

# Practical Computing

An ECC Publication. Volume 2 Issue 1

January 1979

**Playing with the Pet in the Panther**

**We test Nascom-1, the £200 computer**

**Turning IBM typewriters into terminals**

**Is Pascal better than Basic?**

**Learn typing by computer**



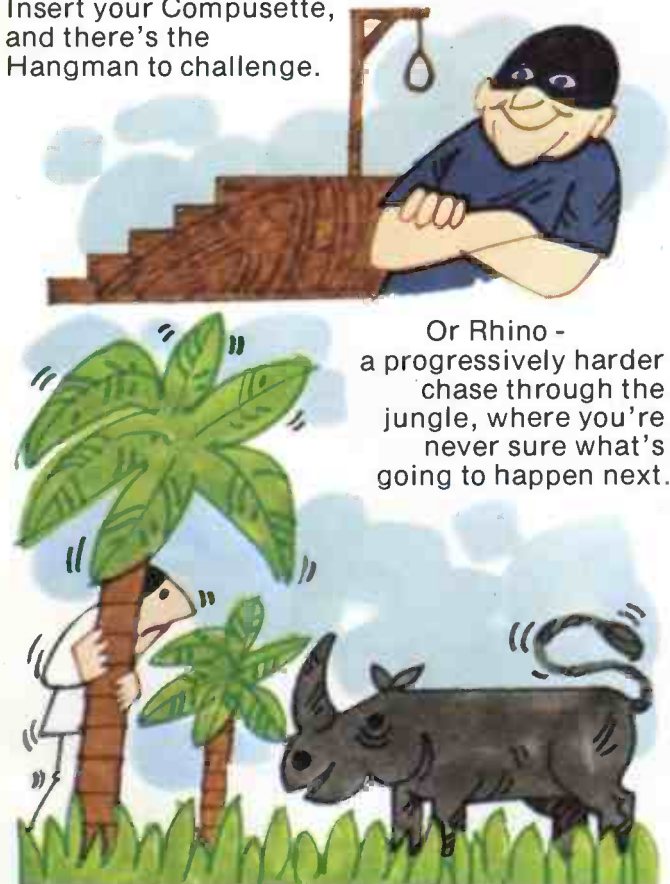
1979  
PANTHER  
DEVILLE  
£44,825.07  
OPTIONS:  
PET COMPUTER

# After you've been chased by rhinos and have met the hangman, it's time to learn a thing or two...

One lesson you'll have to learn on your own - how to tear yourself away from your computer in the early hours. Infoguide provides you with a new concept in recreational, educational and business software.

## You'll probably start in the Playgroup.

Insert your Compusette, and there's the Hangman to challenge.



Or Rhino - a progressively harder chase through the jungle, where you're never sure what's going to happen next.

Insert other Compusettes, and ...

## Middle School

could see you taking your computer on at Mastermind. Or Go!



## High School

sees you and your computer working on statistical programmes. Conversion. Financial management. Forecasting. These - and many other functional programs - are on Compusette.

## At Degree Level,

why not simulate an enzyme reaction? Change any one (or more) of six parameters and see what happens? Maybe discover, when playing chess, that your computer is a Grand Master? A Compusette will supply each of the necessary programs. An interesting variety of Compusettes are being made available for PET, Apple II and TRS 80. Each is accompanied by a fully detailed booklet with listings of the programs - there are up to three on each tape. You will find that most dealers handling personal computers will be stocking the Compusette range. Ask your dealer now.

For as little as £2.70 per program\* - that's value!

# COMPUSSETTES

Compusettes are produced by Infoguide Ltd, 142 Wardour Street, London W1. 120 El Camino Drive, Suite 108, Beverley Hills, Cal 90212 USA

\* Based on three programs on an £8.00 Compusette.



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Every effort has been made to  
ensure accuracy of articles and  
program listing. Practical  
Computing cannot, however,  
accept any responsibility  
whatsoever for any errors.

### **PET IN THE PANTHER**

A British manufacturer is first in the world to  
install a microcomputer for car passengers.

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### **NASCOM-1 REVIEW**

We test the Nascom-1, the £200 British-  
designed computer.

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### **TYPEWRITERS TO TERMINALS**

We tell you how to convert an IBM Selectric  
typewriter into a terminal.

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### **LOS ANGELES COMPUTER FAIRE**

Richard Hease visits California and sees to-  
morrow's trends in the micro scene.

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### **WIN £5,000 WORTH OF COMPUTERS**

Your last chance to enter our Christmas  
competition with three computers as prizes.

Page: 60

### **BUYERS' GUIDE**

Comprehensive guide with prices, configura-  
tions and applications of the micros on the  
British market.

Page: 41

### **AND MUCH MORE**

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59; Glossary, page 74.

February issue on sale January 17, 1979

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Try my S100 computer kit. Buy blankboards separately or complete kit and save.

Kit features:

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#### VECTOR/MICROPOLIS SOFTWARE NEWSLETTER 1

A MULTI-TASKING VERSION OF THE MICROPOLIS OPERATING SYSTEM AS USED ON VECTOR V18A, VMZ AND OTHER S100 COMPUTERS, IS NOW AVAILABLE FROM SINTROM. UP TO 8 USERS MAY BE ENGAGED IN THEIR OWN ACTIVITIES RANGING FROM "MEMORY BASHING" NOODS, TASKS THROUGH LINEEDITING AND ASSEMBLING TO PROGRAM DEVELOPMENT AND EXECUTION IN BASIC.

USERS MAY READ AND WRITE FROM DISK STORAGE AT WILL, AND ANY ONE USER MAY CONTROL A LINEPRINTER ATTACHED TO THE COMPUTER. IT IS EXPECTED THAT THIS SYSTEM WILL BE OF IMMENSE USE IN THE FIELDS OF EDUCATION AND SOFTWARE DEVELOPMENT WHERE MANY TERMINALS SHARE A COMMON SET OF HARDWARE AND WILL ENABLE A COMMERCIAL SYSTEM TO BE ESTABLISHED FEATURING MULTI-POINT ACCESS.

THE COST OF SUCH A TIMESHARING COMPUTER WILL DEPEND ON THE AMOUNT OF MEMORY REQUIRED BY EACH USER. IN GENERAL TERMS, IF EACH USER REQUIRES TO SEE A COMPUTER THE SIZE OF A VECTOR MZ, AN ADDITIONAL 750.00 PER TERMINAL, PLUS VDU, WILL SUFFICE.

\*\*\*\* DO NOT CONFUSE WITH MULTIUSER BASIC OR MULTIUSER APPLICATIONS PROGRAMS \*\*\*\*  
\*\*\*\* VIRTUALLY ZERO OVERHEAD EXPERIENCED FROM DORMANT TERMINALS \*\*\*\*  
\*\*\*\* EXISTING USER SOFTWARE (E.G. BASIC PACKAGES) MAY BE RUN \*\*\*\*  
\*\*\*\* SIMULTANEOUS PROGRAM DEVELOPMENT AT MANY TERMINALS \*\*\*\*

#### SATPC DISK SOFTWARE NEWSLETTER 1

\*\*\*AT LAST\*\*

\*\*MUC-8KD\*\*

TSC MULTI-USER 8K BASIC.

UP TO FOUR USERS SHARE THE FACILITIES OF FLEX WITH PROGRAM STORAGE AND RETRIEVAL AND SEQUENTIAL DATA FILES. THIS SOFTWARE REQUIRES THE TS-1 HARDWARE TIMESHARE BOARD.

MUC-8KD	40.00
TS-1 KIT	105.00
TS-1 ASS.	125.00

#### SATPC DISK SOFTWARE NEWSLETTER 2

WE ARE PLEASED TO ANNOUNCE THAT A NEW VERSION OF THE FLEX DISK OPERATING SYSTEM IS NOW AVAILABLE. IT IS ALMOST IDENTICAL TO THE FLEX USED ON THE DMHF-1, THUS PROGRAMS WRITTEN FOR THE MF-68 ARE UPWARDS COMPATIBLE TO THE 1.2MB HARDWARE.

IMPORTANT NEW FEATURES INCLUDE -

- \*\* RANDOM ACCESS BASIC DATA ARRAYS ON DISK
- \*\* AUTOMATIC SEARCHES FOR FILES ON BOTH DRIVES.
- \*\* PRINTER SPOOLING

FLEX-5 REQUIRES AN 8K MEMORY BOARD LOCATED AT ADDRESSES A000-BFFF, WITH AN MPA-2 PROCESSOR BOARD, AND AT LEAST 16K RAM ADDRESSSED 0000 UPWARDS.

I.E. YOUR COMPUTER REQUIRES AT LEAST 24K WITH AN MPA-2 CARD.

FLEX-5	5.00
MPA-2 KIT	140.00
MPA-2 ASS.	180.00
MP-8 KIT	120.00
MP-8 ASS.	140.00
MP-4 KIT	60.00

(MP-68 ORDERS MAY NOW SPECIFY THE MPA-2 PROCESSOR FOR AN ADDITIONAL 25.00)

#### SATPC DISK SOFTWARE NEWSLETTER 3

SOFTWARE PACKAGES ARE NOW IN STOCK FOR THE FOLLOWING DISK BASED OPERATIONS:-

SOURCE/TEXT EDITOR	25.00
6800 MECHANIC ASSEMBLER	20.00
TEXT PROCESSING SYSTEM	25.00

THESE PACKAGES ARE AVAILABLE FOR EITHER VERSION OF FLEX.

ALL PRICES EXCLUDE CARRIAGE (£1.00), DISK MEDIA (2 75 EA) AND VAT (8%)

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PRACTICAL COMPUTING January 1979

## The SOL Terminal Computer System



Comart's range of S100 microcomputer systems features the Cromemco Z2, Z2-D and System Three Computer Systems, the SOL Terminal Computer System and the North Star Horizon.

## The HORIZON Computer System



S100 sub-systems and modules include 16k and 32k byte memory, PROM programmer and erasers, analogue and digital interfaces, serial interfaces and the Micro Disk System with its optional hardware floating point arithmetic board.

## The Z2-D Computer System



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The Byte Shop, 426/428 Cranbrook Road, Ilford, Essex. Tel. 01-554 2177  
Xitan Systems, 31 Elphinstone Road, Highcliffe, Dorset. Tel. (4242) 77126

**Comart Limited, PO Box 2, St. Neots, Cambridgeshire PE19 4NY.  
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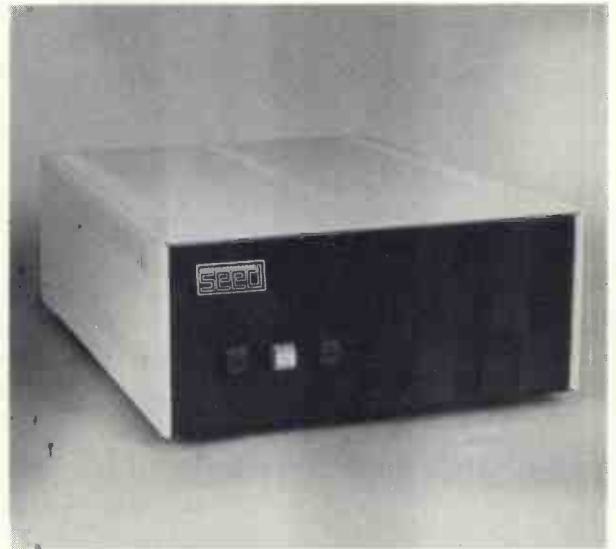
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'System One' is expandable to 56K bytes of memory and will support up to eight I/O devices of serial or parallel types. The system is supplied with a disk operating system. The system includes a basic interpreter.

Further information from Strumech Engineering.

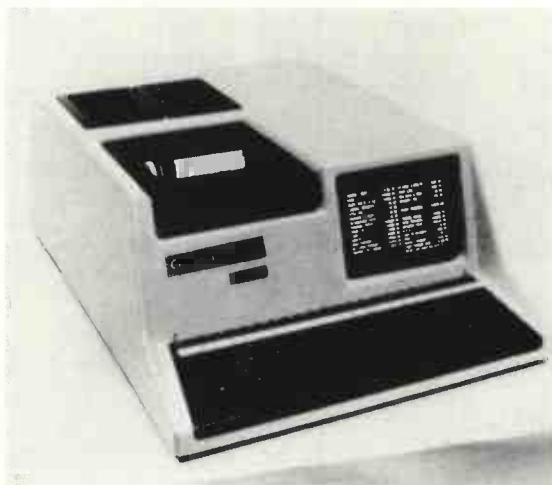
**Strumech Engineering  
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Coppice Side  
Brownhills**

**Tel: Brownhills 4321**



# COMPUCORP ANNOUNCES THE 610

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C207 Interfacing Techniques	£ 7.50
Microprocessor Systems Design, by Edwin Klingman	
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8080 Software Guide & Cookbook from Scelbi.	£ 7.90
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by Rony, Larsen & Titus (1977) 416 pages	£ 6.90
Z80 Programming for Logic Design by Adam Osborne	£ 5.90
Z80 Microcomputer Handbook by William Barden	£ 7.20
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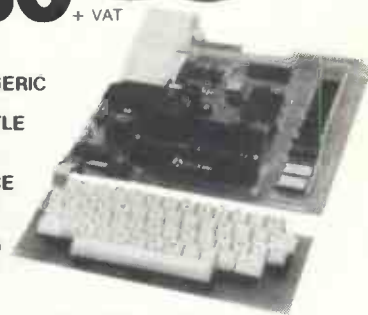
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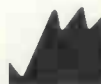
AIM 65 comes to you fully built and tested with a full alphanumeric keyboard, 20 character display and a 20 column printer — for keeping a permanent record of all your work. Available in 1K- and 4K-byte RAM versions, AIM 65 is designed around the 6502 CPU, which has 64K address capability with 13 addressing modes. This is the microprocessor at the heart of many other, more costly, systems such as PET and APPLE. AIM 65 has a 4K ROM-resident monitor program for all peripheral control and user programming functions. Spare sockets are included for expanding on-board program memory via user PROM-based programs and/or Rockwell assembler, text editor and BASIC interpreter plug-in options. AIM 65 has a connector for external access to system bus for memory and I/O expansion, a separate connector



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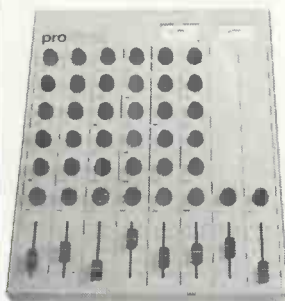
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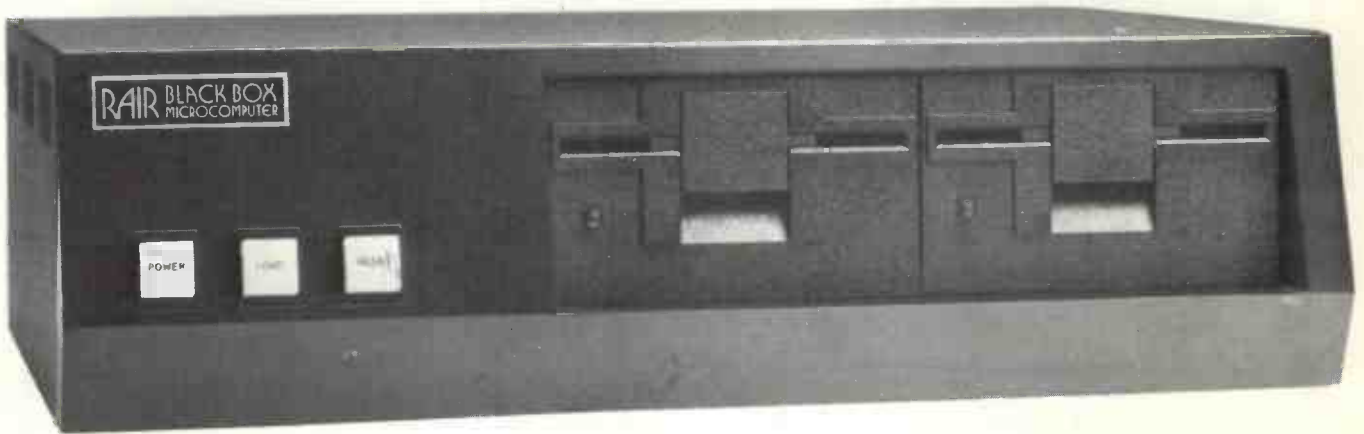
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Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback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

### Pet group

A GROUP of Pet owners has decided to form an organisation for sharing ideas and information about the Pet. The group has taken a formal existence and already has more than 50 members.

I have taken the job of secretary from Norman Fox, who did a splendid job of getting the group set up.

We are hoping that as many Pet owners and users as possible will join and come to our meetings to share their knowledge and to learn from the experiences of others. So far we have held two meetings and I, for one, have learned a great deal.

We have seen the Pet being used to control a variety of equipment through its user port; we have heard it playing music and we have swapped ideas and programs.

The group is deliberately independent of Commodore and we are not in competition with its Users' Club. We feel that there will be times when we wish to be critical of Commodore; the delay in producing the long-awaited printer and the problems of head alignment on the cassette decks are two issues where external pressure may speed up things.

We will be circulating all dealers with information concerning the group, in the hope that they may be willing to supply details of our group to all new buyers. If any dealer wants further information, please get in touch with me.

We will be holding regular meetings throughout the country and we will be producing a regular newsletter with ideas from our own members and with information gleaned from elsewhere, including some of the information produced by Pet groups in the U.S.

If anyone wishes to join, please send SAE to me and I will send details.

Mike Lake  
Independent Pet Users' Group  
9 Littleover Lane  
Derby

### Auto-code

AFTER your monthly issue of *Practical Computing* which contained the programming language Basic, I wonder whether you can send me a booklet on AUTO-CODE.

I am a student and am working on a program to work out problems involving trigonometry but have a problem on the use of tables given by AUTO-CODE—how to look up the tables backwards. For example:

When the computer works out an answer e.g., 1.19, the program requires it

to print this as an angle (TAN), which in this case it is 50 degrees (No backwards).

I wonder whether you can help me on this problem?

N. Chan  
Banbury

● Can any readers recommend a suitable book?

### Manual problems

I WOULD like to comment on my experiences with the Kim so far:

The three Kim 1 manuals assume that the reader has some knowledge of machine code programming. Without advice on some of these points from other sources the gaps are not easily filled.

In contrast, the Vim 1 (Sym 1) has only two manuals—one of which is identical to the Kim programming manual—but the instructions are much easier to understand.

The extra facilities built into the Sym 1 suggest to me it is a much better buy than the Kim 1 than the price difference would indicate. In nearly every respect, I think, it is worth twice the value of the Kim 1.

A tip for Sym 1 users. Use a reed (3–4 volt) relay between the built-in cassette switching and your cassette recorder remote control connector. The polarity of the cassette can then be disregarded. This is particularly useful when trying several recorders to see which one the Sym 1 likes best.

Another tip is to avoid using page 1 except for very simple programs. The Sym 1 control program makes continual use of page 1 for the stack and will overwrite anything you put on (in) page 1.

For raw beginners, remember that 0 (ø) is a number, particularly in hexadecimal. It is obvious when you know but mind-boggling if you don't.

I would have made very little progress with either Kim 1 or Vim 1 (Sym 1) without the considerable help given to me by the Bears at Newbear Computer Store. I would like through your columns to express my sincere thanks to them in general and to Tim Bear in particular.

Jesse James  
Letchworth,  
Herts.

### Alternative

AS AN engineer who makes considerable use of calculators and was considering the purchase of one of the more sophisticated models, it came as a surprise when someone suggested that the personal computer had now reached the stage of development where it could provide an economic

alternative to a good calculator, while providing a fascinating hobby at the same time.

A newspaper advertisement led me to the November issue of your magazine but I must confess that extensive use of trade jargon limited my understanding of the subject matter.

I am writing, therefore, to enquire whether you can recommend a suitable introductory text to the subject, so that I may better understand the specialist terms used and also learn how to join together the many items of equipment to build a system to meet my requirements.

Andrew J. Middup  
Coventry

● Our favourite is *An Introduction to Personal Computing*, by Rodney Zaks.

### Kit site

WITH regard to Mr Richards letter in the November issue of *Practical Computing*, a Sharp Associates kit for conversion of a Selectric may be purchased from J & A Computers of 15 Fleetwood Gardens, Market Harborough, Leics. This kit includes a read/punch port and RS232 serial interface, and it costs £540.

Q. J. North  
Brighton

### System advice

CAN YOU please advise on possible systems meeting the following criteria:

8K Basic on ROM (or tape + 8K RAM); 8K RAM (expandable to 32K); compatible with domestic TV; compatible with cassette recorder; including ASCII (integrated or separate) keyboard, preferably upper- and lower-case characters; additional graphics desirable but not essential; adequate maintenance organisation; price less than £500.

I feel sure such a system would be of general interest since, as you have pointed out, most households have a TV and cassette recorder.

J. S. Palmer  
Altrincham, Cheshire

● We suggest you look at the systems described in the Buyer's Guide in this issue, particularly the Nascom and Micros.

### Who is second?

I ENJOYED the article How to Play Mastermind (November issue), but wish to take issue with the author over his claim that "a good human player has the edge over even the most sophisticated computer strategies."

I have carried-out recently a computer

(continued on page 19)



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(continued from page 17)

analysis of the so-called original Mastermind (4 pegs, 6 colours), the results of which will appear shortly in the *Journal of Recreational Mathematics vol. II*.

The essence of this analysis is that there is a strategy requiring a maximum of five guesses and an average of 4.37 guesses. Further, this strategy, in the form of a standard Fortran program, has been implemented on the PDP-11 computer in this department, and I would back it confidently to triumph over any human opponent in the long run.

Dr. R. W. Irving  
University of Salford.

## For starters

I AM interested in putting together a computer system, starting from a basic kit and expanding at a later date to a floppy disc system with video monitor and hard printing terminal.

I would be grateful if you could advise me of the right kit with which to start. Would Nascom I kit be suitable?

As cost is a limiting factor, I would prefer to spend no more than £250 at present.

M. Regan  
Southport

● Yes, Nascom is a good starting-point. Again, take a look at our Buyer's Guide.

## Keep it simple

HAVING just read Programming the structured way, I would like to prove my skill at reading tea-leaves. Having swilled the dregs at the bottom of my cup, I would say that the author works in education—probably in higher education, possibly a polytechnic.

To be truthful, I cheated. The article appeared to be a collection of bits from lectures I attended at a polytechnic earlier this year. Everything is there, structures, modules, abhorrence of GO TO, waste of time drawing flowcharts, Basic is nasty and Pascal will be our saviour. Module dependency charts appear to have been forgotten.

Most of the programs I write are Basic Plus and sometimes Cobol for a mini-computer. I like Basic and the industry appears to have a growing need for Basic programmers. My three main comments are:

GO TO can be used provided it is used wisely; there are times when the use of unconditional GO TO cannot be avoided.

I write Basic programs as a group of modules and connect them with GOSUB. It works, and provided a REMARK line is put at the start of each module to identify it, there is little difficulty in reading a listing.

What method a person uses to record the logic before writing a program does not matter, be it a flow chart, the shorthand method as in the article, or just scribbling on the back of an old envelope.

If a person has completed a program

he intends to keep and use I would advise that person to draw a flowchart of the logic in the completed program. If the program is to be passed to other people, or there is a possibility that it might be altered in the future, a flowchart can often show more easily how a program works than a well-laid-out program listing.

Two pieces of advice which are perhaps even more important to people programming for the first time—Keep it simple; and enjoy what you are doing.

Paul Woolley  
Enfield, Middx.

## Payroll task

As a complete novice in the world of computers I am (was?) interested in the purchase of a small system purely to operate monthly payrolls for several small companies, a total of approximately 300 staff. I have been told that the equipment, including a suitable printer, would cost some £2,000 but for the one task this is not economic.

Would you agree with the rough estimate I was given and can you give me advice on what equipment would be required?

J. Humphrey  
Great Harwood  
Blackburn

● That is about the right price. Your first point of call could be the Commodore Pet. That costs £695 plus about £500 for a printer and £25 for a payroll package. You could then, of course, use the computer for other tasks apart from payroll. Or you could try a computer bureau like Centrefile.

## Advice to teachers

MAY I congratulate you on the successful launch of *Practical Computing* but express some reservations about your general approach to programming and the educational market?

The best article in your November edition was, in my view, Nick Hampshire's Programming the Structured Way. Unfortunately, its general tone and the fact that it was at the end of the edition gave the impression that simple programming is one thing and structured programming is something to be considered at some later stage.

Not so. Good programming implies readability by people as well as machines and there is no point in learning bad habits in the early stages if they can be avoided. Even in Basic one can and should follow this principle, which implies the avoidance of GOTO statements.

In your review of the Tandy you "definitely recommend that the novice starts with Level 1". But on page 32 of the Level 1 manual appears the suggestion: "The IF-THEN statement is what is known as a CONDITIONAL branching statement". Thus beginners are given a definition which is both incorrect and the

strongest possible incentive to develop bad programming style.

Your article, Pet goes to School, could easily be misinterpreted by British teachers. It is clearly based on U.S. conditions and experience and a British school should think very carefully before it spends about £700 on a machine which does not match requirements of English computer studies syllabuses and teaching practices and has a graphics system without a proper SET or PLOT facility.

The trouble is that in most British schools the purchase of one machine will preclude the purchase of any other for several years. Unfortunately, the limitations of the Pet are such that teachers and pupils are likely to feel the restrictive effects within a very short time after purchase. I would very strongly recommend teachers to talk to a number of educational users before making any important decisions.

Roy Atherton  
Head of Computer Education  
Resources Centre,  
Reading.

## Group request

I HAVE had a Tandy TRS-80 machine for some time and feel it is about time that a users' group was formed. I wrote to Tandy suggesting that it took the initiative in this matter but there was no reply. I wonder if you could indicate in your pages that I would be prepared to organise such a group?

I have been using machine language with my system for some time—via T-BUG—and have succeeded in using it for hardware control with an output port connected to the system bus.

I have just upgraded to 16K of RAM by installing 4116 RAMs myself—far cheaper than having it done by Tandy—and soon will be obtaining the Editor/Assembler which will enable me to write some rather interesting system software. A macro processor is likely to be one of my first efforts.

Congratulations on your magazine. I hope you will include plenty of articles with a software orientation in future issues and keep articles on Basic to a minimum.

L. F. Heller  
Newport Pagnell, Bucks.

## Logic aid

THERE is an article, Peripheral Equipment for a Small Digital Computer, by A. D. Booth and J. M. S. DeVries, on page 155 of the March, 1966, *Electronic Engineering*.

It discusses, among other things, the use of an old-style IBM typewriter; logic diagrams are given but no mechanical details.

If Mr. Richards would care to contact me I will let him have photocopies at cost.

J. B. Jehu  
15 Hangcliff Lane  
Lerwick,  
Shetland



# THE PET AND THE PA

**IT HAD to happen.** What must be the ultimate in luxury car accessories—not a television to watch, a stereo player to listen to, but a computer to play with.

It is either very heartening or extremely depressing, depending from which end of the socio-political spectrum you look, to find that there is a substantial number of people in the world queuing to pay a minimum of £45,000 for a British Leyland-engined car which is designed intentionally to look a good 20 years older than even the dear old Morris Minor.

Motor magazines have dubbed it "the world's silliest piece of motoring extravaganza" or "an automotive exhibitionist's dream come true". It is both, but it is

The bulk of them have been a distillation of the best of 1930s design, based loosely on Jaguar or Frazer-Nash. The De Ville was obviously inspired by the magnificent Bugatti Royale created in France for the exclusive elite of Europe's pre-war establishment.

Powered by a V12 Jaguar engine, the Panther is a classic with its elegant styling. It is the ultimate luxury car. Only three per month are built, and only four a year are allocated to the U.K. market.

It is not as strange as it may seem that

## Practical Computing exclusive by CAROL GOURLAY

also a tremendous example of British craftsmanship at its best—a safe, luxurious car which is totally modern in all but appearance and ambience.

It is to motoring what the Atlas was to computing, a wondrous example of outdated style and opulence which cannot fail to arouse nostalgia in those who behold them.

Panther cars are among the most prestigious, most sought-after cars in the world. The De Ville saloon is one of the latest in a line of fantasy creations which Panther managing director Bob Jankel has been offering to an appreciative world since 1970.

this magnificent anachronism should be the first car in the world to offer that amazing product of the technical revolution of the 1970s, the microcomputer, as a factory-fitted option.

Air conditioning, stereo radio with four loudspeakers, and electric windows are standard fittings. In addition, Panther is often requested to install all kinds of equipment in the De Ville—quadrophonic sound and television for example—and is only too happy to comply.

Naturally, the customer list contains  
*(continued on next page)*

**The Pet console in the rear of the Panther (above); the Pet is dwarfed by the magnificent 1979 De Ville saloon (lower picture).**





# PANTHER

(continued from previous page)

many illustrious names from the show business fraternity—Elton John, Liz Taylor and Sammy Davis junior, not to mention Oliver Reed and James Caan. A Nigerian tribal chief has one, as do several Arab sheiks.

Yet sales director Recharad Govett emphasises that Panther doesn't live from that kind of glamorous market. In general, the average customer is a successful business person.

It was one of those who suggested that Panther install a computer in the De Ville. He wanted it not to play Lunar landings, to pass the time in rush-hour traffic jams, but to be able to run programs from his business computer away from the office.

## Standard console

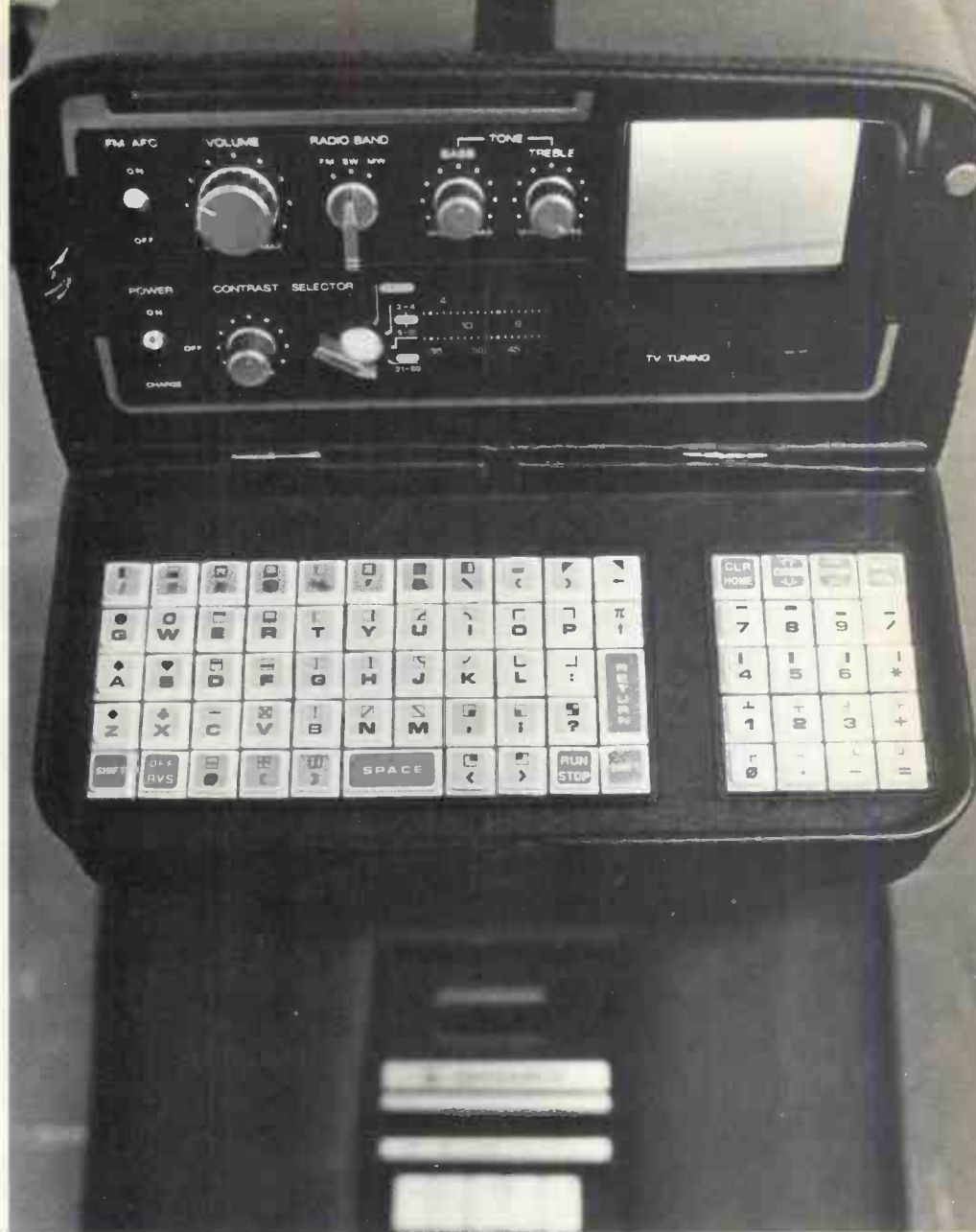
Such a computer had to fulfil two essential requirements—it had to be compact, and it had to be compatible with his business machine.

Panther would also have liked the computer to be totally British-made and designed. Wherever possible it likes to live up to the Union Jack displayed proudly on the front of each model. Despite these patriotic preferences, it was decided that the requirements were met best by the American-built and designed Commodore Pet. The configuration and installation was carried out by David Hughes, of the recently-formed Thames Personal Computers Ltd. Thames made a particularly neat job of building the keyboard into the hinged lid of the radio/television/VDU console. The *Practical Computing* review of the Pet (October, 1978) was not alone in calling the keyboard 'disappointing' because of its smallness, describing it as a 'calculator rather than typewriter keyboard'. In the De Ville the diminutive nature of the keyboard becomes a real asset rather than a disadvantage.

## Clear display

Panther produces a standard console to carry a TV set and cocktail cabinet, or whatever its wealthy customers desire, and the Pet fits neatly inside it with plenty of room left for bottles. The console fits in the car behind the front seat—presumably most De Villes are chauffeur driven.

To accommodate the Pet, Panther added a large base to the console. It contains the CPU and the cassette tape unit. Even with three-inch Sony TV fitted to the model we saw, the display is remarkably clear and surprisingly readable. Future models will have a 4½ in. screen, and this can, of course, be used as



Thames Personal Computers has built the standard Pet keyboard into the hinged lid of the radio/TV console.

a normal television set when the computer is not in use.

The keyboard is in a flap in front of the screen, which can be closed. This must be the first time the Pet keyboard has not seemed too small.

Certain modifications were necessary. The system had to be adapted to run from the car battery, so that the owner does not have to search for a co-operative transport cafe before updating the sales ledger.

The most ingenious innovation is the inclusion of a small transmitter in the base, which transmits the video display to the TV screen. The lack of wires and connections is designed to improve the reliability of a system which must be subject to the potholes of our pock-marked highways.

The Pet has yet to undergo the 7-800 miles of gruelling road tests every Panther car receives before being released to the customer. Panther is optimistic that a computer will prove as reliable as a TV or

any other sensitive piece of equipment.

The whole console containing the Pet can be removed from the car so that one can also use the computer in the privacy of one's own mansion or penthouse.

Panther had the Pet available for demonstration to potential customers at the Motor Show in Birmingham, but has waited for this edition of *Practical Computing* to announce it to the world.

## Waiting list

The price? Well, it is really cheap compared to the £3,000 some customers pay for a complete Music Centre in a De Ville. If any *Practical Computing* reader is looking for the perfect gift for the wealthy executive who already has a limousine with TV and stereo, the Panther De Ville costs slightly less than £45,000. The console and computer increase that only by £2,000. There is still a long waiting list and even after paying £47,000 you will have to supply your own gin and tonic.

# THE EXPANDABLE GENERAL-PURPOSE MICROCOMPUTER



## THE RESEARCH MACHINES 380Z A unique tool for research and education

Microcomputers are extremely good value. The outright purchase price of a 380Z installation with dual mini floppy disk drives, digital I/O and a real-time clock, is about the same as the annual maintenance cost of a typical laboratory minicomputer. It is worth thinking about!

The RESEARCH MACHINES 380Z is an excellent microcomputer for on-line data logging and control. In university departments in general, it is also a very attractive alternative to a central mainframe. Having your own 380Z means an end to fighting the central operating system, immediate feedback of program bugs, no more queuing and a virtually unlimited computing budget. You can program in interactive BASIC or run very large programs using your unique Text Editor with a 380Z FORTRAN Compiler. If you already have a minicomputer, you can use your 380Z with a floppy disk system for data capture.

What about Schools and Colleges? You can purchase a 380Z for your Computer Science or Computer Studies department at about the same cost as a terminal. A 380Z has a performance equal to many minicomputers and is ideal for teaching BASIC and Cesium. For A Level machine language instruction, the 380Z has the best software front panel of any computer. This enables a teacher to single-step through programs and observe the effects on registers and memory, using a single keystroke.

### WHAT OTHER FEATURES SET THE 380Z APART?

The 380Z with its professional keyboard is robust, hardwearing equipment that will endure continual handling for years. It has an integral VDU interface—just plug a black and white television into the system in order to provide a display unit—you do not need to buy a separate terminal. The integral VDU interface gives you upper and lower case characters and low resolution graphics. Text and graphics can be mixed *anywhere* on the screen. The 380Z also has an integral cassette interface, software and hardware, which uses *named* cassette

files for both program and data storage. This means that it is easy to store more than one program per cassette.

Owners of a 380Z microcomputer can upgrade their system to include floppy (standard or mini) disk storage and take full advantage of a unique occurrence in the history of computing—the CP/MTM\* industry standard disk operating system. The 380Z uses an 8080 family microprocessor—the Z80—and this has enabled us to use CP/M. This means that the 380Z user has access to a growing body of CP/M base-software, supplied from any independent sources.

380Z mini floppy disk systems are available with the drives mounted in the computer case itself, presenting a compact and tidy installation. The FDS-2 standard floppy disk system uses double-sided disk drives, providing 1 Megabyte of on-line storage.

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

If you already have a teletype, the 380Z can use this for hard copy or for paper tape input. Alternatively, you can purchase a low cost 380Z compatible printer for under £300, or choose from a range of higher performance printers.

\*CP/MTM Registered trademark Digital Research.

**380Z/16K System with Keyboard £965.00**

**380Z/56K complete with DUAL FULL FLOPPY DISK SYSTEM FDS-Z £3,266.00**

380Z Computer Systems are distributed by RESEARCH MACHINES, P.O. Box 75, Chapel Street, Oxford. Telephone: OXFORD (0865) 49792. Please send for the 380Z information Leaflet. Prices do not include VAT @ 8% or Carriage.



## Paper tape reader

ONCE the staple input device for all computer systems, the paper tape has declined in use, with punched cards, key-to-disc systems, key-to-tape, and all kinds of terminals gaining ground through the years.

The paper tape, however, can still be a cheap and fast input device and ideal for the micro user. So it is interesting to see that Microsystem Services is offering what it describes as a low-cost (£680) paper tape reader for use with its Models 7, 9 and 16 PROM programmers, or any application requiring a serial or parallel interface.

It is called the MSS96R and can run at several speeds up to 9,600 baud. It can handle both the 8-level codes used in data processing, and the 5-level (Baudot) codes used commonly in data communications.

For information: Microsystem Services, Duke Street, High Wycombe, Bucks. Tel: 0494-41661. □

## Managing with micros

THERE are a few tickets remaining for the one-day conference to explore the potential impact of microprocessors on the process of management, sponsored jointly by *Practical Computing* and Eastern Counties Operational Research Society. It is on January 10 at St Albans, Herts, and applications for tickets (£5 each including buffet lunch) should be made to:

Ian Roderick, 237 Lonsdale Road, Stevenage, Herts., enclosing payment. Cheques should be made payable to Eastern Counties Operational Research Society. □

## Cheaper memory

FOR THOSE who've passed the beginner's stage and are starting to play around with the more basic components of microcomputers, there's good news from Intel. This company—which, by the way, produced the world's first commercial microprocessor—



## Plessey add-on memory for Pet

PLESSEY MICROSYSTEMS has developed an add-on memory for the Commodore Pet. Called Petite, the self-contained module expands the Pet to its full capability and allows more complex programs to be run, as well as providing an extension to the graphics facility.

The RAM incorporated in the Petite is organised as 24K bytes in its standard form. Alternative configurations are available from 8K bytes, which is the minimum useful configuration, through to 32K bytes, which provides additional storage for long machine-language programs and display storage.

Each system is complete in a compact portable case and has been designed to interface directly to the Pet memory port. It is supplied with mating connectors to expand the Pet without any modification.

Unlike add-on units, there is no need to open the Pet cabinet and consequently it does not affect the power drain or heat dissipation adversely.

Plessey Microsystems will handle orders from Pet users directly on a cash-with-order basis initially, but expects to

operate through authorised distributors in 1979.

The end-user price is set at £449 for a 24K-byte unit complete with leads, connectors, detailed technical handbook and six months' warranty.

One of the first distributors is Torbus, Chesham House, 150 Regent Street, London W.1. □

## New version of CIS Cobol

THE software house, Micro Focus, has a new version of its CIS Cobol to run on micros under the widely-recognised CP/M operating system.

Marketing efforts have been aimed previously at manufacturers of minicomputers but the micro version is now being sold to end-users of microcomputers which support the CP/M operating system. They include the Altair, Imsai, Cromemco and Casu Super C.

The basic requirement for

## Systems for Intel range

THREE NEW development systems for the Intel range of microcomputers have been announced by GEC Semiconductors. Model 210, the smallest of the three, is for small development projects using the MCS 48, 80 or 85 micro systems.

It has 32K bytes of RAM, interfaces for teletypewriter, display screen, paper tape punch/reader, universal PROM programmer, and an eight-level priority interrupt system.

The middle model, the 221, has a floppy disc and upper- and lower-case keyboard as well as the features of the 210. Top of the range is the 231, which is designed for the user who wants to use high-level languages such as Fortran, Coral 66 and PL/M. It has 64K bytes of RAM and a megabyte of disc back-up storage.

Further information: GEC Semiconductors Ltd, East Lane, Wembley, Middx HA9 7PP. □

running CIS Cobol is an Intel 8080 or Zilog Z80-based system with at least 32K bytes of read-write memory and a CRT terminal.

The only difficulty is that the package is not cheap—in hobby computing terms, at least. It costs £400, probably 10 or 20 times more than many micro users have ever paid for a piece of software.

As Micro Focus points out, using a high-level programming language not only makes programming so much easier, but it also whisks away the user from the realms of back-room electronics into the shining world of data processing. Make sure you're not dazzled by the glare.

For information: Micro Focus, 18 Vernon Yard, Portobello Road, London W11. Tel: 727-5814. □



## Tutorial program

ARE you about to buy a micro, but do not know Basic? If, like many others, you decide to buy one of Commodore Systems' Pet machines, you will be pleased to know that a tutorial program is being supplied to take the user through the nuances and complexities of Basic.

It is in cassette form and costs £9 from Commodore. It has been produced, we are told, because of the Pet success in the educational world—21 percent of its sales, to be precise.

The cassette is loaded into the Pet system and the program gives the lesson to the user on the VDU, asking him questions and checking his progress.

It comprises 15 chapters, six sample programs and even gives the student homework assignments.

More details from Commodore Systems Division, 360 Euston Road, London NW1. □

## Low-cost golf-ball printer available for Pet

A LOW-COST, business-quality printer which interfaces directly to the Commodore Pet is available from GR Electronics Ltd, of Newport, Gwent. Based on the highly-reliable IBM 3982 golf-ball unit, it gives full ASCII printer facilities with the ability to change typefaces and fonts to suit specific applications.

The Petprint 3982 will copy letters, invoices and program listings in upper- and lower-case, either as set on the computer VDU screen or input through the cassette unit. Printing speed is 15cps and line length 130 characters, with 10-pitch which may be modified to 12-pitch if required.

The printer is driven from the Pet user port, not the IEEE interface, and its operation is

controlled by a machine code program supplied on cassette. It gives the user complete flexibility in code conversion and timing, as well as carriage return, line feed, tab and backspace functions.

When loaded into the Pet, the printer program occupies less than ¼K of store normally and will not be affected by loading of further information through the cassette unit. Routines included in Basic are for listing of Peek/Poke characters, solenoid codes and

characters printed. A further facility is a step/print function which allows 'mapping' of other printing elements.

The printers are second-user, heavy-duty units, maintained regularly during their initial service life as satellite printers in a large distributed system. They have been reconditioned by an IBM specialist, from whom service and repair facilities will also be available. Price with fitted interface and software cassette is £475. □

## Limrose system based on 6800

LIMROSE ELECTRONICS, of Northwich, Cheshire, has introduced a new microcomputer system, the LMC 6800-2 based on the Motorola 6800 microprocessor.

Priced at £290 in kit form, the minimum system has 4K of read-write memory, motherboard, power supplies and interface for VDU or teleprinter.

It also features what Limrose calls a 'crash-proof' Basic interpreter, pre-programmed in read-only memory. Software debugging is done by a device called the 'trap', a built-in logic analyser which allows the user to examine the cycle-by-cycle operation of the microcomputer. By trapping up to 250 machine cycles, the user can then single-step backwards in a program in search for any incorrect program commands.

The system comprises three boards. The central processor board holds the 8K Basic interpreter; 4K RAM is on the second board; and the third contains the trap facility and I/O interfaces. To this system can be added a tape cassette interface; floppy disc controller and interface are planned in the near future.

For information: Limrose

Electronics, Microprocessor Division, 241-3 Manchester Road, Northwich, Cheshire. Tel: 0606 41696/7. □

## For estate agents

MICRO-SOFTWARE SYSTEMS, the software house from Essex which appears to be making something of a reputation in the world of micros, has produced a new package for estate agents.

It is designed to run on an Equinox system with 24K dual mini-floppy system. VDU and DECwriter. A complete system would cost slightly less than £4,000, excluding VAT.

The package allows the estate agent to search his records, matching the requirements of prospective buyers to what he has to sell. As a by-product, the system generates letters to both parties to confirm offers, and covers the monetary aspects of the deal from deposit and commission to the final statements.

For information: Equinox Computer Systems, 32-5 Featherstone Street, London EC1Y 8QX. Tel: 01-253 3781/9837. □

## The world's best-selling personal computer



## APPLE II

- \* New powerful basic and new graphics on Rom. £110 card.
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- \* Colour Graphics. High resolution 280h x 192v, 6 colours, easy-to-use. 16 colours, very powerful. Low resolution 40h x 48v.
- \* Apple's disks. Powerful DOS. 116K bytes capacity, multiple drives, fast access. £425.
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## microForth licence

GOLDEN RIVER of Bicester, Oxfordshire, has bought a licence for microForth, a high-level computer language for use in conjunction with the RCA 1802 microprocessor.

A user-defined interactive programming language, microForth has the facility of allowing the user to design his software from the top down, and makes structured programming follow automatically. Algorithms and routines are tested on-line with the development system, minimising the inevitable problems when transporting the finished program to the target system.

An advantage is the minimum system overhead of 512 bytes Nucleus, compared to from 2K to 10K overheads with compilers such as Fortran and Basic.

Golden River will be using microForth alongside its 1802 Assembler for its own and consulting projects in progress. Later it intends to introduce another high-level language for the 1802, this time a compiler for the proposed universal micro language Pascal.

Mike Dagleish, managing director of Golden River, says the Pascal compiler will run on RCA 1802 development hardware with an additional 20K of RAM inserted into the pre-wired 18S005 sockets. A kit for the RAMs will be offered and the total software and hardware upgrade will be less than £1,000. □

## An absorbing crime tale

THE AUTHOR of *The Consultant*—*A Novel of Computer Crime* (Weidenfeld and Nicholson, £4.95) is John McNeil, whom I remember in his pre-Data Logic days as the snappily-dressed, high-living, Porsche-driving, co-founder of a computer consultancy off London's Goodge Street.

The hero of his novel, Christopher Webb, is a snappily-dressed, high-living, Porsche-driving, co-founder of a computer consultancy just off Goodge Street whose success depends materially on his non-standard attitude to the normal codes of professional behaviour and honesty.

While the book is obviously in no way biographical, it would appear as if McNeil may have drawn heavily on his experience with the Scicons and Logicas of the Computer Belt (sic) to provide an extremely inventive and spell-binding who-patched-it?

In the book, Webb's imaginary co-founder of "Systems Technology Ltd" is Andrew Shulton, with whom Webb had worked at IBM. Life at "SysTech" is exhilarating and the only fly in Webb's ointment is that his contentment is flawed fatally by jealousy rooted in the fact that Shulton owns the majority stake in the company, having advanced the initial funding.

This, and a penchant for gambling and the good life, causes Webb to take an unusual approach to the art of con-

sultancy and, in particular, to computer crime detection.

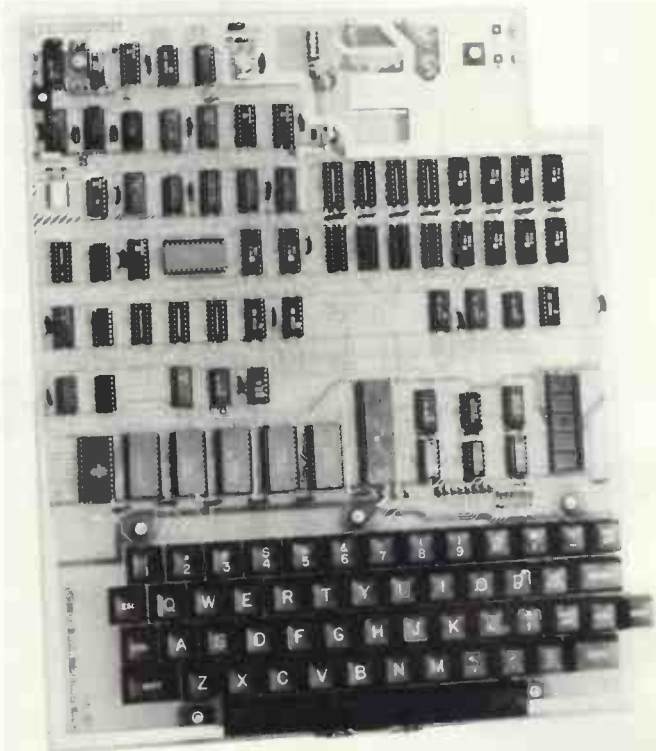
The path into which this leads Webb makes an absorbing, fast-moving tale. While anyone who appreciates a really first-rate thriller will thoroughly enjoy McNeil's first novel, computer freaks will get a special kick from the awesome possibilities for major crime offered by the total dependence of the major banks on their huge computer installations.

The flow of the narrative is slightly checked by the descriptive passages being written in a rather pretentious style which does not match the slick patter of the book's lightly-drawn main characters.

There is also a rather tiresome insistence on listing the street names in the West End, which becomes even more irritating when it leads inevitably to inaccuracies—such as transplanting Rotten Row from the south to the north side of the Serpentine.

These are but minor jolts, however, in a fast and enjoyable journey through an ingenious web of crime and intrigue. Strongly recommended. W.H. □

## OHIO Superboard II.



## Superboard from Ohio

OHIO SCIENTIFIC has introduced what it calls the Superboard II. It is a very attractive deal for the hobbyist or system builder, because it sells for less than £300 with 8K Basic in ROM, 4KB RAM, and a built-in QWERTY keyboard.

It runs from a very simple power supply, which you will need to provide, and has on-board interfaces for video and cassette (Kansas City CUTS standard).

An optional expander board adds 24KB and interfaces for printer and mini-floppies.

Dealers are just being appointed in the U.K. and they should have stocks now. The cheapest we have seen is from CTS in Littleborough, which has Superboard and 4KB at £275; other outlets have it at around £296.

Other items to watch for from Ohio are the Challenger 3, a diskette-only version (32KB and dual floppies plus the three micros at \$3,600 in the States), and the very interesting Challenger 2—"we designed a direct competitor for Pet but with better video and faster Basic"—American price from less than \$600. □

## Instant take-off

MAINS-BORNE interference, a threat to data in small business or hobby systems caused by such things as drills, heaters, central heating and other equipment, can be overcome using the Beyts Logic plug-in suppressor.

The unit needs no wiring and can handle 1,500 watts at 6 amps and reduces interference between 150 kHz and 100 MHz. The device does not suppress radiated interference,

for example from passing motor vehicles.

The unit has been used on micro-based business systems—including a computer, printer, disc drive and VDU. It is complete with 65cm long lead and standard 13 amp mains plug (fused for 7 amp) for £17.90, including VAT and postage, from Beyts Logic Ltd, Windmill Road, Sunbury, Middx. □





# Keen Computers, go SOFT!

A full range of **AppleII** software is now being developed:

## **Software** available at present:

Incomplete record accounting	£250	Co-Resident Assembler	£ 25
Addressing & Mailing program	£ 50	Matrix Inversion	£ 25
Word-processor	£ 50	Analysis of Regression	£ 35
Chequebook	£ 10	Analysis of Variance	£ 35
Shape-Create	£ 25	Correlation Analysis	£ 35

In addition to these packages, we also offer a consultancy service.

## **Hardware**

**Keen Computers** are the only **AppleII** dealer in the Midlands area.

The APPLE II has to be the most advanced Micro on the U.K. market.

— It uses a 6502 microprocessor—a very updated version of the Motorola 6800.

— It has excellent colour graphics and a very comprehensive basic.

Apple II computer (16k)	£985	Data 100 fast matrix printer	£1,750
Additional memory	£200	D.D.T. Decwriter II	£1,050
Disk unit with controller	£425	Centronics 779 printer	£ 850
Disk unit without controller	£375	Axiom Microprinter	£ 349
Applesoft ROM card	£115	Printer card	£ 110

For further information please contact:

**Keen Computers Ltd,**  
**58 Castle Blvd.,**  
**Nottingham**  
**Tele: Nottm**  
**45865**



# Nascom-1 is real value for money

This month we review a £200 computer kit. Building your own computer is becoming an increasingly popular way of starting in computing, as our reviewer discovered.

OUR Nascom-1 was a week late being delivered. Not a criticism, but more a worry as our deadlines seem earlier each month. It is not surprising, though, that the machine was late, as it reflects the phenomenal success story of the Nascom-1.

A little more than a year ago when the Nascom-1 computer kit was a mere twinkle in the designer's eyes, a figure of 300-500 orders was thought to be over-optimistic by Nasco and Lynx Electronics.

To date, they have received more than 12,000 orders and have delivered more than 4,000 kits, overwhelming in anyone's terms. So a delay in delivery, I suppose, is inevitable.

## Construction

Very fortunately for us the review kit delivered was not a kit, but a ready-built and working machine, because the Nascom-1 is not a trivial kit to assemble.

That is its major disadvantage, as it arrives as a box of parts, some 203 components for the CPU board, which amounts to approximately 1,310 solder points in construction. On a board roughly the size of this page with that number of components—55 are integrated circuits—the layout packing is very tight and the printed circuit tracks very thin. The construction notes supplied suggest a total of 20 hours required for construction; I think they are optimistic.

Another criticism is the board layout; component numbering is not in sequence, making finding the place on the board for the correct component difficult.

Remember, part of the price the purchaser pays is the tedious work of putting together the kit. Obviously, the kit is not insuperably difficult as there are many satisfied customers but it needs very careful and patient construction.

## Design

The strongest point of the Nascom-1 is the user's interface. It was designed with how the user communicates with the computer in mind. For the user to talk to

the computer, one of the most acceptable ways is provided by a full alphanumeric keyboard in a conventional typewriter QWERTY layout. This gives the potential for using sensible English words.

The computer should be able to display more than one line of information at a time and not be limited to the permutations of a 7-segment display. The method

by Vincent Tseng

used in most computer installations is by the cathode ray tube VDU, as it has low running costs. The Nascom-1 uses cleverly what is in the majority of homes—a domestic UHF TV set.

The possibility of providing graphics display at a later date is now open. Also,

## Technical specification

### SUMMARY

CPU: Z-80  
Clock rate: 1, 2 or 4 MHz link-selectable (the majority of components suitable only for up to 2MHz operation).  
Keyboard: Alphanumeric on conventional QWERTY layout (ready-built).  
Display: Interface to domestic UHF TV set, displaying 48 char × 16 lines.  
Memory: 1K 2708 EPROM monitor NASBUG; 2K RAM of which 1K is dedicated (memory mapped) for TV interface.  
I/O: Serial interface, link-selectable to audio cassette, Teletype (20mA current loop) or RS232C. 16 lines of programmable I/O on P10 IC.

### SOFTWARE

Monitor: NASBUG Commands  
B Set breakpoint  
C Copy an area of memory to another  
D Dump to serial interface  
E Execute from specified address  
L Load from serial interface  
M Display and modify memory  
S Single-step program  
T Tabulate memory  
. (full stop) Terminate command

### Prices

NASCOM-1 kit £197.50  
Power supply 3A £24.50

to allow the user to retain the work done on the computer on a more permanent mass-storage medium, an interface to an ordinary audio cassette recorder is provided.

The hardware design is well thought out. It was designed from the outside (user's interface) inwards (the CPU) instead of the usual "Here is a micro-processor, what can we put round it?". Considering the user's interface foremost has given the kit the capability of being easy to use and increased its potential for a much wider range of uses even in its basic form.

## Adequate

The TV interface on the basic kit is only just adequate, i.e., the display on the TV screen is legible but not of particularly good quality, and is very susceptible to interference; also, the RF cable provided is rather stiff, along with the fixing method—soldered on to pins on the board—which makes it annoyingly easy to break off if any amount of plugging and unplugging from the TV set is done.

For very little extra cost, Nasco offers a read-built UHF modulator (from a TV game) and details of the necessary modifications which solve both the above problems—the quality of the TV display is likely to be improved by 200 percent.

The cassette interface is not Kansas City standard, but Nascom's own; it is slow, about 10 cps, but reliable if NASBUG-1 "T2" is supplied. If you have problems with the cassette interface, you can check very simply if "T2" or NASBUG was supplied, by tabulating memory from 0045H to 49H:

> T45 49 NL

and the display should be:

0045 30 F7 DB 01 C9 . . . . .

## Monitor

The hardware design gives the kit its potential but the manner in which the computer performs depends on the software implemented—in this case it is the monitor, the NASBUG. NASBUG is

(continued on page 29)

# IF YOU CAN'T BEAT THEM:-

## VECTOR GRAPHIC INC



VECTOR V18A slot Motherchassis accepts the wide range of Vector S100 cards and makes an ideal base to build a microcomputer system. Computing power is available to perform a wide range of tasks from industrial control to small business.

£350

PR2 12K PROM/RAM card holds a comprehensive monitor program for system testing and configuration. Normal operation is in conjunction with a serial terminal via I/O card.

£160

FLASHWRITER, memory mapped VDU with graphics, allows a system to be built without a terminal or I/O card. Specify version EV of monitor program.

£150

I/O, Switchable 110 to 9600 baud serial interface plus two 8-bit parallel I/O ports.

£125

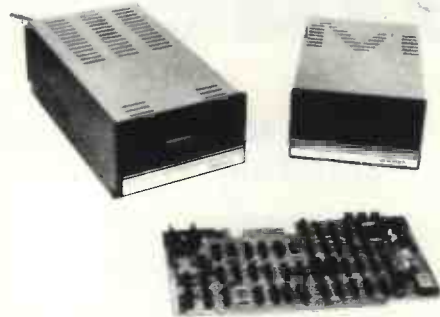
High resolution graphics interface bit-maps 8K of RAM to 256 x 256 points, or 128 x 128 with 16 level grey-scale.

£150

Z80 Processor card	£140	8080 Processor card	£120
8K Static RAM 4MHZ	£140	16K Static RAM 4MHZ	£300
Analogue Interface	£70	Precision analogue interface	£250
Rackmount 18 slot motherboard	£150	Rackmount power supply	£90

8K Computer System £895

## MICROPOLIS



Micropolis disk drives employ higher standards of engineering to pack either 143K or 315K bytes per diskette, formatted, Supplied complete with controller card, cables, manual and software they plug directly into the S100 bus; 8080 or Z80.

Extended disc BASIC, mnemonic editor and assembler are provided, to run under the powerful MDOS operating system.

Add-on units are supplied to extend the system to four drives and one drive per system may be powered from the S100 bus.

143K System S100 powered	£439	143K Add-on S100 powered	£279
143K System Mains powered	£499	143K Add-on Mains powered	£339
315K System S100 powered	£649	315K Add-on S100 powered	£349
315K System Mains powered	£699	315K Add-on Mains powered	£399
Twin drive System 630K	£1159	Twin drive Add-on 630K	£859
S100 bus regulator	£14	Diskettes per five	£24

Unmounted drives available from £225

# JOIN THEM!

## VECTOR MZ



# £2300

Combining the best features of the VECTOR GRAPHIC computer and twin MICROPOLIS 315K byte drives. The Vector MZ produces, in one package a powerhouse of Microcomputer ability.

The VECTOR PROM monitor bootstraps directly to either MDOS, for housekeeping and Assembly language operation, or to BASIC to run high-level user programs. Provision is made to immediately attach a printer, for example one of the extensive range from Centronics sold by Sintrom, enabling use of the powerful printer-related features in the MICROPOLIS Software.

Applications Software for the VECTOR MZ now in preparation will perform a wide variety of business functions; stock control, invoicing, ledger and mailing lists. Further applications exist as a microcomputer development system, and low cost replacement for minicomputer control and instrumentation.

VECTOR MZ configuration includes:

Twin disk 630K minifloppy.  
Full Micropolis disk software.  
Z80 4MHZ 32K processor.  
1 Serial port, 2 Parallel ports.  
12K PROM RAM card with extended monitor.

And will support:

Flashwriter, Graphics interface, Analogue interface  
Additional RAM, additional minifloppy drives.

Centronics Microprinter	£398
Centronics 779	£780
ADM3A VDU	£620



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TELEX: 847395  
CABLES: SINTROM READING





(continued from page 27)

a 1K 2708 EPROM and it offers the basic facilities for the user to make use of the computer's potential.

Although the facilities offered by the monitor could be classed as minimal, all the essentials are there. The monitor commands enable the user to examine and change memory ("M"); start execution of the entered program ("E"); to test and examine the program by single stepping ("S"); and run to breakpoints ("B").

Large blocks of memory may be displayed or tabulated on to the screen ("T") or copied to another area of memory ("C"). Lastly, commands are available to load ("L") from and dump ("D") to the serial interface (cassette and the like).

### Missing Command

The command missing is one to access and modify the registers easily for pre-setting certain conditions prior to an execution. Also note the command characters "B", "C", "D" and "E" are also valid hexadecimal characters—it can be infuriating to think you are addressing memory to find that you have called-up

accidentally one of those commands, and it sometimes can have disastrous effects.

With a little more thought the use of those letters could have been avoided so simply and at no extra cost but these are minor points which do not detract from the good design and potential of the system.

### Uses

It may seem that I have been over-critical of the Nascom-1. Far from it; I stress again I like the good conceptual hardware design and the potential of even the basic system.

I have seen a few good games programs on the basic non-expanded Nascom-1. More seriously, there has been a demonstration of a fairly comprehensive Letter Editor where letters can be created, edited, stored on cassette, read back, modified and outputted to a printer, all on a basic, non-expanded Nascom-1.

Power supplies are awkward because the kit required four power rails of  $\pm 5V$  and  $\pm 12V$ . The power supply offered by Nasco is convenient and good value for the basic kit—well worth having. It is adequate with a little in reserve for the

basic kit; if expansion is considered, then the 8-amp power supply planned might be a better bet. When Nasco can deliver however, is not known.

The main instruction manuals supplied are *Construction Notes* and *Software Notes*. The construction notes are good.

The software notes are adequate, but programming examples using some of the routines in the monitor would have been useful. I understand the software notes are being re-written at present.

### CONCLUSIONS

- The Nascom-1 is tedious to build but that may be what you enjoy.
- Delivery may be slow.
- It is, without doubt, a good basic kit offering good potential and facilities. Although it is short of a few finishing touches, at £200 it represents one of the best value-for-money kits available.
- It is produced by an enthusiastic company which has given some careful thought to the hardware design and which is already planning improvements and expansions to the basic kit, so that the potential will be further extended and exploited.



**"I FEEL sometimes more like a museum curator than a teacher",** says Stephen Green as he steps into his classroom, and you can see what he means. His "collection" of computing hardware must represent some kind of a record in school computing terms—no fewer than five computers and a terminal link to a local college for good measure.

Along the back wall, occupying the width of the classroom, stands what Green describes as his "white elephant", an Elliott 4100, equipped with 24K of 24-bit memory, three tape drives and a card reader.

Arrayed beneath the windows are the curios of the collection, three Monrobot XIs. The name is unlikely to bring a sparkle of recognition. Imported by Adler in the early '60s, they were among the first office computers, taking cards or paper tape as input and producing hard copy on a primitive-looking electric typewriter.

The oddest thing about these odd-looking machines is the memory. The only form of storage is a high-speed drum, offering 2K of 32-bit words, and an access time between 0 and 15 milliseconds.

In a corner and looking inconspicuous by comparison is the school's latest acquisition, a CBM Pet.

Green has been in charge of computing at Bishop Stopford School, Kettering, Northamptonshire for nearly four years. Like many teachers in a similar position, he was given the task of establishing a subject which requires considerable capital equipment—and no money to buy it. Apart from the Pet, the school has paid nothing for its room full of hardware, other than transport costs.

**Two junior pupils deeply engrossed in a lunch-time project.**

The first arrivals, the Monrobots, were acquired from British Airways and from Kettering and Wellingborough councils. At one time there were six of them, which, since there are only 15 in the country, gave Green a near-monopoly.

Despite their primitive facilities and slow speed, the Monrobots have proved to be remarkably useful for teaching, especially since Green and a sixth-former wrote a CESIL interpreter for them. Certainly they provide more and better hands-on experience than the terminal link, which until recently was rationed to four hours' use a week. They have also proved to be extremely durable, with not one CPU breakdown in four years.

### Too much power

The Elliott 4100 is another matter. Acquired in a fit of enthusiasm from SATRA, the Shoe and Allied Trades Research Association, it has proved to have more power than Green or his pupils can deal with comfortably.

Transport and installation cost £200, by far the biggest cost incurred to that point, which had to be raised by the parents' association in the form of trading stamps.

While Green can handle the maintenance needed on the Monrobots, the 4100

# Pet begins era in an and mode school co

needs specialist maintenance by Systems Reliability Ltd. That has cost £175 already, despite the limited use of the machine.

The real problem, though, is the software. The operating system is too complex for classroom use and the only high-level language available is Algol. Basic, which is available in theory, cannot be run because of a missing link in the systems software.

The 4100 might still be a useful machine if the school had a strong sixth form to make use of its capacity and also perhaps to produce software to make it more suitable for younger pupils. As it is, Bishop Stopford is still in the process of going comprehensive, and the new intake has reached only the third year.

Most computing is at CSE and O level standard and it is unlikely that the 4100 will still be around when the sixth form is fully established. Still, Green manages to get some use from it, mainly for demonstrating what "real" computing is like and it certainly makes an impressive piece of furniture.

Whatever their faults, these computers, together with the terminal link, have made it possible to get computing established at the school. All pupils take an introductory course in the third year, and CSE and O level classes are growing in strength from year to year.

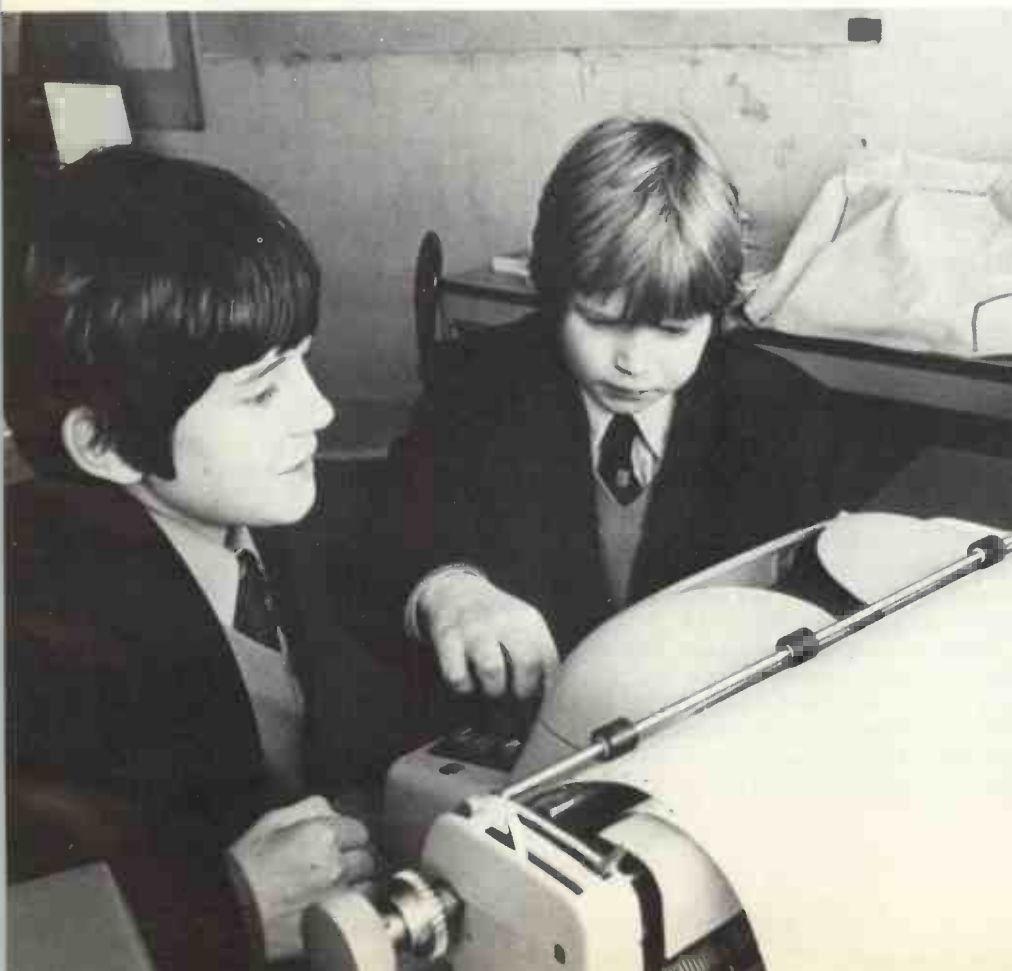
### Endorsement

Enthusiasts are encouraged to work on their own projects in free time and, more recently, have been made welcome on Monday evenings at a club run by the Kettering computer shop, HB Computers Ltd.

The arrival of the Pet could well be the start of a new era in computing at the school and is certainly an indication that Green's efforts have come to fruition. The money to buy it was again provided by the parents' association, and the computer had to compete with numerous other projects for the available funds. The decision to buy it was effectively an endorsement by the parents of the importance of the role of computing in the curriculum.

Although delivered only in September,

*(continued on next page)*



# s new cient rn mputing

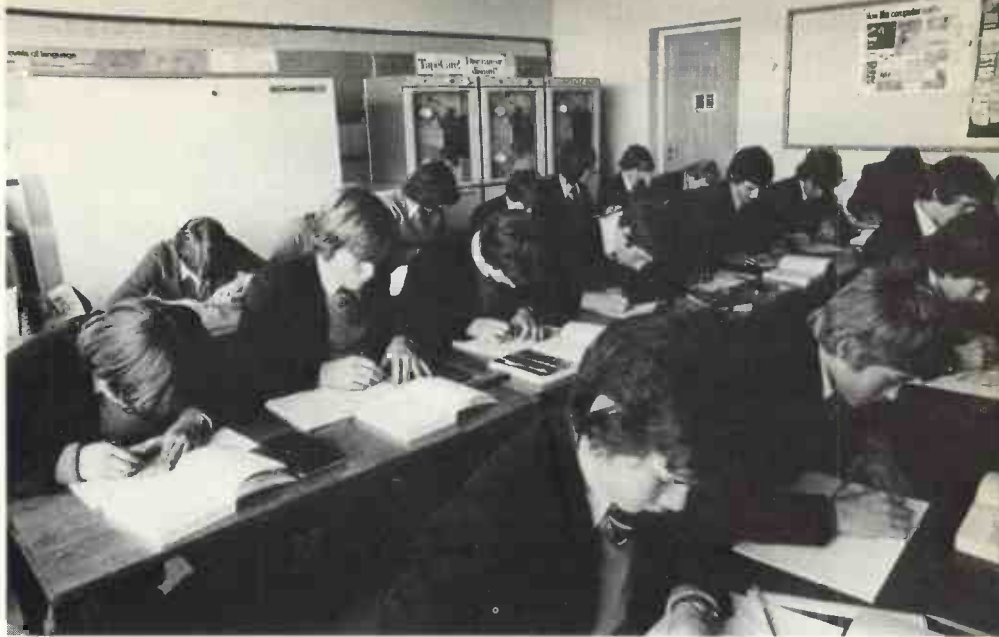
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the advantages of the Pet are already becoming apparent. In the first place, it allows Basic to be taught without recourse to the terminal; and by connecting it to a television set, it can be used for demonstrations to a full-sized class.

Green also appreciates the mobility provided by having the whole package in a single unit. He is keen to spread the gospel of computing to other departments in the school, but so far has met with little success. One reason, admittedly, was the difficulty of finding programs which could be run on the older machines but the main ones were the problems of educating the staff and of getting the class to the computer.

## Creating enthusiasm

The Pet clearly has created much more enthusiasm. Already, staff can be found in the computer room at lunch-time, taking lessons in computing from the pupils. Green is still short of software—at present



**Occasional over-heating problems arise from the Elliott 4100, which occupies the whole of the back wall of the computing classroom.**

he is adapting some of the programs from the *Computers in the Curriculum* course to run on the Pet, but what little is available is finding a ready market.

From the start, Green received enthusiastic support from the headmaster, Dr Hopkins, and as a result, school plans for the future of computing are decidedly ambitious. As part of the re-organisation involved in going comprehensive, a computing laboratory is planned. If the funds can be raised, it should be equipped with six Pets by 1980, one of them reserved hopefully for use by other departments.

The connection with the computer at Nene College will probably be retained. If it were relinquished, the money now spent on telephone charges would not be made available for other purposes,

because of the usual local authority budget restrictions.

Apart from that, programs written as part of CSE and O level projects have to be proved to be working and this is done by sending them for batch processing at the college, after being debugged and tested on the Pet.

The older machines, however, will disappear gradually. The 4100 will probably go first, since it will be impossible to move it upstairs to the new laboratory. The Monrobots will probably be retained until they grind to a halt. Even then, they will still be in good working order, if anyone can be found to repair them from Green's stock of spares.

Is anyone in the market for some vintage hardware? M



**The teacher taught. Marion Brace, of the mathematics department, is instructed by some of her pupils in the use of the Pet.**





# Cheap to I/O

described to collect together the various timing signals from the IBM terminal and combine them into a single signal for the computer, and to cause printing upon the terminal on receipt of data and strobe signals from the computer.

Within the terminal, printing is divided into two separate parts. Firstly, all characters which appear on the golf-ball are identified by a seven-bit code which is generated by the keyboard on input and used to energise the seven-character selection magnets on output.

Secondly, the seven non-golf-ball characters—carriage return, line feed, tab, space, backspace, shift to upper, shift to lower—are brought out as a one-from-seven code from the operational contacts and printed from a one-from-seven code applied to the operational magnets. The nature of those codes depends on the exact model of terminal being used, and whether input or output is being considered.

## Two families

The character selection magnets have an inherent connection with the golf-ball, controlling its tilt and rotation. The code used, therefore, defines the position of the desired character on the golf-ball. There are, however, two families of golf-ball which can be used, the BCD family and the familiar office, or correspondence, family.

The mechanical configuration of the keyboard reflects the nature of the golf-ball for which it was designed so that, when operated off-line, the correct characters appear on the paper.

There are in existence three types of

**This month we show how you can turn an IBM typewriter into an output terminal for your micro and save hundreds of pounds by doing so.**

**by ROLAND JERRY**

COMPUTING POWER has fallen in price at a dramatic rate recently but the cost of input/output terminals, which provide essential communication with the computer, is relatively unmovable. A terminal capable of high-quality printing, if purchased new, is at least as expensive as the whole of the rest of the system.

To our aid, however, there is the IBM Selectric Input/Output writer (type 735), available at present on the surplus market. The 735 is a heavy-duty IBM Selectric typewriter to which a number of contacts and magnets have been added, to enable it to communicate electrically with a computer. Although, from above, the terminal resembles an office typewriter, the base has been extended by a few inches to accommodate the extra mechanics.

The terminal is fundamentally half-duplex—every input from the keyboard is printed directly on the paper—so it can be used off-line as a normal typewriter.

As a printer is a complex mechanical construction, a number of timing contacts are made available to the computer to indicate the position in a printing cycle of the machine when it is free to print the next character or to transmit the next character from the keyboard. It is important to follow those signals exactly to maintain the full printing speed of 15.5 characters per second and to avoid unnecessary wear on the mechanism.

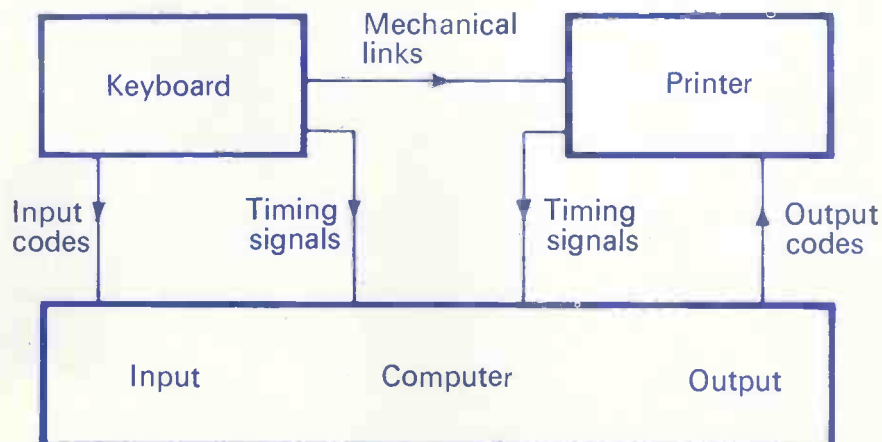
When considering the design of an interface between the terminal and a computer, there are trade-offs concerning the use of hardware and software, in a

suitable combination, to handle the various timing codes. Certain operations, such as "carriage return", take a considerable time compared to a print operation and it is not, therefore, possible to operate the terminal successfully as an asynchronous serial terminal, such as an ASR33 Teletype, but only as a synchronous parallel terminal in the manner of most matrix line printers.

The protocol existing over such an interface relies on a handshake between the computer and the terminal. Firstly, the computer signals that valid data is present on the interface and the terminal accepts and prints accordingly. When the terminal is ready for the next operation it signals back to the computer that new data should be presented.

It is the function of the interface to be

Figure 1





# er route capability

terminal, the BCD terminal, the correspondence terminal and the BCD-converted-to-correspondence terminal. There are considerable differences in the internal wiring and code patterns for the different versions, but suffice it to say at present that

de-energised when C2 N/O closes. The next magnet cycle may begin when C2 N/C recloses.

To ensure continuous synchronous printing, the new magnet driving code must be available when C2 N/C

earth, each operation selection magnet also has its own suppression diode and connection to the rear socket (see figs. 7, 8 and 9). The operational magnets are timed by a collection of feedback contacts spread around the machine. The signals have the same meaning, with N/O closure signifying that the magnet must be de-energised and N/C re-closure signifying that the next cycle may begin.

C3 times shift operations, C5 times backspace, space and tab, while C6 times carriage return and line-feed. Two final contacts are included to ensure that the long operations tab and carriage return have been completed.

Normally they take much longer than any other cycles and the machine must be halted until their interlock contacts have re-made.

## Single signal

All the timing and interlock contacts can be combined to produce a single signal for the interface logic. The bistable (fig. 10) is set by the first "N/O make" and is re-set only after the last "N/C re-make". Although the internal wiring of the terminals as supplied is substantially as illustrated in fig. 10, it has been found that minor differences from machine to machine make it easier in the long run to re-wire the contacts rather than trace the existing wiring.

Primarily an input operation, shift, however, must be examined on output so that the terminal may be placed in the correct case before a character is printed. It is simplest to feed the shift transmit contacts to a bistable and examine the output before each print cycle, performing the relevant shift if required.

The shift is a complete operation,

*(continued on page 35)*

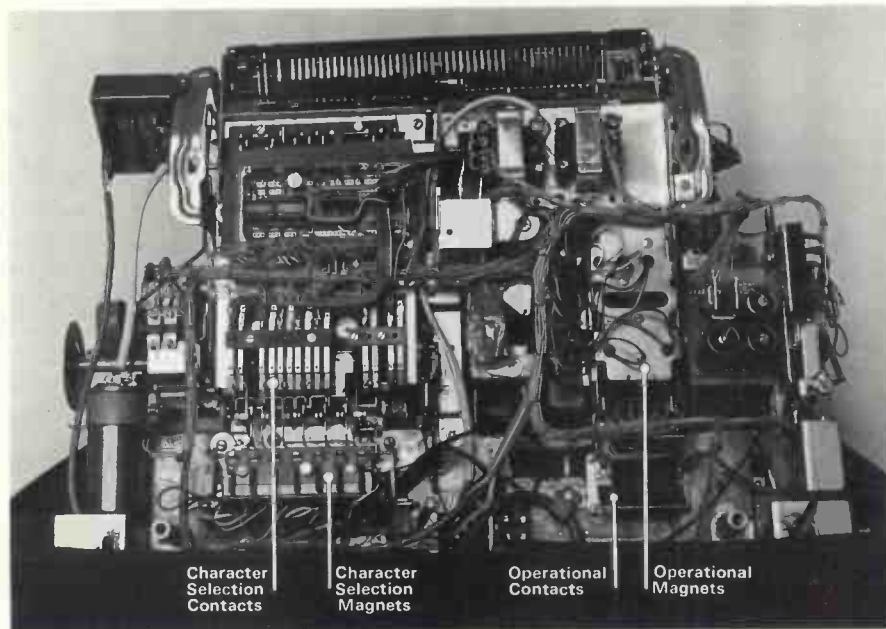


Figure 2.

the interface will handle all types. To remain as simple to implement as possible, it is necessary to re-wire the various contacts within the terminal. The code table given will operate with office golf-balls and must be re-arranged to accommodate BCD golf-balls.

## Positive-earth magnets

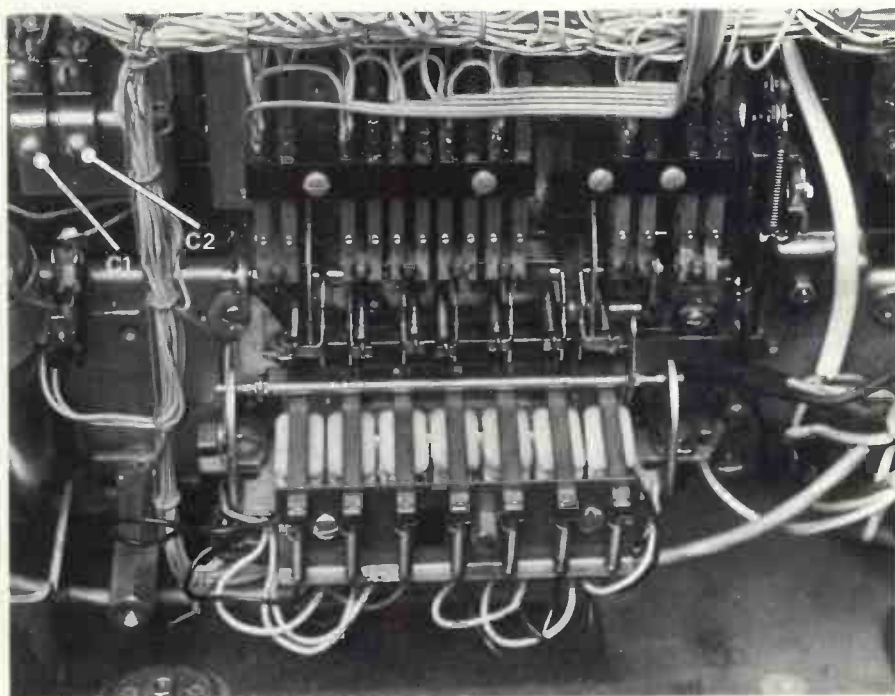
All terminals so far examined have positive-earth magnets which are wired to a common line. A power supply is required to hold this line at +50 volts. As viewed from left to right in fig. 3 and in fig. 4, the magnets activate the mechanism to produce tilt and rotation of the golf-ball. Wires are brought out to the connection socket as indicated, and the use of internal suppression diodes allows a very simple open-collector driving transistor (fig. 5).

Timing is generated from the contact C2 (see fig. 3 for location) and there is a very simple relation between the timing contact and the application of power to the magnets. The magnets may be energised when C2 N/C is closed, and must be

closes again—timing diagram (fig. 6).

Again wired with a common positive

Figure 3



# The Age of Affordable Personal Computing Has Finally Arrived

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Full 8K basic and 4K user RAM  
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Superboard II was designed specifically with low price and the first-time user in mind. It promises to be the most dramatic price and performance breakthrough to date, in the microcomputer industry. Ohio Scientific, with headquarters in Aurora, Ohio, are one of the leading manufacturers of complete computer systems — from hobbyist right up to business and OEM applications.

The single board construction and custom LSI chips used in the Superboard II result in large cost savings, and ease of use. In fact it has more features and better performance than some other systems that are selling at up to £1,000. In the

early 70's computers with inferior performance cost over £10,000.

The broad range of features include 8K BASIC in ROM, up to 8K of RAM on board (4K supplied), full 53 key computer keyboard, Kansas City cassette interface, video display interface (with graphics). Available options include an expander board for additional 24K RAM, dual mini-floppy interface port adaptor (for printer and modem).

The Superboard II comes preassembled, and only needs a power supply and case. Any 5V supply at 3A will power it.

### Standard Features

- Uses the ultra powerful 6502 microprocessor
- 8K Microsoft BASIC-in-ROM
- Full feature BASIC runs faster than currently available personal computers and all 8080-based business computers.
- 4K static RAM on board expandable to 8K
- Full 53-key keyboard with upper-lower case and user programmability
- Kansas City standard audio cassette interface for high reliability
- Full machine code monitor and I/O utilities in ROM
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### Extras

- Available expander board features 24K static RAM (additional mini-floppy interface, port adapter for printer and modem and OSI 48 line expansion interface.
- Assembler/editor and extended machine code monitor available.

### Commands

CONT	LIST	NEW	NULL	RUN
<b>Statements</b>				
CLEAR	DATA	DEF	DIM	END FOR
GOTO	GOSUB	IF...GOTO	IF...THEN	INPUT LET
NEXT	ON...GOTO	ON...GOSUB	POKE	PRINT READ
REM	RESTORE	RETURN	STOP	

### Expressions

Operators  
 -, +, \*, /, ↑, NOT, AND, OR, >, <, <>, >=, <=, =  
 RANGE 10<sup>-32</sup> to 10<sup>+32</sup>

### Functions

ABS(X)	ATN(X)	COS(X)	EXP(X)	FRE(X)	INT(X)
LOG(X)	PEEK(I)	POS(I)	RND(X)	SGN(X)	SIN(X)
SPC(I)	SQR(X)	TAB(I)	TAN(X)	USR(I)	

### String Functions

ASC(X\$)	CHR\$(I)	FRE(X\$)	LEFT\$(X\$,I)	LEN(X\$)	MID\$(X\$,I,J)
			RIGHT\$(X\$,I)	STR\$(X)	VAL(X\$)

Plus variables, arrays and good editing facilities.

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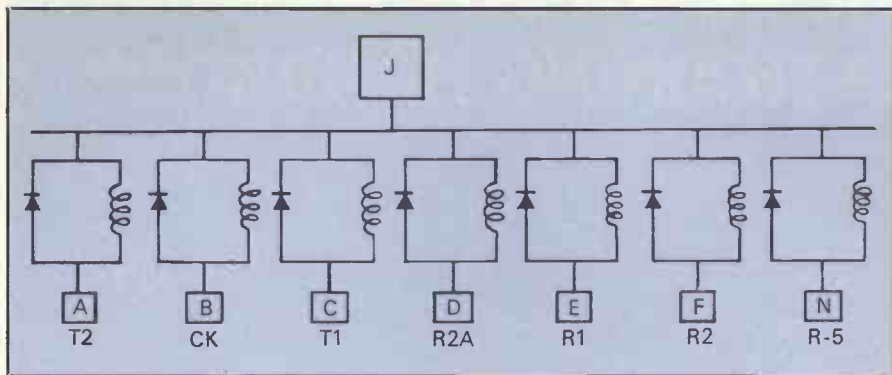
Name .....

Address .....

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PRACTICAL COMPUTING January 1979





**Figure 4**

(continued from page 33)

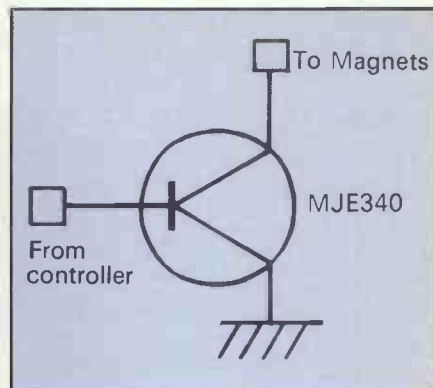
taking one cycle-time of the machine, and cannot be combined with a print from the golf-ball. If the keyboard lock solenoid is wired in parallel with the shift-to-lower-case magnet, the terminal will operate correctly if it is left in manual upper-case lock from the keyboard. The keyboard lock solenoid also removes any shift-lock. The wiring for fig. 10 must be extended to include the keyboard lock contact.

The timing controller has eight input

tacts. The cycle is completed when bistable A is re-set. A circuit diagram and timing diagram are supplied.

Within an operating system such as Southwest Technical Basic or Micropolis MDOS/Basic it is possible to re-write the printer driver routine in assembler code. This allows the use of non-standard hardware, such as the IBM terminal.

In general, this new routine should transform the ASCII values sent by the



**Figure 5**

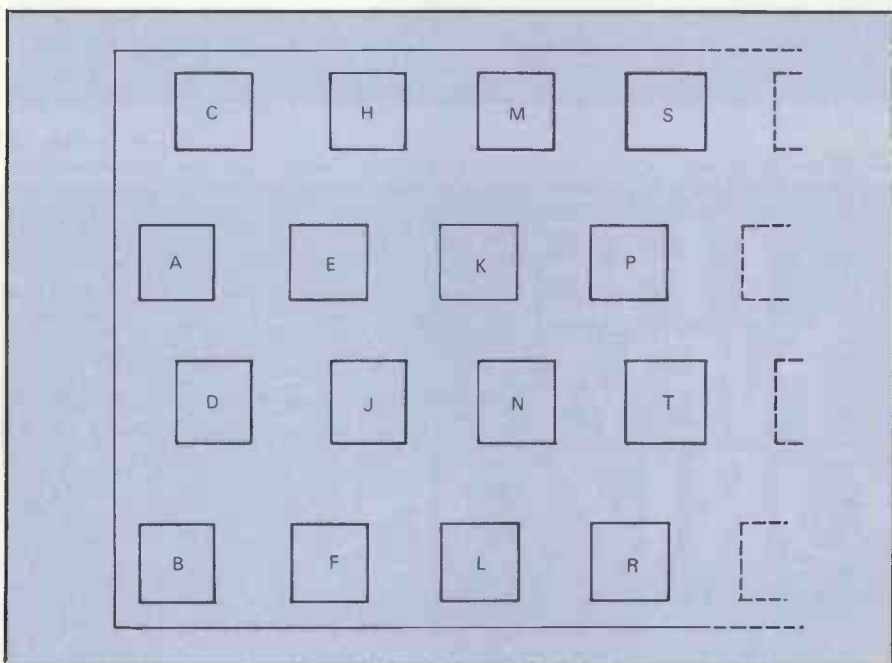
calling program into IBM codes and handle the timing. The program listing to be published next month is in Basic and although it will work at less than full synchronous speed, the ideas contained within it should be translated into assembler code and patched into the target operating system.

The interface may be contained, with its power supplies of +5 and +50 volts, within the terminal, as illustrated; within the computer; or in a separate enclosure. Components required are:

*Interface*

- SN7400 × 2
  - SN7402 × 2
  - SN7404 × 3
  - SN74121 × 1
  - MJE340 × 14
  - 1K0 × 14
  - 4K7 × 4
  - 10nF × 10 (Decoupling capacitors)
  - Veroboard
- PSU*
- RS 207-166 0-20, 0-20 20VA
  - RS 196-303 0-12, 0-12 3VA
  - 1,000uF 100V
  - 1,000uF 25V
  - 1N4001 × 8
  - 7805

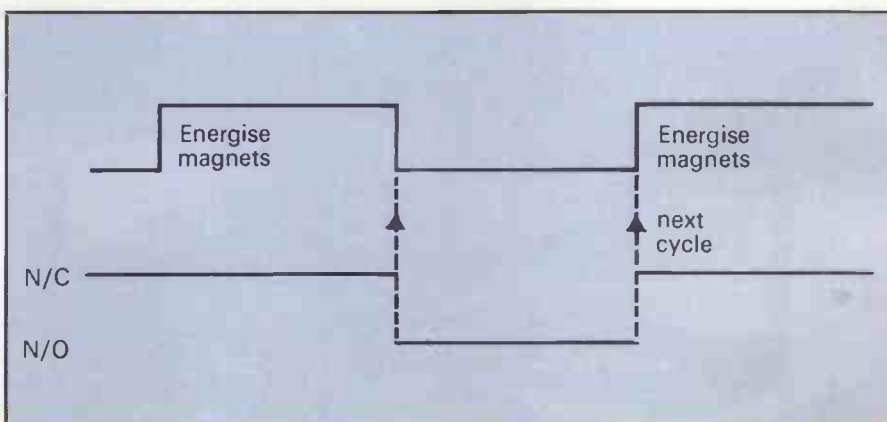
(continued on page 37)



**Figure 4a**

lines and two output lines. The output lines transmit the case and a BUSY status to the computer, while the input lines carry the data and a combined strobe-mode signal. All input lines are active low. On the transition of B7 the monostable is triggered, setting bistable B, energising the magnets. The input code B0-B6 is gated with B7 to select either a character or operational cycle. The BUSY line is lowered as soon as the strobe is received, and stays low until the end of the cycle.

A signal from the timing bistable A de-energises the magnets by re-setting bistable B at the correct point in the cycle as signalled by the feedback con-



**Figure 6**

*Next month: The driving software.*

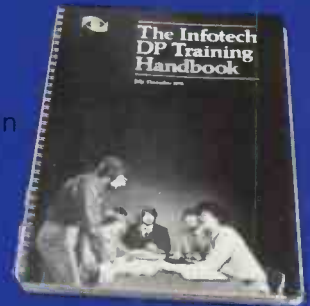


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Powerful basic including sequential and random access disc files • formatted output • strings • line editor • machine language CALL • many other facilities. Optional additional software (under CP/M operating system) includes BASIC

compiler, FORTRAN and COBOL.

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PRACTICAL COMPUTING January 1979

(continued from page 35)

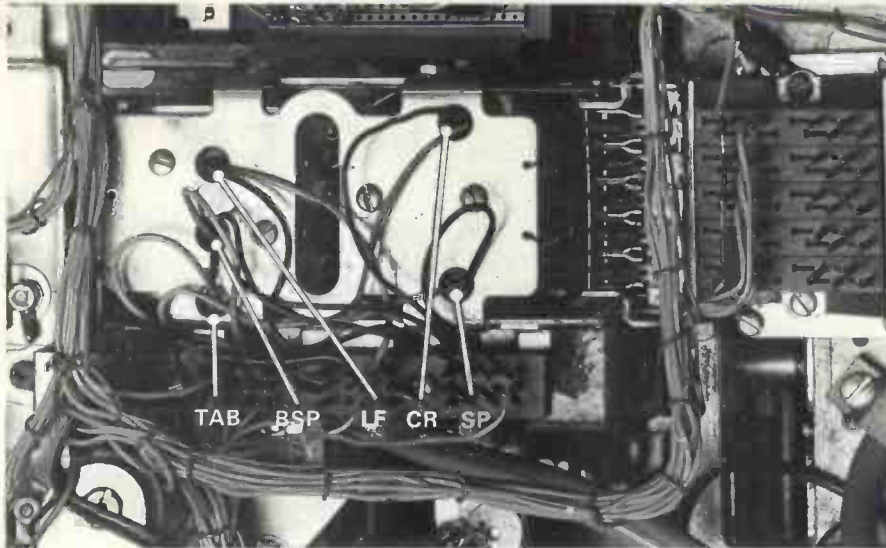


Figure 7

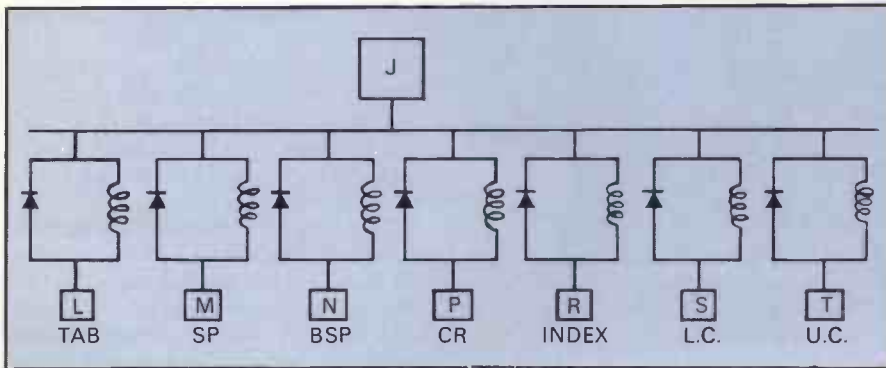


Figure 8

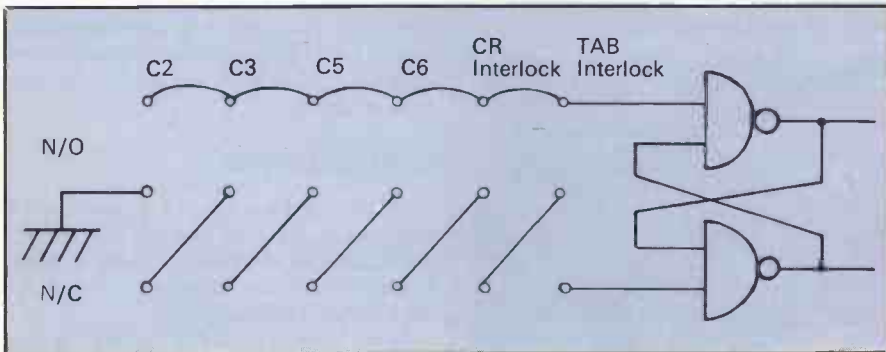


Figure 10

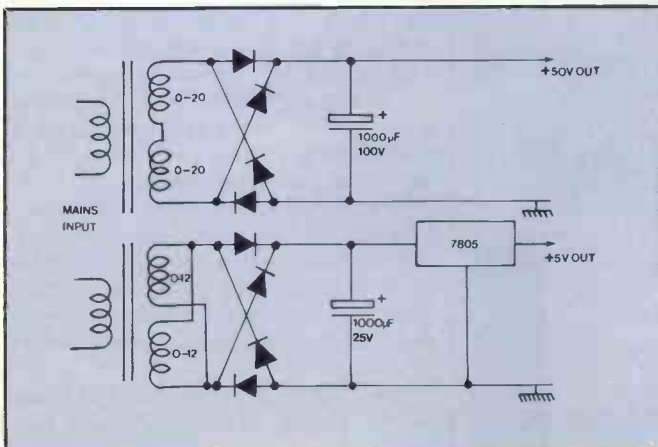


Figure 11

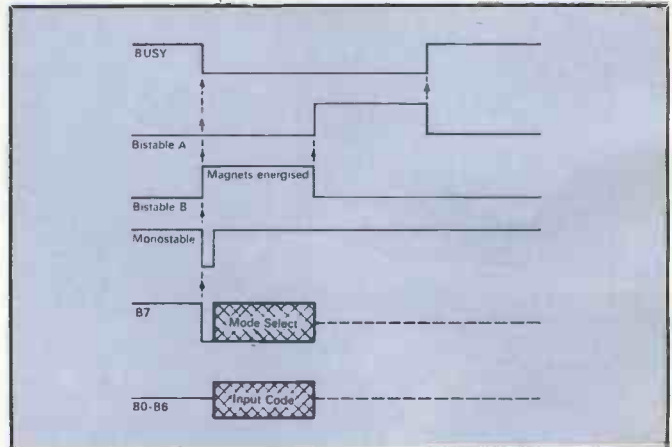


Figure 12

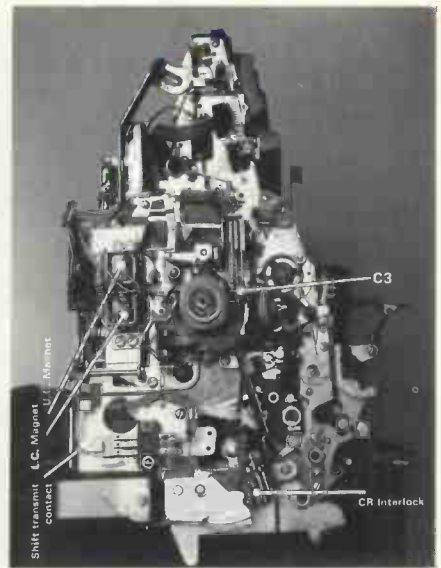


Figure 9a

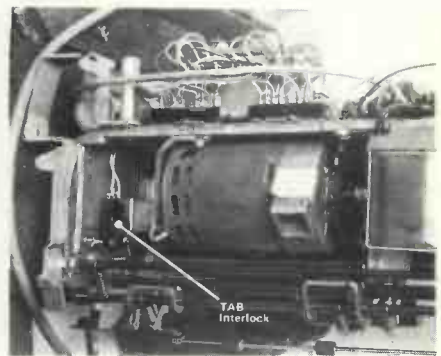


Figure 9b

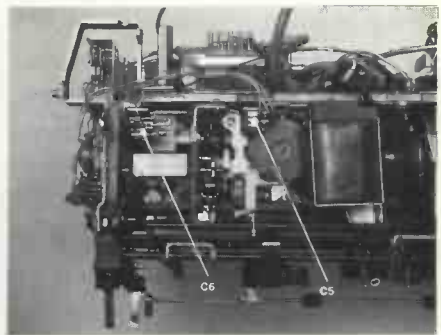


Figure 9c



Visiting an American computer exhibition is like taking a glimpse into the future. You can be almost certain that the new products and ideas on display there will reach the U.K. market after about six months.

The Los Angeles West Coast Computer Faire was no exception. With November temperatures still in the high 80s, the air-conditioned Convention Centre comfortably accommodated the 150-odd companies selling myriad computers, software, peripherals and ideas to the 12,000 visitors.

Personal computing is still going strong in the U.S. You can be certain to find a show taking place each month. Missing from this show—because they

by

**RICHARD HEASE**

cannot keep up with the pace of orders, it is said—were Commodore and Apple, two of the largest-selling computer firms in the U.S. Their computers were there, however, being sold through distributors and shops in abundance.

The Tandy Corporation, known as Radio Shack in the U.S., was there. No wonder. The company is the largest seller of computers for hobby use in the world. It is now estimated to have sold a staggering 200,000 systems.

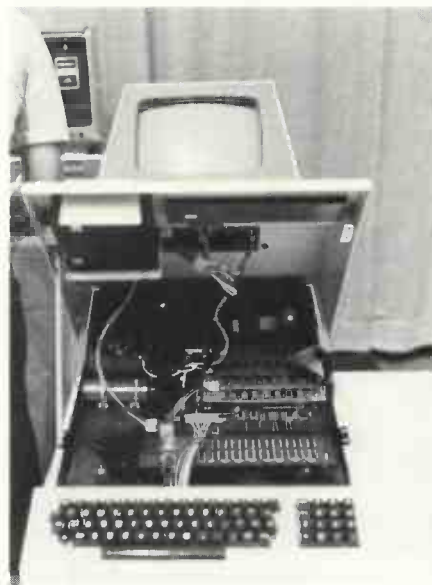
It is not surprising, therefore, that most of the new developments at the show centred on the Tandy computer.

First, though, a word about prices. I know it is a popular topic but the first

thing to strike home in the States is the price of computers.

Tandy, for example, sells its TRS-80 range at almost half the U.K. price. It is difficult for a multi-national company truly to justify this, I feel.

Tandy is, of course, not the only company doing so. Just about every piece of computer equipment, software and peripheral is almost half price compared



A new keyboard for the Pet (above), and (below) Computalker, the talking computer.

# To Los with a crystal

to the U.K. The reason is simple. U.K. companies have to pay shipment and set-up costs for a lower volume market. Because it is a lower-volume market, U.K. companies cannot buy in the quantities which provide the best discounts.

This is unlikely to change in the foreseeable future, unless the U.K. market grows its own competitive system to force the larger companies to offer bigger discounts to remain competitive.

As the market is still very buoyant, however, computers can hold a higher price. So do not expect any significant reductions here for a long time. If it is any consolation, prices in Europe and Japan are higher than our own.

Still, it is rather disconcerting when you can buy a Pet for £400, a Kim for £90 and a CompuColor with graphics and disc for £750—not to mention the fact that Tandy in the States is offering a complete disassembled business system with printer to rent for £75 a week.

The most outstanding point of the show was the amount of software available or under production. Because it is the largest selling system, the Tandy attracts most attention.

## Coming soon

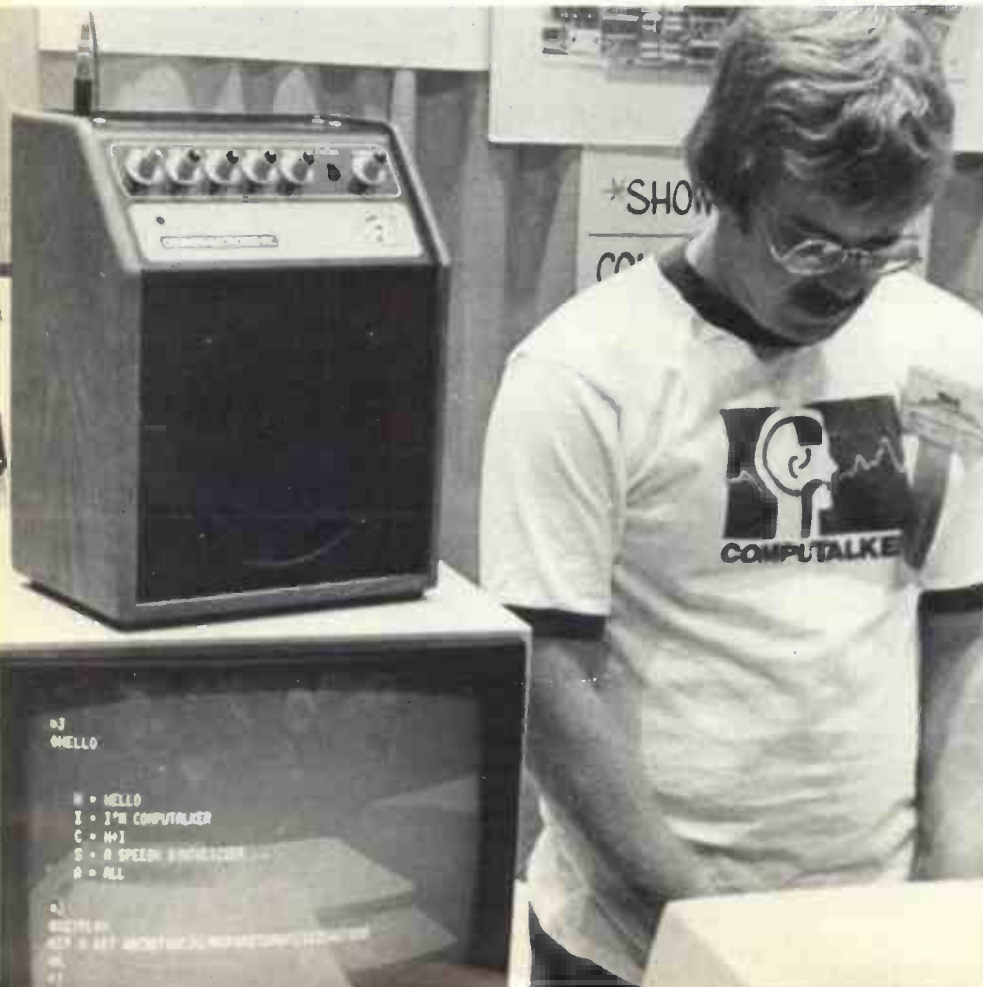
As the system with the greatest sales potential in the U.K., merely because of the number of shops offering the system, it is satisfied that we can expect some software to reach here soon.

At the moment, it is still typically games software. Biorhythms, mastermind, star treks, backgammon, chess, bridge; you name it, it is available, not just for the Tandy but for the Pet and Apple as well.

There is a big increase in the number of business applications packages coming to the market. Word processing appears to be the most popular application, covering automatic letter-writing and text editing. For example, there is a piece of software for the Tandy known as the Electric Pencil which allows you to produce mailing lists, business forms, camera-ready copy for printing, and large numbers of personalised business letters for £50.

For £25 there is a version of Pilot to run on the TRS-80. It is being hailed con-

*(continued on next page)*





# Angeles ball

(continued from previous page)

tinually as the language for educational applications in the U.S.

Payroll, sales ledger and other types of accounting systems for the Pet, Apple and TRS-80 are also becoming available. I brought back software which I plan to test and preview before it arrives here.

On the hardware front there are interesting developments. The most enjoyable was to hear a computer talk. There were three synthesised speech units available as optional extras. The one I enjoyed most was the Computalker. It is S-100 bus-compatible and works in one of two ways—you can produce speech from a pre-determined speech file or type-in phonetically what you want to hear (e.g., HHEHLOW).

## Can be improved

The Computalker, with everything you need for synthesised speech, costs about £250 in the U.S. The quality of the speech, I feel, still needs a great deal of

IBM sells to the "hobby" market.



improvement to be perfectly understandable. I am still waiting to hear a human and a computer carrying-on a conversation and I believe that is no more than a few months away.

A system I am sure we will see soon is the Pascal Microengine from Western Digital. It features the Pascal operating system with a 64K-byte (32K-word) CPU, floppy disc controller, floating point hardware and self-test microdiagnostics. The operating system includes Pascal and Basic compilers, files manager, screen-orientated editor, debugger and a graphics package. The price in the U.S. is £1,500.

IBM, the world's largest computer manufacturer, was also at the show,

displaying its 5110 computer system. It operates either with Basic or APL and was programmed to demonstrate payroll, accounts and management reports. It operates with a screen and printer and floppy discs. The price is £9,000 and upwards.


At the other end of the scale was the Superkim from Microproducts. It is a single-board control computer for applications where intelligent control is desirable, such as manufacturing or production line processes. It is totally compatible with Kim-1 and Apple II hardware interfaces and has TTY, audio cassette interfaces and eight latched priority interrupts which are re-settable individually under software control. It costs £200.

The Exidy Sorcerer, examined in last month's *Practical Computing*, was attracting its fair share of attention.

The Comucolor II is a machine which I hope we shall be able to review soon. It features a beautiful eight-colour, high-resolution graphics and is complete with display and keyboard. The system is based on the 8080 micro, uses discs, and is expandable to 32K. The expected U.K. price is about £1,200.

I am sure it will not be long before the Interact home computer is available here. To be priced at around £300, it connects to your own TV and includes an 8080 micro, 8K RAM, 2K ROM, hand controls, built-in cassette unit 53-key keyboard and a music synthesiser.

For the future, the most interesting gossip around the show was that Schugart has a low-cost floppy disc unit and printer ready to be unveiled early in 1979. The £100 mini-floppy and the £100 printer may be just around the corner.

Apparently, Schugart and Matsushita have a 5in. floppy disc with 70K bytes capacity under development which will retail for £65. The impact printer, also said to be from Schugart, may be priced at £125. If the price of input and output can be reduced to prices of this kind, 1979 will be a very interesting year. 



# DEC Microcomputer System from DICOLL

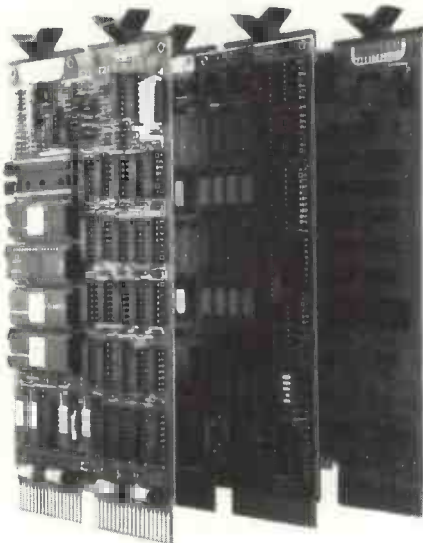
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COMPANY	SYSTEM	APPLICATION	PRICE RANGE
<b>COMART</b> PO Box 2, St Neots, Cambridgeshire 0480 215005	<b>Microbox</b> , Min. size: Chassis with three sockets. Max. size: Chassis with six sockets.	Aimed mainly at OEM industrial users and perhaps the serious hobbyist. Manufactured in Britain by Comart, it will take Cromemco, North Star and other processors and software.	£70-£195
	<b>Cromemco System Two</b> , Min size: Processor alone with six sockets in kit form. Max size: 21 sockets; 512K of memory; up to three mini-diskettes of 90K bytes each.	Software: Extended Basic; Fortran IV; Cobol; Macro-assembler; Word-processing, DBMS. American system suggested for systems development.	£395 to around £5,000
	<b>Dynabyte</b> , Memory board for any S100 bus system. Available in 16-32K units.		£275-695
	<b>Cromemco System Three</b> , Min size: 32K memory; terminal and printer interface; dual 250K-byte IBM compatible floppy discs. Max size: 128K memory; two-three terminals.	Software: Same as System Two. Suitable for a wide range of commercial and scientific applications. Theoretical maximum of 512K of memory.	£4,174-£10,000-plus
	<b>Horizon</b> , Min size: 16K memory; serial interface; one mini-diskette drive with 90K bytes; power supply. Max size: 48K memory; three diskettes; hardware floating point board.	Software: Extended Basic; disc operating system; monitor; access to CP/M range. Manufactured by North Star Computers of the U.S. Aimed at educational and small business users.	£995-£3,500
	<b>SOL 20/16</b> , Min size: 16K memory; integral keyboard and monitor; serial and parallel interface; cassette unit. Max size: 64K memory; up to 1MB disc capacity.	Software: Extended Basic; Fortran; Focal; Assembler; Editor; Games. Another American system from Processor Technology Corp aimed at the small business and education markets.	£1,785-£5,000-plus
<b>COMMODORE SYSTEMS DIVISION</b> London NW1 01-388 5702	<b>PET</b> , Single unit containing screen, tape cassette and keyboard. Memory is expandable from 8-32K.	Software: Basic; Games; Business packages. The British subsidiary of Commodore Systems of the U.S. sells Pet for home, educational and small business applications. Reviewed in the October issue of <i>Practical Computing</i> ; there are more than 50 dealers throughout the U.K.	From £695
	<b>Kim I</b> , Min size: Processor (6502 chip); small calculator-type keyboard; LED six-digit display; built-in interfaces for audio-cassette and Teletype; 1K RAM; 2K ROM. Max size: Can add: Kim 4 motherboard; Kim 3B 8K RAM (up to 64K); Kim 5 resident assembler.	Software: None available yet, but it has three good manuals. An American import which gives Pet-type capabilities with a maximum configuration. For the hobbyist but used mainly as an evaluation board for the 6502 chip. There are two dealers, GR Electronics and J Marshall, which offer further facilities.	£129-£600 (+VAT)
<b>COMPELEC</b> 107 Kilburn Square, Kilburn High Road, London NW6 01-624 7744	<b>Altair System 1300</b> , Min size: 32K memory; dual minifloppy discs, 71K bytes each formatted; serial interface. Max size: 64K memory; 4 serial ports.	Software: Basic (single and multi-user); Fortran; Cobol. The hardware for the Altair systems is from Pertec in the States, but the software is Anglo-Dutch. For educational and small business systems.	£3,000-£5,500
	<b>Altair System 70</b> , Min size: 33K memory; dual floppy discs, 300K bytes each. Max size: 64K memory; provision for up to 8 VDUs.	Software: Single and multi-user Basic; Fortran; Cobol; APL. Aimed exclusively at business applications; packages are available for general and sales and purchase ledger, payroll, word processing, stock control, estate agency, hotel or small airline reservations, transport management and freight costing. A point-of-sale package will soon be ready.	£4,500 to £10,000-plus
	<b>Altair System 300</b> , Typical size: 64K memory; 10MB disc drive; turnkey processor; VDU; Qume daisywheel printer and disc unit.	Software: Single-user Basic; Fortran; Cobol. The same packages as for the System 70 are available for this top-end-of-the-market-business, orientated system. Compelec has its own office in Birmingham, but a full distributor network is being set up.	£10,000-plus
<b>COMPUTERBITS LTD</b> 40 Vincent Street, Yeovil, Somerset 0935 26522	<b>System 8</b> , Typical size: 64K memory; 1MB disc storage; serial I/O port for VDU; parallel port to printer; CP/M operating system.	Software: Basic; Pascal; Fortran. This British-manufactured microcomputer system is almost exclusively for business applications.	£3,000-£5,000

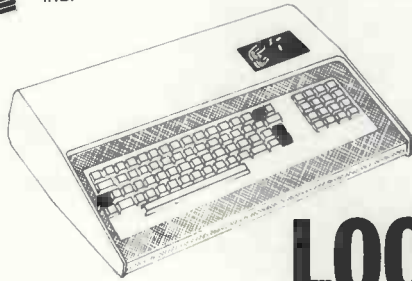
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COMPANY	SYSTEM	APPLICATIONS	PRICE RANGE
<b>COMPUTER MART LTD</b> 38 St Faiths Lane, Norwich. 0603 615089	<b>VDP-80</b> , Typical size: Single desk-top unit housing a 12 in. display, dual standard floppy disc drive, processor, power units, cooling system and fully-programmable keyboard containing 62 alphanumeric, 12 numeric and 12 cursor controls in separate keypads. Normally sold with 32K memory and 1.2M bytes of disc storage but may be expanded.	Software: Included in the price is a sophisticated operating system with Commercial Basic. A range of commercial application packages is available, including word processing if required.	£9,500
<b>COMPUTER WORKSHOP</b> 38 Dover Street, London W1 01-491 7507	<b>System 1</b> , Typical size: 40K memory; dual 8 in. floppy discs, total storage capacity 1.2MB; Ricoh daisywheel printer. <b>System 2</b> , Typical size: 24K memory; dual minifloppy discs of 80K bytes each; Centronics 779 dot matrix printer; VDU. <b>System 3</b> , 12K memory; cassette interface; 40-column dot matrix printer.	Software: Range of Editors, Assemblers, Basics and Games; Information retrieval package. These systems were designed and built in Peterborough and are suitable for educational, small business users and perhaps the more serious hobbyist. There is a large number of dealers around the country.	System 1—£5,000-plus; System 2—around £3,000; System 3—from £1,350
<b>EQUINOX COMPUTER SYSTEMS LTD</b> 32-35 Featherstone Street, London EC1Y 8QX 01-253 3781/9837	<b>Horizon</b> , Min size: 16K memory; Z80A processor; single minifloppy disc drive. Max size: 64K memory, three minifloppy disc drives, any acceptable S100 peripheral boards.  <b>Equinox 300</b> , Min size: 48K memory; dual floppy discs giving 600K bytes of storage; 16-bit Western Digital m.p.u. Max size: Up to 256K memory; up to four 10MB hard discs.	Software: Standard—Basic Interpreter (includes random and sequential access), disc operating system and monitor; Options—Basic Compiler, Fortran, Cobol, and Pilot. The system is suitable for commercial, educational and scientific applications. Application software for general commercial users.  Software: Basic, Lisp, Pascal, Macro Assembler, Text Editor and Processor. All software is bundled. The system is a multi-user, multi-tasking, time-sharing system for 2-12 users. Application software is available for general commercial users.	£1,000—around £2,500  £5,000—£40,000-plus
<b>MICRONICS</b> 1 Station Road, Twickenham, Middlesex 01-892 7044	<b>Micros</b> , Typical size: 1K monitor; 47-key solid state keyboard; interfaces for video, cassette, printer and UHF TV; serial I/Os; dual parallel I/O ports; 2K RAM; power supply.	Software: Extended Basic; Pascal. A British-designed and manufactured system which is being enhanced rapidly. Already available are a 40-column impact printer using plain paper at £360; what is claimed to be the cheapest data terminal around—a system with an acoustic coupler and VDU for £1,020. Prospective applications: small businesses, process controllers and hobbyists.	From £400, assembled

(continued on next page)



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(continued from previous page)

COMPANY	SYSTEM	APPLICATIONS	PRICE RANGE
<b>NASCOM MICROCOMPUTERS</b> 92 Broad Street, Chesham, Buckinghamshire 02405 75151	<b>Nascom I</b> , Min size: CPU; 2K memory parallel I/O; serial data interface; 1K monitor in EPROM. Max size: CPU; 64K memory; up to 16 parallel I/O ports.	Software: Mostly games, but a maths package is on its way. The British-manufactured system started as a hobbyists' package but has found an increasing number of industrial users. Printer and minifloppy interfaces are in preparation. There are about two dozen dealers around the country.	From £197-50
<b>NEWBEAR COMPUTING STORE</b> 7 Bone Lane, Newbury, Berkshire and 2 Gatley Road, Cheadle, Cheshire 0635 49223	<b>Sym I</b> , Size: 6502 chip and keypad, with memory available in 4K blocks to 64K.	Software: Any Kim software. An American system meant to be the foundation for very small business and hobbyist users.	From £200
	<b>7768</b> , Size: CPU board; 4K memory; cassette and VDU interfaces.	Software: Range of Basics and Games. A British manufactured system for the hobbyists. Expandable to 64K memory, it is available only in kit form.	
	<b>Cromemco Z2</b> , Min size: Z2 chassis: power supply; motherboard; CPU; fan; sockets; Byte saver board; 16K memory. Max size: 48-64K memory; dual 8 in. floppy discs.	Software: Basic, Fortran; Assembler; macro assembler. For small business and educational applications. These systems are also supplied to more than a dozen dealers. Same basic system as Comart.	£1,375 to £4,000
<b>PERSONAL COMPUTERS LTD</b> 18-19 Fish Street Hill, London EC3 01-623 1434	<b>Apple II</b> , Min size: 16K memory; 8K ROM; keyboard; monitors; mini-assembler: colourgraphics; Powell card; RF modulator; Games; Paddles and speaker; 4 demo cassettes. Max size: Expandable to 48K memory, and floppy discs and printers are now available.	Software: Basic; Assembler; Games; Business packages. An American system regarded as suitable for any kind of applications. There are 15 dealers throughout the country and maintenance contracts are offered.	£1,000-£2,000
<b>RAIR</b> 30-32 Neat Street, London WC2 01-836 4663	<b>RAIR Black Box</b> , Min size: 32K memory; dual minifloppy discs, 80K bytes each; two programmable serial I/O interfaces. Max size: 64K memory; 8 serial interfaces; 1MB disc storage (or 10MB hard disc); range of peripherals.	Software: Advanced Basic interpreter, Fortran IV compiler; Cobol compiler. Described by the makers as the only 'sensible' British-designed and manufactured microcomputer, its uses are small business and educational applications and in distributed processing networks. Hardware distributors are being signed and agreements made with software houses to add software. It is not for the hobbyists. A warranty and U.K.-wide on-site maintenance is given.	£2,300-£8,000
<b>RESEARCH MACHINES LTD</b> PO Box 75, 209 Cowley Road, Oxford 0865 49793	<b>Research Machines 380Z</b> , Min size: 4K memory; 380Z processor; keyboard. Max size: 48K memory. <b>280Z</b> , 4K board plus connecting cables, £398. 32K board—identical in performance to the 380Z: £722.	Software: Basic Interpreter; 12K Basic; Assemblers. A British system using CP/M software; delivery times are about 6 weeks at the moment. A minifloppy disc system is on trial. Sintel is the sole distributor.	From £830
<b>SCIENCE OF CAMBRIDGE</b> 6 Kings Parade, Cambridge 0223 312919	<b>MK 14</b> , Min size: 8060 SC/MP; ¼K user memory; ½K PROM with monitor program; Hex keyboard and 8-digit, seven-segment display; interface circuitry; 5v regulator on board. To this can be added: ¼K RAM (£3-60); 16 I/O chip (£7-80); cassette interface kit (£5-95); cassette interface and replacement monitor (£7-95); PROM programmer (£9-95).	Software: None provided, but a 100-page manual includes a number which will fit into 256 bytes covering monitors, maths, electronics systems, music and miscellaneous. Based on American National Semiconductor chips. Science will soon have a VDU interface and large manual on user programming. Half of sales are to hobbyists, half to engineers.	Basic price is £39-95. All prices are exclusive of VAT
<b>STRUMECH ENGINEERING ELECTRONICS DIVISION (SEED)</b> Portland Place, Coppice Side, Brownhills, Walsall, Staffordshire 05433 4321	<b>MSI 6800</b> , Min size: 16K memory; Act 1 terminal (keyboard); cassette interface. Max size: Three disc systems are offered: Minifloppy disc system with triple drives of 80 bytes each and 32K memory. Large floppy system with dual 312K-byte capacity disc and 32K of memory. Hard disc system with 10MB, five fixed, five removable, and 56K.	Software: Basic interpreter and compiler; super editor assembler; text processor on small disc system. This is an American-designed system which is being increasingly manufactured in U.K. A SEED survey of its sales showed 60% of the customers were educational establishments, a further 10% research institutes, 10% hobbyists and the rest commercial companies. A distributor network is being set up.	Basic system is £1,100 (£815 as kit); Minidisc—£2,500; large floppy disc £3,200; hard disc £8,000-plus
<b>TANDY CORPORATION</b> Bilston Road, Wednesbury, West Midlands 021-556 6101	<b>TRS-80</b> , Min size: Level 1 4K memory; video monitor; cassette; power supply. Max size: Level 2 16K memory; line printer, floppy disc system.	Software: Basic; some business packages. An American system from the 200-outlet Tandy chain—reviewed in this issue. The Level 1 is aimed at the hobbyist and education market and Level 2 at small business applications.	Level 1—£499; Level 2—£2,434



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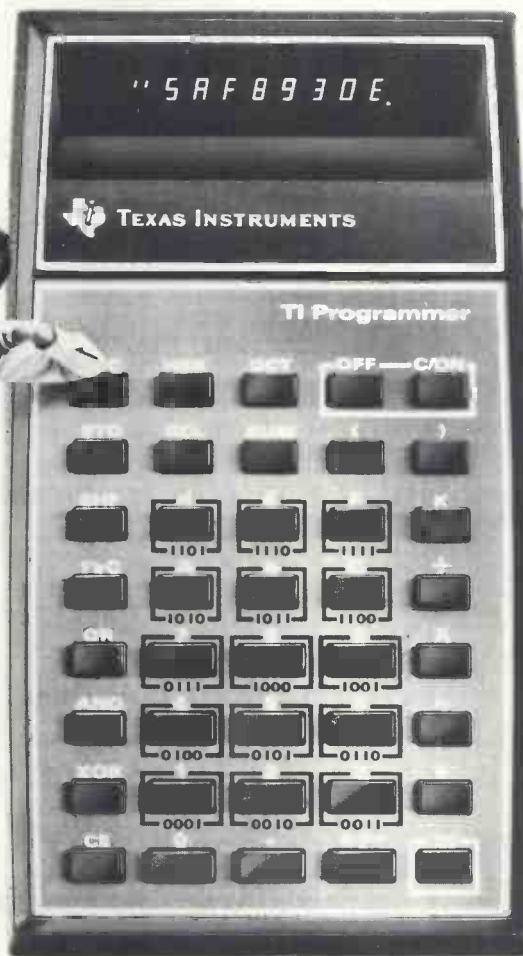
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PRACTICAL COMPUTING January 1979

# Solution to problem of man/machine interface

STAND BACK and watch almost any programmer or part-time keyboard user, such as the typical Apple II user, typing with one or two fingers. Even the really proficient by this means may be typing at 5-10 words a minute.

It is obvious that by far the slowest link in the man/Apple system is the man/Apple interface—the keyboard. The user and the Apple are both capable of working far faster than that 5-10 words a minute. This application is intended to speed this interface by perhaps a factor of 10.

The main object is to learn a form of touch-typing specially designed for Apple, or any other Teletype. And what better way to learn than on the Apple?

The overall objectives are to remove the need to look at the keyboard; to enhance the speed of typing; to be good fun; to concentrate on eliminating the user's bad points; to run on the 4K Apple II; and to be stored on a minimum number of cassettes—hopefully four blocks.

The details of this application are broken-down thus:

The System: ANALYSIS.

The System: DESIGN.

The System: USE.

## The System: ANALYSIS

### Modules

First, the objectives need to be divided into logical groups because I suspect that the whole course cannot be held in 4K or 8K of core.

The Apple II user is likely already to be fairly proficient at two-finger typing, so the first thing is to concentrate on bringing the other fingers into play and to "unlearn" dependence upon the two index fingers. Then an instinctive "feel" of the location of each letter can be learned, followed by real practice at "touch-programming".

So the logical divisions are: finger/key relationships; finger/key character inter-relation; full typing; and speed and accuracy.

### Methods

Apple II is ideal for this application—the only feature not used is the games paddle. Colour graphics, sound generation and the standard keyboard are essential, as are features such as the address stack, used for following series of lessons in response to the users' mistakes in a true "programmed learning" manner.

## Detailed breakdown

**Block 1. Manual skills: Finger/key relationships.** This is the basic touch-

by **A. G. Roberts**

typing skill—being able to use all fingers to strike the appropriate keys. To do this the system uses a screen representation of the keyboard and requests that keys are struck in turn. Note that the range of keys for each finger is indicated by its own colour.

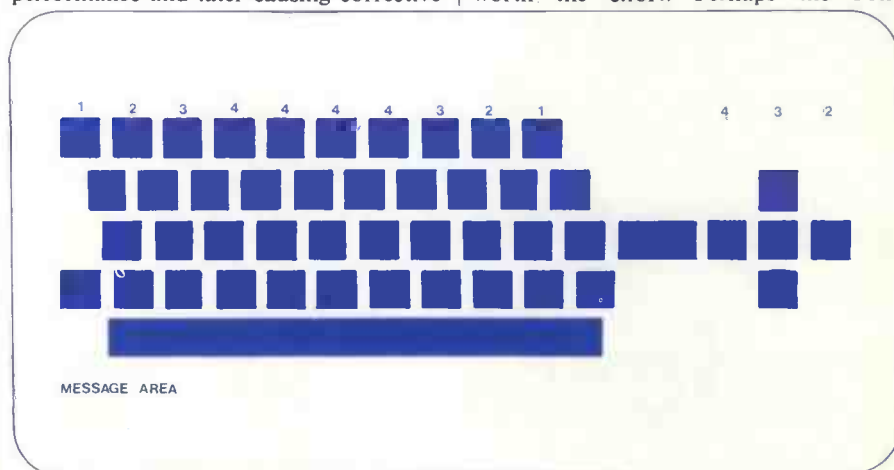
By requesting that a specific finger be pressed down, the position of the hand is calculated and, if incorrect, correcting instructions are given. Also, response times can be noted and, based on them, games can be played requiring rapid recognition and response to the correct finger/key relationship, e.g., by quick flashes of a series of keys on the screen or by the sounding of a tone.

Games are an important part of this learning process and the system makes considerable use of them while evaluating performance and later causing corrective

is deliberately no mention of using the keyboard to generate characters. The emphasis there is upon learning instinctively to use the fingers on specific keys. Now the relationship between key position and its appropriate character on the screen is to be concentrated upon and learned. The method, however, is very similar to the methods of block 1, and, as we shall see, to blocks 3 and 4.

A screen representation of the keyboard is used at first, to learn the characters produced from each key—without looking at the keyboard. Later, groups of letters are used to exercise individual fingers in a different presentation of the games of block 1, to provide motivation, light relief and speedy responses.

It may be possible to generate the sound of letters to be typed via the Apple II loudspeaker. If this can be done, then the resultant exercises would be well worth the effort. Perhaps the Tone



### Approximate screen layout

measures to be taken. For instance, such games can be "tuned" to the speed of response of the user or to particular faults, e.g., difficulty in striking keys controlled by the little finger automatically by totalling response times in an array of store locations.

Hence, at the end of a lesson, or game, the "programmed learning" features of the course can send back the user to study some previous lesson. The games, by insisting upon revision prior to a repeat of the game, can encourage persistence in acquiring these manual skills.

The lesson matter of each session can be varied by introducing a "random" effect into the choice by the system of sequences of keys to be flashed up to the screen.

**Block 2. Basic Typing: Finger/Key/Character inter-relations.** In block 1 there

Generator could be developed further to other uses in the course.

"Special" keys are included in this block, such as the return/newline key, backspace, and the like.

During this stage, some may find it useful to cover the characters printed on the keys by small self-adhesive labels so as to avoid "cheating".

**Block 3. Full Typing.** This block develops real typing skills, using words, phrases and number sequences, but still following the same basic lesson logic. Not only would phrases be written on the screen but written material provided to be copied and checked automatically; if faults are found, corrective lessons are called up, as before.

Particular emphasis is placed on pro-

(continued on page 47)



As they say in Hertfordshire –  
**“If I was going there,  
 I wouldn't start from here.”**



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\*Also at Ashburton, Devon

(continued from page 45)

gram typing, tabulating, codes, numerics and string editing. Those skills, clearly, are those which make Apple II typing distinct from those regular touch-typing.

**Block 4. Speed and Accuracy.** This consists purely of games designed for refresher courses and improvements of typing speed and accuracy. Simple games, such as responding as quickly as possible to a question on the screen, hitting a coloured target moving about a repre-

wordstore, lessons and routing, and lesson logic.

**Wordstore** is an area containing data for use in the lessons. This may be words, characters, codes representing character, colour or tone sequences, screen representation of the keyboard, and special displays or messages.

**Lessons and routing.** This data dictates the content and sequence of lessons as a set of parameters to the lesson logic routines and a number of simple routines

for later re-starts and which will enable the whole route to be started, for example at step 19).

## Block 2

Main content of wordstore:  
Diagram of keyboard with characters.  
Array of characters and "special characters" (N/L) indexed by finger and position.  
Count fields and indicators.  
Messages and instructions.

## Lesson/routing module procedures.

Lesson	Action
1) Position hands:	Display route message. Display Task. Task-check hand positions. Response—set message, if not OK go to 1) if OK go to 2)
2) Home key and space:	Display route message. Display task task-type letters mix from ASDFJKL Space Response—Repeat lesson 20 times, then go to next lesson.
3) 2)+EGH	As above
4) 3)+RT	"
5) 4)+UI	"
6) 5)+CY	"
7) 6)+VB	"
8) 7)+NM	"
9) 8)+WX	"
10) 9)+OP	"
11) All characters, stops:	"
12) Numerals	"
13) "Specials"—Return, Backspace, etc., +, —, etc.	As above. Move 19) to push down stack.
14) Little finger left/right:	Display route message and task. Task-type letters of both little fingers. Response—if poor, write 14) to stack and go to 15).
15) Ring finger emphasis	As above.
16) Middle finger emphasis	As above.
17) Index finger emphasis	As above.
18) Revision	Display route message. Response—go to last in stack.
19) Game 1:	Display route message. Display task. Task—game. Response, as per game, store response analysis. Response at end of game—write required revisions to stack, 20) to bottom of stack.
20) Game 2:	As above, but route to 21) at completion of revision required.

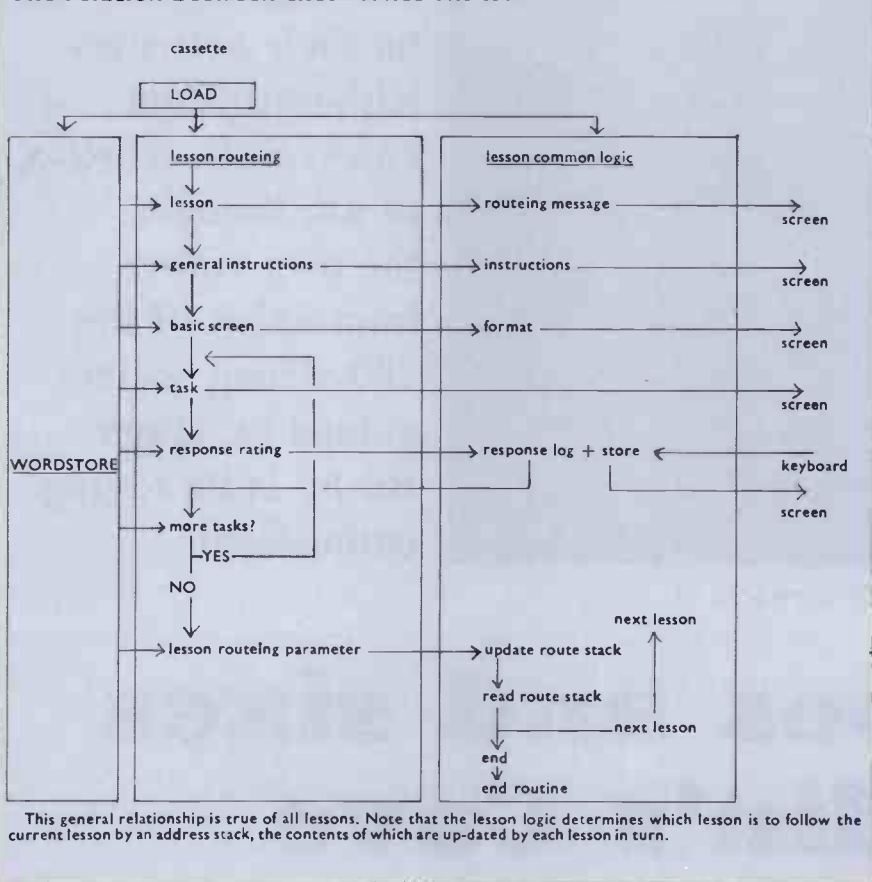
And so on, as space permits.

## Conclusions

- This system is not only useful for Apple II, but for any Teletype. So, although I think it would have an immediate appeal, and therefore market, to Apple II owners and users, it could well be of interest to a wider market.
- For instance, an employer of a number of "Teletype" programmers could well find that an Apple II dedicated to this system would be well worth its cost.
- The system as described would be simple to "tune" to slight variations on other manufacturers' keyboards. Spending one day with the Apple II would probably be all that most programmers would need to show a dramatic increase in Teletype performance.
- The system need not stop there. Once written and successful, it could be extended to teach normal touch-typing, letter layout and other clerical skills.
- Provided the subject matter can be formulated within the logical format of this application, then the resultant course would enjoy the benefits of "programmed learning".

\*A. G. Roberts was one of the runners-up in our Apple competition.

## The relation between these functions is:



sensation of the keyboard on the screen, striking particular keys on a signal tone—or better still on the sound of the letter—the possibilities are legion.

Only experimentation with the Apple II can really show which possibilities are practicable. The logical analysis already discussed in previous blocks will be made, however, and recommendations made on areas worth revising.

## The System : DESIGN

The size of the system presents the first problem in design. Part of this has been overcome by breaking-up the system into study blocks, each with similar design. The logic within those blocks is very modular in concept, placing great reliance on careful use of address-stacking techniques to minimise duplicated code.

Each block is read into RAM as a separate entity and the following notes indicate the working structure of each block. RAM is divided into three areas—

specific to each particular lesson. Insofar as is possible, the routines will be common to several lessons and differ only in the data presented and the sequence of presentation.

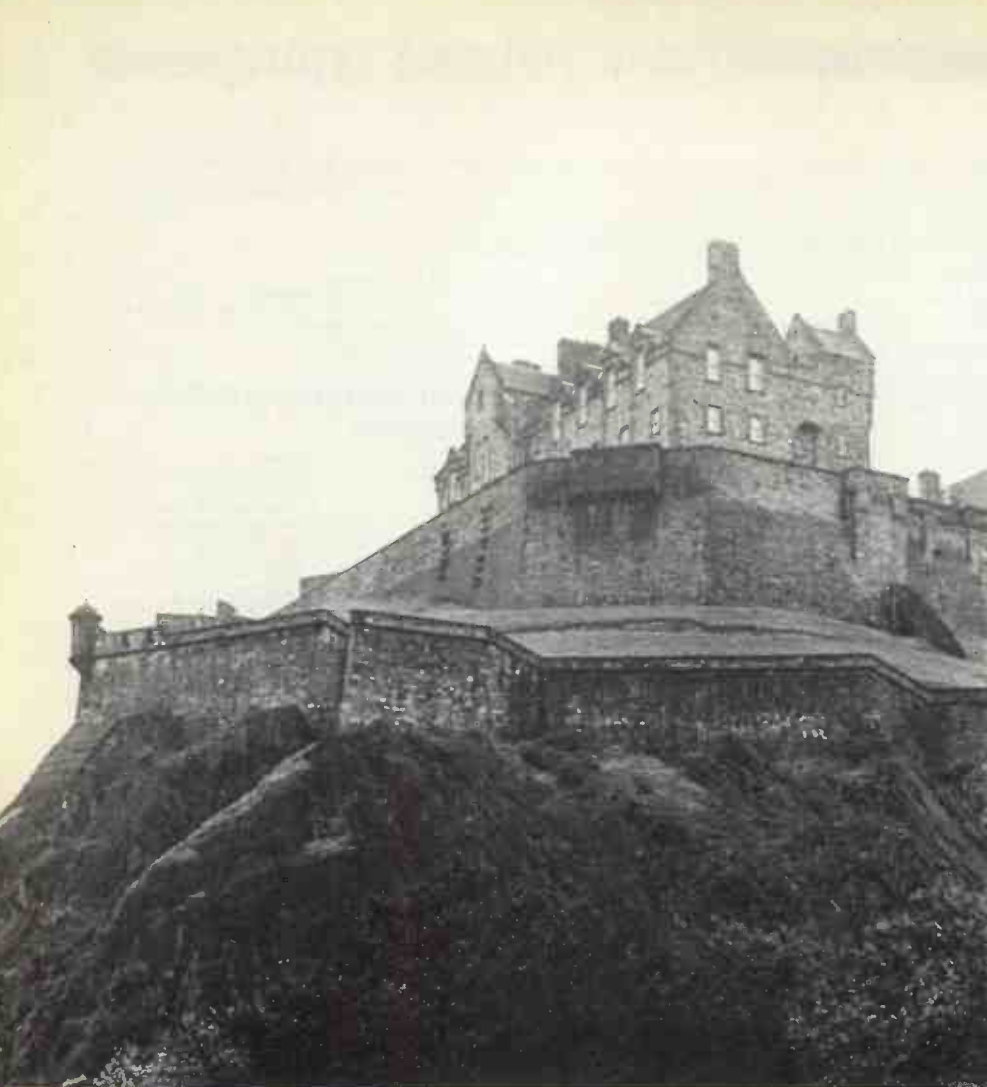
**Lesson logic.** This is a standardised set of routines performed in sequence, depending on the parameters provided at each lesson inter-reacting with the user's response at the keyboard. Much of this logic is common to all lessons at all stages of the course.

## The System : USE

The user will start by following standard procedures to load the desired block from cassette. From then his path through the lessons of the block will be determined by the routing logic in combination with his performance in each lesson. An illustration from block 2 may show this more clearly.

Each module may have an escape sequence which will store current position





**AMONG** the delights for computer professionals who are members of the Scottish Amateur Computer Society is being able to carry on their activities without budget constraints. Most of all, though, the over-riding impression of the 100-strong society gained by Hugh Busby is its raging enthusiasm.

EDINBURGH CASTLE, heart of SACS territory.

## All shapes and sizes in Aladdin's Cave

A MODERN version of Aladdin's Cave, dreamed up by a computer enthusiast, would probably look very much like Norman Rouxel's garage in Edinburgh, a brightly-lit, white-painted interior which seems almost crammed with hardware. Two SWTPC 6800s—though, admittedly, only the one with discs belongs to Rouxel—provide a starting point.

There are terminals in abundance; two Teletypes, a Creed, a converted IBM Selectric and three or four assorted visual displays; two oscilloscopes; drawers full of components and half-finished assemblies and software to match.

Norman Rouxel is not, perhaps, a typical member of the Scottish Amateur Computer Society but then its members, and their equipment, are in all shapes and sizes. Many are computer professionals but just as many are not, and their machines range from 64K twin-disc systems to single-board kits, from LSI-11s to home-brew. Rouxel's evident dedic-

ation to computing is, however, an indication of the raging enthusiasm which seems to be a condition of membership of the SACS.

Founded a little more than a year ago, the SACS is clear proof that computing is alive and well north of the border. The society now has around 100 members, branches in Edinburgh and Glasgow, and is looking for somewhere to site a third branch to cater for enthusiasts in the less populous area further north.

### Surprised at growth

The chairman, Stewart Stevenson, claims to be surprised at the rapid growth, yet his own flair for publicity clearly has contributed a great deal to the society's success. Even the official aims, as declared in the constitution, reflect a desire for recognition. They include:

- To encourage and inform all charities

operating within Scotland as to the uses they may make of computers;

- To inform the general public in Scotland as to the actual and potential benefits and costs or hazards deriving from the use of computers;

- To enter into such agreements with other organisations as may further the preceding aims.

All of which might sound a trifle ambitious for an organisation which at the time numbered little more than 12 members; but in its short existence the SACS has already managed to give substance to its aims.

One recent coup was an appearance on Scottish television by Stevenson and the former chairman, Ken Talbott, explaining society aims to the viewing public on the Scotland Today program. Even more recently Stevenson was in London, where he held forth at an Institute of Data Processing Management seminar on micros.

As a result, he claims unabashedly that

"London now knows more about SACS and the developments in personal computing which are being spearheaded by the amateurs in Scotland than it does about activity, if any, on its own doorstep". Any challengers?

As well as talking about computing, the SACS is taking steps to make itself known by making itself useful. In February, it is booked to handle the scoring for the Scottish Universities rifle shooting competition.

## Outward looking

The program will be run on an SWTPC 6800 and, it is hoped, will produce the results almost as soon as the competition finishes, in contrast to the normal long and tedious wait. If the operation is a success, other practical applications are likely to follow; a computerised light show for discos is one idea being discussed.

Apart from this outward-looking activity, what does the SACS do for its members? There are, of course, monthly meetings in Edinburgh and Glasgow, which normally are well attended—much better, as Stevenson is fond of pointing out, than the local British Computer Society branch meetings.

A software co-ordinator and a hard-

ware co-ordinator have been appointed, one to develop a software library for the free use of members, the other to act mainly as a go-between for pieces of equipment looking for new homes. The society has also been able to save members money on new equipment by, for example, buying memory in bulk at improved discount rates.

There is also the monthly newsletter which, incidentally, carries enough advertising to pay for its own production costs. Normally it includes a number of how-to-do-it articles and shows a healthy balance between hardware and software interests.

The emphasis on software is, in fact, a distinctive feature of the SACS. It appears to emanate from a small group of the more active members, including Rouxel, Harry Sheldrake and software co-ordinator Robert Davidson, but is by no means confined to them. This group is, however, engaged on a major project which it hopes will be of general benefit to the society.

This is MDL, a language intended, according to Sheldrake, to approach the efficiency of assembly language while being considerably easier to use. Its main advantage, however, is that it will be machine-independent, and so, hopefully, provide a medium for the free interchange of software.

MDL is being developed using

NORMAC, a macro processor written by Rouxel. NORMAC works in a way similar to a compiler, taking the user's source code as input and producing the output in machine code. The difference is that it allows the user to define his own commands and so, effectively, to create his own language.

NORMAC has been written for use on a 6800 system but that is no restriction, since NORMAC can be defined as a set of macros and run through itself to produce a version which will run on, say, a Cromemco Z-2. By producing a version of NORMAC for each machine requested by users, all programs written in MDL, or any other NORMAC-based language, will become fully interchangeable without further modification.

## No pressures

One of the pleasures of amateur computing, particularly for computer professionals like Sheldrake and Davidson, is that it can be carried-on without pressures of budgets and deadlines.

With luck, the MDL project will do everything its designers hope. If not, they will still have enjoyed the experience and there will be something else waiting to engage their enthusiasm. For ideas, and the desire to put them into practice, are two things of which the SACS is clearly not short.

*The secretary of SACS is Brian Corner, 14 Abbott Street, Dunfermline.*

**SACS members in Norman Rouxel's computer room, left to right, Norman Rouxel, Alastair MacPherson, Robert Davidson, Harry Sheldrake.**







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★

Alcock *Illustrating Basic*. Chapter 2. c Cambridge University Press. Reprinted by permission.

★

Copies of *Illustrating Basic* can be obtained from *Practical Computing*.

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# GO TO

WITH THIS INSTRUCTION YOU MAY ALTER THE SEQUENCE IN WHICH BASIC OBEYS THE NUMBERED STATEMENTS OF YOUR PROGRAM.

HIS PROGRAM NEVER REACHES ITS END. ON BEING GIVEN A VALUE FOR D IT COMPUTES & PRINTS V, THEN GOES BACK TO LINE 20 TO ASK FOR ANOTHER VALUE FOR D AND SO ON AND SO ON.

THE WAY TO STOP THIS PROGRAM IS TO PRESS THE **BREAK** KEY

(OR WHATEVER KEY YOUR OWN INSTALLATION USES FOR THIS).

```
10 PRINT "VOLUMES OF BALLS"
20 PRINT
30 PRINT "TYPE A DIAMETER"
40 INPUT D
50 LET V = 3.141592 * D^3 / 6
60 PRINT "VOLUME OF BALL IS"; V
70 GO TO 20
80 END
```

RUN

VOLUMES OF BALLS

TYPE A DIAMETER

? 6.5

VOLUME OF BALL IS 143.793

TYPE A DIAMETER

?

**BREAK**

THIS IS NOT A TRIVIAL EXAMPLE. BASIC IS VERY USEFUL AS A CALCULATOR FOR EVALUATING FORMULAE FOR SUCCESSIVE VALUES OF VARIABLES TYPED IN, AND THERE IS NO EASIER WAY OF STOPPING THAN PRESSING A SINGLE KEY.

SYNTAX :

70 GO TO 20

YOU MAY TYPE  
GOTO  
AS ONE WORD

ONLY LINE NUMBERS HERE:  
YOU CAN'T HAVE  
LET L = 20  
AND SUBSEQUENTLY  
GO TO L

YOU MAY GOTO ANY LINE IN THE PROGRAM (EVEN IF IT CONTAINS A NON-EXECUTABLE STATEMENT LIKE REM) AND EXECUTION WILL CONTINUE FROM THERE. IF GO TO POINTS TO A NON-EXISTENT LINE NUMBER THEN MOST BASICS WILL REFUSE TO START EXECUTION WHEN YOU TYPE RUN (SIMILARLY FOR IF & ON).

ILLUSTRATING BASIC PAGE 40

# IF - THEN

WITH THIS INSTRUCTION YOU MAY ALTER THE ORDINARY SEQUENCE OF EXECUTION

BUT ALTER IT CONDITIONALLY.

THE CONDITIONS ARE:

THE LINE HAS TO EXIST

```
20 IF A = B * C THEN 60
```

ONE OF THE SIX POSSIBLE CONDITIONS

GO TO THIS LINE (AND CONTINUE FROM THERE) IF THE CONDITION APPLIES: OTHERWISE JUST CARRY ON

DON'T TYPE A SPACE BETWEEN SYMBOLS IN A CONDITION

LINE NUMBERS ONLY: YOU CAN'T HAVE "THEN L"

==	EQUALS
>	IS GREATER THAN
<	IS LESS THAN
>=	IS GREATER THAN OR EQUAL TO
<=	IS LESS THAN OR EQUAL TO
≠	DOES NOT EQUAL

THE THING ON EITHER SIDE OF THE "CONDITION" MAY BE A NUMBER OR EXPRESSION:

```
30 IF 1 + SQRT(A^2 + B^2) > 0.2 THEN 10
40 IF ABS(A - B) <= 0.01 THEN 15
```

THE WAY TO TEST "APPROXIMATE" EQUALITY OF A & B

OR IT MAY BE A TEXT OR A TEXTUAL VARIABLE WHEN THE CONDITION IS NO MORE COMPLICATED THAN EQUALS OR DOES NOT EQUAL (BUT SEE BOTTOM OF PAGE):

```
50 IF Q$ = "YES" THEN 150
60 IF "FINISH" <> A$ THEN 10
70 IF R$ = T$ THEN 230
```

NOTE: THE TEXTS "YES" AND "YES" ARE NOT EQUAL

IT IS NONSENSE TO COMPARE NUMERICAL VARIABLES WITH TEXTUAL VARIABLES:

```
80 IF Q$ = Y THEN 99
```

MANY BASICS ALLOW THE WORDS "GO TO" (OR THE WORD "GOTO") IN PLACE OF "THEN" BUT FOR THE SAKE OF PORTABILITY IT IS BEST TO STICK TO "THEN".

MOST BASICS ALLOW MORE COMPLICATED COMPARISONS OF TEXTS. GENERALLY "Z" IS CONSIDERED "GREATER" THAN "A" AND "9" IS GREATER THAN "0". A SPACE " " IS LESS THAN ANY LETTER OR DIGIT. THUS YOU MAY SORT NAMES ALPHABETICALLY:

"A" < "ABALONE" < "ACORN" & "V2" < "V8"



# STOP

YOU MAY CAUSE *BASIC* TO STOP EXECUTION AT ANY LINE OF YOUR PROGRAM USING THIS INSTRUCTION.

THE LAST INSTRUCTION OF EVERY PROGRAM MUST BE "END". NO OTHER STATEMENT BUT THE LAST MAY SAY "END".

"END" SERVES IN A DUAL ROLE :

★ IT MARKS THE END OF EVERY PROGRAM FOR THE CONVENIENCE OF THE *BASIC* SYSTEM WHEN TRANSLATING *BASIC* LANGUAGE INTO SOME OTHER COMPUTER CODE STRAIGHT AFTER YOU TYPE "RUN" :

★ WHEN "END" IS ACTUALLY "OBEYED" DURING SUBSEQUENT EXECUTION IT MAKES THE COMPUTER STOP EXECUTING THE PROGRAM.

HOWEVER THERE MIGHT BE SEVERAL PLACES IN A PROGRAM WHERE YOU WOULD LIKE TO TELL *BASIC* TO STOP EXECUTION. YOU CAN DO THIS BY A "GO TO" WHICH SENDS CONTROL TO "END" OR YOU CAN DO IT BY A "STOP" INSTRUCTION. "STOP", UNLIKE "END", MAY APPEAR MANY TIMES AND ANYWHERE INSIDE A PROGRAM.

```

10 PRINT "DO YOU LIKE PROGRAMMING ?"
20 INPUT A$
30 IF A$ = "NO" THEN 70
40 IF A$ = "YES" THEN 90
50 PRINT "NOT AN UNEQUIVOCAL ANSWER"
60 GO TO 100
70 PRINT "PERSEVERE! YOU WILL LEARN TO"
80 GO TO 100
90 PRINT "FASCINATING ISN'T IT?"
100 END

```

THESE TWO SILLY PROGRAMS DO THE SAME JOB AND ILLUSTRATE THE USE OF "END" AND "STOP".

```

10 PRINT "DO YOU LIKE PROGRAMMING?"
20 INPUT A$
30 IF A$ = "NO" THEN 70
40 IF A$ = "YES" THEN 90
50 PRINT "NOT AN UNEQUIVOCAL ANSWER"
60 STOP
70 PRINT "PERSEVERE! YOU WILL LEARN TO"
80 STOP
90 PRINT "FASCINATING ISN'T IT?"
100 END

```

**EXAMPLE** ILLUSTRATINGGO TO,  
IF THEN  
& STOP

HIS PROGRAM SOLVES A PAIR OF SIMULTANEOUS EQUATIONS HAVING ANY NUMBER OF RIGHT-HAND SIDES. LET THE TWO EQUATIONS BE:

$$aX + bY = p$$

$$cX + dY = q$$

USING CRAMER'S RULE THE SOLUTION MAY BE WRITTEN LIKE THIS:

$$X = \frac{\begin{vmatrix} p & b \\ q & d \end{vmatrix}}{\begin{vmatrix} a & b \\ c & d \end{vmatrix}}, \quad Y = \frac{\begin{vmatrix} a & p \\ c & q \end{vmatrix}}{\begin{vmatrix} a & b \\ c & d \end{vmatrix}}$$

WHERE THE VERTICAL BARS INDICATE DETERMINANTS WHICH MAY BE EVALUATED THUS:

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = a*d - c*b$$

IF THE DETERMINANT IN THE DENOMINATOR IS ZERO (OR VERY VERY CLOSE TO ZERO) THEN NO SOLUTION IS POSSIBLE.

```

10 PRINT "TWO SIMULTANEOUS EQUATIONS"
20 PRINT "TYPE COEFFICIENTS OF X&Y; FIRST ROW"
30 INPUT A,B
40 PRINT "NOW SECOND ROW"
50 INPUT C,D
60 REM EVALUATE DENOMINATOR, M
70 LET M = A*D - C*B
80 IF ABS(M) > 0.00001 THEN 110
90 PRINT "SOLUTION IMPOSSIBLE; DET = "; M
100 STOP
110 PRINT "TYPE 2 VALUES FOR R.H. SIDE"
120 INPUT P,Q
130 LET X = (P*D - Q*B)/M
140 LET Y = (A*Q - C*P)/M
150 PRINT "X = "; X ; "Y = "; Y
160 PRINT "ANY MORE R.H. SIDES? YES?"
170 INPUT A$
180 IF A$ = "YES" THEN 110
190 REM YOU COULD HAVE "STOP" HERE
200 END

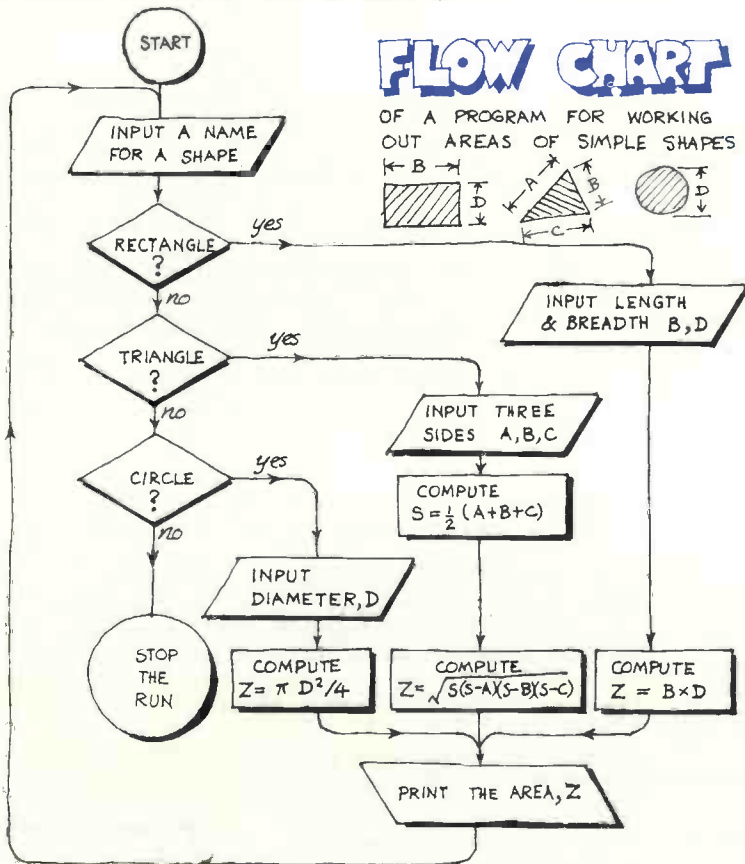
```



# EXAMPLE ILLUSTRATING GO TO & THEN IF

HERE IS A PROGRAM DESIGNED TO CALCULATE AREAS OF RECTANGLES, TRIANGLES AND CIRCLES. IT ASKS YOU TO TYPE THE NAME OF A SHAPE; THEN IT ASKS FOR DIMENSIONS RELEVANT TO THAT SHAPE. IF YOU TYPE ANY NAME OTHER THAN "RECTANGLE", "TRIANGLE" OR "CIRCLE" THE PROGRAM STOPS RUNNING.

THE LOGIC OF THE PROGRAM IS SHOWN BY THE FLOW CHART BELOW. THERE ARE NICER WAYS OF ORGANIZING SUCH PROGRAMS USING INSTRUCTIONS NOT YET EXPLAINED; THIS PROGRAM WAS DESIGNED TO ILLUSTRATE "GO TO" AND "IF THEN".



```

10 PRINT "***AREA CALCULATOR***"
20 PRINT
30 PRINT "TYPE: RECTANGLE, TRIANGLE OR CIRCLE"
40 INPUT S$
50 REM
60 IF S$="RECTANGLE" THEN 130
70 IF S$="TRIANGLE" THEN 180
80 IF S$="CIRCLE" THEN 240
90 PRINT S$, "MEANS STOP"
100 GO TO 320
110 REM
120 REM
130 PRINT "TYPE BREADTH & DEPTH"
140 INPUT B, D
150 LET Z = B * D
160 GO TO 280
170 REM
180 PRINT "TYPE LENGTHS OF 3 SIDES"
190 INPUT A, B, C
200 LET S = 0.5 * (A + B + C)
210 LET Z = SQR(S * (S - A) * (S - B) * (S - C))
220 GO TO 280
230 REM
240 PRINT "TYPE THE DIAMETER"
250 INPUT D
260 LET Z = 3.141592 * D * D / 4
270 REM
280 REM FLOWS MERGE HERE
290 PRINT
300 PRINT "AREA OF "; S$; " IS "; Z
310 GO TO 20
320 END

```

Handwritten annotations in blue ink:

- A cloud-shaped callout at line 100 says "GOES STRAIGHT TO 'END'".
- Two cloud-shaped callouts at lines 310 and 320 each say "SPACE".
- Dashed lines indicate flow paths from lines 60, 70, 80, 130, 180, 240, and 280 to line 320.

RUN

\*\*\*AREA CALCULATOR\*\*\*

```

TYPE: RECTANGLE, TRIANGLE OR CIRCLE
? RECTANGLE
TYPE BREADTH & DEPTH
? 14.6 10

```

AREA OF RECTANGLE IS 146

```

TYPE: RECTANGLE, TRIANGLE OR CIRCLE
? NO
NO MEANS STOP

```

# ON-GO TO

THIS INSTRUCTION BREAKS THE ORDINARY SEQUENCE OF OBEYING INSTRUCTIONS

IT IS A MULTI-WAY SWITCH.

80 ON D+1 GO TO 100,110,120,130

VARIABLE OR EXPRESSION

ONE WORD OR TWO

LIST OF LINE NUMBERS (NOT EXPRESSIONS) ALL NUMBERED LINES MUST EXIST

BASIC EVALUATES THE EXPRESSION AND:

- SOME BASICS "ROUND" THE RESULT TO THE NEAREST INTEGER.
- SOME BASICS TAKE THE INTEGRAL PART.

IF THE RESULT IS 1 THEN BASIC USES THE FIRST NUMBER IN THE LIST (GO TO 100). IF THE RESULT IS 2 THEN BASIC USES THE SECOND NUMBER (GO TO 110) AND SO ON.

```

10 PRINT "TYPE A DIGIT FROM 0 TO 3"
15 PRINT "PRESS 'BREAK' KEY TO STOP"
30 INPUT D
40 IF D-INT(D)<>0 THEN 140
50 IF D<0 THEN 150
60 IF D>3 THEN 150
65 REM NOW CERTAIN D IS 0,1,2 OR 3
70 PRINT "YOU TYPED ";
75 REM
80 ON D+1 GO TO 100,110,120,130
85 REM CAN'T GET HERE
100 PRINT "ZERO"
105 GO TO 10
110 PRINT "ONE"
115 GO TO 10
120 PRINT "TWO"
125 GO TO 10
130 PRINT "THREE"
135 GO TO 10
140 PRINT "NON INTEGRAL"
145 GO TO 10
150 PRINT "OUT OF RANGE"
160 GO TO 10
170 END
    
```

(CONTINUED OPPOSITE )



```

RUN

```

```

TYPE A DIGIT FROM 0 TO 3
PRESS 'BREAK' TO STOP

```

```

? 0

```

```

YOU TYPED ZERO

```

```

TYPE A DIGIT FROM 0 TO 3

```

```

PRESS 'BREAK' TO STOP

```

```

? 6

```

```

OUT OF RANGE

```

```

TYPE

```

THIS IS A USEFUL INSTRUCTION, BUT BE CAREFUL ABOUT ITS SPECIAL INTERPRETATIONS BY DIFFERENT VERSIONS OF BASIC.

★ BECAUSE SOME BASICS USE THE NEAREST INTEGER AND OTHERS THE INTEGRAL PART OF THE EXPRESSION, ENSURE YOUR OWN EXPRESSIONS CAN ONLY YIELD INTEGRAL RESULTS (SEE LINE 40 OPPOSITE).

★ SOME BASICS REPORT AN ERROR AND STOP THE RUN IF THE RESULT OF THE EXPRESSION IS OUT OF RANGE. BUT OTHER BASICS GO TO THE FIRST LINE IN THE LIST IF THE RESULT IS LESS THAN 1 AND TO THE LAST IF THE RESULT IS GREATER THAN THE NUMBER OF NUMBERS IN THE LIST. YET OTHER BASICS JUMP TO THE LINE FOLLOWING "ON" (LINE 85 OPPOSITE) IF THE RESULT IS OUT OF RANGE. SO FOR THE SAKE OF "PORTABILITY" PUT IN YOUR OWN TESTS FOR RANGE (SEE LINES 50 & 60 OPPOSITE).

BELOW ARE SHOWN OTHER (LESS COMMON) FORMS OF THIS INSTRUCTION AS USED IN DIFFERENT VERSIONS OF BASIC.

```

80 ON D+1 THEN 100,110,120,130

```

```

80 GOTO 100,110,120,130 ON D+1

```

```

80 GOTO D+1 OF 100,110,120,130

```

THE INSTRUCTION BELOW MAY BECOME UNIVERSAL IN ADDITION TO THE "ON GO TO" DESCRIBED ABOVE. THE MEANING OF "ON GO SUB" WILL BE CLEAR WHEN YOU REACH PAGE 55.

```

80 ON D+1 GO SUB 100,110,120,130

```

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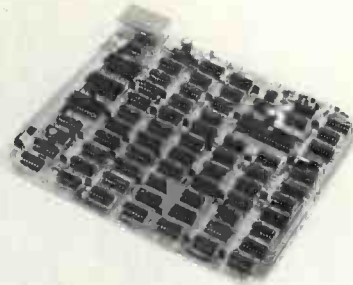
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PRACTICAL COMPUTING January 1979

# In praise of Pascal

MOST READERS will be acquainted with Basic, which nearly every microcomputer available today supports. Readers will not be so familiar with Pascal and I shall try to describe some of its features and explain why it has claim to be the programming language of the future.

To begin, why another language? There are several reasons. Firstly, a need was felt for a language well-defined in its syntax—the grammar which defines valid statements in the language—and in its semantics—the meaning or procedures implied by a statement in the language.

This means that there should be no "versions" of Pascal as there are with Basic, where every machine has a different Basic and a program written for Basic A will not run under Basic B without modification. Essentially, Pascal programs, unlike those in Basic, should be transportable from one machine to another.

Secondly, a language was needed which would enable programming in a structured manner, leading to faster and more error-free solutions to problems, together with easier maintenance of large programs.

Finally, the language had to be easy to teach—and learn—in a logical and systematic manner.

## Popular

Those requirements led to the definition of Pascal by Professor Niklaus Wirth of the University of Zurich in 1968. Since then, the language has been implemented on nearly all mainframe types, and on many mini- and microcomputers. The language has become popular, particularly in educational institutions. It is, however, unlikely to take over in commercial installations from Cobol, which even IBM with PL/I failed to kill.

A language rather like Pascal, Algol 60, existed before Pascal, but it had a crucial weakness in the area of data structures. Pascal, like most other languages, has the fundamental data types of integer and real numbers, characters (strings) and Boolean (logical). In Pascal, however, these and other (programmer-defined) data types may be structured in arrays, sets, records, files and lists.

An array is a structure where an individual element is accessed by a simple data type, e.g., integer. A declaration of a 20-element array A of real numbers would look like.

```
VAR A: ARRAY[1..20] OF REAL;
```

A set is an aggregate of data of one type, e.g., a set of characters. One cannot access individual elements of the set, but perform operations only on the set as a whole. Valid set operations are union, intersection, set difference, equality and membership. For instance, if we want to see whether the value of the character

by Francis Cox

variable X is in the set of alphabetic characters, we write:

```
VAR ALPHAB: SET OF 'A'..'Z';
IF X IN ALPHAB THEN —action—
```

The double dots can be read as "to", i.e., 'A'..'Z' means 'A', 'B', etc., 'Z'. A set may also be denoted by brackets; this can help to avoid complicated conditional tests, e.g., to decide if variable P is 3, 17 or 35 instead of

```
IF (P=3) OR (P=17) OR (P=35) THEN —action—
we may write:
```

```
IF P IN [3,17,35] THEN —action—
which is much clearer.
```

Next we come to the record type. This is perhaps the most powerful and flexible data structure in Pascal. The components which make up a record can be of any type mixed together and additionally parts of the record, known as variants, can be dependent on other parts at execution time: see Ref. 1 pp. 42-47 for a fuller description of the record data type.

The file data structure is the method used to communicate data to and from external devices such as keyboards, discs and printers. All types of data structure may be read from or written to disc files, but only characters are valid for printer and keyboard I/O. The Pascal specification (Ref. 1) does not define random (or direct access) files, only sequential ones, but most implementations of the language have included this facility.

An unusual feature of Pascal worthy of comment is the pointer data type. This defines a variable not to have a value as all others do, but solely to point to another (conventional) variable, which can be of any type.

## Primitives

Although Pascal does not include the list-processing primitive functions like FIRST, LAST and APPEND, found in languages like Lisp and Pop-2, this is not a problem, since one writes these primitives using the simple pointer-moving techniques of Pascal only once, and includes them in a common shared program library for future use.

●Every variable and procedure used in a program must be declared before use. This means it is impossible to sit at a terminal and key-in a program straight from one's head as is possible with Basic.

●There are NO statement numbers. These are an unmitigated pain in Basic, I feel.

●Variable names can be essentially of any length, which helps to make programs you can read six months after you have written them.

●There is no GOTO statement. This is not strictly true, but Pascal makes it so

awkward to use labels and gotos (deliberately) that they may as well not be there.

●Multiple-line statements are the rule, not the exception. In particular, the begin block statement: BEGIN statement; statement; —END is useful in many contexts.

●Most Basics do not permit passing of parameters to subroutines. Parameter passing by reference and/or value is fully-supported in Pascal; also, Pascal functions may return any simple data type. These procedures and functions support local (and global) variables fully and can be fully recursive.

●There are few built-in mathematical functions like RND and there is no exponentiation operator; the programmer is expected to write those features he needs and include them in a library file for use as required. Similarly there are no matrix manipulation statements built-in.

●The FOR statement in Pascal may only have steps of +1 or -1 and may not be executed at all if the loop variable is outside the valid bounds.

Here are two sample programs, one in Basic and one in Pascal, to perform a sort (the bubble sort) on an array A.

```
(★L+★)
PROGRAM SORTEX;
CONST X = 50;
TYPE LIST = ARRAY[1..X] OF REAL;
VAR A: LIST;
    J: INTEGER;

PROCEDURE BUBSORT (VAR L: LIST; N: INTEGER);
VAR I, M: INTEGER;
    T: REAL;
    SORTED: BOOLEAN;
BEGIN SORTED := FALSE; M := N;
  WHILE (SORTED = FALSE) AND (M >= 2) DO
    BEGIN SORTED := TRUE;
      FOR I := 2 TO M DO
        IF L[I-1] > L[I] THEN BEGIN T := L[I-1];
                               L[I-1] := L[I];
                               L[I] := T;
                               SORTED := FALSE;
                               END; (★ END FOR LOOP ★)
      M := M-1;
    END (★ BEGIN BLOCK ★)
  END; (★ BUBSORT ★)

BEGIN (★ MAIN PROCEDURE ★)
  FOR J := 1 TO X DO A[J] := 51-J;
  BUBSORT (A,X)
END.
```

```
10 ! BUBBLE SORT DEMONSTRATION
20 DIM A(50)
30 FOR J = 1 TO 50
40 A(J) = 51 - J
50 NEXT J
55 M = 50
60 GOSUB 1000
70 STOP
80 REM
1000 ! BUBBLE SORT ROUTINE
1010 S = 0
1020 M = N
1030 IF S = 1 THEN 1999
1040 IF M < 2 THEN 1999
1050 S = 1
1060 FOR I = 2 TO M
1070 IF A(I-1) < A(I) THEN 1130
1080 T = A(I-1)
1090 A(I-1) = A(I)
1100 A(I) = T
1120 S = 0
1130 NEXT I
1140 M = M - 1
1150 GOTO 1030
1999 RETURN
```

## References

1. Jensen, K. and Wirth, N., *Pascal User Manual and Report*, Springer-Verlag, 1978.
2. UCSD *Pascal Reference Document*, University of California at San Diego, 1978.



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# Opening new worlds for physically handicapped

by J. R. and G. Seagrave

MICROCOMPUTERS offer many opportunities of great significance in business and administration, research and teaching. The greatest relative benefit, however, compared to what was available before, must surely be the application of the analytical power of the microcomputer to the rehabilitation of severely handicapped people into the mainstream of society.

Our application is, therefore, aimed at the most basic part of that task, the link between man and machine, so that the user can write, and edit what is written, faster and more accurately than was previously possible.

Our project is based on the known needs of two spastics, one aged 11 years—George; the second aged 17—Martin; the actual names are fictional to preserve individual confidence. The project is designed to have a considerably wider application than the two individuals, and to open possibilities for further development in due course.

## Familiar method

The traditional approach, used now by both these lads, is Possum, and its equivalents by other makers. These use a target board, an 8 × 8 matrix, made of perspex with letters and other characters marked on. The board is scanned and each character lit from behind. The user has a switch, operated by suck-blow, joystick or other microswitch input which, when operated, feeds the appropriate character to an electric typewriter. More complex models operate with two inputs and code but the most handicapped users can

manage only one, and this is what principally we describe here.

The following sketch shows how this usually works:

/	:	!	(	+	@	)	IS
K	Q	6	0	%	z	?	IN
W	V	J	5	9	=	'	THAT
U	M	B	;	4	8	←	WAS
&	R	D	Y	.	X	3	OF
*	N	C	F	.	-	1	AND
T	A	S	H	P	G	7	TO
SPACE	E	O	I	L	RET	2	THE
							Λ

TEXT IS SET UP HERE AT THE BOTTOM OF THE SCREEN. THE REQUIRED LETTER MAY BE ENTERED WHEN THE ARROW POINTS TO IT.

This method is familiar and well-tried and has served a generation of severely disabled people well, but it has fundamental drawbacks. The first of them is that it is not possible normally to edit; there is no way of correcting a mistake, let alone changing a line or a paragraph. Secondly, it is often very slow. The tracking rate of electromechanical target board systems can be varied by a switch, but clearly

those handicapped users who are spastics or otherwise have limited muscle control and increasing the speed-rate is bound to increase the error-rate dramatically.

Our proposals are twofold. For the most severely handicapped user, Martin, who has no speech and very limited side-to-side head movement, and further can use only one input, we propose to reproduce the target board on the screen, using a moving cursor. The lower six lines on the screen will display the text typed so far, held in strings scrolling upwards as each line is set. The user will therefore see both text and board together, and not separately as at present.

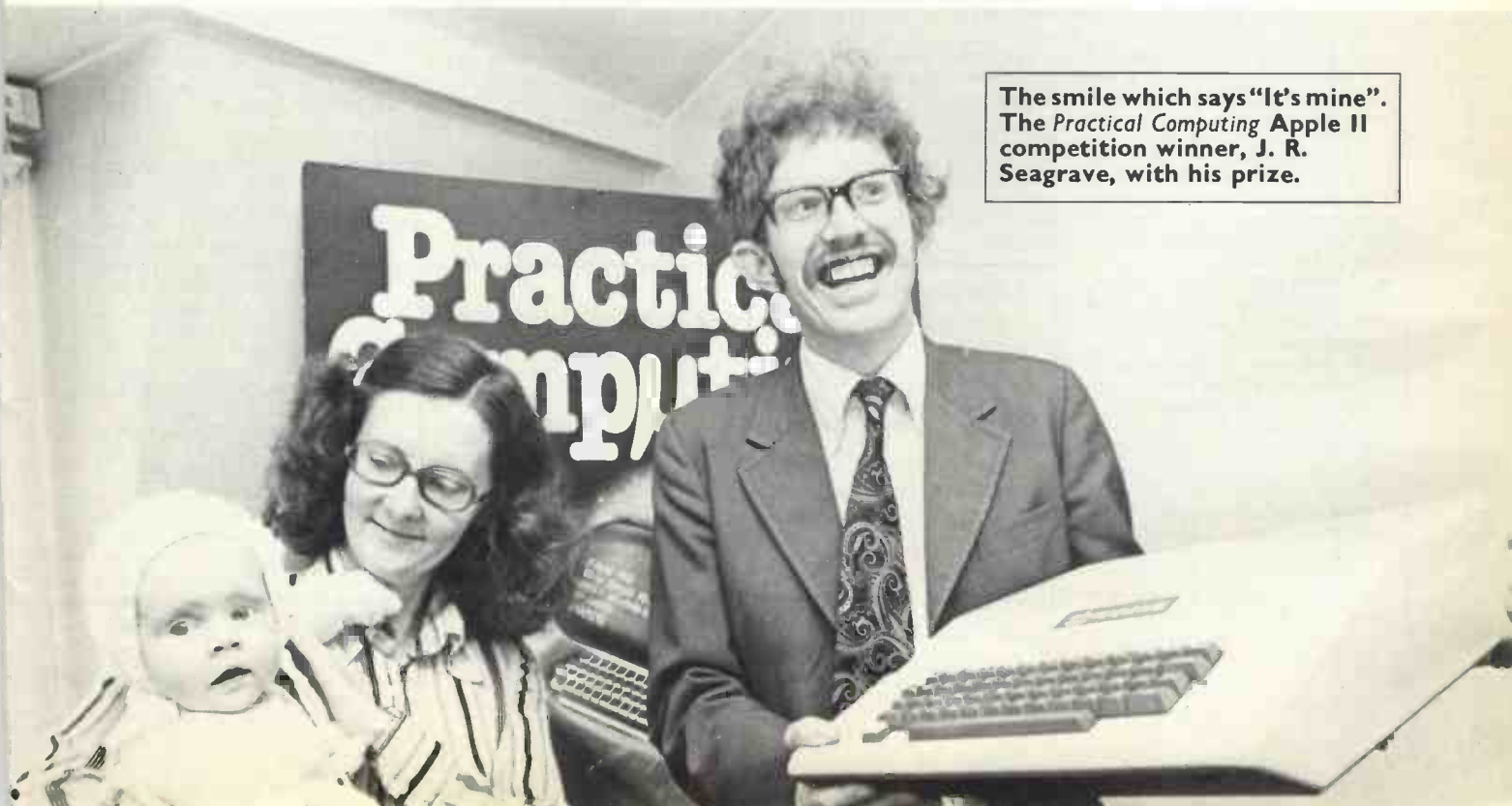
## Major innovation

Our major innovation specifically for Martin will be to introduce a 'homing' routine which we believe will enable him and other users to achieve substantially faster speeds. This will take advantage of the paddle control facility of the Apple.

The electromechanical system makes use of a microswitch which gives a simple on/off message to the typewriter controller. In our version, we assume the

(continued on next page)

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The smile which says "It's mine". The Practical Computing Apple II competition winner, J. R. Seagrave, with his prize.



(continued from previous page)

user will use the switch two-way, i.e., he will enter one character for a traverse in either direction and we will program accordingly.

Thus, when PDL (N) + 128, i.e., when the paddle is in the middle of its slide, the currently-selected character will be entered into a string. Martin has, in fact, slightly more control than is used by the 'on-off' switch, and can control the speed of movement of the paddle. So we will program a progressive slowdown in the tracking speed of the target board as the paddle approaches PDL(N) = 128, the switch. A changing tone will also indicate the approach to the switch.

## More accurate

This will enable a much higher tracking rate to be used—Martin is at present desperately slow—but enable the rate to be slowed as the paddle is moved towards the switching point in anticipation of the tracking cursor reaching the desired character. Because it will be slow when tracking across the desired character, accuracy should increase dramatically, as well as speed. Further, the addition of word processing facilities will make full editing possible.

A further development we envisage is the extended use of word storage. Some word storage is possible in electro-mechanical systems. Apple, however, can do better than this, by storing a whole range of 'stored word' target boards to

meet different subject needs, e.g., a board with program words for programming—words such as hypotenuse, triangle, sine, cosine for someone doing maths, and valley and stream for someone studying geography, and so on.

These different pages of target board could be selected in the same way as the number which leads to the display of the target characters, by selecting an appropriate board with the specialised vocabulary.

Ultimately, we would hope that Martin might be able to do simple clerical jobs and data entry via the machine.

Our second subject, George, is younger but has more control. In fact, with one foot he is able to control a linear paddle accurately. He is much faster than Martin using a double input to a selector device.

We believe that if we constructed a linear paddle, he would be faster still by using the linear paddle to point to characters displayed on a linear keyboard on screen. His other foot, or perhaps one of his hands, could then enter each letter, either by a second paddle input used as a simple switch, or by using the 'press any key on the keyboard' facility for his somewhat uncontrolled hands.

As an extra, we would like to use the speechboard option. We have tried this briefly and, despite slightly slurred speech, George can control the machine effectively. This could be another way of entering text but we particularly envisage using this as a way of controlling games such as

Star Wars, and adapting colour sketch routines, in conjunction with his 'good' foot and a paddle.

We believe that the kind of routine we have described will have a beneficial effect on the development of skills, as they offer rewards for better motor co-ordination. The existing interrupt systems do not have the same stimulus to physical improvement.

Individual handicapped people vary very widely in ability to control the various possible inputs to a microcomputer. We believe we have identified two ways in which the input rate for the most severely handicapped could be speeded—the 'homing' routine and additional stored target boards.

## Speech input

Retention of the target board format has the great advantage of familiarity for those accustomed to electromechanical equipment, an advantage not to be underrated for those who are understandably cautious.

Speech input offers considerable scope for controlling games and we would like to explore this and many other possibilities. At present, however, we would want to focus on the central task of making fast and accurate communication possible for the most severely handicapped.

With the great barrier of communication broken, we believe new worlds will open up for the two lads and many others like them. □

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Our thanks to the companies who donated some of the prizes and advice for the competition. They include Digital, Research Machines, Nascom, Kode, Dicoll, Midlectron and Data Efficiency.

### RULES

No more than one entry per person may be submitted. Each entry must be accompanied by an official entry form. We shall, however, accept group entries from individual educational establishments or amateur hobbyists.

Put together an initial description/explanation of your wonderful new application not exceeding 3,000 words. If possible, it should be typed—double-spaced and on one side of the paper only.

Closing date is December 31, 1978; entries received after that date will not be considered.

The judges' decision will be final and no correspondence about the competition will be entered into. All entries become the copyright of *Practical Computing*. Entries will be returned only if a stamped addressed envelope is provided.

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PRACTICAL COMPUTING January 1979





# Simplifying business in Basic

This is the second part of a two-part article describing a simple program written in Basic to print quotations, invoices and order forms.

by NICK HAMPSHIRE

IN THE first part of this article last month, we looked at some of the problems faced by a businessman considering the purchase of a computer. The main source of problem lies in the need to justify economically the purchase of such a machine. Having considered the various points, we concluded that he should look at applications which could easily result in improved efficiency and reduced effort, both for himself and his employees.

A prime example of such an application is the writing of quotations, orders and invoices—jobs which consume a large amount of time and are prone to a considerable degree of error.

We looked at how such a simple system could be created and how it could be expanded to incorporate more advanced functions at a later date.

The hardware used in the system was a Cromemco Z2-D with two 5in. disc drives and 32K of memory running standard Cromemco disc Basic. This system was interfaced to a Teletype 43 which performs the dual functions of printer and console. The function of printing and calculating invoices, orders and quotations is performed by a set of seven programs.

We looked at the first four of them—Pick, a program select routine, which is used to tie the other six programs together; New, which is used to create the database used by the other programs—this database can be dumped on to the printer to give a written record by List. The last of the four programs in last month's article performed the actual printing of a quotation and was called Quotation.

## Invoice

The first of the three running programs is called Invoice and, as its name implies, its function is to calculate and print an invoice. Because it performs a very similar function to Quotation, the two programs are almost identical. Lines 70 to 420 comprise the data input section of the program—we thus are asked by the pro-

gram to input the recipient's name, address and the date. We are also asked to input the number of items on the invoice and for each item we then input the item number and the number of units of that item.

The remaining section of the program from line 430 to 1000 performs the actual printing, formatting and calculation of the invoice.

In line 630, record number three in the file Pointer is read. This contains the invoice number; the following two lines increment this number and save it on the disc. This number is printed on the invoice in line 660 and is positioned beneath the recipient's address and the date, printed by lines 460 to 600. Lines 680 and 690 print the invoice column headings.

The data on each item is stored as a record on the file Stock; when we wish to use that data it is extracted as a 128-byte string, the required numeric variables being obtained by use of the VAL function.

The various calculations are performed and the totals kept in lines 830 to 880. Having printed the data for all the items on the invoice, those totals are printed on the invoice by lines 920-950. The program concludes by printing the terms and conditions of business on the bottom of the invoice. If no more invoices are to be printed, then program control returns to PICK.

## Update

This program is an amalgam of List and New and allows the user to examine and, if required, change the data on any record in the Stock file. The program is in two parts. The first allows examination of a particular record and the second, which is optional, permits new data to be inserted in the record examined in the first part.

The data is accessed by inputting the record number. This is checked against the contents of record two of Pointer to ensure that we do not try to access a record number above the highest record number in the file.

All the data then is extracted in its alphabetic or numeric form and printed under the relevant headings by line 310. The program then asks the user if he wishes to change this data; if not, we branch to the end of the program. If the entry is to be changed, the program asks us

(continued on next page)

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(continued from previous page)

to input a description and all the relevant data on the item to be placed in the record examined previously. The data, if numeric, is converted to string format and the various substrings re-assembled in their allotted positions to produce the 128-byte record, which is placed on the Stock file in line 550.

## Order

This program, which performs the function of printing-out and calculating an order to a particular supplier, is a modified version of Invoice and Quotation. The first difference is that the program asks the user to input the code number of the supplier to whom the order is to be sent.

That number, as you will remember, contained the data on each item and its purpose is to check that only items from the specified supplier are placed on the order. You will note that record four of Pointer is used to contain the current order number.

The order is printed-out in the same way as in the invoice and quotation programs; you will notice, however, that the unit price is the trade price and not the retail price.

Before the data is printed-out, the supplier code for that item is compared to the code entered in line 260. If the code is different, the data on that item is not printed and the record number is stored as an entry in a list. Having finished printing the order, this list of record numbers is printed-out as being items which are not available from the specified supplier.

## Initialising

We have examined and given the listings of all seven programs in the suite. Before we can use all of them we must set up and initialise the data files. The first stage is to use the CREATE statement of Cromemco Basic to create two DOS files on a disc in drive B; the two files are called "B:STOCK" and "B:POINTER". Having created the files, we must place the correct entries on the four records in the file B:POINTER; thus the highest record number on the file B:STOCK held on record two of B:POINTER must be set to one.

Since at the same time we want to start creating the data file, the easiest way of placing a 1 in record two of B:POINTER is to run a modified version of NEW. If we load NEW into the computer and enter the following line in place of line 120:

```
120 LET A=1
```

line 130 then loads the value 2 into record two of B:POINTER and the remainder of the program loads the first data entry into record one of B:STOCK.

If we then re-load an unmodified version of NEW into the computer, the next data entry will be placed automatically in record two of B:STOCK, assuming, of

course, that the alphabetical sorting section of the program does not re-order the two records. If we do not want our invoice, order and quotation numbers to start at zero, then similar procedures can be used when running the respective programs.

## Running

The system utilises two disc drives; on drive A are the seven programs and on drive B is all the data required by those programs. The program which ties everything together is the menu-picking program, entitled PICK, and is our natural entry point.

Thus, assuming that all the programs have been entered and are stored on disc in drive A, and that the data files on drive B have at the very least been initialised, we load PICK and run it; and, as the sample run shows, we are given a choice of six operations—each has a number which, if entered in response to the question Operation? will load the program automatically from disc to perform that operation. To give an idea of how the various operations are performed, I have included sample runs from three of the six programs.

## List—Example Run

ITEM NO	DESCRIPTION	PRICE R	PRICE P	VAT%	SUPPLIER
1	Z-80 COMPUTER ASSEMBLER				
575		400		8	4
2	Z-80 COMPUTER RACK MOUNT				
395		275		8	4

## Pick—Example Run

```
QUOTATION, INVOICE AND ORDER PROGRAM.
FUNCTION SELECT.
1 PRINT QUOTATION.
2 PRINT ORDER.
3 PRINT INVOICE.
4 PRINT TOTAL STOCK LIST
5 INPUT DATA ON NEW STOCK ITEM
6 EXAMINE AND UPDATE STOCK DATA.
OPERATION? 5
```

## Update—Sample Run

```
ENTER NUMBER OF STOCK LINE YOU WISH TO
EXAMINE
ITEM NO DESCRIPTION
1 ANOTHER ITEM
PRICE R PRICE P VAT% SUPPLIER
4 4 4 4
```

DO YOU WISH TO CHANGE THIS ENTRY?

```
Y OR N Y
DESCRIPTION ANOTHER NEW PRODUCT
PRICE RETAIL (POUNDS) CHANGED ITEM
TRADE PRICE |
VAT RATE % |
SUPPLIER CODE |
```

```
IS THIS CORRECT Y OR N Y
MORE? Y OR N Y
ENTER NUMBER OF STOCK LINE YOU WISH TO
EXAMINE 1
```

ITEM NO	DESCRIPTION	PRICE R	PRICE P	VAT%	SUPPLIER
1	CHANGED ITEM				
1					

DO YOU WISH TO CHANGE THIS ENTRY?

```
Y OR N Y
DESCRIPTION ANOTHER NEW PRODUCT
FROM PRACTICAL COMPUTING.
```

```
*****DESCRIPTION TOO LONG****
DESCRIPTION NEW PRODUCT
PRICE RETAIL (POUNDS) 156
TRADE PRICE 123
VAT RATE % 8
SUPPLIER CODE 9
IS THIS CORRECT? Y OR N N
DESCRIPTION NEW PRODUCT
PRICE RETAIL (POUNDS) 123
```

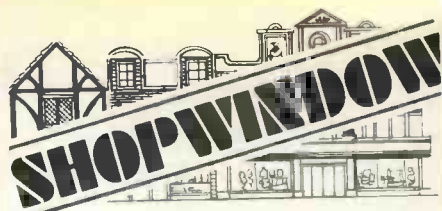
(continued on next page)











(continued from previous page)

mark-space ratio of the waveform; the higher the value the longer the output remains at zero. One hundred and twenty-seven waveforms are available, with varying degrees of asymmetry.

When **RATIO** is set to its mid-point a symmetric square-wave is produced. **RATIO** is located at 0100; it starts at 80, the mid-point, but may be changed before the square wave function is called. Before it is used the bottom bit is set to zero, by **ANDING** it with 11111110, ensuring that it is always an even number, and that the comparison with the **X-register** will always succeed once in the cycle.

A ramp waveform is generated by loading the contents of the **A-register** into the output port and then adding two to it. This is made into a loop. It therefore counts from 0 to 255, outputting 127 evenly-spaced voltage steps to the **D-A converter** before returning to zero to start again.

A triangle waveform is generated by adding the contents of location **FOUR** in a loop, outputting the value to the port each time. Initially, **FOUR** contains the

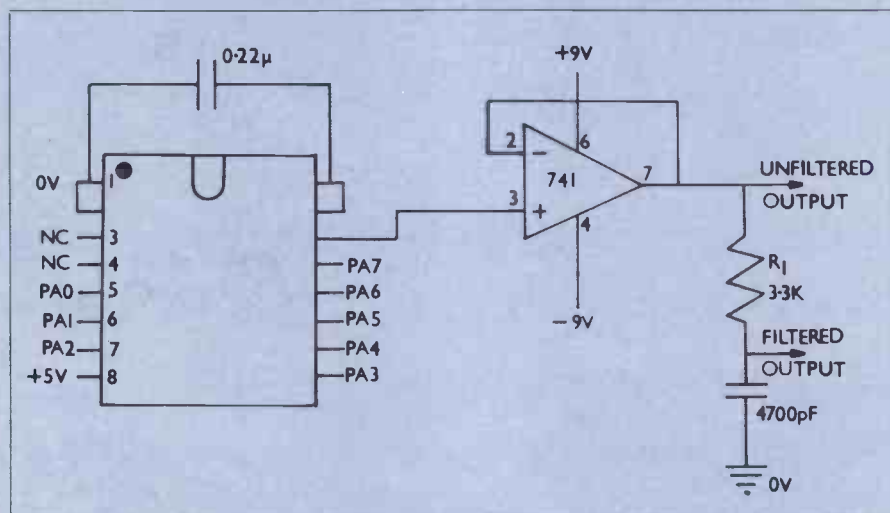
at 458.54, the ramp at 458.7 and the triangle waveform at 459.65Hz. A maximum deviation of 0.242 percent is accounted for by the slight differences in computation required by each of the waveforms.

Displaying the waveform on an oscilloscope shows clearly the discrete steps in the sine, triangle and ramp waveforms. Because they represent distortion at such a high-order harmonic they may be filtered-out by the simplest of filter circuits; the filtering is done by **R1** and **C1**.

The values are chosen to reduce the distortion, so it is invisible on the oscilloscope display, and so as not to degrade the rise and fall times of the squarewave any more than is needed. The 741 op-amp acts as a buffer, so that the output of the **ZN425E D-A converter** is loaded as little as possible (see fig.).

To operate the function generator, '0000' is loaded into the address display and the **GO** button is pressed. The four keys along the bottom can then be used to select the desired waveform—'0' for a sinewave, '1' for the squarewave.

If an asymmetric squarewave is required,



**PA0 — PA7 users output port on Kim-1**

number 4 and the output will rise. When it reaches its highest value the contents of four are replaced by minus 4. Each addition in the loop then reduces the value put to the output port. Every time the **A-register** reaches one of its extremes the contents of **FOUR** are swapped between 4 and -4.

The longest computation loop was required for the triangle waveform, taking a total of 17 machine cycles. Any of the other waveforms which required fewer cycles had to be 'padded out' so that the loop times for all the waveforms were equal—notice the two 'NOP's in the ramp waveform.

Each machine cycle takes one micro-second, and there are 17 cycles in each of the 127 steps in each waveform cycle. Therefore the expected output frequency should be 459.55Hz. In fact, the sinewave was measured at 459.65, the squarewave

the contents of **RATIO** at location '0100' determine the mark:space ratio. The triangle is selected to key '2' and the ramp by '3'. Changing between waveforms is a matter of re-setting, and then pressing the 'GO' key immediately so the start address is not lost. A new waveform is selected as before. The output waveform voltage is between zero and 2.2 volts.

- : A KIM-1 AUDIO FUNCTION GENERATOR
- : AT 460 HZ USING D TO A CHIP
- : ON PA0-7 USER PORT.
- : GO AT 0000; TYPE:
- : 0 FOR SINEWAVE
- : 1 FOR SQUAREWAVE
- : MARK-SPACE RATIO IN 0100 (X.256)
- : 2 FOR SAWTOOTH WAVEFORM
- : 3 FOR RAMP WAVEFORM
- : RESET AND GO FOR NEXT WAVEFORM.
- DA = \$1700
- DDA = \$1701
- GETKEY = \$1F6A

(continued on next page)

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(continued from previous page)

```

0000 A9 FF START LDA # $FF
0002 8D 01 17 STA DDA
0005 20 6A 1F JSR GETKEY
0008 C9 00 CMP # 0
000A F0 0F BEQ SINE
000C C9 01 CMP # 1
000E F0 1A BEQ SQUARE
0010 C9 02 CMP # 2
0012 F0 45 BEQ SAWT
0014 C9 03 CMP # 3
0016 F0 34 BEQ RAMP
0018 4C 00 00 JMP START

;
001B A2 00 SINE LDX # 0
001D BD 00 02 SEI LDA SINEW,X
0020 8D 00 17 STA DA
0023 E8 INX
0024 E0 80 CPX # ESINE-SINEW
0026 F0 F3 BEQ SINE
0028 D0 F3 BNE SEI

;
002A AD 00 01 SQUARE LDA RATIO
002D 29 FE AND # %11111110
002F 8D 00 01 STA RATIO
0032 A0 FF LDY # $FF
0034 A2 00 LDX # 0
0036 8E 00 17 SPACE STX DA
0039 E8 SQ1 INX
003A E8 INX
003B EC 00 01 CPX RATIO
003E F0 06 BEQ MARK
0040 E0 00 CPX # 0
0042 F0 F2 BEQ SPACE
0044 D0 F3 BNE SQ1
0046 8C 00 17 MARK STY DA
0049 18 CLC
004A 90 ED BCC SQ1

;
004C A9 00 RAMP LDA # 0
004E 18 RI CLC
004F 69 02 ADC # 2
0051 8D 00 17 STA DA
0054 EA NOP
0055 EA NOP
0056 18 CLC
0057 90 F5 BCC RI

;
0059 A9 04 SAWT LDA # 4
005B 8D 01 01 STA FOUR
005E AD 01 01 SW0 LDA FOUR
0061 18 SW1 CLC
0062 6D 01 01 ADC FOUR
0065 C9 00 CMP # 0
0067 F0 05 BEQ MFOUR
0069 8D 00 17 STA DA
006C D0 F3 BNE SW1
006E AD 01 01 MFOUR LDA FOUR
0071 49 FF EOR # $FF
0073 8D 01 01 STA FOUR
0076 EE 01 01 INC FOUR
0079 18 CLC
007A 90 E2 BCC SW0

;
007C * = $100
0100 80 RATIO .BYTE 128
0101 FOUR * = * + 1

;
0102 * = $200
0200 7F SINEW .BYTE 127,133,139,146,152
0201 85
0202 8B
0203 92
0204 98
0205 9E .BYTE 158,164,170,176,181
0206 A4
0207 AA
0208 B0
0209 B5
020A BB .BYTE 187,192,198,203,208,
212

020B C0
020C C6
020D CB
020E D0
020F D4
0210 D9 .BYTE 217,221,225,229,233
0211 DD
0212 EI
0213 E5
0214 E9
0215 EC .BYTE 236,239,242,244,247
0216 EF
0217 F2
0218 F4
0219 F7
021A F9 .BYTE 249,250,252,253,253,
254

021B FA
021C FC
021D FD
021E FD
021F FE
0220 FE .BYTE 254,254,253,253,252
0221 FE
0222 FD
0223 FD
0224 FC
0225 FA .BYTE 250,249,247,244,242
0226 F9
0227 F7
0228 F4
0229 F2
022A EF .BYTE 239,236,233,229,225,
221

022B EC
022C E9
022D E5
022E EI

```

```

022F DD
0230 D9 .BYTE 217,212,208,203,198
0231 D4
0232 D0
0233 CB
0234 C6
0235 C0 .BYTE 192,187,181,176,170
0236 BB
0237 B5
0238 B0
0239 AA
023A A4 .BYTE 164,158,152,146,139,
133

023B 9E
023C 98
023D 92
023E 8B
023F 85
0240 7F .BYTE 127,121,115,108,102
0241 79
0242 73
0243 6C
0244 66
0245 60 .BYTE 96,90,84,78,73
0246 5A
0247 54
0248 4E
0249 49
024A 43 .BYTE 67,62,56,51,46
024B 3E
024C 38
024D 33
024E 2E
024F 2A .BYTE 42,37,33,29,25
0250 25
0251 21
0252 1D
0253 19
0254 15 .BYTE 21,18,15,12,10
0255 12
0256 0F
0257 0C
0258 0A
0259 07 .BYTE 7,5,4,2,1,1,0
025A 05
025B 04
025C 02
025D 01
025E 01
025F 00
0260 00 .BYTE 0,0,1,1,2,4,5,7
0261 00
0262 01
0263 01
0264 02
0265 04
0266 05
0267 07
0268 0A .BYTE 10,12,15,18,21
0269 0C
026A 0F
026B 12
026C 15
026D 19 .BYTE 25,29,33,37,42,46
026E 1D
026F 21
0270 25
0271 2A
0272 2E
0273 33 .BYTE 51,56,62,67,73,78
0274 38
0275 3E
0276 43
0277 49
0278 4E .BYTE 84,90,96,102,108,115
0279 54
027A 5A
027B 60
027C 66
027D 6C
027E 73
027F 79 .BYTE 121
0280 14 ESINE .BYTE 20
0281

SECOND PASS FINISHED O.K.
SYMBOL TABLE
20
DA 1700 DDA 1701 SINE 001B
GETKEY 1F6A START 0000 SPACE 0036
SEI 001D SQUARE 002A SPACE 0036
SQ1 0039 MARK 0046 RAMP 004C
RI 004E SAWT 0059 SW0 005E
SW1 0061 MFOUR 006E RATIO 0100
FOUR 0101 SINEW 0200 ESINE 0280

END OF ASSEMBLY
;160000A9FF8D0117206A1FC900F00FC901F01AC902F04
5C9030974
;170016F0344C0000A200B000028D0017E8E080F0F3D0F3
AD00010A3E
;17002D29FE8D0001A0FFA2008E0017E8E0C001F006E0
00F0F20B54
;170044D0F38C00171890EDA9001869028D0017EAEA189
0F5A9040A44
;1600588D0101AD010186D0101C900F0058D0017D0F3
AD0101070A
;08007149FF8D0101EE0101890E204CD
;010100800082
;1602007F858B92989EA4AAB05B5BC0C6CBD0D4D9DD
E1E5E9EC1023
;160216EFF2F4F7F9FAFCFDFFDFEFDFDFCFCAF9F7F4
F2FEFC157E
;16022CE9E5E1DDDD9D4D0C8C6C08BB5B0AA49E989
28B857F790FDC
;160242736C66605A544E49433E8332E2A25211D191512
0F0C0546
;1602580A070504020101000000101020405070A0C0F121
5190107
;13026E1D21252A2E33383E43494E545A60666C73791405
A1
;0000D000D

```



# Address State Analyser

FOR an Address State Analyser, the problems of locating and correcting hardware and software faults within a monitor-based computer can at times be enormous, writes Norman Parron. The monitor provides the power-up bootstrap, controls the systems I/O, and provides the user with the ability to look at and alter the contents of memory locations and registers.

If the monitor program, the processor or I/O is faulty, however we cannot use the monitor to locate that fault. Similarly, if we run a program which, for example, gets stuck in an endless loop, we have no way of knowing where in the program this is occurring.

In earlier machines which employed a front panel with data and address entry switches and lights, one could test a machine by entering a small test program using the switches, and check the output from the LEDs. With those machines one could see if a program was in a loop and where that loop was, simply by looking at the address lights.

The circuit I describe is an add-on to an ordinary oscilloscope and is based on an idea proposed by Steve Garcia in *Byte* (February, 1978). It uses the display on the oscilloscope to produce a "map" or "signature" of what the address lines are doing while executing a program.

The "signature" is a pattern of lines

on the display produced by the two digital-to-analogue converters of the circuit. Each D/A is an independent circuit and feeds either the X or Y axis inputs of the oscilloscope; the digital inputs to the D/A come from either the top or bottom eight address lines.

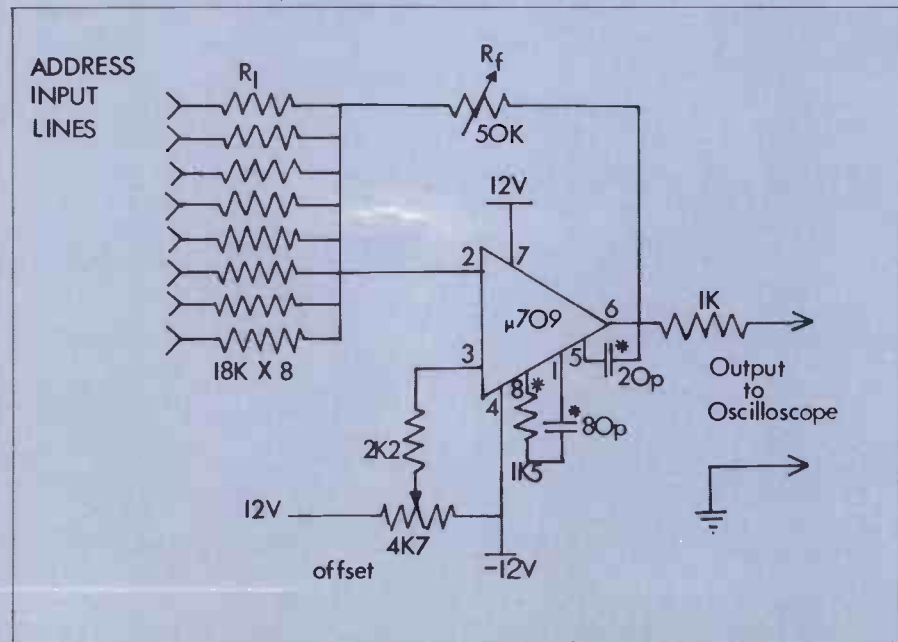
## Address map

The oscilloscope thus displays a 256 × 256 point map of the entire 65,536 possible addresses of the computer memory, where each point represents one byte of memory. Thus, if we have, for example, a 50-byte loop within our program, the display will show one or two short lines, depending whether the 50 bytes was within or across a 256 byte boundary. This program will thus allow us to see the program working and detect which part of the program, if any, is at fault.

The circuit used—note that you will need two of these circuits—is a "summer"; this means that it adds all the '1's in the eight-bit pattern to produce an analogue signal whose amplitude varies with the pattern. The components required are an op-amp and a few resistors; none of the component values are very critical. The resistors can be any convenient value, although the summing resistors should be greater than 10K to

*(continued on next page)*

**Address State Analyser. Parts with \* can be eliminated with 741 op amps. Two of these circuits are needed; one connects to the vertical and the other to the horizontal amps of the oscilloscope.**



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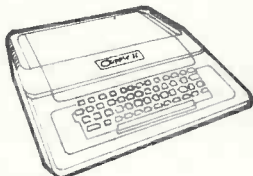
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(continued from previous page)

prevent loading of the address lines.

The only limit to the maximum size of the resistors is the response characteristics of the op-amps and the summing formula:

$$E_0 = \frac{R_c}{R_1}(E_1) + \frac{R_f}{R_2}(E_2) +$$

$$\frac{R_f}{R_3}(E_3) + \dots + \frac{R_f}{R_8}(E_8)$$

The formula states that the values of the input resistors and the feedback resistor and the sum of the eight inputs should be of such values that the op-amp does not saturate. Do not let the formula scare you. It is not as bad as it may seem. If the input resistors are put to the same values, the formula reduces to:

$$E_0 = \frac{R_f}{R_2}(E_1 + E_2 + E_3 + \dots + E_8)$$

If the feedback resistor is changed to a pot, the formula can just about be ignored, because you can trim the op-amp gain to suit the circuit values.

The offset pots are included to enable you to use the full range of the op-amps. Without the offset, the usable range of output is 0-10v—we are summing positive voltages only. With the offset, the range of the output increases to -10 to 10v—20v peak-peak.

By using the offset and the feedback (gain) pots you can trim the response of the circuit for optimum display on your particular oscilloscope.

Some of the simpler scopes have no X-Y mode and their horizontal inputs are limited, so being able to adjust the peak-peak output of the address state analyser can be useful.

### Identical circuits

The op-amps can be of any type available. Although the 741 type is satisfactory, I chose the 709. Its frequency response can be trimmed to optimum performance. Besides, I had a dozen or so in my junk box. The 1K resistor on the output of the op-amp is to prevent the op-amps being harmed by an accidental short-circuit.

The address state analyser consists of two identical circuits, one for each set of eight address lines, A0-A7 on one summer and A8-A15 on the other. The board can be made small and can be placed anywhere convenient, but it is advisable to keep the wires to the address lines as short as possible to prevent noise pick-up.

My system is based on the M6800 and one of its undocumented instructions is HCF 9D<sub>16</sub>, which causes the processor to address all its address lines repeatedly until the M6800 is re-set.

This is a convenient program, because using it I can adjust the op-amp gain and offset until the "map" just fills the oscilloscope screen.

If your system has no HCF or some equivalent instruction, use the oscillo-

scope in the usual manner and look at the output of each circuit. Adjust the offset and gain pots until the signal is between 10 to 20v peak-peak. Then connect one circuit to the vertical amp and the other to the horizontal amp. Adjust the oscilloscope position and gain controls until the display is satisfactory.

As an example of the usefulness of this circuit, I had to write a short program which had a different beginning and end-point. Since I had been using the circuit for some time I was familiar with the "maps". I knew that when I ran my program I should get three maps, the triangular computer ready, the program running map and the single dot produced by a halt.

The oscilloscope display did not do this; instead, it went from the ready map to a small box-shaped map at the top of the scope. This indicated that at the beginning of the program there was an error which caused the program to lock-up in a small loop at a high memory location.

After a few minutes' search at the beginning of the program, I found an incorrect branch instruction; without the address state analyser circuit it could have taken a very long time to find the error.

```

;DEFINE SYSTEM LOCATIONS AND
ROUTINES
DA          = $1700
DDA        = $1701
DB         = $1702
DDB        = $1703
SCANS     = $1F1F
DISP      = SF9
PLOW      = $00
PHIGH     = $02
0000      TEST          *=*+1
0001      MASK         *=*+1
0002      SUM          *=*+1
0003      POINTH       *=*+2
0005      SYNCL        *=*+1
0006      SYNCH        *=*+1

;TEST DECIMAL—DISPLAYS
;NUMBER IN LOCATION 0000
;USING SCANS.
0007      A5 00        TESTD      LDA TEST
0009      20 5C 00     JSR DECIMAL
000C      20 1F 1F     PDLY        JSR SCANS
000F      4C 0C 00     JMP PDLY

; DIGITAL VOLTMETER USING
;RAMP A:D
0012      20 51 00     DVM1        JSR SETUP
;CONFIGURE PORTS
0015      20 8C 00     DVM1A      JSR A2DHMP
;GET VOLTAGE
0018      C9 00        CMP #0     IS IT VALID?
001A      F0 12        BEQ VALID   YES
001C      A9 AB        LDA #5AB
001E      85 FB        STA DISP+2
0020      A9 CD        LDA #5CD
0022      85 FA        STA DISP+1
0024      A9 EF        LDA #5EF
0026      85 F9        STA DISP
0028      20 1F 1F     JSR SCANS  DISPLAY "ABCDEF"
002B      4C 15 00     JMP DVM1A
002E      A5 02        VALID LDA SUM
0030      20 5C 00     JSR DECIMAL
0033      20 1F 1F     JSR SCANS DISPLAY DATA
0036      4C 15 00     JMP DVM1A

;DIGITAL VOLTMETER USING
;SUCCESSIVE APPROXIMATION
;TECHNIQUE.
0039      20 51 00     DVM2        JSR SETUP
003C      20 B1 00     DVM2A      JSR A2DSAT
003F      20 5C 00     JSR DECIMAL
0042      20 1F 1F     JSR SCANS
0045      4C 3C 00     JMP DVM2A

; DIGITAL STORAGE SCOPE
0048      20 00 01     SCOPE      JSR RECORD
004B      20 33 01     SCOPEA    JSR PLAY
004E      4C 4B 00     JMP SCOPEA

```

(continued on next page)



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```

;SETUP DATA DIRECTION
;REGISTERS
0051 A9 FF SETUP LDA #SFF OUTPUT
0053 8D 01 17 STA DDA
0056 A9 00 LDA #0 INPUT
0058 8D 03 17 STA DDB
005B 60 RTS

; CONVERTS NUMBER IN A REG
; TO DECIMAL IN DISP, READY
; FOR A CALL TO SCANS.
005C 48
005D A9 00 LDA #0 CLEAR DISP
005F 85 F9 STA DISP
0061 85 FA STA DISP+1
0063 85 FB STA DISP+2
0065 68 PLA
0066 C9 64 NI00

CMP #100 BRANCH IF <=99
006B 90 08 BCC NI0
006A 38 SEC- NO BORROW
006B E9 64 SBC #100 A LESS 100
006D E6 FA INC DISP+1 HUNDREDS + 1
006F 4C 66 00 JMP NI00 AND AGAIN
0072 C9 0A NI0

CMP #10 BRANCH IF <=9
0074 90 08 BCC NI
0076 38 SEC
0077 E9 0A SBC #10
0079 E6 F9 INC DISP TENS + 1
007B 4C 72 00 JMP NI0
007E 06 F9 NI

ASL DISP SHIFT TENS TO
0080 06 F9 ASL DISP UPPER DIGIT
0082 06 F9 ASL DISP POSITION IN
0084 06 F9 ASL DISP DISP.
0086 18 CLC
0087 65 F9 ADC DISP ADD UNITS
0089 85 F9 STA DISP
008B 60 RTS

;ANALOGUE TO DIGITAL
;CONVERSION — 1 CLOCKS
;ZN325E D TO A CHIP UP TO 256
;TIMES. RAMP ALGORITHM
; IF VOLTAGE IN RANGE:
; RETURNS IN SUM, SETS A REG
; TO 0
; IF VOLTAGE OUT OF RANGE:
; SETS SUM TO 0 AND A REG TO
; SFF
008C A9 00 A2DRMP
LDA #0
008E 8D 00 17 STA DA RESET ZN425
COUNTER
0091 85 02 STA SUM CLEAR SUM
0093 A9 02 LDA #2
0095 8D 00 17 STA DA COUNTER READY
0098 EE 00 17 COUNT
INC DA
009B AD 02 17 LDA DB COMPARATOR
STATE
009E 6A ROR A INTO C BIT
009F 80 0A BCS DONE IS HIGH
00A1 CE 00 17 DEC DA CLOCK ZN425
00A4 E6 12 INC SUM KEEP COUNT
00A6 F0 06 BEQ OVFLOW VOLT
OVERRANGE
00A8 4C 98 00 JMP COUNT
00AB A9 00 DONE
LDA #0 IF A=0 SUM IS
VALID
00AD 60 RTS
00AE A9 FF OVFLOW
LDA #SFF IF A=-1 SUM IS
INVALID
00B0 60 RTS

;ANALOGUE TO DIGITAL
;CONVERSION—2 SUCCESSIVE
;APPROXIMATION TECHNIQUE
;RETURNS IN A REG
00B1 A9 80 A2DSAT
LDA #S80 TOP BIT
00B3 85 01 STA MASK
00B5 8D 00 17 STA DA
00B8 EA NOP
00B9 AD 02 17 NEXT
LDA D8 GET RESULT
ROR A INTO CARRY
00BC 6A BCC ONE LEAVE SET
00BD 90 0A STA MASK ELSE CLEAR
00BF A5 01 EDR #SFF
00C1 49 FF AND DA
00C3 2D 00 17 STA DA COMPLEMENT DA
00C6 8D 00 17 STA DA
00C9 46 01 ONE
LSR MASK
00CB A5 01 LDA MASK
00CD 0D 00 17 ORA DA SET NEXT BIT IN DA
00D0 8D 00 17 STA DA
00D3 90 E4 BCC NEXT MASK INTO
CARRY!
00D5 AD 00 17 LDA DA YES!
    
```

```

00D8 60 RTS
00D9 *=$100

;CONTINUALLY SAMPLES AN
;INPUT WAVEFORM AND STORES
;IN A CIRCULAR BUFFER OF
;512 BYTES. IF PB1 GOES HIGH
;RECORDING STOPS, BUFFER
;POINTER IS STORED IN SYNCL &
;SYNCH.
0100 20 51 00 RECORD
JSR SETUP
0103 A9 00 RESET
LDA #PLOW
0105 85 03 STA POINTR POINTER TO
0107 A9 02 LDA #PHIGH BEGINNING OF
0109 85 04 STA PONTR+1 CIRCULAR
010B A0 00 LDY #0 BUFFER
010D 20 B1 00 ACQUIRE
JSR A2DSAT CONVERSION
0110 91 03 STA (POINTR),Y SAVE
0112 AD 02 17 LDA DB
0115 6A ROR A
0116 6A ROR A
0117 B0 11 BCS ENDFRC
0119 E6 03 INC POINTR
011B D0 F0 BNE ACQUIRE END OF PAGE
011D E6 04 INC POINTR+1
011F A5 04 LDA POINTR+1
0121 C9 04 CMP #PHIGH+2
0123 F0 DE BEQ RESET
0125 85 04 STA POINTR+1
0127 4C 0D 01 JMP AQUIRE
012A A5 03 ENDFRC
LDA POINTR SAVE SYNC
012C 85 05 STA SYNCL
012E A5 04 LDA POINTR+1 POINTR
0130 85 16 STA SYNCH
0132 60 RTS

;REPLAYS CIRCULAR BUFFER
; FILLED BY RECORD. PB1
; SYNCHRONISES SCOPE TO START
; OF BUFFER
0133 A9 04 PLAY
LDA #4 PB2 AS SYNC
0135 8D 03 17 STA DDB OUTPUT
0138 A9 00 RESTRT
LDA #PLOW
013A 85 03 STA POINTR
013C A9 02 LDA #PHIGH
013E 85 04 STA POINTR+1
0140 A0 00 LDY #0
0142 B1 03 CONT
LDA (POINTR),Y
0144 20 72 01 JSR YOURS
0147 8D 00 17 STA DA OUTPUT SAMPLE
014A A5 15 LDA SYNCL
014C C5 03 CMP POINTR
014E D0 10 BNE NOSYNC
0150 A5 06 LDA SYNCH
0152 C5 04 CMP POINTR+1
0154 D0 0A BNE NOSYNC
0156 A9 04 LDA #4 SYNC PLUSE TO
0158 8D 02 17 STA DB
015B A9 00 LDA #0
015D 8D 02 17 STA DE SCOPE
0160 E6 03 NOSYNC
INC POINTR BUFFER
0162 D0 DE BNE CONT POINTER
0164 E6 04 INC POINTR+1 RESET
0166 A5 04 LDA POINTR+1
0168 C9 04 CMP #PHIGH+2
016A F0 CC BEQ RESTRT
016C 85 04 STA POINTR+1
016E 4C 42 01 JMP CONT
0171 60 RTS

;USER DEFINED ROUTINE
0172 60 YOURS RTS
0173
SECOND PASS FINISHED O.K.
SYMBOL TABLE
44
DA 1700 DDA 1701
DB 1702 DDB 1703 SCANS 1F1F
DISP 00F9 PLOW 0000 PHIGH 0002
TEST 0000 MASK 0001 SUM 0002
POINTR 0003 SYNCL 0005 SYNCH 0006
TESTD 0007 PDLY 000C DVM1 0012
DVMIA 0015 VALID 002E DVM2 0039
DVM2A 003C SCOPE 0048 SCOPEA 004B
SETUP 0051 DECIMAL 005C NI00 0066
NI0 0072 NI 007E A2DRMP 008C
COUNT 0089 DONE 00AB OVFLOW 00AE
A2DSAT 00B1 NEXT 00B9 ONE 00C9
RECORD 0100 RESET 0103 AQUIRE 010D
ENDREC 012A PLAY 0133 RESTRT 0138
CONT 0142 NOSYNC 0160 TOURS 0172
END OF ASSEMBLY

Note: Practical Computing has not
tested the circuit. We trust it works.
    
```

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# Bubble Sort is easiest to program

by Paul Woolley

IN MANY commercial applications data is stored and processed sequentially. There are times when the data is in the wrong order and, before processing can take place, has to be sorted into the required sequence.

MONDAY		FRIDAY
TUESDAY		MONDAY
WEDNESDAY	SORTING	SATURDAY
THURSDAY	PROCESS	SUNDAY
FRIDAY		THURSDAY
SATURDAY		TUESDAY
SUNDAY		WEDNESDAY

There are several ways of sorting data but I will discuss only one method, the BUBBLE SORT, which is the easiest to program. The set of data to be sorted comprises the days of the week, to be sorted from normal into alphabetical sequence:

Consider how this operation might be done manually with seven cards, each with a day printed on it. First, two cards are picked up and compared, the one which is first alphabetically is discarded and a third card picked up. Again, the two cards are compared, the one which is first alphabetically is discarded and another is picked up.

This process is continued until all seven cards have been picked up. The card held at the end will be WEDNESDAY, which is put to one side. The six discarded cards are re-processed in the same way as before; at the end, TUESDAY is left and is placed next to WEDNESDAY. The discarded cards are processed again and the operation continues until all the cards are in sequence.

Ideally, I should be able to write a program to go through similar actions to those in the manual method. In Basic, lists (DIM statement) are not able to be dynamic—to grow and shrink as required which is what happens in the manual example. One solution would be to have two lists of equal size. The sorted data is moved from one list to the other which, however, is a waste of valuable space.

The bubble sort requires only one list, which holds all the data, and movements of the data are performed using swapping variables.

The data stored within the list may be shown as:

(1)	DS(7)
(2)	MONDAY
(3)	TUESDAY
(4)	WEDNESDAY
(5)	THURSDAY
(6)	FRIDAY

(6)	SATURDAY
(7)	SUNDAY

The following program will re-order the data and print the sorted results.

P1 controls the number of times the list is accessed.

P2 controls the number of comparisons made.

F is a two-state flag used to detect if the data is in sequence before the sort process reaches its natural end. In small lists it makes little difference but in a large list it could save some time.

```

LISTNH
10 REM
20 REM
30 REM
40 DIM DS(7)
50 GOSUB 100
50 GOSUB 200
70 GOSUB 400
80 GO TO 600
100 REM
110 For I = 1 TO 7
120 READ DS(I)
130 NEXT I
140 RETURN
200 REM
210 FOR P1 = 7 TO 2 STEP -1
220 LET TS=DS(P1)
230 #ET F=0
240 FOR P2=1 TO P1
250 IF TS>DS(P2) GO TO 290
260 LET TS=DS(P2)
270 LET T=P2
280 LET DS(P1)=TS
290 NEXT P2
300 IF F=0 GO TO 340
310 LET DS(T)=DS(P1)
320 LET DS(P1)=TS
330 NEXT P1
340 RETURN
400 REM
410 FOR O=1 TO 7
420 PRINT DS(O)
430 NEXT O
440 RETURN
500 REM
510 DATA MONDAY, TUESDAY, WEDNESDAY, THURSDAY
520 DATA FRIDAY, SATURDAY, SUNDAY
600 END

READY
RUNNH
FRIDAY
MONDAY
SATURDAY
SUNDAY
THURSDAY
TUESDAY
WEDNESDAY
READY

```

This method of sorting works well on small quantities of data but on large quantities it is slower than other types of sort. For example, a set of data which took more than 24 hours to process using a bubble sort took an hour using a second sort method and six minutes using a third.

It is an interesting exercise to time the sorting of different sets of data such as lists of 50, 100, 150, 200 words of the same length, and then to compare the results.

Next month: Using the bubble sort with simple records.



## Dual-density floppy disc

STRANGE but true. Digital Equipment, the biggest manufacturer of minicomputers in the world, has just produced its first dual-density floppy disc system.

It is designed for use with the Digital LSI-11 microcomputer and with double-density manages to cram a megabyte on to a single floppy disc. Called the RX02, it succeeds the RX01 single-density diskette which Digital has been marketing previously. At £2,635, it represents a 60 percent reduction in price compared to its predecessor.

Software enhancements are also promised to take full advantage of the new facilities. According to Edgar Valentine, the company's components group manager: "The data files on RX01 diskettes are exchangeable under program control. To prevent mixing densities on a newly-inserted diskette, using RX02, the controller reads the previous sector automatically for density and will write the subsequent sector only in the same density."

Data integrity is looked after by a power-fail feature, designed to detect an impending power loss, and prevents data being written to an unpowered disc subsystem.

## Versatility

VERSATILITY is the name of the game in the micro business. And adding one more

string to its bow is LP Enterprises, better-known to our readers as suppliers of numerous U.S. magazines on hobby computing.

The Essex-based company is now branching-out into the supply of software and is offering the CP/M operating system for Intel 8080 and Zilog Z-80-based systems using the North Star floppy disc system.

CP/M is becoming the *de facto* standard for microcomputer operating systems, and has many sophisticated features which make the system easier to run and debug.

It runs on 8080 and Z-80 systems with at least 20K bytes of read-write memory. It costs £99 plus VAT.

Further information: LP Enterprises, 313 Kingston Rd., Ilford, Essex. Tel: 01-553 1001.

## Analogue I/O

A DEVICE has been launched by Burr-Brown which allows users of the Zilog Z-80 MCB and MCS microprocessors to take input from analogue devices, such as voltmeters.

The analogue input/out board is called the MP2216 and fits into the Zilog microcomputers without modification. It provides 32 single-ended or 16 differential voltage inputs and, optionally, two analogue voltage outputs.

Further information from Burr-Brown International, 17 Exchange Road, Watford, Herts WD1 7EB. Tel: 0923-33837.

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# A PRACTICAL GLOSSARY

Continuing the terminological gamut with E

## Emulation

In this procedure one computer duplicates the instruction set of another. In practice, it usually involves using a large computer to develop programs for a smaller one. The full facilities and speed of the bigger system make for easier program development, and because it is emulating the smaller machine, the programs which result can be transferred to the target system and run happily.

## Enable

Essentially to enable function is to switch it on. In literal terms, it is defined as setting the processor to accept interrupt signals.

## END

All BASIC programs must end with an END statement. Forgetting this has caused the writer no little heartache.

## Enquiry

As the word suggests, an enquiry is an operation which accesses a record or some other item in storage without altering the contents—that is called an update. There is an important distinction to be made between enquiries and updates, because the amount of processor effort required for an update is considerable, while an enquiry takes very little.

In a fairly simple multiple-terminal system; several terminals can be making enquiries on files and one can be updating. If you want more than one simultaneously-updating terminal, you will require a much more complicated operating system and generally a more complex computer.

## EOB

End of Block, usually a special code defined by a mainframe to indicate the end of a transmission segment.

## EOM

End of message. Someone's special control code.

## EOT

End of text, an ASCII control code.

## EPROM

Erasable programmable read-only memory. We'll deal with ROM and memory in more depth later but as a quick rule of thumb, ROM is read-only memory supplied as ready-programmed. PROM is read-only memory supplied empty and programmed by you, if you have the special tools. EPROM is PROM which can be erased and re-programmed.

The sharp-witted will spot that EPROM sounds a little like RAM, which is random-access memory

(or read/write memory). RAM is the 'user' memory in a system; you can load programs into it and read from it at will.

The difference between EPROM and RAM is that with EPROM you need a special erasing device which utilises ultra-violet light—with RAM the new programming over-writes the old, as a rule. With EPROM you need a special re-programming device, the same 'PROM burner' required for non-erasable PROM.

## Erasable memory

Memory of storage facilities which can be written, erased, re-written *ad infinitum*. Magnetic core, tape, and disc files are all erasable memory. You'll never hear this term but we thought it ought to be included.

## ERCC

Error-checking and correcting memories are becoming more common on bigger minis; mainframes have had ERCC memories for some time. Each word stored is checksummed every time it is used—you remember Checksums from issue no. 2, don't you?—and the system makes sure that no unexpected alteration of its contents has occurred.

ERCC typically can detect and correct any and all single-bit errors; other errors are usually detected and logged, which helps at least. ERCC involves adding six bits to a 16-bit word; that's for the checksum and checking it can slow things a bit, which is why ERCC is limited normally to fast machines.

## Error correction

As systems become more complex, it is important that errors are detected without stopping or re-running the whole thing. Facilities are being developed to effect local correction of errors without interrupting the major activities of the system, hence error correction.

## ETB

End of transmitted block (ASCII again).

## ETK

End of transmission—another ASCII control code.

## Execution time

Not only the cold grey hour of dawn but also the time required for the computer to carry-out an instruction, or a sequence of instructions. It varies, of course, depending on the machine and the operation. It is generally expressed in terms of clock cycles (qv). Also known as Instruction Time. Or Instruction Execution (or Execute) Time.

## Executive

Either the grey-suited individual concealing Bits 'n' Tums inside his *Financial Times* as he boards the 7.57 from Woking or, wait for it, the basic system software which runs a computer. The term 'executive' is used often as a synonym for 'operating system', which means that nobody really has a clear definition. Ours is as follows: the executive is that software which resides in main memory and provides control functions for the computer system.

In general, those functions would include handling interrupts (defined later), reading inputs from and despatching outputs to the control console, giving each component part of the computer circuitry a slice of the processor's attention, and so on.

Executive is not a term encountered frequently in the micro world. You are much more likely to encounter 'monitor', which as far as we can see means exactly the same (though usually implemented in ROM) or 'operating system' which, in practice, will incorporate many more system functions than something called an executive.

## Exerciser

A 'prototyping' or 'development' system for a micro is a set-up which allows the user to write and debug programs, so usually it includes some kind of I/O device and local storage medium. Those programs, once they are working, can then be loaded into a micro configuration which probably does not need to have all those peripherals. The key point is that many applications for microprocessors are in systems which have no requirement for man-machine interaction, but to produce the software which drives those systems, you need such facilities.

An exerciser is the very simplest form of development system. Usually it consists only of a small display screen and a hex keyboard.

## EXORciser

The Motorola development package for the M6800; it consists of several pre-tested modules and minimises the time needed to develop M6800 systems.

## Extended BASIC

BASIC is beautiful, as readers of earlier glossary episodes—and anyone who takes up Donald Alcock's book—will know. It was designed as a fairly simple language for beginners and accordingly it is not as rich in facilities as some of the more complicated programming languages. Many people have been beavering away at BASICs to maximise the potential of the language on their own

computers, so most of the BASIC implementations you'll meet have been somewhat enhanced by comparison with the original specifications.

There is no universally-agreed official definition yet for BASIC, though that is in the offing, so there is no officially-agreed definition of what an extended BASIC includes. Typically, though, a beefed-up BASIC will allow you to do clever output formatting and nice things with files (what is called Record I/O, for instance—look out for the provision of commands like GET and PUT). There will also be extensions to the existing facilities, like a greater range of line numbering, a greater range of permitted numbers, a greater range of permitted variable names and types of variable.

## exB/2

Above all, though, the basic BASIC is generally not good enough to handle commercial applications even with difficulty. It can become very hard to do an invoice calculation and then to print an invoice. The extensions to BASIC generally are provided to simplify commercial programming.

That is a kind of superset of BASIC. There are also subsets of BASIC which provide some if not all facilities of the language in very small systems—Tiny BASIC is the best known example. You'll have to wait for us to reach 'T' for that, though.

## Extender board (or chassis)

Computers are a collection of printed circuit boards which slot into a 'chassis' or 'mainframe'. The processor normally is one or two boards and so takes one or two slots. Depending on the supplier, one memory board occupying one slot can store from 4KB to 64KB or more; the controllers for disc, cassette and other peripherals are all implemented as circuit boards and take more slot positions.

Obviously you reach a limit to the number of PCB slots but some manufacturers will sell an extender or expansion board or chassis or cage. This is generally a separate chassis with more PCB slots and it plugs into the power supplies and data buses of the main chassis.

## External storage

Speaks for itself, really; any type of memory which can be stored away from the computer. Like discs and tapes, internal memory is core or semiconductor storage.

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