DATA3
DATA5 = DATA5 + 23
CODE = DATA2—17—DATA3
```

Assembler development system

COMMODORE has released two more programming languages for the PET floppy disc system, an Assembler Development System and a more comprehensive version of LISP.

Designed to operate with the 16K and 32K Floppy Disk PET system, the Commodore Assembler GD 001 allows programmers to work in real time. The entire package is written in assembly language and operates extremely efficiently. The system includes a screen-based editor, similar to the BASIC editor, but with the additional functions of FIND, CHANGE, AUTOMATIC LINE NUMBERING, LINE RENUMBERING, REPEAT KEY, BLOCK DELETE and all the DOS SUPPORT commands.

Both source files and the KIM/TIM/MDT format object files reside on disk for full flexibility of operatio. Two loaders are supplied which enable the user to load any RAM location. The source code of the editor and loaders is included. These well-documented programs reveal most of the current ROM entry points required to drive the PET and its peripherals from an assembly language environment. Commodore have included EXTRAMON 7.5, a new machine-code monitor, in this package. This will allow the operator to execute machine code in a controlled fashion, thus reducing the time typically taken to debug assembler programs.

The price of £50 + VAT also includes a set of documentation and the standard Commodore Disk Software multi-ring binder.

Commodore LISP

GD 010, the Commodore version of LISP, is much more comprehensive than the original LISP 1.5. It includes functions such as PEEK, POKE, CALL, OPEN, CLOSE, CMD AND PRINØ. Available from Commodore, the price of £75 + VAT includes two demonstration programs and a manual.

Shooting gallery

THIS PROGRAM is a special shooting gallery for the PET, sent in by **D. A. Elworthy**. He writes: For reasons of space, no rules are included in the program itself; but if needed they can be inserted between lines 21 and 99.

The rules are as follows:

'Firstly, the player enters a speed rating between 1 and 9. The game then commences. A white blob moves along a line of boxes, pausing after each move for a time determined by the speed (less than a second). When he wishes, the player may shoot, by pressing any key.

If a white blob lies beneath the "V" then it will be "killed". However, if a box lies beneath the "V", then a new white blob will be created. The object of the game is to kill the white blob(s).

When all have been killed, the program will say how many goes, and how many shots it took. A go is one move of the blob(s).

Note that, while the new position of the blob(s) is being set up, the whole screen is extinguished, and then "zapped" back on, although it is only off for a short time.

If the problem is to be run on machines other than PET, then it will be necessary to modify the memory mapping POKES (lines 230 and 270). The POKES at 200 and 245 are the screen off and on commands. It is also necessary to have a single character input command (GET, in this case).

```
1   REM SHOOTING GALLERY BY
    D.A.H. ELWORTHY
10  DIM A%(9):A%(1)=81:X%=87:
    R%=1:G%=0
20  FOR I%=2 TO 9:A%(I%)=87:
    NEXT I%
100 PRINT"clr":FOR J%=1 TO 9:
    PRINT:NEXTJ%
110 PRINT"          IIIIVIIII"
120 PRINT"          wwwwwwwww"
130 INPUT"homeDELAY (1 TO 9)";S%
140 IF S%>9 OR S%<1 GOTO 130
150 D%=INT(50/S%):H%=0
```

This section contains the initialisation. The following should be noted:
clr is the screen clear character.
I may be replaced by shift], if desired.
home is the home character.
w is shift W.

There are ten spaces at the left hand side of the PRINTs on lines 110 and 120.

```
200 POKE 59409,52:FORK%=1 TO 9
210 Y%=%(K%):A%(K%)=X%
220 X%=Y%
230 POKE 33177+(2*K%),X%
240 NEXT K%:G%=G%+1
245 POKE 59409,60
250 FOR T%=1 TO D%:NEXT T%
260 GET A$:IF A$="" GOTO 200
270 H%=H%+1:A%(5)=168—A%
    (5):POKE 33187,A%(5)
280 IF A%(5)=81 THEN R%=R%+1:
    GOTO 200
290 R%=R%—1:IF R%<>0 GOTO
    200
300 PRINT"GOES"G%"SHOTS"H%:
    END
```

This section contains the main game, plus testing for the end condition, etc. R% is a tally of the remaining blobs. Take care to enter the POKES correctly: it is not a good idea to POKE into the wrong place (oops!).

It is possible to modify this: for example, the line of boxes could be made longer (lines 10,20,110,120,200), or the range of speeds could be altered (lines 130,140,150). But all that is up to you.'

More random numbers

BERYL AND MARTIN GEORGE have written to Pet Corner about the note on random numbers in the December issue. Changing the seed number as suggested in the article, they say, will not change the sequence of random numbers on our Pet fitted with the new ROM's and as far as we are aware will not overcome the problem on machines fitted with the old ROM's.

'For the problem is that no matter what positive number is used for the seed, the same sequence of numbers will be generated starting from power on. This can be shown by running the following programme. Before the programme is entered, the computer should be switched off and on so one can be sure of starting from the power on condition.

```
10 for X = 1 to 10
20 print RND (X)
30 next X
```

One then copies down the numbers displayed on the screen; switch the computer off and on, then enter the above programme but changing line 20 to:

```
20 print RND (1)
```

After running this second programme, you will notice that the same sequence of numbers has been generated, although in the first programme the seed was constantly changing to the value of X.

Whilst the command RND (0) with the new ROM's produces a more random commencement number, thereafter it usually tends to generate a progression of numbers and not a random sequence, as shown by the following programme.

```
10 A = INT (RND (0) × 9 + 1)
20 B (A) = E (A) + 1
30 for C = 1 to 9
40 print B (C); next C
50 print "(home cursor)"; go to 10.
```

If the RND (0) statement is changed to RND (1) in the above programme and the programme rerun, it can be seen that a far more random sequence of numbers is generated.

The most satisfactory way we have found of generating a random number on power up, and a random sequence thereafter, is to include the folowing instructions at the start of a programme using the random function

POKE 138, PEEK (143)

For machines fitted with the new ROM's, then use the command

RND (1).

For the old ROM's, we believe the corresponding instruction is

POKE 220, PEEK (514).

This instruction loads the one memory location for the random number function with the number of JIFFIES on the internal clock memory location. This means that there are a possible 256 possible random sequences which is sufficiently random for most instances.'

Fourier transform

DR D. JONES, from West Wickham in Kent, has enclosed a listing for a Fast Fourier Transform program which he claims has been tried and tested. In return he would like to appeal for help with a problem over the PET extended BASIC instruction GET*.

'It does not work for IEEE Bus devices! GET actually only 'gets' about half of the expected output — 'about' because there is some fluctuation. It is a general problem with the PET. It will not work with three PETS I have had access to and 'getting' from a Hewlett-Packard Instrument. I should add that an H-P controller (in place of the PET) works without fail — so it is definitely the PET.'

*Using the usual check of ST — status.

REMARKS: The Radix 2 FFT is an adaptation to PET BASIC of a FORTRAN algorithm due to Cooley.

It enables the calculation of the FFT of

$m = 2^n$

points with n an integer.

As listed m = 256 — the maximum array size for 8K PETS. For the big PETS the listing may be adapted as indicated by the "!" comments.

Poke top left

FOURTEEN-YEAR-OLD Kevin Jones, from Lytham St Annes, has found his own solution to the problem Mr Patterson discussed in the January 1980 issue, PEEKing and POKEing characters to and from the PET's screen. All PET users, he writes, must have noticed that the codes used in the screen locations are not the same as those obtained using the ASC function.

'My solution to this problem is to place the character that the operator wishes to POKE onto the screen on the top left-hand corner of the screen and ask the computer ?PEEK(32768). This will return the screen code for that character eg. 160 for a filled "square" (a reverse-field space); 42 for an asterisk etc.'

Commodore's 1980 plans

COMMODORE'S PLANS for 1980 reportedly include the arrival in the UK, probably in October, of an 11 MByte 8in Winchester technology hard disc.

Some software specialists doubt that it is practical to link such powerful peripherals to the present generation of PETs, and American Commodore watchers have been forecasting the appearance of a new and much faster processor in future PETs.

Quote from Commodore's annual report: 'Other computer enhancements under development during fiscal 1980 will expand the capability of PET systems to a point where they will be able to talk, listen and draw. Development of a **next generation** computer system is scheduled for completion during 1979/80".

```
 10 REM****FAST FOURIER TRANSFORM****
 20 REM F.F.T. OF 256 REAL POINTS TO BE
 30 REM PUT IN A(0) TO A(255). OUTPUT IS
 40 REM IN A(I) [REAL] AND B(I) [IMAG].
 50 REM MODULUS AND 4 QUADRANT PHASE ARE
 60 REM ALSO COMPUTED.
 70 DIM A(255), B(255)              ..! Dim(m-1)
 80 FOR I = 0 TO 255                ..! 0 to m-1
 90 B(I) = 0
100 NEXT I
110 PRINT "ENTER INPUT DATA ARRAY A(I). #'S 120 TO199
  :   ARE AVAILABLE FOR THIS.
120 STOP
130 REM DEMONSTRATION DATA ARRAY.
140 FOR I = 0 TO 31                 ..! 0 to m/8 -1
150 A(I) = 1
160 NEXT I
170 FOR I = 32 TO 255               ..! m/8 to m-1
180 A(I) = 0
190 NEXT I
200 REM**********************************
210 REM ****NORMALISATION****
220 F = 1/256                       ..! 1/m
230 FOR I = 0 TO 255                ..! 0 to m-1
240 A(I) = A(I) * F
250 NEXT I
260 REM ****REORDER (BINERATE)****
270 J = 1
280 FOR L = 1 TO 255                ..! 1 to m-1
290 IF L>=J GOTO 330
300 T1 = A(J-1)
310 A(J-1) = A(L-1)
320 A(L-1) = T1
330 K = 128                         ..! m/2
340 IF K>=J GOTO 380
350 J = J - K
360 K = .5 * K
370 GOTO 340
380 J = J + K
390 NEXT L
400 PRINT "REORDER COMPLETE. FFT WILL TAKE APPROX. 1.5 MINS."
410 REM ********* F F T *********
420 FOR M = 1 TO 8                  ..! 1 to n
430 U1 = 1
440 U2 = 0
450 M1 = 2 ↑ M
460 K = .5 * M1
470 P = π/K
480 W1 = COS(P)
490 W2 = -SIN(P)
500 FOR J = 1 TO K
510 FOR L = J TO 256 STEP M1    ..! J to m step M1
520 L2 = L - 1
530 L1 = L2 + K
540 T1 = A(L1) * U1 - B(L1) * U2
550 T2 = B(L1) * U1 + A(L1) * U2
560 A(L1) = A(L2) - T1
570 B(L1) = B(L2) - T2
580 A(L2) = A(L2) + T1
590 B(L2) = B(L2) + T2
600 NEXT L
610 U3 = U1
620 U1 = U1*W1 - U2*W2
630 U2 = U2*W1 + U3*W2
640 NEXT J
650 NEXT M
660 REM ********F F T  COMPLETE******
670 PRINT"REAL AND IMAGINARY PARTS OF FT"
680 FOR I = 0 TO 128                ..! 0 to m/2
690 PRINT I;A(I);B(I)
700 NEXT I
710 PRINT "FOR AMPLITUDE AND PHASE PRINT OUT 'CONT'."
720 STOP
730 PRINT"AMPLITUDE AND PHASE (RADIAN/π)
740 FOR I = 0 TO 128                ..! 0 to m/2
750 A1 = SQR(A(I)*A(I) + B(I)*B(I))
760 A2 = -1
770 D = A(I) + A1
780 IF D = 0 THEN 810
790 A2 = 2 * ATN(B(I)/D)
800 A2 = A2/π
810 PRINT I;A1;A2
820 NEXT I
830 END
840 REM ****** D. LL. JONES ******
850 REM ******    10/79     ******
READY.
```

ABEL

ABEL COMPUTER SYSTEMS LIMITED
5 HANLITH·WILNECOTE·TAMWORTH·STAFFS·B77 4BP

Apple Symbolic Assembler

2 pass assembler with good manual. Requires 32K system and diskette drive	
Software on diskette	£26.45

Apple Games

(with comprehensive instructions)	
8 games on diskette	£12.50
8 games on cassettes	£10.00

Diskettes (single sided)

Standard quality	each £2.35
Superior quality	each £3.25
Cassettes	per 10 £3.90

PRICES INCLUDE VAT
Please add 30p p&p to order

• Circle No. 181

CRYSTAL ELECTRONICS
CC ELECTRONICS

The newest Z80 Basic!

XTAL Basic 2·2

HAS to be the best yet for your Nascom 1 or 2
All the usual features of other 8K floating-point BASICs
Plus: Extra commands/functions—INCH, KBD, CMD$ ON ERR GOTO, ERR, PI, CLOAD? (tape verify)
And Add up to 64 reserved words of **your** choosing—**Now** put your own disc, tape, control, graphics commands, etc for the ULTIMATE in BASIC flexibility! Fully upward compatible with version 2.1 (see earlier Ads). Can be easily adapted to most Z80 systems. Works with T2, B-BUG, T4 **and** NAS-SYS monitors. Existing version 2.1 users—Return your original tape (less manual) with 50p P & P and we will update it FREE of charge!

Price: still only £35 + VAT!

CREED PRINTER INTERFACE
For NASCOM or APPLE—lowest cost hard copy!
Complete kit of parts (with software) £18 + VAT.

16 CHANNEL RELAY BOARD
Now in stock for NASCOM 1/2. For £49.95 + VAT
Sixteen switched (isolated) channels for many control applications. This kit will greatly increase the flexibility of your NASCOM.

Members of Computer Retailers Association & Apple Dealers Association

Shop open 0930-1730 except Wed. & Sun.
40 Magdalene Road, Torquay, Devon, England. Tel: 0803 22699

Access and Barclaycard welcome. COMPUTERS AND COMPONENTS

• Circle No. 182

New low book prices

Also dealers for Acorn, Apple, Microstar and Alpha Micro.

CompUtopia Limited

30 Lake Street, Leighton Buzzard, Bedfordshire
Tel: (0525) 376600 24 hour Answering Service

BASIC & BASIC PROGRAMS

Running Wild: The Next Industrial Revolution Adam Osborne	£ 3.50
The Mighty Micro Chris Evans	£ 5.50
X1 Microprocessor Lexicon Sybex Inc.	£ 2.50
Microelectronics Scientific American	£ 4.00
Mind Appliance T G Lewis	£ 4.80
Introduction to Microcomputers Vol 0 — The Beginner's Book Adam Osborne	£ 5.40
Introduction to Microcomputers Volume 1 — Basic Concepts Adam Osborne	£ 5.90
Your Home Computer James White	£ 5.90
Peanut Butter & Jelly Guide to Computers Jerry Willis	£ 6.30
C201 Microprocessors: from Chips to Systems Rodnay Zaks	£ 6.90
Illustrating BASIC Donald Alcock	£ 2.30
Microcomputers in the Three R's: A Teacher's Guide Christine Doerr	£ 4.90
Little Book of BASIC Style: How to write a program you can read John Nevison	£ 5.40
Programming in BASIC for Business Bosworth/Nagel	£ 6.90
Basic Handbook David Lien	£11.00
BASIC and the Personal Computer Dwyer/Critchfield	£11.90
Computer Programs that Work! Lee/Beech/Lee	£ 3.00
Basic Computer Games David Ahl (Ed)	£ 5.50
More Computer Games David Ahl (Ed)	£ 5.50
Some Common BASIC Programs Poole/Borchers	£ 6.50

6502/6800/8080/Z80

8080A/8085 Assembly Language Programming Lance Leventhal	£ 6.30
Z80 Assembly Language Programming Lance Leventhal	£ 6.90
Z80 Microcomputer Handbook William Barden	£ 6.90
Sargon: A Computer Chess Program Dan & Kathe Spracklen	£ 9.50
6800 Assembly Language Programming Lance Leventhal	£ 6.30
6502 Assembly Language Programming Lance Leventhal	£ 6.90
C202 Programming the 6502 Rodnay Zaks	£ 6.90
First Book of KIM Butterfield et al	£ 7.00
D302 6502 Applications Book Rodnay Zaks	£ 7.90
Programming a Microcomputer: 6502 Microprogramming MOS' KIM-1 Caxton C Foster	£ 7.90
Practical Introduction to Pascal Wilson/Addyman	£ 4.00
Pascal User Manual & Report Jensen/Wirth	£ 5.90
Introduction to Pascal Welsh/Elder	£ 7.00
Programming in Pascal Peter Grogono	£ 7.80
Microcomputer Problem Solving using Pascal Kenneth Bowles	£ 7.90

OTHER READING

Cheap Video Cookbook Don Lacaster	£ 4.40
How to Build a Computer-Controlled Robot Tod Loofbourrow	£ 4.90
C207 Microprocessors' Interfacing Techniques Lesea/Zaks	£ 7.90
Computerisation: Layman's Guide for Directors & Senior Management E G Cluff	£ 4.90
How to Profit from your Personal Computer T G Lewis	£ 5.50
Vol 1 Fundamental Algorithms Donald Knuth	£10.50

Books will be despatched within 24 hours or our acknowledgement giving precise delivery date. All prices include p&p within the UK. Outside the UK please add 10%.
For details please contact 30 Lake Street, Leighton Buzzard. Tel: (0525) 376600. When ordering please state your cheque/postal order/Barclaycard number.

• Circle No. 183

Make day number

IN MANY BUSINESS, and indeed other, applications one requires to enter the day or date before beginning to enter other data, **writes Frank Atkinson.** Even if one allows the date to be "reprinted" by the machine for a visual check, there is still a chance of error.

The following program has therefore been designed to check the correct entry of a date. Its chief claim to further consideration is that, when the date is "reprinted", it is "preceded" by the "day of the week". Thus if, for example, one enters the date 26, NOV, 79, the machine "reprints" this on the screen in the form "MON: 26, NOV, 79, thus giving one a good chance of really checking that one's entry was correct.

An additional feature of the following program is that a Record Number is created which can be used to store data in a Text File on disc, so that appropriate records for each day can be associated with the Record Number and easily recalled as required.

Three sets of data are read into memory. Z$(K) holds "JAN" etc. M(K) holds the number of days to the point immediately preceding this particular month; thus January has no days preceding it whereas "February" has 31 days preceding it. The third set of data is the abbreviated days of the week: "FRI" etc.

Aren't you dating?

When the program is run, one is requested to enter the date, in a specified form, and this is then read into memory as three separate pieces of data: the actual date within the month, the name of the month and the last two digits of the year.

A search is then carried out to identify the name of the month and from this to ascertain "K", thus relating the other data to the name of the month. Note here that on line 530, allowance is made for the mis-spelling of the month. Thus if one enters NØV instead of NOV, then it does not satisfy the "IF" statement and falls through on to line 530, where a check line is returned to the screen.

However, if the month has been correctly input, then we move onto line 540 where the 'day-number' "F" is created by adding the number of days leading up to the beginning of our month with the actual number of the days within the month: ie M(K) + D2. Next a check is made on line 550 for the presence or otherwise of a Leap Year. And if we have entered a Leap Year, then LY = 1. Otherwise LY = Ø.

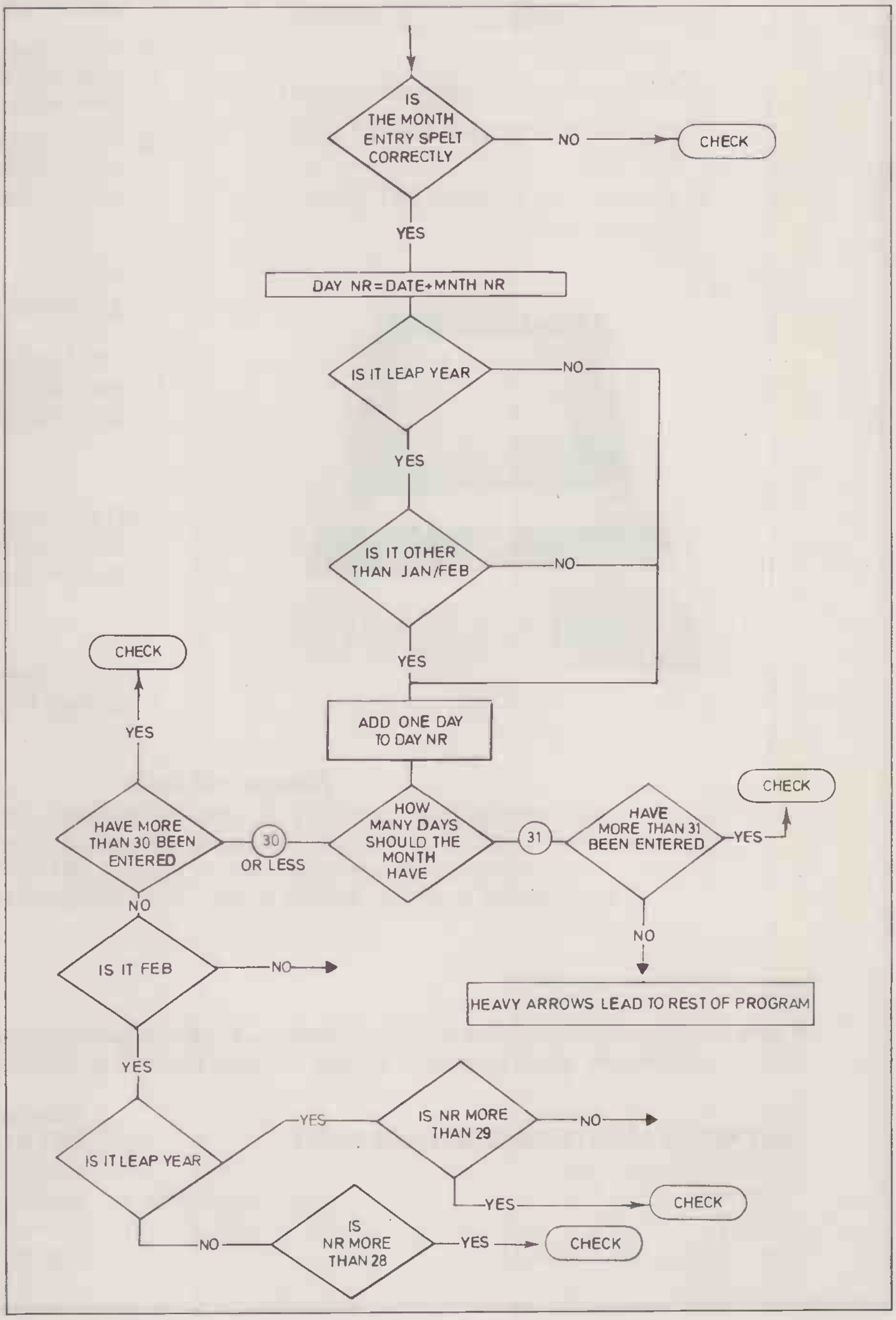
Then for three separate checks to ascertain whether or not entries have been made correctly, in connection with the number of days in the month: ie whether or not there should be 30 or 31 and whether the correct maximum of 28 or 29 has been made for February. In each case, if an incorrect entry has been made, then an indicator line "TS$" is returned to the screen.

In lines 700 to 745, a running total is built up of the number of days which have elapsed since a given horizon, until the date of our entry. In this case the horizon is set (line 700) at 1977, so that references can be made backwards to that year if so wished. Of course the horizon can be set wherever one wishes, bearing in mind the need to consider Leap Year. It will be seen that in line 720 C1 adds .25 to every year. Thus in the fourth year another day is added at line 750 (integer of C1).

Line 770 obtains the "remainder" after a small calculation whereby the total number of days is divided by 7. It may seem odd that this number is then multiplied by 8 and the integer taken from that, but because of the vagaries of binary arithmetic within the micro-processor, an exact number is not returned. At line 780 TT$ is established by adding together the various parts of our date, namely B8$(L) shows the day of the week, and the other items are attached as already input or sorted.

Finally if we wish to create a Record Number starting at January 1st, then "F" will give us just this. If we wish it to start from April 1st, then we must deduct 90 if the year is not a Leap Year, or 91 if it is. Naturally this is easily done by lines 790 and 800.

When this small program is operated on an Apple II, there is a perceptible pause between completing our entry of today's date and its "reprint" on the screen, but the added information which comes back with the "reprint" certainly makes this worthwhile and intrigues any new computer operator when she first comes across this little surprise!



```
]LIST

0  REM *****************
1  REM *               *
2  REM *  MAKE DAY NR.  *
3  REM *    * * * * *   *
4  REM *   COPYRIGHT    *
5  REM * FRANK ATKINSON *
6  REM *      1979      *
7  REM *               *
8  REM *****************
10  REM MAKE DAY NR
15 D$ =  CHR$ (4)
31  DIM Z$(12),M(12)
32  DATA   "JAN","MAR","MAY","JUL" ,"AUG","OCT","DEC","APR","JUN",
"SEP","NOV","FEB"
33  DATA  0,59,120,181,212,273,334,90,151,243,304,31
34  DATA  "FRI","SAT","SUN","MON", "TUE","WED","THU"
35  FOR K = 1 TO 12: READ Z$(K): NEXT
36  FOR K = 1 TO 12: READ M(K): NEXT
37  FOR L = 1 TO 7: READ B8$(L): NEXT
38 TS$ = "** CHECK  DAY **"
150  REM  SPACE HERE FOR ENTRY FORMAT
450  PRINT "ENTER DATE HERE,USING COMMAS"
455  INPUT "EG.13,NOV,79";D2,M$,Y2
460  GOSUB 500
470  PRINT "THE DATE IS ";TT$
480  END
500  FOR K = 1 TO 12
510  IF M$ = Z$(K) THEN 540
520  NEXT
530 TT$ = "** CHECK MNTH *": RETURN
540 F = D2 + M(K)
550  IF  INT (Y2 / 4) = (Y2 / 4) THEN LY = 1: GOTO 570
560 LY = 0
570  IF K < 12 AND K > 1 THEN F = F + LY
580  IF K > 7 THEN 610
590  IF D2 > 31 THEN TT$ = TS$: RETURN
600  GOTO 700
610  IF D2 > 30 THEN TT$ = TS$: RETURN
620  IF K = 12 THEN 640
630  GOTO 700
640  IF D2 > 29 THEN TT$ = TS$: RETURN
650  IF LY = 1 THEN  GOTO 700
660  IF D2 > 28 THEN TT$ = TS$: RETURN
670  GOTO 700
700 B1 = 0:Y1 = 77:C1 = 0
710  FOR A = 1 TO 21
720 B1 = B1 + 1:Y1 = Y1 + 1:C1 = C1 + .25
730  IF Y1 = Y2 THEN 750
740  NEXT
745 TT$ = "** CHECK YEAR **": RETURN
750 B1 = (B1 * 365) + ( INT (C1))
760 B1 = B1 + F
770 L = 1 +  INT (8 * ((B1 / 7) - ( INT (B1 / 7))))
780 TT$ = " " + B8$(L) + ":" +  STR$ (D2) + "," + Z$(K) + "," +  STR$
(Y2) + " "
810  RETURN
910  PRINT D$;"RUN CHOICE"
1000  END
```

Prime yourself for the video future

AS VIDEOTEX technology (the now-approved overall term to cover both the land-line viewdata and broadcast teletext facilities) becomes integrated with the rest of the small computer revolution, this clutch of books provides a modest library with which to arm yourself.

***The Viewdata Revolution* by Sam Fedida and Rex Malik. Associated Business Press 1979 186pp, £11.50.**

By pedigree this should be the best book. Fedida is the inventor of Viewdata which he first demonstrated in 1972-74 while employed at Martlesham by the Post Office, and Malik is a veteran observer and propagandist of the computer world. Unhappily their book's appearance was badly mistimed — I'd like to think almost exclusively the fault of their publisher.

In the course of a few months last autumn, Viewdata made enormous strides from being just an interesting experiment with plenty of potential to achieving on-line commercial reality. In the same period the first true production-line Prestel sets were shown to the public, intelligent editing and user terminals appeared, the coin-op machine, an obvious idea which was developed by a former arcade game company and not the Post Office, showed itself in stores and hotels, and some of the databases set up by the information providers at long last lost their experimental qualities and began to look as though they might be of use to someone.

So Fedida and Malik's book has signs of hasty last-minute revision which does no one any credit. Its strengths thus lie in its historical account and in the authors' sometimes jokey vision of its future in detail.

In particular they provide useful answers to the keenest question of all: when can we expect the emergence of a true mass residential market? The answer, they suggest, lies in looking at the time when the existing generation of colour TVs will need replacing.

***The Electronic Bookstall* by Rex Winsbury. International Institute of Communications, 1979 74pp, £4 (available only from 11C, Tavistock House East, Tavistock Square, London WC1 9LG).**

Winsbury's extended pamphlet neatly fills the omissions of *The Viewdata Revolution.* The author has emerged as one of the most articulate of the present generation of information providers: he is the editor of Fintel which uses the resources of the *Financial Times* and Extel to give an extensive financial database.

As one might expect with that sort of background, he is more concerned about the commercial preconditions necessary to make viewdata secure. He has grasped the essential quality of Viewdata — not its technical sophistication or lack of it, nor yet either its potential social significance in some ill-defined future.

Viewdata's value is that it is here and now and represents the only system of its kind that is actually working.

For me the most valuable sections were on costing an IP venture — he gives four sample economic models. But he also discusses a number of dilemmas thrown up by Viewdata's existence and the way in which the Post Office has decided to make it available for use.

How, with all those diverse interests, is Viewdata to be marketed to the public? Will overall balance be achieved merely by the working of commercial forces? Is a special code of conduct required? What are the implications of a medium in which traditional boundaries between advertising and editorial are all too easy to blur? What will happen to the older communications media? How will the unions react?

***Third International On-line Information Meeting, December 1979: Proceedings.* 428pp.**

This year's conference devoted a substantial part of one day to videotex and included displays of a sophisticated American version — Viewtron — currently on trial in Florida and the French system that will piggyback on the new telephone directory retrieval device that will place, free of charge, a VDU by every French phone.

Of the papers that appear in the printed Journal, the interesting ones are on the public library role and on typographical and design considerations in using Viewdata-type character generators. The IPs who presented papers seemed to be keeping their cards close to their chests.

It is quite obvious that the spirit of friendly co-operation goes only so far and that some IPs don't propose to show their work until they are convinced that their new ideas have such instant commercial viability that they can't be ripped off.

***Teletext and Viewdata* by Steve A. Money, 1979, Newnes £5.50. 151pp.**

This is in a well-known technical series and is aimed largely at the TV engineer who wants to extend his range. It is ideal for anyone considering building a micro using the teletext character generator as a VDU. More ambitiously, those considering building intelligent terminals for viewdata and teletext capture and exploitation, or cards for linking to their existing micros, will need to read this book. Money writes attractively and assumes little or no knowledge of digital transmission techniques.

The one cause for regret is his concentration on Teletext at the expense of Viewdata. Perhaps future editions will rectify this.

— Peter Sommer

Micromice need speed and style

A LOT OF people tell us they're interested in the Micro-mouse contest, but they can't make head or tail of the rules. 'They're too simple!' they cry. 'What do they *mean?*'

The rules are as published in our October 1978 issue. The general import is that the mice have run a maze. The passages in the maze are 6½in wide, the walls are 2in high and ½in thick. In the first, and main section, the mouse has some time to explore the maze and then has to make a timed run to the centre. When it gets to the centre, the judges' watch will stop and its owners can retrieve it as best they can.

Dead end Street

What does this tell the mouse designer? It's very simply: a maze consists of straight passages with turns off, dead ends and corners. The mouse needs some kind of sensor — it could be tactile, sonic, radar, visual, according to choice — which will tell it about these things.

It needs to fit into a passage 6½in wide and be short enough to turn round in it. If the upper parts of the mouse (some of the American ones were like a block of flats) are to be more than 6½in wide, then allow at least 2in height to clear the walls of the maze.

Up a drainpipe

To win the first section, a mouse must be able to remember where it has been, to deduce short-cuts, and retrace an idealised course.

To win the second section, it has to be damned fast.

To win the third, it has to have quite sophisticated sensors that are capable of recognising arbitrary objects.

To win the fourth, the freestyle contest, it has to do something spectacular. Just what, is up to you.

Look out for April's *PC* featuring this zany Mazegame...

Practical Computing **shows you how to**

Get some more space into those North Star programs

SOME BASIC interpreters only store typed spaces in program when they are inside strings. Their LIST routines include coding to insert spaces during the printing of a program, whether or not these existed in the original version. The North Star Basic interpreter, amongst others, stores all spaces exactly as typed and a LIST will produce a printout identical to the original version. In this article **Dr John Lee** and **Timothy Lee** present a routine which shows how the spacing on a North Star Basic line can be changed to improve its readability.

The following rules define the objectives of the program:

1. A single space is inserted immediately following each line number. This conforms with the ANSI specification for Minimal Basic.
2. In general a space is put before and after each reserved word. (Reserved words are stored as the numbers 128-255 in a single byte, and correspond to all of the words in the Basic language such as PRINT, LET, IF, FOR, SQRT, COS, etc, together with arithmetic operators + — * / ↑ = > < etc.). The two symbols \ and , are not stored as reserved words, but are treated as such by the program. The following exceptions to this general rule have been included, since experience has shown them to be essential or highly desirable.

- ☐ No respacing is performed on characters comprising a string.
- ☐ REM statements are not respaced. This is necessary because reserved words appearing in REM's are compacted to a single byte. Avoiding respacing prevents errors such as the word FUNCTION, where the letters ON form a special word, being respaced as FUNCTI ON. The program does not detect embedded REM statements, that is REM's occuring as the second or subsequent statement in a multi statement line, hence these may be respaced.
- ☐ Spaces are not included before a comma except in strings and REM statements.

```
10 DIM Q(132), F$(10), O$(10), A$(10)
20 INPUT "TYPE NAME OF INPUT FILE ?", F$
30 F = FILE(F$)
40 IF F = 2 THEN 110
50 IF F > - 1 THEN 80
60 PRINT "FILE '", F$, "' DOES NOT EXIST!"
70 GOTO 20
80 PRINT "NOT A BASIC TYPE 2 FILE"
90 INPUT "TYPE 'RETURN' TO CONTINUE", A$
100 IF A$ <> "" THEN 20
110 OPEN #0%F, F$, L
120 INPUT "TYPE OUTPUT FILE ?", O$
130 F1 = FILE(O$)
140 IF F1 > - 1 THEN 190
150 PRINT "CREATING ", O$, " SIZE", INT(L
  * 1.25), " TYPE 2"
160 CREATE O$, INT(L * 1.25), 2
170 OPEN #1%2, O$
180 GOTO 240
190 IF F1 = 2 THEN 230
200 PRINT "NOT A BASIC TYPE 2 FILE"
210 INPUT "TYPE 'RETURN' TO CONTINUE", A$
220 IF A$ <> "" THEN 120
230 OPEN #1%F1, O$
240 READ #0, &L
250 READ #0, &Q(2), &Q(3)
260 READ #0, &L
270 IF L = 32 THEN 260
280 Q(4) = 32
290 P = 4
300 IF L <> 143 THEN 390 \ REM REM
310 P = P + 1
320 Q(P) = 143
330 P = P + 1
340 READ #0, &Q(P)
350 IF Q(P) <> 13 THEN 330 \ REM RETURN
360 P = P - 1
370 GOTO 760
380 READ #0, &L
390 IF L = 13 THEN 760 \ REM RETURN
400 IF L = 44 THEN 500 \ REM,
410 IF L = 92 THEN 500 \ REM \
420 IF L > 127 THEN 500
```

- Following the detection of character 154 no space is inserted. This character indicates that a line number is embedded in the line (for example following a THEN or GOTO), and the next two bytes contain the line number which is copied exactly. Failure to do this would corrupt all embedded line numbers.
- No space is inserted after the reserved word FN, to prevent FNA being converted to FN A.
- The following special rules apply to the use of parentheses (often wrongly called brackets) except in REM's and strings: Spaces do not occur before) or after (. a single space is inserted before the character (only if the preceding character was + — * / ↑ or =. A space is inserted after the character) only if next non space character is a reserved word.

File handling

At its simplest, the program reads an input file from disc and writes an output file to disc either on the same disc or on a different disc. The user is asked for the name of the input file, and checks are performed to ensure that it exists, and that it is a type 2 (BASIC) file. The user is then asked for the name of the output file. If this already exists, a check is made to ensure that the file is type 2 (BASIC). The original file will be overwritten during the run, and the program will eventually fail if the original file is not large enough. If the output file does not exist, a new file is created with size 1.25 times the size of the input file. This has been found in practice to give a file plenty big enough. The program will fail if there is insufficient disc space for the output file. It is probable that if the files names are not type 2 the user has typed the wrong filename, and the user is offered the choice of typing a new file name, or continuing with the old file name despite it being the wrong type.

The input file is read one byte at a time, tidied, and temporarily stored in the Q array until a whole line has been processed. This is then output. The large buffers held Basic for input and output to and from disc minimise disc activity and improve the execution speed.

```
430 P = P + 1
440 Q(P) = L
450 IF L <> 34 THEN 380 \ REM HOLLERITH
460 P = P + 1
470 READ #0, &Q(P)
480 IF Q(P) <> 34 THEN 460
490 GOTO 380
500 IF L <> 154 THEN 550
510 Q(P + 1) = 154
520 READ #0, &Q(P + 2), &Q(P + 3)
530 P = P + 3
540 GOTO 380
550 IF Q(P) <> 32 THEN 580
560 P = P - 1
570 GOTO 550
580 N = Q(P)
590 IF N = 224 THEN 660 \ REM(
600 IF L = 44 THEN 660 \ REM,
610 IF L = 41 THEN 660 \ REM )
620 IF N = 227 OR N = 229 OR N = 226 OR N = 231
 OR N = 225 OR N = 245 THEN 640
630 IF L = 224 THEN 660 \ REM(
640 P = P + 1
650 Q(P) = 32
660 P = P + 1
670 Q(P) = L
680 M = L
690 READ #0, &L
700 IF L = 32 THEN 690
710 IF M = 144 THEN 750 \ REM FN
720 IF M = 224 THEN 750 \ REM(
730 P = P + 1
740 Q(P) = 32
750 GOTO 390
760 Q(1) = P + 1
770 FOR I = 1 TO P
780 WRITE #1, &Q(I), NOENDMARK
790 NEXT I
800 WRITE #1, &13, NOENDMARK
810 READ #0, &L
820 IF L > 1 THEN 250
830 WRITE #1, &1
840 CLOSE #1
```

The program

Lines	Function
10-230	open input and output files and perform associated checks.
240-290	handles space after line number.
300-370	copies REM's exactly.
390	detects end of line character.
400-420	detects reserved words.
430-440	copies normal ASCII character.
450-490	copies string exactly.
500-540	detects and handles embedded line numbers.
550-570	removes spaces before reserved word.
580-650	inserts a single space before a reserved word except in special cases.
660-670	copies reserved word.
680-700	searches input line for next non space character.
710-740	inserts a single space after a reserved word except in special cases.
750-800	outputs tidied line.
810-840	detects end of file mark and closes files.

The listing of the program has been tidied by itself, and illustrates the various points discussed. A trivial problem which has not been overcome is shown in line 50:

50^IF^F^>^ —^1^THEN^80

The splitting of the — from the 1 looks incorrect, but by contrast line 360 looks correct:

360^P^ =^P^ —^1

The ability to renumber the input file was considered but not included since the REM function already exists in Basic. It is conceivable but highly unlikely that a line of input which approaches the maximum length of 132 characters could be respaced to make it too long. The program will fail since the Q array is dimensioned at 132. It was not considered necessary to include a check for this since the ANSI standard for minimal Basic defines the maximum line length as 72 characters. Finally it was considered unnecessary to protect users from the results of their own sabotage if they should choose to use the same file for both input and output.

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

EXTRA MEMORY
8 × 2114
only
£35.00 + VAT

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

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.

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. Our catalogue is still available and if you're one of the few who haven't got a copy, order your FREE copy today.

Dynamic RAMS	£
4027	3.01
4050 (200ns)	2.50
4050 (350ns)	£2.35
4060 (300ns)	2.39
4116	6.74
Static RAMS	
2102A	1.16
2102A-2	1.16
2111A-1	1.70
2112A-2	1.83
21L02	1.16
2114	5.17
4035 (1000ns)	1.07
4045 (250ns)	6.15
5257 (TMS4044)	6.93
6810	3.03
ROMS	
2513 (U.C.)	6.25
2513 (L.C.)	6.25
MM5230	4.62
CPU	
6800	6.01
8080	5.08
9900	26.05
Z80	9.00
6502	9.50
E-PROMS	
1702AQ	5.16
2708	6.26
2716	24.00
T.V. Controller	
SFF96364	14.59
Buffers	
74365	0.52
74366	0.52
74367	0.52
74368	0.52
81LS95	0.86
81LS96	0.70
81LS97	0.86
81LS98	0.70
8T26	1.90
8T28	1.90
8T95	1.57
8T96	1.57
8T97	1.57
8T98	1.57
Interface	
8205	3.00
8212	2.00
8216	2.08
8224	2.77
8228	4.13

8251	5.00
8253	6.93
8255	5.08
Baud Rate Generators	
MC14411	5.87
MM5307	9.38
UARTS	
AY-5-1013	3.65
MM5303	5.04
*TMS6011NC	4.30

2708 only £6.26 +VAT

TTL	
7400	0.10
7401	0.10
7402	0.10
7403	0.11
7404	0.12
7405	0.13
7406	0.21
7407	0.21
7408	0.12
7409	0.13
7410	0.11
7411	0.17
7412	0.13
7413	0.19
7414	0.40
7416	0.19
7417	0.25
7420	0.10
7423	0.18
7425	0.18
7426	0.18
7427	0.25
7428	0.29
7430	0.10
7432	0.18
7437	0.19
7438	0.19
7440	0.16
7441	0.46
7442	0.35
7445	0.56
7446A	0.56
7447A	0.40
7448	0.49
7450	0.10
7451	0.10
7453	0.10

*7454	0.12
7460	0.10
7470	0.19
7472	0.17
7473	0.23
7474	0.20
7475	0.25
7476	0.17
7482	0.52
7485	0.90
7486	0.16
7489	1.30
7490	0.24
7491	0.54
7492	0.29
7493	0.24
7495	0.35
7496	0.42
74107	0.19
74109	0.30
74121	0.20
74122	0.29
74123	0.45
74125	0.39
74126	0.39
74132	0.54
74141	0.40
74145	0.40
74147	1.17
74148	0.86
74150	0.50
74151	0.42
74153	0.37
74154	0.59
74155	0.40
74156	0.37
74157	0.35
74160	0.50
74161	0.49
74162	0.50
74163	0.43
74164	0.52
*74165	0.49
74166	0.86
74170	1.30
74173	1.05
74174	0.50
74175	0.50
74176	0.63
74177	0.63
74180	0.37
74181	1.25
74182	0.58
74184	0.99

PLUS SUPERBOARD II
only £188.00 + VAT

74185	1.05
74188	2.75
74189	2.17
74190	0.45
74191	0.43
74192	0.43
74193	0.44
74194	0.38
74195	0.61
74196	0.69
74197	0.65
74198	0.86
74199	1.13
*74221	0.91
*74247	1.17
*74251	0.70
*74273	1.10
*74283	0.98
74365	0.52
74366	0.52
74367	0.52
74368	0.52
*74390	0.85
C.MOS	
4000	0.25
4001	0.15
4002	0.13
4006	0.68
4007	0.13
4008	0.54
4009	0.30
4010	0.26
4011	0.25
4012	0.14
4013	0.35
4014	0.58
4015	0.62
4016	0.28
4017	0.57
4018	0.58
4019	0.48
4020	0.63
4021	0.58
4022	0.62
4023	0.14
4024	0.51
4025	0.14
4026	1.30

4027	0.30
4028	0.52
4029	0.65
4030	0.52
4032	0.83
4034	1.13
4035	0.79
4040	0.60
4042	0.48
4043	0.52
4046	0.65
4049	0.30
4050	0.30
4051	0.45
4052	0.45
4053	0.45
4054	1.10
4056	1.35
4059	4.64
4060	1.04
4066	0.30
4068	0.16
4069	0.15
4070	0.15
4071	0.15
4072	0.15
*4075	0.15
4077	0.15
4081	0.15
4082	0.15
4085	0.71
4086	0.71
4093	0.44
4099	1.30
4502	0.67
4508	1.70
4510	0.61
4511	0.65
4514	2.17
4515	2.50
4516	0.52
4517	3.64
4518	0.57
4521	1.63
4522	1.09
4526	0.72
4528	0.57
4534	4.78

4536	3.03
4543	1.35
4553	3.87
4566	1.40
4583	0.72
4585	0.99
LS series	
74LS00	0.12
74LS01	0.12
74LS02	0.14
74LS03	0.14
74LS04	0.16
74LS05	0.19
74LS08	0.18
74LS09	0.18
74LS10	0.18
74LS11	0.18
74LS12	0.18
74LS13	0.37
74LS14	0.65
74LS15	0.18
74LS20	0.18
74LS21	0.18
74LS22	0.18
74LS26	0.18
74LS27	0.18
74LS28	0.19
74LS30	0.18
74LS32	0.26
74LS33	0.26
74LS37	0.23
74LS38	0.23
74LS40	0.18
74LS42	0.65
74LS47	0.81
74LS48	0.81
74LS49	0.81
74LS51	0.18
74LS54	0.18
74LS55	0.18
74LS73	0.33
74LS74	0.27
74LS75	0.40
74LS76	0.27
74LS78	0.27
74LS83	0.78
74LS85	.81
74LS86	0.27
74LS90	0.57
74LS91	0.97
74LS92	0.69
74LS93	0.60
74LS95	0.81
74LS96	1.16

74LS107	0.32
74LS109	0.32
74LS112	0.32
74LS113	0.32
74LS114	0.32
74LS122	0.69
74LS123	0.72
74LS124	1.39
74LS125	0.36
74LS126	0.36
74LS132	0.60
74LS133	0.39
74LS136	0.36
74LS138	0.58
74LS139	0.58
74LS145	0.97
74LS151	0.81
74LS153	0.52
74LS154	1.30
74LS155	0.72
74LS156	0.72
74LS157	0.57
74LS158	0.57
74LS160	1.09
74LS161	0.69
74LS162	1.16
74LS163	0.69
74LS164	1.06
74LS165	0.72
74LS166	1.65
74LS168	1.71
74LS169	1.71
74LS170	1.72
74LS173	0.81
74LS174	0.97
74LS175	0.97
74LS181	2.77
74LS188	0.44
74LS189	2.08
74LS190	0.86
74LS191	0.86
74LS192	1.04
74LS193	1.04
*74LS194	0.86
74LS195	0.97
74LS196	0.97
74LS197	0.97
74LS221	0.92
74LS240	2.08
74LS241	2.08
74LS242	2.08
74LS243	2.08
74LS245	2.50
74LS247	1.09

74LS248	1.09
74LS249	1.09
74LS251	0.96
74LS253	0.92
74LS257	0.92
74LS258	0.92
74LS259	1.39
74LS261	4.50
74LS266	0.37
74LS273	1.70
74LS279	0.57
74LS283	1.09
74LS289	4.50
74LS290	0.91
74LS293	0.91
74LS295	1.30
74LS298	1.16
*74LS348	1.39
74LS352	1.04
74LS353	0.92
*74LS362	4.21
74LS365	0.47
74LS366	0.47
74LS367	0.47
74LS368	0.47
*74LS373	0.78
74LS386	0.36
*74LS393	0.84
*74LS668	1.17
74LS670	1.71

8 × 4116
only
£49.50 + VAT

21L02
8 for £8.50
16 for £14.50
32 for £26.50
64 for £49.50
All + VAT

All prices are EXCLUSIVE of VAT. Postage and packing 30p (computers charged at cost). CALLERS WELCOME. Hours 9.00 am-6.00 pm (enter through stationers). TRADE and EXPORT inquiries welcome. Phone your orders through our ORDER-RING line quoting your Access or Barclaycad number (Min. mail order £5).

• Circle No. 186

A systematic approach to program design

by Nick Hampshire

FOR THE AVERAGE microcomputer user, the prospect of writing a set of programs to perform, say, a business application is daunting. Many give up at this stage and don't even try, preferring to use an off-the-shelf package or find someone else to do the programming.

Yet this does not have to be so, since any averagely intelligent person can write and design such a program. Given a logical framework on which to build, plus a few aids in the form of standard subroutines, the process of writing a program becomes considerably easier.

Let us consider a hypothetical user with a 32K PET, dual 2040 floppy disks and 3022 printer who wishes to use this system to write a library reference data base. The first stage in system design is for the user to decide exactly what the program must do.

In this case the program is required to reference a book or books from a small library of 500 titles either by subject matter or author. Thus the user wants to be able to type in a subject in which he is interested and get the computer to produce a list of titles of books in his library containing information on that subject.

Similarly, the user wants to produce a list of books written by a particular author. The problem is thus a fairly straightforward one of data access and retrieval from a data base stored on disk.

Four-part program

The program can be divided into four parts:

☐ **Data entry**, used to enter details of new titles added to the library.

☐ **Data update** needed to correct mistakes in the data base or to delete entries whose titles have been removed from the library.

☐ **Data access**: the part of the program which performs the user's requirement of accessing data from the data base in response to a particular input.

☐ **Data file maintenance:** to allow the user to make security backup copies of the data file. It will also perform functions like sorting the data file into alphabetical order.

You will notice that of the four parts of this program, three parts are concerned with the upkeep of the data file and this is typical of all programs using disk data bases. Each of these four program parts is totally independent of the other parts and interacts with the others only via the data base.

Since each part is independent it can be written as a separate program, which makes life much simpler for the programmer — only one part of the program need be written at a time. Each part can be stored on disk as a separate program and loaded by the user when required. A collection of programs like this is referred to as a program suite.

The unifying factor of all the programs in a suite is that they all use the same data base. Therefore, before any programs are written, the nature and format of the data must be defined. This is probably the most critical and trickiest part in the design of a program: bad file structures are the cause of a lot of poor programs.

Choice of data file

Unfortunately there is no easy rule of thumb which can be used to select the best kind of data file to be used in a program. The only rule worth remembering is that if the data file is very large, by which I mean a file which contains more data than can be stored in the machine's internal memory, then that file should in most cases be a random access file.

Short files which can be loaded into arrays and stored in core are best stored on disk as sequential files. The reason for this is that it makes data access times considerably faster and also makes file maintenance much easier.

In the example program, careful examination of the problem reveals that three major data files are required. The largest is the primary data base file which contains book titles and details of the contents: this file is to be organised as a random access file.

The other two files are both sequential: an author file and a subject file. It is one of these two shorter files which is searched during data access. Each record contains, say, the author's name followed by a series of pointers to records in the random access main data base file.

These pointers are simply record numbers: in a random access file system this is all the information required to access a particular block of information from a file. The advantage of using a short file consisting of a key and one or more pointers into a larger file is primarily one of speed, but also it is much easier to sort a short key file than a long random access file.

Another advantage of using short key files is that one can have multiple key files, just as here we have an author file and a subject file.

Having decided the types of file to be used in the program suite, and this example is very typical of many applications programs, we must decide on what data format is to be used in those files.

Very careful thought should be given to data formatting to make optimum use of the storage capacity of the machine. First let's look at random access files. A random access file consists of a set of records. There may be one hundred, a thousand or even ten thousand, depending on the application and the machine.

In our example the maximum number of titles is 500, therefore we do not require more than 500 records in the random file. Each record is of the same length, common record lengths are 128 (2^7) or 256 (2^8) bytes or some other power of 2 since using a record 128 bytes long makes for greater reliability because this is the natural organisation of the computer system.

Since our hypothetical user has a PET system which has a fixed record length of 256 bytes, we shall consider the formatting of a record of this length. The first step is to jot down a list of all the different data you wish stored in each record, and against each item to note the maximum number of bytes required to store it together with a note of whether the data is numeric or alpha.

Memory total

A running total of the number of bytes used should be kept since it is very important that the total should not exceed the maximum which we have set for the record, in this case, 256 bytes. Great care should also be taken that each data item, or field as it is known, within a record has sufficient space to accommodate the maximum possible size data entry necessary to ensure transfer of all required information in that field.

In our example the list would probably look something like this:

Field name	Bytes	Type
AUTHOR	20	Alpha
TITLE	50	Alpha
DATE	6	Numeric
CONTENTS	180	Alpha

There are one numeric and four alpha fields in the record. It is always desirable to store a record so that all the fields are of the same variable type. Thus in the example, the date should be converted to

Continued over page

an alpha string before it is entered into the record.

The date field always occupies six bytes but the three alpha fields are of variable length; the number of bytes quoted above is the maximum allowed for each entry. Any entry shorter than the maximum is padded out with spaces on the end of the string to bring it up to the maximum length.

For instance well-known author Kay, J. will be stored as KAY,J. ØØØØØØØØØØØØØØ Shakespeare,W. as SHAKESPEARE,W. ØØØØØØ while George Bernard Shaw just makes it under the wire as SHAW, GEORGE,BERNARDØ

Using this method we know that the title field, for example, always starts at the 21st byte of a record and ends on the 70th byte. This makes it easy, using the string manipulation commands in Basic, to retrieve each item of data from a record — see Figure 1.

Since it is envisaged that our example random access file will have a maximum of 500 records, each of 256 bytes the total data base will have a maximum size of 125K bytes. This will fit nicely on one disk, something which should always be aimed for when designing a program, since it is good practice to use one disk drive for data and the other for program storage.

By the same token, it is not desirable to have to change disks during program execution since this invariably leads to unreliability and a greatly increased chance of losing a data file.

While random access records must always have a fixed length, records in sequential files can have either fixed or variable lengths. The choice depends on the application. In many cases the data will always be the same length, making a fixed length and format sequential file the logical choice. Or, as with the random access file in our example, each sequential file record may contain multiple fields, so fixed-format, fixed-length records are the answer. They are much easier to dissect than variable length records.

But there are applications, and our example is one of them, where fixed-length sequential records are impractical. Each of the two sequential files contains a variable number of records. Each record consists of a key (the author's name or his subject) and a variable number of numeric pointers to records in the random access file.

To use fixed-length records in this application would require the allocation of sufficient space in each record to accomodate the maximum length key word, together with the maximum number of pointers. Since the file is to be stored in core memory as an array, the large amount of space (and therefore memory) wasted by using fixed-length records makes this totally impractical.

Figure 1

0	20	70	76	256
AUTHOR	TITLE	DATE	CONTENTS	

When records do not have fixed lengths, demarcation markers must be used between fields. The marker most commonly used is an asterisk. To dissect this sort of record, search from right to left for the first occurrence of the marker character. The record to the right of the marker is removed and the next marker searched for. This method is clumsier than that used for fixed-length, fixed-format records but is just as effective. In our example then, a record in the author file may be stored as:

SMITH.J.*14*56*79*125*2566*428*

The first field is a key — the author's name — SMITH.J. The next and subsequent fields are the pointers to the random access file showing that titles written by this author are stored in records 14,56,79,125,256, and 428. Using this method the author's name can be as long as necessary and can be followed by as many references as is required (subject only to the maximum length of a record which is limited by the maximum length of a string. (In most BASICs, strings must be less than 256 characters long).

Whatever file type is used, pointers must be used to locate the last entry on the file. This is vital if one is to be able to add further data to the file without risk of erasing existing data.

In a random access file zero could be used, so long as the programmer remembers that this record must *only* be used to contain the number of the next free record.

In a sequential access file, the easiest method is to use a special end record as the last record on the file. This way one simply continues to read records from the file until the end record is encountered. The usual form of end record is one filled with a string of Z's:

ZZZZZZZZZZZZZZZZZZZZZZZZZZ

It is then a simple matter to check if the first three bytes of a record are "ZZZ" since the odds against this combination occurring naturally in text are large. It is a reliable indication of the end of the file. The actual number of records in a sequential file can be obtained, as the file is read, by counting the records. Since the file will be stored in core, records can be easily added and inserted in the correct location using a sort procedure.

The new file created in this way is then rewritten over the old file. If the file becomes larger than the available array area, it will have to be broken into two sub-files, as we have done with the author and subject files which could have been merged as one file if core space permitted.

In these first stages, we have defined how the data will be stored by the program and what functions it is desired that the program perform. From these decisions a program specification can be written. This is the framework of the program around which the actual coding will be built.

It is important that it is correct in every detail since a mistake at this stage may prove very difficult to correct later on. The specification should contain a complete description of the operation of each program in the suite, showing what data is required from the operator, what data is to be output and which data files are accessed.

This written description should be accompanied by a diagram showing the flow of data, as in **Figure 2.** The second part of the specifications should be a complete table of the data file structures used by the suite. The third and last part should be a description of how data input, and output either on the screen or on a printer should be formatted. This may seem to be just a cosmetic operation but the ease with which an operator can use the system is almost entirely dependent on the thought put into this part of the specification.

At each stage in the program the screen layout and/or printer output should be drawn out on a piece of squared paper. A table should be made of standard forms

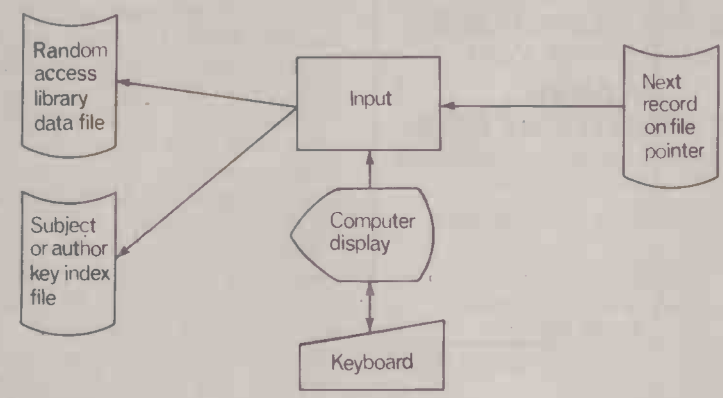


Figure 2

of input to be used throughout the programs. One example would be the format of all date inputs.

All inputs ought to be made using the same variable type and format since it is disturbing to have some inputs terminated by a carriage return and others not.

So one might make a decision to have all inputs in string format with a fixed-length prompt and traps for null entries, illegal carrage returns etc. Decisions should also be made at this stage as to the nature of any input validation and error checking procedures, such as the use of a check digit.

Once the specifications have been written, programming can begin when working on a suite of programs, it is best to start with data entry since this program can then be used to create the data files needed to test the other programs in the suite. Each of these programs can be divided into a set of subroutines. A subroutine is a short, self-contained program written to perform a specific function which can be run by itself without the rest of the main program.

The great virtue of using standard subroutines to build a program is that they need not be specific to that program and can be reused in any other program requiring them. This means that once, for example, a good subroutine has been written to input and validate the data, it can be converted to a standard internal format which can be easily stored and recovered whenever required by another subroutine written for the purpose.

This pair of subroutines can then be repeatedly used in other programs, greatly reducing programming effort. The extensive use of standard sub-routines is the key to writing good programs quickly and easily. To make maximum use of standard sub-routines the programmer must adopt a strict discipline about the use of variable names.

This is essential since a sub-routine

Variable either string or numeric.	Function
E	All E variables refer to error flags and messages.
A,B	Temporary variables in subroutines
S	Disk sector variable.
T	Disk track variable.
I	Index variables.
D	Disk drive designator variable.
F	Format variables, printer and disk.
P,R	Parameter variables passed by subroutines.
Q,I,X	For-Next loop variables.
Z	File delimiter variable.
TI	Time variable.
DA	Data variable.
COL	Column number of cursor.
LNE	Line number of cursor.

Figure 3

All the above variables can be either string or numeric and except for the four multiple character variables can be followed by any character. Thus with E variables one might have EM$ and ES,ET,ED,EP etc, providing the resulting variable is neither one of the four multiple character variables or a reserved word Basic.

communicates with the main body of the program (ie the code which links the subroutines together) by means of input and output parameter variables. Obviously a specific set of variables must therefore be reserved for this purpose.

A set of variables must also be allocated for specific purposes, such as error states, or temporary variables used within a subroutine. Figure 5 is a suggested table of such reserved variables.

When writing a program, the task will also be made much easier if subroutines are allocated a specific block of line numbers. Similarly blocks should be allocated to program header, variables and arrays, and the main program. They could be arranged thus:

Line Nos	Function
1-99	Description of the program using REM statements.
100-999	Definition of variables and arrays used in the program.
1000-9999	Main body of the program.
10000-30000	Standard subroutines.
30000-32000	Error handling routines.

The standard subroutines in this arrangement are located in line numbers between 10000 and 30000. They might include:

Input and validation routines for strings and numbers.
Address input and validation.
Address output.
Date input and validation.
Date output.
Date conversion to internal format.
Date reconstruction from internal format.
Creation of check digit and error detection in numerical input.
Screen handler and cursor positioning.
High density graph and bar chart plotting routines.
Sorts of array and disk file data.
Searches of arrays and files.
Disk handling and file access, random and sequential.
Linked list file create.
Head and tail file create.
Dump screen contents out to printer.
Draw borders around the screen.
Error message handling.
Yes/No validation.
etc......

These are examples of some of the subroutines which are commonly used. Carefully used, a library of such sub-routines can reduce the time and effort required to write a program by as much as 75%.

• This article is a shortened version of the introductory chapter of a new book entitled *A Handbook of PET Sub-routines* written by Nick Hampshire and available in April 1980 from Commodore dealers and computer bookshops. This book is a library of sub-routines written for the PET but of interest to anyone running a version of Microsoft Basic.

BUYERS' GUIDE

The Buyers' Guide is a summary of low-cost computers available in this country. It appears each month; we add new computers and amend existing information, as required, to keep it up-to-date. Systems are listed by manufacturer.

ACORN COMPUTERS

Acorn. Single Eurocard-sized microcomputer with 6520 processor, IKB RAM, 16-way I/O. Max size; a second Eurocard adds hex keypad and CUTS cassette interface. Monitor and machine-code programming now. Basic and disc operating system in the future. "Highly cost-effective basis for a computer or an industrial development system". Available from Acorn (0223) 312772 or Microdigital (051) 236 0707.

£74.75 kit, £86.25 assembled

APPLE COMPUTERS

Apple II. Min size: 16K memory; 8K ROM; keyboard; monitors; mini assembler; colour graphics; Pal card; RF modulator; games; paddles and speakers; 4 demo cassettes. Max size; Expandable to 48K memory; floppy discs and printers are now available. Two versions of Basic, PASCAL; Assembler; games; business packages. An American system regarded as suitable for any kind of aplications. Maintenance contracts offered. Microsense Computers is the sole U.K. distributor and has a national dealer network. Tel: (0442) 41191/48151 (24-hour answering service).

Around £1,000

ATTACHE

Attache: Min size: system with 10 slots, S100 bus, 8080 processor and 16KB housed in desk-top case with built-in keyboard. Max: 64KB, parallel printer interface, two single or double density 8" floppies, video screen. Disc Basic. Full business system includes all software. Mecotronic is UK agent south of Birmingham. Tel: (0276) 29492, R. J. Spiers, 3 Birch Court, Woodlands Garden, Norwich, north of Birmingham.

From £1737. Full business system £7000

BILLINGS

Billings Microsystem (BMS): Z-80A, 64K RAM, 12" screen, QWERTY keyboard, range from double density 8" floppies (600KB), to 200 MB hard disc. Software includes COBOL (ANS174 with extensions), FORTRAN, Extended BASIC and MAC80 Assembler. The microsystem could be used as a program development aid. Availability: Mitech Data System Ltd, Woking (04862) 23131.

From £4295

BRUTECH ELECTRONICS

BEM-CPUI. Single-board processor with 6502 and no RAM. Applications software. Available from Data Precision Equipment (04862 67420). (Reviewed March, 1979.)

£133 exc VAT

BYTRONIX MICROCOMPUTERS

Megamicro. 8080A/Z-80 processor. 64K. Double-sided discs, two-page addressable VDU, 140 cps printer. Software includes Basic, Fortran, Cobol and Pascal, all running under CP/M. Applications include automatic letter writer, sales ledger and stock control, payroll and bought ledger. Self-diagnosis utilities. Aimed at business and university user. Available from Bytronix (0252) 726814. *From £6,080.*

COMART

Microbox: Chassis with three to six PCB sockets for S100 boards, plus fan. Several S100 boards available. Aimed mainly at OEM industrial users and perhaps the serious hobbyist. It will take Cromenco, North Star and other processors. Available from Comart (0480) 215005. *£195*

VDM Board: Adds word processing power to the S100 bus by providing on-board screen storage. Generates 16 by 64 character lines from data stored in a 1024 byte on-board memory. *£145*

COMMODORE SYSTEMS DIVISION

Pet. Single unit containing screen, tape cassette and keyboard. Floppy disc, printer and full-size keyboard are options, as are external cassettes. Basic; games; business packages. The British subsidiary of Commodore Systems of the U.S. sells Pet for home, educational and small business applications. About 80 distributors. *£460-£795 exc VAT*

Kim-1. processor (6502 chip); small calculator-type keyboard; LED six-digit display; built-in interfaces for audio-cassette and Tele-type; IK RAM; 2K ROM (can add up to 64K). No software available, but it has three good manuals. An American import which gives Pet-type capabilities with a maximum configuration. For the hobbyist but used mainly as an evaluation board for the 6502 chip. Twelve to 15 dealers. (Reviewed October, 1978.). *£99.95*

COMPELEC ELECTRONICS

Series I. Z-80 processor 512MB floppy, 32KB, Centronics printer, VDU. Up to 4MB disc and 64KB. CP/M, Basic, Cobol, PASCAL, Fortran IV, Assembler, Business and word processing packages available. From Compelec (01-580 6296), which is also sole supplier of Altair systems. *Less than £5,000 for basic system*

COMPUCOLOR

Compucolor II. Packaged system including 13in. eight-colour display with alphanumerics and graphics, 72-key detachable keyboard, 8KB, and bult-in mini-floppy. Max size: 32KB. Extended disc. Basic in ROM, graphics progams and games. The system now ranks fourth behind Pet, TRS-80 and Apple in personal computer sales. Abacus (01-580 8841) is sole U.K. agent and is arranging distributors, including the Byte Shop and Transam. (Reviewed June, 1979.) *From £1,390*

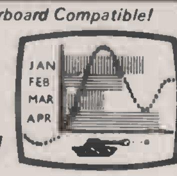
COMPUCORP

610: desk-top unit using Z-80 and incorporating screen, 150KB floppy, 48KB. Up to 60 KB memory, four floppies, printers. Basic, Assembler, DOS, text editor, file manager; business packages. Nine dealers. *From £3,890*

COMPUTER CENTRE

Mini kit: Z-80 CPU, CTC, USART, serial and parallel I/O, 16 bytes memory, Western Digital disc controller, SA400 5in. drive plus CP/M, cables and connectors. *Mini kit: £786*

Maxi kit: As above but with DRI 7100 8in. drive instead of 5in. drive. All (33) volumes of CP/M user group library available for cost of media. Library includes utilities, games. Basic compilers/interpreters and Algol compiler. Microsoft Basic, Cobol, Fortran also available. Computer Centre (02514 29607). *Maxi kit: £886*



COMPUTER WORKSHOP

System I. Typical size: 40K memory; dual 8in. floppy disc, total storage capacity 1.2MB; Ricoh daisywheel printer.
System I, £5,000 plus

System 2. Typical size: 24K memory; dual minifloppy discs of 80K bytes each; Centronics 779 dot matrix printer; VDU.
System 2, around £3,000

System 3. 12K memory, cassette interface; 40-column dot matrix printer. Editors, Assemblers, Basic, games, information retrieval package. The systems were designed and built in Peterborough and are suitable for educational and small business users and perhaps the more serious hobbyist. Twenty-five dealers.
System 3, from £1,300

CROMENCO

Single-card computer: 4MHz Z-80 CPU, S-100 bus, 1KB RAM, sockets for 8K ROM. 20mA/RS232 serial interface and parallel bidirectional interface. Basic in ROM and Z-80 monitor. For OEM and industrial users; used with backplane for "full computer compatibility" (Reviewed February 1979).
£225 (in kit form) to £260

Z-2: Min. size: chassis, 31A power supply, motherboard, Z-80 processor, 16KB memory. Max size: 512KB, 21 sockets, three minifloppies or four 8" floppies. Basic, Fortran, Cobol, assemblers. For serious hobbyists, OEMs, educational applications, and industrial/scientific userers.
£360 (in kit form) to £3700

System Two. Min size: factory-assembled system with 32KB, dual 90K minifloppies, dual printer interface, serial interface. Max size: two additional floppies, 512KB, up to seven terminals, CP/M-compatible operating system (CDOS), Fortran, Cobol, Basic, assemblers, word processing, database manager. Multi-user system for software development, or scientific/industrial/business users.
£1,995 upwards

System Two/64: 64KB, dual 90K mini-floppies, dual printer interface, serial interface. Options: two additional floppies, 512KB, up to seven terminals, CP/M compatible operating system (CDOS), Fortran, Cobol, Basic, assemblers, word processing, data-base manager. Multi-user system for software development, or scientific/industrial/business users.
£1995 upwards

System Three. Min size: 32KB, dual 256KB floppies, dual printer interface, 20mA/RS232 serial interface, Z-80 processor. Max size: two additional discs, 12KB, seven terminals, multi-channel A/D and D/A interface, PROM programmer. Software as for System Two. Described as appropriate for small to medium business, scientific and industrial users — "rivals minicomputers at more than twice the price".
£2,995 to more than £8,000

System Three/64: New configuration featuring dual 8" floppies, Z-80A processor, 64K of 4MHz memory; console and printer interfaces. Macro assembler, Fortran IV, Extended Basic, Cobol, Multi-user Basic. All systems sold by Datron Interform, Comart, Micro Centre. Prices quoted by Comart.
£3270

DIGITAL MICRO SYSTEMS

DSC-2. Min size; 32KB, but 64K standard; Z-80; over IMB floppy disc on two single-sided 8in. drives; four programmable RS232 and one parallel interface. CP/M and Basic included in price. Extended Basic, Fortran, Cobol, text processing, Macro Assembler, Link Loader, business packages and CAP-CPP business software. Add-on rigid disc system (14 and 28MB) available soon. Modata (0892 39591) is sole U.K. distributor; dealers being appointed.
From £4,465

DYLE HOUSE

Business Computing System 2000. Z-80A. Dual 8in. discs, 140 cps 132 char printer. Dyle House Business Basic, and disc operating system. Accountancy, payroll and parts control suites. Applications: Sales acknowledgments, sales invoices, delivery notes, purchase orders, customer statements, remittance advice. Dyle House Ltd (01-529 2436).
No price announced

EQUINOX

Equinox 300. Min size; 48K memory; dual floppy discs giving 600K bytes of storage; 16-bit Western Digital m.p.u. Max size; up to 256K memory; up to four 10MB hard discs. Basic, Lisp, PASCAL, Macro Assembler, Text Processor. All software bundled. The system is a multi-user, multi-tasking, time-sharing system for two to 12 users. Application software available for general commercial users. Sole distributors Equinox Computers Ltd (01-739 2387).

£5,000-£40,000 plus

EURO-CALC

Euroc: 8080A CPU, 64KRAM, two times double-dsided single-density 8" floppy disc drives with approximately 1 MByte capacity. 15" screen with 80 by 25 characters, QWERTY keyboard. CP/M operating system 140 CPS tractor feed matrix printer. Software: C-BASIC 2. Supplied with accountancy package for sales, purchases and nominal ledgers and initial stationery. Sold through Euro-Calc, 55/56 High Holborn, London W.C.1. Tel: 01-405 3113.

£8000

EXIDY

Sorcerer: based on Z-80, 16K and 32K; cartridge and cassette interfaces; 79-key keyboard; 256-character set (128 graphics symbols), 12in. video monitor; expandable with Micropolis floppy discs. Basic, Assembler and Editor; games, word processor. Other pre-packaged programs plus EPROM Pack for your own programs on cartridges. Factor One is sole distributor for U.K. (Reviewed March, 1979.)

From £760 without VDU to £1,200 with floppy discs

HEATH SCHLUMBERGER

H8. 8080 CPU. 4664K PAM. Serial/cassette I/O; front parallel monitor; keypad; optional parallel I/O; serial multiport; breadboard I/O and disc system. Basic, Ext Basic, Mierosoft Basic, HDOS, CPM.

From £262 (in kit form)

WH89. All-in-one computer. Z-80 processor plus Z-80-controlled VDU. 16K expandable to 48K, user-accessible. Two RS232 I/O ports. Operating system includes Benton Harbour Basic, two-pass absolute assembler, text editor, utility programs, Mierosoft Basic and Fortran word processor package. Heath Schlumberger (0452 29451).

About £1,600

HEWART MICROELECTRONICS

Mini 6800 Mk II. IK monitor; IK user RAM, IK VDU RAM; CUTS. Upper- and lower-case VDU with graphics option. 128-byte scratchpad; decoder/buffer; power supply; Basic in ROM; monitor command summary. SWTPC programs; Newbear 6800; Scelbi 6800 Cookbook. Markets are small business, education and home user. Cash with order to Hewart. (0625) 22030.

From £127.50 plus VAT

6800S. 16K dynamic RAM; IK Mikbug-compatible monitor; room for 8K Basic in ROM; upper- and lower-case graphics; single floppy disc drive; printer and high-speed tape interfaces. "Mountains of software available." Test tape with CUTS test tones, test message and games with kit.

From £275 plus VAT

IMSAI

VDP 40: 32K or 64K RAM memory; 9in. display screen, standard keyboard. Two 5¼in. floppy disc drives; serial I/O. Full software support, and packages available for the VDP 42, which has larger disc capacity. Packages for VDP 80 could be converted for smaller systems. This would be from about £700 per package. Two main dealers in the country.

£4,507 for 32K model. £4,950 for VDP 42

ITT

2020. Identical to Apple II. Min. size: 4K memory; 8K ROM; keyboard, monitor, colour graphics, mini assembler; Powell card; RF Modulator, games, paddles and speaker; Max size: 48K with floppy discs and printers. Basic, Assembler, games, business packages. Generally suited to any type of application. Fifteen wholesalers, including Fairhurst Instruments.

From £827 to £3003 for 48K, two floppies and printer

LUXOR

ABC 80. Min size: 35K with keyboard, CPU 12in. screen and cassette. Max size: 40K RAM with discs. Z-80 processor, loudspeaker with 128 effects, real-time clock. Options: printers, plotter, discs, module cards, digitiser, modem. 60 compatible I/O memory boards. Software: Basic with resident editor; assembler; games; business and educational packages. Personal computer aimed at home market, small business and education. CCS Microsales is U.K. agent and is looking for distributors.

£795 plus VAT

MICRONICS

Micros. Typical size: IK monitor; 47-key solid state keyboard; interfaces for video, cassette, printer and UHF TV; serial I/O, dual parallel I/O parts; 2K RAM; power supply. 2K Basic; British-designed and manufactured system. Claimed to be the cheapest data terminal — a system with an acoustic coupler and VDU for £1,020. Prospective applications for small businesses, process controllers and hobbyists. Manufacturer is sole distributor (01-892 7044).

From £400, assembled

MICRO V

Microstar. Single box with twin 8in. flopy discs, 64K RAM, three RS232 serial inputs, STARDOS operating system enables system to have three VDUs, plus a fourth job running simultaneously. Word processing software available. Packages being developed include invoicing system, payroll, accountancy type system. Price includes a reporter generator language. Imported by a Data Efficiency subsidiary, Microsense Computers, Microsolve is London agent; other distributors being arranged.

£4,950 machine and software

MIDWEST SCIENTIFIC INSTRUMENTS

MSI 6800. Min size: 16K memory Act I termnal; cassette interface. Max size: three disc systems — minifloppy system with triple drives of 80 bytes each and 32K memory, large floppy system with up to four 312K-byte discs and 56K of memory mounted in a pedestal desk, or hard disc system with 10MB and 56K Basic interpreter and compiler; editor, assembler; text processor on small disc system. American-designed system being manufactured increasingly in the U.K. Sole U.K. agent is Strumech (SEED) (05433 4321) but a distributor network is being established.

Basic system: £1,100 (£815 as kit); Minidisc, £2,500; floppy disc £3,200; hard disc, £8,000-£12,000

NASCOM MICROCOMPUTERS

Nascom I. Min size: CPU; 2K memory; parallel I/O; serial data interface; IK monitor in EPROM. Max size: CPU, 64K memory; up to 16 parallel I/O ports. Mostly games, but also a dedicated text editor system written by ICL Dataskil Nascom is working on large versions of Basic, and 8K Microsoft Basic should be available soon. Eleven distributors in U.K. Nascom is negotiating to increase the number. (Reviewed January, 1979.)

£165 exc VAT

NATIONAL MULTIPLEX

Pegasus. Min size: 48K, Z-80; double-density floppies (320KB); S100 bus; 12in. CRT; 58-key keyboard; two serial and one parallel interfaces; bi-directional printer. Options: 8in. drives; 1-2MB additional drives; digital recorder 9,600 baud. Assembler, Cobol, Fortran, Extended Basic. General business package available as well as text editing and mailing list. All run under CP/M. Suitable for education, business and home users. London Computer Store (01-388 5721) sole supplier.

£2,700 exc VAT

NETRONICS

Elf II: single-board computer in kit form or assembled. RCA Cosmac 1802 processor, hex keyboard, 256 bytes RAM; options include up to 64KB, ASCII keyboard, cassette and RS232 I/O, and video output. Machine code or Tiny Basic. Promoted as a teaching system in minimal form, but expandable for more general use. Sole U.K. distributor HL Audio (01-739 1582).

Basic kit £79.95. Assembled £99.95. I/O board £35

Explorer 85: Min size: 4K. Max. size: 64K. 8085A processor, VDU board, ASCII Keyboard, S100 expansion. Cassette, RS232, TTY interface on board. I/O ports, programmable timer. Disc software, Microsoft Basic on cassette, 8080 and Z-80 software can be used. Aimed at hobbyist, OEM and small business. Available from Newtronics (computer division of HL Audio). *From £297 plus VAT*

NEWBEAR

7768: CPU board, 4K memory, cassette and VDU interfaces. Range of Basics and games. British manufactured system for hobbyists. Expandable to 64K memory available only in kit form. From Newbear in Newbury and Stockport. *From £45*

NORTH STAR

Horizon. Min size: 16K memory; Z-80A processor, single minifloppy disc drive (180KB). Max size: 56K memory, four minifloppy disc drives (180KB), any acceptable S100 peripheral boards. Basic (includes random and sequential access), disc operating system and monitor. Options: Basic Compiler, Fortran, Cobol, Pilot, PASCAL and ISAM. The system is suitable for commercial, education and scientific applications. Application software for general commercial users. Twenty distributors. (Reviewed April, 1979.) *£995 to £2,500*

OHIO SCIENTIFIC

Ohio Superboard II. Min size: 6502 processor, 8K Basic in ROM; 2K monitor in ROM; 4K RAM; Cassette I/F, full keyboard, 32 x 32 video I/F, 8K Basic in ROM; Assembler/Editor; American single-board system with in-board keyboard. Aimed at hobbyist/small business. Ohio makes games, personal maths tutors, and business programs. This and other Ohio products have six U.K. distributors. (Reviewed June, 1979.) *From £298*

PERTEC

System 1300. Min size: 32K memory; dual minifloppy discs 71 bytes each, formatted; serial interfaces. Max size: 64K memory; four serial parts. Basic (single and multi-user), Fortran, Cobol. The hardware for Compelec Altair systems is from Pertec but the software is Anglo-Dutch. Sole distributor Compelec (01-580 6296). *£3,000-£5,000*

POWERHOUSE MICROPROCESSORS

Powerhouse 2: Desktop unit using Z-80A with 5" built-in VDU and built-in minicassette (optional), 16K or 32K RAM, full keyboard, real-time clock, two spare slots, RS232 interface. Software: Disc and cassette operating system, programmable keyboard facilities for eight PROM chips giving a max of 16 or 32K or ROM, 2K monitor in EPROM. Extended basic (optional). Aimed at OEMs and expert users such as scientists or researchers. Applications include real-time process control, engineering calbulations. Availability: Powerhouse only (0442) 42002. (Reviewed, September 1979). *From £1200*

PROCESSOR TECHNOLOGY

Sol. 808-based S100 microcomputer packaged with cassette and video interfaces (including graphics), keyboard with numeric pad, and 16KB RAM. Basic, assembler, word processors. Floppy disc systems available. Several distributors including Comart (0480 215005), which can offer nationwide maintenance contracts (Reviewed July, 1979.) *From £1,750 (excluding monitor and cassette). Complete floppy disc systems with word processing about £5,000*

RAIR

Black Box. Min siz: 32K memory dual minifloppy discs, 80K bytes each; two programmable serial I/O interfaces. Max size: 64K memory; eight serial interfaces; 1MB disc storage (or 10MB hard disc); range of peripherals. Basic, Fortran IV, Cobol, Hardware distributors are being signed and agreements made with software houses to add software. A warranty and U.K.-wide on-site maintenance is given. From manufacturer (01-836 4663) and systems houses. *From £2,300*

RESEARCH MACHINES LTD

380-Z. Min size: 4K memory; 380-Z processor, keyboard. Max size: 56K memory. Options: cassette, single or dual minifloppy discs, dual 8in. double-sided discs (IMB); serial interfaces; parallel interfaces; analogue interface; printer available. Basic Interpreter, Z-80 Assembler; interactive text editor; terminal mode software; data logging routines; CP/M, DOS, text processor, CBasic, Fortran, Algol, Pilot, Cobol, CP/M users' club library. Sold principally to higher and secondary education, and for scientific research, data processing and data logging. Available from Sintel and the manufacturer. (Reviewed December, 1978.)

From £830-£3,500

280-Z. Board version of 380-Z system, 4K or 32K (identical in performance to the 380-Z). Interfaces; software as for 380-Z.

4KB version at £398; 32KB for £722

RCA

Cosmac. 1802 micro with hex keypad and output to TV screen. Assembler and machine code programming; options include Tiny Basic. Available by mail order from HL Audio (01-739 1582).

Kit £79.95. Assembled £99.95 exc VAT

ROCKWELL

Aim-65. Kim-compatible with full keyboard and on-board printer. 1K or 4K RAM. The 4K version is described as a development system rather than a personal computer. Assembler, editor, Basic. Available from Pelco, Microdigital and Portable Microsystems (Reviewed July, 1979.)

1K — £249.50
4K — £315

SCIENCE OF CAMBRIDGE

Mk 14. SC/MP processor, 256 bytes user memory; 512-byte PROM with monitor program; hex keyboard and eight-digit, seven-segment display; interface circuitry; 5V regulator on board. To this can be added: ¼K RAM (£3.60); 16 I/O chip (£7.80); cassette interface kit (£5.95); cassette interface and replacement monitor (£78.95); PROM Programmer (£9.95). No software provided but a 100-page manual includes a number which will fit into 256 bytes covering monitors, maths, electronics systems, music and miscellaneous. Based on American National Semiconductor chips. Science will soon have a VDU Interface and large manual on user programming. Mail order from manufacturer (0223 312919) and by selected dealers. (Reviewed May, 1979.)

£39.95 basic

SDS

SDS 100. Single unit containing 32K memory (expandable to 46K); up to 8K PROM; twin double-sided floppy disc drives of 500 bytes each, serial and parallal RS232 interfacing; keyboard; 12in. video display; power supplies; SD monitor program: line printer available. CP/M, 8080 assembler, E Basic, Editor supplied with system; M Basic, Fortran, Cobol available for business use, industrial process monitoring and control (with additional hardware). All CP/M games and business packages. Sole supplier Airamco (0294 65530).

From £3,750

SEMEL

Semel I. Min size: 4K with CPU, keyboard and monitor. Max side: 64K with single floppy disc unit, printer, VDU and keyboard. Can be coupled to any external device and controls up to 8 x 250K floppy disc units. Four configurations available. Options: Light pen attachment; 12V DC power supply; remote terminals. Software: Editor, Assembler, debug, full file-handling capabilities in Basic, Fortran and Cobol available on 64K machine; user-defined programs written and compiled by agreement; word processing. General-purpose unit for use as a terminal controller. Suitable for small business and OEMs. Available from Semel exclusively (0822) 5439.

£1,950 with Basic

SOLID STATE TECHNOLOGY INC.

Athena Dt/C 8200: Eight-bit 8085 desktop computer with in-built dual mini floppies, inbuilt dual mini-cassette, inbuilt matrix printer and 1920 display. Can be expanded with 10 micros, beyond the CPU, each working as an intelligent controller, up to four floppy disc drive and four rigid disc drives. Maximum memory is 1.2GBytes. Standard system software is the AMOS multi-task operating system. Claims a performance roughly comparable to the DEC PDP-11/34. Butel-Comco, Southampton (0703) 39890, are the sole U.K. distributors.

From £3000

SORD

M100. Min size: 16K RAM; 4K ROM Monitor; full keyboard plus function keypad; two-channel joystick dual cassette I/F; 11K E Basic on cassette; video; graphics; printer; S100 bus; converters; speaker; 24-hour clock. Max size: 48K RAM, 8K ROM; black and white or colour graphics; mini-floppy discs. Suitable for OEMs, small business, education, laboratory and scientific and home computing. Main distributor is Dectrade, but for London and South contact Midas Computer Services (0903) 814523.

From £726

SYNERTEK

Sym 1. 6502 chip and keypad with memory available in 4K blocks up to 64K. Port expansion kit, TV interface card, RAM expansion kit, cassette and Teletype interfaces. Any Kim software, Basic interpreter, Assembler/Editor, American, meant to be the foundation system for every small business and hobbyist users. Available from Newbear (0635 49223).

From £160 plus VAT.

TANDY CORP.

TRS-80. Min size: Level I 4K memory; video monitor; cassette; power supply. Max size: Level II 48K up to 350K on-line via floppy discs; line printer; tractor feed printer and quick printer; floppy disc system. Modem, telephone interface soon available. Basic; some business packages. Level I aimed at the hobbyist and education market and Level II at small business applications. Hundreds of dealers. (Reviewed November, 1978.)

Level I — £499
Level II — from £578-£4,700

TRANSAM COMPONENTS

L4.1. 1K monitor, 2K Basic in EPROM; full graphics capability; 128 character set; power supply; cabinet; 56-key keyboard. Expandable to 65K. Available from manufacturer (01-402 8137).

£286 kit with SKB

ULBRICH AUTOMATION

Powerhouse II. 16K or 32K RAM, Z-80 processor, RS232 interface; 5in. built-in VDU; full keyboard; built-in mini cassette; real-time clock. Software; Programmable keyboard in 16K PROM; 2K monitor system; DOS; Extended Basic. Options: larger VDU; discs, 14K Basic, Tripoli interface; X-Y graphics; IEEE interface. Compatible with all computers and peripherals. Applications: file management, off-line data processing and assembling capabilities. Suitable for OEMs and expert users. Available exclusively from Powerhouse Microprocessors Ltd. (0442) 42002, which will also manufacture it next year.

VECTOR GRAPHIC

48KB RAM, Z-80 micro; 63K bytes, mini-discs are standard. Options: graphics. Monitor, MDOS, Basic; business packages from dealers. Several distributors.

£2,300

Shop Window

MICRO ADS

L & J COMPUTERS

3 CRUNDALE AVENUE, KINGSBURY NW9 9PJ 01-204 7525

THE "PET" SPECIALISTS

COMMODORE OFFICIALLY APPROVED DEALER

HARDWARE

COMPARE OUR PRICES!

NEW PET 8K	£499
New PET 16K	£599
New PET 32K	£725
EXTENSION CASSETTE DECKS (WITH COUNTER)	£55

DUAL DRIVE DISK UNITS

PET 3040	£740
COMPUTHINK 400K	£949
COMPUTHINK 800K	£1099

PRINTERS

PET 3022	£620
CENTRONIC 779 *(Tractor feed)*	£869
SWT PR 40 (Inc Interface) *(becomes an on-line printer)*	£295
TELETYPE 43	£875

SUNDRIES

TOOL KITS	from £55
VARIOUS INTERFACES	from £40
FLOPPY DISCS	from £2

PAPER: ROLL & TRACTOR FEED
FULL RANGE OF PETSOFT & COMMODORE SOFTWARE
If you can't see what you want — ask.
We pride ourselves on getting what the Customer wants — quickly!

PRICES DO NOT INCLUDE VAT

SYSTEMS

WE OFFER SMALL BUSINESS SYSTEMS FOR UNDER £2099 + WHICH CAN NOT ONLY CARRY OUT MOST OF THE DAY TO DAY CHORES, BUT ALSO HAVE ROOM TO SPARE TO COPE WITH THOSE "ODD JOBS". TAKE YOUR CHOICE!

EACH PACKAGE COMPRISES A 'PET' 32K, CABLES, ANY INTERFACES REQUIRED, BUT DOES NOT INCLUDE PAPER, DISKS ETC.

DUAL DRIVE DISK UNIT	*TRACTOR FEED PRINTER*		
	PET 2022	*TELETYPE43*	*CENTRONIC779*
PET 3040	*£2099*	*£2399*	*£2399*
COMPUTHINK 200K × 2	*£2129*	*£2429*	*£2379*
200K × 4	*£2289*	*£2589*	*£2539*

PRICES DO NOT INCLUDE VAT

SOFTWARE

As well as a full range of Petsoft and Commodore Software, we hve some highly reliable "Home-Brewed" programs available.

STOCK CONTROL & INVOICING £60
(Handles up to 500 items — 32K) (180 on 16K). Stock depleted on invoicing, search etc. Cassette, disk (& print option).

STOCK CONTROL & INVOICE (RANDOM ACCESS) £120
On-line handling of 3400 items (50 char.) per disk. Disk (+ printer option) (16 or 32K) search etc.

ADDRESS/PHONE BOOK £35
Create, amend, enlarge, search (+ print option) (16K or 32K).

MINI CAB/DELIVERY INVOICE & DRIVERS WAGES £220
Weekly or monthly invoices — cheque writing facility — optional deductions. (16 or 32K + disk + printer).

INFORMATION RETRIEVAL £130
Multi field; multi item; infinitely variable. Print facility: automatic sort.

ALARM CLOCK £5
See the time — hear when you're overdue! (All Pets).

YOUR MONTHLY PLANNER £7
Print your own planner on your own printer! Any year or month.

RANDOM ENTRY & ANALYSIS £40
Makes adding up all those different invoices childs' play! Cash, cheques etc., balances & VAT.

SCHEDULE 'D' £25
Check your own tax without being an accountant!

SEND SAE. FOR FREE BROCHURE
PRICES DO NOT INCLUDE VAT.
We can write specialist programs for you. Ask us for a quotation.

ACQUISITION

You are welcome to try, browse & purchase at our premises.
You can phone your order.
You can fill in & send off the form below.
Whichever way you choose, you cannot help but be delighted with our service.

ORDER FORM

TO L & J COMPUTERS:
PLEASE SEND ME BY RETURN: —

__________ £ ______
__________ £ ______
__________ £ ______

ADD £12 for large items **
ADD £1 for small items

VAT £ ______

TOTAL £ ______

CHEQUE/P.O ENCLOSED*
CHARGE TO MY ACCESS/BARCLAY/VISA CARD No.*
*(*delete as req'd)*

ALL GOODS SENT SAME DAY WHEREVER POSSIBLE
Recorded delivery by post: or Securicor. **

BARCLAYCARD VISA

• **Circle No. 260**

Shopping List

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 ‘rmats available immediately) .... £95/£15

NEW

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 mnemc NEW uires 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 cros NEW ssembler. All Macro and utility features of MACRO-80 p ge. Mnemonics slightly modified from Intel ASM86. Comp. ility 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 I** — 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

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 NAD 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. NAD and Company Sales systems. Requires CBASIC-2 .... £325/£15

Ⓛ **NAD** — 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 Pur NEW ases, General Accounting, and NAD systems .... £950/£45

Ⓛ **SALES ORDER PROCESSING PACKAGE** — ‘ nbined Stock Control, Order Entry and Invoicing and NAD NEW ns . £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 updat NEW facility makes information management easy. Sophis d report generator provides customised reports using s cted records with multiple level breakpoints for summarisation. Requires CBASIC-2, 24 x 80 CRT, printer and 48K system .... £125/£10

LETTERIGHT — Program to cre te edit and type letters or other documents. Has facilities to NEW r, display, delete and move text, with good video scree sentation. Designed to integrate with NAD for form letter m ings. 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 soft/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

GRAHAM—DORIAN SOFTWARE SYSTEMS

Ⓛ Ⓜ **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies. etc. Requires CBASIC-2. Supplied in source code. .... £300/£25

Ⓛ Ⓜ **INVENTORY SYSTEM** — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC-2. Supplied in source code .... £300/£25

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

Ⓛ **CASH REGISTER** — Maintains files on daily sales. Files data by sales person and item. Tracks sales. Overrings, refunds, payouts and total net deposits. Requires CBASIC. Supplied in source Ⓜ code .... £300/£25

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 debug 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

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

Ⓜ **PASCAL/MT** — Subset of standard PASCAL. Generates portable 8080 machine code. Symbolic dubugger included. Supports interrupt procedures and BCD arithmetic for real variables. CP/M file I/O and assembly language interface supported. Lacks sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion. Requires 32K .... £65/£17

Source for PASCAL/MT run time package. Requires MAC (See under Digital Research) £30

tiny C — interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... £45/£30

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

Ⓜ **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

Ⓜ **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

Ⓜ **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 Diablo Wheel printers includes variable pitch justification and motion optimization. .... £45/£10

Ⓛ **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

Ⓜ **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

Ⓜ **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

Ⓜ **DISILOG** — As Distel to Zilog Mostek mnemonic files. Runs on Z80 only .... £35/£7

Ⓜ **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

Ⓜ **POSTMASTER** — A comprehensive package for mail list maintenance. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Requires CBASIC £75/15

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

Ⓜ **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

Ⓜ **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

Ⓜ **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

Ⓜ **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

Flippy Disk Kit — Template and instructions to modify single sided 5¼" diskettes for use of second side in singled sided drives £6

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

Lifeboat Associates
32 Neal Street
London WC2H 9PS
01-379 7931

Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model 1 computers.

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

*CP M is a trademark of Digital Research
**Z80 is a trademark of Zilog Inc.

The Software Supermarket is a trademark of Lifeboat Associates.

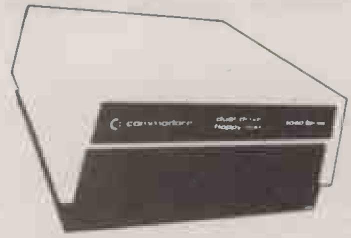
EFFECTIVE JANUARY 1980

• Circle No. 219

TOMORROW TODAY at Birmingham Computer Centre

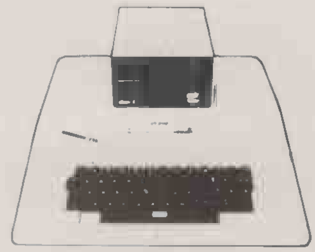
Commodore official distributors

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. 220

INNOVATIVE
TRS-80 SOFTWARE

- ✓ Business
- ✓ Personal
- ✓ Games
- ✓ Programming Aids
- ✓ Custom
- ✓ Utilities

6 Years Microprocessor Experience!

BINDERS Our Software List is being updated so frequently now that we are supplying it pre-punched for a ring binder. We are also supplying, without profit, a handsome ring binder which will house the list and also has room for program instructions, notes etc. Large 18p SAE for list alone, 95p plus 50p postage for list and binder.

A.J.HARDING (MOLIMERX)

28 COLLINGTON AVENUE, BEXHILL-ON-SEA, E.SUSSEX.

TEL: (0424) 220391

Access
BARCLAYCARD
VISA

• Circle No. 221

XITAN SYSTEMS

CROMEMCO SYSTEM 3

£4,054.00 for this system with vdu.

The ideal business system. System includes a full 64K fast RAM, dual full-size floppies (Persci 277), RS232 interface/20mamp loop for console device, parallel printer port (Centronics/Anadex compatible), 21 slots for expansion, Lear Siesler 24 lines or 80 chars vdu, and ... CROMEMCO's CDOS operating system with their 14 digit BCD extended disk Basic — ideal for those accurate large numbers required by successful businesses. CDOS is CP/M functionally equivalent, with many extra facilities. Optional extras from Xitan include Fortran, Cobol, Text Formatting, Z-80 macro-relocating assembler and DBMS at £59.00 each, CIS interactive screen handling Cobol at £425.00 (recommended to serious business users), Cromemco S100 boards, CP/M (we are an authorised oem distributor of Digital Research's CP/M) for the System 3, Wordmaster, Wordstar, Supersort, and CPM374X utilities.

COMING SOON! ... Full 7-terminal multi-user operating system from Cromemco for System 3 users. Up to 48K per user, all running independently. This operating system has to be seen to be believed. It will run any of the Cromemco provided and supported software packages, in any combination. Features include partition rescue facilities, allocating more memory to users, real-time clock for time/date stamping of jobs and disk queueing techniques. Buy your System 3 now, expand later as you need it.

S100 BRITISH COLOUR BOARD

We are proud to offer the first BRITISH S100 Colour board. Manufactured by a local Southampton company — Hi-tech, we can thoroughly recommend this product. Features include true PAL colour generation for high-definition on your television or colour monitor, 15+ colours and black/white with 6 additional grey scales, 24 lines with 40 characters per line, with standard character set plus 44 numbers and symbols, and 64 computer selected graphics symbols. Symbols include fractions and the £ symbol. Plotting is available at 80 × 72 resolution. Single or double-height characters, with flashing on an on/off duty cycle of 3-1. The board is memory mapped on any 2K boundary, with its I/O port set at any of the 256 available on the S100 bus. Just plug into your S100 system and colour television and go! Driver software and documentation provided. Price £295.00 ex vat cash with order. Please specify if for television or 75 ohm monitor.

ON DEMO NOW!
THE CROMEMCO Z2-H

For only £4,995.00 set the reliability and quality of Cromemco, coupled with the capacity of the new IMI 11 megabyte hard disk drive. This is incredible value for money. Specification includes transfer rates of up to 10 times faster than the fastest standard floppy disk, DMA controller for up to 7 hard disk units, and the new extended CDOS operating system. Systems available in three configurations: — A) The Z2-H complete integral system, 64K RAM, Z80A cpu, two double-sided mini-floppies, RS232 console port, parallel printer port, power supplies, cables, case and 12-slot S100 motherboard (7 slots free). B) Additional hard disk subsystem for existing system 2 or system 3 users consisting of one hard disk, DMA controller, power supply, case and cable. C) As unit B but with two hard disks. Prices: Unit A) £5,380.00.
B) £4,330.00.
C) £7,420.00.

Xitan Systems also supplies and stocks vdus, printers, NORTH STAR HORIZON computers, Commodore Business Machines PETs, S100 boards, and books. We are here to demonstrate the range of quality microcomputer systems available for use today. Ring up for an appointment now! You'll not be disappointed. We have Osborne's Sales Ledger and Payable Ledger in source form for use on Cromemco System 3 with CBASIC2, and we can offer a customising service on these programs. Additional software includes Microsoft Basic Interpreter and Compilers, Cbasic, Macro80, and CP/M for the North Star Horizon.

Xitan Systems Ltd., 23 Cumberland Place, Southampton SO1 2BB.

Tel: (0703) 38740 **Hours Tue-Sat 9.30 am to 5.30 pm**

• Circle No. 225

tridata + MICROS = SOFTWARE

Business systems available now for the TRS 80

Sales Ledger	(OPEN ITEM/DEBTORS ANALYSIS/STATEMENTS/INVOICES/VAT/DAYBOOKS etc.)	from £150
Purchase Ledger	(OPEN ITEM/CREDITORS ANALYSIS/REMITTANCE ADVICE/VAT/DAYBOOK etc.)	from £150
Invoicing	(UPDATES SALES LEDGER/DOWNDATES STOCK/MAINTAINS BACK ORDERS)	£75
Stock Control	(ISSUES/RECEIPTS/MOVEMENT, USAGE, VALUATION, RE-ORDER REPORTS etc.)	£200
Payroll	(WEEKLY, MONTHLY, CASUAL STAFF/BONUS SCHEMES/COIN ANALYSIS/PAYSLIPS etc.)	£218
Nominal Ledger	(Available shortly)	

12 MONTH WARRANTY ON ALL PACKAGES - TAILORED SYSTEMS TO YOUR REQUIREMENTS

FOR THE BEST IN PROFESSIONAL MICRO BUSINESS SOFTWARE CONTACT US DIRECT OR CALL YOUR NEAREST TRIDATA DEALER FOR A DEMONSTRATION.

CAMBRIDGE COMPUTER STORE (CAMBRIDGE)	0223 68155
COMPUTER DEVELOPMENT SERVICES (SWANSEA)	0792 26085
ELECTRON SYSTEMS (SANDY, BEDS.)	0767 81195
A. J. HARDING (BEXHILL, E. SUSSEX)	0424 220391
KATANNA MANAGEMENT SERVICES (CHELMSFORD)	0245 76127
OPTRONICS (TWICKENHAM)	01 892 8455
GPW ELECTRONICS LTD (PORTSMOUTH)	0705 693341

Tridata Micros Ltd.
Smithfield House
Digbeth
Birmingham B5 6BS
Tel: 021 622 6085

• Circle No. 230

West London's Pet Specialists

- Comprehensive advisory and demonstration service before you buy.
- Systems tailored to your requirements.
- Consultancy and maintenance service after installation.
- Business software including sales and purchase ledger, stock control, invoicing, payroll and data management.
- Full range of peripherals including memory expansion, floppy disks and printers.
- Books, games and accessories.

adda

we add up to a great deal.

Adda Computers Ltd.,
17/19 The Broadway
Ealing, London W5 2NH
(Between W.H. Smith and Burtons.)
Telephone 01-579 5845

• Circle No. 231

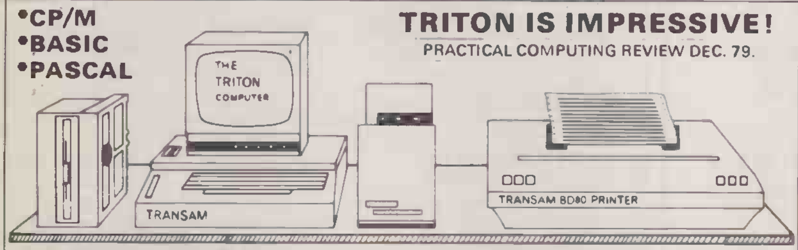
TRANSAM

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.

● L4.1 with 1k monitor 2k basic	£286
● L5.1 with 1.5k monitor 2.5k basic	£294
● L6.1 with 2k monitor 7k basic	£399
● L7.1 with 2k mon 8k extended basic	£409
● L8.1 4k ed/mon 20k res pascal	£611
● L9.1 CP/M disc based system	P.O.A.
● 8k ram card kit (2114L)	£97
● 8k Eprom cards (EXCL 8×2708)	£31
● Motherboard expansion 8 slot	£50
● Trap-res assm/edit etc (8×2708)	£80
● Transam BD80 Bi-dir printer	£595
● TVM10 video monitor 9"	£79
● 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.

DISK DRIVES & POWER SUPPLIES

SHUGART

SA400 5¼" drive	£205.00
SA800 8" drive	£380.00
Power one quality power supplies	
CP249 1×5¼" PSU	£33.00
CP323 2×5¼" PSU	£60.00
CP205 1×8" PSU	£56.00
CP206 2×8" 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 £90—*P.O.A.

FULL RANGE OF MICRO SUPPORT CHIPS – IN STOCK

SN74LS00N	22	SN74LS54N	21	SN74LS138N	96	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	2.46
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	5.60
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	5.00	74C920	11.00
SN74LS12N	25	SN74LS86N	40	SN74LS158N	99	SN74LS247N	1.25	SN74LS374N	1.70	8253	11.00	74C921	11.00
SN74LS13N	55	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	5.00
SN74LS15N	25	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	5.00
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	0.62	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

COMPUCOLOR II – FULL COLOUR

- ● 13" 8 colour crt display
- ● Built in 5¼ disk
- ● 16k extended basic in rom
- ● 71 key keyboard – detached
- ● R5232 + 50 pin bus
- ● 8k user RAM – fully expandable

SPECIAL GRAPHICS PACKAGE

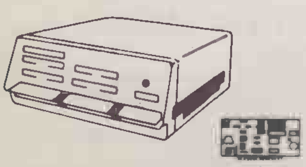
£985 Plus VAT

S100 DISC CONTROLLER £195 Plus VAT

As used on Triton. Fully built will drive 8×8" or 8×5¼" drives. Single or double sensity. Works with all Shugart compatible drives. Uses the 1791 chip on board crystal – CPU independent

DPS.1 MAINFRAME – PASCAL SYSTEM

S100 to IEEE spec



ITHACA

PASCAL/Z build your own Pascal Micro Development system. IEE – S100 bus system using DPSI mainframe. Supports K2, ASSEMBLE/Z and PASCAL/Z on 8" disc

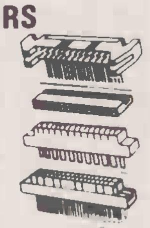
S100 BOARDS

8K Static RAM board (450ns)	£123.75
8K Static RAM board (250ns)	£146.25
Z80 cpu board (2MHz)	£131.25
Z80 cpu board (4MHz)	£153.75
2708/27 16 EPROM board	£63.75
Prototype board (bare board)	
Video display board (64×16, 128U/L Ascu)	£108.75
Disc controller board	£131.25
K2 disc operating system	£56.25
ASSEMBLE/Z Macro Assm	£37.50
PASCAL/Z compiler	£131.25

WE STOCK THE FULL RANGE OF S100 CARDS AND ACCESSORIES

MULTIWAY CONNECTORS

INSULATION PIERCING			
20 way plug	2.30	35/70	4.60
26 way plug	2.70	36/72	4.74
34 way plug	3.30	40/80	5.00
50 way plug	4.60	43/86	5.50
20 way skt	3.40	50/100	5.80
26 way skt	4.00	GOLD .156 PITCH	
34 way skt	4.80	6/12	1.25
30 way skt	6.00	10/20	1.50
		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	4.80

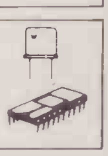


64 way DIN male 2.50
64 way DIN female 4.50

VISIT OUR SHOWROOM

WE ALSO STOCK:— A comprehensive range of books-magazines. VERO products including S100 and Eurocard and Wire Wrap equipment, Weller soldering equipment, Ribbon Cables, tools, tapes, diskettes and connectors.

CRYSTALS					
100k	3.00	4MHz	2.10	F8(3850)	9.50
200k	3.70	4.43M	1.00	8080A	6.33
1MHz	3.60	5MHz	2.70	6809	24.00
1008k	3.50	6MHz	2.70	Z80	8.00
1843k	3.00	7MHz	2.70	Z80A	15.00
2MHz	1.50	7.168M	2.50	8085A	12.95
2457k	3.05	8MHz	2.70	6502	8.00
3276k	2.70	10MHz	2.70	SCMP11	10.00
		10.7M	2.70	6802	13.95



ALL PRICES

Exclude VAT & P/P

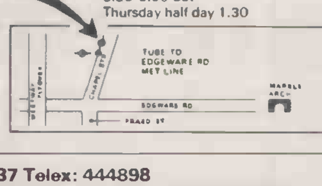
VAT 15% P. & P. 40p on small orders. For larger items please Tel. Telephone credit card orders accepted subject to £5 min. RAPID MAIL ORDER SERVICE

CATALOGUE

NEW A4 SIZED ONLY 40p & 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. 232

ITT 2020

NEW PROFESSIONAL KEYBOARD

Word Processing ITT2020
Available with full 128 key ASCII keyboard including lower case normal and flashing characters. Very high quality capacitive keyboard.
16k **£999** 32k **£1063** 48k **£1127** ex. vat

Make full use of your hiresolution graphics.

BIT PAD ONE

Complete and ready to use with machine code and basic operating software for ITT2020. Includes RS232 Interface Card and Pen Stylus.
Paint in light for only **£845** ex.vat

PLUG IN LOWER CASE BOARD

Increase the capability of your ITT2020 to include lower case flashing and normal characters.
£45 ex.vat

CUSTOM SOFTWARE

Any ITT2020 software written in basic or machine code.
We will finish your program yesterday at yesterdays prices.
For all your ITT 2020 requirements contact:
Guestel Limited, Refuge House,
2-4 Henry St., Bath. Tel: (0225) 65379

• Circle No. 233

JPS FOR ELECTRONICS T.T.L. standard and L.S., C.M.O.S., linear, micro-processor I.C.s, consumer circuits, semi-conductors, resistors, capacitors, Vero products, Eagle products, etc.

thandar INSTRUMENTS
By Sinclair Electronics
SC110 Scope 10MHZ
10MV/DIV £159.85

PFM200 FQ METER
20HZ-200MHZ
£57.27

DIGITAL METERS
DM235 3½Digit 21 range £57.27
DM350 3½ Digit 34 range £79.35
DM450 4½ Digit 34 range £113.85
PDM35 3½ Digit 16 range £34.44
Full range of accessories available
Large S.A.E. for more details

nascom-2
Micro-Computer
Kit 20K on board memory 8K Micro soft basic Z80A CPU 4MHZ
£339.25 inclusive

SPECIAL OFFER +16K RAM BUT LESS 8K ONBOARD RAM

Imp Plain Paper Printer £373.75

nascom-1 4K Kit £143.75 Assembled £161.00
3 amp power supply £33.93
Full range of expansion accessories available, Large S.A.E. for more details

A selection from our range of surplus new or ex-equipment electronics.
Untested except where stated.

TEN TURN POTS 50K £2.00
Counter Dial for above £1.50
15W AUDIO AMP P.C.Bs with circuit 2 for £1.50
MINI WAFER SWITCHES
2 pole 6 way 40p. 6 pole 2 way shorting 30p. 1 pole 3 way 30p
3 POLE C/O TOGGLE SWITCHES
250V 10A 50p
SELECTIVE CALL UNITS ENCODER AND CONTROL HEAD. 12V Operation 5 thumb wheel switches 37TTL 74 series. I.C.s 32 8KHZ XTAL Reed Relay 13 transistors 2 min relay 8 edge connectors + components and 2 nice cases. £9.80
MULTI-POLE CONNECTORS
Sub min plug and socket 15 way £1.00 20 way £1.00
STANDARD CONNECTORS plug and socket 18 way £1.00, 12 way £1.00 4 way 70p, 2 way 60p

EDGE CONNECTORS 18 way ·15 40p
PANEL METERS Scale 0-25 MA
Basic FSD 10 MA 2¾" x 2¼" £2.50
L.E.D. WATCH MODULES 4 for £2.00
CALCULATOR PCBs complete untested most work 3 for £3.20
METER CASES AVO Style
9¾H x 6¾W x 3½D black £3.00
RELAYS 12V 4 pole c/o about 5 amp including base 80p
MIN FANS 3" x 3" x 1½" 115 VAC £2.00
KNOBS ¼ black 4 for 25p
HEAT SINK with 3 new power transistors 8" x 2½" x ¾"
40251 SIM to 2N3055 x 2
40318 NPN 300V 35W £1.50
NEONS Red Lens 12p
PROJECT BOARD 4.I.C. 60p, 2.I.C. 30p
Transistor 22 strips x 5" 50p
13 ASSORTED PANELS mainly for components but some can be repaired £5

Lists 20p + large S.A.E. VAT inclusive prices. Add 50p p.p. on orders under £10
Cat. Available shortly 75p
JPS Dept., P.C., 9 East Street, Colne, Huntingdon, Cambs. 0487 840710

• Circle No. 234

WE OFFER A COMPLETE SERVICE!

When you buy a computer from us — we don't give you the box and wave goodbye.

We realise this is a major purchase for a Company and take the time to find out your requirements, design your computer system and write the software, or if you prefer to write your own, we will always be available to advise you.

You can buy a wide range of fully-documented packages — Word Processing/Purchase & Sales Ledgers/ Stock Control/Incomplete Records/Medical Systems/Teaching Programs etc.
on Microcomputers such as—

APPLE II from £750 (16K)
A complete business system 48K Apple, 2 Disk Drives, VDU & Printer £2,550

MICROSTAR from £4,950
Multi-user/Multi-task
1.2/2.4 or 4.8 mb.
A complete system with 2 VDUs & Printer £7,000

ALPHA MICRO from £9,950
From 1 to 32 terminals.
From 10 mb. to 90 mb. disk storage.
16-bit processor, Multi-user operating system.

e.g.
LOW COST PRINTERM
matrix printer £695
LEAR SEIGLER
200A matrix printer £1,650
QUME Sprint 5
daisywheel printer £2,115.

We stock a full range of VDUs, Printers, Computer Stationery, Diskettes, Disk Boxes etc.

all prices ex VAT.

Come and see us to discuss your requirements and have a demonstration.

MICROSOLVE

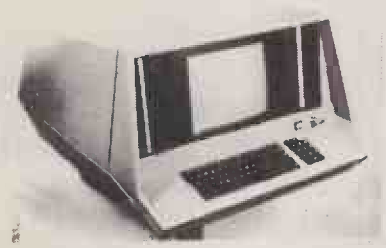
3rd Floor, Middlesex House,
High Street, Edgeware, Middlesex.
Tel: 01-951 0218/9 and 01-951 0210

M1 junction 4/20 mins from Central London

• Circle No. 235

Buy a System...Not just a "PrettyBox"

The SD System*—From about 97p per hour (40-hour week)



*The SD System includes:
SDS-200 Microcomputer T.I. 810 Printer (or equivalent) i.e., NEC SPIN WRITER £1,899. SDS 200 £4,750, T18 10 £1,499

The SDS-200 TOTAL System features:

System Hardware

The SDS-200 gives you features that are not found in systems costing thousands more. State-of-the-Art Engineering. Quality Production and Full Reliability testing make the SDS-200 a dependable, compact and easy to operate data processing system.

- Up to 256K Bytes RAM
- Full Keyboard with Special Accounting Key Pad
- Large 12in. Video Display Screen
- Full Cursor Control including Addressable Cursor
- Blinking, Underlining, Reverse and Protected Fields
- Uses 8in. Flexible Diskettes for Permanent Storage 2 Mbyte on-line
- Forward and Reverse Scrolling
- Capable of up to 160 Special Characters
- Expandable with Memory and Peripheral Equipment
- Will Operate as a Remote Batch Processor for Large Systems
- S 100 industry standard bus
- 4 spare S100 slots.

System Software

A range of Business Programs are available from CAP-CPP written in Microcobal.
The system will support all normal high level languages including:—
Fortran
Cobol
Basic
CP/M

A Total System

SD Systems knows that small businesses do not keep full-time programmers on staff. We also know that individually designed business programs can be expensive on a one-time basis. That is why we offer the SDS-200 and compatible business software.

Leasing Available

The SDS-200 is available by leasing. This gives the small business the opportunity to select the method of acquisition that best fits their needs.

SD SYSTEMS

SDS-200 Expandable

The SDS-200 is designed in a manner to give you expansion capabilities. As your needs change the computer system that you select today should be able to change with you. By the addition of memory and peripheral equipment, the SDS-200 can expand to fit your needs.

Authorised dealers are:

Anglo American Computers Ltd
Milburn House, Suite D, Dean Street
Newcastle-upon-Tyne.
Tel: 0632 29593

Peter McNaughton Ass.
Anfield, Glenalmond
Perthshire 073-888 267

Bell Computing Ltd
62 Lowther Street
Carlisle 0228 43690

Codified Computer Systems Ltd,
69 Calabria Road,
London N5 1HX
Tel: 01-226 1319.

Picodyte
Linton House,
Catherine Street
Aston, Birmingham
Tel: 021-328 4840
Telex: 335511

Optimal
142 Britannia Street
Valletta, Malta
Tel: 356 21818
Telex: Malta 683.

Barcellof Ltd

Kimberley House,
Vaughan Way, Leicester

UK Distributor:

AIRAMCO LTD

Unit A2, 9 Longford Avenue, Kilwinning Ind. Est.,
Kilwinning, Ayrshire KA13 6EX.
(0294) 57755 Telex 779808

Dealer enquiries invited

• Circle No. 236

Considering a Microcomputer?

Be Sure to Check Out the Product Offerings of the World's Largest Full Line Microcomputer Company.

All Ohio Scientific machines come with microcomputing's fastest full feature BASIC-in-ROM or on-Disk for instant use.

Challenger I Series

Economical computer systems that talk in BASIC.
Ideal for hobbyists, students, education and the home.

	Minimum Configuration	Base Price
Superboard II – World's first complete system on a board including keyboard, video display, audio cassette, BASIC-in-ROM and up to 8K RAM	4K RAM	£ 188
Challenger IP – Fully packaged Superboard II with power supply	4K RAM	£ 238
Challenger IP Disk – Complete mini-floppy system expandable to 32K RAM	16K RAM	£ 865

Challenger IIP Series

Ultra high performance BUS oriented microcomputers for personal, educational, research and small business use.

C2-4P – The professional portable	4K RAM	£ 404
C2-8P – The world's most expandable personal machine for business or research applications	4K RAM	£ 548
C2-4P Disk – The ultimate portable	16K RAM	£1050
C2-8P Single Disk – Ideal for education, advanced personal users, etc.	16K RAM	£1199
C2-8P Dual Disk – Most cost effective small business system	32K RAM	£1790

Challenger III The Ultimate in Small Computers

The unique three processor system for demanding business, education, research and industrial development applications.

C3-S1 – World's most popular 8" floppy based microcomputer	32K RAM dual floppys	£2334
C3-OEM – Single package high volume user version of C3-S1	32K RAM dual floppys	£2334
C3-A – Rack mounted multi-user business system directly expandable to C3-B	48K RAM dual floppys	£3403
C3-B – 74 million byte Winchester disk based system. World's most powerful microcomputer	48K RAM dual floppys	£8654
C3-C – 29 million byte Winchester disk based system.	48K RAM dual floppys	£6320

Full Business and Data base Software

OS.AMCAP	– A complete small business accounting package including inventory, invoicing, A/R, A/P, CR, CD, general ledger and P/L	£ 656
OS.DMS	– Data base Management System designed specifically for small business information management.	£ 175
	– DMS based modules for Inventory/order, A/R & A/P, General Ledger, personnel/payroll, Query, Word Processing.	£ 175 each
WP-2	– Complete word processing system with character justification, global editing, paging, text justification, proportional spacing and hyphenation.	£ 116

– ALL PRICES ARE EX VAT.

OHIO SCIENTIFIC also offers you the broadest line of expansion accessories and the largest selection of affordable software!

Compare the closest Ohio Scientific Model to any other unit you are considering. Compare the performance, real expansion ability, software and price, and you will see why we have become the world's largest full line microcomputer company.

I'm interested in OSI Computers. Send me information on:

- ☐ Personal Computers
- ☐ Educational Systems
- ☐ Small Business Computers
- ☐ Industrial Development Systems

Name __________
Address __________
____
____
Phone __________

MICROCOMPUTER BUSINESS MACHINES
4 Morgan Street,
London E3 5AB
Tel: 01-981 3993

WE ARE LOOKING FOR DEALERS THROUGHOUT EUROPE
PHONE MARK STRATHERN ON 01-981 3993

• Circle No. 239

IN ESSENCE THE BEST IN INTEGRATED CIRCUIT TECHNOLOGY

ALTOS
SUN-SERIES 8000
LOGITEK

The ALTOS Sun Series ACS 8000 BUSINESS/SCIENTIFIC micro computer creates a new standard in quality and reliability in high technology micro computers.

High Technology

The ACS 8000 is a single board, Z80 disc-based micro computer. It utilises the ultra reliable Shugart 8 inch, IBM compatible, disc drives, double density — single sided, and providing 1 M. byte of data storage. The ACS 8000 features the ultimate in high technology hardware: a fast 4 MHz.Z80CPU,64 kilobytes of 16 K dynamic RAM, 1 kilobyte 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.

Built~in Reliability

The ACS 8000 is a true single board micro computer. This makes it extremely reliable and maintainable. The board and two Shugart drives are easily accessible and can be removed in less than ten minutes. All electronics are socketed for quick replacement. Complete diagnostic utility software for drives and memory is provided.

Quality Software

Unlimited versatility. The ACS 8000 supports the widely accepted CP/M disc operating system 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 is 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?

Stop Press!

The Winchester hard disc, singleand multi user ALTOS systems are now available, supporting from 1 to 4 users and providing up to 58 Megabytes of data storage capacity. The systems are truly flexible and allow the ALTOS floppy disc system to be expanded to keep pace with the users requirements.

Availability

Logitek carry deep shelf stocks of ALTOS hardwareand 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 Suppliers

LONDON
Logic Box Ltd.
Tel; (01) -222 1122

Boyd Microsystems
(Watford)
Tel: (01) 950 0303

GLASGOW
Robox
Tel: (041) - 221 5401
Aethotrol Consultancy Services
Tel: (041) - 641 7758

BIRMINGHAM
Saba Computer Systems
Tel: (021) - 643 2021

SHEFFIELD
Sheffield Computer Centre
Tel: (0742) 53519

GLOUCESTERSHIRE
Woolsack Computer Centre (Tetbury)
Tel: (06666) 269

DARLINGTON
Vane Consultants
Tel: (0325) 67766

WILTSHIRE
Validata Services (Melksham)
Tel: (0225) 705957

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
Telex: 777255

• Circle No. 243

Buy here at discount prices!

☆ Full after-sales service in our own workshops
☆ One year guarantee on all machines

Save money-

Improve your 8K PET with memory expansion boards

internally mounting,
full instructions supplied,
plug and socket connections only

24K £249

24K to support disc drives £320
32K to support disc drives £432

Free Installation

Credit terms available

The only 16k complete computer for under £400

keyboard, computer, power supply, UHF modulator and all cables to plug into your own TV set and cassette recorder and go!!
16K of user RAM for decent size programmes and data, sophisticated level II microsoft basic.
Fully converted to UK standard including frame sync. frequency (no wobbly display).
Tandy don't do this!
Complete with level I and level II programming manuals. What more could you ask?

£399

Extra numerical keypad £33.95
Expansion interface complete with 32K RAM £299

This lot must be today's best buy!

Get into print this easy way!

Fast!

Anadex DP 8000 dot-matrix printer

*Speedy 112 ch/s bidir. *Fits A4 page – up to 80 cols. *Up to 4 copies. *Precision form-filling with sprocket feed. *Special headings using double-width chars. *Modern paper format to match A4 filing systems. *Other paper sizes with adj. sprocket. *Full punctuation, U/L case, £ sign, 96-ch. set. *Reliable – strongly built, 100 M.ch. head.

Knock down price!

£499

Interfaces - Pet £45, Ohios £10, TRS-80 £12, Sorcerer £6, Apple £69

Immaculate!

IBM golfball printer ideal for word-processing

*Forget expensive Spin-Wheel printers – the Golfball produces equal quality at up to 15 ch. per sec. *Match various typewriter styles with IBM interchangeable heads. *Completely reliable – each machine rebuilt by IBM trained engineers and fully guaranteed. *Precision form-filling possible with 15 in. pin-feed platen.

Limited supply!

£595

Interfaces - Pet £45, Ohios £10, TRS-80 £12, Sorcerer £6, Apple £69

Silent!

Trendcom 100 thermal printer

*Stop disturbing others with noisy printout! *Neat, clear, 96-ch.set, U/L case & symbols. *Matches Pet/Apple line lengths. *Fast, 40 ch/s bidir. *Reliable – robust – only two driven parts. *Plug in and go, built in PSU, detailed manual. *Thermal paper 4½ in wide x 80 ft, less expensive than electro-sensitive paper.

While stocks last

A snip!

£249

Interfaces - Pet £45, Ohios £10, TRS-80 £12, Sorcerer £6, Apple £45

PET

Converted to UK frame sync. (no wobbly display) – no one else does it!

NEW 2001-8N (8K RAM New large keyboard)

£499

2001 – 16N (16K RAM and new large keyboard)	£590
2001 – 32N (32K RAM and new large keyboard)	£690
External cassette deck, suitable for all Pets	£53
CBM dual drive mini floppy	£745
CBM tractor feed printer with Pet graphics	£605

Make PET talk to the outside world

IEE/RS232 serial i/f input/output	£140
IEE/RS232 serial i/f output	£89
Pet to S100 4-slot motherboard	£112
Pet to TV improved adaptor – *connects to aerial socket*	£25

IEE/Centronics parallel i/f **£45**

Leasing available to companies

COMPUTERAMA LTD.

Please add £10 Securicor delivery on computers etc. plus 15% VAT on all prices

Tel: Bath (0225) 28819

Your dealer for Bath, Bristol and S.W.

Computerama Ltd.
Harpers Kensington Showrooms
London Rd. Bath, Avon

Credit card orders accepted by telephone for immediate despatch.

• Circle No. 247

March

2-7 **Oceanology International Exhibition.** Venue: Brighton. Advanced technology exhibition. Hardware, systems and support services for the offshore industries exhibited by 400 companies. Contact: BPS Exhibitions Ltd, 18 Marine Parade, Brighton, BN2 1TL, Sussex, tel: Brighton 698281.

3-5 **Microprocessor workshop.** Venue: London. 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. Fee: £195 + VAT. Contact: Microsystems Consultants Ltd, PO Box 65, Camberley, Surrey GU15 1QN, tel: (0276) 27417.

3-5 **Microcomputers and the businessman — BASIC for beginners.** Venue: Skyway Hotel, Heathrow-London. This course teaches the fundamental programming skills of BASIC as well as BASIC programming language and enables participants without any previous knowledge of computing to write competent commercial, technical and domestic programs. Fee: £250 + VAT. Contact: Commodore Business Machines Ltd, 360 Euston Road, London NW1 3BL, tel: 01-388 5702.

4-6 **Computermarket '80 Exhibition.** Venue: New Century Hall, Manchester. Supplies of mini, micro and mainframe computers, peripherals, services and software will be showing a complete range of systems. Contact: John A. Godley, Couchmead Ltd, 42 Great Windmill Street, London, W1V 7PA, tel: 01-437 4187.

4-7 **Distributed processing and computer networks.** Venue: Royal Horseguards Hotel, Whitehall Court, London, SW1A 2EJ. Designed for those who are involved in the selection, installation and management of distributed processing systems. Provides a comprehensive introduction to the tools, techniques, requirements and benefits of distributed processing. Fee: £470 + VAT. Contact: ICS (UK) Ltd, Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: (03723) 79211.

5-7 **Pascal language programming.** Venue: Bedford. Designed 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.

6-7 **Disk programming course.** Venue: Skyway Hotel, Heathrow-London. Designed for systems engineers and those interested in designing microprocessor systems and BASIC programs for sequential and random access files, with the use of the Commodore 2040 floppy disk system. A prior working knowledge of BASIC is essential. Fee: £125 + VAT. Contact: Commodore Business Machines, 360 Eston Road, London, NW1 3BL, tel: 01-388 5702.

10 **Microcomputers and the businessman.** Venue: Skyway Hotel, Heathrow-London. Of special interest to anybody considering the purchase of their first microcomputer system. Fee: £50 + VAT. Contact: Business Machines, 360 Euston Road, London, NW1 3BL, tel: 01-388 5702.

10-14 **Troubleshooting microprocessor-based systems.** Venue: Polytechnic of Central London, ICS/PCL Microprocessor Training Centre, 235 High Holborn, London WC1V 7DN. Designed for engineers and senior technicians involved in production testing, field service, and design of microprocessor-based systems, although no previous experience of computer hardware or software is necessary. Fee: £540 + VAT. Contact: ICS (UK) Ltd, Pebblecoombe, Tadworth, Surrey KT20 7PA, tel: (03723) 79211.

11 **Microcomputers in control systems.** Venue: Skyway Hotel, Heathrow-London. This seminar deals with the use of microcomputers as programmable monitoring and control tools, interfacing micro computers to industrial and laboratory equipment, and the microcomputer as a development tool for dedicated system software. Fee: £50 + VAT. Contact: Commodore Business Machines, 360 Euston Road, London, NW1 3BL, tel: 01-388 5702.

11-13 **Computermarket '80 Exhibition.** Venue: Manchester. For details, see above.

11-13 **Basic fault diagnosis.** Venue: Cannock. Designed for senior operators to help them diagnose causes of failure and initiate planned recovery action. Fee: £160 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

11-14 **Data communications.** Venue: Royal Horseguards Hotel, Whitehall Court, London SW1A 2EJ. Designed for engineers, scientists and systems designers who are involved in the planning, design or implementation of all types of digital communication systems. Covers the fundamental principles of signal conversion, encoding/modulation, data transmission and error control. Fee: £470 + VAT. Contact: ICS (UK) Ltd, Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: (03723) 79211.

11-14 **Computer graphics.** Venue: Royal Horseguards Hotel, Whitehall Court, London SW1A 2EJ. Designed for analysts, programmers, design engineers and program managers who configure and implement computer graphic systems. Fee: £470 + VAT. Contact: ICS (UK) Ltd, Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: (03723) 79211.

12-13 **Advanced BASIC.** Venue: Skyway Hotel, Heathrow-London. Designed for those wanting to improve and speed up their programming techniques. Covers handling data files on cassette and introduces some techniques for using different commands. Fee: £150 + VAT. Contact: Commodore Business Machines Ltd, 360 Euston Road, London NW1 3BL, tel: 01-388 5702.

13-14 **Introduction to microprocessing.** Venue: Bedford. Designed to enable participants from a wide range of backgrounds to implement and supervise microprocessing at work. Fee: £95 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA, tel: (0234) 67466.

17-21 **Management in project development.** Venue: Cannock. Designed for senior analysts and programmers. Covers management concepts, analysis techniques, communications/project control and management development. Fee: £255 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

18 **Computer bureaux v mini v microcomputers.** Venue: London. Discusses the choice between a bureau and your own mini/microcomputer. Of particular interest to small and medium-sized companies, either as potential first-time computer users or as existing users contemplating change. Fee: £18 + VAT. Contact: London Chamber of Commerce and Industry, 69 Cannon Street, London EC4N 5AB, tel: 01-248 4444.

18-20 **Computermarket '80 Exhibition.** Venue: Glasgow. For details, see above.

19-21 **Microprocessor Pascal run-time support.** Venue: Bedford. Designed for system designers, project engineers and programmers who can write single-process Pascal programmes. Includes process definition and creation, interrupt processing and inter-process communication. Fee: £250 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA, tel: (0234) 67466.

●20 **Microprocessor seminar.** Venue: St Albans. Designed for the businessman, to give a general introduction to the technology and commercial uses of microcomputers. Contact: Naomi Buhai, Birklands Management Centre, 330 London Road, St Albans AL1 1ED, tel: St Albans 66661.

●24-26 **Fundamentals of computer operations.** Venue: Cannock. Designed for trainee and junior DP staff. Fee: £125 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

●25 **Pascal programmking.** Enrolment starts March 25, course proper on April 1). Venue. Manchester University. Fundamentals of PASCAL. Fee: £8. Contact: Enrol ment Secretary, Dept of Extramural Studies, The University, Manchester M13 9PL.

●25-27 **Computermarket '80 Exhibition.** Venue: London. For details, see above.

●25-27 **First International conference on assembly automation.** Venue: Nottingham. Contact: British Robot Association, 39 High Street, Kempston, Bedford MK42 7BT.

●25-27 **Assembly automation.** Venue: Bedford Hotel, Kings Road, Brighton, Sussex BN1 2JF. This course deals with

●25-27 **Assembly automation.** Venue: Bedford Hotel, Kings Road, Brighton, Sussex BN1 2JF. Designed for engineers and managers, this course deals with the latest developments taking place worldwide in assembly automation. Fee: £165 + VAT. Contact: Organising Secretary, First AA/IFS Conference Ltd, 35-39 High Street, Kempston, Bedford MK42 7BT, tel: (0234) 853605 or 855271.

●25-28 **Satellite communications and navigation systems.** Venue: Royal Horseguards Hotel, Whitehall Court, London SW1A 2EJ. Designed for engineers, engineering managers, systems planners and scientists involved in the use, planning and design or implementation of satellite or space communications systems. Fee: £470 + VAT. Contact: ICS (UK) Ltd, Pebblecoombe, Tadworth, Surrey KT20 7PA, tel: (03723) 79211.

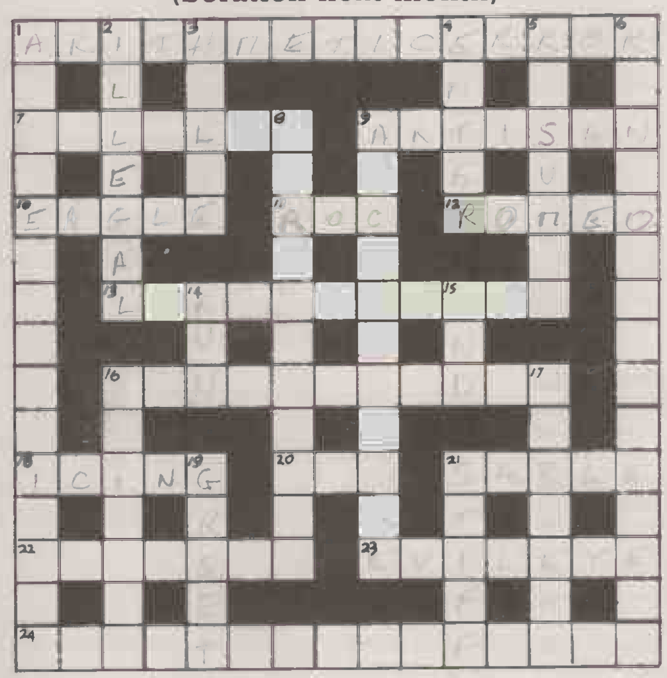
●27 **Fortran programming.** Enrolment starts March 27, course proper on April 3). Venue: Manchester University. Designed for people without any previous knowledge of computers or computer programming. Fee: £8. Contact: Enrolment Secretary, Dept of Extramural Studies, The University, Manchester M13 9PL.

●27-28 **Introduction to microprocessing.** Venue: Bedford. For details, see above.

●31-April 2 **Microprocessors and the businessman — BASIC for beginners.** Venue: Skyway Hotel, Heathrow-London.

Crossword by Mysterion

(Solution next month)



ACROSS

1. The result if one cannot add up.
7. Palindrome — stop first in.
9. His trade is a strain.
10. The — has landed.
11. Backward core without direction.
12. He meant nothing to Rome.
13. May have to be stored using double precision.
16. A part of.
18. Sounds as if I am happy on the cake.
20. This rock is large, even in reverse.
21. Is this fur delivered in mixed bales.
22. State quickly.
23. Devilish look.
24. A main interruption.

DOWN

1. Doting parents may think their computer is.
2. This entry is unlawful.
3. Chasten endlessly.
4. Come in or put in.
5. About the total, about reversed.
6. Not just any old saying.
8. Calculated odds.
9. You may be held to be if things go wrong.
14. Start your program . . .
15. . . . And stop.
16. Disjointed, principle not in.
17. Is this a tabulation with a small arithmetic unit.
19. A Scot would cry when you say hello.
20. Starchy.

A PRACTICAL GLOSSARY

Continuing the terminological gamut with P, Q & R

Program

And not *programme*, please God. Language is evolving: when a specific meaning is attributed by a large enough number of people to a particular bunch of syllables, let's assist the process of general comprehension. Let's give a unique word to a unique meaning.

Or to put it another way, we don't like 'programme' to mean 'program' — and the latter means a set of instructions that tells a computer what operations are to be performed to produce the desired results.

One important point is that a program is usually a complete entity that does something. But a group of programs may be linked together, one working with the results from another: and within an individual program there may be *subroutines* which each do something that contributes to the whole. So it's not necessarily clear-cut.

Programmer

Used to be a fuzzily bearded individual with a faded Hepworths jacket, patched jeans, a pocketful of multi-coloured biros, and an open invitation to the girls of the local sixth form to come up and see his computer sometime.

That's all changed: we're all programmers now. There's a great shortage of professionals who write computer programs for a living, though. The top-flight programmer needs a funny mix of goal-directed logical appreciation and Edward de Bono creativity: that's why they are paid so well.

Programmers aren't the same as systems analysts, though you with your personal computer will be combining the job functions. In a highly structured world, programmers come in three flavours — applications programmer, who write programs that *do* something systems programmers, who produce software that help the applications programmers do what it is that they *do* do: and maintenance programmers, who correct other people's work and keep existing programs up to date.

Programming

The basic steps in the ideal version of the programming process are five. First, you think: this is usually called understanding the problem, and you'll end up with a bunch of doodled notes on how the problem might be solved.

Then you draw a flowchart: or rather, you draw several, since your first effort won't work. Well, mine don't.

Third, you actually write some code — and, fourth, you test it on a computer until it works. Finally you produce the documentation that will help you and others to understand and use it (and probably to maned it in the future). In fact you should have been keeping notes and flowcharts all along the line to help you write the documentation.

PROM

Storm-lashed stretch of crumbling asphalt at Skegness? Expensive opportunity to stand for five hours in the Albert Hall with 37 other people and listen to the first-ever performance by 16-year-old sensation Waldemar Billings of her Opus *Everything I Know in Two Parts* featuring nine choirs, J. Arthur Rank on gong, and a Newcomen beam engine? Programmable Read-Only Memory? Answers on a £10 note, please.

You'll find a discussion of PROM back in the *memory* section. It's a type of ready-only memory which can be individually programmed by the user (ordinary ROM comes ready-programmed by the factory). You'll need a special device called a PROM programmer, which is what puts the bit patterns into a PROM chip. Some PROMs are erasable: they are called EPROMs, and they can be reprogrammed.

Protocol

As in diplomacy and elsewhere, it's a collection of rules that governs intercourse. Stop sniggering at the back there. A communications protocol is a set of formal conventions for the exchange of information, essentially so that both sides (a computer and a terminal, say) know what's supposed to be happening and when. Otherwise the stream of bits coming down the link would be more or less meaningless to the recipient.

PSN

Witty and much-needed abbreviation for PSTN.

PSTN

Public Switched Telephone Network. The ordinary public phone system, as compared with *private lines*.

PSW

Processor Status Word: some computers call it the Program Status Word. It's a reference area within the processor that is updated automatically with useful information — like what exactly is going on right now. It is used by clever programmers and operators to alter some detail of the execution of a program.

PTP

Paper tape punch.

PTR

Paper tape reader. It detects the presence of absence of punched holes. Usually it does this optically, by picking up light shining through the holes. Electrical sensing has also been used.

Pulse

Red-eye beans qualify. So does a short and sudden burst of electrical activity. It's important because a computer system can easily be designed to accept information transmitted as pulses — after all, pulse/no-pulse condition is a binary state, exactly like the off/on 0/1 internals of the computer.

'Pulse code modulation' or PCM is a pretty simple data transmission technique that uses this: an alternative is frequency modulation, where information is represented not by pulse/no pulse but by the frequency of signals.

Punch

Apart from the obvious impact this can have, a punch is an ingenious mechanical device constructed cleverly for the purpose of putting holes into punched cards. Obviously a punched card isn't a punched card until it has been punched with a punch. See **card**.

QWERTY

The traditional typewriter keyboard layout, which starts with these letters. On the Continent you'll find most start AZERTY.

Radio Shack

A line of home electronics stores in the States bought a few years ago by a leather goods company called Tandy. Today Tandy retains the name Radio Shack for its direct selling in the US, which is why TRS-80s still have Radio Shack stamped on them even though you might be buying them in a Tandy shop.

RAM

That husky Hemeling frinker with the MGB who gets the spotty *au pairs* — but lots of them. It's also random-access memory, which is the kind you load programs and data to and from. The other sort is already there ready-loaded with programs or data: that's called ROM. See the extended exposition on **memory**.

RAM is sometimes called read/write memory, because that's what you can do with it — and this distinguishes it from read-only memory (ROM). But RWM doesn't make a neat acronym, unlike RAM. That's life.

RAM might be qualified as 'dynamic' or 'static'. This is getting into heavy electronics, but in essence a RAM chip stores information as **bit patterns** (qv) in electrically charged cells, one cell to a bit: so when a charge is present, that bit is read as '1'. In *static* RAM, information is retained until power is interrupted. In dynamic RAM, the storage cell must be continually recharged to maintain an 'on' state.

RAM memory chips are sometimes called simply RAMs. Use this if you want to appear sophisticated and knowledgable, or perhaps if you need to save your outlay on breath. One of the hot areas in memory technology at the moment is just how much information you can store on RAM chips — obviously the greater the capacity, the more compact and cheap the overall system.

It should also be simpler and more reliable, too, for cutting down on the number of components required (the 'chip count') means that the electrical requirements and heat dissipation are easier for the designer: and less heat means greater longevity in electronics. The original RAMs stored 1024 bits (1Kb): they were displaced by 4K RAMS, then by 16K chips — which is what most minis and many micros use now. 64K RAMs are becoming available on a few systems, and soon there will be 256K-bit memory chips.

RAMP

You might not come across this uncompromising slogan in the personal computer world, but it stands for 'Reliability Availability and Maintenance Performance'. These are what you need to keep your computer up and running.

US mini manufacturers, in particular, put together RAMP 'kits' or 'RAMP course' to help you and/or their engineers to get the maximum working life out of your buy.

IBM has a similar slogan, RAS, for Reliability, Availability, Serviceability.

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
Nascom I with Nas-sys — Limited quantities	Special Price
Kit	£125.00
Assembled	£140.00
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
Lexicon Language Translator	£125.00
Modules for Lexicon	£29.00
Eprom Boards	£63.00
8K Static Ram Boards – S100	£110.00
Grandstand Video Game	£59.00
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

only **£399** + 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

only **£295** + VAT

TRS80 EXPANSION INTERFACE

Expand your TRS80 by 32K

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 baud rates between 100 and 9600 and Parallel Bit data.

Attaches either directly or through interfaces to Pet, Apple, TRS80, Sorcerer, Nascom, Compukit etc.

NEW REDUCED PRICES

8K **£449**
16K **£549**
32K **£649**
+ VAT

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

RRP £690 only **£590** + VAT

IBM SELECTRIC GOLFBALL

Refurbished IBM Golfball Printers to new specs. Accepts Centronics parallel data. Friction feed. Prints at 15 cps.

Attaches either directly or through interfaces to Pet, Apple, TRS80, Sorcerer, Nascom, Compukit etc.

32K **£690** + VAT

48K **£790** + VAT

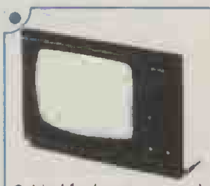
EXIDY SORCERER

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**



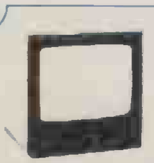
video 100

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%.



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.

RRP £975 for 48K

48K – **£690** + VAT

ITT 2020

Full colour into your own colour T.V. PALSOFT 9 digit floating point Basic in ROM as standard. Low and High resolution graphics. Built in loudspeaker. Compatible with most Apple Hardware add-ons and software.

NASCOM-2 MICRO-COMPUTER

only **£295** + VAT

FREE POWER SUPPLY

Microprocessors Z80A 8 bit CPU This w... 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 lv 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.

FOR ONLY **£3250** + VAT

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.

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 Dissampler and Monitor with each Kit. ★ If you want to learn about Micros, but did'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

Simple Soldering due to clear and concise instructions compiled by **Dr. A.A. Berk,** BSc. PhD.

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.

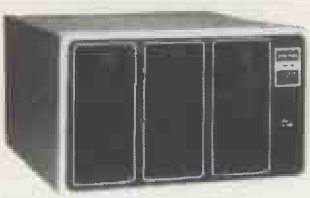
You get the enhanced Level III version of TRS-80's already-famous Level II BASIC language and "TRSDOS" operating system, automatically loaded in memory when you "power up." (About 24K of RAM is used by this software.)

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.

32K 1-Disk Model II **£1999.00** + VAT

64K 1-Disk Model II **£2200.00** + VAT



3 DISK EXPANSION

500K per Drive gives total of 1.5M Byte for only **£1399** + VAT

Just Plug In

WE ARE NOW EX-STOCK

EXTENDED WARRANTY BY COMPUCARE

Why do people buy more from COMPSHOP than anywhere else?

★ **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

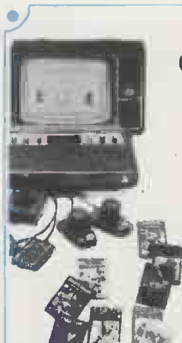
COMPUCARE

Compucare is a company that has been set up to provide servicing and maintenance for the popular makes of micro-computers i.e. Sorcerer, Pet, Apple, TRS80, Nascom, Compukit. Our charges are £7 per hour plus parts.

Because of the extensive range of spare parts stocked you can usually expect your micro to be repaired within 10 days for an average charge of £14 labour.

Emergency 24 hour repairs can be handled for a £10 surcharge where possible.
Compukits and Nascoms unsuccessfully constructed will be charged a standard £25.

THE ATARI VIDEO COMPUTER SYSTEM £138 + 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

COMP SHOP LTD

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
✸NOW OPEN ALL DAY SUNDAY — For Shop Sales Only ✸
Close to New Barnet BR Station — Moorgate Line.

COMP COMPUTER COMPONENTS
(Part of the Compshop Ltd. Group)