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Finally, before submitting an article, please check it through thoroughly for legibility and accuracy.

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64K 2 Megabyte Model II Interfaced with Advanced Lineprinter and System Desk

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This book differs from the established literature in three ways. First, it deals with interactive languages, which demand different techniques and present different challenges from the traditional non-interactive languages. Second, it is a practical book — it assumes you actually want to implement something, rather than study theoretical concepts; there is, therefore, as much material on planning and performing the task of implementing a language as there is on the underlying theoretical principles. Third, it aims to be a simple book, assuming no more from the reader than an ability to program and a familiarity with interactive working. If you are more knowledgeable, there are some sections you will be able to skip over. (Wiley Series in Computing; Editor: D.W. Barron, University of Southampton)

CONTENTS

Preface;
Part 1. PLANNING: Why Interactive; Planning Use of Resources; Documentation; Designing the Source Language and the User Interface; Encoding the Compiler;
Part 2. THE STRUCTURE OF A COMPILER: Filling the Gaps; Description of Terminology and Environment; Source and Internal Languages; Incremental Compiling; Re-creating the Source Program; Levels of Internal Language; True Compilers; Error Checking; Error Messages, Names, Scope and Data Type; Dictionaries and Tables; Storage Management; The Editor; Input and Output; Break-ins; Summary of Design;
Part 3. THE DESIGN OF AN INTERNAL LANGUAGE: Reverse Polish Notation; Operators; Encoding Reverse Polish; A Brief Summary;
Part 4. THE TRANSLATOR: Overall Translator Organization; Lexical Analysis; Grammars; Using Grammars for Parsing; Checking and Resolving Data Types; Semantic Actions;
Part 5. THE RUN-TIME SYSTEM: Error Detection and Diagnosis; Executing; Reverse Polish; Allocating and Referencing User Variables; Execution of Statements; String Temporaries;
Part 6. OTHER MODULES: The Pre-run Module; The Re-creator Module; The Command Module;
Part 7. TESTING AND ISSUING: Testing the Compiler; Issuing;
Part 8. SOME ADVANCED AND SPECIALIZED TOPICS: Some Special Compilers; Dynamic Compiling; Summary of the Deadly Sins; References; Index.
The subject of this video monitor was originally used in an armoured defense as a large computer terminal. It contains several silicon electronics, including a high voltage power supply, a heat sink, and a large heatsink. The heat sink is situated in the upper right corner of the terminal.

Detailed description:
- **High Definition Video Monitor**
- Contains several silicon electronics, including a power supply.
- Heatsink and heat sink material.
- Used in an armoured defense as a computer terminal.
- Dimensions: 20 x 13 x 12.5 inches.

**Specifications:**
- Power Supply: 12-20 volts D.C.
- Heatsink Material: Aluminum.
- Heat Sink Material: Copper.

**Additional Information:**
- The heat sink will be mounted on a heat sink material.
- The size of the terminal is 100 x 75 x 5 cm.

**Supplied with:**
- Complete Deface.
- 12V Battery.

**Accessories:**
- 12V Battery.
- Complete Deface.

**Price:** £45.00

---

**High Efficiency Smiths Power Supply**

**Specifications:**
- Input: 220-240V, 50Hz or 60Hz.
- Output: 12V, 5A.
- Efficiency: 90%.
- Ripple and noise: <100mVpp.
- Size: 20cm x 15cm x 10cm.

**Features:**
- High efficiency.
- Low ripple and noise.
- Compact size.

**Price:** £100.00

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**TTL/SILICON 1x2 PNP Power Supply**

**Specifications:**
- Input: 9V-15V.
- Output: 5V, 10A.
- Efficiency: >85%.
- Ripple and noise: <100mVpp.

**Features:**
- Suitable for TTL/CMOS logic circuits.
- High current capability.
- Low cost.

**Price:** £50.00

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**OPL MOSSA**

**Specifications:**
- Type: Linear MOTOR OPERATED SOLID SCREW.
- Speed: 100 RPM.
- Torque: 25 oz-in.
- Power Supply: 12V, 5A.

**Features:**
- High speed operation.
- Smooth operation.
- Great for automation purposes.

**Price:** £30.00

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**SCOOP OF THE YEAR HAZELINE H1200 V.T.U. TERMINAL**

**Specifications:**
- Type: High performance terminal.
- Features: Large display screen, fast response, and high resolution.

**Features:**
- Large display screen.
- Fast response.
- High resolution.

**Price:** £500.00

---

**MPU EXPERIMENTS POWER SUPPLY**

**Specifications:**
- Output: 12V, 5A.
- Efficiency: >85%.
- Ripple and noise: <100mVpp.

**Features:**
- Suitable for MPU experiments.
- High current capability.
- Low cost.

**Price:** £200.00

---

**DATA STORAGE MEDIUMS**

**Specifications:**
- Type: Magnetic tape.
- Capacity: 200mb.
- Transfer rate: 5mb/s.

**Features:**
- Suitable for data storage.
- High capacity.
- Fast transfer rate.

**Price:** £50.00

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**SEMICONDUCTOR "GRAB BAGS"**

**Specifications:**
- Various types of semiconductors.
- Preamplifier modules.
- Linear amplifiers.

**Features:**
- Assorted types of semiconductors.
- Suitable for experimenters.
- Great for hobbyists.

**Price:** £25.00

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**MUFFIN FANS**

**Specifications:**
- Spindle: 120mm.
- Power: 1W.

**Features:**
- Suitable for experimenters.
- Quiet operation.
- High efficiency.

**Price:** £6.00

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**ELECTRONIC COMPONENTS & EQUIPMENT**

**Specifications:**
- Assorted types.
- Suitable for experiments.
- High quality.

**Features:**
- Assorted types.
- Suitable for experiments.
- High quality.

**Price:** £200.00

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**HIGH DEFI**

**Specifications:**
- Type: High performance.
- Features: Fast response, high resolution, and high capacity.

**Features:**
- Fast response.
- High resolution.
- High capacity.

**Price:** £500.00

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**SCOOP OF THE YEAR HAZELINE H1200 V.T.U. TERMINAL**

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**Features:**
- Large display screen.
- Fast response.
- High resolution.

**Price:** £500.00

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**HIGH EFFICIENCY SMITHS POWER SUPPLY**

**Specifications:**
- Input: 220-240V, 50Hz or 60Hz.
- Output: 12V, 5A.
- Efficiency: >85%.

**Features:**
- High efficiency.
- Low ripple and noise.
- Compact size.

**Price:** £100.00

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**WELOW POWER SUPPLIES**

**Specifications:**
- Type: Linear regulator.
- Output: 12V, 5A.
- Efficiency: >85%.

**Features:**
- Suitable for experiments.
- High current capability.
- Low cost.

**Price:** £200.00

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**KEYBOARD**

**Specifications:**
- Type: QWERTY.
- Features: Ergonomic design, quiet operation.

**Features:**
- Ergonomic design.
- Quiet operation.

**Price:** £50.00

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**VIDEO MOUTH POWER FETs**

**Specifications:**
- Type: NMOS/PNP.
- Features: High efficiency, low cost.

**Features:**
- High efficiency.
- Low cost.

**Price:** £100.00

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**SMALL CASSETTE RECORDERS**

**Specifications:**
- Type: Small cassette.
- Features: Portable, high quality.

**Features:**
- Portable.
- High quality.

**Price:** £200.00

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**PC BOARD DESIGN**

**Specifications:**
- Type: Circuit design.
- Features: Custom design, high quality.

**Features:**
- Custom design.
- High quality.

**Price:** £500.00

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**SILICON 1x2 PNP POWER FETs**

**Specifications:**
- Type: PNP.
- Features: High efficiency, low cost.

**Features:**
- High efficiency.
- Low cost.

**Price:** £100.00

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**SUPER CASSETTE RECORDERS**

**Specifications:**
- Type: Cassette.
- Features: High quality, portable.

**Features:**
- High quality.
- Portable.

**Price:** £200.00

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**SMALL CASSETTE RECORDERS**

**Specifications:**
- Type: Small cassette.
- Features: Portable, high quality.

**Features:**
- Portable.
- High quality.

**Price:** £200.00

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**SMALL CASSETTE RECORDERS**

**Specifications:**
- Type: Small cassette.
- Features: Portable, high quality.

**Features:**
- Portable.
- High quality.

**Price:** £200.00

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**Features:**
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**Price:** £200.00

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**Features:**
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**Price:** £200.00

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**Specifications:**
- Type: Small cassette.
- Features: Portable, high quality.

**Features:**
- Portable.
- High quality.

**Price:** £200.00
Philips Mini-Digital Cassette Recorder.

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<td>£ 188</td>
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<td>Challenger IP</td>
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<td>Challenger IP Disk</td>
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<td>C2-8P Single Disk</td>
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<td>C3-OEM</td>
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<td>C3-A</td>
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<td>C3-B</td>
<td>£ 6504</td>
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<td>C3-C</td>
<td>£ 6320</td>
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**Full Business and Data Base Software**

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<td>OS.DMS</td>
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The 380Z with its professional keyboard is a robust, hardwearing piece of equipment that will endure continual handling for years. It has an integral VDU interface — you only have to plug a black and white television into the system in order to provide a display unit — you do not need to buy a separate terminal. The integral VDU interface gives you upper and lower case characters and low resolution graphics. Text and graphics can be mixed anywhere on the screen. The 380Z has an integral cassette interface, software and hardware, which uses named cassette files for both program and data storage. This means that it is easy to store more than one program per cassette.

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Versions of BASIC are available with the 380Z which automatically provide controlled cassette data files, allow programs to be loaded from paper tape, mark sense card readers or from a mainframe. A disk BASIC is also available with serial and random access to disk files. Most BASICs are available in erasable ROM which will allow for periodic updating.

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- Accepts E2 paper (tractor feed).
- Tractor/pressure feed.
- Baud rate from 110 to 9600.
- Tractor/pressure feed.
- Accepts 91" paper (tractor feed).
- Accepts 81" paper (pressure feed).
- External signal for optional
- Synchronisation of baud rate.
- 60 lines per minute. 80 characters per line. Bi-directional printing.
- 10 line print buffer. Automatic CR/LF.
- 96 character ASCII set (includes upper/lower case, $, @, °)
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- Tractor/pressure feed.
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our complete range of computers and peripherals including the very latest developments in Winchester Technology and microcomputers. We will demonstrate a no-nonsense series of practical software packages on our hardware for use in the commercial business world.

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9) You benefit from our experience of having sold over 450 micro-computers to industrial, educational and business, personal users.
10) We specialise in programs and interfaces for weighing applications for average weight control and counting etc.

Petact authorised distributors for central Southern England for the full range of Computhink disc systems (dealer enquiries welcome)

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<th>Computhink Old ROM 400K</th>
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<tr>
<td>New ROM 400K</td>
<td>£795.00</td>
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<td>New ROM 800K</td>
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Specialists in applications requiring interfaces for electronic balances (Sartorius, Metler, Oertling, Salter) also instruments like Pye Unicam SP8 100 Spectrophotometre, other interfaces are available by special manufacture.

Stockists for Petact Business Systems (Sales accounting, purchase invoicing, payroll, Stock Control, Nominal Ledger and management information.

A wide range of Printers available i.e. Teletype 43, Anadex C.B.M., Printerm

COMPUTER BOOKS — for professionals, hobbyists, businessmen and newcomers.

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We also supply: Apple II 16K, 32K or 48K, mini-disk drives, interface cards and software.

If you require any more information or demonstration regarding the PET 200118 or any associated equipment, programs, etc., please contact Mr. P.J.A. Watts or Mr. D.W. Randall at:

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Tel. Woking 21776/23637
By Thee Ing The Dust

The computer retail chain — Byte Shop — is dead: long live Byte Shop (1980). The old trading company is in receivership, and a new trading company, Summary 87 Ltd, has taken over the assets. It was under this arrangement that managing director Derek Wetherby was suspended from duty and replaced as MD by the accountant he himself had appointed six months earlier — Derek Wetherby.

The reason for the appointment of a receiver was that Byte Shop's major backers, becoming anxious about the future of their investment, called in their money. These backers were the merchant bank offshore, Charterhouse Developments Ltd and United Electronic Holdings Ltd and, according to Charterhouse director Richard Strong, both had invested £75,000.

Having said all that, the list of absolute facts that can be written down on paper becomes very short. Indeed Charterhouse's view of events is quite simple: Byte Shop was insolvent, because it couldn't pay its debts as they fell due.

Talking to people inside the group elicits the widespread opinion that this was only part of the problem. It seems there was a personality clash between Cannings and Charterhouse and it is said that, because he controlled half the shares, any conflict could never be resolved at board level.

What Cannings' style of management may have lacked is the emphasis on debt. Indeed Charterhouse's view of events is quite simple: Byte Shop was insolvent, because it couldn't pay its debts as they fell due.

A timetable compiling package from Petsoft: it costs £95, and needs a 32K byte Pet.
CRA pulls down the Shade

A really useful trade association arises when public outrage at malpractice threatens to close down the business. The most useful trade association is ABTA, which rebuts your charge if you get taken for a ride by a shyster travel agent; it also finds the criminal and prosecutes him.

Things generally have to be pretty bad before a trade association gets off the ground and, as most of us now know, the computer retail trade has now set up a Computer Retailers' Association (CRA).

Are things really that bad?

Are the retailers that desperate? Well, no. Judging the ads himself. Both of these errors were perpetuated in my last Newsprint by a badly aimed editor's pen.

Slipup

There is still time to enter the Computer Advertisement of the Year competition — to be judged at the opening of the cheap computer market on March 25 at West Centre Hotel. Just as well, as it gives much chance to observe that Coulson managing director John Godfrey is not John Godfrey, and he (Godfrey) will not be judging the ads himself. Both of these errors were perpetuated in my last Newsprint by a badly aimed editor's pen.

H.P stand alone

The first purveyor of standard computermarket's product to get into the cheap computer market is Hewlett Packard. It's launched a product, at £1,950, at the top end of the retail spectrum, at £1,950.

For the money, the customer will get what used to be called the Capricorn, when it was a secret, and what is now called the HP 85. It's a small, light and neat unit, including video screen, keyboard, tape drive, and printer; it has a 32K BASIC interpreter including graphics, and an integral UK standard power supply.

Full details will be revealed when our machine review is completed. For the moment, I am happy to leave the description of the machine as above. The only comment worth adding is that, £1,950 is too much, and £1,200 would be more like it. Within a year, that will probably be what Hewlett Packard is asking too.

The intriguing aspect of the HP-85 is the missing partner on stage. It was expected that this New Year would see the appearance of IBM with a retail computer of similar spec but costing maybe £3,000 more.

IBM has lost its nerve. It would have to change its nature too radically if it wanted to sell a retail product, and while the writing on the wall says it will have to do so someday, executives would rather put off the evil hour.

Simply summarised, IBM sells computers the way Saville Row sells suits. It isn't the cloth, it's the fit. IBM can cut a computer system to suit a customer because it employs a very highly paid salesman to visit him often, and to get inside his company, and to understand the motivations of the buyer — and work on them. IBM would add that it also produces a much more suitable system, but its detractors would deny it.

That just won't work when the product costs £3,000 or less. If it did, car salesmen would try a similar approach — spending a week teaching a prospective customer to drive. They don't.

IBM knows this. It can see Commodore, Texas Instruments, Hewlett Packard and Tandy selling programmable calculators across the counter, and it can see that it needs a similar retail chain carrying IBM before it can sell consumer products in high volume. Unfortunately for IBM and for all of us, the executives putting this plan together are the men who were typical IBM salesmen ten years ago, and have been promoted. They understand salesmanship but they do not understand retailing and the customers dragging their feet.

Oddly enough for Hewlett Packard, this is not good news. The HP-85 has come into the market with a price

**NEWSPRINT**

"Coo, Bill, I am glad we got this Atari from Ingersol." "Makes you feel fitter at once, don't Tracey?" "Yeh. Stimulates the appetite, this sporting life — but enough's enough." "You fancy a quiet, uh, rest darlin'?" "Yeh. Makes you feel fitter at once, don't it Tracey?" "Yes. Stimulates the appetite, this sporting life — but enough's enough." "You fancy a quiet, uh, rest darlin'?" "Yeh. Stimulates the appetite, this sporting life — but enough's enough."
tag which would have looked very nice to people who were waiting for the IBM 5105 (if that was what it was going to be called). But in the absence of the IBM machine, the only similar computer—packaged in one case, with BASIC and graphics and a tape—is the PET, at a third of the price or less. All the HP offers that PET doesn’t, to the first glance, is a thermal printer, and a better quality tape drive.

There’s little doubt that HP-85 is better than PET. The question is whether it’s three or four times better, and the answer is certainly no. That means the price will come down. When it does, of course everybody will think they are getting a bargain. That’s retailing for you.

Forget superpet

Computer makers do not like you to hear of planned new, super machines because naturally they are afraid that you will postpone your purchase of the old, unsuper machines they still have on the shelves. However, anybody who postpones the buying of a PET on the grounds that Commodore is now known to be planning the Super PET, for launch in the Autumn, will be making a mistake.

Inevitably, a new machine hits the market in ones and twos; the first may be available in September, but “yours” won’t come till next April. By then, any number of other new machines will have been announced by any number of other manufacturers; you can wait for ever for the right one. At the moment, according to Printout, the superpet will have a 1 1/2 inch screen with 80 columns; it will have more internal memory (up to 64K bytes); and it will probably feature a cheap modem, to allow the machines to talk to each other down phone lines. A big disc drive with 30 million characters of store is planned too, but Printout doesn’t expect this until next year.

Heath reshuffle

More astonishing than the news that Heatkit has been taken over, is its claim, at the time of the merger with Zenith, to be number four in the US micro league.

Zenith Radio has taken over the Heath Company from Schlumberger—which itself recently acquired the chip maker, Fairchild. Quite why a group which had just bought into chip making should drop the number four end-user company in the same quarter, is not clear. Certainly rationalisation is planned at the Schlumberger HQ, and one of the results is that Fairchild is being asked to reconsider another operation in the UK—its joint venture with GEC, to build a factory near Liverpool.

As far as Heath goes, the change in this country will be minimal for some time; the name Heath (Gloucester) will give way to Heath Electronics (UK) and micro range items will be called Zenith Data Systems products. Details on Gloucester 29451.

PET W/P

A complete word processing system based on the Commodore PET, costing £2,900, and with software costing only £380, has been released by Dataview of Colchester. It’s called Worderact, and uses a dual diskette. Details on 0206 78811.

NASCOM1 routines

Instant programs for the NASCOM 1 kit: a book of them has been published by Sigma Technical Press.

They aren’t programs in the sense of being long accounting, managerial or control suites—they are more like useful routines of the sort that a high level language often provides free, but which a man with only a thousand bytes of useable memory has trouble squeezing in. The examples are not horrifyingly sophisticated, but as an improvement on starting from scratch, it’s valuable, for instance, to show how to draw a chess board, how to read a screen character for word processing, how to control interrupts.

Sigma is at 23 Dippons Mill Close, Tettenhall Wood, Wolverhampton.

Ohio utilities

Utility software for the Ohio Scientific C1 and C2 range means software that does what the system software really ought to do. It renumbers BASIC statements, sorts for variables in a program, and runs the program as soon as it is loaded. All this and more, at prices between £2 and £10, from Mutek in Bath, 0225 743289.

T'is true

An add-on memory board with 16K bytes for £100 is available from Mike Dennis. It won’t surprise nobody to discover that I think this is the best value ever to be offered to users of the Comp Shop’s UK 101 kit, or the Ohio Scientific Superboard. Mike is, after all, a consultant to PCW, and we wouldn’t have anybody on the list who didn’t produce superlative stuff.

Mike has also announced a relay control board for these machines. Both his add-ons sit on a 43-way bus, derived from the 40-pin expansion socket on the computers. This, to keep costs down, is a simple piece of Vero onto which fit both memory and relay control boards.

The relay is not for mains switching, the eight relays on the board controlling up to 100V at low power. “I don’t approve of having mains on the same board as a micro,” commented Mike. The board is latched into the memory map—“and that’s to say it’s a single byte which can be addressed as if it were a memory location, but instead of storing or recalling the data, it acts upon it.”

Details from Blackberries, Sheriffs Lench, Evesham, Worcs WR1 1SR.

Transam Pascal

A new version of Pascal has been picked by Transam, the inventor of the Triton 8050 kit. Instead of going for the version of Pascal offered by University of California at San Diego (UCSD) Transam has decided to offer a version closer to the International Standards Organisation working draft.

Cost will start at £80, and the main point that distinguishes it from UCSD Pascal is that it will run under the CP/M operating system. UCSD Pascal is its own operating system. The language is a compiler/interpret version: your statements are condensed to Perl, which is interpreted at run time. It occupies 20K bytes of memory and it was written by Keith Frewen of TCL software (a Transam subsidiary).

At the time of going to press, the language was being tested under the Pascal Users Group validation suite, a testing system described in unpleasing terms by Derek Rowe of Abacus. The gist of his remarks was that if it fails the validation, you will know it really is rubbish, because the test will let some strange...
Your Commodore PET System

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

* In Education for teaching Computer Science and as a teaching aid for other subjects.
* In Science and Engineering for solving problems and for monitoring laboratory equipment.
* In Business the PET system can be put to a wide range of functions including Payroll, Accounting, Statistical Analysis, Stock Control and Word Processing.

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

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Capital Computer Systems, W1 637 5551
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We celebrated by slashing Ledger systems prices by over 60%:

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<td>Sales Ledger</td>
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All prices correct at the time of going to Press. 

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

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.

- 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
- Word Processor £25
- PET BASIC Tutorial £15
- Assembler/Editor £15
- Invoicing £20
- Forth £50
- Statistics £7
- Super Startrek £8
- Eliza Doctor £8
- Backgammon £8

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

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.
errors through. But it may be a good one for all that.
Details, phone 01-2620814.

Sharp dealers
The list of Sharp MZ-80K dealers is now available. In alphabetical order, they are:
A. & G. KNIGHT
Aberdeen. 0224 630526
B.C.G. LTD.
Bristol. 0272 425338
B.C.G. LTD.
Reading. 0734 54015
B.C.G. LTD.
Torbay. 0296 624887
CENTRAL CALCULATORS
Leicester. 0658 65894
H.B. COMPUTERS
Kettering. 0556 83922
KEEN COMPUTERS
Manchester. 061-928 8928
GILBERT COMPUTERS
Manchester. 061-928 8928
KETERING. 0556 83922
KEEN COMPUTERS
Manchester. 061-928 8928

If the retail computer business that is now developing ever wants to contribute to its founders, then it had
because some aren't tied down yet, and others may pull out. But HB Computers will have the machine at the PCW Show, so I can stop you mentioning them.'
I mention this, not to beat Paul Streeter over the head at the time of his distress, but to make a point. The point is: a month passes between my writing Newsprint, and your reading it. It's still the most up-to-date news you'll get; no use saying: 'You can have the information next week,' and complaining three weeks later that the information is available, and not published.

The clever thing about this £108 video display trolley from Data Efficiency is the fact that the wheels will go under an office desk, and the platform will go over it. It means the user can have it "on the desk" without lifting it up and down. It appears with 1500 other accessories in the new DE catalogue — tel 0442 57137.

better remember Colin Stanley.
Colin runs HB Computers in Kettering, and he is a founder of and driving force behind the Computer Retailers Association. Sometimes he gives the impression of being the only lucid human there.
But that achievement is not what should make him famous. His glory will be based on a little book that I only had space to mention briefly last month — called "Microcomputers and the Smaller Business". I actually think I could show this to my dentist without fear of frightening him off computers for ever.

Instead of the typical: "All computers have a central processor which consists of three units — the arithmetic unit which does the actual work of manipulating numbers, the memory which holds the program or operating instructions and certain data, and the controllers which control the transfer of information and instructions between the memory and the other parts of the computer" — all of which tells you nothing unless you knew it already, Stanley's little sales pamphlet is actually written in English. For instance: "Data. Data is the information you keep at present — in ledgers, books, filing cabinets, drawers, even in your head."..."The micro-

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The five volt power supplies of micros need protection from the higher voltages used for industrial control: this input-output module from Rapid Recall will do that. Outputs up to 3 amps at up to 140V, inputs up to 130V are converted to micro levels.

Communicator cuts

The “Communicator” board went, says Mel Philips, as a way of getting inputs into Pet and outputs out, has been drastically cut in price. From £135, the price on the single-page brochure has been amended to £27.

Ruir, the Communicator, the user can turn lamps on and off, read thermostats, ring bells, start electric motors, and so on. You’ll need another board to switch mains voltages, however. Details on 061-798 0803.

Booze news

The Winemaster is a £6,000 computer... “the first of its kind designed specifically for the wine and spirit importer and wholesaler,” according to Instar Business Systems in Croydon. It allows “instant control of purchase ledger, sales ledger, nominal ledger, and aged debtors.”

It is in fact a suite of software programs plus a North Star Horizon micro plus a terminal to run the programs on. Details on 01-680 5330.

Jeprevis

The French small computer firm Logabax is very active (in France) in educational computing. In Britain, it is very active in the orthodox “small business machine” market which it shares with firms like Philips, Olivetti, Nixdorf and the Digital Equipment value-adding.

As an illustration of how computer buyers are thinking, even in this market where the salesman is still king and retail is a seldom-tried novelty, Logabax has published figures for “small business computers” showing that the market will grow by 22% per year until 1988, by which time the total sales will be worth £414 million. That’s in the UK. In Europe, the figure will be £2,700 million — according to Logabax’s estimate.

At this stage, Logabax doesn’t break the figures down into sub-classes. These statistics apply to “single or multi-station disc computers costing less than £35,000.”

It’s obvious that very broad spectrum covers a range of machines that will never be sold over the counter. In the sub £5,000 range, where Logabax doesn’t break down its figures, the company will probably see most of its growth — especially in France.

Strangely, this is an area of growth — especially in France. Monthly, the company will grow by 22% per year until 1988, by which time the total sales will be worth £414 million. That’s in the UK. In Europe, the figure will be £2,700 million — according to Logabax’s estimate.

Enter RML Algol

A new language for Exidy Sorcerer users “and other Z80 systems with Micropolis discs” is RML Algol. It costs £99 from Liverpool of St Ives, Cornwall and they describe it as an extended version of Algol 60 — the extensions being to use disc, and to handle data strings rather than mere items of input and output. Details 0736 798157.

Stock control plus

A system costing £9,950 “including training” has been launched by TDS Business Systems for the purpose of production planning; it’s based on the Addis micro-system. The software is the heart of the system, and it will also run on Data General systems.

The crux of the software itself is that it’s a very pragmatic stock control system, and beyond the mere storage of statistics. TDS says that it will not only tell the user if an order can be met by a given date, but will also spew forth information on rearranging stock if the answer is negative. That information would include a list of who supplies the parts, who is quickest on delivery, who is cheapest, and so on.

Details on Blackburn 662114.

Rair addition

Software for the Rair Black Box micro. The range already offered by Sword Data Systems has been expanded and it now includes an integrated business/accounting system. With hardware, the system is available on rental from £45 per week. Details, Redhill 609860.

Other bits

Osborne/McGraw Hill has just published a book called “Some Common BASIC Programs”. For just $33 you get the book and an accompanying cassette containing 76 programs covering things like recipe costings, future value of an investment, days between two dates and all sorts of statistical routines. In these days of user friendliness, you may be astonished to find that programs expect you to key in 0 for YES and 1 for NO!!

Best mixed metaphor of the month: “It seems we’re barking up a gum tree”. This was uttered in the heat of the recent CRA meeting. Latest news is that they are, once again, secretariesless, but all should be resolved on 23rd January.

An unashamed plug for regular contributor, Mike Knight. He will be running a residential weekend course for small businessmen called “The Mighty Micro — Is it for You?” Reasonably priced at £50 plus VAT it offers an introduction to microcomputing from first principles to implementation considerations. It will run from 23rd February in a 4 Star hotel — telephone 0303-892540 for details.
THE ACT SYSTEM 800

A late arrival this month — but one that we simply can’t afford to ignore — is the ACT System 800. Its importance you’ll discover in a moment, but of primary interest is the fact that it offers a growth path for users of Britain’s most popular personal computer, the PET (but, no, it’s not a Commodore product). David Tebbutt reports...

Our man, Julian Allason, the man who founded PETSOFT, went to the USA charged with the task of finding a machine which could be marketed in the UK for at least seven years. There were many contenders for the prize, a substantial deal with ACT Computer Systems — in the USA there is apparently much clamouring for the British market! In the end Compaq won with their Minimax system; they claim it to be one of the most advanced microcomputers in today’s market place. The machine was chosen primarily for its user friendliness, graphics capabilities and minicomputer-like features.

Hardware

The system comprises an operator’s console containing the computer, a keyboard and video, plus one or two floppy disc drives, depending on the system chosen. Most business systems will also have at least one printer attached.

Upon closer inspection the console is seen to have an IBM compatible keyboard plus three other keypads — one for screen control, one for numerics and one for those special characters that are usually so difficult to find. The screen control block has full cursor controls plus insert and delete, the numeric pad includes the mathematical symbols and the special pad contains characters like $, ( ), <, >, etc. It takes some getting used to, but the effort is well repaid by a high operating speed.

Like the PET, the keys can operate in upper and lower case ASCII or upper case ASCII and PET graphics. The keyboard shift can be locked just like a typewriter. It’s also possible to program in upper and lower case ASCII or upper/graphic symbols.

The 12” screen comprises either 30 lines of 64 characters or a 512 by 240 point high resolution graphics facility. Using the “scroll” option it is possible to hold 120 lines of text in the video buffer with the screen acting as a “window” on its contents.

Field protection facilities are offered ideal for operator prompts for example — which allow data entry only in unprotected areas. This can have a marked effect on the speed of data entry, especially when used with the automatic skip facility which is also provided. It’s even possible to split the screen such that the different parts can operate totally independently of each other. Together with some powerful editing facilities, this must be one of the most advanced intelligent video attached to a microcomputer.

Moving on to the data storage, it gives the option of 800K Byte (8") or 2.4M Byte (8") disc drives. Each drive contains 4 heads operating on two double sided diskettes. It's possible to daisy chain another drive giving a maximum of 4.8M Bytes on line. Serial access of data from disc is very fast due to the fact that this system reads a whole track at a time. Subsequent accesses are then made to the disc buffer, rather than to the disc itself.

Tests showed that 100 x 250 character records can be written in just over 5 seconds, including file opening and closing.

Industry standard parallel printers can be attached to the printer port without the need for additional interface boxes. And just to complete the picture, it will be possible to buy tailor made desks to house the system. Compu/Think are supplying them and expect to have some in the UK in time for the launch.

Having seen the visible aspects of the machine, let’s now have a look inside.

The heart of the system is a 2MHz 6502 processor with 48K user RAM, supported by 16K ROM, 26K video RAM and 16K disc RAM; between them they hold Microsoft BASIC plus graphics and disc extensions, FIFTH, a monitor, MDOS — the disc operating system, disc buffers, video buffers and up to five character sets. In addition to the dedicated disc, video, keyboard and parallel printer ports, the ACT System 800 has one serial and one parallel port. The parallel port has an associated programmable interval timer using 3 pins of the 36 pin connector. The port is driven by an INTEL 8255 programmable peripheral interface giving the options of 3 independent 8 bit parallel input or output channels with handshake capability, or one bidirectional channel with bidirectional handshaking.

To the uninitiated, this means that all manner of keyboards, CRTs, D/A and A/D converters, discs machine tools and even other computers can be attached.

The serial port consists of a National Semiconductor 8250 Asynchronous Communications Element (ACE). This port is typically used for telecommunication or for driving serial printers and it can be programmed to run at anything from 50 to 56,000 baud.

Software

The ACT System 800 contains 8K Microsoft BASIC, surely by now the standard for microcomputers. In addition there are two sets of extensions —

<table>
<thead>
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<th>TECHNICAL FEATURES</th>
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<tr>
<td>Languages</td>
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</table>

PRICES

| 808 (800K) | £3950 |
| 824 (2.4M Byte) | £4950 |
Top: the ACT System 800 with its 5¼" disc drive. Above left: the standard IBM keyboard flanked by the extra control pads. Above right: an example of split screen operation.

Accessing data can be either serial (just like a cassette) or direct, according to the position of the record in the file. In the first case record lengths may vary, but in the second all records must be the same size. This enables MDOS to calculate the position of the nth record relative to the start of the file. A number of direct commands are also available for handling the 'housekeeping' aspects of disc storage. Facilities offered are: disc formatting, essential for unused discs and handy for clearing used ones; disc directory, this displays a list of file names and free space contained on the disc; program saving and loading; program or file erasing; and, finally, a memory reset option.

All the "behind the scenes" work associated with these commands is carried out by the disc operating system — MDOS. It treats each side of each disc independently, holding the directory on track zero and leaving 39(5¼") or 76(8") tracks free for use. All files occupy a whole number of tracks which means that they must be a multiple of 5K or 8K respectively. Not surprisingly, the 8" disc holds a maximum of 76 files per side and the 5¼" up to 39 per side, only one of which may be open at any time. This should not concern the user unduly, but it does mean a certain amount of care must be taken by the programmer. As only one file can be open at a time then the close instruction needs no parameters — thus simplifying the programmer's task.

It is interesting to note that one of the manuals gives a diskette a working life of 120 hours. It therefore comes as something of a relief to learn that the disc drive motor is switched off after each operation.
pleased to learn that this system contains a monitor, has microprogrammed facilities and runs the FIFTH language natively.

The monitor has a very tiny assembler which is included, along with all of the 6502 opcodes plus three extras: BYT, TXT and END. BYT and TXT are used to store data — up to 15 bytes or 30 ASCII characters respectively. END is used to leave the last statement in a program. Other features offered by the monitor are a memory dump, a disassembler and a breakpoint facility. Some of the 6502 opcodes is insufficient, it is possible to microprogram a further 64 instructions using the opcodes whose two low order bits are turned on, i.e. those whose LSBs are 3,7,B or F. The advance publicity literature suggests that a good use for this facility would be to perform Pascal.

Finally, the FIFTH language has been implemented on this machine. This language has been designed for each of the scientific and education markets' preference for the assembler programming systems this should not come as a shock to them.

Anyone who has invested time and money in developing programs will find their investment protected.

Although the transformation requires a little juggling — modifying POKE locations for example — it's minor compared to the rewrite. ACT intend to have some new utilities which will take care of these minor irritations in due course.

ACT suggest that the system is aimed at all those people who need a mini-computer but who can't really afford one. Certainly, in many respects it comes well — the mix of high resolution graphics, characters, split screen, field protection and a comprehensive keyboard make it as good as, if not better than, many systems in the market.

Perhaps the differences are to be found under the surface — for example at the moment it supports just one user, the disc capacity is limited and file access methods usually include some form of indexing. Compared with most other micros this machine must be ranked with the leaders.

Attachment of laboratory equipment should pose few problems for the scientific and educational users, thanks to the programmable parallel port.

In the same way communications should be straightforward via the serial port, with its variable baud rate, data handling and modem control functions.

ACT packages available are Sales Ledger, Invoice, Purchase Ledger, Stock Control and Word Processing. A "Pagemate" database system is available, which enables the user to store his business information in such a form that he can interrogate the data in various ways and produce reports according to his requirements. Updating facilities are included in the package as well as mathematical and statistical functions which can be applied to the data. This explanation is a gross simplification but I trust that it gives some idea. A Payroll package will be released in time for the new tax year. In addition, ACT will be offering compendia of programs on discs — games, programming aids, utilities, tutorials etc.

Finally, games. Of course this machine is ideal for games, in the same way that there's no point in going to the shops. That is not to say it won't happen, it's just that it's unlikely to form part of the decision to purchase.

**Documention**

This is one of the best documented systems I have ever come across (in 14 years). Everything is explained clearly in the manuals that I was given.

The beginner's guide to Minimax, the Minimax Technical Manual and the Pagemate Database System. One general criticism is that all three manuals would benefit from more drawings. In particular, describing the FIFTH stack handling without pictures is rather like describing a spiral staircase without using your hands.

As well as straight facts, the manuals offer sensible advice. One example is in giving standard names to the multitude of fields which are referred to by the assembler dispatcher. Such conventions are obvious to the experienced programmer, perhaps, but the advice is ideal for the novice. The manuals also contain a very light sprinkling of wry humour: **"There is no great advantage to be gained from inventing new symbols for expressions which are already defined by the FIFTH stack but it will make the meaning of programs clearer to the layman. At least, it's an obvious one."

Perhaps the most important section is that of field protection and a comprehensive statement in due course. ByB and TXT are used to handle data, and END.

Finally, ACT themselves have almost completed an integrated business package comprising order processing, stock control, invoicing, sales ledger, purchase ledger and payroll, all bound together by ACT's own database system. If you buy this package ACT will offer a maintenance agreement by which you receive all system and application enhancements as they are released.

Another possible area of development is that of ROM based software, especially after the success of the PET programmers' toolkit. This, however, is speculation and there are no firm plans for its introduction.

**Conclusion**

A number of business packages have already been written and, with substantial backing from ACT, plus 9 regional distributors and dealers throughout the country, all carefully chosen for their experience and engineering support — I cannot see how this system can fail. It's a well made, easy to use product and it goes with the slide rather (relatively) easy growth path. It's bound to sell extremely well with the limit likely to be dictated by Compu/Think's production capacity rather than by level of demand.

**At a glance**

**FIRST IMPRESSIONS**

<table>
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<th>SETS</th>
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**HIGH LEVEL LANGUAGES**

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<td><strong>available</strong></td>
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**PACKAGES**

| Business | **** |
| Education | **** |
| Home | n/a |

**PERFORMANCE**

| Processor | Compu/Think Prosette |
| Disc | *** |
| Peripherals | n/a |

**EXPANSIBILITY**

| Memory | n/a |
| Cassette | n/a |
| Discs | *** |
| Bus | *** |
| Ports | *** |

**COMPATIBILITY**

| Hardware | **** |
| Software | **** |
| **DOCUMENTATION** | **** |

**VALUE FOR MONEY**

| **** excellent | **** very good |
| *** good | ** fair |
| * poor | **** |

**Benchmark Timings (in seconds)**

| ACT 800 | 0.9 | 4.6 | 8.5 |
| Microsram | 11.3 | 1.4 | 4.4 | 11.2 |
| Z-Plus | 10.5 | 9.3 | 11.2 |
| Cromemco System 3 | 12.6 | 1.7 | 4.6 | 14.9 |
| PET | 20.4 | 1.7 | 9.9 | 18.4 |

PCW 41
Homebrew notes

Martin Lea's design for a Z80 has done for the Z80 what the 77-68 did for the 8080. It may not be the first Z80 system of its type, but it is the first I have seen in print. I was not wishing to detract from his design, I feel a few comments may be of interest to Martin and other prospective constructors.

These mostly concern expansion of the present design.

1. “All that is needed to interface 16K of dynamic memory is an address multiplexer” - a fairly oversimplified. Although I would agree that the Z80 does make interfacing of dynamic memory simpler than say the 6800 or the 8080 it still requires at least 5 SSTL devices and 3 STTL devices, and could not be used at 5MHz with the current design without WALT states. See the Zilog Application Note “Interfacing 16 pin Dynamic RAMs to the Z80A Microprocessor” for more information.

2. The reset circuit shown (N22, N23) is adequate if only static RAMS are to be used, but must not be used with Dynamic RAM if data is to be retained after reset. This is because if “RESET” goes low during T3 of an Opcode fetch (M1) cycle then MREQ goes indeterminate about 10 clock cycles later, possibly causing a short or aborted RAM access and destroying data in the RAM (see P.59 of the Mostek MK3880 [Z80] Manual).

3. The minimum memory access time is during an Opcode fetch cycle and is 445ns (not 560ns as stated in the article) at 2.5MHz and 255ns at 4MHz (Zilog Appn. Note). Allowing worst case figures for IC7, IC12, IC6 and IC8 (18, 18, 10 and 25ns respectively) then data could be available a maximum of 321ns (for 25ns Memory) or 521ns (for 450ns Memory) after MREQ goes low. While typical times for these devices show that they probably will work, Martin “says” that they won't without WALT states (250ns will be OK at 2.5MHz). WALT states rather defeat the object of a fast system and should be avoidable if possible.

4. Finally, if it is intended to use the vectored priority interrupt system then the data bus buffer IC7 must have its R/W pin pulled low by both M1 and RD since RD is not active during the interrupt acknowledge cycle when the CPU searches the interrupt vector. This is simply done by “OR-ing” M1 and RD since all M1 cycles are RD cycles anyway (see P.61/62 of the Mostek Manual).

Anyway, congratulations to Martin for having the guts to publish his design. Keep up the good work in 1980, PCW. I.Caplan, Southgate

Martin Lea replies: Thankyou for your comments, especially point 4 which has revealed an oversight in my circuit. However, your solution of combining M1 and RD will require an additional AND gate in the circuit which will either have to be one of the buffer gates or will require an extra IC. A nearer solution is to reverse IC7 so that B0 to B7 are now connected to the MPU. The direction of IC7 (R/W pin 1) is now controled by WR. During an interrupt acknowledge cycle WR is inactive so the buffer is in the read mode, allowing the interrupt vector on to the MPU data bus.

Cassette cure1

As any PET user knows the most annoying part of loading from Cassette is waiting for the FOUND message.

This is mainly due to the lack of a tape counter, but even with a counter you would not know if the PET had passed the Program Header. You can sometimes miss the header -- wait several minutes -- only to find you are on blank tape. My method is as follows:

Connect a Soundbox to the user Port Pin 6 (cassette No. 1 Read). The Soundbox connection is Pin M (CB2 Line).

On both SAVE and LOAD you can then hear the following:

a) The Header Tone
b) The Header Token
c) The Header 'Title'
d) The Program DATA
e) The 'Half Way Point'
f) Second copy of DATA
g) End of file Token
h) By using the F.FWD, P.PLAY andREW keys you can then locate the header on a multi-program tape -- Press PLAY -- and wait. If you do not get the message "FOUND" at the Header Title stage, rewind slightly and try again. Using this method you can CUE the tape to the right position.

Other advantages that you can also hear:

a) DROPOUTS
b) CROSSTALK
c) NOISE

d) VARIATION in PITCH due to tight Cassettes.

e) The difference between DATA and PROGRAM tapes.

This is an invaluable aid, and is best implemented by fitting a small toggle switch to the cover of the user port connector, i.e.

Position 1 SOUND (Pin M)
Position 2 OFF (No Connection)
Position 3 CASSETTE (Pin M)

With Pin N being the 'earth'.

For those who like to keep a 'Working Copy' of their programs in addition to the MASTER a separate cassette is an advantage.

I use an Hitachi TRQ 299 which has an automatic level control (ALC) and a Cue and Review facility. In my case the ALC gives perfect results on the PET recordings every time. The Cue and Review facility allows you to fast wind using Cue to find the 'nth' program on the tape tape.

Position the header using Review and transfer the tape to your PET cassette.

Perhaps somebody will devise a method to convert the PET cassette to 'Cue the Review'.

Incidentally can anybody suggest a method of recovering data from a Program tape, on which the header and part of the first copy of DATA has been erased or overwritten? (Caused by pushing RECORD instead of PLAY).

R. Cason, Sawbridgeworth, Herts

Mind your language

I should like to take the opportunity to draw to your editorial attention that someone in your publication seems to have taken a liking to capitalizing the name of the programming language Pascal. I don't know what he or she means by "A.S.C.A.L. or PASCAL might stand for, nor do I have much sympathy with the implicit lack of knowledge. However, it is an easy thing to say, if you will alert your sub-editors.

On page 47 of the December issue reprinted a set
of eight Basic Benchmarks with a Bench Test of The Micromation Z-Plus. In case anyone wishes to run the tests and compare them with a Pascal performance, I have translated the tests into Pas-
cal. I also have a table show-
ing the performance of Berkeley Pascal running under Unix on a PDP-11/34 (anyone interested in a copy, send SA to PCW — Ed.). The combination of inter-
pretive system, little optimization, and slow processor yields results very similar to those with the basic Pascal, with the addi-
tional feature that their code is more readable.

Pascal's motto has never been "do it any-
how, as long as it is fast", but "do it right". I will however comment in passing that I know some Pascal compilers that generate code for microprocessors that would realize that much of the code in these Bench-
marks does nothing, and would delete it. One compiler, I suspect, would reduce them all to C statements. Comparative results will then be fascinating!

Arthur Sale, Professor of Infor-
mation Science, University of Tasma-
nia (on leave at South-
ampton).

Thanks for the Benchtests. The person in our organisa-
tion with the "implicit lack
of knowledge" points out (most humbly) that he is
obviously in good company, as you yourself have refer-
ed to Basic — as opposed to BASIC (standing for Begin-
ing All-purpose Symbolic Instruction Code). With re-
spect to your observation re-
garding the code in the Bench-
marks does nothing, the
same person asks the
question: "Is putting a deli-
berate delay in a program really
doing nothing?" Last time I
heard him it was surprising.

Peter Verstage, London WC1

Howabout VAT

I've been playing with a
word processor package, hence this extraordinary pro-
duct! (The letter is "long
and thin"). However, don't worry — I've got a Healthkit
Printer on order and I've promised the indefinite loan
of a Daisywheel Printer too, so you or any other of my
 correspondents won't suffer long. (Well — I might as well put my hard-earned
experie accuse to some purpose!)

I was interested to read
J. S. Linfoot's letter in reply to
my bit about VAT. ("Interrupt" October 1979) You were right — it is an or-
dered sub-routine. He seems to be refer-
ing to the word "luxury"
However, you hoped that
that column would "stir
up a bit", didn't you?

You might want to publish a
comment from me, so here
goes:

"You've caught me with
my pants down, Mr. Linfoot.
What can I say? I'm sorry
— you are right and I was wrong.

So, we now have a stan-
dard rate of 15% VAT instead
of a luxury rate of 15%? I
suppose that's OK then —
let's all forget it. I suppose that it doesn't matter what
we pay as long as it isn't
called a luxury".

D.R. Daines, Sutton-in-
Ashfield, Notts.

MK14 message 1

In a way of reply to the letter sent by Mr. Clarke (PCW Dec), concerning the
problem of displaying mes-
sages on the MK14, I enclose a
program that demonstrates
the way which a word can be
shown for short periods of
time.

A delay must be set after
each character is written out
so giving a steady line — a
delay after all 8 characters
would leave the last character
slightly brighter than the oth-
ers. After the line has been
shown once, instead of just
doing the whole operation again, we reduce a counter by
1 and test for 00. So we loop
round 256 times only — long
enough for the message to be
noticed, in fact from 1 to 10
seconds depending on the
delay value at 0F33. The
program displays the mes-
gage stored backwards at
0F30-7 and therefore changes it for
the message at 0F30-7. This
process repeats endless-
ly.

Thanks for the SC/MPP
programming pencil! — Ed.

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**ACT800 DEALER GUIDE**

**ACT COMPUTER SYSTEMS**

**ACT SYSTEM 800**

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From its inauguration some 21 years ago, the BCS is now probably the longest running computing club in the UK. With some 25,000 members drawn from all walks of computer life, it offers a forum for discussion and exchange of information between people interested and involved in the various aspects of computing. Among the rapidly growing interest in personal computing, there are already a number of sub-groups devoted solely to micros.

Branches cover the UK in geographical areas; they are interested by specialist groups, clustered around specific areas of interest and only occasionally split on a regional basis. For example, a very large number of people interested in medical computing and a relevant specialist section runs sub-groups, meetings and activities all over the country. To a lesser extent, the Committee for the Disabled (originally based in the Home Counties) now has a centre of activity in Manchester, and further centres in Bristol and elsewhere are well past the planning stage.

A specialist group, dealing with personal computing, only requires half-a-dozen affiliate members to be able to set up within the proven guidelines laid down by the Society. It is not the (small) budget available to assist such groups that is important, but the secretarial and support services, the medium for social and technical interchange and the Society’s status in the world outside. Says Steve Shirley: “The BCS lays out the welcome mat for everyone involved in personal computing. We feel that the Society has much to offer and can itself only benefit from the involvement of microcomputer buffs”.

And apart from affiliate membership, some PCW readers will be technically eligible for the professional member grade — one that is of real, and monetary, value to employers. It’s even possible that a few of those amongst us could become Fellows of the Society. Each year about two Fellows are appointed by the BCS for their special contribution to the history of computing. But, most important perhaps, the Society welcomes personal computing enthusiasts as affiliates.

Extra benefits include a library which, among other things, is a goldmine for proven algorithms, and a journal — a rather intimidating document, appropriate to a learned society. There’s also a whole range of events and functions; for example a computer fair next Summer (run in conjunction with the DOI) and a seminar in March dedicated to high level languages for micros. And for those who are interested, there’s a series of examinations by which one can obtain professional qualifications.

PCW readers and the BCS have several areas of mutual interest, two in particular being compatibility and communications. On the former, one time President of the Society, Alex d’Agapneyeff, said at the Thames Polytechnic earlier this year: “People don’t want personal computers to be entirely different microboxes. We want a situation where, if you work, you go to the office next door, or the house next door, and you borrow theirs. You are only going to do that if they are the same.”

The solution to this problem was invented by one Alan Shearing, well before the era of the hobbyist or even mainframe computing. In the computer pioneering days, he defined the need for a language which could be executed by the machine in the same way, regardless of the equipment used. That idea, originally English, has now been developed in this country by CAP. It is of course Microcobol.

On communications Steve says: “I should not like to predict the precise impact of personal computing on business from a security point of view. As computers become more widespread, it gets easier and easier to attach them to telephone lines, they’ll carry potential benefits to users as well as potential threats to large networks containing sensitive information.

Several known perpetrators of fraud have used home computers to simulate either false input or output, to program routines that determine unknown passwords, or to break into a network and sign on as a legitimate user. Is it therefore any wonder that the BCS is laying down the welcome mat to these machines.

“To be more positive, personal computing may well bring desk-top interrogation facilities to the auditor’s office, remote from the installation, but able to make dynamic enquiries as a legitimate terminal in a totally automated fashion. The BCS is much involved in developing ‘dynamic auditing’ techniques, using non-intelligent terminals.”

Various distinguished members of the BCS are active in fields which the layman would consider almost synonymous with personal computing. Jack Cluley, Chairman of the membership board, is himself very involved with micros and mainly their use in industrial applications. Steve Shirley again: “Everyone concerned with education and training — and who can argue with that — is committed to making the education system cope with the new technologies. For all aspects of life, working or not, are being pervaded by micros.”

“The new hardware is often home-programmer driven and cuts across all previous curricula. The BCS recognises personal computing enthusiasts and hobbyists as a very important grass-roots movement that’s pushing for more knowledge and more information. And it is ready and willing to provide the forum”.

If you would like to join the BCS, apply, preferably in writing, for affiliate membership to: The British Computer Society, 13 Mansfield Street, London W1M 0BP. Telephone 01-637 0471.
Hardware
The Heath WH-89 (shortly to appear under the new logo of Zenith Computer Products) is an all-in-one computer with integral 5¼" Wang floppy disc. It’s quite heavy (50lbs) but not too awkward for one person to carry and it’s fairly deep (20") and so would, ideally, need a larger than normal desk for comfortable operation. The housing is a two tone grey cabinet with optional green sheet of perspex that flops over the screen. Access to the inside is via a hinged, removable top cover and mounted to this is a cooling fan which, on the review sample, was excessively noisy — Heath say that this is not normal.

The majority of the electronics are carried on two large vertical boards at the rear of the case and any additional PCBs (eg floppy disc controller) plug into the front board. There is space for 6 extra PCBs but since one is already tied up with floppy controller and another for printer intercacing, this leaves four. The VDU screen gives quite a pleasant display although the review sample, was excessively noisy — Heath say that this is not normal.

The general standard of construction was rather mediocre giving an impression of hurried assembly. There is a veritable birds-nest of wires down the side of the case and boards and bits sprout everywhere and one capacitor case was peripherally close to shorting out the main bridge rectifier — the sticky bit of foam rubber to prevent this event happening had slipped. I would hate to have to repair one.

Heath have only two service centres (London and Gloucester) but can arrange for a servicing contract with Computer Field Maintenance.

System layout
The VDU section is intelligent and has its own Z80, 6845 CRT controller, 3K of RAM and 1K of ROM. There are nine additional function keys and these generate ESC followed by another letter. It is then up to the user's program to detect the appropriate codes and act upon them. In fact, extensive use is made of the ESC key and others to provide a VDU with remarkable flexibility — on screen editing, graphics, direct cursor-addressing etc. These capabilities can, of course, just as easily be used by the computer outputting the appropriate codes.

There is also a separate numeric keypad, but unfortunately I was unable to exit from its alternative set of key values, whether this was due to a genuine fault or the exit routine supplied by the manual, I don’t know. Anyway, suffice it to say that with its 80x24 character format (and optional 25th line for system messages etc.), the VDU section is remarkably comprehensive. As the interface to the computer is via a RS-232 circuit, it does mean that you can also hook the WH-89 up to any other computer, as an intelligent terminal.

The computer board again uses the Z80 with 48K of dynamic RAM, 1K of static RAM for the floppy disc and 4K of firmware in ROM. On switch on, you either boot down HDOS or operate at machine code level. Machine code programming is further supported with the inclusion of two disc based utility programs — DBUG and an assembler.

DBUG provides general debugging routines (including the ability to set a breakpoint in a loop, execute that loop for n-1 times and then break). Apart from that, DBUG is not particularly memorable.

The assembler also is a bit of an apology for it only accepts 8080 mnemonics and instructions. True, you can bodge it and make it accept the extra Z80 codes but you are still stuck with 8080 mnemonics plus all the hassle of the bodge. What’s worse is that the assembler, in common with all the machine code routines, is done using OCTAL!

To my mind, that decision is indefensible; why Heath stuck to Octal is beyond my comprehension, especially as the CPU is a Z80. If you want to do any machine code development using the Z80 then look elsewhere.

System software
System software comes with HDOS and Extended Benton Harbor (where Heath come from) BASIC (abbreviated to EBHB). HDOS has close affinity to DEC’s RSX-11 operating system.

The BOOT is a little untidy — you type "oot" for you!), type some spaces then enter the date (no silly dates allowed — apart from April3lst!) and then you are in HDOS. The whole routine takes about 26 secs.

Technical Data

<table>
<thead>
<tr>
<th>Computer</th>
<th>Z80 — 2MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>48K dynamic RAM</td>
</tr>
<tr>
<td>Cassette</td>
<td>Not tested</td>
</tr>
<tr>
<td>Disc drives</td>
<td>One 5¼&quot; WANG</td>
</tr>
<tr>
<td>Printer</td>
<td>Not tested</td>
</tr>
<tr>
<td>Bus</td>
<td>Heathfis own</td>
</tr>
<tr>
<td>Ports</td>
<td>via serial I/O cards</td>
</tr>
<tr>
<td>System software</td>
<td>HDOS, DBUG</td>
</tr>
<tr>
<td>Languages</td>
<td>Extended Benton Harbor BASIC, ASM — 8080 only</td>
</tr>
<tr>
<td>Microsoft BASIC (MBASIC)</td>
<td></td>
</tr>
<tr>
<td>VDU</td>
<td>Z-80</td>
</tr>
<tr>
<td>CPU</td>
<td>3K static RAM</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Standard QWERTY, Nine function keys</td>
</tr>
<tr>
<td>Separate numeric pad.</td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td>RS-232</td>
</tr>
<tr>
<td>VDU</td>
<td>Reverse video</td>
</tr>
<tr>
<td></td>
<td>80x24</td>
</tr>
<tr>
<td></td>
<td>Optional 25th line</td>
</tr>
<tr>
<td></td>
<td>Graphics</td>
</tr>
</tbody>
</table>
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but you have to be there in attendance and as I was booting into and out of the system quite frequently (of that more later), it all became a trifle tedious. There would appear to be no turnkey facility.

Once into HDOS, you can INITialise, SYSGEN a disc, make a back-up copy and run a very comprehensive diagnostic TEST routine. This includes a head seek test (typically 30ms but the review sample actually achieved 8ms which is good). Since you can SET various parameters, perhaps seek the disc does provide the user with the opportunity of "fine-tuning" the system to achieve optimum performance. You can set flags for each file, the most notable being LOCK (but does there exist a no UNLOCK command! The only way to unlock a file is to INITialise the entire disc but since this will erase all your other files, it does seem a bit drastic. You can also run a sector check, note down the bad sectors and feed the information in at the appropriate time during INIT. The disc being INIT’d will make a note not to use them in the future, which makes for a nice feature. You can also ask HDOS for a status report whereupon the number of soft and hard errors and reads and writes made to date are printed to the screen — quite a useful facility. The documentation for this stage does include a first time users path to follow but it’s not really obvious what the overall aim of the various stages are; for example, does one always have to SYSGEN every disc? It’s not made very clear by the instructions although the ‘first time users path here’ concept is very good.

The only slight quibble was that sometimes backspace did backspace and sometimes it did not (this is one of the many alternative modes of VDU operation that the WH-89 will accept). In fact, in general, I wasn’t entirely confident that pressing some keys would produce the same response as the last time if the system had been rebooted or MBASIC entered. One had a feeling that there were one or two little quirks, although this could be partly due to unfamiliarity on my part. So all in all, a very flexible VDU keyboard and DOS.

**DISC ACCESS TIMES** (in seconds)

<table>
<thead>
<tr>
<th>Disc Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>20.5</td>
</tr>
<tr>
<td>3</td>
<td>19.0</td>
</tr>
<tr>
<td>4</td>
<td>22.0</td>
</tr>
<tr>
<td>5</td>
<td>18.5</td>
</tr>
</tbody>
</table>

**Basic**

I ran the benchmarks for EBHB and as you can see, they’re very, very slow. No information is given as to whether or not you can access the disc using EBHB; I assume not because even much of EBHB and so looked forward to trying Microsoft Basic (MBASIC) which was supplied on another disc.

The first disc I tried evoked the error message from HDOS telling me that the disc needed to be SYSGENed first. As it was a so-called distribution disc it does seem a bit daft that it wasn’t already done. As it was my only copy, I was rather reluctant to try my hand at SYSGENing for the first time. Nor could I copy the disc as all my Verbatim and "white box" discs yielded a "ERROR MEDIA" error message when I tried to INIT them. Apparently, only Memorex discs seem to work satisfactorily which is great for Memorex but not for the user.

Fortunately, a man from Heath came by bearing another copy and this worked fine — or so I thought. The unfortunate fact was that although both the main system disc and the MBASIC disc purported to have the same issue and version of HDOS, the two were not compatible. Booting up with one disc and trying to use the other always caused the system to "FATAL SYSTEM ERROR" necessitating a complete reboot of HDOS; the repetition began to get a bit tedious.

I was also unable to INITialise any discs using this particular copy of MBASIC and therefore any disc access timing had to be carried out using one which was rather full. As a result any timings would have an unfavourable bias added to them, as compared to a virtually empty disc. To be fair to Heath, the disc was not write protected and so it is more than likely that somehow part of HDOS was clobbered; but I have to tell it how it is.

Booting up HDOS and loading in MBASIC left 21355 bytes free — MBASIC would seem to be therefore about 16K Bytes long. The tables show the available commands and also the benchmark timings. They are improvement on EBHB but still slow when compared with others. Many of the Microsoft facilities are provided plus

**BASE COMMANDS**

**Program development**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTO</td>
<td>Repeat next statement</td>
</tr>
<tr>
<td>REM</td>
<td>Remove last statement</td>
</tr>
<tr>
<td>DELETE</td>
<td>Delete specified statement</td>
</tr>
<tr>
<td>RENUM</td>
<td>Re-number specified range</td>
</tr>
<tr>
<td>EDIT</td>
<td>Edit specified range</td>
</tr>
<tr>
<td>END</td>
<td>End program</td>
</tr>
<tr>
<td>LIST</td>
<td>List specified range</td>
</tr>
<tr>
<td>SAVE</td>
<td>Save specified range</td>
</tr>
<tr>
<td>LOAD</td>
<td>Load specified range</td>
</tr>
<tr>
<td>TROFF</td>
<td>Return to buffer</td>
</tr>
<tr>
<td>TRON</td>
<td>Return to program</td>
</tr>
</tbody>
</table>

**Initialisation and assignment**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEAR</td>
<td>Clear specified range</td>
</tr>
<tr>
<td>LET</td>
<td>Assign specified range</td>
</tr>
<tr>
<td>SWAP</td>
<td>Swap specified ranges</td>
</tr>
</tbody>
</table>

**Control structures**

<table>
<thead>
<tr>
<th>Control</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONT</td>
<td>Continue program</td>
</tr>
<tr>
<td>GOTO</td>
<td>Go to specified label</td>
</tr>
<tr>
<td>FOR</td>
<td>Start loop</td>
</tr>
<tr>
<td>NEXT</td>
<td>Go to next iteration</td>
</tr>
<tr>
<td>ELSE</td>
<td>Continue from specified label</td>
</tr>
<tr>
<td>RESUME</td>
<td>Resume program</td>
</tr>
<tr>
<td>GOSUB</td>
<td>Call subroutine</td>
</tr>
<tr>
<td>STOP</td>
<td>Stop program</td>
</tr>
</tbody>
</table>

**Machine level**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEF USR</td>
<td>Define user function</td>
</tr>
<tr>
<td>OUT</td>
<td>Output data</td>
</tr>
<tr>
<td>PEEK</td>
<td>Peek data</td>
</tr>
</tbody>
</table>

**Input/output**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSE</td>
<td>Close file</td>
</tr>
<tr>
<td>DATA</td>
<td>Define data</td>
</tr>
<tr>
<td>KILL</td>
<td>Kill a process</td>
</tr>
<tr>
<td>INPUT</td>
<td>Input data</td>
</tr>
<tr>
<td>PRINT</td>
<td>Print data</td>
</tr>
<tr>
<td>TAB</td>
<td>Tabulate data</td>
</tr>
<tr>
<td>WAIT</td>
<td>Wait for input</td>
</tr>
<tr>
<td>WIDTH</td>
<td>Adjust width</td>
</tr>
</tbody>
</table>

**Functions**

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Absolute value</td>
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<tr>
<td>EXP</td>
<td>Exponential</td>
</tr>
<tr>
<td>EXPN</td>
<td>Exponential</td>
</tr>
<tr>
<td>FIX</td>
<td>Fix to nearest value</td>
</tr>
<tr>
<td>SIN</td>
<td>Sine</td>
</tr>
<tr>
<td>COT</td>
<td>Cotangent</td>
</tr>
<tr>
<td>INT</td>
<td>Integer</td>
</tr>
<tr>
<td>SQR</td>
<td>Square root</td>
</tr>
<tr>
<td>MOD</td>
<td>Modulus</td>
</tr>
<tr>
<td>LOG</td>
<td>Logarithm</td>
</tr>
<tr>
<td>TAN</td>
<td>Tangent</td>
</tr>
<tr>
<td>VARPR</td>
<td>Variable precision</td>
</tr>
</tbody>
</table>

**System**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERASE</td>
<td>Erase specified range</td>
</tr>
<tr>
<td>ERL</td>
<td>Erase buffer</td>
</tr>
<tr>
<td>ERR</td>
<td>Error handling</td>
</tr>
<tr>
<td>ERROR</td>
<td>Error handling</td>
</tr>
<tr>
<td>NAME</td>
<td>Name a variable</td>
</tr>
<tr>
<td>ON ERROR</td>
<td>On error handling</td>
</tr>
<tr>
<td>RES</td>
<td>Resume program</td>
</tr>
<tr>
<td>PRE</td>
<td>Pre-execution</td>
</tr>
</tbody>
</table>

**Conversions**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDBL</td>
<td>Convert double precision</td>
</tr>
<tr>
<td>CV</td>
<td>Convert value</td>
</tr>
<tr>
<td>HEX$</td>
<td>Convert to hexadecimal</td>
</tr>
<tr>
<td>MKD$</td>
<td>Convert to millikilobytes</td>
</tr>
<tr>
<td>OCT$</td>
<td>Convert to octal</td>
</tr>
<tr>
<td>MKS$</td>
<td>Convert to kilobytes</td>
</tr>
<tr>
<td>CVS</td>
<td>Convert value</td>
</tr>
<tr>
<td>MKS$</td>
<td>Convert to kilobytes</td>
</tr>
</tbody>
</table>

PCW 51
The use of Octal elsewhere seem even more silly.

The usual arrays can be used, including multidimensional string arrays, i.e. \( A(X,Y,Z) \) - but a slight drawback is that you rapidly run out of reserved string space (as MBASIC doesn't automatically alter the amount of memory reserved for strings dynamically). You get round it by specifying CLEAR XXXXX but it's a bit tedious and gives the programmer something else to worry about which to my mind is unnecessary. Numerical variables can either be integer, single or double precision but you can't define them once and for all — you always have to add the suffixes to each variable. The accuracy of the double precision needs improving. For instance, \( 1.987 - 0.987 \) yields \( 2.013171116905303 \) (work it out!). Only radians are supported by trig functions.

MBASIC has the added bonus of an Editor, which can either be summoned via EDIT (line no.) or entered automatically during RUN when a SYNTAX ERROR occurs. The faulty line number is printed out but not the statement, which is a pity. No clues are given as to the offending portion of the statement and there are virtually no checks for syntax when the statement lines are entered.

The MBASIC disc accessing is fast but fiddly to use. It supports either sequential files or random access; the random access records are fixed length at 256 bytes - a bit of a shame. A FIELD statement will allocate \( x \) bytes as \( A \), the next \( y \) bytes as \( B \) etc., but care is needed with any subsequent references to \( A \) and \( B \) and so, normally, any input statements (from the keyboard) are made into \( X \) and \( Y \) and then a second statement using LSET \( A = X \). which is fiddly. All numerical variables have to be converted into strings before being stored onto disc, and then reconverted back into numbers when they are read back. You have to remember to do this and it's a chore. One ends up writing about three times as much program as should be necessary. Any number of files can be opened although only one can be open for output.

Having said all that, as the figures show, it's quite respectfully fast at storing and retrieving 100 records of 256 bytes and also it is truly "random". A pity then that you can't call for a CATalog of the files on the disc from MBASIC! You have to return to HDOS, CAT and then reload MBASIC. This omission I found rather irritating. However, Heath do say that CP/M will shortly be released; it will be interesting to see what improvements that will bring.

**Other languages and software**

Apart from CP/M, the only package that Heath have announced is a word-processing package called Autoscribe that's designed to be used with a Diablo printer. Dual 8" disc drives with 1M byte of storage are expected next March. Heath supplied one of their printers for review but forgot to include any ribbon; therefore I couldn't review it.
Business & education potential

It's difficult to give an accurate assessment. Heath would seem to have already realised the business limitations inherent in the single disc concept and the software does make provision for other drives; it would be interesting to look at this machine again when the 8" drives are available. At the moment, business packages are rather thin on the ground - in fact I don't know of any - but hopefully the release of CP/M should solve that. It has many extra facilities that are often lacking on other machines but this can cloud the issue; it may require a greater amount of knowledge to effectively use it. It is not a machine that I could recommend for the beginner.

Documentation

The documentation is very good. The program manuals are well laid out and the indices, most comprehensive. The operation/service manual is also good and provides a useful background to how the computer works. At times, however, the order of presentation is a little peculiar. for example, the appendix is in the middle! The blue service manual (not normally supplied) is superb and even provides specifications and data sheets on all the devices used. My only (minor) quibble is the constant reference throughout all the texts and diagrams to U 512, U 608 etc. You have to keep looking up in the tables to see that U512 is really a 74LS74.

Conclusion

The WH-89 is an all-in-one computer that has the added advantage of being usable as an intelligent terminal into a different computer. The VDU section boasts many extra features not normally found, as does the computer itself. It needs to be "intelligently" treated in order to realise its full potential - at which time the "niggles" and minor irritations should take on a different perspective. However, I do have some reservations on the apparent lack of software support for business users.

Thanks go to Heath (Gloucester) - and in particular to Tony Smithson - for help received during the compiling of this Benchtest.

At a glance

**FIRST IMPRESSIONS**

<table>
<thead>
<tr>
<th>Looks</th>
<th>Setting up</th>
<th>Ease of use</th>
<th>High Level Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>***</td>
<td>***</td>
<td>**</td>
<td>Basic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cobol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fortran</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Pascal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>System Software</td>
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**PACKAGES**

<table>
<thead>
<tr>
<th>Business</th>
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<th>Home</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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</tbody>
</table>

**PERFORMANCE**

<table>
<thead>
<tr>
<th>Processor</th>
<th>Cassette</th>
<th>Disc</th>
<th>Peripherals</th>
</tr>
</thead>
<tbody>
<tr>
<td>***</td>
<td>not tested</td>
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**EXPANDIBILITY**

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**VALUE FOR MONEY**

| **** | v. good | *** | good | ** | fair | * | poor |

As PCW has recently received two letters criticising the Benchmark of the Challenger C3 S1 we feel that we should make a few points clear:

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4. We review a machine against the claims made for it. That is to say that if a machine is claimed to be aimed at the inexperienced user, as many micros are, then we tend to be critical of those aspects which require, for example, the attention of the programmer - Ed.

*The letters came from suppliers of the C3 S1, namely, MUTEK of Corsham, Wiltshire and U-Microcomputers of Northwich, Cheshire.*

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**PRICEs (Excluding VAT)**

- 16K WH-89: £1490 Assembled
- 16K extra RAM: 80
- 16K cassette interface: 70
- Kit version (H-88): 948
- (without floppy disc): N/A
- MBASIC: 60
- HDOS & EBHB: 70
- Cassette interface: 80
- Processor: 60
- Discs: 70
- Other: 80
- System Software: 80

**Total price of review sample £1830**

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<td>BM 8  13.0 15.0</td>
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| BM 1 | 4.1 | 2.5 |
| BM 2 | 17.0| 9.2 |
| BM 3 | 35.0| 25.8|
| BM 4 | 38.8| 26.0|
| BM 5 | 44.0| 27.0|
| BM 6 | 75.8| 46.6|
| BM 7 | 113.0| 73.2|
| BM 8 | 13.0| 15.0|

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*The letters came from suppliers of the C3 S1, namely, MUTEK of Corsham, Wiltshire and U-Microcomputers of Northwich, Cheshire.*
Malcolm Peltu takes as his theme this month, the publishing of a new book from Adam Osborne. It's Osborne's first significant departure from straight fact and marks his arrival in the ranks of the "professional speculator".

Wild and wooly

Adam Osborne has built a powerful reputation as a writer and publisher of lucid textbooks introducing the technical aspects of microelectronics and microprocessors. It is therefore surprising that his first venture into the wider field of the economic and social impact of technology should be a turgid mish-mash of superficial, badly organised and often misleading punditry.

Called Running Wild, Osborne's contribution to the Great Microelectronics Debacle comes complete with a puff saying that it has been written for the layman — "to provide a head start in preparing today's citizen for the coming twenty-five years". Even though some of the issues he highlights are of great significance to the future, the way in which he offers top-of-the-head guesstimates and throw-away observations as if his 'reputation' absolves him from providing analytical justifications to his views makes me reluctant to recommend the book as a preparation for the next twenty-five microseconds.

Running Wild covers a terrain that should be familiar to a British audience which has recently been provided with an abundance of media coverage on the impact of the dreadful (or eagerly-awaited, according to taste) silicon chip. Yet Osborne concludes, "No one is paying attention to the way in which microelectronics and computers are being used, or to the impact such uses might have on our society. We had better start paying attention, or we will be very, very sorry."

Running Wild seems to have been written by throwing text into a word processor and then joining it together in haste. Open the book at any page and you will find crisply written sentences, racyly strung together and apparently making a point clearly. But read sequentially it is tough going because it has little internal structure and rhythm and is frequently contradictory.

For example, Osborne often says that 50% of all current jobs could be eliminated within 25 years, totalling around 50 million jobs in America alone. Yet in the chapter on "The White Collar Future", he states, "But when push does come to shove, microelectronics and automation will not have a dramatic impact on office jobs. Fewer secretaries will be needed - but they are in short supply anyway. Fewer file clerks will be needed and low-level office positions may be eliminated. Office jobs will be more demanding, and office personnel will require more education, but there will be no significant decline in the number of jobs."

Note the utter certainty with which the statement is made. No ifs, buts or supportive evidence, even though in a different chapter he estimates that almost 45% of all professional, managerial and administrative white-collar workers will lose their jobs.

Serious studies of the impact of microelectronics, such as Automatic Unemployment by Colin Hines and Graham Searle and The Collapse of Work by Clive Jenkins and Barry Sherman (reviewed in PCW September and October 1979), clearly show that the most revolutionary impact of the technology is likely to be in office and white-collar jobs. These have been the under-automated, labour-intensive activities which soaked up the unemployment created by the switch away from employment in agriculture and manufacturing industry which has occurred this century.

Unlike Running Wild, those other books try to back up their conclusions with some facts and figures. Osborne seldom bothers, even though he acknowledges that he had two "research editors" to help him. Some of their research appears to extend little further than Prestel publicity puff from the British Post Office.

At the end of the chapter on the white collar future, Osborne does a standard Tomorrow's World-style round up of the way in which computer terminals in the home will enable people to shop, find jobs, book airline tickets, look up electronic news services, etc.

He concludes: "We can argue about the way in which computer terminals will be used in homes and offices, but there is no argument that homes and offices will all have computer terminals. It is already happening, particularly in Europe. The trend in Europe began in Britain with a system called Viewdata, which transmits written material via telephone lines to television sets all over Britain. Any Briton whose television set is appropriately equipped can read news bulletins or the weather forecast, he or she can buy a variety of products or use various services. In short, he or she can already do most of the things described in the preceding pages."

This gives a misleading impression of the Prestel reality and is just one example of where technological potential is confused with technical, economic and social reality.

The best parts of Running Wild (not surprisingly, given Osborne's background in the microcomputer business) are the early chapters which sketch in the historical development of Silicon Valley, micro games and the emergence of the hobbyist market led by MITS and Altair. In contrast to the rest of the book, these chapters have substance and character, filled with intriguing anecdotal material about the people who, in the heady days of the mid-1970s, started the whole new industry with names like Apple, North Star, Radio Shack, Pet and all those others which now fill the pages of PCW.

Although this material is interesting, it has little to do with the rest of the book, except as an illustration of the new industries the technology can create. To go into detail about the hobbyist market while covering other important areas so superficially is a distortion of the weightings that should be given to a book that claims to be about the next industrial revolution.

These enjoyable opening chapters, one of which is trenchedly called Roots, are followed by a dreadful chapter on computer intelligence which somehow contrives to make the exciting subset of artificial intelligence into a boring and detailed plod through the logic used by computers to add numbers together. He does this to try to illustrate the "garbage in/garbage out", our computer-is-a-programmed-idiot principle.

There seems little excuse, other than having a handy chunk of text in the word processor, to go into such great detail on such a relatively unimportant topic.

Osborne shows little insight into modern developments in artificial intelligence — such as "expert systems" which are programmed with human reasoning. It is also unclear why the chapter on computer intelligence, containing its heavy-going logic analysis, should come so near the beginning of the book when the more relevant and entertaining description of micro-
electronics is confined to an Appendix.

The section I personally find most amazing in this high-brow book is where Osborne looks at the three areas in which the application of computers and microelectronics should be excluded. Aha! I thought, now we can look at some real computer abuses, like the computers in defence systems that nearly caused World War 3, the invasion of privacy by unauthorised access to medical files or the use of computers by dictatorships to infringe human rights. I was wrong... Osborne's three nasties are concerned with three American obsessions - democracy, money and business.

Ban computers from being used to count election results, to transfer money, and in the central operations of stock exchanges, says Osborne. His main concern is that in these three areas, computers can be tampered with to rig results or commit frauds. This danger, although, of course, quite real, applies to many other uses of computers. For someone who later (in the same chapter) goes on to ridicule attempts to regulate computer crime because the laws do not differentiate between illegally producing a Snoopy printout and a financial fraud, Osborne shows barefaced cheek in suggesting glibly that all electronic fund transfers should be outlawed.

Besides being totally impractical - given the bank's investment in computers and the difficulty of monitoring the flow of digital information to see if the transaction is a money transfer, a letter, or anything else - this suggestion also contradicts Osborne's own enthusiasm for home-based shopping, which he believes is so rife in England.

Osborne and his research editors are clearly out of their depth in Running Wild. Its glib and crisp style might suit an American public whose minds are incapable of assimilating more than the five-minute gobs of information spat out from the TV sets between advertisements; but, it cannot be considered as a serious contribution to the debate and analysis concerning the impact of information technology, particularly when there is such a substantial and growing range of books that examine the issues with depth and subtlety. Running Wild is to these other books as The Beano is to Dickens.

Compiling sins

My original sin was to believe in the infallibility of I, the Programmer. Then I believed in my inherent programming frailty and the Rightness of the Machine. But my faith was shattered by the realisation that the Compiler is not of the Machine but is merely mortal software.

That cycle of illusion and disillusion is probably true of anyone new to programming. The first time a program goes wrong, the Virgin Programmer instinctively feels the machine is at fault, not his or her own perfect logic. After the first debug, however, it becomes evident that the fault lies closer to home.

But I felt a real shock when I first realised that the compiler was not an inherent part of the Machine. I was working for a manufacturer and when one day a program went wrong and we couldn't find out why, someone suggested we go to the compiler support team. Sure enough, the cause was a bug in the compiler.

In those days of about a decade or so ago, compiler writers, like the compilers they wrote, were regarded as being one step removed from those arch high priests, the operating system writers. It would have seemed unbelievable then that anybody could conceive of writing their own compiler. Even more unlikely was that one day someone would write a book on how to do just that — and what is more, a book that is as intelligent, intelligent and (miracle of miracles) as witty as Peter Brown's Writing Interactive Compilers and Interpreters.

This, for me, is a rare publication because it is a "straight" technical book which I actually enjoyed reading. The hobbyist world has, of course, produced many relaxed, colloquial, cartoon-filled, jokey books. But Brown's effort is in the more academic tradition of the mainframe computer world, yet it manages to appeal to the "lay" personal computer enthusiast and the professional programmer.

The tone of the book is captured by its fourteen deadly sins which pepper the text. The first deadly sin, for example, is "to code before you think" and the last is "not to read to the end of the book" (which appears as the last line on the last page). The "sins" are a vivid way of encapsulating important advice without being patronising or lecturing, while the last of the deadly sins shows that Brown has a comedian's wit and sense of timing.

The book works on two levels: as a general introduction to computer concepts and as a practical guide to a programmer wishing to actually write a compiler. The practical examples relate to BASIC and the guidelines provided are not dogmatic. Brown is not afraid to recommend one approach Continued on Page 87
One of the enigmas of most businesses is that our customers expect us to give them unlimited credit for what seems like unlimited periods of time but our suppliers expect us, as customers, to pay our accounts as soon as they are rendered. Of course none of us really like paying bills but unfortunately in both good and bad times we depend to a great extent on the goodwill of our suppliers. In both good and bad times we depend to meet our credit needs of our expanding markets. In bad times an extra month's render. Of course none of us really expect us, as customers, to pay our accounts as soon as they are rendered to control and record details of monies owed by a company for materials, services or goods supplied to it. In the last Systems I dealt with Sales Ledger; Purchase Ledger can be considered as the other side of the cash flow equation and when the management information it can provide is used together with labour costs, it plays a major part in determining pricing strategy.

**Objectives of purchase ledger**

To control and record details of monies owed by a company for materials, services or goods supplied to it.

**Tasks and volumes**

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**VOLUMES**

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Compiled and edited by Mike Knight of Mike Rose Micros.

This is available direct from Vlasak Elec-
tronics Limited, Marlow, Bucks (06284 74789) or from their dealers throughout England and Scotland. The package is designed to be fully integrated with their Sales and Nominal Ledgers but is available as stand alone at a cost of £315. It was first released in November and has ten users at present. The package is written in machine code and is supplied with systems and operating manuals. Requests for customisation are always considered and quotations are made according to the amount of work involved. At Vlasak, where their entire software package is written in Busicom Extender and North Star BASIC with some assembler modules, their claim looks valid since complete processing is detected automatically by the software. The package has been available since July 1979 and there are eighteen users.

Their operating manual is designed primarily for the inexperienced user and whilst I believe they have succeeded in this objective, even experienced users have been tempted to disobey their exhortations that, in the event of breakdown, one doesn’t kick the computer or punch the VDU. Included in the software package are half day’s operating training on installation and another half day on the system, usually about two weeks after installation.

PERSONALISATION IS INCLUDED IN THE COST OF THE PACKAGE.

The minimum hardware to run their system is a 48K Apple II, two disc drives and a 132 column printer, which altogether costs £3,350. Included in the cost of the software is free training which can be on site or at Marlow. They expect that all packages together and offer two types of maintenance contract — one costing 5% of the purchase price per annum which provides a repair service either in house or on site, and the other costing 15% of the purchase price per annum which guarantees a replacement service within 24 hours.

SERENDIPITY SYSTEMS INC ACCOUNTS PAYABLE

This American produced package has been introduced to this country by Great Northern Computer Services Limited (0456 20667) They have completely Anglicised the package together with another eight Serendipity packages and have negotiated an exclusive distributorship for these products throughout the United Kingdom and Ireland. Great Northern’s objective is to establish about thirty dealers countrywide and to date they have already established offices in England and Scotland above a line from the Severn to the Wash. There are twelve users in the UK and over two thousand in the USA and Canada.

The package costs £275 and can be supplied in CBASIC, Cromemco Extended BASIC and North Star BASIC. The minimum hardware requirement is 48K, dual floppy drives, VDU and 80 column printer — costing between £3,000 and £6,000. Great Northern supply their dealers with source code and user manuals and provide a full time enquiry service as back up. Installation, training and maintenance services depend on the policy of each individual dealer.

PAXTON COMPUTERS PURCHASE LEDGER

This is available direct from Paxton Computers Limited, St. Neots, Huntingdon, Cambs, (0480 213785) or from their dealers throughout Britain. The package can be purchased for £750 but is normally sold together with Sales Ledger; the minimum hardware is: 48K North Star Horizon, 2 floppy disc drives, VDU and printer at an inclusive cost of £4,750. The package is written in North Star BASIC with some assembler modules.

Although there are ten programs in the suite this would be transparent to the user since control is always returned to the Menu program. In fact control of the programs is never handed over to either the BASIC interpreter or the operating system (usually CP/M); this is to ensure that mis-operation will not corrupt data.

Paxton’s major selling claim is the resilience of their software: “So far no system of ours has crashed through keyboard action, and they retain data integrity in the face of disc faults.” This is available direct from HB Computer Services, Limited, Leeds (0536 83922), or from their expanding dealers throughout the country. The package is supplied with an operating manual but systems information is limited. The minimum configuration is 32K Pet; printer and either cassette or Commodore dual disc drives and costs £750 for the cassette system or £2,250 for the disc system. Bugs are corrected free of charge but Petsoft offer no customisation service.

PETACT PURCHASE LEDGER

This is available direct from Petact Business Systems, Birmingham (021 454 5348) or like their subsidiary Petsoft from any of their expanding dealers throughout the country. The package costs £350 and it’s a conversion from a well established mainframe system which has been in use for over 15 years. The cost of the package includes a one day training course at Birmingham and is designed particularly for the first time user.

The minimum configuration is 32K Pet, 80 column printer and dual Compu/Think disc drives. The facilities provided are very similar to the Petsoft systems but instead of five individual programs for the functions there are nine, all of which are driven via a menu selection program. Once again bugs are corrected free of charge but no customisation service is provided.

BENCHMARK ‘SNIP’

SNIP is a fully integrated Sales, Nominal, Inventory, and Accounts system. It can be purchased from any of Petsoft’s 250 dealers throughout the country. The package costs £950. Each package, however, is available stand alone from the writers of the software: Benchmark Computer Systems Limited, St. Austell, Cornwall (0726 61000) — purchase ledger costs £250. The system is supplied with all media — including security discs, systems specification and operating instructions. The cost of the package includes an installation service and personalisation.

The minimum hardware required is 32K North Star Horizon, 2 disc drives, VDU and printer (including delivery and installation). Bugs are corrected free of charge during a 90-day warranty period but outside this users are notified and are offered the amended program or a replacement disc. Both packages come with a full file error and sample output. The documentation has obviously been produced using their word processing system which I will be reviewing when I cover that topic in two months’ time.

See Page 100 “Bludners”
**Tied up with strings**

There is one thing that puzzles me about microcomputers regarding their string handling. Could you please explain why it is not possible to refer to the nth character in A$ as A$(n,n)? I am considering buying a PET but I can only see mention of LEFTS, MID$ and RIGHTS. Does this mean that it is not possible to use the A$(n,n) format?

H. Frost, Crawley, Sussex

It's not the computer that provides the differences found in string handling, it's the compiler/interpreter; so the way in which strings are handled is independent of whether the computer is a micro or a mainframe. You have encountered one of the many areas of BASIC which are undefined. String handling in one version of BASIC is quite likely to be different to string handling on another machine, even on the same machine you can get different versions of BASIC, each with its own rules. You have, in fact, met one of the less frequent types of BASIC and it is comparatively rare to find a micro that does not use a PET-type system. I won't give any examples here because virtually any book on BASIC will use the LEFT MID RIGHT system. I can only tell you to try it as it is as good if not better than your system.

**No go**

I am considering the purchase of a personal computer and, being a new venture, I require some advice. My price range is £1000-£1250 and this puts the PET, Apple etc. in my class. One of my prime uses will be the playing of games such as Chess, and particularly GO (not Gomoko or Go Bang). Are you aware of any games for GO on personal computers? A letter to Computettes elicited no response whatsoever.

I. Jones, Guynedd, Wales

I am afraid that I know of no programs that have been written for GO. You may care to ask the British GO Association, 15 Wantage Rd., Reading, Berks to see if they have any more information. Book is a growing thing and the Apple (or ITT 2020) graphics should be able to display the board and pieces, etc., but personally I prefer the extra facilities that the Apple provides.

Writing your own program is one answer — preferably with large chunks written in machine-code to speed up the program. It may be tricky writing the part of the program that looks for "eyes" within the opponent's territory, but by no means impossible. If any of our readers can add any more information to add then I'll gladly pass it on. By the way, writing the machine code is very much easier on the Apple than on the PET. Also, if you are considering expanding to floppy discs at some future date then I would have to recommend the Apple's discs in preference to PET's own discs.

Mike Dennis

**School pleas**

The maths department at my school is indecisive as to whether to buy a PET or an Apple or even whether to buy a computer at all. Would pupils soon learn to write useful programs? The school has about 1,000 pupils. How can I raise the money?

T. Lord, Clitheroe, Lancs

In trying to answer your question I will get onto my hobby horse yet again and say that if industry expects teachers, but with their pay so far behind that of industry the reason for the shortage is obvious.

SW

**Policy making**

I work in an insurance brokers. In my spare time I have developed a BASIC program which helps produce insurance quotations. It substantially reduces the time taken to prepare a quote. I am sure it could be of use to many people working in insurance broker offices. I would like some advice on marketing/submitting my program. I am particularly worried about people taking unauthorised copies without paying for them.

A. James, London N4

I can see a number of paths which you could follow. The simplest would be to sell your program to one of the specialist micro software shops; they are geared up to advertising specialist packages like yours.

Speaking from personal experience, you may have considerable difficulty obtaining what you consider to be a 'fair' price for your rather specialised program. If your package is well presented, (documented/programmed) you may be able to interest one of the larger software shops who will act as distributor, and pay you royalties for each program sold. I may add that they will only handle really high quality software in this way.

Secondly, have you thought of handling the sales inside the trade? Perhaps your company would be willing to buy a number of machines and install your software in them. Alternatively, you could approach an insurance company and see if they are willing to buy your program outright and market it to their clients. You could buy your own machines (if it really is cost effective, perhaps we will put their money out).

On your point of stopping possible thefts (unauthorised copies) I suggest you investigate the possibility of placing your program (or part of it) into PROM. This would not make copying impossible, but for most users, it would be easier to buy the program than steal it. You failed to mention the machine on which you have developed your program. I can therefore only give some general points on Proms. PROM programmers can be bought for most micros, and the actual interface to a Bus/Port is straightforward. Typical cost of a programmer is £35. PROMs can be written for your rather specialised package is well presented, (documented/programmed) you may be able to interest one of the larger software shops who will act as distributor, and pay you royalties for each program sold. I may add that they will only handle really high quality software in this way.

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As a newcomer to micro-computing I would like you to answer some questions regarding cassette mechanisms. I understand that there are audio drives and digital drives and that’s about my limit. What are the differences in speed, reliability, method of operation and cost? Can cassette written on one type of drive be read by others of the same type? What I am leading up to is to ask how easy it is to exchange program and data between different systems?

P. Carlson, Battersea

As you say, there are two basic recording formats (sometimes referred to as digital and audio); there are also two basic kinds of cassette mechanisms. The difference between them is that digital recording techniques are implemented on mini computers (PDPs/Data Generals etc) whereas the audio systems came along as the cheaper alternative and was based around expensive, servo driven reel-to-reel tape mechanisms, important if high packing density tape is used. Audio drives use servo controlled, linear DC motors. The method of operation of the audio system is normally very similar to programming a teletype! After a transfer has been initiated the hardware will set a flag when it is ready to receive/transmit a character; the software writes/reads the next character to/from a suitable location. Obviously there are a number of time limitations imposed by the hardware, e.g. you must supply the next character within the final quarter of the second of the hardware requesting it. To save programming effort and to remove a source of error, many tape drives come with software which provides a “block” interface. The software simply tells the software where a block is and whether it is to be read/written and leave the rest up to it. Blocks are normally 50-150 characters long. This leads up to your final point - ease of exchange of tapes between machines. Transfer between digital and audio systems it not possible. There is little trouble to transfer information between machines of the same make. Similarly exchange between hardware which uses the “Kansas City Format” can also be straightforward. Unfortunately a number of micros use their own internal code when writing information to tape. (It has the advantage that they can replace long commands like “PRINT” and “GOSUB” with single characters). This makes the operations of saving and loading programs much faster. Ron P. Malone

Lance A. Leventhal

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PCW 59
For most PCW readers astrology is a matter of Lucky Stars columns in newspapers and magazines: brief little forecasts that never seem to come true. Real astrology is much more complex. Instead of dividing the sky simplistically into twelve Zodiac signs, one for each month of birth, it takes into account the whole solar system at the exact moment of birth.

From this map of the heavens, it’s possible for the astrologer to make a surprisingly detailed character assessment of the person involved: his temperament, inner emotional disposition, talents and hang-ups and even the state of his psyche at any moment in life.

To do this correctly, the astrologer must be both a mathematician and artist. Mathematics are required to calculate the exact positions of the Sun, Moon and planets at the time of birth; and artistry is needed to interpret these hieroglyphs and numbers into a sympathetic language which the client can understand.

Since astrology, like most people, are more literate than numerate, the traditional way of calculating a horoscope has been made, over the centuries, as painless as possible. All they need do is look up tables of planetary motion, called ephemerides, and interpolate between one day’s position and the next. Then they must find the angular separation between any pair of planets, and, again referring to tables, discover which degree of the Zodiac was rising above the eastern horizon.

The whole process takes half an hour, at most. Then they can become artists again. Astrologers, as you can imagine, like to believe that their craft requires a great deal of intuition... And so, at the most exalted level, it does. But at an everyday level it is surprisingly logical. Astrological interpretation is really a series of equations: on the left side, a planetary pattern such as ‘Mars in Capricorn square Venus in Libra’, on the right side a description like ‘His dynamism at work contrasts oddly with a sweet but lazy disposition in bed.’

It follows that not only the mathematics of astrology, but some of its artistry too, are amenable to computerisation.

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It follows that not only the mathematics of astrology, but some of its artistry too, are amenable to computerisation.

I was the first astrologer in this country to put my name to computerised character studies and forecasts. That is, I wrote the necessary paragraphs while a professional programmer stitched them together on an IBM 370. I knew nothing about programming, he knew nothing about astrology, and the end-result lacked any subtlety.

There are three areas of complaint that can justifiably be made against these early efforts:

1. Mathematical accuracy
In my own case, we simply fed an abbreviated 20th-century ephemerides into memory: a highly inefficient use of man and machine.

2. Integrity of text
When a text is composed of disparate paragraphs, without any reference to each other, the most shocking contradictions can occur. A client, for example, can have two conflicting astrological factors: Sun in Gemini, let us say, and Moon in Capricorn. The human astrologer, writing his own report, can marry these factors into a balanced account, explaining how these factors can sometimes help and sometimes hinder each other. But a crude computerised report will blindly announce ‘As a Geminian you are lively, restless and fickle’ and, in the next sentence, say ‘With Moon in Capricorn you are stoical, cautious and conservative.’
Business considerations

Everything is running smoothly now. I'm sure a number of PCW readers are thinking of tackling a similar entreprenuerial venture at some time, in some field if not astrology itself. It is worth analysing my experiences with some care.

If you are thinking of setting up any computerised cottage industry, bear these points in mind.

**Equipment**

There's a minimum investment below which you cannot get. As the actress said, don't do a man-sized job with a boy's set of tools. Not only are cheap micro-computers too slow and small and unreliable for the task, but they prevent adequate future expansion. The equipment I chose - wisely, looking back - was a Cromemco System Three computer, with 64K core memory and 1MB of disc memory; and Tally 1612 printers, picked for their reasonable throughput (about 120 cps) and with their wide range of expanded matrix typefaces. The 7 x 7 half-matrix typeface lacks descendents true enough; but the end-result on the page is stylish and professional. In common with many Tally clients, I have had a number of stoppages caused, apparently, by some kind of tarnishing within the RAMs through over-use, but Tally have done what they can to have solved the problem now. With the Cromemco cards I've had virtually no trouble at all; but the discs have, like medieval hecatombs, frequently passed into a state of error. Sometimes this has been bad luck: components were supplied that were quicker than they should. More often the fault has been my own dust; French-windowed office, full of Somerset motes. If I were buying afresh, I would pick the new Cromemco Hard-Disc systems, for their promised reliability and speed.

The Starlife programs

These split into two groups: those dealing with data input and the main Birthday Horoscope program which creates the actual reports. Let's take them in order:

1. **Data input**

Each application must be processed in two ways: temporarily into an ORDERS file (holding 100 at a time) and permanently into my alphabetical CLIENTS files. The first data to be entered are surname, date, month and year of birth. Armed with this information, the appropriate CLIENT file is searched to see whether this is a new or existing customer. Additions: Data first entered: birthplace and birth-time (with summer time automatically deducted and the computer picking a random birth-time if the actual time is unknown), name, sex; marital status; address type of report needed; and payment. There are various fail-safe routines for trapping and changing input errors; and the data is then stored in ORDERS and the correct CLIENT files.

2. **Ancillary files**

There are various files supporting this program. Latitude and longitudes of every place-name in the British Isles are held in the 26 LATLONG files. Time-zones are extremely complicated, especially in the US where adjacent counties in the same state might - or might not - adopt summer time in a particular year. Various TIME files calculate these adjustments for most countries in the world. Most important of all are the CLIENT files, 575 of them grouped alphabetically on 36 discs which can accept a maximum 50,000 clients. The first four letters of a client's surname establish which file is the correct one. (Problem: The MACs, JOHNSons and SMIThs now take quite a few seconds to search.) With a hard-disc system there would be none of this swapping and changing of discs, of course. On the other hand, this disc-handling does add variety to the operator's routine and prevents, I think, errors through boredom. As it is, we have an average error-rate of 2%.

There is no back-up for these 36 discs. (What! Ed). My Verbatim 9" floppies have never let me down, after a year's operation.

Birthday horoscope

This is the most complex astrological word-processing program ever written. It generates a 10-page report covering the next 12 months of the client's life. The first half deals with the broad trends: your overall attitude to life in the coming year, how the world will treat you, and how you will fare at home and work, in love and friendship, in health and finances. The second half picks out the key dates in the coming year, giving some 90 precise predictions.

The text is composed of about 136 different paragraphs, chosen from a total data-base of about 2,500 different paragraphs. The chance of receiving the same report as another client is virtually nil; you would need to be born within five minutes of each other, and still be living in the same town, and to apply for your horoscopes on the same day, for this to happen.

A Birthday Horoscope is personal, in the sense that it's based on a detailed analysis of your individual birth-chart, and impersonal in the sense that nothing in the report is personally written for you alone. To give each report
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more of a personal touch, there are numerous references inserted into the text: your first name, your age, your place of birth, your marital status and so forth. Certainly this style — to say nothing of the content — seems to be successful, for out of 10,000 clients in the first year of operation only seven have asked for their money back.

The flow-chart of this program shows how detailed is the mathematical analysis of the horoscope. First the program calculates the position — to the exact second of arc — of the Sun’s geocentric longitude at your moment of birth. This is done using formulae, not an ephemeris, taking into account all the gravitational perturbations within the solar system. Then it works out the moment of solar return, when the Sun returns to this same position in the sky in 1980, and calculates all the remaining planetary positions for the same time. This is the solar return chart.

This chart is believed to resonate at different frequencies for different people, and so it’s turned into your Harmonic Year chart by multiplying all factors by your age. Then the computer works out the positions of all planetary midpoints — that is, halfway points of the angles of separation and the angles between these midpoints and the Sun.

Are you still with me? The next step is discovering the harmonic content of each of these angles: the frequency at which it vibrates, so to speak. Once this is done, the computer selects at random which of two similar paragraphs will be printed.

To give an example: let’s say that in your 1980 harmonic year chart Venus is at 140 degrees and Pluto at 190 degrees. So their midpoint is 165 degrees. If the Sun is at 120 degrees, the angular separation is 45 degrees, which means that it vibrates on the 8th harmonic (360 degrees, of the sky divided by 45). In disc memory there’s a file called HARMONIC.35 corresponding to the Venus-Pluto midpoint, which contains 24 records — two for each of the twelve possible harmonics at which this angle can vibrate. So the program picks one of the two relevant records, and prints it.

That takes care of the first half of the report. For the remainder, the program returns to the original solar return chart and calculates all its 78 midpoints, sorting them in anti-clockwise order from the Sun’s position. It then works out when, in the course of the next 12 months, the Sun moving at variable speed through the geocentric Zodiac forms a transit with each midpoint and planet in turn. For each transit there’s a set of 10 similar paragraphs, one of which is randomly chosen for inclusion in the report.

This program fulfils two important objectives: first, it produces a standard-sized report for each client, ensuring value for money (for the snag with other forms of astrological prediction is that they give a bumper crop of forecasts one year and perhaps a dearth the next); and secondly, it is perpetual, as valid in 100 years’ time as it is today. If any religious PCW readers wish to know the prospects in 1980 for the Living Christ, Starlife can tell you — provided, of course, that you supply the correct birth-data.

Future prospects

Although I’m proud of Birthday Horoscope, I recognise its short-comings. Despite its intricacy, it remains a ‘painting-by-pictures’ report. The program, when printing a paragraph, cannot relate it to any other paragraph.

So the next step must be to program the computer to weigh and consider each astrological factor in the light of other factors. In a character analysis program that I’m writing now, the computer will scan the whole chart and give it a label or nickname, a summary of its salient characteristics. It might be ‘Lucky Spiv’ or ‘Melancholy Scientist’ or ‘Shy Do-gooder’. It will then stitch together the appropriate sentences in a way that suits the person involved.

The aim of all astrological program design should be to reduce the data-base whilst increasing the flexibility. An example: you need 12 paragraphs to cover the Sun in each of the 12 signs, and another 12 for the Moon in each of the signs. But 144 are needed to cover the Sun-Moon combinations and 1728 to cover the Sun-Moon-Ascendant permutations.

If, on the other hand, you have a smaller number of sentences, or parts of sentences; and marry them together with ingenuity, you can produce a much more individual report. Shakespeare, after all, had a data-base of 30,000 words; he just put them together in such idiosyncratic ways.

Starlife software

Software, suitable for 8K and 16K PETs, Apples or TRS-80s, is available on cassette or 5" disc. With this package you can generate birth-charts, solar and lunar returns, transits, progressions and synastric charts, together with aspects, midpoints and harmonics. Prices range from £15 to £25.

If you are keen to develop your own programs in astrology, you should get hold of copies of Matrix magazine from 1041 North Main Street, Ann Arbor, Michigan 48104, USA. It’s a quarterly, and six have been issued so far. They are packed with invaluable advice, formulae, short cuts and programs. They cost $10.00 each, airmail. The best approach, now that there are no currency restrictions, is to mail $20 or $30 in notes to Michael Erlewine at that address, and he lets you know when you owe more.

Birthday horoscopes (£4.80 — send date, place and time of birth) — and software catalogues (£1.00) are available from Starlife, Cossington House, Bridgewater, Somerset.
SUBSCRIPTIONS

Less than 2 years ago PCW became the first magazine in Europe to deal exclusively with the home and business use of Personal Computers. It has been an unqualified success. The current subscription list stands at well over 3,000, with a staggering 70% renewal rate! PCW reader loyalty is already a byword in the publishing business. We aim to keep it that way. So if you are having difficulty in obtaining PCW at your newsagent, why not take out a subscription and have the magazine mailed to you direct?

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PCW SURVEY - THE PRIZEWINNERS

At least 1,957 people will hardly need reminding that back in our November 1979 issue, not only did we include the first Reader Survey of the new "regime" — we also promised to give away to the sender of the first questionnaire out of the bag, a really exciting and valuable "star prize" — a Sharp MZ-80K microcomputer, very kindly donated to us by Sharp UK.

As promised, on 10th December last, Sharp's Paul Streeter drew the winning entry — plus another 25 runners-up, who will all receive a free year's subscription to PCW.

Why 1,957 people...? Well, that's the number of questionnaires returned, as of December 10th. As magazine surveys go, such a return ranks very high indeed, and entirely apart from the fact that the information gained is already starting to prove most valuable, we've had quite a few chuckles over some of the "comments" concerning the Age/Name blunder on Question 1!

To quickly put 1,956 readers out of their misery, the winner is: Terry Rigby, a TV Transmission Engineer from East Sheen in London. He received his prize from Paul Streeter at a ceremony that took place at Personal Computers Limited, in London's Bishopsgate on December 21st. PCL's Mike Sterland generously upped the 24K Sharp to full size and he also gave Terry a year's free guarantee on the machine. Total value £850.

The 25 subscription winners are: Clive Crocker of Pinner in Middlesex; R.A. Du Boisson of Stretford in Lancashire; John Hyde of Frimley in Surrey; "no name" of East Horsley in Surrey; Andrew Thompson of Cottingham, N. Humberside; M. E. Morrice of Rugby in Warwickshire, D. I. Smith of Urmston in Lancashire; M. J. Parker of Letchworth in Hertfordshire, R. Wilson of Cirencester in Gloucestershire; John Kirk of Rothwell in Northamptonshire; Mr P. A. Varnes of Wigan in Lancashire; Bill Oliver of South Harrow in Middlesex; "no name" of Andover in Hampshire; David Akerman of Dagenham in Essex; N. W. Edgerton of Hove in Sussex; Mr G. R. Pretts of Caversham in Berkshire; W. Flavell of Crawley in Sussex; Nigel Cook of Wickford in Essex; Tony Falls of Nottingham; B. S. T. Marriott of Slough in Berkshire; Jerome Perkins of London SE8; John Lee of Southwell in Nottinghamshire; G. F. Clarke of Cheylesmore in Warwickshire; S. J. Evans of London SE19; "no name" of Waterlooville in Hampshire.

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VECTOR GRAPHIC FLASHWRITER II

There are really only two ways to convey text (or graphics symbols) to a VDU screen from a computer. Either characters are transmitted serially from the computer to a terminal unit, which then orders them on the screen according to their position in the sequence, paying due attention to any embedded formatting instructions; or, the computer directly places each character in a memory location which corresponds, via a one-to-one hardware mapping to a screen location. This second method, known as "memory mapping", is implemented by the "Flashwriter II" video board, manufactured by Vector Graphic Inc. Andrew M Stephenson reviews it.

Features
The noteworthy features of the Flashwriter II are:
1. Flicker-free display of 80 characters on each of 24 lines, consecutively addressed from a choice of starting locations.
2. S-100 bus compatible.
3. Non-interlaced pseudo-US frame standard, with true descenders supplied, plus graphics in "control" code area.
4. Re-programmable font of symbols: 128 supplied; 256 possible. Full ASCII supplied with true descenders supplied; plus graphics in "control" code area.
5. High bit (bit 7) sets inverse video and/or reduced intensity; or it helps select 1-of-256 characters.
6. 4MHz addressing, with "waits".
7. On-board parallel keyboard port.
8. Socket for optional ROM, with optional "Jump-on-power-up".

Availability
At least three stockists of the Flashwriter II regularly advertise in PCW. Currently, Almarc say that it should be available either ex-stock or at 8-10 weeks' notice, at around £230. Kit versions are not made.

The board was designed to interwork with the Vector Graphic "mindless terminal", which houses both keyboard and direct-drive monitor. As the terminal is not sold on its own, it must be ordered with the board, in which case the appropriate connecting cables will be fitted or supplied. Some sources will happily sell the board alone, others are reluctant, so ask.

Compatibility
Nominally an S-100 unit, the Flashwriter II does not appear to conform to the new IEEE specification. Board buffering has not been fitted, but it is probably safe enough to assume a single, normal TTL load/source per line. All three power rails are needed: +8v (@ 910mA), 16v (@ 31mA), -16v (@ 54mA), 16v (@ 54mA), 16v (@ 31mA).

My board is Revision 2, dated 7 February 1979. Revision 1 of the manual (dated 29 March 1979) is clearly and informatively written, though at times it seems uncertain whether it is being read by an expert or a "box operator". Presentation and style are clean, the diagrams uncluttered, the printing good.

On the whole, the manual (Revision 3, dated 29 March 1979) is clearly and informatively written, though at times it seems uncertain whether it is being read by an expert or a "box operator". Presentation and style are clean, the diagrams uncluttered, the printing good.

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My main complaints would be that, although the circuit diagram shows all components and their values, and identifies the important waveforms, enough component numbers are missing to be a nuisance and some S-100 edge connectors are repeated with no indication of the fact, thereby making circuit tracing needlessly difficult. There are also at least three mistakes in it. However, these are slight defects in otherwise helpful documentation.

Construction
The standard is good, with a double-sided glass fibre p.c. board that has plated-through holes and solder masking, and gold plating on the S-100 connector. Video output is through a 6-pin Molex connector, for which a plug kit is supplied. For those with mainframes of the correct dimensions, removal of the board is assisted by a pair of corner levers.

Apart from the odd IC (which may have been in short supply at the time of mass assembly) sockets have only been fitted where they are essential, such as under the two character ROMs, the key-board port, and the spare ROM. Several options have to be selected by cutting PCB tracks and linking others. Competent workmen should encounter few difficulties here.

The VDU
To the CPU and the programmer, the VDU board "looks" like a 2K block of 4MHz RAM, of which the lower 1920 addresses match screen locations running across from the top lefthand corner, down the screen in the conventional reading pattern, with consecutive addresses throughout. The 128 bytes are "spare" and may be used as the programmer prefers.

The display is beautifully steady (but see "Tips", later) and, completely free of update/flicker, that's because CPU access is restricted to the inter-line blanking period. As a result, the CPU may be forced to wait (using the "PRDY" line [pin 97]) for anything up to 48 microseconds. In practice, this delay will only bother the most demanding users. For example, a 2.5MHz 280 should be able to perform an average of three "LDIR" cycles per screen line period, which means a complete screen re-write would take about 44ms. A 4MHz 280 could do much better. Delays can occur during both "write" and "read" operations, including those involving the top 128 bytes.

The empty on-board ROM socket may be strapped for 2708 or 2716, with the same choice of base addresses as the VDU. If the "Jump-on-power-up" option is selected, pulsing the "POC" line (pin 99) will enable the ROM and can also (if strapped) force the "PHANTOM" line (pin 97) low until the ROM is addressed. Sadly, if the user's system does not use the "PHANTOM" line, the Flashwriter II's Jump-on-power-up option could be tricky to set up correctly, so this feature would appear to be of doubtful value. Thankfully, only two NAND gates have been sacrificed to it.

The board is also capable of generating "DWRITE" (pin 56) from "PWTR" (pin 77) and "SOUT" (pin 45).

Video Output
Both composite video and direct drive monitors are catered for. Line standard is pseudo-US, that is, vertical scan rate is 59.92Hz; there are 262 lines per scan, the scans not being interlaced. The composite video signal measured at the output of my board is shown in Fig. 1. Voltage levels are not standard but good results were obtained on a Ceedata 1230 GHB monitor having a bandwidth of 10-12MHz. The 4 micro
second line sync pulse in the inter-line blanking period can be repositioned by an Ed Pye drum-tap foot, sliding the display block of text left/right across the screen.

The direct drive signals available are: an approximately 4 micro second positive “horizontal” pulse from a TTL gate; an approximately 128 micro second negative “vertical” sync pulse from a TTL gate (option: positive pulse); positive “video” from two 7406 gates with a 150 ohm pull-up resistor.

Unfortunately, there is no true standard for direct drive monitors, so various manufacturers’ units require all sorts of pulse widths and phases. The Flashwriter II is meant to drive a Ball Brothers TV120, but mine is being used successfully on a Digivision MWD12 having a nominally incompatible set of sync pulse requirements. In fact, only slight alteration of the VDU board was required (the addition of a 680pF capacitor).

Varying the displayed characters

As supplied, the Flashwriter II will display a full set of ASCII characters, white-on-black, including “DEL” (7F) which shows as a fine-grain chequer-board. “Control” codes show as graphics, as in Fig 2: cells “a’-e” reflect the states of bit 7 (the “on”); and if bit 7 is set, “a’-e” are inverted and cell ‘f’ is set “on”.

In general, if bit 7 is set, inverse video is specified for that screen location. Optionally, reduced intensity may be selected (the user fits a resistor whose value defines the intensity), simultaneously or as an alternative. Since both 2K PROMs define the entire location field, 8 dots wide by 10 lines high; one handles the top 8 lines, the other the lower 2 lines (see Fig 2). Most of the supplied characters lie within a field of 5 dots by 7 lines, plus 2 lines for descenders. If the user wishes, the set of 128 symbols can be expanded to 256, by substituting a 2716 and at the expense of inverse video and reduced intensity (unless, of course, these features are to be used simultaneously with the “upper” 128 symbols in the new set).

Keyboard

The latched keyboard port can respond to either positive or negative going strobe edges. Port addresses are selectable: 2n (status) and 2n+1 (data), where n=97. If desired, an interrupt on line “PINT” (pin 73) may be generated when data is available; also, the status byte shows READY on bit 6 and READY on bit 9. Bit 5 of the status byte is “q” during the 22-line vertical blanking period.

Tips

Here are a few tips drawn from personal experience:

Without a doubt, it is a very poor copy of direct drive monitor which will not give a display superior to that obtainable from a comparably priced composite video unit. With a dot rate (the rate at which screen character elements travel) of 14.318MHz, the Flashwriter II needs a monitor of about that bandwidth. Reasonably priced composite video units can usually offer 10MHz or so, guaranteed. Whilst this will permit the resolution of most details, it is less than adequate if the screen must be looked at for very long. By contrast, an average direct drive monitor has a bandwidth in excess of 20MHz.

Having bought a good VDU board and a monitor, novice users then link the two with inferior cable. This is silly: don’t just take it for granted that cable, sockets, plugs or joints are up to scratch — check them. Noticeable improvements can be produced with this simple precaution.

If the display wobbles or ripples, check for stray magnetic fields, such as from power supply transformers. Monitors powered by 50Hz mains but displaying at 60Hz field rates are especially sensitive to this problem, although a separation between mainframe (metal case) and monitor of a couple of feet is usually sufficient.

Finally, the good news: the Flashwriter II seems quite happy with unmodified mainframe supply rails, demanding no special precautions in that area.

Optional 2K systems monitor

(Note: this section was written purely from Vector Graphic literature kindly supplied by Almara Data Systems Ltd. Therefor, remarks made here are dependent entirely upon the accuracy with which I have interpreted that literature. However, in common with the Flashwriter II manual, it’s well written and seems unambiguous.)

Vector Graphic also sell a 2K Extended Systems Monitor for the Z80. Release 4.0 (dated 15 October 1979) is available on two 2708s at around £25 and is aimed specifically at the Flashwriter II in a Vector Graphic system. As such, it embodies several commands which are system specific jumps to strange addresses, for example — and expects a keyboard on ports 0 and 1. No one can damn it for that. However, we shall see that it also embodies enough oddities, and even defects (in my considered opinion), to give any wise potential purchaser reason to pause.

Without these idiosyncracies, it would be a useful addition to the system software, for it has several fine features such as a versatile video driver, two powerful memory test commands, and a useful memory examine/change command. In all, there are some two dozen commands. Unfortunately, the principle of caveat emptor cannot be allowed to prevail, for Vector Graphic has filled no fewer than four sides of their Flashwriter II manual with attractive publicity for their Monitor, so an overt warning here seems fair.

Several of the Monitor commands exhibit a curiously half-engineered appearance, as if the designer(s) failed to think through the logic of their functions fully. For example, there are separate commands for one and two bytes, and separate commands for wide and narrow-screen memory dumps; these are but two examples of commands that could easily have been rationalised.

Then, the method of entering hex values is ridiculously clumsy. If, say, four characters are needed, either exactly four must be given, with no chance of error recovery save by restarting the command, or “SPACE” must be hit to signify leading zeroes; other Monitors are content to accept the last four characters entered, and use “SPACE” to signify completion of the entry, leading zeroes always being assumed, by default.

But the real villain of the piece is the Block Move command. If a block of bytes is moved upward through memory into an area which partially overlaps the original area, the overlapped area will be corrupted; yet this glaring fault is actually claimed by the Monitor manual to be a useful feature.

To its credit, the Monitor does take such sensible precautions as converting lower case letters to upper case, and ignoring meaningless entries. All is by no means lost. However, I could not with a clear conscience recommend this Monitor to anyone, except those desperate for a video driver (a nice piece of programming, as I have said); owning a Vector Graphic system might sway the decision, otherwise, one should wait for future revisions.

Verdict

Let’s be quite clear about one thing; whilst I have little love for the Extended Systems Monitor, Release 4.0, I have no hesitation in recommending the Flashwriter II video board. Some users may find that a couple of options clash with their systems, but as a straight video board my unit has given next to no trouble at all. It is for the casual user, perhaps (the need for a good quality monitor is a complication) but, as an adjunct to my “WordStar”-based wordprocessor for the past six weeks, it has proved entirely satisfactory. Besides, it appears at present to be the only realistically priced 80x24 memory mapped S-100 VDU board on the British market.

Figure 1: measured composite video signal from VDU (inter-line period).

---

Figure 2: supplied character format; graphics use cells ‘a’-‘f’, “DEL” fills whole area.
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Two-person games

Two-person games, such as chess, backgammon and draughts, are usually more interesting and challenging than one-person games, and it is to these that we shall be devoting most of our studies. The introduction of a second player creates manifold difficulties that do not exist in a one-person game, but fortunately for today's programmers these difficulties have been extensively analyzed in the computing literature and the problems are now rather well understood.

The two-person game tree

Game trees become more complex structures when an opponent appears on the scene. Let us consider a relatively simple game, noughts and crosses (tic-tac-toe to our American cousins), and examine how its tree will look after a move or two of look-ahead. We shall assume that "cross" moves first.

From the initial position there are three essentially different moves:
1) e (the centre)
2) a, c, g and i (the corners)
3) b, d, f and h (middle of the edges)

On the first move, any of group (2) is equivalent to any other, since all four moves are merely reflections or rotations of each other. Similarly, within group (3) all moves are equivalent. This technique of utilizing symmetry to reduce the magnitude of the problem is well worthwhile when programming a game that lends itself to a symmetrical analysis. By reducing the number of moves that need to be examined at any point in the tree you will be cutting execution time dramatically, because the combinatorial effects of tree growth are enormous. The savings in time that can be achieved through using symmetry can be extremely valuable when improving the performance of the program by making its evaluation function more sophisticated (and slower).

If we so decide, our program can terminate its search of the tree after looking at each of its possible moves from the root. This is called a 1-ply search because the program only looks one "ply" deep. (The term "ply" is used to denote a single move by one player.) In order to decide which move to make, out of \( m_1, m_2 \) and \( m_3 \), the program will then apply its evaluation function to the three positions at the lower end of the tree (these are called the terminal positions). Whichever position had the best score would then be assumed to be the most desirable position for the program, and the program would make the move leading to that position.

How should we set about designing our evaluation function? This is one of the fundamental problems in game playing programming because a good evaluation function will help the program to make good judgements, and hence to play well, even though the depth of look-ahead may be shallow. A poor function, on the other hand, might well result in poor play even with a deep and time consuming search of the game tree. It is therefore very much worthwhile putting some careful thought...
into the design of the evaluation function, and the following example should illustrate the type of thinking that is necessary.

The object of the game is to create a row of three of your own symbols. We shall call this a "3-row". The next most important thing is to prevent your opponent from making a 3-row, which means that he should not have a 2-row after you move (a 2-row has two symbols of one player and one empty space). Next most important is the creation of your own 2-rows; then it is important not to leave your opponent with 1-rows (one of his symbols and two empty spaces); and finally you should try to create your own 1-rows. All of these features could well be incorporated into a noughts and crosses evaluation function.

If we denote the number of cross' 3-rows by \( c_3 \), the number of nought's 2-rows by \( n_2 \), the number of cross' 2-rows by \( c_2 \), the number of nought's 1-rows by \( n_1 \), and the number of cross' 1-rows by \( c_1 \), ... then one measure of the merit of a position from cross' point of view would be:

\[
c_3 - n_2 + c_2 - n_1 + c_1
\]

but this measure has one obvious drawback. It does not allow for the fact that the term \( c_3 \) is more important than \( n_2 \), which is more important than \( c_2 \), and so on. This can be done by multiplying each of the terms in the evaluation function by a numerical weighting, in such a way that the weightings (hopefully) reflect the relative importance of each feature. The evaluation function then becomes

\[
(k_3 X c_3) - (k_2 X n_2) + (k_2 X c_2) - (k_1 X n_1) + (k_1 X c_1)
\]

where \( k_3, k_2', k_2, k_1' \) and \( k_1 \) are the numerical weightings. Since one \( c_3 \) is worth more than all the \( n_2 \)'s in the world, i.e. a winning row is more important than any number of 2-rows, we can set \( k_3 \) to be some arbitrarily high number, say 128. By studying the game for a few minutes it is possible to see that if one side has a 3-row, the other side may have at most two 2-rows, so to reflect the relative importance of one's own 3-rows and enemy 2-rows it is necessary to ensure that \( k_3 > 2 \times k_1 \). We can therefore try \( k_3 = 63 \). (If one side has a 3-row and his opponent two 2-rows, the opponent will not have any 1-rows to upset this scoring mechanism.)

If there are no 3-rows, but one side only has a 2-row, his opponent cannot have more than three 1-rows, as in the following situation.

\[
128 \times c_3 - 63 \times n_3 + 31 \times c_2 - 15 \times n_1 + 7 \times c_1
\]

to the three positions \( P_1, P_2 \) and \( P_3 \) we find that in each case \( c_3 = n_3 = c_2 = n_1 = 0 \), and therefore:

\[
S_1 = -128 \times 0 - 63 \times 0 + 31 \times 0.15 \times 0 + 7 \times 0 + 0.15 \times 0 + 7 \times 3 - 28
\]

\[
S_2 = -128 \times 0 - 63 \times 0 + 31 \times 0.15 \times 0 + 7 \times 3 - 21
\]

\[
S_3 = -128 \times 0 - 63 \times 0 + 31 \times 0.15 \times 0 + 7 \times 2 - 14
\]

and \( S_1 \) is the most desirable of these scores so the program would make the move \( m_1 \) to reach position \( P_1 \) (i.e. it would play in the centre).

The 2-ply search

The 1-ply search is the simplest form of tree search in a two-person game, but it does not take into account the fact that once the program has made its move there is an opponent waiting to reply. It may be the case that a move which, superficially, looks strong, is seen to be an error when we look a little bit further into what may happen. The 2-ply search will "see" more than the 1-ply search and so moves made on the basis of a 2-ply search will be more accurate (provided that the evaluation function is not a disaster area). How can we take into account this extra dimension of the opponent's move?

Let us look at the same tree, grown one ply deeper, i.e. to a total depth of two ply — one move by the program and one move by its opponent. If "cross" plays in the centre, "nought" has two essentially different replies, in a corner or on the middle of an edge (represented by positions \( P_{11} \) and \( P_{12} \) respectively). If "cross" makes his first move in a corner (\( P_{12} \), "nought" will have five different reply moves (\( m_{21}, m_{22}, m_{23}, m_{24}, m_{25} \)) leading to positions \( P_{21}, P_{22}, P_{23}, P_{24}, P_{25} \). After "cross" plays move \( m_3 \), "nought" again has five replies. It is easy to see how the tree grows. In last month's example, the 8-puzzle, the
branching factor (number of branches from each position on the tree) was never more than three. Here it is more, even allowing for symmetry.

Let us consider how the program might analyze the situation. It uses its evaluation function to assign scores to the terminal nodes P11 and P12. In each case c3 = c2 = c1 = 0. In position P11, c1 = 3 and n1 = 2. In position P12, c1 = 1 and n1 = 1.

We now have:

\[
\begin{align*}
S_{11} &= -(15 \times 2) + (7 \times 3) = -31 \\
S_{12} &= -(15 \times 1) + (7 \times 3) = -9
\end{align*}
\]

This information indicates that if the program is sitting in position P11, with its opponent to move, its opponent may choose between moves m11 (leading to position P11, of value -9) and m21 (leading to position P12, of value -31). The program's opponent wants to minimize the score and so it would choose move m11, for a score of -9, and so the real value of position P11, represented by S11, is this backed-up score of -31.

If we apply the evaluation function to positions P21, . . . , P25 we get:

\[
\begin{align*}
S_{21} &= -(15 \times 3) + (7 \times 2) = -31 \\
S_{22} &= -(15 \times 2) + (7 \times 2) = -16 \\
S_{23} &= -(15 \times 2) + (7 \times 2) = -16 \\
S_{24} &= -(15 \times 1) + (7 \times 2) = -9 \\
S_{25} &= -(15 \times 2) + (7 \times 3) = -9
\end{align*}
\]

We must now minimize the score when making its move from P11, the program's opponent would choose move m21, leading to position P12 and a score of -31.

Similarly, when applying the evaluation function to positions P31, . . . , P35, we get:

\[
\begin{align*}
S_{31} &= -38 \\
S_{32} &= -8 \\
S_{33} &= -31 \\
S_{34} &= -16 \\
S_{35} &= -23
\end{align*}
\]

so the program's opponent, when making its move from P3, would choose move m31, for a score of -38.

We now have the following situation. If the program makes move m1, its opponent, with best play, can achieve a score of -9. If the program plays m2 then its opponent can achieve a score of -9. If the program plays m3 then its opponent can score -38.

Just as the program's opponent wishes to minimize the score, so the program wishes to maximize the score. The program must now choose between m1, (for -9), m2 (for -31) and m3 (for -38). Since the maximum of these three values is -9, the program will play move m1, and the backed-up score at the root of the tree will be -9. This represents the score that will be achieved with best play from both sides.

This procedure of choosing the maximum of the minimums . . . etc. is known, not surprisingly, as the minimax method of tree searching. It is an algorithm that finds the move which will best, and assuming correct play for both sides, provided that the evaluation function is reasonably accurate.

**Memory requirements for a minimax search**

One of the great advantages of the minimax type of search is that it is not necessary to retain the whole tree in memory. In fact it is necessary to keep only one position at each level of look ahead, together with a certain amount of information of the moves from each of these positions. Let us see how this works for our 2-ply tree.

From the initial position P0, the program generates the first move for cross, to position P1. Before proceeding to the other moves that cross can make, the program generates the first reply move by nought, m11, reaches position P11, and assigns it the score S11 (-9). This is the first terminal node to be evaluated, so the score of -9 represents the best score found so far and this is the score that is assigned to S1. Since P1 is the first move at 1-ply to be examined, this score of -9 also represents the best score found so far at the 1-level, and this is the score assigned to P0.

The program now looks at P12, which we sometimes refer to as the brother of P11, and P1 is father to both of them. The program determines the score S12, compares this value (6) with the best score found so far at this level (-9) and finds the -9 preferable, so the scores S1 and S0 need not be adjusted at this stage. The program next looks for a brother to P11, but finding none it goes back up the tree and looks for a brother to P1, which leads it to position P2 and then to P12. On the way down this part of the tree the program assigns to P1 a score of -9, since this is the best that can be achieved so far. When looking at P2, the program finds a score of -31, which is better for the program's opponent than -9 and so S2 is now set to -31.

Note that as this process continues, the brother nodes that have been examined in the past no longer serve any useful purpose and so they can be discarded. At the present point in our search we no longer need the brother of P3 that has already been examined (P13), so P9 and its successor nodes are not kept in the tree at this time. The tree, at this moment, comprises only P0, P1 and P2.

Having evaluated P11, we throw it away and look at P21, which has a score of -16. The program's opponent would not prefer this to the -31 already discovered, and so no change is made to S1. The program discards P21 and replaces it with P23 for a score of -16, also of no value to the program's opponent, and this is replaced in turn with P24 and P25 which also produce no change in S1.

Since S1 (-31) is less attractive for the program than the best score found so far (-9 at S0), the score at P1 is not backed-up. P2 itself is discarded to make way for P3, and the same process continues, with the program looking in turn at the scores of P31 . . . P35.

**Task for the month**

The evaluation function for noughts and crosses which we have been using in this example has five features. Try to devise evaluation functions with as few features as possible, for playing noughts and crosses with (a) a 2-ply search; and (b) a 3-ply search, and test your functions by writing a program to play the game using a minimax search. The fact that deeper search will sometimes compensate for a less powerful evaluation function may make it possible for you to reduce the number of features while still writing a program that can play perfectly. If you complete this task, or even if you do not, you might like to think of a way to make the search much faster. This will be the subject of next month's article.
**Master pack**

I have now received a production sample of the Master Pack set of programs for the Casio 501/502P briefly mentioned in an earlier Corner.

The Pack consists of a 54 page bound User Manual and a cassette; it sells at a recommended price of £17.95. The programs on the cassette consist of 15 originals, followed by the 120 odd Casio Program Library programs in the order printed. Incidentally it has come to my notice that a few early samples of the cassette were supplied with an inferior, earlier edition, program library which contains fewer programs and in a different order (which would make its use with the Master Pack very difficult indeed). The way to tell if you have this edition is that the first program is titled Mathematics I. In the later, superior, edition the first program is Mathematics I.

The Master Pack programs are identified only by spoken introduction (all have the same file no. 100) and the order in which they appear in the User Manual/Program Library. Users with a recorder which has a tape counter could make up their own counter reading index, but in any case it’s recommended that frequently used programs be transcribed to a working cassette and the Pack kept as a master copy, to avoid damage.

The User Manual contains sections on basic and advanced programming which, though shorter than the Casio Manual, are more clearly and logically written, and will not insult the intelligence of anyone who has a minimal familiarity with programming. They do not include a key-by-key guide to the calculator so the absolute novice would best use them in conjunction with the Casio Manual.

The advanced section covers loops, labels and subroutines well, and goes into indirect operations in far more depth than the manufacturer’s manual. It concludes with some original programming techniques for entering extra labels and program titles, data scrolling and prompts and display formatting which will be useful to “intermediate” standard users.

The manual also contains full documentation for the 15 original programs, and concludes with a key-code index and an explanation of telephone transmission of programs using a dictaphone type telephone pick up.

The 15 original programs included 7 are games such as Lunar Landder, Bomber Pilot and Number Palience. They are all well thought out and make maximum use of the Casio’s superior display capabilities. Of the rest, 7 are “utility” programs such as Reaction Timer, Price Comparator, Diet Calculator, and there’s Electronic Scoreboard which replaces chips or money in card and board games such as Monopoly. The final program is the most interesting. It’s a set of subroutines for data processing which means creating a virtual array of addressable memories with less than 12 digit capacity. For instance the 502 can be given the equivalent of 200 independently addressable single digit memories, or 100 two-digit memories. The data packing routines may be used manually or incorporated into user’s programs. An obvious application is in statistical analysis of certain types and the routines are written so as to leave the statistics registers (MT, 8 and 9) free for this purpose. The source code was designed to provide a 10 x 10 playing field which may be viewed by scrolling it line-by-line up the display. To this end a further routine is incorporated which generates a key-pad compass cursor to “seeer” a target digit through the background field of view.

All things considered it’s a useful package, not so much for the hobbyist who will probably write his own material, but for the professional user who needs frequent recourse to the Program Library material. It’s rather a pity Casio didn’t supply such a package themselves.

The pack should now be available in shops or from:

Premier Publications, 12 Kingscote Road, Addiscombe, Croydon, Surrey.

**Broadwater economics simulations**

These 5 programs (with 6 more to follow in the Spring of 1980) are designed as a teaching aid for A-level economics students and are the work of Graham Addis, an economics teacher.

The programs are written for Texas TI 58/59, Casio 501/502P and in BASIC, all three listings being supplied with teachers and students notes and an explanation of the economics used, in booklet form. They may also be obtained on cassette or magnetic card.

Intended for use by a group of students, they demonstrate the dynamic behaviour of various Keynesian economic parameters (such as for instance the investment multiplier), without the need for the tedious arithmetical calculations which often can be an obstacle to the understanding of complex systems.

However, three of the programs — Fisgam, Poligam and Macropol are simulations of the operation (massively simplified of course) of a whole economy, and as such are fascinating, even to the economic illiterate such as myself.

I found Macropol in particular quite engrossing. This simulates an island economy with no foreign trade. You are placed in the position of Chancellor of the Exchequer and by manipulating public expenditure and direct taxation, you attempt to control the economy, year by year. At each year end, you see the results of your “policies” on unemployment, inflation, investment, growth, capacity, consumption, budget deficit, income and stock disinvestment; then you try to do better next year! Although the model used reduces the economic relationships to a mere 9 equations, it nevertheless has sufficient realism to exhibit the sorts of economic fluctuation of which newspaper headlines have been made for the last 10 years. Although our present Monetarist Mentors would disagree, it seems likely that the sort of Keynesian theory illustrated by Macropol is still provides the best description available of the workings of the modern industrial economy; certainly since 1945 it has significantly shaped the Institutions of the economic world in which we live.

Playing with Macropol for a few hours certainly gave me a small insight into the frighteningly sensitive and unstable nature of the feedback systems which operate in the economy, and perhaps even gave me a little more sympathy for those much maligned line of administrators whose task is to tinker with it.

I’m sure that a very enlightening and demanding game could be contrived using Macropol where various players represent different "parties" and take turns to have five years in power, being judged by the "electorate" on their performance.

The 6 programs to be added later will all deal with the theory of the individual firm, with pricing, profitability and competition. These programs are well presented, very reasonably priced at £1.50 each and will, I’m certain, be well received in the educational quarters and by all, economics students and educators alike.

4 Hill Barn Lane, Worthing, W. Sussex.

2 PCW
14th May, 1979 Letter to the Post Office.

Perhaps I could remind you that we are suggesting that users of personal computers be allowed to transmit over the public telephone network without type approval if the following conditions are met:

1 That only acoustic couplers should be used.
2 That the acoustic coupler employed should be fully type approved by the Post Office.
3 That any personal computer owner employing acoustic couplers as a means of transmitting data on the public network should register such use with their local telephone manager.

We look forward to hearing from you.

8th June 1979 Reply received from the Post Office.

My comments on your letter of the 14th October, acoustically coupled modems could be required at both ends of a data transmission line and as such there are no policy objections provided that both modems are used itinerantly. I would hope, however, that users were aware that broadband modems are sensitive to background noise and therefore, if used at both ends of the link, will suffer additional transmission degradation. Consequently, I must emphasise that the Post Office could in no way be held responsible for the correct transmission and receipt of data using such a system. Post Office responsibility is to ensure that speech communication is satisfactory.

2(a) As regards the question of voltages bridging the insulating gap I think that you and your advisers would agree, on reflection, that the degree of risk would depend upon the size of the voltage and insulating gap concerned. However, I am advised that in the field of personal computing the danger to the network from high voltages is remote and we are therefore, willing to withdraw for the time being the restrictions proposed in paragraph 2(a) of my letter of 11 January.

2(b) The particular interference problem mentioned in my letter is that of converter-type (also known as 'switching') power supplies which can produce interfering frequencies of 20 KHz or more. However, this is only one aspect of the interference problem which can be produced by an undefined attachment to the acoustic coupler. I agree that the problem may not be caused by the coupler and I am therefore not insisting that this be solved by the coupler. However, if the coupler is unable to prevent the transmission to line of frequencies outside the limits laid down in Technical Guide No 32 it will be necessary for the terminals to be used with the coupler to be evaluated in conjunction with the coupler. This interference problem can, of course, as you point out, occur with electrically connected modems and I am becoming increasingly concerned with this aspect. However, the resources which we have at our disposal are limited and I have to seek, as far as is practicable, that at the moment these resources can best be used by dealing with the more pressing problem, i.e. acoustic couplers. By their very nature acoustic couplers are portability and therefore, in an itinerant situation could cause interference on the PSTN which would be extremely difficult to trace.

3 If the acoustically coupled modem stands separately from the personal computer system and the interference problem can be overcome by incorporation of a suitable filter in the modem I can confirm that it will not be necessary for the computer system to undergo an evaluation. However, if the acoustic coupler does not protect the network adequately (paragraph 2(b) of my letter of 11 January refers) or the computer system has an integral modem, an evaluation of the terminal and the modem will be necessary. We will naturally have to react to any increase in the number of applications arising from clarification of this aspect of our policy. The level of evaluation fees raised will be commensurate with the resources employed by the Post Office and this should encourage developers and constructors to produce equipment which is likely to be readily acceptable to the Post Office, thereby minimising our charges.

4 In conclusion, I should like to add that the Post Office in no way wishes to inhibit developments in the area of personal computing and I agree that this is a potential source of revenue to the Post Office. However, my responsibility is to ensure as far as is reasonably possible, that any private attachments to PO services will not adversely affect other users of PO services and this responsibility can only be discharged by our evaluation of private equipment. It may be that the development of an acoustic coupler which contained suitable filtering would be a reasonable solution to the particular problems which you have raised but I must leave this to the technicians to consider.

I am sorry for the delay in replying to you.

26th June 1979 Letter to the Post Office.

Many thanks for your letter of the 8th June. I am delighted to see that we are converging paths as far as this matter is concerned. However, one technical point seems to be outstanding. It is my understanding (and that of my technical advisers) that the 20 KHz interference caused by switching power supplies is a radio transmission. This is picked up by the exchange line acting as an antenna and is therefore, detectable by your engineers' oscilloscope.

However, it is difficult to see how such a signal could be transmitted across the telephone network which has a nominal bandwidth of only 300-3400 Hz. All frequencies above 3400 Hz are filtered out by Post Office equipment; there is no way in which filters in any type of modem (acoustically coupled or otherwise) could eliminate such a radio transmission. A faraday cage would be necessary around the DTE might. But if the 200 KHz cannot get beyond the exchange line, why is there a problem? I note with pleasure that you are prepared to waive type approval of personal computers working through acoustic couplers (subject to the resolution of the above problem). Now we seem to have most of the technical problems resolved, could you please clarify the regulatory aspects of usage? For example:

1 Will registration with local Telephone Managers be necessary?
2 Will any restrictions apply to the type of date which may be transmitted?

Please appreciate that I am not looking for trouble! However, I think it would be in everybody's interest if you could provide some form of statement which I could publish through my Personal Computer World 'On The Line' column. This could help to avoid misunderstandings at a later stage. I look forward to hearing from you again.

2nd July 1979 Received acknowledgement of my letter.

10th September, 1979 Letter to the Post Office requesting a reply.

11th September, 1979 Letter to the Post Office.

22nd October, 1979 Letter from the Post Office.

"Thank you for your further letter of 26th June concerning the outstanding points with regard to personal computer communications via the Public Switched
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Telephone Network (PSTN). I am sorry for the delay in replying.

You raised the question of interference and in particular interference at frequencies above 3400 Hz. Although the nominal frequency band generally offered over the PSTN is between 300 and 3400 Hz the Post Office network (including customer's local lines) is in fact capable of carrying much higher frequencies (which are incidentally not normally filtered out by PO exchange equipment as stated in your letter). This capability is, for example, utilized by the Post Office in the use of fdm carrier systems in the PO High Frequency (HF) network and in certain local network services. Consequently Technical Guide No 32 lays down frequency spectrum requirements not only for signals up to 3400 Hz (Diagram 3) but also above 3400 Hz (Diagram 4). The spectral rolloff characteristics of Diagram 4 are in particular designed to:
1. Avoid interference with the PO HF network (by minimising crosstalk at higher frequencies, preventing over spill into adjacent fdm channels).
2. Avoid interference with services which exploit the HF capabilities of the local network.
3. Prevent 'beat' signals produced by attachment signal harmonies and the 8KHz sampling frequency of wide - spread PCM systems.

In view of this explanation I hope you will accept that signals above 3400 Hz from attachments could cause network problems and interference to other users of PO services. It follows that the evaluation of the personal computer systems connected behind acoustically coupled modems will be necessary unless the modem involved incorporates suitable filtering.

With regard to the actual use of personal computers via acoustically coupled modems over the PSTN I confirm that it will be necessary for Post Office subscribers to first obtain the written consent of their local Telephone Area (Sales) Office.

As mentioned in my letter of 11 January the general conditions under which telephone service is provided and private attachments may be used are as laid down in the Post Office Telecommunication Scheme 1976 (and amendments). From the outline description of the system which you have supplied I do not envisage that any additional restrictions (other than the technical ones referred to above) will be required subject to the running of the systems falling within the ambit of the General Licence for Private Attachments to Post Office Telecommunication Installations which was published in the London Gazette on 1 July 1977.

I hope that this letter clarifies the outstanding issues and will enable you to offer the appropriate advice to personal computer users. The interference problem remains to be resolved of course, and I must leave you to consider how best to approach its resolution.

So that is where it presently stands. In case you got lost the current arrangement is as follows:
1. You can transmit data over the public telephone network using an approved acoustic coupler.
2. Your computer system does not need to receive Post Office type approval for this.
3. The only exception to points 1 and 2 above are those micro computers which employ switching board supplies. (I hope someone at Microsens is reading this).
4. You need to write to your local Telephone Area (Sales) Office to get their go-ahead first.

The only issue outstanding is that of the switching board supply. The Post Office clearly does not understand that this is caused by an electro-magnetic emanation from the board supply concerned and has nothing whatsoever to do with acoustic couplers. Indeed, the same problem will occur when using Post Office modems. Again the problem will occur if you are playing Star Trek on your Apple near a telephone line even if you have no communications equipment involved. I will pursue this matter further with the Post Office to try to get it resolved.

I now propose to try and persuade the Post Office to let us communicate through hardwired modems with the use of a barrier kit for safety reasons.

I will keep you posted (sic) on developments.

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Coming soon – Part 2 – which will include all remaining editions in the 2nd Volume. From then on we shall be publishing a list, cumulative issue by issue, for our current 3rd Volume. Please Note: The following issues of PCW have completely sold out: Volume 1 Nos.4, 5, 9 & 12.

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FORGING LINKS WITH THE OUTSIDE WORLD

The advent of the microprocessor and the relatively cheap personal computer has been accompanied by frenzied activity in many quarters to apply them in the obvious business and commercial fields — after all, most micros have to earn their living. Marketing of both software and hardware has been concentrated on the office environment. be it the accountant, the solicitor or the small business of any kind. Less well served have been the fields of industrial and laboratory instrumentation and control. Keen to correct this uneven investment of effort, Alan Mills and K.T. Kibase of 3D Digital Design and Development examine the design and “connective abilities” of the IEEE 488 bus.

A peep inside a 16-channel analogue to digital converter — typically used to handle signals from devices such as thermometers, pH meters and pressure transducers.

Understandably, any imbalance of microcomputer research stems largely from a lack of knowledge and experience on the part of both sellers and buyers. Now, however, the possibilities inherent in the combination of cheap computing power plus transducers, actuators, detectors, and instruments of various types is becoming all too apparent to many potential users. The great stumbling block, of course, is the interface. One can buy a computer in the region of £500, which is cheap enough for it to be installed as a dedicated controller, even if only for periods at a time; but how do you connect it up to the other devices? The need for a standard interface has long been recognised, but international standards have lengthy gestation periods and take even longer to achieve general acceptance.

The one standard interface that is approaching respectable maturity is designated the IEEE-488 (1978). This is the bus that merits study by all computer users intent on extending beyond the processor-discs-printer triangle.

WHAT IS IT?

The bus consists of a set of 16 parallel wires (plus ground wires) along which signals are passed between devices that may be simultaneously connected. Eight lines are used for bit-parallel byte serial data transfers. Three lines are used to ensure orderly transfer of data by “handshaking” (i.e. signals going back and forth to synchronize transmission and reception — two-wire handshaking is the common rule, but with more than two devices connected together three wires become necessary). The remaining five lines are used for bus management functions.

Devices that can be connected to the bus are described either as “Talkers” (if they put information out onto the bus), “Listeners” (if they receive information from the bus), or “Controllers” (if in addition to talking and/or listening, they take charge of the bus management functions). Only one Controller may be active on the bus at any one time, although it is possible to have a bus without a Controller e.g. a Talker connected to two Listeners.

Also, to avoid confusion, only one Talker may be active on the bus at any one time, although it may be talking to more than one Listener.

As many as sixteen devices plus a Controller may be simultaneously connected in star, ring, or linear configurations. Each device has an address number (0 thru’ 15) assigned to it.

A critical point to appreciate is that, generally speaking, Talkers only talk when the Controller has previously told them they may talk, and similarly Listeners only listen on previous instruction from the Controller.

The Controller can also de-activate devices on the bus by issuing UNLISTEN and UNTALK commands, known as...
universal commands.

Examples of Talkers include paper-tape readers, analog-to-digital converters and keyboards. Paper-tape punches, X-Y plotters, digital-to-analog converters, stepper motors, and display devices are Listeners. Combined Talker/Listeners could be disc drives, tape cassette units, data loggers, and VDUs; at any instant they either talk, listen, or are de-activated.

The best example of a Controller is the CBM PET which can talk, listen and manage the bus. In many applications the decisions about which device is to talk, which device(s) is (are) to listen, are made entirely by the Controller, so that, for example, the sequence of data transactions may be completely determined by the statements within a BASIC program running in a PET.

**INTERRUPT FACILITIES**

The bus is designed to permit a form of INTERRUPT capability, in that a device may signal a SERVICE REQUEST (SRQ) by putting a logic level on the wire reserved for that purpose. On noticing that service has been requested the Controller must bring the present bus transaction to an orderly close, and then proceed to find out which device has interrupted. The protocol permits two ways of doing this, either by "Parallel Polling" (i.e. asking them all at once) or "Serial Polling" (asking for them each in turn).

Unfortunately, the CBM PET does not implement these latter features, or some of the other more sophisticated facilities of the bus protocol. It economises in other ways, too, departing in a number of minor instances from the recommended IEEE-488 standard (e.g. connector style). It should, in fairness, be noted that polling could be implemented in 6502 machine code, but this is only recommended to those who make a habit of treading boldly.

The PET, however, does have the tremendous advantage of addressing over the bus in BASIC, so that simple BASIC functions like PRINT and GET may be used in programs to put data out to or bring it in from external devices.

The IEEE-488 bus uses a 16-line cable to quickly link up any instruments equipped with appropriate interface circuitry into a system. Data transfer is byte-serial, bit-parallel at rates as high as 1 megabit per second.

In fact, the internal architecture of the PET is such that its keyboard, two cassette ports, and screen, are treated as IEEE-488 devices with the first four device address numbers, 0 to 3, assigned accordingly. By logical extension, the Commodore discs and printer also use the IEEE-488 interface.

**AREAS OF APPLICATION**

With more people appreciating the usefulness of the IEEE-488 bus in the industrial and laboratory environments, the PET is becoming very popular with scientists and engineers as a machine that can be brought into contact with the outside world.

The drawback until recently has been that IEEE-488 instruments have tended to be fairly expensive, sometimes many times the price of a PET. Now, however, firms like 3D Digital Design & Development are making available a number of peripheral devices designed specifically for use with the PET form of the IEEE-488 bus, even down to using the same style of connection.

Analog voltage or current signals from whatever source may be sensed or monitored using a 16-channel analog-to-digital converter unit. By simply connecting the voltage into a front panel socket of the unit, and connecting the unit to the PET with the double-ended bus cable, the voltage may be monitored by executing the following simple program:

```
10 OPEN 1, 8, 6
20 GET #1, A$
30 PRINT ASC (A$)
40 GO TO 20
```

Since the converter is of 8-bit resolution the value printed to the screen will be between 0 and 256. The input amplifiers are usually set to, say, 5 volts in which case the conversion of the value back to a voltage is a simple matter of multiplying by the appropriate scaling factor (0.0625). In the OPEN statement above, the device address (8) and channel number (6) are assigned to logical file no. 1.

An 8-channel 8-bit resolution digital-to-analog converter unit allows analog voltages to be generated under program control by equally simple program statements, except that values are PRINTed out to the converter unit. Each of the output channels has its own digital latch and digital-to-analog converter, so that a voltage sent to a channel stays there until changed from the PET.

Another interesting and useful device is a 16-channel relay closure unit containing 16 reed relays. The relay contacts are brought to front panel sockets with LED indicators to show the state of each relay. The relays may be set on or off in any desired sequence under program control by simple BASIC statements.

There is also a versatile digital data acquisition interface used for connecting up digital instruments which, although without an IEEE-488 interface, nevertheless provides digital output signals (as if often the case), such as digital voltmeters, frequency counters, transient recorders. This interface may also be used to monitor as many as 64 simple contact closures or logic levels.

Any combination of these units can be simultaneously connected on the IEEE-488 bus, so that an enormous range of possible systems can be built up to monitor, indicate, measure, and control.

By introducing such a system into a small manufacturing plant, various levels of process automation can be achieved in a cheap and relatively painless way. Temperatures may be measured, indicator lamps switched on, heaters turned up, motors started, valves closed, shaft rotations counted — the possibilities are virtually limitless. The automation of testing, or of laboratory experiments, can be achieved with a minimum of time and effort if IEEE-488 compatible devices are chosen, and the PET is used as a controlling computer.

Indeed, the IEEE-488 is such a boon to the black art of interfacing that it will almost certainly be adopted by some future computers. Already the new Powerhouse II is available with the IEEE-488 interface.

The second half of this article, to appear soon, will take a look at actual case studies where the PET and IEEE-488 peripherals have been installed into working situations.
Computer programmers, the languages they program in and sometimes even the computers on which these programs run tend to be biased either towards number-crunching (immense calculations) or data-processing (huge quantities of information). This chapter is intended to provide an introduction to PASCAL's approach to the second of these.

Computers have traditionally been employed in the fields of scientific research and business data-processing. The different requirements of these two types of user have produced opposing specialisms amongst computer professionals — conflicting designs and configurations of both hardware and software, and most importantly from our point of view, programming languages with differing facilities and capabilities. Scientific languages tend to standardize on specialized and sophisticated mathematical functions and to leave non-standard and bulk-data handling features which are consequently provided (with greater or lesser degrees of effectiveness) by the individual implementors of the language. This reflects perfectly reasonably the general format of a mathematical problem where complex operations need to be performed on a relatively restricted amount of data.

Commercial languages, however, often don't provide sophisticated or even convenient mathematical functions since their processing tends to consist of more routine operations but with much larger quantities of data. This is not to suggest that a good sorting algorithm is not every bit as complex as, say, a Fourier transform module, but while the latter operates on the supplied data to produce completely different data, the former works with data, reordering it but not actually changing any values. In any case, in a typical data-processing problem, the quantity of supplied data is generally so large that no more than a small fraction can fit into the machine at one time — the organizational problems associated with containing this data in machine-readable form and of making it available to the program in a controlled and ordered manner dominate these commercial languages.

While the data is being manipulated within the machine it is grouped together in structures called records. Loosely, a record is a number of data items, usually of different types, which need not be methodically structured in some way, probably because they all pertain to a single entity. A second record would contain the corresponding information, in the same format, pertaining to another entity, and so on. An entry in a telephone directory, i.e. Name, Address... Telephone No. is a simple example of a record.

A file is a data structure external to the program and consists of a collection of records. The characteristics of any particular file will depend not only on the size and number of the records it is to contain, but also on the medium on which the file is being stored. Magnetic tape files are called sequential files because records are stored in sequence and can only be accessed as such — i.e. start at the beginning and deal with each record in turn. Clearly, quite a bit of complicated programming has to be done at system level to control the tape drive and the motion of data through the read/write tape heads. This software can usually be initiated by fairly simple calls embedded in the programming language. Wirth's standard PASCAL provides a set of these sequential file-handling facilities.

PASCAL, however, was designed when discs were considered as a sort of extension of the memory in large computer systems and were too expensive and bulky to be a suitable medium of data file storage. The advent of small hard disc packs and reliable diskettes has put this medium within reach of smaller system users making it reasona--
ables to discuss direct-access files. As with the mag. tape drive, special system software is required to direct the read/write heads to the correct track and sector on the disc and to control the flow of data to and from this location. However, all the data is spread over the surface of the disc and is consequently not directly accessible directly—hence the name.

Although this software is utilized at operating system level (in the form of file-handling and/or editing utilities), high-level language calls are seldom available to the programmer so that most disc data-files tend to be sequential. UCSD PASCAL is an exception to this general rule and we feel that direct-access facilities are sufficiently important to be incorporated in any future standard PASCAL. It is with a small degree of reluctance therefore that we abandon Wirth PASCAL in Section 4 to describe the UCSD file-handling facilities.

Records

The record was defined in the previous section as a grouping of associated data items. These data items are known as the fields of the record. There is no restriction on the type which each field may be so that the structure is distinct from the array where all elements must be of the same type. In addition, fields are not directly accessible via computable indices like array elements, but must be referenced by a fixed field identifier.

The record is declared in a TYPE statement which is stipulated both the field identifiers and their corresponding types. The syntax diagram of Box 1 shows the reserved words required for this declaration, together with the format for the field list. Note that a field within a record could be another record, or even an array.

As an example of the uses of records in a program, look at program FILESTILL in Box 2. This represents a cash register for a small shop which sells printers and stationery for microcomputers. A tally is kept of every sale so that, in addition to producing a slip for the customer, a daily summary can be output at closing time. The record type STOCK is declared in lines 2 to 8 with the field list laid out in lines 3 to 7. The field NAME is declared as a PACKED ARRAY. Packing is a device whereby elements of a particular data type are packed into the smallest amount of memory needed—e.g., a bit for a BOOLEAN, a byte for a CHAR etc. Numerical array elements frequently incur too large an overhead to make packing worthwhile but BOOLEANs and CHARs usually repack with substantial space-saving. The PACKED ARRAY OF CHAR is formally defined as a string which we shall be dealing with at some length in the next chapter. In line 10, array ITEM is declared as type STOCK which implies that 5 records will be set aside in memory for this data structure. Each record can be referenced by a different value of the array index. Line 15 and the procedure SET UP provide illustrations of the method by which individual fields within a record are referenced. The record name and the field name, separated by a., must both be supplied, and lines 15 to 19 refer to the same field in different records. Lines 22 and 23 on the other hand refer to different fields in the same record (Section 4).

The instruction in line 24 clears the screen (in UCSD PASCAL).

Lines 25 to 27 reflect today's uncertain commercial climate by offering the user an opportunity to input altered prices and VAT rates.

Procedure HELP reveals the menu-driven nature of the program, since each of the different functions may be selected by inputting a single character at the keyboard. The most important key to remember, especially for an inexperienced teller, is 'H' which executes HELP itself. The two procedures TILLSLIP and SUMMARY show how record fields can be manipulated like ordinary variables although the referencing scheme makes them appear a bit long-winded. This can be avoided by means of the WITH statement whose syntax diagram is given in Box 3. When the record identifier is given in the "variable" box, all identifiers appearing in the "statement" are checked by the compiler against the field names pertaining to that record as well as the normal identifiers that appear in that procedure. The record name is thus taken as a default for the duration of the statement. This is illustrated in the new version of SUMMARY appearing in Box 4, lines 10 to 15.
Exercise: Re-write FIRSTILL using WITH statements where appropriate.

Files

One of the essential characteristics of a file is that it is external to the program as a whole. Only a small portion of the data is accessible to the program at any one time and although it is possible to have a file of arrays, say, we will assume that a typical file contains records. In this section we are discussing the sequential files of Wirth PASCAL as defined in the introduction so that the file will consist of a sequence of records in strict order. When a file is accessed therefore, the "unit" in which the program must deal with the data is one record.

A file is declared by means of a type statement as shown in the syntax diagram of Box 1. In our case, the "type" referred to in the declaration will be a record which will have been declared earlier on in the declaration part. When the compiler encounters the file declaration, apart from noting the file identifier and establishing the correct I/O channel (and peripheral) on which the file is to be found, it creates a structure in memory of exactly the type (i.e. record) previously defined. This structure is known as the file window or buffer variable and is referenced as follows;

file identifier -> or file identifier depending on the character set supported by your terminal.

During execution of the ensuing program, any reference to "file identifier" will involve those memory locations set aside for that structure. It is the job of the programmer, however, to ensure that the contents of these locations are in fact the fields of the record under consideration. For this purpose there are a number of file-handling operators available. These enable the programmer to manipulate the peripheral on which the file is stored and so access the data needed.

The file-handling operators are

**RESET (filename) —** starts at the beginning of the file and puts the first record into the buffer variable. This is used when reading data out of a file.

**REWITE (filename) —** starts at the beginning of a new file or out-of-date file for the purpose of writing to the file. Nothing is actually written on the file at this stage, however.

**GET (filename) —** advances the file window by one record and assigns the data contained therein to the buffer variable.

**PUT (filename) —** writes contents of buffer variable out to file — i.e. creates a new record at the end of the file.

In addition to the file window, another file control element is maintained in the machine while file operations occur. This is a BOOLEAN variable called EOF (for end-of-file) which is FALSE as long as there are unaccessed records still in the file and becomes TRUE when the last record is reached. When a RESET is executed, EOF is made FALSE unless no file can be found. When a REWRITE is executed EOF is made TRUE. A GET on a file won't work unless EOF is FALSE beforehand and a PUT won't work unless EOF is TRUE before-

**Normal** Reference

```plaintext
record identifier   field identifier

with Statement

variable DO statement
```

**Field Referencing**

1. PROCEDURE SUMMARY (*); 2. CONST TAB = 'ATQ'; 3. VAR TOTAL, TAX: REAL; 4. BEGIN 5. TOTAL := 0.; 6. TAB := 0.; 7. WRITELN ('NAME', TAB, QUANTITY, TAB, QUANTITY.PRICE); 8. WRITELN ('SUBTOTAL ='); 9. WRITELN ('TOTAL = TOTAL + TAX'); 10. END (*SUMMARY*)
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<tbody>
<tr>
<td>Sales Invoicing / Credit Controls</td>
<td>15,750</td>
<td>356.90</td>
</tr>
<tr>
<td>Payroll on Equinox 300, with 10 Megabyte Disk, visual display unit and printer.</td>
<td></td>
<td></td>
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<td>Purchase Accounts, Sales Accounts, Payroll on Cromemco System III with workstation, visual display unit and 180 c.p.s. printer.</td>
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WHILE (NUM > 0) AND (NUM < TOTALNUM) DO
38  WITH ITEM NUM DO
39  BEGIN
40       WRITENVNAME, 'PRICE' := PRICE)
41       TOTALQUALITY := TOTALQUALITY + 1
42       WRITE ('TASSUMITY') := QUANTITYSold + QUANTITYSold + 1
43       TOTAL := TOTAL + PRICE
44       TAX := TAX + 0.01*VAT + PRICE
45       READLN (NUM)
46       END (*WRITE*)
47  END (*TILLATEGY*)
48  END (*TILL*
49  PROCEDURE DAYSTILL;
50  BEGIN
51    WRITE ('NEW NAME -->')
52    WRITE ('NEW VAT RATE -->', ITEMENUM.VAT)
53    WRITE ('NEW REORDERING LEVEL --:', ITEMENUM.PRICE)
54    WRITE ('NEW ORDERING LEVEL -->', ITEMENUM.REORDER)
55    WRITE ('NEW PRICE -->', ITEMENUM.TOTAL)
56    END (*CHANGE*)
57  END (*TILL*
58  PROCEDURE TOTCHANGE;
59  BEGIN
60    WRITE ('NEW STOE MARK -->', ITEMENUM.TOTAL + TAX)
61    TOTAL := TOTAL + TAX
62    READLN ('NO CHANGES MADE.')
63    CONT
64  END (*CHANGE*)
65  END (*TILL*)
66  PROCEDURE NAMECHANGE;
67  BEGIN
68    WRITE ('NEW NAME -->', ITEMENUM.NAME)
69    WRITE ('NEW VAT RATE -->', ITEMENUM.VAT)
70    WRITE ('NEW REORDERING LEVEL -->', ITEMENUM.REORDER)
71    WRITE ('NEW PRICE -->', ITEMENUM.TOTAL)
72    END (*CHANGE*)
73  END (*TILL*)
74  PROCEDURE ORDERCHANGE;
75  BEGIN
76    WRITE ('NEW REORDERING LEVEL -->', ITEMENUM.REORDER)
77    WRITE ('NEW ORDERING LEVEL -->', ITEMENUM.REORDER)
78    END (*ORDERCHANGE*)
79  END (*TILL*)
80  PROCEDURE PRICECHANGE;
81  BEGIN
82    WRITE ('NEW STOE MARK -->', ITEMENUM.TOTAL + TAX)
83    TOTAL := TOTAL + TAX
84    READLN ('NO CHANGES MADE.')
85    CONT
86  END (*ORDERCHANGE*)
87  END (*TILL*)
88  PROCEDURE NAMECHANGE;
89  BEGIN
90    WRITE ('NEW NAME -->', ITEMENUM.NAME)
91    WRITE ('NEW VAT RATE -->', ITEMENUM.VAT)
92    WRITE ('NEW REORDERING LEVEL -->', ITEMENUM.REORDER)
93    WRITE ('NEW PRICE -->', ITEMENUM.TOTAL)
94    END (*CHANGE*)
95  END (*TILL*)
96  PROCEDURE NOCHANGE;
97  BEGIN
98    WRITE ('NO CHANGES MADE.')
99    CONT
100   END (*CHANGE*)
101  END (*TILL*)
102  PROCEDURE TOTCHANGE;
103  BEGIN
104    WRITE ('NEW STOE MARK -->', ITEMENUM.TOTAL + TAX)
105    TOTAL := TOTAL + TAX
106    READLN ('NO CHANGES MADE.')
107    CONT
108   END (*ORDERCHANGE*)
109  END (*TILL*)
110  PROCEDURE NAMECHANGE;
111  BEGIN
112    WRITE ('NEW NAME -->', ITEMENUM.NAME)
113    WRITE ('NEW VAT RATE -->', ITEMENUM.VAT)
114    WRITE ('NEW REORDERING LEVEL -->', ITEMENUM.REORDER)
115    WRITE ('NEW PRICE -->', ITEMENUM.TOTAL)
116    END (*CHANGE*)
117  END (*TILL*)
118  PROCEDURE NOCHANGE;
119  BEGIN
120    WRITE ('NO CHANGES MADE.')
121    CONT
122   END (*CHANGE*)
123  END (*TILL*)
124  PROCEDURE AMENDFILE;
125  BEGIN
126    READLN (ITEMENUM.TOTQUANTITY)
127    WRITE ('NEW NAME -->')
128    WRITE ('NEW VAT RATE -->', ITEMENUM.VAT)
129    WRITE ('NEW REORDERING LEVEL -->', ITEMENUM.REORDER)
130    WRITE ('NEW PRICE -->', ITEMENUM.TOTAL)
131    END (*CHANGE*)
132  END (*TILL*)
133  PROCEDURE SETUP (lines 19 through 29): each record is read, READLN
134    WRITELN ('NO CHANGES MADE.')
135    CONT
136  END (*CHANGE*)
137  END (*TILL*)
138  PROCEDURE TOTCHANGE;
139  BEGIN
140    WRITE ('NEW STOE MARK -->', ITEMENUM.TOTAL + TAX)
141    TOTAL := TOTAL + TAX
142    READLN ('NO CHANGES MADE.')
143    CONT
144   END (*ORDERCHANGE*)
145  END (*TILL*)
146  PROCEDURE AMENDFILE (lines 34 through 59) is called. In line 39 the
147    WRITE ('NO CHANGES MADE.')
148    CONT
149   END (*CHANGE*)
150  END (*TILL*)
151  PROCEDURE WRITEFILE (lines 61 through 71): opens the STOCKFILE
152    READLN ('NO CHANGES MADE.')
153    CONT
154   END (*ORDERCHANGE*)
155  END (*TILL*)
156  PROCEDURE TOTCHANGE;
157  BEGIN
158    WRITE ('NEW STOE MARK -->', ITEMENUM.TOTAL + TAX)
159    TOTAL := TOTAL + TAX
160    READLN ('NO CHANGES MADE.')
161    CONT
162   END (*ORDERCHANGE*)
163  END (*TILL*)
164  PROCEDURE SOLLCHANGE;
165  BEGIN
166    WRITE ('NUMBER SOLD -->', ITEMENUM.TOTQUANTITY)
167    WRITE ('NEW NUMBER SOLD -->', ITEMENUM.TOTQUANTITY)
168    READLN (ITEMENUM.TOTQUANTITY)
169    END (*SOLLCHANGE*)
170  END (*TILL*)
171  PROCEDURE ORDERCHANGE;
172  BEGIN
173    WRITE ('NEW REORDERING LEVEL -->', ITEMENUM.REORDER)
174    WRITE ('NEW ORDERING LEVEL -->', ITEMENUM.REORDER)
175    READLN (ITEMENUM.REORDER)
176    END (*ORDERCHANGE*)
177  END (*TILL*)
178  PROCEDURE TOTCHANGE;
179  BEGIN
180    WRITE ('NEW STOE MARK -->', ITEMENUM.TOTQUANTITY)
181    TOTAL := TOTAL + TAX
182    READLN ('NO CHANGES MADE.')
183    END (*CHANGE*)
184  END (*TILL*)
185  PROCEDURE AMENDFILE:
186  BEGIN
187    WRITE ('RECORD NUMBER -->')
188    READLN (NUM)
189    WITH ITEM ENUM DO
190    BEGIN
191      REMENU;
192      READLN (FIELD)
193      IF FIELD > 6 OR FIELD < 0 THEN FIELD := 0;
194      CASE FIELD OF
195        0: NOCHANGE;
196        1: NAMECHANGE;
197        2: PRICECHANGE;
198        3: TOTCHANGE;
199        4: SOLLCHANGE;
200      END;
201    END (*CHANGE*)
202  END (*TILL*)
203  PROCEDURE WRITEFILE (lines 124 through 209) allows the user to alter any of the information in array

hand. This makes it impossible to write a record into the middle of a file.

PROGRAM BIGTILL in Box 5 is an expanded version of FIRSTILL. In
FIRSTILL the data was input at the beginning of each program run. This
may be acceptable for a shop that sells five items, but for one that sells fifty it
would be a tedious and time consuming process. BIGTILL differs from FIRST-
TILL in that the records are held on disk in a file (called RECORDSDATA),
loaded into memory at the start of each day's transactions and copied back at
the end of each day. Throughout the day the records are held in memory in
array ITEM.

In FIRSTILL, PROCEDE SUM-
MARY produced the day's results. In
BIGTILL results are produced weekly by PROCEDURE WEEK (lines 106
through 122). As it's important to know what should be in the till at the end
of each day PROCEDURE DAYSTILL
(lines 98 through 104) is provided.
DAYTOTAL (line 225) and DAYTAX
(line 230) keep tabs of the shop's money and the government's money
respectively.

Upon starting up the execution of the program the user is asked if there is
an old file (line 227). If the answer is yes, PROCEDURE SETUP (lines 19
through 32) opens the file (line 23) and gets the first record. Note that RESET
takes two parameters - the identifier STOCKFILE and the string RECORDS-
DATA (which actually appears in the system directory). The second parame-
ter is required by UCSO PASCAL and is not required in standard PASCAL.
In lines 24 through 29 each record is read, one at a time, from the STOCKFILE
into ITEM. The loop is terminated when the End Of File marker is hit (line 14).
Line 30 contains another reserved word, CLOSE, that is needed only in UCSO
PASCAL. In this version of PASCAL files must be closed before the next
RESET or REWRITE can occur. CLOSE(X) deletes X as well as closing
it while CLOSE(X, LOCK) retains X in the directory.

If the user does not have a file, then PROCEDURE INITIALIZE (lines 64
through 59) is called. In line 39 the STOCKFILE is opened for writing.
(Note that RECORDSDATA is only needed by UCSO PASCAL.) For each
record, the FOR DO loop (lines 40-56) reads each field into a record STOCK-
FILE and then writes this record (line 55) to STOCKFILE. Since this
process does not put the information into ITEM it is necessary to call SET-
UP (line 58) to read the new discfile into memory.

PROCEDURE WRITEFILE (lines 61 through 71): opens the STOCKFILE
for writing (line 64) and then the FOR DO loop (lines 65 through 69)
assigns each element of the array ITEM into the file window STOCKFILE so
that it can be written to the file (line 68). In fact, line 67 (and line 26) shows
one of the major advantages of having a record data structure. Assignment of
one record to another of the same type can be done in a single statement. This
is true even if the fields of the record contain records, sets and arrays.

PROCEDURE AMENDFILE (lines 124 through 209) allows the user to alter
any of the information in array

PCW 85
ITEM. This allows for the correction of mistakes made, as well as for changing the stockfile levels when stock comes into the shop or "walks". In line 208 PROCEDURE WRITEFILE is called to make the changes permanent. It isn't essential to do this, since before exiting from the program for the day, the file is written to disc (line 239); it's a precaution to prevent the loss of data if the system crashes.

Compared with handling ordinary variables, the business of file-accessing is clearly rather awkward in programming terms. In particular, where large files of textual materials are concerned, PASCAL supports a number of specialized features. These will be dealt with in our subsequent chapter on word-processing.

Direct Access File handling

Up to this section all the examples have dealt with sets of data that could be completely held in main memory while processing occurred. With memory prices decreasing generally and the new 16-bit micros with their enormous address spaces coming on the market, many applications will actually be able to keep their data in main memory in this way. However, if one isn't planning to purchase a 28000 with a megabyte of RAM there probably will come a time when the amount of data required is too large for the memory available. In this case files are kept on disc (or tape) and only the record currently being processed will be in memory. As access speeds on disc are very much slower than those of main memory, every effort has to be made to minimize access time.

When data is held in main memory, the data can be updated during each transaction. When the data is held in sequential files, however, such alteration is more complicated. The file must be copied over into a new file, one record at a time. When the record to be altered is reached, it is brought into memory, amended and then written out into the new file. The rest of the file is then transferred as before. Although this technique ensures that the data being accessed is always up-to-date, the delay between transactions would be of the order of minutes for any reasonably sized file. In consequence, sequential files are not usually updated in this way. Instead, a secondary file with the update information is established and all alterations over some period (e.g. a day) are collected. At the end of the period the master file is updated. Unfortunately, as this period drags on, the master file becomes progressively more inaccurate and in some applications (e.g. airline reservation systems) such out-of-date information is completely unacceptable, although in our till program, the name, price and VAT rating of the stock are likely to be constant over longer periods of time.

If PASCAL is to become acceptable as a viable language for data processing, it will have to offer the more convenient direct-access facilities associated with disc-based backing store rather than the current standard tape-based approach. We hope that the standards bodies currently working on PASCAL will take this into account. In the meantime we have taken the liberty of discussing the UCSD implementation of these access methods, which, although non-standard, are widely available on micros.

SEEK is a UCSD reserved word that will search out an individual record from a disc file. SEEK requires two parameters, the first being the file identifier, and the second, an integer representing the record number to which the window must be moved. The first record of a UCSD direct-access file is number 0.

If STOCKFILE in program BIGTILL became so large that the internal array ITEM could not fit into the available memory, several changes would be necessary in the program. Since only one record would be present in memory, the array ITEM would become superfluous. Procedure TILLSLIP is called in BOX 6 is a rewrite of the version in Box 6. Line 10 locates the required record on disc while line 11 reads it into the window STOCKFILE. Line 18 - TAX - TAX + 0.01*VAT: SEEK (STOCKFILE, NUM); line 19 on the other hand is a very common feature in direct-access files. Instead of reading a record into the window, it is written out into the new file. The rest of the file is then transferred as before. Although this technique ensures that the data being accessed is always up-to-date, the delay between transactions would be of the order of minutes for any reasonably sized file. In consequence, sequential files are not usually updated in this way. Instead, a secondary file with the update information is established and all alterations over some period (e.g. a day) are collected. At the end of the period the master file is updated. Unfortunately, as this period drags on, the master file becomes progressively more inaccurate and in some applications (e.g. airline reservation systems) such out-of-date information is completely unacceptable, although in our till program, the name, price and VAT rating of the stock are likely to be constant over longer periods of time.

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SEEK is a UCSD reserved word that will search out an individual record from a disc file. SEEK requires two parameters, the first being the file identifier, and the second, an integer representing the record number to which the window must be moved. The first record of a UCSD direct-access file is number 0.

If STOCKFILE in program BIGTILL became so large that the internal array ITEM could not fit into the available memory, several changes would be necessary in the program. Since only one record would be present in memory, the array ITEM would become superfluous. Procedure TILLSLIP is called in BOX 6 is a rewrite of the version in Box 6. Line 10 locates the required record on disc while line 11 reads it into the window STOCKFILE. Line 18 on the other hand is a very common feature in direct-access files. Instead of reading a record into the window, it is written out into the new file. The rest of the file is then transferred as before. Although this technique ensures that the data being accessed is always up-to-date, the delay between transactions would be of the order of minutes for any reasonably sized file. In consequence, sequential files are not usually updated in this way. Instead, a secondary file with the update information is established and all alterations over some period (e.g. a day) are collected. At the end of the period the master file is updated. Unfortunately, as this period drags on, the master file becomes progressively more inaccurate and in some applications (e.g. airline reservation systems) such out-of-date information is completely unacceptable, although in our till program, the name, price and VAT rating of the stock are likely to be constant over longer periods of time.

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Eine kleine byte musik

One of the first applications of digital program control was the music roll pianolas or "reproducing piano player". That was in the 1920s, long before the first expensive fidelity equipment dealt with computer music in the 1950s and 60s and the more recent micro music explosion. The Byte Book of Computer Music provides an interesting and illuminating survey of the scope and practicability of computer music. Its seventeen articles range from a look at those early reproducing pianos through to an assortment of music chips, Fourier Transforms, and a $19 music interface. There is also a trip to the musical fringes of the 20th Century with a program which translates contour maps into music.

Most of the articles first appeared in Byte magazine in the last few years but six have been specially commissioned, including ones on singing KIMs and musical Altair 8800s.

There is plenty in the book to stir the imagination and to give practical hints to show that the book's editor Christopher Morgan, calls the "new generation of music enthusiasts, who would be musically interested and computer minded" who are sampling the "delights of digital music synthesis."

Books discussed in this month's Bookfare have been Running Wild by Adam Osborne (Osborne/McGraw-Hill, £2.95) Writing Interactive Compilers and Interpreters by P. J. Brown (John Wiley & Sons, £9.75) Understanding and Writing Compilers by Richard Bornat (Macmillan, £5.95 paperback, £12.00 hard cover) Books about computer music edited by Christopher P. Morgan (Byte Books, £6.75 - available from LP Enterprises)
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 TOOLED EXCELLENCE IN HARDWARE AND SOFTWARE AND A TOTALLY FLEXIBLE APPROACH TO SYSTEM BUILDING. POWERFUL AND EASY TO USE SYSTEM MONITORS - A RANGE OF LEVELS AVAILABLE. Firmware is EPROM-based and upgradable from one level to the next is easy.

FULL RANGE OF MICRO SUPPORT CHIPS IN STOCK

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**DISC DRIVES & POWER SUPPLIES**

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**POWER SUPPLY**

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**TPS 940 INTERFACE**

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</tr>
</tbody>
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**TRITON IS IMPRESSIVE!**

**Component Systems Ltd.**

12 Chapel Street London NW1 Tel 01-402-8137 TELEX 444298
Acorns

that survive.

I’m afraid that I don’t have access to an ACORN but it does look like a rather well designed machine. I’d be interested to hear from anyone who has written other programs for it.

Expression Input

Last September I asked for suggestions for getting an equation into a running BASIC program. The only general solution that emerged was that the file should be saved with the equation in it and then that the new file should be CHAINED in. Even using this technique there are several variations, like these:

Joshua Danziger of Whitfield, Manchester suggests the following, in PDP-II BASIC:

```
10 PRINT "INPUT YOUR EXPRESSION"
20 INPUT E$   
30 OPEN "PROGB" FOR INPUT AS #1  
40 PRINT "OPEN "PROGB",20 CHAIN PROGB,100"  
50 CLOSE "PROGB"  
60 CHAIN "PROGB"  
100 REM CONTINUE PROGB
```

J. Marten of Chelmsford suggested the following variation, in PDP-II BASIC:

```
10 PRINT "INPUT YOUR EXPRESSION"
20 INPUT E$   
30 OPEN "PROGB" FOR INPUT AS #1  
40 PRINT "OPEN "PROGB",20 CHAIN PROGB,100"  
50 CLOSE #1  
60 OVERLAY "FUNCTION"
100 REM CONTINUE PROGB
```

It certainly is hard work isn’t it!

Jobs

I’ve had about 25 replies from people looking for jobs and have managed to place a few of those, I am glad to say. I will keep my eyes open for other companies looking for young people and will continue to pass on details to companies. Please don’t ask me to send "details of the jobs available" because most of the jobs go almost immediately and you anyway the better ones may often make the job match the person rather than the other way round — which is rather nice.

380Z programs

I am on the scrounge for some really good programs for the R. M. 380Z — both games with good graphics and useful programs — again using graphics wherever possible. I would like to receive these on cassette or disc so as an inducement I will send a free copy of the next month’s PCW to anyone who sends in a cassette program (I keep the cassette!) or I will send a free copy of PCW and return your disc. In a few months time this page should be packed with 380Z programs (remember how it takes to get things in print). I’ll tell you later why I am on the scrounge.

Help

As usual please send stuff in that you would like to see published. It can be a program, an electronic design or your suggestions and comments on some equipment, service or software. My address is Laxton House, Oundle, Peterborough. Thanks.

PETs and tanks

Lastly, Kevin Jones (13) of Lytham St Annes has, with the aid of his father, produced a Tank Battle simulation for the PET. He tells me that it will work in a 4K PET if all the REMs are removed and it will work in both new and old ROM PETs. The game takes place across a minefield, with the additional hazard of walls to negotiate. The game is for two players, each equipped with a tank, and the first to score ten points wins. A point is scored by hitting your opponent’s tank with a missile. Each player has 9 controls arranged in a 3 by 3 square. Though the game was written for a PET it should be fairly easy to adapt. The PET’s instruction POKE 32768+40*Y+X,Z is equivalent to PLOT X,Y,Z on other machines.

The listing is in the “Programs” section.
### Machine (Price from) | Main Distributor/s (No. of dealers) | Hardware | Software | Documentation | Miscellaneous
---|---|---|---|---|---


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**List of Abbreviations**

<table>
<thead>
<tr>
<th><strong>C/P</strong></th>
<th>Commercial program package</th>
<th><strong>I</strong> Introductory</th>
<th><strong>O/S</strong> Operating system</th>
<th><strong>U</strong> Utility</th>
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<tbody>
<tr>
<td><strong>A</strong></td>
<td>Assembler</td>
<td>Int Interface</td>
<td>P/P Parallel port</td>
<td>Win Utility</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>BASIC</td>
<td>I/S Indexed sequence</td>
<td>S Software</td>
<td>W/P Word length</td>
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<tr>
<td><strong>B/P</strong></td>
<td>Business package</td>
<td>K/B Keyboard</td>
<td>S/P Serial port</td>
<td>W/P Word processor</td>
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<tr>
<td><strong>C</strong></td>
<td>Cassette</td>
<td>R/B Keyboard</td>
<td>TBA To be announced</td>
<td>T/P Text editor</td>
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<tr>
<td><strong>H</strong></td>
<td>Hardware</td>
<td>M/A Macro assembler</td>
<td><strong>T/E</strong> Text editor</td>
<td>T/P Text processor</td>
</tr>
<tr>
<td><strong>T</strong></td>
<td>Floppy disc</td>
<td>N/P Numeric pad</td>
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<tr>
<td><strong>G</strong></td>
<td>Graphics</td>
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<tr>
<td><strong>C</strong></td>
<td>Cassette</td>
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Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.
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<thead>
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<th>Machine</th>
<th>Main Distributor/s</th>
<th>Hardware</th>
<th>Software</th>
<th>Documentation</th>
<th>Miscellaneous</th>
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<tr>
<td>CHALLENGER C3 (£2,334)</td>
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<td>32-56K RAM: 6502, 6800</td>
<td>OS65D: BASIC, CP/M</td>
<td>S&amp;H</td>
<td>Also C3B &amp; C3P H/D modules 74 MB for about £10,000</td>
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<td>2-16 S/P: 17&quot;x22&quot;x12&quot;</td>
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<td>32K RAM: LSI 11: dual 8&quot;</td>
<td>RTI I D/S</td>
<td>H</td>
<td>Many configs possible: max 20 MB, H/D—about £27,000</td>
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<td>S</td>
<td>Also with double density F/D, 1MB, £9,200; 1K EPROM</td>
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<td>B: BASIC: U:</td>
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<td>Also available, 655 model with 315K F/D capability &amp; 12&quot;</td>
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<td>Comp Workshop: 01-491 7507 (n/a)</td>
<td>32K RAM: dual 54&quot; F/D (1G0K): 9&quot;, 16x64 b/w VDU: modular</td>
<td>A: BASIC: FORTRAN, FLEX, PASCAL, PILOT: B/P</td>
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<td>768K RAM: 6809: dual 8&quot; F/D (1MB): 64MB H/D: 10 intelligent 20x80 terminals: 2 132 col, 120cps printers: 2 80 col, 125cps printers: 2 daisy wheel Sprint 3 printers: max 16 ports.</td>
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<td>CROMEMCO SYSTEM 3 (£2,995)</td>
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<td>32-64K RAM: Z80: dual 8&quot; F/D (512K): options as above: extra dual F/D, £1,200</td>
<td>CDOS: BASIC, COBOL, FORTRAN: multi-user BASIC</td>
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<td>DYNABYTE DB8/1 (£1,500)</td>
<td>Dynabyte UK/Europe Ltd: 0723 65559 (6)</td>
<td>32-64K RAM: Z80: 8100 bus: 2 RS232 ports: 1 P/F: 20&quot;x18&quot;x7&quot;: option: dual 8&quot; F/D (1MB), £2,000</td>
<td>CP/M: BASIC, H: COBOL, FORTRAN, PAS- CAL: W/P: B/P</td>
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<td>Expands to multi-user system: also DB8/2 with dual 54&quot; F/D (400K), £3,000</td>
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<tr>
<td>Machine</td>
<td>Main Distributor/s</td>
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<tr>
<td>EUROC (€7,995)</td>
<td>Eurocalc Ltd: 01-405</td>
<td>64K RAM: 8080A: dual 8&quot; F/1 (1MB); 12&quot; 25x80 b/w VDU; 132 col.; 140cps printer</td>
<td>CP/M: CBASIC: S</td>
<td>A year’s maintenance</td>
<td>A year’s maintenance and stationary supply inc.</td>
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<td></td>
<td>3113 (TBA)</td>
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<td>A: account system: U: B/P</td>
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<tr>
<td>EXIDY SORCERER</td>
<td>Liveport Data Products Ltd: 073 670 6320 (27)</td>
<td>8-32K RAM: Z80: RS322: 1 P/P: 310 connector; 30x64 VDU 1/0: options - dual 8&quot; F/1 (630K); £1,200; 12&quot;, 30x84 green VDU; £240; £120 chassis; £210</td>
<td>O/S: ExBASIC I</td>
<td>High resolution graphics capability</td>
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<td>ROM: W/P: A: games</td>
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<tr>
<td>H11 Kit (£1,544)</td>
<td>Heath: 0452 29451</td>
<td>LSI 11: 16-32K RAM: 24x80 VDU int: up to 16 S/P: options - dual 8&quot; F/1 (512K); £1,325; 12&quot;, 24x80 VDU, £85k; S&amp;H</td>
<td>O/S: BASIC:</td>
<td>S&amp;H CPU and VDU int</td>
<td>Cassette available instead of F/D, £882; in kit form WH89 is £1,200</td>
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<td></td>
<td>(n/a)</td>
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<td>FORTRAN: A: games</td>
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<tr>
<td>HEATH WH89 (£1,380)</td>
<td>As above</td>
<td>16-48K RAM: Z80: single 5&quot; 3408 F/1 (102K); 12&quot;, 25x80 b&amp;w VDU; RS322: 13xin17x20; options - 16K RAM, £150</td>
<td>BASIC: A:</td>
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<td>W/P: B/P: I</td>
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<tr>
<td>IMS 5000 (£1,935)</td>
<td>Equinox: 01-739</td>
<td>32-64K RAM: Z80: dual 5&quot; 24x80 F/1 (320K)</td>
<td>CP/M: BASIC:</td>
<td>S&amp;H</td>
<td>3 drives option</td>
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<td></td>
<td>2387 (30)</td>
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<td>COBOL: FORTRAN:</td>
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<td>PASCAL: W/P:</td>
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<tr>
<td>IMS 8000 (£3,515)</td>
<td>As above</td>
<td>64-256K RAM: Z80: dual 8&quot; 24x80 F/1 (1MB)</td>
<td>CP/M: BASIC:</td>
<td>S&amp;H</td>
<td>4 drives optional</td>
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<td>COBOL: FORTRAN:</td>
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<td>PASCAL: W/P:</td>
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<tr>
<td>IMSAI VDP 42 (£3,900)</td>
<td>Computermart: 0603</td>
<td>32-64K RAM: 8085: dual 5&quot; 24x80 b&amp;w VDU: 1 S/P: 18x27x12&quot;</td>
<td>IMDOS: H</td>
<td>Can support 8 addi-</td>
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<tr>
<td></td>
<td>615089 Corner Comp: 03727 41101 (2)</td>
<td></td>
<td>(CP/M comp): A: ExBASIC: U: CBASIC: COBOL: FORTRAN</td>
<td>tional F/D drives; also available, VDF 44 with</td>
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<td>F/D (780K), £4,400</td>
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<tr>
<td>IMSAI VDP 80 (£6,200)</td>
<td>As above</td>
<td>32-64K RAM: 8085: dual 8&quot; 24x80 b&amp;w VDU: 1 S/P: 25x15x25&quot;</td>
<td>IMDOS: H</td>
<td>B</td>
<td>360x192 high resolution graphs; ExBASIC in 6K</td>
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<td>(£32K, £931 48K, £995)</td>
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<td>0061 (13)</td>
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<tr>
<td>MEGAMI-CRO (£6,080)</td>
<td>Bytronics: 0925</td>
<td>256K: 8080A: dual 8&quot; 24x80 F/1: 12&quot;, 25x80 b&amp;w VDU: 120cps printer: 2 S/P: 2 P/P: option - printer stand, £100</td>
<td>CP/M: U:</td>
<td>H&amp;B</td>
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<td></td>
<td>726814 (5)</td>
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<td>B/P:</td>
<td></td>
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<tr>
<td>MICRO-ENGINE (£2,080)</td>
<td>Pronto: 01-599</td>
<td>64K RAM: MCP 1600: 2 16x13x5: options - dual 5/4&quot; F/1 (1MB); £1,500; 12&quot; F/1 (2MB), £1,200</td>
<td>BASIC: PASCAL:</td>
<td>H&amp;S</td>
<td>CPU has user written word set: FASCAL uses integral P code: available as board, £1,400</td>
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<tr>
<td></td>
<td>3041 (TBA)</td>
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<td>File Manager: U:</td>
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</tbody>
</table>

List of Abbreviations

- C/P Commercial package
- C Assmblr
- B BASIC
- B/P Business package
- C Cassette
- E Extensive
- F/D Floppy disc
- G/C Graphics card
- H Hardware
- H/D Hard disc
- I Introductory
- I/S Indexed sequential
- K/B Keyboard
- M/A Macro assembler
- M/A Micro assembler
- N/P Numeric pad
- O/S Operating system
- P/P Parallel port
- U Utility
- W/L Word length
- W/P Word processor
- TBA To be announced
- T/E Text editor
- T/P Text processor

Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.

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<tr>
<th>Machine</th>
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<th>Software</th>
<th>Documentation</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSI 6800 (12,100)</td>
<td>Strumech: 05433 4321 (5)</td>
<td>16K RAM: 6800: C: (9&quot;), 16x64 b&amp;w VDU: 1 S/P: option = PROM prog</td>
<td>BASIC: mini A H&amp;S T/E: U</td>
<td>Up to 8 serial or parallel interfaces possible.</td>
<td></td>
</tr>
<tr>
<td>RESEARCH MACHINES</td>
<td>Research Machines: 0865 49791 (n/a)</td>
<td>32K RAM: Z80A: 5&quot;: 27x96 b&amp;w VDU: 1 S/P: 1 P/P: 17&quot;x11&quot;x7&quot;: options = IEEE488 int, £110, C, £170, G/C, £190</td>
<td>CP/M: BASIC: H COBOL: FORTRAN: M/A: T/E: B/P: E</td>
<td>16K RAM expansion, £250.</td>
<td></td>
</tr>
<tr>
<td>SEMEL 1 (2,500)</td>
<td>Strutt Electrical: 0822 5439 (n/a)</td>
<td>16-64K RAM: Z80: single 8&quot; F/D (250K): 12&quot;, 24x80 b&amp;w VDU: RS232 port: option single 8&quot;</td>
<td>BASIC: COBOL: FORTRAN: B/P: I Supports up to 8 drives</td>
<td></td>
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</tr>
<tr>
<td>SHARP MZ-80K (520-570)</td>
<td>Sharp UK: 01-571 2157 2157 (22)</td>
<td>6-32K RAM: Z80: C: 10&quot;, 24x80 b&amp;w VDU</td>
<td>BASIC: A: games: B Graphics: loudspeaker: BASIC in 14K RAM:</td>
<td></td>
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</tbody>
</table>
### Machine (Price from) | Main Distributor/s (No. of dealers) | Hardware | Software | Documentation | Miscellaneous
---|---|---|---|---|---
**SIMPELEC**
- Mk I (£6,900)
  - Compelec: 01-636 1392 (n/a)
  - Hardware: 64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 55cps daisywheel printer: 2 S/P: 1 P/P: options 150cps bi-directional printer, £2,000
  - Software: CP/M: BASIC: W/P
  - Documentation: S&H
- Up to 44MB H/D possible, £4,500 extra. Multi-user system with 206K RAM, £12,150.
- Mk II (1MB), £3,950.

**SIROCCO** (£3,900)
- Elvingate Computers: 0890 24 5189 (TBA)
- Hardware: 64K RAM: Z80: dual 5¼" F/D (740K): 12", 24x80 VDU: RS232 port: 19"x14"x13": options up to 3 ports; 10MB H/D, £4,000
- All Solitaire systems are compatible: graphics on 11x13 dot matrix

**SMOKE SIGNAL**
- Windrush Micro Designs: 069-24 5189 (TBA)
  - Software: DOS: BASIC: W/P: specialised B/P
- As above

**SOLITAIRE/BS200** (£7,950)
- Midas Computers: 0903 814523
  - Software: O/S: BASIC I
- As above

**SOLITAIRE/HBS100** (£9,500)
- Icarus: 0632 29593
  - Software: O/S: BASIC: I
- As above

**SORD M100 ACE** (£2,650)
- Sord Training Services Ltd 0903
  - Software: ExBASIC
- H&S

**SORD M223** (£3,500)
- As above
  - Software: O/S: BASIC: CAP B/P
- Other configs possible.

**SUPER-BRAIN** (£1,995)
- Icarus: 0632 29593
- Hardware: 64K RAM: 2xZ80: dual 5¼" F/D (320K): 12", 25x80 b/w VDU: S100 bus: RS232: TRS80 port: 21"x23" x14": options — dual 5¼" F/D (320K); dual 8" F/D (4MB); 8-120MB H/D
  - Software: CP/M: BASIC: COBOL: FORTRAN: APL: B/P
- Limited graphics: mainframe interface available

**TANDBERG EC10** (£5,000)
- Tandberg: 0532 35111 (n/a)
  - Software: ExBASIC
- H&S

**TANDY TRS 80 LEVEL 1** (£380)
- Tandy: 021 556 6101 (200)
- Hardware: 4-16K RAM: Z80: C: 12": 16x64 b/w VDU
  - Software: BASIC: games: I A
- BASIC in 4K ROM: upgradable to level 2

**TANDY TRS 80 LEVEL 2** (£515, £1,005)
- As above
- Hardware: 4-48K RAM: Z80: C: 12": 16x64 b/w VDU: RS232 int: 1 P/P: option — single 5¼" F/D (78K), £478 (max of 4)
  - Software: BASIC: games: I M/A: FORTRAN: B/P
- 16K machines include N/P: 4-16K upgrade, £120, without pad, £85

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<tr>
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<tr>
<td>TECS (£1,600)</td>
<td>Technologies: 051 724 2395 (TBA)</td>
<td>16-56k RAM: 6800: 8K PROM: RS232 port: C int: &amp; 128k option — dual 5&quot; F/D (320K), £800</td>
<td>BASIC</td>
<td>H</td>
<td>256 char graphics: Prestel compatible: plugs into standard TV</td>
</tr>
<tr>
<td>TEI 208 (£4,400)</td>
<td>Abacus: 01-580 8841 (5)</td>
<td>32-60k RAM: 8080/8085: dual 5&quot; F/D (320K), 24x80 green VDU: 3 P/P: 17&quot;x18&quot;x10&quot;: option — 150cps printer, £1,250</td>
<td>CP/M: BASIC: COBOL: FORTRAN: PASCAL: ALGOL:</td>
<td>H&amp;S</td>
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<tr>
<td>TERODEC DPS 64/1-4 (£3,014)</td>
<td>Terodec (Microsystems) Ltd: 0344 51160 (TBA)</td>
<td>64K RAM: Z80: dual 8&quot; F/D (1MB): 12&quot;: 24x80 b&amp;w VDU: 2 S/P: 2 P/P: 20&quot;x17&quot;x8&quot;: option — 150cps printer, £1,250</td>
<td>DOS: BASIC: COBOL: FORTRAN: PASCAL:</td>
<td>H&amp;S</td>
<td>TMZ 80 enhanced model in integral work station £4,495, (with 4MB F/D); DPS 64 with 2MB F/D is £3,319</td>
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<tr>
<td>VECTOR GRAPHICS SYSTEM B (£2,650)</td>
<td>As above</td>
<td>48K RAM: Z80: dual 5/4&quot; F/D (630K): 12&quot;: 24x80 b&amp;w VDU: 1 S/P: 2 P/P: 20&quot;x17&quot;x8&quot;:</td>
<td>DOS: BASIC: COBOL: FORTRAN: PASCAL:</td>
<td>E</td>
<td>With graphics and N/P</td>
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<tr>
<td>Z-PLUS (£4,000)</td>
<td>Rostronics: 01-874 3665 (TBA)</td>
<td>32-64K RAM: Z80: dual 8&quot; F/D (1MB): 2 S/P: 2 P/P: 10&quot;x29&quot;x11&quot;:</td>
<td>CP/M: A: U: micro COBOL: W/P</td>
<td>H&amp;S</td>
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**SINGLE BOARDS**

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<tr>
<th>Machine</th>
<th>Main Distributor/s (No. of dealers)</th>
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<th>Software</th>
<th>Documentation</th>
<th>Miscellaneous</th>
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<tr>
<td>AIM 65C (£265)</td>
<td>Pelco: 0273 722155 (4)</td>
<td>1-4K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: Cx2: RS232 port</td>
<td>A: Di A: T/E: 8K monitor in ROM</td>
<td>E</td>
<td>Available as S100 system with A or BASIC in ROM (£480) from Portable Micros (0280 702017); they also have briefcase version (£750)</td>
</tr>
<tr>
<td>CRONEM-CO SC (£260)</td>
<td>Comart: 0480 30505 (17)</td>
<td>1K RAM: Z80A: 8K EPROM sockets: RS232 port: 3 P/P: option — S100 bus.</td>
<td>Monitor and control BASIC in EPROM</td>
<td>E</td>
<td>5 program interval timers: can put own BASIC programs in EPROM.</td>
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## Machine Access

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<thead>
<tr>
<th>Machine (Price from)</th>
<th>Main Distributor/s (No. of dealers)</th>
<th>Hardware</th>
<th>Software/Firmware</th>
<th>Documentation</th>
<th>Miscellaneous</th>
</tr>
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<tbody>
<tr>
<td>HEWART 6800S (£299)</td>
<td>Hewart: 0625 22030 (n/a)</td>
<td>16K RAM: 6800: full K/B: VDU int: 2x2Int: 1 S/P: 2 P/P: option = 16K RAM, £90</td>
<td>1K monitor: H</td>
<td>Can be upgraded with 6809.</td>
<td></td>
</tr>
<tr>
<td>HEWART 6800 Mk III (£152)</td>
<td>As above</td>
<td>1K RAM: 6800: VDU board: options — single 5¼&quot; F/D (75K), £350; PROM programmer, £32: calculator board, £32</td>
<td>Machine code H</td>
<td>Designed for control applications rather than high level computing expansion.</td>
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<tr>
<td>Mk 14 (£39.95)</td>
<td>Science of Cambridge: 0223 311488 (n/a)</td>
<td>8060: 1¼-2K RAM: Hex K/B: 7 char LED: options — VDU int (32x16 with graphics), £29; C int, £6; PROM prog, £10, 2K memory expansion, £15</td>
<td>2K monitor: BASIC in ROM</td>
<td>S&amp;H</td>
<td>Now available as Nascom 2 with 8K RAM and 8K microsoft BASIC in ROM, £295</td>
</tr>
<tr>
<td>NASCOM 1 (£165)</td>
<td>Nascom: 02405 75155 (20)</td>
<td>4K RAM: Z80: full K/B: TV int: 2 P/P: 1 S/P</td>
<td>1K monitor: DOS in ROM</td>
<td>E</td>
<td>Kit: available assembled, £196</td>
</tr>
<tr>
<td>SBC 100 (£135)</td>
<td>Airamco: 0294 57755 (11)</td>
<td>1K RAM: Z80: 8K ROM: S100 bus: 1 S/P: 1 P/P: option = voltage regulator.</td>
<td>4K monitor: BASIC</td>
<td>S&amp;H</td>
<td>Available with 32K RAM and single 5¼&quot; F/D, £867</td>
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<tr>
<td>SUPER-BOARD (£188)</td>
<td>NBM: 01-981 3993 (n/a)</td>
<td>4-8K RAM: 6502: 10K ROM: full K/B: VDU int: C int: options = RS232, single 5¼&quot; F/D (100K), £316; 8K RAM, £188</td>
<td>Machine code H</td>
<td>Designed for control applications rather than high level computing expansion.</td>
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<tr>
<td>SYM-1 (£160)</td>
<td>Newbears: 0635 30505 (n/a)</td>
<td>1-4K RAM: 6502: Hex K/B: 244 bps C int: VDU int: 2x6522 ports: option — TV int</td>
<td>4K monitor: BASIC</td>
<td>S&amp;H</td>
<td>Can be expanded to 64K RAM</td>
</tr>
<tr>
<td>TRITON 4.1 (£286)</td>
<td>Transam: 01-402 8137 (n/a)</td>
<td>2K RAM: Z80: 8K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: option = 2K RAM, £30</td>
<td>1K monitor: 2K S&amp;H BASIC: U</td>
<td>S&amp;H</td>
<td>64 character graphics: 8 levels interrupt: kit.</td>
</tr>
<tr>
<td>TRITON 5.1 (£294)</td>
<td>As above</td>
<td>2K RAM: Z80: 8K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options = 8K RAM, £97; 8K EPROM, £97</td>
<td>2K monitor: 7K scientific BASIC in 8K EPROM or A: Dis A: U</td>
<td>S&amp;H</td>
<td>Either firmware package available for extra £110: CP/M compatible disc interface available available soon.</td>
</tr>
<tr>
<td>TRITON 6.1 (£399)</td>
<td>As above</td>
<td>2K RAM: Z80: 8K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options = 8K RAM, £97; 8K EPROM, £97</td>
<td>2K monitor: 7K scientific BASIC in 8K EPROM or A: Dis A: U</td>
<td>S&amp;H</td>
<td>Either firmware package available for extra £110: CP/M compatible disc interface available available soon.</td>
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### List of Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>C/P Commercial package</td>
<td>Commercial Parallel Interface</td>
</tr>
<tr>
<td>E Extensive</td>
<td>Extended</td>
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<tr>
<td>F/D Floppy disc</td>
<td>Full Dual</td>
</tr>
<tr>
<td>G/C Graphics card</td>
<td>Game Color</td>
</tr>
<tr>
<td>H Hardware</td>
<td>Hardware</td>
</tr>
<tr>
<td>H/D Hard disc</td>
<td>Hardware Dual</td>
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<tr>
<td>I Introductory</td>
<td>Initial</td>
</tr>
<tr>
<td>I/S Indexed sequential</td>
<td>Indexed Sequential</td>
</tr>
<tr>
<td>K/B Keyboard</td>
<td>Keyboard</td>
</tr>
<tr>
<td>M/A Macro assembler</td>
<td>Macro Assembler</td>
</tr>
<tr>
<td>N/P Numeric pad</td>
<td>N/P Numeric Pad</td>
</tr>
<tr>
<td>O/S Operating system</td>
<td>Operating System</td>
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<td>T/P Text processor</td>
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Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.
For Sale


Norris Electronic Projector, almost new - £225. Phone Atherstone (Warks) 2560.

Nascom 1. B-Bug (2K) monitor, complete, fully socketed board and keyboard, UHF modulator, tested and operational. PSU not included - £150. Phone Lee on 01-549 0279 (evenings/weekends).

All going cheap... Z-Plus Microcomputer/ Disc - Z80, 64K, 1M Byte with Ebit Terminal 1920-X - £3,000; IP125 Matrix Printer - £400; Nascom 1 £150; Tektronix Scope 545 - £100.

DIARY DATA

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Pet 2001-8K... limited home use, excellent condition, complete with 2nd cassette and many programs - £495 ono. Also P.E. VDU board, needs attention - £100.

SWTPC 68000 Disc System... 16K RAM, dual 5in floppy, FLEX operating system, editor, assembler, BASIC, many extras. Fully working. I am happy to arrange a demonstration anywhere - £850 ono. Phone 01-994 2360 any evening.

Challenger IP... 8K RAM, UK Power Supply, UHF modulator, 8K Microsoft BASIC, plus supplied extra software. As new - £300. Phone Ruislip 72852 (after 6.30pm).

Apple II 48K... great value! 3 months old and still under guarantee. It includes parallel printer interface card for Apple II.

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Apple II 48K... great value! 3 months old and still under guarantee. It includes parallel printer interface card.
Now, the complete MK 14 micro-computer system from Science of Cambridge

VDU MODULE. £33.75
Display up to ½K memory (32 lines x 16 chars, with character generator; or 4096 spot positions in graphics mode) on UHF domestic TV. Eurocard-sized module includes UHF modulator, runs on single 5 V supply. Complete ascii upper-case character set can be mixed with graphics.

Delivers 8 V at 600 mA from 220/240 V mains - sufficient to drive all modules shown here simultaneously. Sealed plastic case, BS-approved.

MK 14 MICROCOMPUTER KIT
£46.55 inc. p & p.
Widely-reviewed microcomputer kit with hexadecimal keyboard, display, 8 x 512-byte PROM, 256-byte RAM, and optional 16-lines I/O plus further 128 bytes of RAM. Supplied with free manual to cover operations of all types - from games to basic maths to electronics design. Manual contains programs plus instructions for creating valuable personal programs. Also a superb education and training aid - an ideal introduction to computer technology. Designed for fast, easy assembly, supplied with step-by-step instructions.

CASSETTE INTERFACE MODULE.
£7.25, inc. p & p.
Store and retrieve programs on any cassette recorder. Use for serial transmission down single line at up to 110 baud (teletype speed), e.g. over telephone line, or to communicate between two or more MK 14s.

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Use to transfer your own program developed and debugged on the MK 14 RAM to PROM (74S571) to replace SCI0S monitor for special applications, e.g. model railway control. Software allows editing and verifying.

Full technical details of the MK 14 System, with order form.

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

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.

Please send me:
☐ MK 14 standard kit @ £46.55.
☐ Extra RAM @ £4.14 per pair.
☐ RAM I/O device @ £8.97.
☐ VDU module including character generator @ £33.75.
☐ VDU module without character generator @ £26.85.
☐ Cassette interface module @ £7.25.
☐ PROM programmer @ £11.85.
☐ Power supply @ £6.10.
☐ Full technical details of the MK 14 System, with order form.

☐ I enclose cheque/MO/PO for £______ (total).

Name:

Address (please print):

PCW/280
F.P., BASIC ROM card, colour and graphics card — £1,218 (saves you £300). Apple Dual Disk II with controller and box of diskettes — £769 (saving £177); OR £1,950 the lot. Phone Mike McKibbon on Malmsbury (06662) 39935 (day).

Nascom I...no need to slave with a soldering iron, this is ready built by a professional for use by an amateur. Includes standard documentation plus a few programs, complete with keyboard, ribbon cable and Aztec modulator — only £150 ono. Phone Stevenage (0438) 53807.

Tandy TRS 80...4K Level II, system built into moveable Hi-Fi cabinet, with extending keyboard. Complete with technical manual and instruction books etc; also software. Offers, or exchange for Pet. Phone Hereford 3047.

OSI Superboard II...4K, plus PSU, case — £300; 2K RAM, type 211 (bought for Triton but unused) — £30; Module KB 756 Professional ASCII keyboard plus data (cased) — £50; P.E. VDU, built — £50 (keyboard plus VDU — £90). Contact B. Mistry, 75 St Margaret’s Road, Bradford.

Centronics 779...excellent condition, 9 months old, lightly used — £700 ono; also SWTPC PR 40 — £150 ono. Phone Kings Langley 62469.

TI-58 and HP33E calculators...complete with all accessories as supplied. Both in first-class condition, both £30 each plus p&p. Phone Frank on 041-778 2419 (after 7pm).

Two IBM 7330 Magnetic Tape Drives...FREE if you have them both and can transport them (they are very heavy). At least one was working when stored. Manuals and circuits included. Phone Wentworth 4275.

Pet 2001-8K...£395; Teletype ASR33...£395; Interface B — £140; Teletype stand — £20. All as new condition, also books and programs. Offers? Contact Dave Bird, 92 Gardiner Street, Gillingham, Kent (0634 53127).

Wanted

Personal Computer World...Volume 1, numbers 4 and 5. Phone Mark Whiddy on 061-273 7121 ext 5676 (office hours only).

Apple, Pet, Sorcerer or TRS 80. newish, have Philips 8100LP VCR, Phillips 14825 14in col portable, Bell & Howell 2143XL Lowlight cine camera, all brand new, boxed with guarantees — plus other brand new Hi-Fi items. Cash either way. Phone Geoff Heward 021-353 6589 (evenings) and start haggling.

The 6502 mnemonics arranged by op-code Based on information contained in “Programming the 6502” by Rodney Zaks Published by Sybex

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1 = indirect 0-P = page zero
**COMMUNICATION**

Continued from Page 43

of the segment pattern of the
initial letter of the word,
from 0F12 to 0F1A (if we
want the second word), or to
0F22 (if we want the third
word)

We shall need 4 counters.
The message has 5 words:
Counter 1 is set initially to 3
and is decremented after dis-
playing each word.
There are 8 positions in the
display: Counter 2 is set
initially to 8.
To have a word in the dis-
play for a convenient period,
we need to go through the
scanning process a certain
number of times. Counter 3 is
set initially to this number.
To have a pause of suitable
duration, we need to go
through a delay loop a cer-
tain number of times. Counter
4 is set initially to this
number. (20 in hex is a conve-
ni ent value).

With the subroutine,
during the pause which
follows the third word, the
last word appears in the dis-
play. If we wish to avoid this,
before executing the delay
loop in the main program, we
send “00” to 0D00.
If the last character of the
last word of the message is a
full-stop, it will be displayed
during the pause which
precedes the repetition of the
message. We may prefer
this. If the last character of
the last word is not a full-
stop, we may wish to avoid its
display during the pause.
The following modification
to the main program will
prevent it:

Of5B C4 00
Of5D C0 01
Of5F C4 FF
Of61 8F FF
Of63 B8 1D
Of65 9C F6
Of67 9D 06

Tom Palmer, Kew

Other suppliers of purchase ledger pack-
eges that we know about are:

| Byte Shop | 01-518 1414 |
| Comma Computers Ltd | 0277 811131 |
| Computa Store Ltd | 061-832 4671 |
| Crystal Electronics | 0603 22699 |
| Digitus Ltd | 01-588 0105 |
| Equinox Computers Ltd | 01-739 2387 |
| Graffcom | 01-734 8862 |
| Katanna Management | |
| Services Ltd | 0245 76127 |
| Microcomputition | 01-882 5104 |
| Micro-Facilities Ltd | 01-979 4546 |
| Micromedia (Systems) Ltd | 0633 63310 |
| Microsolv Computer Services | 01-951 0918 |
| Padmeden | 025-671 2434 |
| Profcomp Ltd | 01-889 8177 |
| Templeman Software Services | 0789 66327 |
| Tridata Micro Ltd | 021-622 1754 |
| 3-Line Computing | 0482 895169 |
Submitting programs to PCW

Having written and thoroughly tested your original program (be it an application, a game, or a useful subroutine) send it to us, along with a suitable explanation. In order of preference we would like your program submitted as a clear, dark listing on plain paper; on cassette or disk; clearly, accurately typed; or, clearly, accurately handwritten.

We pay the sender of any listing published at least £10 and often much more — depending on the size and quality of the contribution. If the program is too large or complex for the “Programs” section we will sometimes publish it as a feature in the magazine.

It seems that PET users are in the majority... we get more of their programs than any others. For the sake of “balance” how about you others pitching in as well? Post your submissions to PCW Programs, 14 Rathbone Place, London W1P 1DE. We look forward to hearing from you.

380Z Pictures

by John Yale

The program is an interpreter written in BASIC for a 16K Research Machines 380Z to draw pictures on the TV screen. It should be adaptable to any computer with memory mapped display.

Commands to control the picture come from one of two sources:
1. Immediate commands from the keyboard.
2. Commands stored in DATA statements at the end of the program. The commands are an extension of those used in Reference 1.

The plotting area used is 79x47 cells. This is one cell smaller than allowed on the 380Z but provides better display. This may be changed at line 30. When the trace goes off the screen, it reappears on the opposite side.

Initially the program is in stored program mode. Enter the number of the program stored in the data statements that is required. To add new programs, ensure that they start with "PROG" and finish with "END".

Entering zero or just ‘RETURN’ will switch to immediate command mode. Pushing ‘RETURN’ again will switch back to stored program mode.

In immediate mode, command strings are obtained from the keyboard, terminated by carriage return, when they will be executed. For example, to draw a line ten units long enter 10F RETURN. To draw a square enter 4(10F2R) RETURN.

Macros may be defined using the ‘D’ command. e.g. D G 5F RETURN defines G to be equivalent to 5F. Macros may refer to other macros or even themselves in their definition (see PROG 1).

If a macro is redefined then the most recent definition will be used.

To view the current macros type ‘LIST’ in immediate mode. Note that this will restore the full screen scroll.

Different screen sizes will produce different patterns with programs 2, 3 and 4. Also try turning program 3 through 45 degrees by the immediate command ‘R’ before running it. These three programs will generate different patterns for hours with totally unexpected patterns appearing.

REFERENCE

MICROMART

PET EDITOR
Provides full creation and editing of symbolic text or data files, etc, using 12 POWERFUL COMMANDS including; CREATE, EDIT, FIND, REPLACE, INSERT, MOVE, TAB, etc.

(SAE for full software list.)

On cassette

CIRCLE £20.00
SOFTWARE + VAT

(State old/new ROM + size)

33 Restrop View, Purton, Swindon, Wilts. SN5 9DG.

SOUTHAMPTON PET HIRE
Weekly charge: 8K £20, 16K £26.50 plus VAT, inc. manuals, MICROCHESS.

Charges count towards any purchase.

BUTTERFIELD'S ENCYCLOPEDIA £12
(inc. VAT and postage. Contains 33 programs on cassette including STARTREK, BATTLESHIPS, LUN LANDER)

Demonstrations of large range of Commodore and Petsoft software
Tool kit at £55 + VAT.

See the NEW 8K PET with large keyboard at £495 + VAT. Also 16K, 32K, Floppy Disk and Printer

£50 free software with purchase of any PET Computer, P.Ex. welcome

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Telephone (0703) 774023
After hours (0703) 554488

TOPMARK Computers
dedicated to APPLE II

Simply the best!

Full details from Tom Piercy on Huntingdon (0480) 212563

PROGRAMS

- 220 REM ** READ PROGRAM **
- 230 RESTORE
- 240 READ A$
- 250 IF LEFTS(A$, 4)="PROG" THEN 240
- 260 P=P-1:IF P>0 THEN 240
- 270 FOR L1=1 TO 25
- 280 READ A$
- 290 IF A$="END" THEN 320
- 300 "L1)=$":A$
- 310 NEXT L1
- 320 L1=L1-1
- 330 REM **EXECUTE PROGRAM**
- 340 FOR N=1 TO L1
- 350 IF LEFTS(A$ (N), 1)="D" THEN 380
- 360 A$=A$ (N)
- 370 GOSUB 410
- 380 NEXT N
- 390 GOTO 30
- 400 REM **RECURSIVE SUBROUTINE TO INTERPRET A$**
- 410 I=1
- 420 M=0:AF=0
- 430 IF I>LEN(A$) THEN RETURN
- 440 C$=MID$(A$, I, 1)
- 450 IF C$="A" THEN M=AF=1: I=I+1: GOTO 430
- 460 IF ASC(C$)<48 OR ASC(C$)>57 THEN 490
- 470 I=I+10=M=VAL(C$)
- 480 I=I+1:GOTO 430
- 490 IF M=0 AND AF=0 THEN M=1
- 500 REM **SEARCH COMMAND STRING**
- 510 FOR A1=1 TO LEN(C1$)
- 520 IF C$=MID$(C1$, A1, 1) THEN 730
- 530 NEXT A1
- 540 REM **MUST BE MACRO**
- 550 GOSUB 970
- 560 PW=PW+1:SN(PW)=N
- 570 IF N=0 THEN A1=A$: REM EXMD MODE **
- 580 FOR H=1 TO 1 STEP -1
- 590 IF C$=MIDS(A$, H, 1) THEN 610
- 600 NEXT H
- 610 PRINT "NO 1A.:130";C$;
- 620 IF 34(PW)<0 THEN 550
- 630 GOSUB 410
- 640 S1=3+3*(PW-1):GOTO 620
- 650 H=SN(PW):PW=PW-1
- 660 IF N>0 THEN A$=A$(H) ELSE A$=A$
- 670 IF LEFTS(A$, 1)="D" THEN A$=MIDS(A$, 1)
- 680 I=A$1(I)
- 690 P1=PW-1:PW=PW-1
- 700 GOTO 740
- 710 FOR I1=1 TO N
- 720 GOSUB 770, 830, 920, 930,
- 960, 1020, 310, 111, 1190, 1210, 1230,
- 1280, 1290, 1300, 1320
- 730 I1=I1+1
- 740 IF NO THEN 710
- 750 REM ** COMMAND SUBROUTINES **
- 760 REM ** FORWARD **
- 770 GOSUB 810
- 780 IF SW=0 THEN 930
- 790 GOSUB 1360: P1=2*(1-P2)
- 800 PLOT X, Y, P1: RETURN
- 810 X1=X+1:Y1=Y+1:REM ** MOVE **
- 820 IF X=X1 THEN X=X1
- 830 IF Y=Y1 THEN Y=Y1
- 840 IF Y1=Y THEN Y=Y1
- 850 REM ** TURN RIGHT **
- 860 REM ** TURN LEFT **
- 870 DT=DX
- 880 DX=DX:RY=RY:RY=RY:RY=RY:RETURN
- 890 A=a+1:RETURN:REM ** PLUS **
- 900 A=a-1:RETURN:REM ** MINUS **
PROGRAMS

920 RETURN: REM ** SPACE **
930 A2=A: A1=A: A1=A2: REM ** /
940 RETURN
950 REM **
960 IF A<=0 THEN GOSUB 113: RETURN
970 PI=PI+1: RI=PA+1
930 SI(PI)=I: SA(PA)=A
990 A=0
1010 REM **
1020 SA(PA)=31(PM)-1
1030 IF SA(PA)>0 THEN I=SI(PI): RETURN
1040 IF S4(PM)=-100 THEN I=LEN(A$)
1050 PA=PM-1: PI=PI-1
1060 RETURN
1070 REM ** ?
1080 I=I+1
1090 IF RND(1)>0.5 THEN 1130 ELSE 1120
1100 REM ** T **
1110 I=I+1: IF A<=0 THEN 1130
1120 1=-99: GOSUB 970: RETURN
1130 3=1
1140 I=I+1: CS:A ID$(A$, I, 1)
1150 IF C$="(" THEN 3=13+1
1160 IF C$=")" THEN 3=13-1
1170 IF B=0 THEN RETURN ELSE 1140
1180 REM ** HOME **
1190 X=INT((D1+1)/2): Y=INT((YA+1)/2)
1200 PLOT X, Y, P1: RETURN
1210 DX=0: DY=1: RETURN: REA ** NORTH **
1220 REM ** CLEAR **
1230 GRAPH 1: IF P1=2 THEN RETURN
1240 FOR X1=0 TO XM STEP 2
1250 FOR Y1=0 TO TM STEP 3
1260 PLOT X1,Y1,255
1270 NEXT Y1, X1: RETURN
1280 P1=0.5: S=W: RETURN: REM ** BLACK TRACE **
1290 P1=2: SW=0: RETURN: REM ** WHITE TRACE **
1300 Sx=1: RETURN: REM ** CLEAR **
1310 REM ** =**, SET A TO NEXT POINT **
1320 X2=X: Y2=Y: GOSUB 970: RETURN
1330 A=PI2: X=X2: Y=Y2: RETURN
1340 REM ** SUBR TO EXAMINE POINT X, Y **
1350 REM ** P2=0 OR ON **
1360 XY=62555+INT(X/2)-64*INT(Y/3)
1370 GRAPH 2: P2=PEEK(XY): GRAPH 3
1380 X1=X-2*INT(X/2)+1
1390 Y1=2-Y+3*INT(Y/3)
1400 P2=P2 AND X1*INT(2*(2*Y1)+.5)
1410 IF P200 THEN P2=1
1420 RETURN
1430 DATA PROG 1 HILBERT CURVE
1440 DATA DUT(-V G 5R U 2R G G G 5R V +) 6R
1450 DATA DVT(-U 2R G V G 5R 2R V G U +) 2R
1460 DATA DG3F
1470 DATA UV HN 23F 5R 30F C V 4R U
1480 DATA A-4+2
1490 DATA END
1500 DATA PROG 2 SPIRAL
1510 DATA 3A-993(4(AFR)+)
1520 DATA END
1530 DATA PROG 3 SQUARE SPIRAL
1540 DATA 3A-993(4(AFR)+)
1550 DATA EN3
1560 DATA PROG 4 SQUARE3
1570 DATA 924(AFR2+)
1580 DATA DX Z 5R 21 3R 4*
1590 DATA CHN=999X
1600 DATA END

COMMAND SUMMARY

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Move forward one cell</td>
<td>Increment Accumulator.</td>
</tr>
<tr>
<td>R</td>
<td>Turn right 45 degrees.</td>
<td>Current value of Accumulator.</td>
</tr>
</tbody>
</table>

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If you are blessed with oil-fired central heating and if your above-ground storage tank is shaped like a tin of beans lying on its side (but larger), you may have been puzzled as I was to compute the amount of fuel remaining from the measurement taken on a dipstick. This is a handy little problem to run off on a programmed calculator or micro. If you have a printer you could perhaps prepare customized tabulations for your friendly neighbourhood fuel oil co.

STATEMENT OF THE PROBLEM

Given a level right circular cylinder of diameter D and length L: to find the volume of fluid contained in it at heights H from H=0 to H=D.

FUEL TANK
by Tyrone Crusidis

Solution

You won't likely find this one in the handbooks, and if your calculus is rusty, you might have a little trouble deriving it, so take my word for it! It comes with arc cosine terms which I have converted to arc tangent form for the convenience of those who have only the latter function. The language is BASIC and the graphical layout is for PET: others may adopt and adapt as desired.

Test the expression: if the answer is not zero for H=O, you've goofed. If the answer for H=D does not correspond to the nominal volume of your tank, just insert a fudge factor, C5, to compensate for its shape.

PCW suggests that the reader uses a correction factor of 1 if no "fudging" is required.

\[ \text{Volume} = \pi D^2 L \times (1 - \frac{H}{L}) \]

\[ \text{If } H = L \text{ then Answer = Volume for Cylinder} \]

\[ \text{If } H = 0 \text{ then Answer = Volume for Tank} \]

\[ \text{If } H = \frac{L}{2} \text{ then Answer = Volume for Sphere} \]

NOTES ON RML BASIC

1. String space must be reserved before strings are used. CLEAR 500 at line 10 reserves 500 bytes.
2. PLOT X, Y, P plots a white square at X, Y if P is 2 and a black square if P is 0.
3. GRAPH 1 restricts the scrolling display to the bottom four lines and clears a plotting area of 48 x 80.

GRAPH 2 The area of memory containing the screen data is "opened" for reading by BASIC "PEEK".
GRAPH 3 The display memory is "closed" to "PEEK".

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Tank battle
by Kevin Jones

Here is the listing for the PET tank battle mentioned in Young Computer World this month.

3 PRINT "TANKS"
15 PRINT "EX: ";
25 REM *** TANKS ***
35 PRINT "BACK";
40 PRINT "LEFT"
50 PRINT "THE OBJECT OF THE GAME IS TO SCORE"
60 PRINT "10 POINTS"
70 PRINT "THE LEFT TANK IS SHOWN AS O.";
80 PRINT "THE RIGHT TANK IS SHOWN AS X.
90 PRINT "STEP ON A MINE *.A POINT IS SCORED FOR";
100 PRINT "THE OBJECT OF THE GAME IS TO SCORE"
110 PRINT "THE LEFT TANK IS SHOWN AS O.
120 PRINT "THE RIGHT TANK IS SHOWN AS X.";
130 PRINT "THE KEY IN THAT DIRECTION FROM YOUR"
140 PRINT "STEP ON A MINE *.A POINT IS SCORED FOR"
150 PRINT "THE OBJECT OF THE GAME IS TO SCORE"
160 PRINT "THE LEFT TANK IS SHOWN AS O.
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1000 PRINT "THE OBJECT OF THE GAME IS TO SCORE";

Tanks can be controlled by pressing the four arrow keys. Up is up, down is down, left is left, and right is right. To fire a missile, press the fire button. The object of the game is to score as many points as possible. Missiles will half destroy targets, and missiles will totally destroy them. Each player has nine controls as shown on the board. Wall.
This routine displays a large numeral as a 6 by 7 matrix of asterisks. Written for PET, it should run on other micros quite easily.

The routine sets up two arrays, AS and A in lines 110 to 190. AS contains the four elements used to construct the numeral, while A contains ten sets of codes used to select the appropriate element for each row.

This subroutine will work as it is because line 200 contains an instruction to input the value, X, to be displayed.

### String routines

by Michael Parr

These routines were designed to run on an Altair system but are intended for any Microsoft-type system — e.g. Tandy, PET etc.

### String Changing

A common operation when working with character strings is to change part of a string, leaving the rest unaltered. For example, to change “COMPUTOR” to “COMPUTER” the operation can be specified as replacing “TO” by “TE”.

Some versions of BASIC have a statement of the form:

```
CHANGE F$ TO T$ IN L$
```

where F$ is a string and T$ is the character to replace F$ with. L$ is the string to search in.

An example of how this might be used is to change "A" to "E" in a word. This could be implemented as follows:

```
PUBLIC F$ TO T$ IN L$
```

### An INSTR Routine

Frustrated Pet users will have realised that, though their BASIC includes LEFT$, RIGHT$, and MID$, the INSTR function (which locates the position of a substring within a string) is missing. Fortunately, fig 3 lists a subroutine which exactly simulates the Altair INSTR function. It has been intentionally written in “simple” BASIC to aid implementation on a range of systems.

The routine takes F as the starting position of the search, and examines L$ for an occurrence of F$. The position is set in P$, and is zero if F$ is not found.

To produce the effect of:

```
1230 P$=INSTR(F$, L$, F$)
```

use:
```
1230 GOSUB 2000
```
Bells & Whistles

1. 1200 REM * * CHANGE FS 10 T$ IN LS * *
   1210 REM USES $S.$L.$F.PB
   1220 F*1
   1230 IF P$=INSTR(F.$,F$)+1
   1240 IF FS=10 THEN RETURN
   1250 SS=$
   1260 L=LEN($S)
   1270 IF L=length THEN L=TS:$ RETURN
   1280 IF FS=LEN(F$)+1 THEN L=LEFT($L,0)-1)+T$: GOTO 1310
   1290 IF FS=LEN(F$)+1 THEN L=RIGHT($L,1)-1)+TS:$ RETURN
   1300 L=LEFT($L,PS-1)+TS:$ RETURN
   1310 IF FS$=LEN(F$) THEN RETURN
   1320 GOTO 1250
   1330 REM SUB END.

2. IF FS$=INSTR(F$,F$)+1
   20 IF P$="OPEN","OUTPUT": RETURN
   20 IF LINEINPUT "OPEN": RETURN
   20 OPEN"I",1,A$
   20 REM OPEN "I"NPUT
   20 CLEAR 500
   20 REM END
   20 RETURN

3. IF L=LEN(I$)
   30 IF FS$="OPEN" THEN 20
   30 OPEN"O",1,A$
   30 REM OPEN "O"UTPUT
   30 RETURN

Naming Nascom Files
by J. Dartnell

Although the basic Nascom 1 (T2) Monitor is quite powerful it does not have any facilities for dumping and loading named tape files. This routine (within the confines of the memory available) is designed to provide the facility of named tape files, thus allowing several programs (particularly sub-routines) to be stored on one tape and recalled by a search. Tape positioning for cassette recorders without footage routines) to be stored on one tape and ing several programs (particularly sub-

Firstly, dumped data cannot have an address higher than 0E0F in the basic system. Secondly, the Monitor LOAD routine will (as usual) overwrite memory with the contents of any intermediate files.

Three commands are available within the routine:-
1. Modify the addresses of the area of memory to be dumped, command character M.
2. Dump the area of memory specified by the addresses set up by M, command character D.
3. Load the file specified, command character L.

The maximum length of the file name is 8 bytes.

Example 1
To dump a file extending from 0C50 to 0E0F called TESTFILE.
>EF15 N/L
P? TESTFILE
C? M
0E0F XX 50 0C F0 0E. N/L
C? D
Enter filename (8 bytes maximum) terminated by full stop. Full stop is not repeated on the screen.
M - modify dump addresses. Enter M only.
D - dump file. The cassette motor should be started before entering D as the routine starts the dump immediately. Any spurious characters generated by switching on the cassette motor are recalled by a search.
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---

**PROGRAMS**

ignored as the routine only accepts M, L or D at this stage.

Header dumped. File dumped.

Finished. N.B. N/L may be required here. Return to Monitor

**Example 2**

To load a file named TEST2

>EF16 N/L

? TEST2

C L?

Enter file name terminated by full stop.

L — load. Enter L only. Switch on monitor. Monitor LOAD information with scroll if checksum incorrect.

Finished return to Monitor
Another good response — over 80 entrants — indicates that Puzzle 4 was not all that difficult (particularly for those of you with micros, programmable calculators, or use of OPCs — that’s Other People’s Computers).

In fact, I judge that the hardest part of the problem was actually fitting the answers onto a postcard, as requested; we even had one or two of the giant, home made variety.

The first correct entry selected out of the bag came from Mark Domby of Christchurch in Dorset; he will be receiving through the post, the promised bottle of Bollinger extra quality, very dry, special cuvee champagne. His answers (which are not unique — in fact there are an infinite number of answers) are as follows:

\[
\begin{align*}
\text{a}^2 & = 1015263157894736842 \\
\text{b}^2 & = 1012658227848 \\
\text{c}^2 & = 1014492753623188405797759271176844677966 \\
\text{d}^2 & = 101694915254237278136593220383983050847457627111564406779655172413559322033898305084745762711156440677966 \\
\text{e}^2 & = 102040816326530612244897959183673469387755 \\
\text{f}^2 & = 10242735623183940579775752808988764044943820224719 \\
\text{g}^2 & = 1028564 \\
\text{h}^2 & = 1033482788206896655172413793 \\
\text{i}^2 & = 10382564 \\
\text{j}^2 & = 10420481620630612244897959183673469387755 \\
\text{k}^2 & = 10451290955056179775752808988764044943820224719 \\
\text{l}^2 & = 10492735623183940579775752808988764044943820224719 \\
\text{m}^2 & = 105263157894736842 \\
\text{n}^2 & = 1058246806896655172413793 \\
\text{o}^2 & = 1062564 \\
\text{p}^2 & = 106694915254237278136593220383983050847457627111564406779655172413559322033898305084745762711156440677966 \\
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\text{y}^2 & = 11112538955056179775752808988764044943820224719 \\
\text{z}^2 & = 11162564
\end{align*}
\]

(I just hope the typesetter isn’t too full of party spirit when this page is being set!)
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<td>PETSET 1 A/D*</td>
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<td>C15 CASS HIGHGRADE*</td>
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<td>PER 10 IN LIBRARY CASES*</td>
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<tr>
<th>Requirements</th>
<th>Description</th>
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<td>Software</td>
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</table>

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<th>TRS 80</th>
<th>ex. VAT</th>
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<td>4K Level 2</td>
<td>(c/w K/bd, VDU, Tr/Rec)</td>
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<td>16K Level 2</td>
<td>(c/w K/bd, VDU, Tr/Rec)</td>
<td>500.00</td>
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<td>195.66</td>
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<td>COMMODORE PET</td>
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<tr>
<td>2001-32N</td>
<td>(New keyboard &amp; 32K)</td>
<td>782.61</td>
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<tr>
<td>2040 Dual Disk Drive 343K</td>
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<td>Printer cables, each</td>
<td>39.13</td>
<td>45.00</td>
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