Taking the chore out of VAT

Two bargain terminals

Wiring for sound

We review Pet — the £700 computer
Imagine installing a microprocessor on a Formula 1 racing car. This was just one of the varied tasks given to Scicon's Micro Systems team. Speed, suspension movement, g-forces and chassis roll were the parameters that had to be measured. Vibration, interference, weight and temperature were just some of the problems to contend with.

Our Micro Systems team took it in their stride and came up with an innovative solution. They are also at home with commercial, industrial, scientific and military applications.

For further information about Scicon's capability in micros circle No. 101 on the free reader enquiry service. We can't offer you a drive around Brands Hatch but we can offer you fast, effective solutions to your special microcomputer requirements. Or if you like the sound of working for a team involved with advanced technology telephone or write to—

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MK14—the only low-cost keyboard-addressable microcomputer!

The new Science of Cambridge MK14 Microcomputer kit

The MK14 National Semiconductor Scamp based Microcomputer Kit gives you the power and performance of a professional keyboard-addressable unit— for less than half the normal price. It has a specification that makes it perfect for the engineer who needs to keep up to date with digital systems, or for use in school science departments. It's ideal for hobbyists and amateur electronics enthusiasts, too.

But the MK14 isn't just a training aid. It's been designed for practical performance, so you can use it as a working component of, even the heart of, larger electronic systems and equipment.

MK14 Specification
* Hexadecimal keyboard
* 8-digit, 7-segment LED display
* 512 x 8 Prom, containing monitor program and interface instructions
* 256 bytes of RAM
* 4MHz crystal
* 5V stabiliser
* Single 6V power supply
* Space available for extra 256 byte RAM and 16 port I/O
* Edge connector access to all data lines and I/O ports

Free Manual
Every MK14 Microcomputer kit includes a free Training Manual. It contains operational instructions and examples for training applications, and numerous programs including math routines (square root, etc) digital alarm clock, single-step, music box, mastermind and moon landing games, self-replication, general purpose sequencing, etc.

Designed for fast, easy assembly
Each 31-piece kit includes everything you need to make a full-scale working microprocessor, from 14 chips, a 4-part keyboard, display interface components, to PCB, switch and fixings. Further software packages, including serial interface to TTY and cassette, are available, and are regularly supplemented.

The MK14 can be assembled by anyone with a fine-tip soldering iron and a few hours' spare time, using the illustrated step-by-step instructions provided.

Tomorrow's technology—today!
"It is not unreasonable to assume that within the next five years ... there will be hardly any companies engaged in electronics that are not using microprocessors in one area or another."

The low-cost computing power of the microprocessor is already being used to replace other forms of digital, analogue, electro-mechanical, even purely mechanical forms of control systems.

The Science of Cambridge MK14 Standard Microcomputer Kit allows you to learn more about this exciting and rapidly advancing area of technology. It allows you to use your own microcomputer in practical applications of your own design. And it allows you to do it at a fraction of the price you'd have to pay elsewhere.

Getting your MK14 Kit is easy. Just fill in the coupon below, and post it to us today, with a cheque or PO made payable to Science of Cambridge. And, of course, it comes to you with a comprehensive guarantee. If for any reason, you're not completely satisfied with your MK14, return it to us within 14 days for a full cash refund.

Science of Cambridge Ltd,
6 Kings Parade,
Cambridge,
Cambs. CB2 1SN.
Telephone: Cambridge (0223) 311488

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

Please send me an MK14 Standard Microcomputer Kit. I enclose cheque/Money order/PO for £43.55 (£39.95 + 8% VAT and 40p p&p).

Name
Address (please print)

Allow 21 days for delivery.

£39.95
(+ £3.20 VAT, and p&p)
We will pay £5 for the best letter published each month. Here is this month’s winning letter:

## Home-brew club for London

On Wednesday, October 5 at 6.30 pm, we are holding the inaugural meeting of the North London Hobby Computer Club in Room 47 in the Old Polytechnic Building at Holloway Road, just opposite Holloway Road underground station on the Piccadilly Line.

The Department of Electronic and Communications Engineering and the Polytechnic of North London have made available many resources for this venture. Within the department there are two Pets, with a third coming, four SWIP 6800 computer systems, with floppy discs, printers and VDU’s and some Kim and Motorola microcomputer systems. Most will be available for use, as will some Pets and SWTP systems in other departments.

As we envisage the club at the moment little “home-brew” activities are anticipated before Christmas, with any meetings centring on talks by manufacturers and discussions on programming.

From the New Year, however, we anticipate three sets of activities running concurrently, or sequentially—it all depends on how many people turn up. They are short courses on programming, Basic and machine level; a home-brew section using the facilities of the department—up to 35 people can solder and test at the same time—and introductory talks and discussions for those anticipating their own systems.

As you can see, we are preparing a varied programme which should be of interest to a wide variety of people. Obviously, students from the Poly will be coming, but we want to emphasise that this is a club open to all interested. The Poly will be providing some back-up, especially with expert staff and other facilities. This is all part of the Community Development Programme instituted recently.

I hope Practical Computing will be able to help us get this off the ground. Those organising it are members of the Amateur Computer Club, as well as lecturers in digital electronics.

Robin Bradbeer, 
Senior Lecturer, 
Acting Club Secretary

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### MPU system prices

There has been some controversy recently concerning the price of American MPU systems in the U.K. There are companies who simply change the $ sign for a £ sign and call that the U.K. price; most are more reasonable. My own company does not, as yet, sell any American systems—we build our own—but recently I have been working out some figures.

Let us take as an example a reasonably-priced American microcomputer system which sells for a basic $2,000. A U.K. agent receives 25 percent discount but will usually have to order 10 units at a time; he therefore puts up $1,500. This is probably done by letter of credit; it could be three months before he gets delivery.

Adding interest charges at 10 percent on $15,000 for three months produces a total outlay of $15,900. Add freight and duty to the imported product and you finish with a total outlay of $18,000 for 10 units. A quick conversion reveals this to be about £1,000 per unit. You can count in another 15 percent for technical back-up and physical stocks; then there will be a 50 percent mark-up. You end up at about £1,600—£1,700.

Why should the U.K. dealer receive the equivalent of 30-40 percent discount when his American cousin gets only 25 percent? There are several possible reasons:

- Low-volume sales compared to the U.S. market which is 12-18 months ahead of ours;
- Need for more technical back-up due to the low level of customer education in U.K.
- Part of the profits may be disappearing to a central European distribution office in France, Germany or Switzerland—this may also include currency conversions which work to the benefit of the Europeans, so the U.K. dealer may be getting only about 25 percent discount.
- Because of hobby magazines, local computer stores and the next-door neighbours, the average American buyer has a good idea of the product and price before he shops. His U.K. counterpart will want several demonstrations and a long talk with an expert before he even considers taking away a data sheet to study. So the actual cost of each sale is higher in the U.K. than in the U.S.
- Sales volumes are low because of the relatively high prices of the equipment in the U.K. Even if the U.K. dealer made no profit and sold the example system for £1,000, this probably represents a quarter of the average annual salary for a programmer or engineer, the most likely first customers.

In the U.S. the typical engineer or programmer can expect to get about $20,000 per annum; our £2,000 example is equivalent to only one-tenth of his salary.

This difference is magnified by the higher salary rate paid to foreign engineers and the costs of importing, including (continued on page 11)
LET YOUR SYSTEMS GROW WITH S.E.E.D.
Please send S.A.E. for details to:

STRUMECHE ENG. ELECTRONICS DIV.
PORTLAND HOUSE, COPPICE SIDE, BROWNHILLS, WALSALL
"Sole U.K. Distributors"

THE NEWBEAR COMPUTING STORE

The Bear announces its new store at:
2 Gately Road, Cheadle, Cheshire
Tel: 061-491 0134

callers welcome, mail order to Newbury.

PETTVIEV YOUI K 45
110 to 1,200 baud V24, 64 ch, x 16 line scrolling, all on
8in. x 4in. PCB. Needs TV set, UHF Modulator and
ASCII keyboard.

PORTLAND HOUSE, COPPICE SIDE, BROWNHILLS, WALSALL

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8in. x 4in. PCB. Needs TV set, UHF Modulator and
ASCII keyboard.

THE NEWBEAR COMPUTING STORE

0 Circle No. 107

Hardware Components Section

NEW RANGE OF LOW COST S100 RK RAM
BOARDS, PCBs, ETC... PLEASE SEND FOR
LATEST LIST.

BEAR BAGS (Kits)
1 U7A-40 components and edge connectors...41.90
1 Z 80A CPU and switches...41.95
1 Z 80A Power Supply...37.75
1 PET80A and edge connectors...25.00
1 U7A-46 Pin 1 PCB and components...25.00
7 U7A-46 Petiile 1 CB and components...161.00
9 U7A-46 PET CPU (as for item 7...87.00
9 PET80A VDU Kit...85.00
16 U7A-46 PET...39.00
12 PET80A CPU...64.00
12 PET80A VDU...1...from one of two uatil now basic Beor Bag Stockists
(Dealers enquiries welcomed).

VIM I
The new 6512 based micro from Synertak. Fully assembled
and tested £195.00 plus VAT. Send for data.

Hardware Components Section

MEMORIES

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THE NEWBEAR COMPUTING STORE

Callers welcome, mail order to Newbury.

0 Circle No. 108

PRACTICAL COMPUTING October 1978

THE NEWBEAR COMPUTING STORE

Callers welcome, mail order to Newbury.

0 Circle No. 107

PRACTICAL COMPUTING October 1978

THE NEWBEAR COMPUTING STORE

Callers welcome, mail order to Newbury.

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PRACTICAL COMPUTING October 1978
At present, the U.K. boasts something like six companies making home and small business computers based on microprocessors, my own company being one of them. Recently we had 95 percent of our kits waiting on the shelves for three months, due to the 'memory famine'. During that time we have had to watch the customers dwindle and the bank overdraft charges rise. We hope soon to be able to deliver from stock, but the majority of the advertising and selling done three and four months ago has been wasted. Other U.K. companies are in similar situations for various reasons.

The Government is considering investing £50 million in a product which has not yet been designed (the 64K RAM) to be made in a factory which has not yet been built. Foreign manufacturers are already beginning to produce prototypes to be made by experienced personnel in existing factories.

Why not invest some of that £50 million in an attempt to stimulate a home market by reducing the prices of the end products? There are several U.K. companies capable of designing better microcomputers than the Americans and with the world-famous U.K. software in them.

As an example, we considered buying an American microprocessor development system for £365; in fact, we designed our own with improved hardware, better interface facilities, and much-improved software. It sells for £155, less than half of the American equivalent. A fall in component prices of about 25 percent helped but, even so, we could have done it for about half the cost of any equivalent American design.

Apply this philosophy to our $2,000 product and it would end up at about £700; and a simple home computer, such as those currently selling at £500-£700, could be built for £350-£400.

<table>
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<th>Question of logistics</th>
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| I read with great interest the article which appeared in the July/August issue of Practical Computing. Concerning the brief history of the personal computing industry, I must say that I think the NASCOM I success story tends to conflict with the conclusions you have drawn in your article and I would welcome the opportunity to expound this company's philosophy as far as the amateur market is concerned. I am sure you are familiar with NASCOM I and I am also of the opinion that you will understand the original philosophy behind its design to some degree discounted and offset the factors you outlined in the early part of your article concerning relatively high prices on a cash-in-advance basis for something which proves to be of dubious engineering standards. While I would be the first to concede that we have not been able to attain the delivery schedules we had anticipated, this was not for the reasons you have outlined but for the logistics of dealing with an indigenous manufacturer in the U.K.

I am pleased to say that our company enjoyed a great deal of interest at the Do-it-Yourself computer show and this has been followed by a reasonable number of confirmed orders. It is our intention to stay in the forefront of microcomputer design and development and we will always aim a portion of our marketing effort and expertise towards the bottom end of the market you say is developing, namely the amateur enthusiast.

I would like to wish your magazine every success in the future as I feel that dedicated publications to this new industry are of benefit to manufacturers and customers alike.

John H. Miller-Kirkpatrick, Technical Director, Bywood Electronics.

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<td>My colleagues and I would like to point out some errors in biographical details at the end of your reprint of our On-line paper, Microcomputers in the Construction Industry. John Paterson is a lecturer at Reading University. Ted Cogswell is a lecturer at Southampton College of Technology. My surname is Frith, not Firth.</td>
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J. A. Marshall, Managing Director, Nasco Sales Ltd, Chesham, Bucks.

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<th>Feedback for you</th>
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<td>Whether you are using or contemplating the use of computers in the home, in business or in education, the Practical Computing Feedback columns may be of help to you. Starting next month, Feedback will deal with your problems. If you want to know how to put a system together, or to find out what is available from where and at what price, tell us about it and we will do what we can to assist. If we cannot answer your query, we will publish your request and pass on the replies we receive. Feedback will also be a forum for any interesting developments you may have made. Please let us know about them, so that we can tell others. Write to Feedback, Practical Computing, 2 Duncan Terrace, London, N1 8BJ. We look forward to hearing from you.</td>
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Pets in the kitchen

East meets West at the Orient Restaurant off Tottenham Court Road in London. East, represented by Chandru Idnani, who owns the restaurant, is supplying initiative and expertise, while West—or to be more accurate South-West Technology—adds hardware, the result being a computerised restaurant.

Chandru claims that when his system becomes fully operational it will be the first of its kind, helping waiters and kitchen staff to keep track of orders, preparing bills, controlling stock levels and perhaps eventually moving into the more mundane area of payroll.

Nor does he intend to keep it to himself. "We've tried to make it as universal as possible, so that it can be used in other types of restaurant," he says. To this end he is preparing to open a computer store on the floor above his restaurant, there to sell packages not only to caterers but also to other businesses whose functions he thinks can be computerised in a similar way.

Baking hot

As you may imagine, he is a man of considerable energy and expertise. He also has a background in mathematics and a degree in physics at University College, London, where work with a research group introduced him to computer hardware. That was in the late 1960s but it was not until the end of last year that he decided that micros could benefit his business.

He left the academic life for the baking of bread, a task which had formerly required a man with an asbestos forearm. Chandru has been working now on the computer system for about five months and expects to have it running in another month. It uses an SWTP 6800 with 40K bytes of RAM, a cassette interface, keyboard and printers.

He has added "bits and pieces to the micro" but it is the software which has delayed him. "I thought it would be very easy but in the end I had to get experienced help." The experienced help came from friends but even so he has written much of it himself, having learned Basic from scratch. When it's finished the program should run in about 16K.

Coded orders

The program has two major loops—one for overall control, the other for the processing of customers' orders. When the restaurant opens in the morning there are the usual initialization procedures—entering the date, marking any items from the 180 on the menu which are not available, and setting totals to zero if required.

So business begins. A waiter—identified by a code—takes orders—broken into coded items from a table, which is again given a number. There is nothing unusual so far but the waiter then takes his notebook to the bar and details of the order are typed into the system from a numeric keypad.

The 'order loop' has three options; to initiate an order, to add to it, or to produce a bill. In the first and second cases the order will be transmitted to a PR40 printer in the kitchen; a second printer will be kept behind the bar to print bills. Chandru is using rolls of paper 4½ in. wide for this purpose.

When the customer pays, the system records the method and size of payment, handling credit cards, luncheon vouchers and complimentary meals as well as cash. At the end of a day's trading a reconciliation can be produced and a list showing the totals of each item ordered during the day. By comparing this list to the stock input, Chandru has an immediate balance of stock and a guide to future buying.

There are other incidental benefits—menus printed daily—infallibly accurate and legible bills, and possibly improved service. The cost has hardly been prohibitive; Chandru estimates £2,000 for the hardware and plenty of goodwill for the software.

The customer will probably notice very little difference—the only immediate sign will be a line reading Bill Produced By Computer at the foot. Grafton Way's only oriental dancers may well cause them to overlook even that.

Chandru also has a Commodore Pet which he hopes to use in the restaurant when he

Checkmate for Ian

If you are used to cramming your programs into systems with only 2K of memory, you will have little sympathy with Ian Toyn, a 16-year-old schoolboy from Lincoln. He has just written a chess-playing program but cannot test it as it is too big even for the mainframe at the local College of Technology to handle.

Ian is at Yarborough High School, Lincoln, where the maths department has been running courses since 1976. A Teletype terminal at the school sends programs and data to the College of Technology for processing. Ian's program, however, is so big that until the college expands its system, he will not be able to run and debug it, so it looks like checkmate.
TALKING TO YOUR APPLE

"1 TALK to the trees", ran the song. A silly thing to do, perhaps, but there is an inanimate object to which you can talk which will understand you, the Apple II micro system.

Keen Computers of Nottingham, which markets Apple products, is selling a voice input system which allows you to give spoken commands to your machine.

The system is called the Speech Lab Model 20A and costs £165. It comprises a microphone, the voice recognition board, manual, and six demonstration programs.

The programs are either tape or listings and allow the beginner to do voice prints on the screen; play Mastermind and Blackjack; teach the cursor to go up and down, left and right; recognise people by their voices; and play Shooting Stars.

As Keen says, the advantages of using voice input are enormous, as "speech is a human's highest capacity output channel".

Two models

Speech Lab is in two models. Model 20 has a vocabulary of 32 words. It is available as the 20S for S-100 computers and the 20A for the Apple II unit. Features include:

- ROM-based software with a re-locatable program so that you can load it anywhere you have memory; after loading, the 2K ROM can be disabled under computer control.
- The speech recognition program, callable from any Basic, requires 4K bytes of RAM supplied by the user, which can be located anywhere in the address space.
- Hardware includes two band-pass filters with two bits of amplitude, two zero crossing detectors and a linear amplifier.
- A combined hardware/software manual includes 10 experiments.
- Model 50 is an S-100 bus compatible system (8080 or Z-80) capable of handling a 64-word vocabulary, using 64 bytes of storage per spoken word. Features of Model 50 include CMOS design for reliability and low power consumption. Response is real-time.

Software for Speech Lab includes seven complete programs, three of which are offered in source and on paper tape and four in source alone. The three paper tape and source are: speech basic programming language; assembly language recognition program; and hardware self-test program.

The source programs are provided in Speech Basic to plot and correlate speech data. Two recognition programs offered will clarify speech concepts.

A voice response unit working on the Apple II.

Home keyboard

SIRTON PRODUCTS has produced a very cheap ASCII keyboard for use with any home micro system. It costs £88.50 and is complete with case, power supply and UHF modulator, so that it can be plugged straight into a domestic TV set.

Sirton also offers a self-contained VDU system which gives a display of 16 lines of 64 characters. In addition to normal cursor controls, it can present reverse video—black on white—and the facility to make the whole screen or selected characters flash to attract the attention of the operator.

Further details: Sirton Products, 13 Warwick Road, Coulsdon, Surrey CR3 2EF. Telephone: 01-660 5617.

Addition to family

CHIP manufacturer Zilog has expanded its MCZ-1 family of microcomputer systems with the introduction of a new business system, the MCZ-1/60. Like other systems in the range, it is based on the Z80 microprocessor.

It is equipped with a display and keyboard and two floppy disc drives. To make it acceptable in the business environment, it can be programmed in standard Cobol, as well as PLZ and two versions of Basic.

The minimum configuration costs £5,300, and has 32K bytes of main memory, expandable to 64K.

The MCZ-1 range starts at around £3,500 for the model 01 and is marketed in the U.K. by Memec Systems, of Thame, Oxfordshire.

Design courses

A SERIES of three-day courses on the design of micro processor-based systems has been set up.

Day 1 of the course is entitled Microcomputer Systems—Fundamental concepts, day 2, Microcomputer Interface and Programmable Devices; and day 3, Microcomputer Software and Program Design.

Details from Prodex (Seminars) Ltd., 79 High Street, Tunbridge Wells, Kent TN1 1XZ; telephone 0892 39664.
Catalogue update

PETSOFT, the microsoftware house specialising in programs for the Commodore Pet is now updating its catalogue of more than 60 titles monthly.

New programs include stock control, sales analysis, reformat, Life, and a backgammon program which displays the board, 'shakes' the dice, and plays either the Pet user or itself.

Petsoft says the introduction of business and application software has generated sales to universities, banks and large corporations, including ICI, Rank and the Post Office.

Special high-energy, low-noise cassettes chosen for their low drop-off characteristics in the short C-12 length, cost £4.75 for 10 plus 50p postage, or £45 for 100, carriage paid in the U.K.

Catalogues can be obtained, from Petsoft, PO Box 9, Newbury, Berkshire, RG13 1PB. Telephone 01-353 1100, and 0635-201131.

Bet with Ecstasy

"ECSTASY" may not be the first thing to register when calculators are mentioned and it does not occur often in the presence of bookmakers, either—unless you win, of course.

Efficient Computing Systems of Douglas, Isle of Man, however, has put together a system based on a Texas Instruments TI-58 programmable calculator, called it Ecstasy, and made it essential equipment for many local bookmakers.

The key to the betting shop application of the TI-58 is a device known as the Custom CROM—which stands for Constant Read-Only Memory. It is a small module which contains special programs developed by Dr Les Waller, a consultant to ECS.

The programs, which Dr Waller designed to be economical in terms of memory usage and number of steps, can calculate complex bets from double to Yankee in one operation.

Further information: John Gibbons, Texas Instruments. Telephone: Bedford 67466; or Dr Les Waller, Middlesborough 85399.

Mersey beat micros

LIVERPOOL has acquired a micro shop, Micro Digital, spawned by Datapool Services, a computerised book-keeping bureau based in the city.

Bruce Everiss, the managing director, is casting the net very wide and the bureau parentage means a strong bias towards the small business market. The shop caters for customers wanting dedicated micro-packs and general-purpose micro systems and kits.

Initially, it is acting as a showroom for Apple, Nascom, Casu and Cambridge Mark 14. Micro Digital is geared towards the hobbyist and the small business. Everiss reckons to be able to supply tailored systems to most requirements and with that in mind is developing a system around the Z80 and a British-made S100 bus.

Micro Digital is at 25 Brunswick Street, Liverpool 3; you can call on 051 - 708 8624. Open from 9 am to 5.30 pm.

SINTROM means business

From an established base in scientific, educational and personal computers using SWTPC 6800 and S100 8080 equipment, Sintrom announces a range of small systems for the business user. Easy availability of Micropolis-compatible applications software plus CP/M, COBOL, APL, FORTRAN and BASIC allows a speedy implementation of the total system.

**Ledger** **Payroll** **Inventory** **Word Processing** **High Resolution Graphics** **Industrial Control**

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<td>Dual Disk</td>
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<td>Include PSU, S100 controller, Basic/MDOOS</td>
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<td>Host S100 computer with 32K and 1/0 card</td>
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<td>Plus integral dual Disk</td>
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<td>ADM 3A VDU</td>
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<tr>
<td>Centronics μPrinter</td>
<td>£350-£400</td>
</tr>
<tr>
<td>Centronics 701</td>
<td>£1400</td>
</tr>
<tr>
<td>Office Hours: Monday - Saturday</td>
<td>Write for free catalogue</td>
</tr>
<tr>
<td>Access/Barclaycard</td>
<td>Sintrom Microshop</td>
</tr>
<tr>
<td>Prices exclude VAT/CARR</td>
<td>Ardwright Road, Reading, Berks. RG2 0LS.</td>
</tr>
<tr>
<td></td>
<td><strong>Circle No. 109</strong></td>
</tr>
</tbody>
</table>
Expertise the key

PETs and Apples are now being sold in Tottenham Court Road, London, W1 by Euro Calc. The shop, which has been specialising in calculators, has now added these computers to its range of equipment.

Tony Mantor, who runs the shop, explains that Euro Calc is concerned mainly with selling ready-built systems, for which it will supply software development effort and expertise rather than kits.

The shop opens from 9.30 am to 6pm (7pm on Thursdays) at 244 Tottenham Court Road, London, W1. Tel: 01-636 8161.

Close to Euro Calc is Heathkit, which is worth a visit.

Calculator packages

Texas Instruments has set up a library of cheap software packages for use on its programmable calculators. The library is called the Professional Program Exchange and includes hundreds of ready-written programs which users of TI-58/59 calculators can buy for $3 each—that's about £1.60.

It costs $15 (£8) to join the exchange and membership includes a catalogue listing all the programs available. Twenty separate categories are covered, including games, engineering and finance.

As well as buying packages, users are being encouraged to contribute their own programs to the library. Prizes are offered to those whose software is approved and added.

Back-up storage for Zilog

Anyone with a microprocessor system based on the Intel 8080 or Zilog Z80 and in need of more back-up storage should be interested in a new product being marketed at the Sintrom Microshop.

The Micropolis Meta Floppy 1054 is a four-drive minidiskette unit. It takes four 3½in. high capacity floppy discs and provides 1.26 million bytes of on-line storage.

That exceeds the capacity of many larger floppy disc drives and Sintrom claims the 1054 has a number of exceptional technical features which make it superior. Not only is capacity high but performance is very respectable, too. Tracking to-track access time is 30 milliseconds and data transfer can be as high as 250,000 bytes per second.

One other handy feature is a disc insertion interlock which prevents accidental damage to the disc by ensuring that the user cannot close the drive door until the disc is positioned properly. An illuminated display always shows the logical address of each drive to prevent operating errors.

The 1054 is complete with controller, power supply, chassis, enclosure, cabling and a new basic software package.

The Micropolis Disk Extended Basic includes a new chain command which allows the user to split large programs into segment. Each segment resides on disc and is called into main memory when required—the technique referred to as virtual storage in the world of mainframe computers. The 1054 costs £1,999.

Further details from Sintrom Electronics Ltd, Arkwright Road, Reading, Berkshire. Telephone, Reading (0734) 85464.

Home computer coupling

Tune in to Crystal

Torquay now has a micro shop. Crystal Electronics, run by Trevor Brownen and his wife. They have the agency for Apple, Nascom and Newbear —whose Bearbags must be one of the newest pieces of marketing in the field.

As well as supplying kit—and Crystal is the only agency south of Bristol, Brownen believes—there is an in-built consultancy service, since he likes to spend time discussing customers' requirements and advising them on their systems.

Brownen's background is in electronics and computers and the consultancy is free. The shop is at 40, Magdalene Road, and is open from 9am to 5pm. Although you might have to wait a week or so for some items, Brownen is confident he will be able to satisfy most requirements on a cash-and-carry basis shortly. Call Crystal on 0803—22699.

Extension for Kim

The Commodore Kim 1 micro has been extended by GR Electronics of Newport with the addition of a video board, additional memory, a pocket terminal and a range of software products.

With the video board a television becomes a VDU with 16 lines of 64 characters. At £150 this item costs £1 more than the Kim 1 itself. The Memory Plus board contains 8K bytes of random access memory and provides for up to 8K bytes erasable programmable read-only memory. It costs £199.

The GR Electronics pocket terminal, costing £240, allows input of the full ASCII character set.

My love and I have decided to buy a microcomputer personal kit and a semidetached software house in which to program it

with bit-sliced ducks flying up the wall
and Chinese Girl printouts papering the entrance hall.

Through logic gates of love each night we enter our world of Basic delights

riding along our 1/O fun bus
holding hands with our bugs

and drinking ROM with iced coke
while you solder-iron my best dreams
and I edit your schemes
to upgrade some day

to a much bigger machine
and a man with a DP budget and a much bigger development team.

And our database is grown pregnant with shopping lists and babies names, with shattered hopes and video games even this poem's now being writ by the (LOGIN)

micro computer personal kit

(A ND NOW HE HAS GONE
HIS LOVE WITH I
IS NO LONGER SHY.
LOGOUT)

by Malcolm Peltu, Editor, Computer Weekly. Version 2.3
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- Income Tax
- Share Portfolio
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- Line Renumber
- Peek & Poke
- Addressbook
- Super Startrek
- Backgammon
- LIFE
- Statistics
- PET Basic Tutorial

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NATIONAL PANASONIC, ETC.

We stock the COMMODORE PET 2001-8
and APPLE II
microcomputers with a full range of hardware and software options.
Micros or Calculators?

'Programmable calculators can take over many of the functions of a computer in a small business system and can represent a very cost-effective alternative to the use of time-sharing services'.

so much has been written about the applications of microprocessors that it is often forgotten that many tasks for which they are being proposed are within the scope of a good programmable calculator. In fact, programmable calculators can take over many of the functions of a computer in, for example, a small business system, and can represent a very cost-effective alternative to the use of time-sharing services.

Obviously, there will always be some functions requiring, say, mass storage, where the computer approach will be the only viable one, but the programmable calculator is expanding its range of applications all the time.

Comparison

The term 'programmable calculator' covers a wide range of products, ranging in price from below the £30 mark to about £1,700. When one is considering calculators which can be considered as alternatives to microcomputer systems, however, one has to look to the more sophisticated machines with program steps running into hundreds or thousands, either on magnetic cards or in pre-programmed modules.

Some idea of the computing power obtainable from a modern hand-held programmable calculator can be gained from the table, which compares a mainframe computer circa 1955 with a modern hand-held programmable calculator, the TI-59. It can be seen that, in terms of what the modern machine can do, 'personal computing' is now very much with us.

Professional users, small businesses and home users all can benefit from the flexible programming, computing power, data-storage capability and high reliability of the modern calculator.

It is worth looking in more detail at the various modes of operation available to the user with a programmable calculator such as the TI-59.

First, the magnetic card facility can be used for the storage of user programs and data. Users can build their own personal program libraries, for example. Next, the user can benefit from the availability of what TI calls 'solid state software,' plug-in modules containing a host of pre-written programs stored in solid-state ROM. Among those available are a Master Library containing a selection of commonly-used mathematical, statistical, and financial routines and conversions, as well as games and diagnostic programs. There are also program libraries aimed specifically at marine navigation, surveying, aviation and applied statistics.

This concept has been extended recently with the introduction of custom CROMs (Constant Read-Only Memories) which take the same plug-in form but which are developed specifically where a user has a volume requirement for a particular application.

One enterprising company, Efficient Computer Systems, is taking a customised calculator plus a PC100B printer, adding a CROM developed to its own specification, and re-packaging the complete machine as a device known as ECSTASY. This is designed specifically to help bookmakers in calculations associated with combinations of bets, which can be very time-consuming using conventional methods.

It is important to remember that all the functions can be incorporated in what is a hand-held machine. Even with the addition of a thermal printer—which also permits simple user prompting, plotting and editing routines—the result is still a very compact machine.

Applicability

Some idea of the applicability of programmable calculators to tasks which normally would be considered the province of a full-scale computing system can be gained from our own experience, as users, within the world-wide Texas Instruments organisation. Almost 10,000 TI-59

Table I.

<table>
<thead>
<tr>
<th>Components</th>
<th>IBM 650 computer</th>
<th>TI-59 calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power, KVA</td>
<td>177</td>
<td>0.00018</td>
</tr>
<tr>
<td>Volume, cu.ft.</td>
<td>270</td>
<td>0.017</td>
</tr>
<tr>
<td>Weight, lbs.</td>
<td>5650</td>
<td>0.67</td>
</tr>
<tr>
<td>Air conditioning</td>
<td>5 to 10 tons</td>
<td>none</td>
</tr>
<tr>
<td>Memory capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>3,000 bits</td>
<td>7,680 bits</td>
</tr>
<tr>
<td>Secondary</td>
<td>100,000 bits</td>
<td>40,000 bits</td>
</tr>
<tr>
<td>Execution time, milliseconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add</td>
<td>0.75</td>
<td>0.070</td>
</tr>
<tr>
<td>Multiply</td>
<td>20.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Price</td>
<td>$200,000 (1955 dollars)</td>
<td>$299.95 (1978 dollars)</td>
</tr>
</tbody>
</table>
programmable calculators are in use within the TI organisation alone and it is estimated that, as a result, company time-sharing costs have been cut by around 40 percent.

In addition, of course, there are considerable savings on executive time, since they have the calculators immediately available. Accuracy is improved, repetitive operations are speeded, and programmability offers the additional benefits of 'what if?' operations and better, quicker decisions.

Versatility

Typical application areas for this type of programmable calculator include sales desks—for instant pricing and order totalizing; buyers—prices, discounts and profit comparisons; estimators—least-cost analysis and estimations; production control—yield calculations and production costs; stock control—usage forecasts, service factors; accountants—costing, planning, depreciation, cash flow and taxation; actuaries—investments, yields and prices; estate agents—investment comparisons and return on assets; general management—planning, decision-making and 'what if?' decisions; insurance—cash analyses, plan evaluations and presentation; and architects—building design, heating requirements and insulation.

In addition to normal business-type use, applications include TI-58 or TI-59 calculators being employed by hot-air balloonists for navigational and endurance computations in pursuit of a world-record bid, sailors in The Observer Round-Britain yacht race for navigational/speed calculations, and as part of a training/evaluation North Polar flight by the RAF.

The next step from this type of calculator is represented by the Texas Instruments SR60A, termed a 'personal-computer/calculator' because it fills the gap between the conventional programmable calculator and the presently-available personal computers, which tend to be tied into a TV-display type of presentation and require the use of a formal programming language.

Costing between £1,200 and £1,700, depending on memory configuration, the SR60A offers a combination of a highly-intelligent calculator, a ‘question/answer’ prompting display with normal English-language instructions and a quiet built-in thermal printer.

As a result, the machine is ideally suited to small businesses and other applications where it is likely to be used by operators without special training in the use of computers.

One business equipment firm, Betos Systems of Nottingham, has developed its own payroll program for the machine and reckons it can save considerable sums for any firm with more than 50 employees in this role alone—apart from all the other facilities managers can use.

At the bar

Another company, Abacus of Dublin, has developed a program for calculating bar stocks, while the organisers of the 1978 Milk Race, the Tour of Britain cycle race, found the SR60A invaluable in providing instant printouts of the complex points system for results at each stage of the race.

This brief review of some aspects of the current programmable-calculator scene has highlighted certain aspects. Application areas are still growing and there are signs that the gap between programmable calculators and microprocessor-based personal computers will be closed still further in the coming months.
THERE'S a school in Dorset which saved 40 tons of waste paper to buy its Pet computer.

Last month 500 Pet systems were sold in the U.K., bringing the total to 1,500 here and 3,000 in Europe.

There is no doubt Pet is the fastest-selling “home” computer of its kind in this country and we like it.

We would not recommend you to go to the limit of hunting around for 40 tons of waste paper, like Queen Elizabeth's School, but it is certainly worth hunting for your local Pet dealer to have a look at the system.

The Pet was introduced to be sold to the home computer market, so it would be unfair, we feel, to review it from the view of a computer professional.

We know, however, a number of large organisations who are buying, or considering buying, Pets and, presumably, they are not going to use them as playthings.

According to Commodore which manufacturers the Pet, education and super calculator applications account for more than half its sales. Business administration and program development accounts for about 20 percent, while the hobbyist is about five percent.

Our Pet (price £695 inc VAT) which we had on loan for a short time, arrived without documentation. We received a booklet entitled An introduction to your new Pet which shows how to write simple programs and how to load, but not to save, programs.

In an appendix there is a command and statement summary and notes on cleaning the tape heads. There are, in fact, two versions of the booklet; the first tells how to investigate hardware problems and what the interface specifications are, and the second lists and explains the software error messages.

Programs without problems

Working from the booklet we wrote and ran a number of simple programs without problems. The display is very clear and steady, although it is a little cluttered with text on adjacent lines. The keyboard is a calculator rather than a typewriter keyboard, although letters are held in the normal QWERTY sequence.

Using a two-finger “hunt and peck” technique the keyboard was not too unpleasant to use but we asked one of our typists to try it. “Oh, my God”, she said, “I will have to cut my nails”. It is certainly not possible to touch-type if you are used to using a normal typewriter and our typist soon adopted a two-finger technique. One advantage of the keyboard is that program entry normally does not require the use of the shift key.

Using the cassette unit to save and load programs was very easy. Tapes can hold multiple named files and the LOAD command will either load the next file or search for a named file.

We had no instructions on using the SAVE command to dump a program to tape but we had no problem in doing so. Type SAVE or SAVE “name” and the message “PRESS PLAY AND RECORD” is displayed; press these and the program is written to tape.

Pet responds with READY when the program has been written. The tape we used for saving and loading programs was a W. H. Smith C90, which is reasonably cheap. There is a note in the users' manual which says that you should use “good, low-noise, high-energy tape” and not “three-for-£1 type tapes”.

Pet BASIC is a good extended BASIC. Features include:
- Integer, floating point and string variables;
- A full set of scientific functions;
- Logical operators;
- Multistatement lines;
- String functions: LEFT$, RIGHT$, MIDS$,
  CHR$, VAL, STR$;
- PEEK, POKE, USR, SYS to interface to memory and machine language subroutines;
- Logical operators;
- Times/day variable.

Variable names are a letter or a letter followed by a letter or a digit. Integer

(continued on next page)
variables have a % following the name and strings have a $. Floating point variables occupy seven bytes and maintain nine significant digits.

String variables can be up to 255 characters long. The documentation is not very clear about integer variables; they occupy seven bytes (the same as floating point) but are restricted to $32767 to $32768.

For reasons which are not explained in the manual, integers cannot be used in some statements. For example, FOR 1% TO 20 gives an error message. In addition to simple variables, one- and twodimensional arrays can be used. Each element of a string array can contain 0 to 255 characters.

**Simplified keying**

As well as the normal INPUT and PRINT statements there is a GET statement which gets a single character from the keyboard or tape. Data on tapes can be read or written and named files can be specified so that a tape will be searched for a specific file.

The PEEK and POKE statements allow a specific memory location to be examined or changed. The SYS function allows control to be transferred from BASIC to a machine routine at a specified address.

Program keying is simplified by the fact that the shift key is not required. There is a delete key which deletes the last character input and an insert key which allows characters to be entered in the middle of a line. There is no RENUMBER command, but a re-number program is available.

Running programs can be interrupted with the STOP key and variable values can be entered or displayed using immediate statements. The program can then be continued by typing CONT.

We received the following documentation:

*An Introduction TO YOUR NEW PET.* There are two versions of this, both of which have much the same introductory and statement summary sections. They have different information in the appendices; the first has hardware notes and the second has software error information. We recommend you have both versions although a re-print containing the best of both is said to be coming shortly.

**PET Users' Club Newsletter.** There were two of these, both containing useful hints, details of errors found by other users, and information on new hardware and software releases.

There are also hardware and software manuals on the MCS 6500 for people who want to delve deeper into the machine. There is also a tutorial tape available from Petsoft, a company selling PET software.

A golden rule for small computer users is "don't buy unless the system can be expanded!". Pet has the following hardware ports-

- IEEE-488 interface
- 8-bit user interface
- 2nd cassette interface (drive available now for $9.95)
- Memory expansion interface.

You can buy an adapter (but not from CBM) to enable an RS 232 device (a printer) to be interfaced via the IEEE port. If you plan to store data files on the cassettes you will need a second drive to enable files to be updated (reading on one drive, and writing with the updates to the second drive).

It is a safe bet the PET hardware and software items will be available from a large number of alternative sources. In the U.K., alternative hardware, memory expansion and RS 232 adaptors is available from Petsoft, a company selling PET software.

**Wide variety of software**

One of the main attractions of buying a Pet is the software available. Worldwide, the number of independent dealers, users and "publishers" of software for the Pet is astonishing, until one realises that the company expects to sell 35,000 Pets this year. If it can get anywhere near its production targets, it could sell 100,000.

Commodore publishes software both developed by itself and by its users. Software for the Pet can be obtained from two sources—one is obviously Commodore and its dealers and companies selling Pet, the other is the community of Pet users. Examples of software available from Commodore—by no means a comprehensive list—

**Basic**—Interactive. Written by two college professors. Teaches you BASIC and how to program. Fifteen chapters, six sample programs and homework assignments. Price £9.95.

**OSERO**—A game of skill offering two levels of play against the computer. Price £8.

**Pon-ti-o-n**—Board game with a true 52-card pack.

**Wrap Trap**—Dynamic graphics game in which the player has to trap the computer. Good arcade-quality graphics. Price £8.

**Noughts & Crosses**—Exactly the same as that. Price £3.

**Lunar Lander**—Try to put your spaceship on the moon. £6. We had great fun with that.

**Rotate**—Difficult for non-experts. Similar to little plastic trays with movable letters and letter missing. Price £5.

**Biorhythms**—Find out when you are up or down. Price £8. We see it for ourselves.

The Commodore also has a number of packages for business applications like management, stock control and inventory programs.

Typical of the software produced by outside firms for the Pet is that produced by PETsoft at 318 Fulham Road, London, SW11. Among the software available from that company is:

**Fighter pilot**—Rates your skill against shooting down enemy pilots as they streak past the cross hairs of your gunsight. Addictive. Price £7.50.

**Alien attack**—Dynamic graphics as you...
PRACTICAL COMPUTING

CONCLUSIONS

- Disappointing keyboard.
- Poor documentation, except for the simple introduction.
- Much more than a simple home computer.
- Very good BASIC.
- Good display and graphics capability but lower-case restricts the graphics.
- Reasonable expansion capability.
- Wide range of programs available and under development.

TECHNICAL SPECIFICATIONS

- Dimensions: 16½' wide by 18½' deep.
- 14' overall height.
- Weight: 44lbs

MEMORY

- Random Access Memory (user memory): 8K included Expanded to 32K externally.
- Read only Memory (operating system resident in the computer): 13K bytes
- 8K BASIC interpreter
- 4K Operating system
- 1K Diagnostic routine

VIDEO DISPLAY UNIT

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- 1,000 character display, arranged 40 columns by 25 lines
- 8 x 8 dot matrix for characters and continuous graphics
- Automatic scrolling from bottom of screen
- Winking cursor with full motion control
- Reverse field on all characters (white on black or black on white)
- 64 standard ASCII characters; 64 graphic characters

KEYBOARD

- 9½' wide x 3' deep; 73 keys
- All 64 ASCII characters available without shift. Calculator style numeric key pad
- All 64 graphics and reverse field characters accessible from keyboard (with shift)
- Screen Control: Clear and erase
- Editing: Character insertion and deletion

CASSETTE STORAGE

- Fast Commodore-designed redundant-recording scheme, assuring reliable data recovery
- Cassette drive modified by Commodore for much higher reliability of recording and record retention
- High noise immunity, error detection, and correction
- Uses standard audio cassette tapes
- Tape files, named

OPERATING SYSTEM

- Machine language accessibility
- File management in operating system
- Cursor control, reverse field and graphics accessible from keyboard (with shift)
- Screen Control: Clear and erase
- Editing: Character insertion and deletion

INPUT/OUTPUT

- All other I/O supported through IEEE-488 instrument interface which allows for multiple intelligent peripherals
- All I/O automatically managed by operating system software
- Single character I/O with GET command
- Easy screen line-edit capability
- Flexible I/O structure allows for BASIC expansion with intelligent peripherals

BASIC INTERPRETER

- Expanded 8K BASIC, 20% faster than most other 8K BASICS
- Upward expansion from current popular BASIC language
- Strings, integers and multiple dimension arrays
- 10 significant digits; floating point numbers
- Direct memory access through PEEK and POKE commands

PRICES

- Pet 2001 Personal Computer: £695 inc VAT
- Pet cassette deck: £59 inc VAT
- Pet 2020 printer: £495 inc VAT
- Typical software prices in text.
- Pet users' handbook: £5
- Pet introductory booklet: £1
- Pet users' club manual: £10

AUTHORISED COMMODORE DEALERS

LONDON & HOME COUNTIES

C.S.S. Systems Ltd.,
502 Kingsland Road,
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13 Clerkenwell Close,
London, ECI
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Manchester,
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Cortex Computers Ltd.,
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Liverpool 2.
Tel. 051-263-5783

D.A.M.S. (Office Eqpt.) Ltd.,
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Liverpool 7.
Tel. 051-227-3301

Sumlock Electronic Services
(Manchester) Ltd.,
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Manchester,
M3 3WE
Tel. 061-228-3507

Automated Business Eqpt. Ltd.,
Mersey House,
Heaton Mersey Industrial Estate,
Batterssea Road,
Heaton Mersey,
Stockport,
Cheshire SK4 3EA
Tel. 061-432-4299

LONDON RETAIL

The Byte Shop,
426/428 Cranbrook Road,
Gants Hill,
Ilford,
Essex.
Tel. 01-554-2177

Laskys
42 Tottenham Court Road,
Tel. 01-637-2332

(continued from previous page)

(continued on next page)
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Good Homes for Intelligent Pets

THE PET 2001 Computer

£643.52 + VAT

This unbelievably versatile, compact, portable and self-contained unit has many varied applications and offers tremendous benefits in the worlds of:

- **BUSINESS** and **COMMERCE**:
  Can be used efficiently for Trend Analysis, Stock Control, Payroll, Invoicing, Inventory Control, etc.

- **SCIENCE** and **INDUSTRY**:
  The 'PET' has a comprehensive set of scientific functions useful to scientists, engineers and industry.

- **EDUCATION**:
  An ideal tool for teaching and it can be used to keep records, exam results, attendance figures, etc.

- **ENTERTAINMENT**:
  Games including Backgammon, Noughts and Crosses, Pontoone, Black Jack and Moon Landing.

Possesses all usual alphanumerics PLUS 64 graphic characters for plots, artwork, etc.

**AND IN THE NEAR FUTURE**

'Floppy Disc' data and programme storage system and a printer, also 2nd cassette deck available.

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Kirkintilloch,
Glasgow.
041-776-4388

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Commercial Business Systems Ltd.,
Les Forgettes,
Clos au Conte,
Castel,
Guernsey.
Tel. 0481-55574

WEST COUNTRY & SOUTH WALES

Computabits Ltd.,
41 Vincent Street,
Yeovil,
Somerset.
Tel. 0935-26522

C.S.S. Systems Ltd.,
351 Fishponds Road,
Bristol BS5 6RB
Tel. 651449

GENERAL

For full details and demonstration contact Mr. P. J. Watts... Now!
WIN A COMPUTER COMPETITION

To mark the launch of Practical Computing we are giving away an Apple II computer.

**THE MAIN PRIZE**

The winner of the competition will receive a complete boxed system including microprocessor, keyboard, power supply, high level language interpreter (in firmware), plus 4K bytes of read and write memory.

You will also get game paddles and a tape cassette machine. All you will then have to do is connect the system into a standard colour television and it is ready to use. It comes in a smart moulded plastic case which you simply plug into your mains supply.

**PLUS**

In addition to the computer we shall be giving away TEN prizes of £25 to runners up in the competition.

**HOW TO ENTER**

We are looking for ideas on how you would use the Apple II computer which was reviewed in the July/August issue of Practical Computing.

It could be a game you have invented. Or it could be a business application which you have developed. It could even be a project which you are working on in school or in college.

To enter all you have to do is write a description of not more than 3,000 words on your application. We require a description of the application or project plus your solution on how you would develop the application.

No more than one entry may be submitted per person. Each entry must be accompanied by an official entry voucher.

We shall, however, accept a project entry from a single education establishment.

Each entry must not exceed 3,000 words and must be typed, double-spaced. Handwritten manuscript will be accepted provided it is legible.

Closing date for the competition is October 15 1978 and entries received after that date will not be considered.

The competition will be judged by the editorial staff of Practical Computing. The Judges’ decision will be final. No correspondence will be entered into. All entries become the copyright of Practical Computing and entries will only be returned if a stamped addressed envelope is provided.

Employees and relations of ECC, Practical Computing and WHICH COMPUTER? are, of course, excluded from entering. Winners will be notified by post, and winning entries will be published in future editions of Practical Computing.

Please detach and enclose with your entry

I accept the entry rules stated and agree to abide by the judges’ decision.

Name

Company (if applicable)

Address

Tel No: Date

Signed

PRACTICAL COMPUTING October 1978

Now post please to: Practical Computing 2 Duncan Terrace London N.1.
IT'S NEARER to Mayfair than Soho; so Computer Workshop is, as the estate agents would say, nicely situated. So nicely situated that the initial impression is really quite distressing by comparison with other computer shops—has one arrived at the wrong address? You step into the cream-painted and mirror-panelled entrance lobby, casting around for some sign to confirm that Computer Workshop is indeed here. All one knows is that this is 38 Dover Street, London, W1, and that is where Computer Workshop is said to be found.

One wades across a few acres of carpeting and seizes a passing pin-striped stranger with one's steely gaze. Said stranger pleasantly admits that he's never heard of it but observes that something called South West Technical Products is on the first floor.

On the first floor one finds it—South West Technical Products, that is. Then, in smaller letters, Computer Workshop. The keen youth there reluctantly leaves the VDU and asks if he can help. One considers that there isn't really much chance of that but asks for John Burnett, the managing director. At last one finds what one was looking for: and in some respects it resembles entropy.

In a small office to one end of the main showroom he is on the telephone. Around him are two other people similarly engaged. Around and beneath him are cardboard cartons of things without names and printed circuit boards with the name M6800 stamped on them. Minifloppy discs holding data and coffee cups abound. See what one means?

"I used to be a computer man selling bureau services," proclaims Burnett. "But I'd always wanted to start my own business and for years I'd been trying to sort out how to do it. To be a consultant or maybe to sell bureau time, but to be independent while doing it. Looking for a low-cost data-collection device I came across a low-cost VDU kit. It sold for £215 without a case. You had to provide your own TV or monitor but there was nothing in the country like it."

It was made by a company called South West Technical Products and as a direct result of the encounter in May, 1976, Computer Workshop was formed. It was the first computer firm of its kind in Europe.

"I used to go around showing the VDU kit to people, walking into expensive computer showrooms and hooking it into the cables there. It never failed to work, though. The idea evolved from selling a service to emulating the burgeoning microcomputer shops in the States—although, in the end, we didn't exactly do that. Instead we became a specialist supplying South West Technical Products goods."

In May, 1976 Computer Workshop turned over £2,000-worth of the VDU kits and was based in Fulham. The address isn't all that has changed.

**Beating barriers**

"The partner with whom I started is always starting new businesses—and then selling them. His next success was selling camping holidays in the Mediterranean. He likes to put his money into new ventures and then finds something else to do. "Early this year we had become the biggest single SWTP customer in this country so started talking about setting up a factory here to beat freight and duty barriers."

"During the negotiations SWTP in the U.S. financed 50 percent of the U.K. operations and 50 percent was financed by Computer Workshop. In effect, Computer Workshop was then taken over by South West Technical Products Computer Ltd, the holding company for the new factory in Peterborough and the shop."

At that point Burnett's original partner sold out, leaving him with a sizeable chunk of the action for himself.

Today, Computer Workshop is the retailing end of South West Technical Products; as you would expect, it sells only SWTP kit. "We decided that to support a large number of different systems would weaken our support capability and we (continued on next page)"
would never get to grips with every system. We felt it was the right decision to concentrate on SWTP because it was the lowest-cost manufacturer in the equipment area and one of the largest”.

Judging by the new premises and the current turnover of around £75,000 per month, he may be correct, in business terms. But is it a shop you would want to visit? To whom, for instance, does it sell all its kit?

“We’re still selling right across the field,” says Burnett, with the exception of, say, the hobbyist. Hobbyists in this country tend to build their own systems from chips and other components which they buy from large distributors. This is not what we sell: we offer the complete thing. Hobbyists per se represent such a small part of our market that one can almost discount them. Someone comes in and says they’re going to buy them for the home—but then they come back later and say they’re using it in the office.”

**Not a toy**

If you want to know what he is selling which makes him so unsuitable for hobbyists you can send for a catalogue or read any of his advertisements. Neither of those two pieces of reading matter is very lengthy. That is because it is all essentially about one system which is expandable.

The SWTP processor is of course an M6800-based device which, with twin minifloppies, VDU and 16K of memory will cost around £1,925. That is the price fully assembled with a disc-based operating system and BASIC compiler. It is fun to play with but it is definitely no toy.

As an example, Burnett attaches a bi-directional daisywheel printer (made by Rioch and about £1,800 more) and runs off a few impressively-personalised letters on it. One of the packages is word processing—“but we don’t really sell it on that,” he adds casually.

There is no way of looking at a cheque for £2,000 without thinking it a lot of money even if you get a lot for it. So how about something cheaper? Remove the minifloppies and replace them with an ordinary audio cassette recorder—that saves you about £760. Buy it in kit form and assemble it yourself—that knocks off about 20 percent. Use less than 16KB RAM and you are definitely well below £1,000.

“If you compare this to something like the Pet or the Tandy TRS-80 which are completely integrated units, we can’t really compete. To build Pet-like systems from our equipment would cost more. But ours is more flexible and you can expand it as much as you like. There is no difficulty at all; you can plug in any kind of terminal and add any cards you want.”

It is, in short, a system you cannot easily outgrow. Which must be fine for customers, included among whom are ICI, Rolls Royce, Dunlop, Hawker Siddeley, GEC, Marconi and ITT.

Computer workshop also has systems installed in “many Ministry of Defence establishments, but they never tell us what they use it for.” Possibly they play Star Wars on it; maybe something more prosaic, like Real Wars.

“We’re also getting a new type of customer—first-time users and people who are replacing their visual record computers. And we are suddenly beginning to attract smaller companies.”

This is something Burnett is pleased about. Whereas most firms selling computers want a few more customers like ICI, Burnett thinks small.

**Plenty of ideas**

“I get people coming in who are interested in writing expensive software. I want to stamp on that sort of thing—I’m writing ledger programs I want to sell for £50. Fundamentally I believe that software is overpriced but it depends on the number of copies you expect to sell. If you have an integrated ledger at £50 you will have a hundred sales for it almost as a matter of course.

“When it comes to business it is clear that Burnett is running a lot of new ideas and not running a charity, but in no way is he trying to keep all of the gravy to himself.

“We just cannot support more than a tiny fraction of the customers out there. So we try to attract programmers—not just coders but people who know business—to install systems and in some cases write applications software.

“As packages become available they will probably make their money by selling (continued on next page)
hardware we will let them have at a discount. We foresee one-man turnkey systems houses.

"I'm beginning to develop a network of people on this activity—the one thing that I'm trying to instill in them all is that very shortly they will be making their margins from installing systems and not from writing software."

Some people, it seems, engulf markets slowly and insidiously: Burnett appears to be doing it quickly and insidiously. Consider the established computer industry. It has a 'bible'—the Computer Users Year Book—which lists every computer installation in the country; or, at least, it used to do. It is already missing a few hundred installations, for Burnett's activities seem to have gone unnoticed by the CUYB.

Changing face

Such a standard reference source is the CUYB that salesmen traditionally look in it to see who has what and by implication who has no computer. Burnett and his ilk are changing that. Once the mainframe computer manufacturers knew the exact state of the market. Now they do not and the situation will worsen from their point of view as one-man systems outfits start installing £2,000 systems for smaller and smaller outfits.

"The big companies are stuck with marketing strategies and structures which cannot handle unit sales at such low cost. They have dug their own graves and one way they have done it is by convincing people that the user cannot go near the computer. Operators are trained on a particular machine; programmers knowing only one language. With BASIC there is no loyalty to any machine; it is easy to learn; the users will no longer have to rely on specialist programmers. The ignorance in the established computer industry of these things is mind-blowing".

At this point one quickly begins to wonder whether the sky might not be too low a limit to set on Computer Workshop aims. What is coming next? Will the machines start talking??

"Yes. This machine will have a plug-in card for £350 to give a full vocabulary of voice output using phonetic input—it is easier than voice input, but you never knew what it is coming next."

"It is all a bit like doing a jigsaw where you’re told where every bit goes. The only problem is if they don’t work immediately, you’re told. The little boxes are a piece of solder where it shouldn’t be causing current to flow where it shouldn’t flow. If you are just a little used to assembling circuits on printed circuit boards you will probably be able to spot it. Failing that you can always take it back to Computer Workshop."

Burnett confirms our view that the VDU kit is "an absolute sod" to build, though. In fact, if help and service is on your mind you can take out a maintenance contract on your system. Computer Field Maintenance, a well-known maintenance firm in the established industry, will give you a choice of maintenance contracts, right to guaranteeing an engineer on-site within eight hours of a malfunction.

Training courses

Perhaps your worries do not concern the hardware so much as the concepts or the programming. Well, Computer Workshop is using part of its London showroom to run training courses. They cover BASIC for business users; word processing; programs for microprocessor control systems (for logic designers); and the use of micros in education.

It sounds fine and surely all that is needed is for the price to come down a little so everyone can have one in at home? It seems not.

"Between £2,000 and £5,000 we are in a price range where businesses can justify the use of systems for a much lower volume of data or even a much more

(continued on next page)
trivial application. Prices are failing but as we introduce new and more sophisticated items we will stay in that price range and the cost of existing systems will fall accordingly."

Burnett is after business and he knows how much business has to spend. He also knows exactly from where his business is coming.

"How many people," he asks rhetorically, "are using computers at the moment compared to those who aren't using computers? That's where the market is."

If you do not have a computer, Computer Workshop is thinking of you.

**Only a start**

Meanwhile, just off the Peterborough by-pass, a low and featureless building in a sickly shade of green sits in the raw landscape of Peterborough's new industrial estate. That is the new factory of Southwest Technical Products (Computing) Co. Ltd., the first manufacturing operation to be set up in this country by a U.S. micro manufacturer.

In fact, the Americans own half the company, the balance being held by Burnett and his partner, Hugh Woodsend.

In July, the 10,000 sq. ft. unit was sparsely occupied. It had a staff of 26, of whom 14 were employed on production. The resulting output is around 150 units a month—processors, terminals and disc drives—equivalent to about 50 complete systems.

This, however, is only the start. Burnett is prepared to meet a rapid increase in demand and intends to train up to 10 production staff a week—"the forecast is for 40 production staff and 12 engineers by March, a year after the factory opening.

The plant next door is also earmarked for takeover and with other production tweaking this will move its production capacity up to 400 complete systems a month.

The ability to respond rapidly to increased demand is, of course, one of the main reasons for manufacturing in this country: "Where micros are concerned, if you do not have it on the shelf, you can kiss the customer good-bye."

Delays in shipments have been a big Computer Workshop problem in the past but Burnett reports that back orders are down to around £40,000, compared to £150,000 last year.

"We're beginning to get a high-speed turnaround on repairs, too," he adds. "It was chronic at one time." There are now engineers working full-time on repairs in London and Peterborough.

The interesting and ever-growing library of software available includes a text editor and a system for use by barristers. The invoicing system and production scheduling program written for SWTPC use are likely to be developed as packages and a freight-handling package is also in the pipeline.

**Cosmetic aid**

Given this development of software skills, SWTPC should be able to offer the business user an attractive package. Even the cosmetic deficiencies of the casings have been noted and we are assured that their spartan functionalism will soon be a thing of the past.

Cosmetic aid

All in all, SWTPC optimism looks like being well-founded. The product is already well-liked in many quarters and has an established customer base. Product development seems to be proceeding at a reasonable pace.

The presence of a manufacturing base in the U.K. will certainly be an asset as competition strengthens—at least until other U.S. manufacturers follow the lead.
In deepest Cornwall, a 53-year-old schoolmaster is waging a campaign to spread the word of the microprocessor revolution to schools in the county. The man, a self-confessed “bit of a nut-case”, is Desmond Old, head of the department of electronic engineering and computing at Cornwall Technical College and he is in the process of building his sixth microprocessor system for educational purposes.

Much of his research is done in his attic at home where he finds it “much more convenient. I can leave things when they’re half done and I don’t have to clear up afterwards”.

He first became interested in computers in a “serious” way in the early 60s when Sir Walter Puckey, a Cornishman on the board of ICL, decided he would like to do something for Cornish children.

He tried partially to finance some form of computing facility for use at this college and schools”, says Old, “The immediate result was that a number of us on the computing and technical side attended an ICL course in London to learn how to write programs in Fortran”.

The college came involved in computer education in a big way in 1965, using time on the county treasurer’s ICL 1902 computer. It was then decided to branch out into the schools and teach computing in a general way. College lecturers visited the local grammar schools and gave lectures in computer appreciation and, in particular, Fortran programming.

“We took away the programs from the scholars, on coding sheets, and took them back to college”, explained Old. “We had a dp clerk who punched them and they were sent to the county treasurer’s installation over a very early and crude form of data link with an old ICT 70 003.”

 Blocked by the inspectorate

The situation was clearly not satisfactory and in the early 1970s the college tried to obtain its own mainframe but was blocked by the inspectorate, which “regarded us as not really big enough users in the educational world to warrant having a machine of our own, whether it be stand-alone or some terminal. As a result we were encouraged to use a London bureau in no way associated with the local government machine.”

That, too, was not an ideal situation and when Old “got wind of the micro revolution in the U.S., it opened dramatically what was to us a very closed door in financial terms.”

The first system the college built was the Motorola D1 kit, “which got our feet wet in the business”, says Old. “We then built the cheapest one which could run Basic in kit form, the MITS 680b, which we purchased almost two years ago. That worked extremely well, and still does, but it is a design which MITS has decided not to proceed with and, as a result, much of the extension of that system for which we were hoping didn’t materialise.

“We then built the MITS 8800b which, complete with a pair of floppy disc units and one or two other miscellaneous facilities, is now the main system in the college.”

A fair amount of software is written in the college both in machine language and in high-level languages such as Fortran and principally in Basic. They also run an in-between language used in education, called Cesil.

That started with a form of CES. “IBM did a version of it for us to use on the 4360 system which was Cecil, to get over any copyright business there might have been,” Old said. “We have now implemented it ourself on micro and call it Secil.” That is written in Basic for the

(continued on next page)
college microprocessors, the 6800 and the 8080.

The main system applications are running programs written in either Basic or Secil. “We simply try to get people to gain confidence in program writing”, says Old. “Where possible, we get them to enter and run the programs themselves. Where physically impossible, we deal with them on a batch basis. This is not 100 percent satisfactory but providing the teaching in the classroom situation is well thought out and well done, it’s not that unsatisfactory.

Servicing noise measurement

Some help is also given to other groups in the college where computerisation is applicable, such as the noise laboratory. There thought is being given to a system for a library for maintaining a file which can be accessed readily for servicing noise measurement and abatement. They also help people with power systems and access to data and they help to set up their systems.

Old estimates that his work in the college has saved a considerable sum. In the last full year of using the bureau service, they spent £6,500 on time-sharing and the rental of terminal equipment, and about £2,000 in telephone charges. The bulk of that will be saved in future years and the college is now able to use the extra money to enter new and more advanced fields.

He estimates that he has saved £1,000 to £2,000 by using the three working systems in the college—the MITS 680b, 8800b and the SWTP 68, which they do not use much for “serious” data processing.

Old believes the widespread use of micros for small businesses is not far away. “The micro system we have is very readily capable of performing in any dp situation in which a small-to-medium-size business finds itself, whether it be manufacturing, medical practice or an office, assuming that the work could have been done by a bureau”, he says.

There are cost advantages and security would play a large part in deciding to buy a micro. “If a doctor can lock away his disc files at night, then he will feel far happier that he has 100 percent security.” “In the States many medical people with a streak of do-it-yourself have written a tremendous amount of software to keep patient records. If it is happened there, it is bound to happen here”.

Another area where he thinks micros can be used is by small-to-medium-sized firms for payroll. “There is not much software about at the moment!”, says Old, “but I think if people are prepared to write their own it will be a very attractive proposition”.

Coin analysis program

The college is writing a modular program for payroll based on the British fiscal method and one based on PAYE is already running.

The approach taken by Old and his colleagues is that of partial computerisation. If the computer breaks down, then people can go on doing the work manually.

“We feel that many of the small business people will gain much more confidence in adopting an increased payroll activity if they see partial computerisation agreeing with what they can check.”

They also have a program which will deal with graduated pension reductions. For demonstration purposes there is a coin analysis program with which they can work out the various denominations of currency as required for each pay packet. They are now constructing the payroll file, structuring the employee information and the correct number of hours he works in the day or the week. Most of the projects originated in the attic of Old’s home in Camborne. His interest in electronics began with radio and he still works in that sphere.

“I’ve always been very keen on building

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anything just for the sheer hell of it", he says. "It was through the amateur radio journals coming from the U.S. in the 1973-74 period that my attention was drawn to firms like MITS and the people bringing micros to the end-user in a very economic way.

Attic place for innovation

The Old attic has been the scene of most of the innovations in use in the college. Old is wholeheartedly backed by his wife—affectionately known as "Miss"—and his two sons, graduate electronic engineers.

"We are continually exchanging ideas and I am gradually getting a band of my own staff in the college enthusiastic about this; but it's a question of how many hours there are in the day and most of my staff find there are only 24. With the cooperation of my wife, I have managed to find 36 and those extra 12 hours are taken up with the microprocessing business".

Old has a MITS 8800b for his personal use and has built a hybrid from what he considers to be the most cost-effective components available in the business. He imported them from San Francisco and they consist of a Morrow's front panel and another board, "plus a load of memory from a firm called Thinker Toys. For something like £500 I have a very powerful machine with an 8080 processor, 32K memory and $100 bus."

He is all for bringing computers to the people, especially in education. "For many years computers have been in the hands of the wrong people", he says. "They are now coming back to the engineers who conceived them originally. "There was a time when they were so large and so expensive that only management types could persuade the boards of companies to buy them. As a result, there was an elite class looking after computers who tried, rather successfully, to maintain a cloak of mystique about what was going on. Computers are now coming down to the engineer. This is where the micro will really take off. They will build a bridge between the real world and the computer world.

Fantastic future for micros

"I think in education the microprocessor has a fantastic future. One can make learning such fun that one can now bring about what was tried in the early '60s with the old electromechanical machines—program arrangement. It might be mundane things or conventional education.

"If someone only had the courage to employ 10, 20 or 100 unemployed graduate teachers and set up a software house which is really well-conceived and well-organised, there is plenty of money to be made. If one is looking for steady employment, there is a fantastic field for producing packages for physics or any of the O and A level subjects where a person can go to a computer centre and get involved with what they want to talk about.

No plans to commercialise

Old has no plans to market his own system commercially. "Money doesn't interest me as long as I have enough", he says. "I don't like working to the deadlines of the commercial world. I'm a bit of an academic, I suppose. I do what interests me. My two sons may wish, when the microcomputer business settles a little, to go out into the wide world of business and they might tempt me to act as some form of partner."

He sees himself retiring within the next year or so, even though he is still only 53. "It's not because I have nothing to do," he says. "It simply means that I can get in contact with the other 24 hours in the day, which I can't at present."
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Bargain VDUs

by Martin Collins

Until recently there were few computer terminals, apart from the ubiquitous Teletype, which cost less than £1,000; and most VDUs even today cost considerably more than that. While one can still be charged more than £1,500 by some manufacturers, however, it is possible to buy a VDU for less than £500. This article compares the Computer Workshop CT-64 and the ACT-I from Strumec Engineering.

The CT-64

The ACT-I

THE CT-64 was designed by South West Technical Products and is being manufactured by a subsidiary in Peterborough. The terminal is sold either in kit form or fully assembled and can be used with a monitor—Computer Workshop supplies a matching monitor—or via a VHF modulator and a standard television.

Computer Workshop, like most small system suppliers, is trying to sell assembled systems rather than kits. The people there say that the CT-64 kit is difficult to assemble; it takes three times as long as the SWTP processor kit based on the M6800, so you should probably buy it in kit form only if you have had a lot of experience in assembling systems.

The display consists of 16 lines of 64 (or 32) characters. The full 128-code ASCII character set can be generated as characters are formed by a 9 x 5 dot matrix, lower-case letters have true descenders. The control characters for cursor movement, home, page or scroll and the like, can be defined by the user. Inverse video is supplied for all or part of the screen. As an option the terminal can have two pages of memory, each holding 16 lines of 64 characters, which can be selected on an either/or basis.

The terminal can be operated in scroll or page mode. In scroll mode, as a new line is displayed or entered the display rolls up by one line and the top line is lost; in page mode, information is entered or displayed from the top to the bottom of the screen. These two modes of operation, together with the fact that all normal cursor movements are allowed, mean that any required screen formatting can be performed.

Normal layout

The keyboard follows the normal QWERTY layout with additional keys for escape, backspace, echo, and on-line/off-line. Additionally there is one user-definable key available to anyone assembling the kit. If a key is held down the character repeats. The keyboard has a rather imprecise feel to it compared to more expensive terminals.

The terminal has a standard RS 232 interface and can be configured to any required combination of parity and stop bits. The assembled units have an external baud rate switch which enables the terminal to be operated at 110, 150, 300, 600, and 1,200 baud. Computer Workshop is also working on a modification to enable the terminal to operate at 9,600 baud.

Kits carry a 90-day warranty, subject to their being sensibly assembled, while the factory-built units have a full 12-month warranty. Maintenance can be arranged through an independent company (CFM) or faulty units can be returned to the factory for repair.

At present there is a six-week lead time on delivery of assembled units but once full production is under way in Peter-

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borough, Computer Workshop is planning to be able to supply from stock.

The ACT-1 offers rather fewer features than the CT-64. The terminal is imported from the U.S. and is available only as an assembled unit.

The display consists of 16 lines of 64 characters and upper- and lower-case characters can be displayed. As with the CT-64, output can be to a standard video monitor or, with an optional VHF modulator, to a standard TV set. Characters are formed by a 9 x 7 dot matrix and lower-case characters have full descenders. There is no page mode but the screen can be scrolled up or down. Left, right and home are the only cursor movements allowed; the screen formatting capability, therefore, is more limited than on the CT-64.

The keyboard is a normal QWERTY unit with additional keys for escape, tab, backspace, break, rub-out and clear. The unit appears to be more robust than the CT-64, with a metal rather than a plastic case and a more positive action on the keyboard. There is an internal switch for the baud rate and the terminal can run at 110, 300, 600, 1,200, 2,400, 9,600 and 19,200 baud.

Conclusions

- Compared to the costs of two or three years ago, both terminals offer good value for money.
- If you are not experienced at assembling kits and you do not want the extra features by the CT-64, the ACT-1 scores because it is cheaper. It certainly feels more robust than the CT-64 as well. On the other hand, the CT-64 offers plenty of features for a low price.
- If you plan to spend a lot of time using the VDU, it is definitely worthwhile investing in a monitor; and the monitor for the CT-64 is very clear. An alternative to buying a monitor from either Computer Workshop or Strumec would be to shop around for a second-hand or re-conditioned unit, which should cost about £60-£80.

The terminal has a standard RS232 or 20mA current loop interface and can be configured to any required combination of parity and stop bits.

The terminal has a 90-day warranty and Strumec will arrange maintenance for terminals sold as part of a complete system. Faulty units can be returned to Strumec for repair. The company has only just started to supply the ACT-1 and at present is quoting three weeks for delivery, but intends in time to meet orders from stock. Strumec will also supply a monitor if required.

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<th>CT-64</th>
<th>ACT-1</th>
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**SUMMARY**

CT-64

- *4,000 character page with 1,920 characters viewable at any one time*
- *64/96 character set*
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- Black-on-white & White-on-black.
Four off-beat entrepreneurs in Surbiton are enjoying themselves picking up old computers and making them work. And, what is more, they're making money at it. We visit Galdor Computing to find the secret of their success.

ELECTRONIC GRAVEYARD

THE ENTRANCE to Galdor Computing Ltd, at 52 Brighton Road, Surbiton, is a narrow doorway sandwiched between a men's boutique and an insurance broker. Through it, you enter a dark passage where there is just room to squeeze past a tired-looking disc drive, two huge air-conditioning units and several dusty boxes of components. The passage leads to what was once the back garden of No. 52, now the Galdor computer room.

It is no ordinary computer room; at first sight it is more like an electronic elephant's graveyard. Some 40 ft. square by 9 ft. high, it is packed full of machinery - so full that there is barely room to move between the grey cabinets. Almost every known peripheral seems to be represented. An old ICT card interpreter stands in a corner; a multiplexer nudges a graph plotter. Some cabinets stand open to reveal half-embowelled innards, and every flat surface is stacked with boxes of cards, discs and tapes, chunks of abandoned core store, manuals, and PCBs by the hundred.

Somewhere in the midst of all this you should find one or more directors of Galdor, perhaps mending a disc drive, testing a highly-modified version of an ICL operating system, playing Star Trek, or running a job for a customer. For while Galdor is a properly constituted limited company offering conventional bureau services, it is not run in the same way or with the same aims as an ordinary computer bureau.

Natural

Perhaps the easiest way to understand Galdor is to go back to its beginnings. Around 1968, half-a-dozen students of electrical engineering at Kingston Polytechnic decided they needed more computing facilities than the Poly could offer. It seemed the natural thing to buy their own, so they did. London University was dispensing with an ICT 1301, and they obtained it for £300, buyer to collect.

Finding somewhere to put it was no problem; there was plenty of room in the back garden. It was a matter of getting planning permission, knocking down the existing shed, building a computer room from the foundations, dismantling the computer, transporting it to Surbiton, and putting it together again. Nothing to it.

Flippancy aside, the nonchalance with which Galdor "staff" tackle the most daunting projects is one of the things which most impresses the visitor. Another is their equal familiarity with hardware and software. Commercial computing tends to divide people into hardware or software specialists, so that real all-round knowledge has until recently been a rarity. At Galdor it is taken for granted.

Then there were two

Of the original half-dozen, only Andrew Keen and Stuart Fife remain. They have been joined by Pete Singleton, who paid a visit two years ago, decided to stay the night, and has been there ever since.

The three form the full-time staff of Galdor. Another director, John Sheane, has a job with ICL, and there are part-time helpers who drop in whenever possible.

After serving long and well, the ICT 1301 was replaced a little over a year ago and is now being re-commissioned by another enthusiast. Since then, hardware development has been extremely rapid. The first replacement was an ICL 1901, which quickly showed itself to be very short of processing power. It was soon replaced by an ICL 1903.

That is the machine which Galdor is now running, equipped with 32K words of core store, six EDS8 disc drives, eight 7-track tape drives, paper tape reader and punch, card reader and punch, and two line printers of 600 and 1,250 lines per minute.

That, however, is by no means the end of the story. One main reason for the congestion in the computer room is the vast bulk of a 1905E which stretches almost the length of the room. It has a 128K (continued on next page)
All the same, he is already planning the well under way. "We seem to have bitten VDUs, and a multiplexer to handle up to a local video controller initially with three disc drives, three printers, a graph plotter, eight tape drives, but no fewer than 14 store and will be equipped with the same (continued from previous page)

Naturally enough, not all the equipment acquired in this way is in perfect working order. One or two of the tape decks, for example, have a nasty habit of splitting tapes, and disc drives are often a source of trouble. That is a problem which Galdor members take in their stride and there is very little with which they are not capable of dealing, though there are times when it proves simpler to replace the faulty unit rather than track down and cure the fault.

Financially, Galdor has always been self-supporting. Almost from the start, it sold machine time on the 1301. The first customer was a friendly society which took one and a half hours a day and the volume has grown steadily ever since. Today, the work includes such projects as mailing lists for clubs and societies and a back-up service for firms running 1900 series machines of their own. Predictably, Galdor rates are among the lowest in the land—at £12 an hour. Even that may be modified and payment in kind accepted from particularly hard-up customers. It is characteristic that Fife sees this as an advantage, allowing Galdor to offer a service to organisations which would otherwise not be able to afford it.

The unconventional approach to computing seems to affect some customers. Users perhaps unacustomed to the idea that computing can be fun are liable to offer thanks for a pleasant evening by "accidentally" leaving behind a couple of boxes of stationery. Singleton is doing some programming for a firm which is test-marketing beefburgers. The "spin-off" from this project has considerable effect on the diet of the resident members.

All this adds up to a method of running a computer bureau which is unlikely to make anyone a fortune. Turnover in 1977 was regarded as healthy at £180 a week showing a trading profit of £40-60 a week; not the kind of figures to set a bank manager's heart aglow.

Making a fortune, however, is clearly not one of the Galdor aims. What those aims are is less easy to define and seems to depend largely on which of the directors or helpers you choose to ask.

In general, the sheer pleasure of building and running a large computer system without the normal pressures and restrictions of commercial life seems paramount. The profit motive is conspicuous by its absence.

Playing hard

Galdor finances, while they must be a taxman's nightmare, are extremely simple by normal standards. Since all workers are either directors or paid voluntary helpers, the firm has no employees, a fact which eliminates effectively nearly all the bureaucracy involved in running a business. While Galdor customers expect and receive professional service, its members are relatively free to decide whether or not to accept a particular job.

It was perhaps Singleton, who admits to being unemployed more times than he cares to tell, who put it best. "I decided long ago," he said, "that work was a dead loss. So nowadays I don't work—I just play hard."

Galdor positively welcomes visitors, whether just to look round, to make use of the machine, or to help. Most professional users, and possibly even more equipment, are also welcome.

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THIS MONTH we begin a series of articles on how to program in Basic, probably the most widely-used programming language for small computers.

For this series we have secured the serialisation rights for one of the best books on the subject, *Illustrating BASIC*, by Donald Alcock.

Each month we shall publish a chapter from the book which was specially written for the newcomer. Even if you are not in that category, it can still teach you a great deal.

It is written with distinct informality and has a rather unusual presentation; but it is this style, we believe, which makes it one of the most easy-to-read tutorials.


Copies of *Illustrating BASIC* can be obtained from *Practical Computing*. See the enquiry card in this issue for details.
To make a computer do a calculation — however simple — you must first describe every step of that calculation in a language the computer can understand; this description is called a program. This book presents a popular and widely available language called Basic and explains how to write simple programs in it.

Although more elegant and powerful languages are favoured by professional programmers, Basic is adequate for most non-professionals and excellent for beginners.

Basic was born in America at Dartmouth College, New Hampshire, in 1964 as a simple computer language for beginners. It proved popular and has been copied and extended by many computer makers, colleges, universities and "time-sharing" services. Now, like English, Basic has dialects: a program written in one is unlikely to work on a computer committed to another.

There is soon to be a standard for "Minimal Basic" by the American National Standards Institute (A.N.S.I. X3J2), and "Specification for Standard Basic" by Bull, Freeman & Garland, which has been published by the National Computing Centre, U.K. These have not yet had time to encourage everyone to fall into line so the Basic you meet will probably not be standard. I have accepted this as a fact of life, and, in writing this book, kept at my side eleven manuals defining a different Basic. Four of these versions are available on big computers operated by international "time-sharing" services; the other seven on computers ranging from big to "desk-top". From these eleven manuals I have tried to discover and point out where Basic commonly differs from one another and recommend ways of avoiding dependence on any one particular version. I have used the word "portable" to describe a Basic program written with independence in mind and treat the need for portability as an axiom.

† A.N.S.I. X3J2/76-01 issued for public comment in January 1976
+ referred to in the text as "N.C.C. Standard Basic"

You don't have to be a computer scientist to read this book: it is for students meeting computers for the first time, for those in industry (particularly engineers) who never formally studied computing but would like to write simple computer programs, for managers who do not want to write programs but would like to know more about a field in which they often have to take decisions; and for those who can already write in Basic but seek a broader view of "portable" programming and an introduction to a few programmers' techniques like "state tables" and "list processing".

The text of the book is arranged for the most part in double-page spreads, each dealing with a single "statement" of the Basic language. Because so many statements are interdependent this arrangement demands forward references now and again, but novices to computing may ignore forward references first time through the book without fear of missing something essential to understanding the subject matter.

I record my deep gratitude to three people who made this book possible: my wife, Fay, who suffered grass widowhood but never ceased her warm encouragement; my partner, Brian Shearing, who has taught me so much about computing and allowed me time off work to write the book; and Charles Lang, who believed in my ideas and persuaded me to give them form.

My book is informal in language and unusual in presentation, rather than write a justification I would only remark that a careful reader might diagnose a severe astigmatism in my eye and a persistent shake in my hand.

Reigate, Surrey, U.K.

Donald Alcock
January 1977
TO MAKE A COMPUTER DO A CALCULATION HOWEVER SIMPLE, YOU MUST FIRST DESCRIBE EVERY STEP OF THAT CALCULATION IN A LANGUAGE THE COMPUTER CAN UNDERSTAND; THIS DESCRIPTION IS CALLED A PROGRAM. THIS BOOK PRESENTS A POPULAR AND WIDELY AVAILABLE LANGUAGE CALLED BASIC ANDExplains HOW TO WRITE SIMPLE PROGRAMS IN IT.

ALTHOUGH MORE ELEGANT AND POWERFUL LANGUAGES ARE FAVOURED BY PROFESSIONAL PROGRAMMERS BASIC IS ADEQUATE FOR MOST NON-PROFESSIONALS AND EXCELLENT FOR BEGINNERS.

BASIC WAS BORN IN AMERICA AT DARTMOUTH COLLEGE, NEW HAMPSHIRE, IN 1964 AS A SIMPLE COMPUTER LANGUAGE FOR BEGINNERS. IT PROVED POPULAR AND HAS BEEN COPIED AND EXTENDED BY MANY COMPUTER MAKERS, COLLEGES, UNIVERSITIES AND "TIME-SHARING" SERVICES. NOW, LIKE ENGLISH, BASIC HAS DIALECTS: A PROGRAM WRITTEN IN ONE IS UNLIKELY TO WORK ON A COMPUTER COMMITTED TO ANOTHER.

THERE IS SOON TO BE A STANDARD FOR "MINIMAL BASIC" BY THE AMERICAN NATIONAL STANDARDS INSTITUTE† (A.N.S.I. X3/32), AND "SPECIFICATION FOR STANDARD BASIC" BY BULL, FREEMAN & GARLAND HAS BEEN PUBLISHED BY THE NATIONAL COMPUTING CENTRE, U.K.® (1975). THESE HAVE NOT YET HAD TIME TO ENCOURAGE EVERYONE TO FALL INTO LINE SO THE BASIC YOU MEET WILL PROBABLY NOT BE STANDARD.

I HAVE ACCEPTED THIS AS A FACT OF LIFE, AND IN WRITING THIS BOOK, I KEPT A SIDE ELEVEN MANUALS EACH DEFINING A DIFFERENT BASIC. FOUR OF THESE VERSIONS ARE AVAILABLE ON BIG COMPUTERS OPERATED BY INTERNATIONAL "TIME-SHARING" SERVICES; THE OTHER SEVEN ON COMPUTERS RANGING FROM BIG TO "DESK-TOP". FROM THESE ELEVEN MANUALS I HAVE TRIED TO DISCOVER AND POINT OUT WHERE BASICS COMMONLY DIFFER FROM ONE ANOTHER AND RECOMMEND WAYS OF AVOIDING DEPENDENCE ON ANY ONE PARTICULAR VERSION. I HAVE USED THE WORD "PORTABLE" TO DESCRIBE A BASIC PROGRAM WRITTEN WITHINDEPENDENCE IN MIND AND TREAT THE NEED FOR PORTABILITY AS AN AXIOM.

† A.N.S.I. X3/J2/76-01 ISSUED FOR PUBLIC COMMENT IN JANUARY 1976
‡ REFERRED TO IN THE TEXT AS "N.C.C. STANDARD BASIC"

THE TEXT OF THE BOOK IS ARRANGED FOR THE MOST PART IN DOUBLE-PAGE SPREADS, EACH DEALING WITH A SINGLE "STATEMENT" OF THE BASIC LANGUAGE. BECAUSE SO MANY STATEMENTS ARE INTERDEPENDENT THIS ARRANGEMENT DEMANDS FORWARD REFERENCES NOW AND AGAIN, BUT NOVICES TO COMPUTING MAY IGNORE FORWARD REFERENCES FIRST TIME THROUGH THE BOOK, WITHOUT FEAR OF MISSING SOMETHING ESSENTIAL TO UNDERSTANDING THE SUBJECT MATTER.

I RECORD MY DEEP GRATITUDE TO THREE PEOPLE WHO MADE THIS BOOK POSSIBLE: MY WIFE, FAY, WHO SUFFERED GRASS-WIDOWHOOD BUT NEVER CEASED HER WARM ENCOURAGEMENT; MY PARTNER, BRIAN SHEARING, WHO HAS TAUGHT ME SO MUCH ABOUT COMPUTING AND ALLOWED ME TIME OFF WORK TO WRITE THE BOOK; AND CHARLES LANG WHO BELIEVED IN MY IDEAS AND PERSUADED ME TO GIVE THEM FORM.

MY BOOK IS INFORMAL IN LANGUAGE AND UNUSUAL IN PRESENTATION, RATHER THAN WRITE A JUSTIFICATION I WOULD ONLY REMARK THAT A CAREFUL READER MIGHT DIAGNOSE A SEVERE ASTIGMATISM IN MY EYE AND A PERSISTENT SHAKE IN MY HAND.
HOW MANY POTS OF PAINT DO YOU NEED TO PAINT THE ROOF AND WALL OF THIS WATER TANK?

WE COULD GO STRAIGHT AT IT LIKE THIS:

roof area, \( T = \pi \times \frac{6.5^2}{4} = 33.2 \)

wall area, \( S = \pi \times 6.5 \times 27 = 551 \)

Total area, \( A = T + S = 884.2 \)

number of pots, \( G = \frac{A}{4.236} = 2.04 \)

rounding up, \( R = 3 \)

you need 3 pots of paint

OR WE COULD WRITE A PROGRAM (IN ENGLISH) TO SOLVE THE PROBLEM

1. REMARK: A PROGRAM IN ENGLISH
2. THE FOLLOWING NUMBERS ARE THE DATA: 6.5, 27, 236
3. READ THE DATA, CALLING THEM D, H, C RESPECTIVELY
4. WORK OUT \( 3.14 \times D^2 / 4 \) AND LET THE RESULT BE CALLED \( T \)
5. WORK OUT \( 3.14 \times D \times H \) AND LET THE RESULT BE CALLED \( S \)
6. ADD \( T \) TO \( S \) AND LET THE RESULT BE CALLED \( A \)
7. WORK OUT \( A / C \) AND LET THE RESULT BE CALLED \( G \)
8. ROUND \( G \) TO THE NEXT WHOLE NUMBER AND LET THE RESULT BE CALLED \( R \)
9. PRINT "YOU NEED"; \( R \); " POTS"
10. THE END

THIS HAS THE ADVANTAGE OF BEING GOOD FOR ANY SIZE OF TANK AND PAINT POT SO YOU NEED ONLY REPLACE THE DATA ON LINE 2.

TRY OBEYING THE ENGLISH PROGRAM OPPOSITE TO FEEL WHAT IT WOULD BE LIKE TO BE A COMPUTER OR WRITE THIS PAGE BY WRITING NUMBERS IN THE LITTLE BOXES BELOW.

NOW

I ILLUSTRATING BASIC PAGE 3
HOW MANY POTS OF PAINT DO YOU NEED TO PAINT THE ROOF AND WALL OF THIS WATER TANK?

WE COULD GO STRAIGHT AT IT LIKE THIS:

roof area, \( T = \pi \times 6.5^2 / 4 = 33.2 \)

wall area, \( S = \pi \times 6.5 \times 27 = 551 \)

Total area, \( A = T + S = 884.2 \)

number of pots, \( G = A / 236 = 2.48 \)

rounding up, \( R = 3 \)

\( \therefore \) you need 3 pots of paint.

OR WE COULD WRITE A PROGRAM (IN ENGLISH) TO SOLVE THE PROBLEM.

1. REMARK: A PROGRAM IN ENGLISH
2. THE FOLLOWING NUMBERS ARE THE DATA: 6.5, 27, 236
3. READ THE DATA, CALLING THEM \( D, H, C \) RESPECTIVELY (think of this as putting the data into little boxes labelled \( D, H, C \) respectively — see opposite page)
4. WORK OUT \( 3.14 \times D^2 / 4 \) AND LET THE RESULT BE CALLED \( T \) (i.e. put the result in a little box labelled \( T \))
5. WORK OUT \( 3.14 \times D \times H \) AND LET THE RESULT BE CALLED \( S \)
6. ADD \( T \) TO \( S \) AND LET THE RESULT BE CALLED \( A \)
7. WORK OUT \( A / C \) AND LET THE RESULT BE CALLED \( G \)
8. ROUND \( G \) TO THE NEAREST WHOLE NUMBER AND LET THE RESULT BE CALLED \( R \) (i.e. add 1 to \( G \) and take the integral part of the result)
9. PRINT "YOU NEED"; \( R \); "POTS" (i.e. print whatever whole number \( R \) turns out to be)
10. THE END

THIS HAS THE ADVANTAGE OF BEING GOOD FOR ANY SIZE OF TANK AND PAINT POT — YOU NEED ONLY REPLACE THE DATA ON LINE 2.

TRY OBEDIING THE ENGLISH PROGRAM OPPOSITE TO FEEL WHAT IT WOULD BE LIKE TO BE A COMPUTER. DEFILE THIS PAGE BY WRITING NUMBERS IN THE LITTLE BOXES BELOW.

ILLUSTRATING BASIC PAGE 2
CHAPTER 1

PREPARE YOUR PROGRAM BY TYPING INSTRUCTIONS AT THE KEYBOARD.
THE COMPUTER SIMPLY STORES THE PROGRAM AT THIS STAGE.

FIRST

IT DOESN'T OBEY ANY INSTRUCTIONS

1. READ A PROGRAM IN BASIC
2. DATA 6.8, 57, 236
3. READ D, H, C
4. LET T = 3.14 x D x H/4
5. LET S = 3.14 x D x H
6. LET A = T
7. LET G = A/C
8. LET R = INT (G + 1)
9. PRINT "YOU NEED: R; " POTS"
10. END

THEN

TYPE RUN

WHICH SETS THE COMPUTER TO WORK OBEYING THE STORED INSTRUCTIONS ONE AFTER THE OTHER IN NUMBERED SEQUENCE
WHILST YOU RELAX.

EVENTUALLY THE COMPUTER WILL OBEY THE INSTRUCTION END THAT MAKES IT STOP.

BUT

BEFORE YOU CAN TAKE THE FIRST STEP AND START TYPING THE PROGRAM YOU HAVE TO GO THROUGH THE RITUAL OF SIGNING ON AND TELLING THE COMPUTER YOU WANT TO USE BASIC.

DIFFERENT COMPUTERS (EVEN IDENTICAL COMPUTERS RUN BY DIFFERENT ORGANISATIONS) OFTEN HAVE DIFFERENT WAYS OF DOING THESE THINGS, SO IF YOU WANT TO TRY THE PROGRAM NOW GET SOMEONE WHO "KNOWS THE SYSTEM" TO SIGN ON FOR YOU AND CALL UP BASIC.

KEYBOARD

PROBABLY SOMETHING LIKE THIS

WHICH SETS THE COMPUTER TO WORK OBEYING THE STORED INSTRUCTIONS ONE AFTER THE OTHER IN NUMBERED SEQUENCE.
WHILST YOU RELAX.

EVENTUALLY THE COMPUTER WILL OBEY THE INSTRUCTION END THAT MAKES IT STOP.

IF YOU WANT TO TRY THE PROGRAM NOW GET SOMEONE WHO "KNOWS THE SYSTEM" TO SIGN ON FOR YOU AND CALL UP BASIC.

ALTHOUGH POSITIONS OF LETTERS & DIGITS ARE THE SAME ON MOST KEYBOARDS, KEYS LIKE IN THE PICTURE ABOVE VARY IN NAME, POSITION AND FUNCTION FROM ONE INSTALLATION TO ANOTHER.

NOTICE ALL LETTERS ARE CAPITAL LETTERS. NOTICE ALSO THERE IS A KEY FOR 1 AND A KEY FOR ZERO (BOTH IN THE TOP ROW). NEVER PRESS THE LETTERS I AND O IN THEIR PLACE.

AS ON AN ORDINARY TYPEWRITER, PRESSING AT THE SAME TIME AS ANOTHER KEY GIVES THE NUMBER OF KEYS SHOWN ON THE UPPER HALF OF THAT KEY.

THE "BACK ARROW" SERVES TO DELETE THE CHARACTER ON ITS LEFT FROM THE COMPUTER'S MEMORY; TWO OF THEM DELETE THE PREVIOUS TWO CHARACTERS, AND SO ON.

THUS IF YOU TYPE PRIMP...NT THEN BASIC RECEIVES THE WORD PRINT (REMEMBER THIS BY EXCLAIMING OH SHIFT! WHEN YOU HIT THE WRONG KEY.) SOME BASICS, HOWEVER, USE AN UNDERSCORE CHARACTER FOR THIS PURPOSE: PRIMP___NT.

MOST BASICS USE A KEY (PERHAPS "DELETE") WHICH, WHEN PRESSED, DELETES THE WHOLE OF THE LINE YOU ARE TYPING FROM THE COMPUTER'S MEMORY; ANOTHER (PERHAPS "BREAK") STOPS A PROGRAM RUNNING.

FOR A NEW LINE IN BASIC PRESS "RETURN".

BUT

"BUG" IS COMPUTER JARGON FOR A MISTAKE. THE BOOK SHOWS THIS LITTLE BUG AGAINST ILLUSTRATIONS OF MISTAKES IN PROGRAMS.

ILLUSTRATING BASIC PAGE 4
Chapter 1

Prepare your program by typing instructions at the keyboard. The computer simply stores the program at this stage.

It doesn't obey any instructions.

1. Read a program in basic
2. Data 6, 8, 37, 32
3. Read D, H, C
4. Let T = 3.14 * D * H/4
5. Let S = 3.14 * D ** 2
6. Let A = T
7. Let G = A/C
8. Let R = INT (G + 1)
9. Print "You need 3 pots"
10. End

Then type run, which sets the computer to work obeying the stored instructions one after the other in numbered sequence whilst you relax.

Eventually the computer will obey the instruction END, that makes it stop.

Before you can take the first step and start typing the program you have to go through the ritual of signing on and telling the computer you want to use BASIC.

But different computers (even identical computers run by different organisations) often have different ways of doing these things. So if you want to try the program now get someone who "knows the system" to sign on for you and call up BASIC.

Although positions of letters & digits are the same on most keyboards, keys like in the picture above vary in name, position and function from one installation to another.

Notice all letters are capital letters. Notice also there is a key for 1 and a key for zero (both in the top row), never press the letters I and O in their place.

As on an ordinary typewriter, pressing at the same time as another key gives the character shown on the upper half of that key. Thus together with gives # whereas alone, 3.

The "back arrow" serves to delete the character on its left from the computer's memory; two of them delete the previous two characters, and so on. Thus if you type PRINT "NT" then BASIC receives the word "PRINT" (remember this by exclaiming on shift! when you hit the wrong key). Some basics, however, use an underscore character for this purpose; PRIMP...NT.

Most basics use a key (perhaps "rubout") which, when pressed, deletes the whole of the line you are typing from the computer's memory; another (perhaps "break") stops a program running.

For a new line in BASIC press RETURN.

"Bug" is computer jargon for a mistake. The book shows this little bug against illustrations of mistakes in programs.

Illustrating Basic Page 4

Every program in basic has to be typed on a keyboard, probably something like this.

Although positions of letters & digits are the same on most keyboards, keys like in the picture above vary in name, position and function from one installation to another.

Notice all letters are capital letters. Notice also there is a key for 1 and a key for zero (both in the top row), never press the letters I and O in their place.

As on an ordinary typewriter, pressing at the same time as another key gives the character shown on the upper half of that key. Thus together with gives # whereas alone, 3.

The "back arrow" serves to delete the character on its left from the computer's memory; two of them delete the previous two characters, and so on. Thus if you type PRINT "NT" then BASIC receives the word "PRINT" (remember this by exclaiming on shift! when you hit the wrong key). Some basics, however, use an underscore character for this purpose; PRIMP...NT.

Most basics use a key (perhaps "rubout") which, when pressed, deletes the whole of the line you are typing from the computer's memory; another (perhaps "break") stops a program running.

For a new line in BASIC press RETURN.

"Bug" is computer jargon for a mistake. The book shows this little bug against illustrations of mistakes in programs.

Illustrating Basic Page 5
IF YOU INTEND TO USE BASIC A LOT, LEARN TOUCH TYPING. TEN FINGERS ARE FASTER AND LESS FRUSTRATING THAN TWO.

THERE IS A LIMIT TO THE LENGTH OF A TYPED LINE. MOST BASICS ALLOW LINES UP TO 72 CHARACTERS LONG. SOME ALLOW LONGER LINES BUT IT IS BEST TO ACCEPT A LIMIT OF 72.

SOME BASICS ALLOW GREAT FREEDOM WITH THE SPACE BAR. SOME DISREGARD SPACES EXCEPT THOSE BETWEEN QUOTATION MARKS. ThUS IT WOULD BE ALLOWABLE TO TYPE:

```
8 FORD = STOP
```

INSTEAD OF:

```
8 FOR D = S TO P
```

BUT IT IS OBVIOUSLY SILLY TO OBFUSCATE THE MEANING OF THE PROGRAM IN ORDER TO SAVE A FEW TAPS ON THE SPACE BAR.

SOME BASICS REFUSE TO ALLOW SPACES WITHIN THE CONTROLLING WORDS OF THE LANGUAGE. Thus the following would be wrong:

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

SOME BASICS DEMAND AT LEAST ONE SPACE BEFORE EACH CONTROLLING WORD, OR AFTER IT, OR BOTH:

```
20 DATA 6.5, 27, 236
80 PRINT "YOU NEED: R. " POTS"
```

SOME BASICS REFUSE TO ACCEPT SPACES WITHIN LINE NUMBERS BUT DO NOT OBJECT TO THEM INSIDE OTHER NUMBERS:

```
1000 LET A = 1000.0
1000 LET A = 1000.0
```

SOME BASICS DO NOT ALLOW SPACES IN FRONT OF LINE NUMBERS:

```
95 LET A = B
100 LET C = D + F
```

GENERALLY WHEN ONE SPACE IS ALLOWED (OR DEMANDED) THEN SEVERAL ARE ALLOWED, AND GENERALLY A SPACE IS OPTIONAL ON EITHER SIDE OF THESE:, ; * / = : > <.

BUT NOT IN 1.5E2 (SEE PAGE 9) NOR BETWEEN > AND = (SEE PAGE 41).

A PROGRAM WHICH ACCEPTS ALL THESE RESTRICTIONS SHOULD BE ACCEPTABLE TO ANY VERSION OF BASIC.

---

**LINE NUMBERS**

There is a mistake in this program. The last line was forgotten. Inserting it is simple; just type:

```
75 LET R = INT (G+1)
```

AND THE COMPUTER PUTS LINE 75 BETWEEN LINE 70 & LINE 90. IT MAKES NO DIFFERENCE IN WHAT ORDER YOU TYPE THE LINES. THE COMPUTER SORTS THEM INTO ASCENDING ORDER OF LINE NUMBER.

IF YOU TYPE SEVERAL LINES WITH THE SAME LINE NUMBER THE COMPUTER OBSCURES EACH PREVIOUS VERSION THEREFORE ACCEPTING THE LINE TYPED LAST IS JUST A LINE NUMBER WITH NOTHING AFTER IT THEN THE WHOLE LINE VANISHES FROM THE COMPUTER'S MEMORY INCLUDING THE LINE NUMBER. THAT IS HOW TO DELETE UNWANTED LINES, THUS:

```
120 LET A = B + C
125 LET E = F
120 LET A = B + G
125
120 LET A = B
```

RESULTS IN THE COMPUTER REMEMBERING ONLY:

```
120 LET A = B
```

THE FIRST LINE NUMBER IN A PROGRAM MUST BE GREATER THAN 0. THERE IS ALWAYS A LIMIT TO THE HIGHEST LINE NUMBER. SOME BASICS STOP AT 9999, SO IT IS BEST TO ACCEPT THIS AS THE LIMIT. THE LAST STATEMENT OF EVERY PROGRAM MUST BE (NO OTHER STATEMENT BUT THE LAST MAY SAY END).
**Typing**

If you intend to use Basic a lot, learn touch typing. Ten fingers are faster and less frustrating than two.

There is a limit to the length of a typed line—most Basics allow lines up to 72 characters long. Some allow longer lines but it is best to accept a limit of 72.

Some Basics allow great freedom with the space bar; some disregard spaces except those between quotation marks. Thus it would be allowable to type:

```
800 PRINT "YOU NEED; R; "POTS"
```

Instead of:

```
800 PRINT 'YOU NEED; R; "POTS"
```

But it is obviously silly to obscure the meaning of the program in order to save a few taps on the space bar.

Some Basics refuse to allow spaces within the controlling words of the language. Thus the following would be wrong:

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

Some Basics demand at least one space before each controlling word, or after it, or both:

```
20 DATA 6,5, 27, 28, 6-
80 PRINT 'YOU NEED; R; "POTS"
```

Some Basics refuse to accept spaces within line numbers but do not object to them inside other numbers:

```
1,000 LET A = 1,000,0
1000 LET A = 1000.0
```

Some Basics do not allow spaces in front of line numbers:

```
95 LET A = B
100 LET C = D+F
```

Generally when one space is allowed (or demanded) then several are allowed; and generally a space is optional on either side of these: (, ; * / = + - > < ) but not in 1.5E2 (see page 9) nor between > and = (see page 41).

A program which accepts all these restrictions should be acceptable to any version of Basic.

---

**Line Numbers**

There is a limit to the length of a typed line. Most Basics allow lines up to 72 characters long. Some allow longer lines but it is best to accept a limit of 72.

Some Basics allow great freedom with the space bar; some disregard spaces except those between quotation marks. Thus it would be allowable to type:

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20 DATA 6,5, 27, 28, 6-
80 PRINT 'YOU NEED; R; "POTS"
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Generally when one space is allowed (or demanded) then several are allowed; and generally a space is optional on either side of these: (, ; * / = + - > < ) but not in 1.5E2 (see page 9) nor between > and = (see page 41).

A program which accepts all these restrictions should be acceptable to any version of Basic.

---

**Illustrating Basic Page 6**

**Illustrating Basic Page 7**
A STATEMENT MAY SIMPLY STATE SOMETHING OR IT MAY INSTRUCT THE COMPUTER TO DO SOMETHING. A COMMON SYNONYM FOR STATEMENT IS INSTRUCTION; THE STATEMENTS THAT DO THINGS ARE EXECUTABLE INSTRUCTIONS. THE COMPUTER FINDS OUT WHAT IS STATED OR WHAT TO DO BY LOOKING AT THE FIRST WORDS DATA, END, READ, LET etc. OR SOMETIMES AT THE FIRST TWO WORDS: MAT READ, MAT PRINT etc. (WE MEET MAT ON PAGE 76). BUT THERE IS AN IMPORTANT EXCEPTION; THE WORD MAY BE OMITTED IN MOST VERSIONS OF BASIC.

A BASIC PROGRAM IS A SEQUENCE OF NUMBERED LINES CALLED STATEMENTS.

A REM STANDS FOR REMARK. REM STATEMENTS CAUSE NO ACTION BY THE COMPUTER; YOU INCLUDE THEM TO CLARIFY YOUR PROGRAM.

IN SOME BASICS THE BIGGEST NUMBER THAT CAN BE STORED IS APPROXIMATELY ±10^{38}. 10^{38} MEANS FAR FROM ZERO ON EITHER SIDE; SMALL MEANS CLOSE TO ZERO ON EITHER SIDE. IT DEPENDS ON THE COMPUTER’S “WORD LENGTH” AND WHETHER THE “WORDS” ARE USED SINGLY, IN PAIRS, OR IN MULTIPLES. BUT NO BASIC SHOULD REFUSE TO HANDLE A NUMBER AS BIG AS ±1,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000

IN SOME BASICS THE PRECISION OF STORAGE AND ARITHMETIC IS BETWEEN 6 AND 7 SIGNIFICANT DECIMAL DIGITS (987,654,321) WOULD BE STORED AS APPROXIMATELY 987,654,321. OTHER BASICS OFFER MUCH HIGHER PRECISION, IS SIGNIFICANT FIGURES BEING TYPICAL. AGAIN IT DEPENDS ON THE COMPUTER’S “WORD LENGTH” AND HOW THE “WORDS” ARE USED. BUT NO BASIC SHOULD WORK TO LESS PRECISION THAN 6 TO 7 SIG. FIG.

THE VAGUENESS OF “6 TO 7” IS BECAUSE MOST COMPUTERS USE BINARY ARITHMETIC, NOT DECIMAL. A MORE PRECISE RENDERING WOULD BE “24 BINARY DIGITS FOR POSITIVE NUMBERS, 23 FOR NEGATIVE, OR VICE VERSA.” BUT THESE IMPLICATIONS NEED NOT BOther THE NOVICE TO BASIC.
STATEMENTS

A statement may simply state something:

30 READ A,B,C
40 LET G = A*B+2+C
50 PRINT "ANSWER IS"; G

Or it may instruct the computer to do something:

A common synonym for statement is instruction:

30 READ A,B,C
40 LET G = A*B+2+C
50 PRINT "ANSWER IS"; G

The statements that do things are executable instructions:

The computer finds out what is stated or what to do by looking at the first word: Data, End, Read, Let etc.

Or sometimes at the first two words: Mat, Read, Mat, Print etc. (We meet Mat on page 76.)

But there is an important exception:

The word Let may be omitted in most versions of Basic.

40 G = A*B+2+C

REMARKS

Rem statements cause no action by the computer. You include them to clarify your program:

10 REM *** WATER TANKS ***
20 REM
30 REM A PROGRAM TO ILLUSTRATE BASIC
40 REM FOR EMBELLISHMENT
50 DATA 6.5, 27, 236
60 REM DIAM, HEIGHT, COVERAGE

The examples in this book do not have many "Rem" statements because I have annotated programs with little arrows and clouds so as to save space.

NUMBERS

You can type numbers three ways:

(a) As integers
(b) As reals or in E-form

Integer form:

\[ \begin{align*}
160 \text{ DATA } & 1, 2, 4, 1000, -30 \\
170 \text{ END}
\end{align*} \]

Real form:

\[ \begin{align*}
160 \text{ DATA } & 1.7, 4.5, 1000, -30 \\
170 \text{ END}
\end{align*} \]

E-form:

\[ \begin{align*}
160 \text{ DATA } & 1E3, 13.6E4, 13.6E-4, -13.6E9 \\
170 \text{ END}
\end{align*} \]

E introduces an integer saying how many places to shift the decimal point. Shift to the right if the integer is positive; otherwise left.

In the E form there must always be a number in front of the E and an integer after it. Some Basics allow spaces within an E form but it is best not to have them.

\[ \pm 10^{38} \]

In some Basics the biggest number that can be stored is approximately \( \pm 10^{38} \).

Other Basics can handle much bigger numbers than \( \pm 10^{38} \). It depends on the computer's "word length" and whether the "words" are used singly, in pairs, or in multiples. But no Basic should refuse to handle a number as big as \( \pm 100,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000 \).

In some Basics the precision of storage and arithmetic is between 6 and 7 significant decimal digits. 987,654,321 would be stored as approximately 987,654,000. Other Basics offer much higher precision. It is significant figures being typical. Again it depends on the computer's "word length" and how the "words" are used. But no Basic should work to less precision than 6 to 7 sig figs. The vagueness of "6 to 7" is because most computers use binary arithmetic, not decimal. A more precise rendering would be: "24 binary digits for positive numbers, 23 for negative, or vice versa" but these implications need not bother the novice to Basic.
VARIABLES

There are 286 Simple Numerical Variables in Basic.

We saw some of these on page 3. They are the little boxes used to hold numbers.

The full 286 are shown below. It is useful to keep a large-scale chart like this and make a photocopy for each new program. As you use each variable, write a note in its box saying what you use it for. This stops you from using variables already used for something else—a common source of trouble.

Useful to keep a large-scale chart like this and make a photocopy for each new program.

The first is the one on page 3 with new line numbers, and make a photocopy for each new program.

**REPLACEMENT**

Putting a number into a variable simply replaces the one already there. Compare the following two programs:

The first is the one on page 3 with new line numbers; the second does the same job but uses variable \( T \) over and over again.

When a program starts running, every variable has some initial value; it depends on the version of Basic. What that value is in some Basics it is \( \text{zero} \); in some it is whatever the previous program left behind. In others it is a special signal to say \( \text{variable not set} \). In the following complete programs:

10 REM TO ILLUSTRATE REPLACEMENT
20 DATA 6.5, 27, 236
30 READ \( D, H, C \)
40 LET \( T = 3.14 \times D + 2/4 \)
50 LET \( E = 3.14 \times D + H \)
60 LET \( A = T + S \)
70 LET \( G = A/C \)
80 LET \( R = \text{INT}(G+1) \)
90 PRINT "YOU NEED"; \( R; "POTS" \)
100 END

10 REM TO ILLUSTRATE REPLACEMENT
20 DATA 6.5, 27, 236
30 READ \( D, H, C \)
40 LET \( T = 3.14 \times D + 2/4 \)
50 LET \( E = 3.14 \times D + H \)
60 LET \( T = T/C \)
70 LET \( T = \text{INT}(T+1) \)
80 PRINT "YOU NEED"; \( T; "POTS" \)
90 END

You might get 0 or rubbish like \(-123.456\) or a message from the computer to say it cannot go on because variable \( V \) is not set when first used. Don't rely on any variable being zero when the program starts; set it first.

10 LET \( V = 0 \)
**CHAPTER HAPK-R**

**VARIABLES**

There are 286 simple numerical variables in Basic.

We saw some of these on page 3. They are the little boxes used to hold numbers.

The full 286 are shown below. It is useful to keep a large-scale chart like this and make a photocopy for each new program. As you use each variable, write a note in its box saying what you use it for. This stops you using variables already used for something else—a common source of trouble.

**REPLACEMENT**

You may use each variable many times.

Putting a number into a variable simply replaces the one already there, compare the following two programs:

The first is the one on page 3 with new line numbers:

```
10 REM A PROGRAM IN BASIC
20 DATA 6.5, 27, 236
30 READ D, H, C
40 LET T = 3.14 * D + 12 / 4
50 LET E = 3.14 * D * H
60 LET A = T + 3
70 LET G = A / C
80 LET R = INT (G + 1)
90 PRINT "YOU NEED" ; R ; "POTS"
100 END
```

The second does the same job but uses variable T over and over again:

```
10 REM TO ILLUSTRATE REPLACEMENT
20 DATA 6.5, 27, 236
30 READ D, H, C
40 LET T = 3.14 * D + 12 / 4
50 LET T = T + 3.14 * D * H
60 LET T = T / C
70 LET T = INT (T + 1)
80 PRINT "YOU NEED" ; T ; "POTS"
90 END
```

When a program starts running every variable has some initial value; it depends on the version of Basic what that value is. In some Basics it is zero; in others it is whatever the previous program left behind. In others it is a special signal to say variable not set. So in the following complete program:

```
10 REM TO ILLUSTRATE REPLACEMENT
20 DATA 6.5, 27, 236
30 READ D, H, C
40 LET T = 3.14 * D + 12 / 4
50 LET T = T + 3.14 * D * H
60 LET T = T / C
70 LET T = INT (T + 1)
80 PRINT "YOU NEED" ; T ; "POTS"
90 END
```

You might get zero or rubbish like -123.456 or a message from the computer to say it cannot go on because variable V is not set when first used. Don't rely on any variable being zero when the program starts; set it first:

```
10 LET V = 0
```

**Chapter:**

Illustrating Basic page 10
BASIC CAN HANDLE WORDS AS WELL AS NUMBERS. WE SAW THIS ON PAGE 4.

9 PRINT "YOU NEED"; R; "POTS"
10 END
RUN
YOU NEED 3 POTS

THE "YOU NEED" AND THE "POTS" ARE CALLED TEXTS IN THIS BOOK. OTHER TERMS IN THE JARGON ARE STRING; LITERAL STRING; ALPHAMERIC STRING; ALPHAMERIC LITERAL; AND THERE MAY BE MORE.

TEXTS ARE WORDS OR SENTENCES OR ARRANGEMENTS OF CHARACTERS ENCLOSED IN QUOTATION MARKS. BY THIS DEFINITION YOU CAN'T HAVE A TEXT CONTAINING QUOTATION MARKS BECAUSE THE COMPUTER WOULD THINK THEY MARKED THE END OF IT; BUT YOU CAN HAVE APOSTROPHES IN TEXTS:

20 PRINT "IT'S EASY"

HOWEVER, SOME BASICS ALLOW TEXTS TO BE ENCLOSED BETWEEN APOSTROPHES AS AN OPTION; SUCH TEXTS MAY HAVE QUOTATION MARKS IN THEM BUT NOT APOSTROPHES. GET ROUND THE PROBLEM BY TREATING A PAIR OF QUOTATION MARKS INSIDE A TEXT AS SIGNIFYING A SINGLE QUOTATION MARK:

30 PRINT "SHE SAID "OHH!"

PRODUCES:

"SHE SAID "OHH!"

BUT IT IS BEST TO AVOID HAVING QUOTATION MARKS IN TEXTS.

SEMICOLONS IN THE "PRINT" STATEMENT MAKE THE COMPUTER ABUT THE THINGS TO BE PRINTED ONE AGAINST THE OTHER; COMMAS WOULD MAKE THE COMPUTER SPREAD THEM OUT ACROSS THE PAGE. ALL THIS IS EXPLAINED FROM PAGE 28 ON, WHERE THE "PRINT" STATEMENT IS EXPLAINED IN DETAIL.

TEXTS IN THE "PRINT" STATEMENT MAY BE OF ANY LENGTH THAT WILL FIT THE LINE BEING TYPED. IF YOU WANT SOMETHING PRINTED RIGHT ACROSS THE OUTPUT PAGE YOU MUST PRINT TWO OR MORE TEXTS; ALL BUT THE LAST HAVING A SEMICOLON AFTER THEM.

120 PRINT "-------------------"
130 PRINT "-------------------"
140 PRINT "-------------------"

TEXTUAL VARIABLES MAY BE SET BY "LET" STATEMENTS:

10 LET W$ = "***"
20 LET Z$ = "ONLY 18 CHARACTERS STORED"
40 END
RUN
***ONLY 18 CHARACTERS***

TEXTUAL VARIABLES MAY ALSO BE SET BY "READ" (PAGE 16) AND BY "INPUT" (PAGE 18). THEY MAY BE COMPARED BY "IF" (PAGE 41).
THE "YOU NEED" AND THE "POTS" ARE CALLED TEXTS IN THIS BOOK. OTHER TERMS IN THE JARGON ARE STRING; LITERAL STRING; ALPHANUMERIC STRING; ALPHANUMERIC LITERAL; AND THERE MAY BE MORE.

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```

HOWEVER, SOME BASICS ALLOW TEXTS TO BE ENCLOSED BETWEEN APOSTROPHES AS AN OPTION; SUCH TEXTS MAY HAVE QUOTATION MARKS IN THEM BUT NOT APOSTROPHES. OTHER BASICS GET ROUND THE PROBLEM BY TREATING A PAIR OF QUOTATION MARKS INSIDE A TEXT AS SIGNIFYING A SINGLE QUOTATION MARK:

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```

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```
120 PRINT  "--------------------"
130 PRINT  "--------------------"
140 PRINT
```

TEXTUAL VARIABLES MAY ALSO BE SET BY "READ" (PAGE 16) AND BY "INPUT" (PAGE 18). THEY MAY BE COMPARED BY "IF" (PAGE 41).
BOOK REVIEWS

The BASIC book business is hotly contested. Preparing for this review, we found more than a dozen widely-available texts from a variety of publishers, ranging from hobby computer firms to conventional hard-back houses. Among computer languages, Basic is relatively easy to learn; it is also widely available. It will almost certainly be one of the languages, probably the only one, offered with any small system you consider.

We used two reviewers; one was an experienced computer user, consultant and teacher of dp concepts, the other a newcomer, with a very recent low-level introduction to the subject of computing. The books we chose illustrate the several different styles available to the Basic book writer; there are many other titles, of course, and we would be glad to hear of any personal preferences from readers.

ELEMENTS OF BASIC
by R. Lewis and B. H. Blakeley
published by NCC Publications Ltd, 1972
cloth cover: A4
price £3.

In such a competitive market, there are a number of ways of selling a book. You might commission a well-known author from another field. You might be a well-known publisher yourself. Or you can rely on gimmicks.

The NCC Elements of BASIC falls into the second category. One could reasonably expect it to sell a large number of copies simply because it is published by the National Computing Centre. The book is fairly conventional, an A4 paperback, with the slight difference that it is laid out sideways, giving two columns to a page.

Simple in approach

In some places, the format is used to good effect—for example, by listing a program in the right-hand column with the accompanying text in the left. It might have been advantageous further to exploit this feature.

Its introduction proclaims that “a great deal of attention has been given to its design so that it can be used as part of a course in computing at secondary school level”. The book is essentially simple in approach and could be of use for self-teaching; this is helped by the extensive use of flowcharts for sample programs.

Similarly, the authors try to adopt a friendly stance, involving much use of the personal pronoun. “Some BASIC systems require us to reserve space... we have seen that... you may have tackled problem 1c. 3 earlier...”.

As a style of English, this is frequently condescending and occasionally irritating. Neither characteristic improves the appeal or the lucidity of the book.

How about this? “If it is desired to have the numbers printed in descending order, you may change statement 140...”. What the writer means by this confusion of the personal and impersonal is something like “if you want the numbers printed in descending order...”.

The book is also misleading at times. “Statements are stored in the computer at specific addresses (their statement number)...”. Well, the first part of this is self-evident; and statement numbers do not relate to specific addresses.

Elsewhere there is the instruction LET A=A+2 with the comment “notice that ‘2’ is not contained in a storage location but is generated by the computer when required”. By this the authors mean that ‘2’ is not a variable and it is not an address; their phrasing, however, leaves plenty of room for confusion.

Similarly, there are points which pass unexplained. On string-handling, the book states correctly that BASIC imposes a limit on the number of characters allowed in a string; it then says that “we shall restrict ourselves to 40 characters” with no explanation of this, apparently arbitrary limitation.

Likely to confuse

In fact, the maximum number of characters in a string differs from one implementation of the BASIC language to another. Some allow as many as 4,096 characters, others as few as 18. Alcock’s book points out that if you adopt 18 as the upper limit, you will be learning a use of character string which will apply to any BASIC.

The 40-character restriction would be acceptable, if explained, provided the authors concentrated on the same system throughout the book. Unfortunately, that is not the case. One chapter states specifically that all the programs in it were run on different computers; at best, that is likely to lead to confusion.

Also likely to confuse are statements like “on the system used to run the program, a number is printed for a %”. In a book which seems to have had a fairly expensive production, it would have needed little effort to edit the program so that the student was not required to remember the alteration.

The book uses program listing taken directly from the computer printout. This (continued on next page)
The tricky question of file handling, which can vary dramatically from one BASIC to another, is dealt with by a chapter covering "the main ideas, problems and flowcharts", while some specific BASIC implementations are treated in an appendix. The authors picked six simple file handling programs and show how they are coded in nine different BASICS.

Could be updated

Only two of those can legitimately be described as minicomputers—the HP 2000 and CTL Modular One—and both machines have now been superseded by newer models. The other implementations are on two time-sharing services (IBM and Honeywell), two ICL mainframes (1900 and System 4), one deleted system (Xerox Sigma), the Burroughs B7000 (now virtually displaced by the newer B8000), and the DECSystem-10.

As illustrations of alternative BASICS, this multiple-machine appendix is interesting, particularly as the authors' annotations are useful and to the point, but the computer business moves quickly, and this book dates from 1972. Some more up-to-date examples might be more valid.

CONCLUSION

- Overall we found the book competent but boring, generally worthy but often patronising, concerned to make the instruction comprehensive rather than effective.

INTERACTIVE COMPUTING WITH BASIC – A FIRST COURSE

by Donald M. Munro

published by Edward Arnold Ltd, 1974

paperback: A4

price £3.25

Another fairly conventional book. Designed originally for use by electrical engineering students at Imperial College, London, it has a very strong mathematical bias to its examples. They show the power of the language but it will deter many people. The sections on matrix operations are particularly impenetrable, and some readers would not wish to be able to solve the Laplace equation in BASIC. A lack of interest in the examples might well be reflected in the reader's attitude to BASIC itself.

That is a pity, since the book, in general, shows much evidence of thought and care in its preparation—for a start, there is a really handy list of BASIC statements inside the front covers and the language is summarised in a useful appendix.

Style is terse

It was never written for business users and for them its inappropriateness is made more certain by the absence of a description of some language features which would be of particular use to such people.

The most important omission is some coverage of file handling—although the book deals with the use of a READ statement from DATA within the program. Similarly, little attention is paid to features of the BASIC system as opposed to those of the language. The general style is terse and the approach of the book definitely displays its origins. We cannot comment on its suitability as a textbook for scientifically-orientated undergraduates, which is undoubtedly its chief aim but we could not recommend it as an introduction to BASIC or a self-instruction text for business users.

CONCLUSION

- Conventional, competent, probably a good textbook for anyone who requires to learn the language for solving problems with a mathematical bias, but not for the small business system buyer.
(continued from previous page) one way of graphics—fancy borders, illustrations, line drawings and a variety of aggressive typefaces.

That approach does not work. It does not serve to break up the text in an inter-
esting and attractive manner, it does not make the book “fun to read” and it certainly does not make it easy to use.

In fact, Instant BASIC is not as bad as it sounds. It covers most of BASIC and it does so quite accurately—we found no obvious flaws in the text. It is aimed squarely at the novice—it even tells you in quite banal detail how to use a keyboard—and it applies to small computers; both attributes separate this book from many others.

In our view, though, the design and presentation of Instant BASIC are a serious misjudgment, and that title should not be taken too literally—the book has 158 pages, each of which must be read.

CONCLUSION

CRITICISME

Good try in terms of ambitions, an explicit and sometimes simply monotonous rendition of the Altair and Digital versions of BASIC, an irritating and ultimately unreadable presentation if you do not share its ideas on humour and style.

ILLUSTRATING BASIC

by Donald Alcock

published by Cambridge University Press,

1977

paperback, A5

price £1-50 (hardback at £4-95)

WE LEFT the best until last. This book also adopts a somewhat gimmicky style—it is handwritten throughout, including the printout examples. On the other hand, this imparts an appealing quirkiness rather than the offensive self-congratulation which might have ensued.

Alcock’s introduction does not seek to explain the absence of type-setting but it indicates a dry wit we liked: “My book is informal in language and unusual in presentation. Rather than write a justification I would remark only that a careful reader might diagnose a severe astigmatism in my eye and a persistent shake in my hand.”

Practical Computing readers may already have deduced that the reviewers liked this book. It should be, however, that handwriting can be tiring if you read much of it at a time—that might not be very likely, of course; and at least one of us took issue with Alcock’s idiosyncratic hyphens—larger than the average printed dash, resembling a somewhat tipsy slug, and casting a fat shadow.

The pen, however, also gives the ability to use more graphic means of representing concepts than is usually the case. For example, a bug appears in text like a cross between a ladybird and an untidy spider—very effective.

The book is written at a fairly introductory level. As such it is clearly appropriate for the novice but it seems unlikely to satisfy one category at which it is apparently aimed, namely those that are already able to program reasonably well in BASIC and who need a reference work. Nevertheless, even such people would gain some useful information about the language from this book, though an alternative like the NCC one might make a better reference textbook.

Dialect problem

From the start the author makes the point that there are many versions of the BASIC language and that they are noticeably different. He says “I have accepted this as a fact of life and, in writing this book, kept at my side manuals, each defining a different BASIC”.

Discussing the language function, he has attempted to show the differences between dialects; this might result in the reader knowing all the differences between various dialects, while being unable to program in any one of them. An alternative approach might have been to concentrate on one version, perhaps pointing out the various differences in an appendix.

What Alcock does, in fact, is to present a truly portable BASIC as far as he can. In particular, where there are differences in scope he will pick the interpretation which covers most of the options. For instance, as we noted earlier there is considerable variety in just how many characters you can have in a string. Illustrating BASIC points out that if you assume 18 is the maximum, you will be writing BASIC programs with text strings which should run on most machines.

There are few technical errors in the text and we had to search to find any inadequate statements. Here is one, though: “In some BASICS, the biggest number which can be stored is approximately $\pm 10^4$”. This is meaningless un-
critised for attempting to satisfy everyone if he succeeds—and, by and large, he does.

Arrays and matrices are probably the most difficult aspect of BASIC for the novice business system user to grasp. Alcock gives plenty of description on arrays without saying what difference there is between an element in an array and a ‘simple’ variable. That is not too bad, in fact—the relationship becomes clearer with practice.

Matrix algebra can, however, become tricky. As Alcock says, “In BASIC a matrix is simply a rectangular array of subscripted variables... Don’t run away—you don’t have to know matrix algebra to find MAT statements useful”. In principle he is right, and his treatment of this area is as lucid as any we have seen.

On the other hand, MAT arithmetic and knowledge of matrices in general are by no means essential to writing business-orientated programs.

It is refreshing to find a BASIC text which takes this much care over the needs of readers, rather than stopping short at the nature of the language.

CONCLUSION

CRITICISME

Humane, interesting, comprehensive, and—in paperback form, at least—excellent value for money. Congratulations to the author. Very highly recommended.

PRACTICAL COMPUTING October 1978
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Stop press...

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Admission: £4.50 (inc. VAT). Lunch will be available at £4.00 (inc. VAT) per head if there is sufficient demand.

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TAKING THE CHORE OUT OF VAT

Probably one of the most disliked and time-consuming of the statutory chores imposed on businessmen is the calculation of Value Added Tax returns. Accounting for VAT was thus a natural application for one of the low-cost, microprocessor-based computers. A computer will not abolish the amount of work but it will reduce it substantially, with the bonus of increased accuracy and clarity of records.

This is the first of two articles which will contain a complete suite of programs written to handle VAT accounting. They are written in TDL Basic but can, with minor modifications, be run with most versions of Basic available on small computers.

BEFORE discussing the design and use of these programs it is necessary to point out that they have certain limitations which all potential users must bear in mind. The most important is that they have not been cleared by Customs and Excise as a computerised VAT system.

By virtue of the audit trails and transaction listings produced on hard copy, however, they do not have to be authorised; they represent one method among many for accounting for VAT. The second limitation is that although the system can handle credit notes, imports and exports, as well as normal sales and purchases, it has not been designed to cope with any of the retailers' VAT schemes.

Time-consuming

The author's business deals with retail sales of microcomputer equipment, mainly complete systems. Therefore some method of recording the appropriate details was needed, namely tax point date; some method of identifying the transaction back to the invoice; an indicator to signify whether to add, delete or change the record in question; the type of transaction—sale, purchase, import; the VAT rate applicable; the values involved—VAT, gross & nett value; some indicator as to the VAT return classification.

As I do not participate in one of the retailers' VAT schemes, I needed only to account for VAT on a transaction-by-transaction basis, with some method of reading all the records for a chosen VAT period and deriving the figures required for my VAT return—probably the most time-consuming part of VAT accounting.

Before you can claim VAT relief on a purchase you need to be registered; the purchase must be wholly as a result of your business needs; and the supplier's invoice must show the minimum of information as required by law.

The system does not hold all this information on the computer, as the key to the system is a number held on the VAT transaction record and written on the original invoice. Thus an audit trail exists, both forwards from the original, into the system, and backwards from the system to the original documents.

The programs listed in this article are written in a pre-release version of TDL Disc Basic for use under the Digital Research operating system CP/M on Z80 systems. The minimum requirements are the provision of an operating system and Basic which allows sequential disc file accessing of up to three files at once, console device, a list device and memory sufficient to allow an internal memory sort of the largest transaction file you will ever create in one run.

Minimum of change

To use these listings with the minimum of change a good extended Basic will be required—North Star, Microsoft, Cromemco. I use a Lear Siegler ADM-3A, PerSCI dual discs running under CP/M, 48K of memory, and an old Teletype model 33 as the list device.

The current system has no automatic control of file versions, although this would be relatively easy to add. You are required to keep a log of which files are what. Also, due to my business being relatively small in terms of individual transaction value, no single transaction with a gross value larger then £9,999.99 (continued on next page)
THE NORTH STAR HORIZON COMPUTER

HORIZON—a complete high performance computer system with integrated floppy disk memory.

HORIZON is attractive, professionally engineered and ideal for business, educational and personal applications.

To begin programming in Extended BASIC, merely add a CRT, Teletype or other hardcopy terminal.

HORIZON is a 2MHz processor, 256K 16K RAM, minifloppy disk and 18-slot S-100 motherboard with serial interface, all standard.

HORIZON includes the North Star DOS, Monitor and Extended BASIC from diskette ready at power on. Optional software includes utilities, assemblers, APL, games, debuggers, text editors, COBOL, Fortran and more.

Quality at the right price:
* Horizon-1 (single drive): £1,275
* Horizon-2 (dual drives): £1,550

All prices are for assembled and tested units, exclusive of VAT and carriage, and subject to change.

The system consists of four programs in the old-fashioned classic system architecture—a data entry and format validate program, a sort, an update master file program and finally the report program.

The data entry program collects data entered by the user from invoices, performs validation on fields, outputs to both the list device and to a disc file.

Under CP/M many transaction files can be created and concatenated into one prior to the sort using PIP—Peripheral Interchange Program, a CP/M utility.

Thus as long as you keep a record, data entry can be performed as often as required. The sort uses the file created by the data entry program as input, reads all the records into memory, and sorts them into ascending order based on the 13-byte key (more of which later).

Once the sort is completed, the records are output to a file with the same name as the input, but with an extension of 'new'. A previously-created master file is input to the update program, along with the sort's transaction file. Records are added, deleted or replaced as appropriate.

As this is being done, a listing is produced of the actions being taken and this provides the audit trail so necessary in accounting. As in all the programs, control totals are produced for clerical reconciliation.

Cassette changes

The listing of the update should be perused by the user to spot if any errors have occurred and, if so, they should be corrected by creating the appropriate transactions using the data entry program and performing the sort, update cycle again. Once satisfied that all data which should be on the master file is present—i.e. all that period's invoices—and it is all correct, the report program may be run.

The report program asks for the file name, as do the other programs, and then asks for the dates in which the period falls. The dates must be correct for the VATman to be happy. The master file is read and the data accumulated to produce a report in VAT return format. Once again, the controls should be reconciled and, once done, the report transcribed on to the return, signed and posted.

For those with only cassette drives, programs one and four can be amended by you to run on cassettes, and this would give some assistance to VAT record-keeping. You would lose the ability to sort and update, unless you had three cassette drives but you could ensure that all one period's transactions went on to the transaction file, which the report program will work from with little amendment.

TDL Basic supports print and input statements to the console—device #0 or the default device; a list device— & device #2; a reader—device #3; a punch—device #4; and disc files—device #5 to 255. Device #1 is reserved for the program load/save device—normally a disc file. The disc files require to be explicitly opened.

Open #<Unit>, <Mode>, <FileName> where unit is number, mode is a string with the value of "I" for input, "O" for output, "R" for random mode and "U" for update in place mode. <FileName> is any CP/M acceptable filename string. The file is then accessed by reference to its unit number in print or input operations, which are ASCII mode commands.

Ease of testing

Internal format storage is also supported—via write & read statements—but I have used ASCII for ease of testing and cross-machine support. Once a file has been opened, if input, an EOF statement is required to direct action at end of file; e.g., 1200 on EOF #5 GOTO 1340.

In this system all disc data is handled as string variable records of 63 bytes length (not including the CR, LF). The record size is not required by the system as it uses the CR, LF or the 'quote marks' to delimit the records. Thus to read a record:

1210 INPUT #<Unit>, TLS

This would input the next record into string variable TLS, where I can then dissect it, using the MID$ and VAL (QV) functions.

An output file must be closed to ensure that the end of file marker is written and CP/M marks its own EOF on the file.

This is accomplished by

1400 CLOSE #<Unit>, <Unit>

This would close files 5 and 6. An all-embracing close is available, which is close without any reference to a unit. The clear statement has an I/O function not normally seen. A clear statement under TDL Disc Basic has a second argument, e.g.

CLEAR 3000, (N)

The <N> is the total number of disc files which will be open at any one time. This is required to reserve space for the file control blocks needed under CP/M.

TDL Disc Basic has numerous other I/O options but as none of them is invoked I will desist from a tedious explanation.

TDL Basic has an extensive repertoire

(continued on next page)
Basics typing a comma followed by zero, comma, zero and return will be sufficient.

The next set of data entered consists of a single character to indicate if the transaction is to add, delete or replace a record on the master file. This is followed by up to 23 characters of 'comment'—type data—normally supplier's name and invoice number, or customer's name. Not all this data is printed, but all 23 characters are held on the record. If this system is to be interfaced to an accounts-payable and/or accounts-receivable system, this field can be used for account coding information.

The last entry indicates whether the transaction is a normal sale(s), a normal purchase(p), or one of the 'specials'. A look at the corresponding entry for transaction 5 will show the codes available.

In a 'D' was entered as the transaction type, no modification will be requested from the user, as the rest of the fields will be filled-in for him, as a delete does not require values. Transaction 4 is an example of such a transaction.

Calculates values

The third set of data requested is the VAT rate—S for standard, A for higher rate, and Z for zero rate. These rates are held in the program against the code indicated. A change in VAT rates will require values. Transaction 4 is an example of such a transaction.

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(continued from previous page)

**VAT TRANSACTION & MASTER FILE LAYOUT**

<table>
<thead>
<tr>
<th>START</th>
<th>NO</th>
<th>POS</th>
<th>VAR</th>
<th>BYTES</th>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TAX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>2</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>3</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>4</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>5</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>6</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>35</td>
<td>7</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>40</td>
<td>8</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>45</td>
<td>9</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>10</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>55</td>
<td>11</td>
<td>TDC</td>
<td></td>
<td>TRANSACTION TX DATE (YYMMDD)</td>
<td></td>
</tr>
</tbody>
</table>

**VALUES FOR STS ARE AS FOLLOWS:-**

0 = EXIT SALE CLASS
1 = VALUE ADDED TAX DECLARATION
2 = VAT DUE ON UNDERDECLARATIONS, NOTIFIED BY CUSTOMS
3 = VAT DUE ON OTHER UNDERDECLARATIONS
4 = VAT REFUNDABLE DUE TO ASSET PURCHASE
5 = VAT DUE ON OVERDECLARATIONS, NOTIFIED BY CUSTOMS
6 = VAT DEDUCTIBLE ON OTHER OVERDECLARATIONS
7 = NORMAL TAXABLE SUPPLY (S&L)
8 = NORMAL TAXABLE SUPPLY (S&L)
9 = NORMAL TAXABLE SUPPLY (S&L)

**8** = NORMAL TAXABLE PURCHASE (BOTH THESE MAY BE ZERO RATED)

1 = EXEMPT TRANSACTION (SALE)

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Systems and software for business and process control applications.

**Circle No. 138**
PRACTICAL COMPUTING  ACTION CREATE  SUITE VAT DATA ENTRY & TRANSACTIONS  =  ADDITIONS (continued from previous page) 770 750 M=VAL(MIDS(TDS, 3, 2)) 420 410 REM IF NULL STRING INPUT AS TD$ THEN 690 680 REM PRINT HEADINGS 630 REM INIT OTHER VALUES HERE 560 REM OPEN #5 AGAIN ! 500 REM TLS- STRING PORTION OF RECORD 420 REM VKS- TOTAL NETT VALUE 400 REM 1$= - 340 REM TLS- STRING PORTION OF RECORD 340 REM TLS= TOTAL DATE YYMMDD 300 REM TC$- TRANS CODE IN YYNNN 200 REM TC$= TRANS CODE IN YYYNNN 210 REM SS- SERIAL NUMBER WITHIN THE TRANSACTION (1-9999) 200 REM SS- SERIAL NUMBER WITHIN THE TRANSACTION (1-9999) 110 REM CP$- COMMISSION PERCENTAGE 100 REM CP$- COMMISSION PERCENTAGE 210 REM TDS- TRANSACTION DATE YYMMDD 200 REM TDS- TRANSACTION DATE YYMMDD 110 REM M$- MESSAGING NUMBER 100 REM M$- MESSAGING NUMBER 810 REM G=100 IF M$ = "8" THEN 1$ = "I" 780 REM G=100 IF M$ = "8" THEN 1$ = "I" 300 REM TC$= TRANS CODE IN YYNNN 290 REM TC$= TRANS CODE IN YYNNN 800 REM IF M$ = "1" OR M$ = "2" THEN PRINT "ERROR IN 790 REM IF M$ = "1" OR M$ = "2" THEN PRINT "ERROR IN 290 REM TC$= TRANS CODE IN YYNNN 280 REM TC$= TRANS CODE IN YYNNN 780 REM M<1 OR M>12 THEN PRINT "ERROR IN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 280 REM TC$= TRANS CODE IN YYNNN 270 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 760 REM M<1 OR M>12 THEN PRINT "ERROR IN 270 REM TC$= TRANS CODE IN YYNNN 260 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 750 REM M<1 OR M>12 THEN PRINT "ERROR IN 260 REM TC$= TRANS CODE IN YYNNN 250 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 740 REM M<1 OR M>12 THEN PRINT "ERROR IN 250 REM TC$= TRANS CODE IN YYNNN 240 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 730 REM M<1 OR M>12 THEN PRINT "ERROR IN 240 REM TC$= TRANS CODE IN YYNNN 230 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 720 REM M<1 OR M>12 THEN PRINT "ERROR IN 230 REM TC$= TRANS CODE IN YYNNN 220 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 710 REM M<1 OR M>12 THEN PRINT "ERROR IN 220 REM TC$= TRANS CODE IN YYNNN 210 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 700 REM M<1 OR M>12 THEN PRINT "ERROR IN 210 REM TC$= TRANS CODE IN YYNNN 200 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 690 REM M<1 OR M>12 THEN PRINT "ERROR IN 200 REM TC$= TRANS CODE IN YYNNN 190 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 680 REM M<1 OR M>12 THEN PRINT "ERROR IN 190 REM TC$= TRANS CODE IN YYNNN 180 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 670 REM M<1 OR M>12 THEN PRINT "ERROR IN 180 REM TC$= TRANS CODE IN YYNNN 170 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 660 REM M<1 OR M>12 THEN PRINT "ERROR IN 170 REM TC$= TRANS CODE IN YYNNN 160 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 650 REM M<1 OR M>12 THEN PRINT "ERROR IN 160 REM TC$= TRANS CODE IN YYNNN 150 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 640 REM M<1 OR M>12 THEN PRINT "ERROR IN 150 REM TC$= TRANS CODE IN YYNNN 140 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 630 REM M<1 OR M>12 THEN PRINT "ERROR IN 140 REM TC$= TRANS CODE IN YYNNN 130 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 620 REM M<1 OR M>12 THEN PRINT "ERROR IN 130 REM TC$= TRANS CODE IN YYNNN 120 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 610 REM M<1 OR M>12 THEN PRINT "ERROR IN 120 REM TC$= TRANS CODE IN YYNNN 110 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 600 REM M<1 OR M>12 THEN PRINT "ERROR IN 110 REM TC$= TRANS CODE IN YYNNN 100 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 590 REM M<1 OR M>12 THEN PRINT "ERROR IN 100 REM TC$= TRANS CODE IN YYNNN 90 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 580 REM M<1 OR M>12 THEN PRINT "ERROR IN 90 REM TC$= TRANS CODE IN YYNNN 80 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 570 REM M<1 OR M>12 THEN PRINT "ERROR IN 80 REM TC$= TRANS CODE IN YYNNN 70 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 60 REM M<1 OR M>12 THEN PRINT "ERROR IN 60 REM TC$= TRANS CODE IN YYNNN 50 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 40 REM TC$= TRANS CODE IN YYNNN 40 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 30 REM TC$= TRANS CODE IN YYNNN 30 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 20 REM TC$= TRANS CODE IN YYNNN 20 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 10 REM TC$= TRANS CODE IN YYNNN 10 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN 0 REM TC$= TRANS CODE IN YYNNN 0 REM TC$= TRANS CODE IN YYNNN 770 REM M<1 OR M>12 THEN PRINT "ERROR IN (continued on next page)
(continued from previous page)

(WRITE IT OUT, LIST IT)

| 1440   | REM |
| 1450   | REM |
| 1460   | LC=LC+1 |
| 1470   | PRINT 85, USING 85S: LEFT$(DL, 2), TCS, MID$(DL, 2), R, G, N, V |
| 1480   | REM NOW READ TO OUTPUT FILE |
| 1490   | MID$(DL, 3, 2)-TDS |
| 1500   | MID$(DL, 1, 2)-S |
| 1510   | MID$(DL, 1, 2)-TTS |
| 1520   | MID$(DL, 2, 3)-CMS |
| 1530   | MID$(DL, 3, 1)-ST |
| 1540   | MID$(DL, 3, 1)-ST |
| 1550   | NO NOW TOTAL UP HASH TOTALS FOR |
| 1560   | CONTROLS |
| 1570   | TG--TG=TN+V+TV+V |
| 1580   | TR--TR=TA+1 |
| 1590   | IF TT$="D" THEN TD--TA |
| 1600   | IF TT$="K" THEN TC--TC+1 |
| 1610   | REM NOW GET RID OF DECIMAL POINTS |
| 1620   | REM |
| 1630   | REM |
| 1640   | R=100 : G=G*100 : N=N*100 : V=V*100 |
| 1650   | REM FINISHED |
| 1660   | J=1 |
| 1670   | RETURN |
| 1680   | REM |
| 1690   | REM LINE PRINTER HEADINGS ROUTINE |
| 1700   | REM |
| 1710   | RETURN |
| 1720   | REM |
| 1730   | PRINT #2, " VAT TRANSACTION CREATE PROGRAM", TAB(60), " PAGE |
| 1740   | PRINT #2, " I.C--4 |
| 1750   | RETURN |
| 1760   | REM |

LISTING OF PROGRAM TWO, VAT SUITE TRANSACTION FILE MEMORY SORT

10 REM VAT TRANSACTION SORT PROGRAM
20 REM COPYRIGHT (1978) XIAN SYSTEMS
30 REM WRITTEN BY G. C. LYNCH
40 REM
50 REM
60 REM USES SHELL-METZNER METHOD
70 REM
80 REM READS VAT TRANSACTIONS INTO
90 REM STRING ARRAY 1$, 
100 REM SORTS THEM INTERNALLY
110 REM CHANGES NAME OF INPUT FILE TO
120 REM EXTENSION OF OLD
130 REM OUTPUT TO FILES WITH EXT OF NEW
140 REM NET TO FILE WITH EXT OF NEW
150 REM GROSS TO FILE WITH EXT OF NEW
160 REM
170 REM
180 REM
190 REM
200 REM
210 REM
220 REM
230 REM
240 REM
250 REM
260 REM
270 REM
280 REM
290 REM
300 REM
310 REM
320 REM
330 REM
340 REM
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145 REM
146 REM
147 REM
148 REM
149 REM
150 REM
151 REM
152 REM
153 REM
154 REM
155 REM
156 REM
157 REM
158 REM
159 REM
160 END
WIRING FOR SOUND

A SIMPLE and amusing application for single board computers like the KIM is to use it as a mini electronic organ. Each key of its integral keyboard can be used to produce a different note.

In this version we use 21 of the keys (0 to F, A,D,A, +, GO, PC) to give notes in ascending order from the G below Middle C (196 Hz) to the C sharp below Middle C (555 Hz).

The waveform is not the ideal output of a music generator, since it is an asymmetrical square wave; the result, however, is acceptable. The waveform is generated by the software and is output on any of the PIA,PA0-7 pins; the output from any one of the pins can then be fed with suitable attenuation into an audio amplifier.

The program starts at Hex 200 with an initialisation routine and carries on to a loop at Hex 210 which looks for key depressions. The GETKEY subroutine of the KIM monitor places a number, between 0 and 21, depending on which key is being depressed, into the index register from which it can be used as a pointer by the interrupt routines to the correct value in the data tables.

This data value is loaded into the counter/timer of the 6530, which generates a sine wave whose frequency and amplitude are dependent on the index value. The waveform is not the ideal output of the PIA,PAO-7 pins; the output from any one of the pins can then be fed with suitable attenuation into an audio amplifier.

Each alternate interrupt gives rise to an output from the PIA of either 00 or FF Hex.

; PROGRAM STARTS AT $200
GETKEY -$1F6A
INT VEC --$17FE
; THE INTERRUPT HANDLER

; TABLE 1 .BYTE 126,90,184,134,84,4,4,3,3,3
; TABLE 2 .BYTE 126,90,184,134,84,4,4,3,3,3

; TABLE 1 .BYTE 126,90,184,134,84,4,4,3,3,3
; TABLE 2 .BYTE 126,90,184,134,84,4,4,3,3,3

; THE MAIN PROGRAM, START AT $0200

; The VAT programs described are on an 8" CP/M or QDOS compatible disc as
ASCII source files for only £30.00

Convert to your own BASIC or to the BASIC-E provided FREE on the disc.
Sorry, no documentation for BASIC-E, that's why it's free. A sample game is provided to assist.)

Send £30 to:
XITAN SYSTEMS
31 ELPHINSTONE RD
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DORSET BH23 5LL

Credit facilities can be arranged.

APPLE II
available in the SOUTH from:

PAMDEE COMPUTER SERVICES
The Tuns, High Street, Odiham, Nr. Basingstoke, Hants.
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Circle No. 144

Circle No. 145

Circle No. 146
CONTROLLING AC POWER

The ability to use a low-cost computer like the Pet to control external AC power devices such as electric lamps and motors opens a wide range of applications in many fields.

The problem may appear simple; there is an output port from the processor and one connects one of these lines to a TRIAC or SCR and connects the load across it. But this solution will almost certainly prove to be dangerous and because of noise problems make your processor unreliable. To overcome these problems we must separate the AC power device ground from the computer ground and electrically isolate the outputs of our processor from the control circuitry.

The circuit which I shall outline is that required for one single control output. If you wish to utilise all eight outputs of a PIA you repeat the circuit eight times. The output from a PIA, like the 6820 or 6520, is a latched TTL level output, each applied by the control circuit's own +12v power supply, the control circuit is shown in fig 1. The output of the circuit A comes from the transistor via a 680 ohm resistor, whose function is to limit the current in case of a short circuit; the output is about 5v at 10ma. For low power DC applications, this output could be fed into a reed relay, which would allow control of DC devices drawing up to 5 amps at up to 30 volts.

We want to be able to control high power AC devices and the ideal device for doing this is the solid state relay. The SSR is similar in construction to an opto-isolator, in that its input portion is an LED. Instead of a phototransistor, however, a photosensitive resistor is used; it provides the turn-on current of the TRIAC portion of the SSR.

Thus we are able to control AC mains power at currents of up to 25 amps with a 5v 10ma input.

Fig 2 shows an SSR-based power control circuit. The resistor capacitor filter is to suppress transients produced by inductive loads which might cause erratic operation of the SSR. The LED provides an indication of the ON/OFF status and the fuse provides overload protection.

These two simple circuits should give some idea of how to construct systems requiring the control by computer of large AC and DC electrical devices.
ONE of the best and most sophisticated operating systems available for microcomputers is known as CP/M.

It is surprising how many people tend to give a great deal of time and thought to choosing hardware but put very little effort into the selection of software. Often it is the quality of the software rather than the hardware which makes a system perform well.

A very important part of the software, especially on disc-based computers, is the operating system software, which usually goes under names like DOS, MINIDOS, RDOS, CDOS or CP/M.

The operating system is the software which integrates and controls all the individual components of a computer system. It can be regarded as a software interface between the machine code environment and the high-level language environment.

**Widespread use**

It is the operating system which controls the speed and efficiency of disc access by the high-level language. Some operating systems also provide user functions like disc copying and initialization, as well as offering the user the ability to look at and change sections of RAM in disc.

The choice of operating system also determines the range of software you can run on your system. Thus, some operating systems will allow you only to run software from one manufacturer, while others will allow you to use a wide range.

In its various forms CP/M has been in widespread use for more than three years and with a price tag of around £50 represents amazing value in a software package.

**Easy to alter**

CP/M is marketed by an American company, Digital Research. The package is defined as a control program/monitor for a microcomputer system employing Intel 8080 or Zilog Z80 CPU and IBM-compatible flexible disc for back-up storage.

Its importance lies not only in the success and universal use of the 8080 and its extended family of chips, but also in the ease with which CP/M can be altered to work in different configurations.

The secret of its easy re-configuration is its highly-structured and modular design. Although it was developed originally for the Intel MDS 800, its structure and excellent documentation has attracted the attention of other manufacturers. Consequently, CP/M can be obtained for a variety of 8080 micro systems employing hard- or soft-sectored, single- or dual-density, mini- or full-size floppy discs.

**Sophisticated**

CP/M is essentially a monitor or system. The term 'monitor' may not be obvious to those who have not developed programs in interactive environments but, as it suggests, it simply monitors, in particular, the operator's keyboard. A monitor program would, for example, reflect, in a duplex system, the keyboard input to a video monitor or terminal printer and at the same time respond to a set of commands which execute programs or routines.

This is what CP/M is about. Time-sharing users and computer operators will be very familiar with the advantages of an interactive monitor and those with such experience will appreciate the sophistication of commands available under CP/M.

Starting-up CP/M is much like any other disc operating system with a two-stage cold and warm 'boot'. As the system springs to life, it outputs a sign-on message to the console, followed by a prompt to indicate the monitor is ready for a command.

**Similarity**

Those used to developing programs on sharing systems could probably guess what to do next. Type in DIRECTORY, perhaps? Right. In fact, the command is abbreviated to DIR and, as you would expect, a list of the files on the directory—in this case a floppy disc—is produced at the console device.

The size of files or directories can be determined by the statistics or STAT command. Another command, TYPE, followed by a filename, will list ASCII files at the terminal. Other simple commands also exist for re-naming files (REN), erasing files (ERA) and copying files (PIF).

Digital users may feel that some of this looks familiar and the similarity of CP/M to Digital systems continues. For example, where have you seen the file name extension BAS before? This extension and others allow the user and system to identify file types.

One file extension, COM, is particularly important. If you feel you would like an

(continued on next page)
additional command in your monitor set, program and test it, call it whatever COM and you have a new command.

Another close similarity to Digital software is the CP/M text editor. ED filename initiates a very powerful character and line-editing system which compares favourably to the best editors available on large time-sharing systems.

It's a delight

The editor allows paging in chunks of a file, string searching, string substitutions, moving a character pointer and inserting or deleting characters or lines. A casual user might find it a little difficult to cope with but those who are modifying code frequently will delight in using this super program development aid.

Along with CP/M is a standard Intel 8080 assembler. In general, one assembler looks much like another and the only features of the CP/M assembler worth mentioning are directives such as ORG, EQU, SET, IF and ENDIF—the last three provide good facilities for conditional assignments. Diagnostics are as helpful as most assemblers and the product of the assembly is a print and a hex file written to disc.

With bonus

LOAD, predictably, loads the HEX files into memory. More exciting are the debugging aids in the program DDT. Facilities are fairly extensive and allow direct input of code, display of code in HEX, ASCII or mnemonics, movement of segments of memory and substitution of memory values or CPU register content or state. Finally, debugged programs can be saved back on disc by the SAVE state.

CP/M is flexible to different hardware configurations and to this end the input/output drivers are available as source files. The size of the CP/M system can be modified from 16K upwards and after the BIOS (Basic input output system), which contains the drivers, has been 'patched in' using the aids mentioned, the new system can be saved back on disc with SYSGEN.

Finally, CP/M usually has one bonus piece of software free—a BASIC-E compiler. Although BASIC-E would be considered by most a fairly indifferent BASIC, it has an extended Dartmouth BASIC set and at the price must be considered excellent value.

The documentation to CP/M is excellent. The five manuals are available for a price of £15. Compared to most system manuals, they are extremely well-written and, even more surprisingly, accurate.

Outside CP/M are several other features which indirectly make the product look more interesting. For example, there is an extensive CP/M users' library. It embodies 20 full diskette volumes of 'public domain' software, and, at about £10 per volume, they represent exceptional value.

Free entry

The content varies from esoteric utilities to general business packages and games. The CP/M Users' Club costs nothing to join and details are available from the Editor, Practical Computing, 2 Duncan Terrace, London, N1. (Please send a stamped-addressed envelope). Yet one other exciting aspect of CP/M has to be mentioned—Microsoft products for CP/M. Microsoft, an American organisation, has developed undoubtedly the best set of micro software which runs under CP/M. It includes the Microsoft BASIC interpreter—this is very similar to Altair BASIC—an ANSI FORTRAN compiler, an ANSI Cobol compiler and most recently, APL and PASCAL. The price range of these interpreters/compilers is as low as £190-£400.

Even the pundits who criticise the 8080 series hardware for particular applications have to admit that software systems such as CP/M and an 8080 disc system out-perform in facilities, though not necessarily in speed, many of the minis on the market.
Pilot new language for micros

A new language for micros called Pilot is available from Computer Workshop. Pilot (Program Inquiry Learning or Teaching) can be used for controlling interactive conversation with a computer. It is capable of being used successfully by very inexpert programmers, but is also attractive to the expert.

It is built around four instructions—Type, Accept Input, Match Input, Conditional Jump. "Accept input" will literally take anything.

Match input will search the input for a variety of things such as an embedded numerical answer, an embedded keyword, a choice or combination of keywords, or gross mis-spelling of keywords. The Jump may be made dependent on the previous Match or use a condition, as required and takes appropriate action.

All-round aid

The importance of such a language must not be under-estimated. It is useful for an accountant to be able to type "print-out time sheet for Jones Ltd" and then the computer sorts out each file as required and takes appropriate action.

It is useful for a teacher to have a program which accepts a French phrase, points out spelling mistakes, wrong tense, and the like. In the past this has not been possible, except on large systems in complicated languages. It is now possible on a cheap micro and with minimal programming skills.

Passing it on

To help get things going, a Pilot Users' Group has been set up. "We hope to hear from people who have produced something useful and we shall organise distribution of the information," says Charles Sweeten, director of computing at Oundle School, who is also Secretary of MUSE (Minicomputer Users in Secondary Education).

If you are interested in the user group contact Philip Couzens, Oundle School, Oundle, Peterborough.

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A PRACTICAL GLOSSARY
Running the terminological gamut from B to C

Buzzwords
The term buzzword is a piece of jargon used to describe the jargon the computer industry generates with such whole-hearted enthusiasm, and which this glossary is hopefully an aid to penetrating.

Byte
If a bit is the smallest unit of information stored in a computer, then a byte is the smallest unit with any real meaning. It is a collection, normally, eight bits, which together represent a number or a character. Sharp-eyed readers will note that ASCII users habitually describe one byte as being eight bits. The so one byte usually corresponds to one character and byte are frequently used so one byte usually corresponds to one character and byte are frequently used in computer culture. The next stage from floppy discs and cost more.

Cassette
Philips has set the standard for both audio and data cassettes. Micros will work happily on audio cassettes, although if you need to keep data very clean and tidy, you will probably have to pay more and buy a data cassette.

Character
A letter or numeric digit. Included here for completeness, although you know exactly what it is anyway.

Chassis
The computer chassis is the box which contains the processor and main memory. It incorporates various electronic parts, like the backplane, so it is an integral part of the computer system rather than a receptacle.

Checkpoint
See breakpoint.

Chip
A chip is a piece of silicon, nor call it a chip if you prefer, but either a chip or a microcomputer—one or two micros. Having said this, you are dealing with whole characters, IBM and not many other companies, so one byte usually corresponds to one character and byte are frequently used in computer culture. The next stage from floppy discs and cost more.

COBOL
The Common Business Orientated Language is one of the best-known high-level programming languages. It was designed for commercial applications, so its mathematical abilities are limited—some of us can sympathise with this. Because it has been designed to make program-writing easy in a commercial context, it can take up a good deal of room in the computer; this makes it more popular in other systems rather than for micros. Having said that, there are at least two Cobol for micros and they are British.

CODASYL
The organisation responsible for the design of Cobol and an attempt to produce a database manager which is universally accepted. It lives in the United States, consists of representatives from government bodies and suppliers of computer systems and services, and promotes standardisation of its outpourings are detailed and esoteric, which means that Cobol- and Cobasyl-compatible database systems are complex and verbose. It stands for Committee on Data Systems Languages.

Code
A code in computer terms means the same as in other contexts; it is a means of representing one thing by something else. James White, in Your Home Computer (recommended) says. Sometimes a code is used for secrecy: in a computer a code is used for efficiency. Some programmers are confused by this.

The most common codes in computing, used to represent numbers and letters, are ASCII and EBCDIC. qv. (Which is code for 'which see').

Checkpoint
See breakpoint.

Clock
The rate at which a computer performs operations is controlled internally by a clock. That is an electronic circuit or group of electronic components which generates a set of control signals. Each set of control signals will initiate an action in the part of the central processing unit (CPU).

Compiler
The language in which instructions for the computer are written—say a COBOL program—is not one which the computer can use directly. It needs to be changed into a form which the computer can recognise. One way of doing this is to use a compiler.

A compiler is a specialised program which translates the source program into code the computer can execute. It does so rather faster than the other method of translating the instructions, which involves using an interpreter. The interpreter has the great virtue, however, of enabling the user to change bits of a program and test the change immediately, which makes it very useful for program development.

You can also interrupt an interpreter in full space to get some immediate results, say, and then tidy it carry on. A computer would not like you to do that.

What goes into a compiler is source; what comes out is object code.

Computer
A computer is a clever collection of components which enables you to put in information, store it, modify it, and get it out again. That is a very arbitrary definition and one which would fit a programable calculator, too. A programmable calculator can be distinguished from a computer by its name—the distinction is a marketing one.

Console
What you do to mournful micros. Also the control point of a computer system from the human operator's point of view. It is probably a keyboard and printer or VDU, for inputting messages to the system and getting back a response. Sometimes the term is used for the front panel of a mini or a micro, the switches and/or push buttons which initiate system operations. Some minis have a programmer's panel or programmer's console, which include switches to set the contents of particular memory locations.

Content Addressing
A method of obtaining information in the main computer memory by scanning it to find that information specifically. Conventional computer to tell you what is in a particular address. Sometimes the very special, very expensive, and very unproven content, addressable memories, to do it. This idea sounds great in principle.

CORAL
CORAL, usually CORAL 66, is a language developed for radar applications by the Royal Radar Establishment at Malvern. It is a trifle esoteric for the micro user. Still, the hills there are pleasant.

PRACTICAL COMPUTING October 1978
New from Texas Instruments.
The world's most powerful pocket calculators.
For the easiest problem solving ever.

The new Texas Instruments Programmable Ti-58 and Ti-59 make your problem solving simpler and easier by making the electronics do more work. Now, commonly encountered programmes in maths, science, finance and statistics are set up and accessible at the touch of a key. You need add only the variables.

Solid State Software is the name of this technological achievement from Texas Instruments. Even the programming is now included in the solid-state electronics. You get complete, pre-written problem solving libraries in convenient plug-in modules. Yet, no prior programming knowledge is necessary.

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