Practical Computing

50p

April 1980

Volume 3 Issue 4

Memories are made of this

How to finance a micro business

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Reviews: Nascom 2, Commodore Database, Superbrain

More on assembly language

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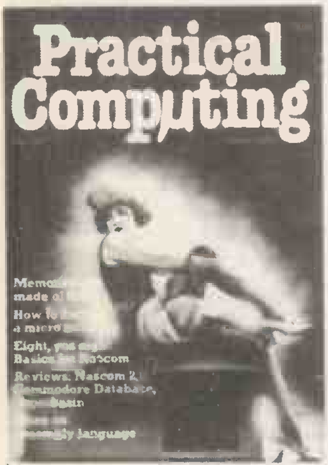

Remember Marlene Dietrich in the Blue Angel? Seen our cover? Well, that's all she's got to do with 'Memories are made of this' on page 72. Painting by Mark Wilkinson.

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

CONTENTS

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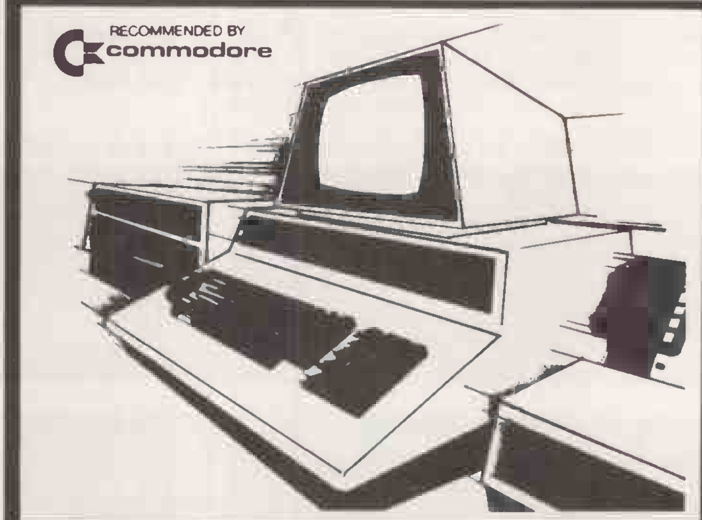

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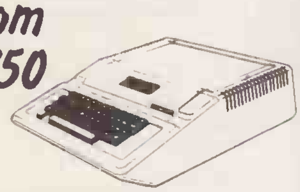

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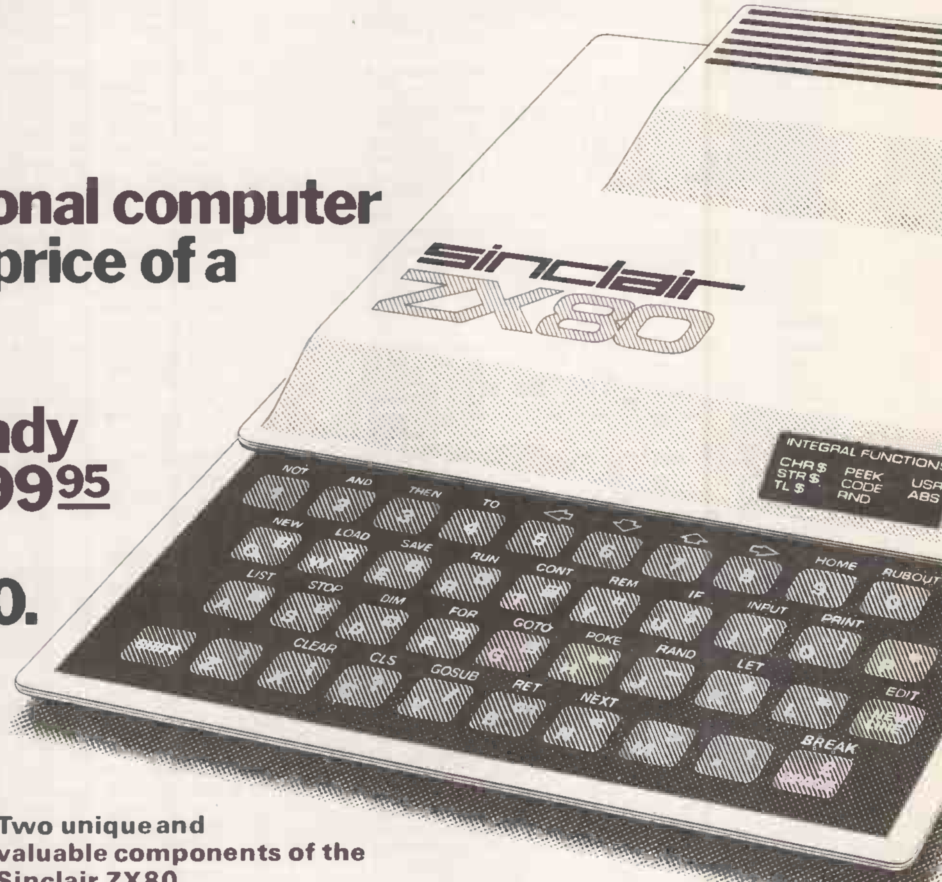

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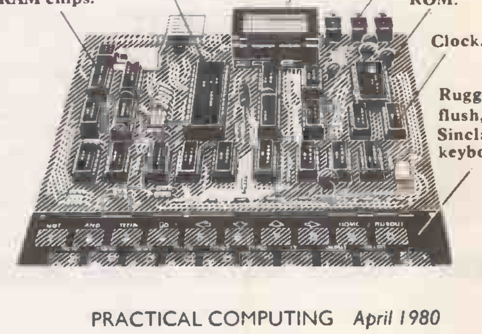

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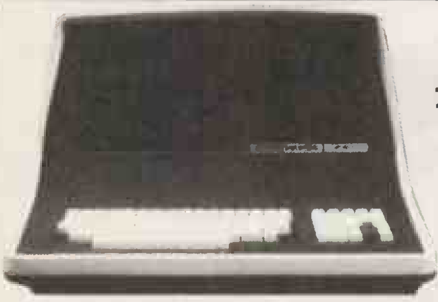

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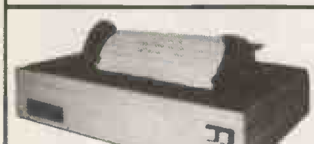

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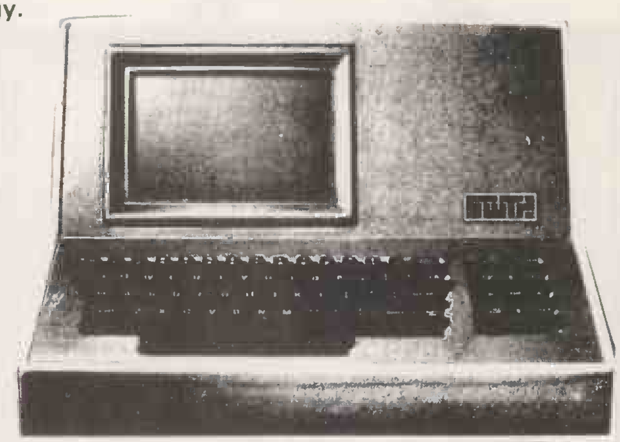

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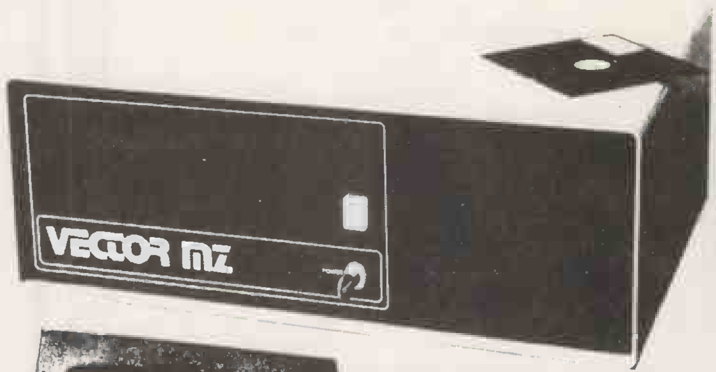

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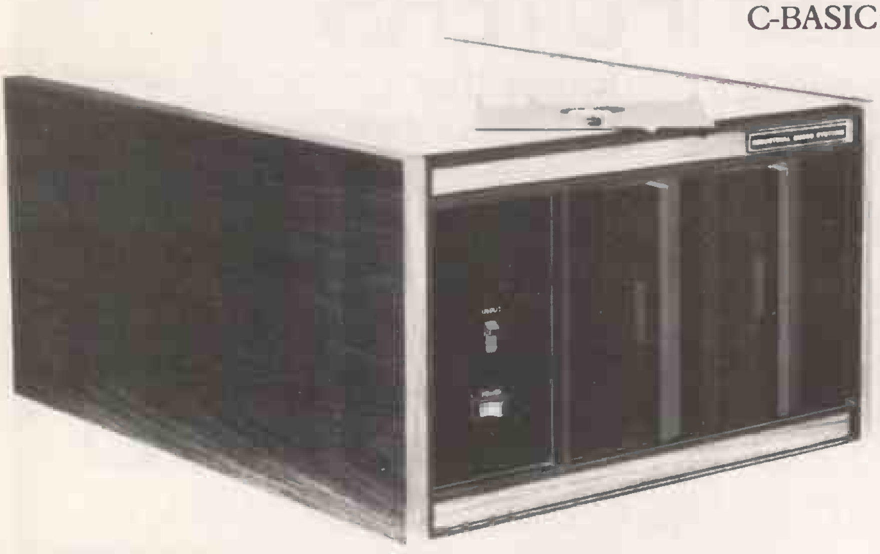

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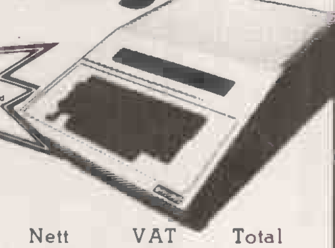

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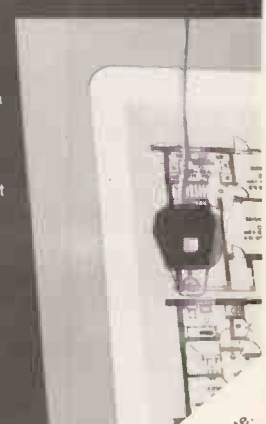

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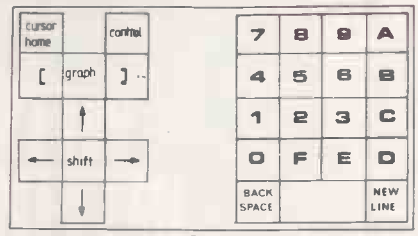

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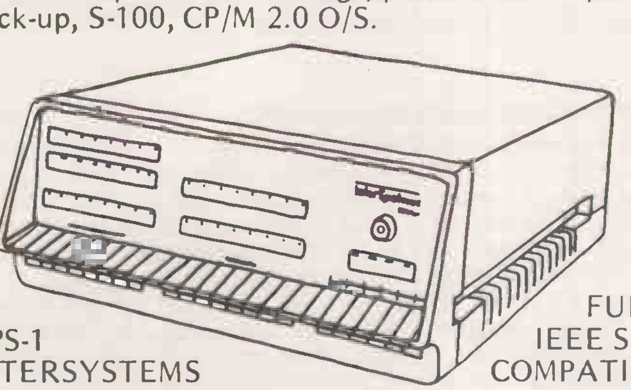

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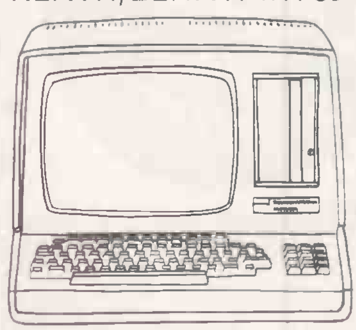

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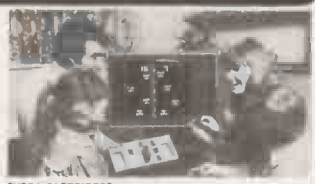

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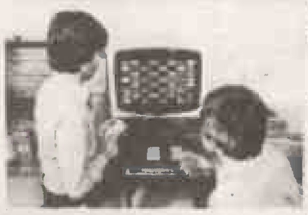

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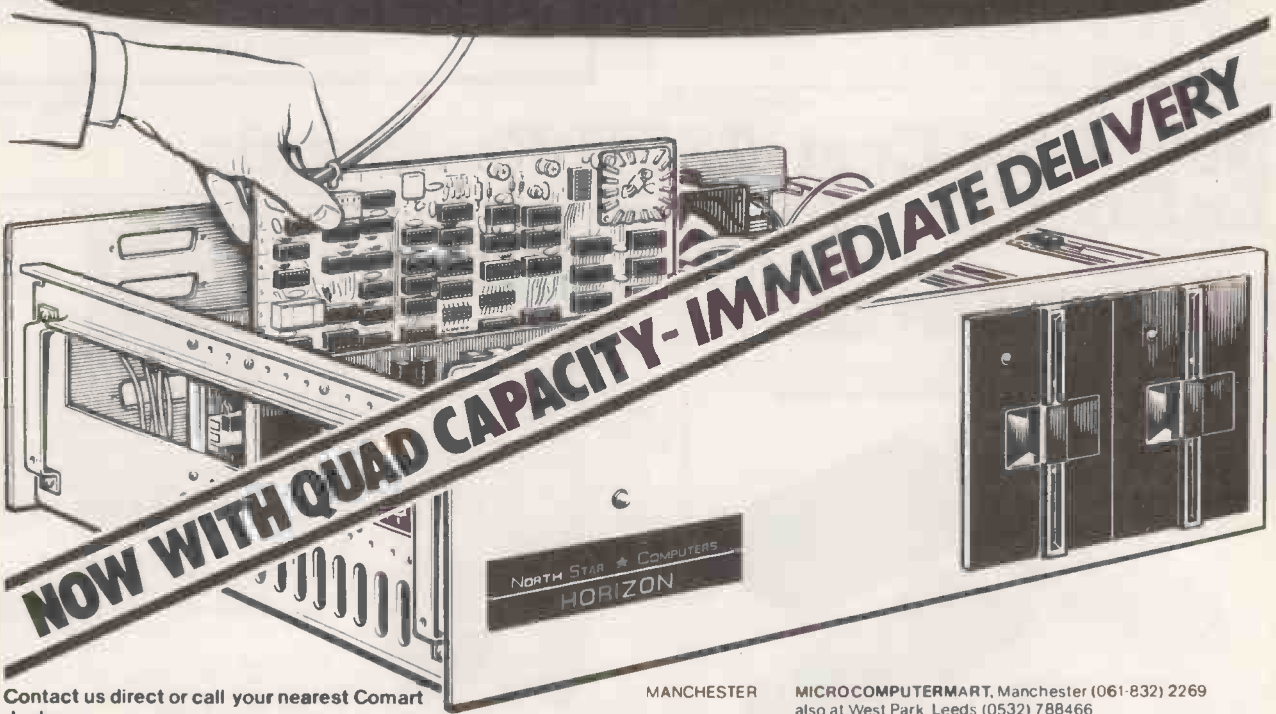

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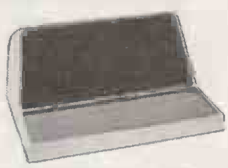

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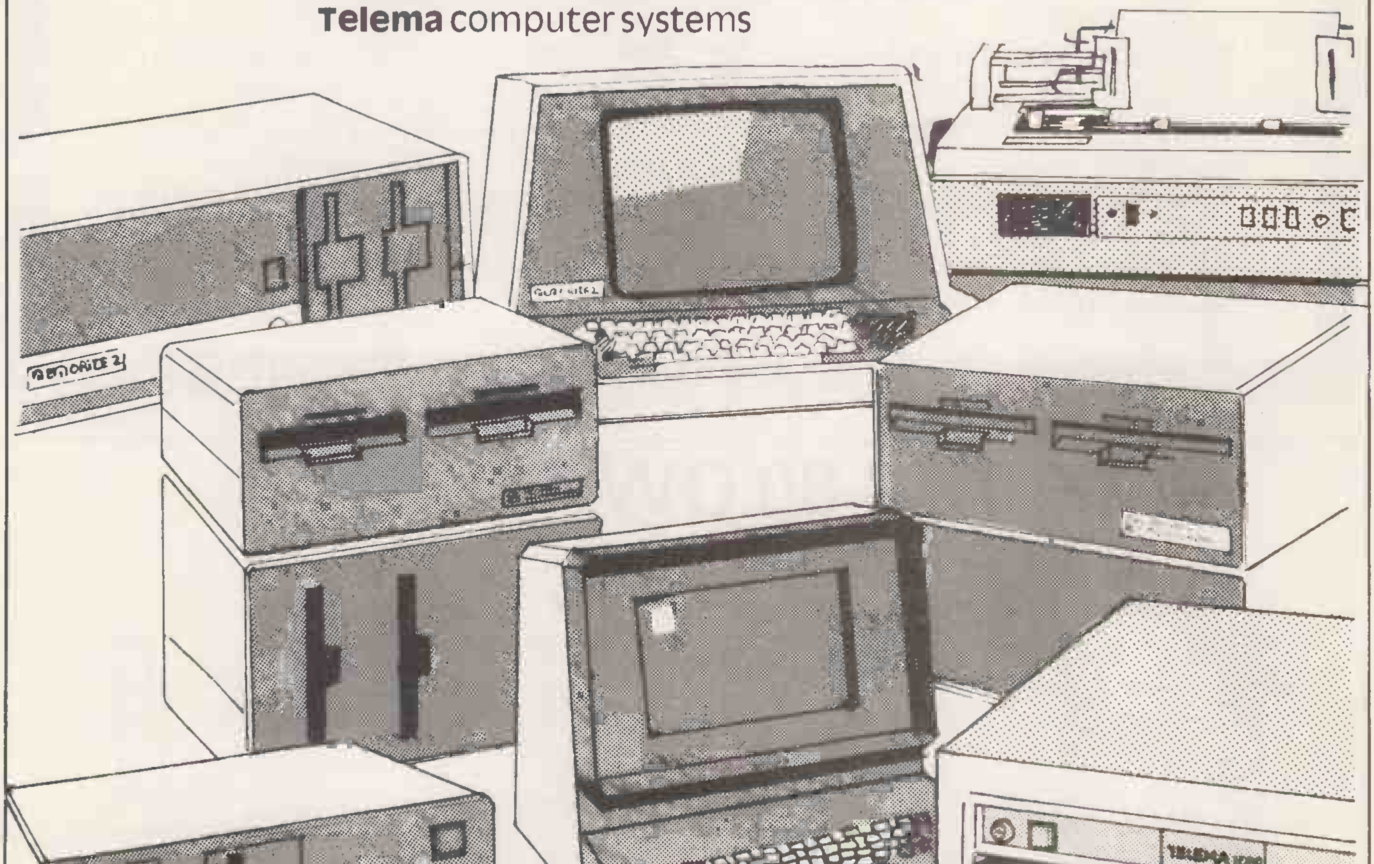

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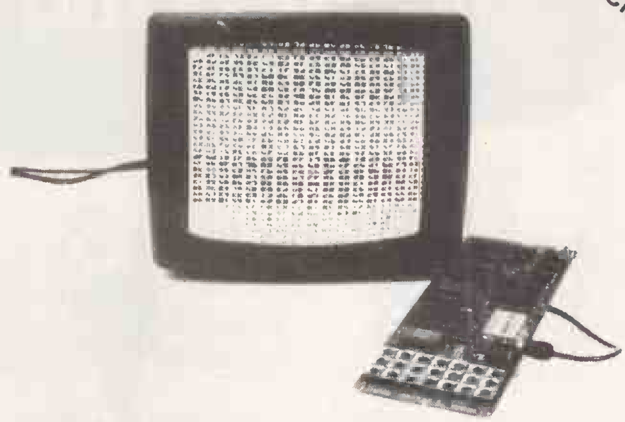

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Data may be entered into the SOFTY RAM via the **serial port, parallel port, direct memory access**, or the **keypad**, and manipulated using the **assembler key-functions**. When the program has been entered, and the internal microprocessor can be 'turned off', and the external microsystem and it's resident microprocessor allowed to access and run the program in SOFTY's RAM and/or programming socket. In this way, modification can be made until the required program is complete — **the contents of the RAM being clearly visible as a 'page' on TV** or **monitor**. 4 pages are available, 2 of the Data RAM and 2 of the programming socket.

In the end, when the program is complete and working, the DIL plus is removed and replaced by an EPROM device programmed by SOFTY. **SOFTY** is able to **program the 2704/2708/2716 family** which have 3 voltage rails — we supply with each SOFTY details of a simple modification which allows SOFTY to program the single rail 2716/2732 etc.

(If you want to program EPROMs/PROMs other than the 2704/2708/2716 family, we may be able to help you — our range of add-on Programming Modules is currently under development.)

To help in the process of program development SOFTY has various assembler key-functions, which include — **block shift without overwriting, block store, cursor control, match byte and displacement calculations** (for jumps etc).

A **high speed cassette interface** is also provided for storing working programs and useful subroutines.

Software is supplied for serial data transfers — which means that you can write an assembler for your favourite MPU in BASIC on your Superboard, UK101, Nascom etc., and transfer the hex code directly to EPROM via SOFTY. The serial transfer program runs in the scratchpad and can be easily loaded from cassette or the programming socket.

Besides software development and EPROM programming, SOFTY has other uses — as a **training aid**, or as a **control computer** in it's own right, with up to **2K bytes firmware, 1K of RAM, 22 I/O ports and Direct Memory Access**.

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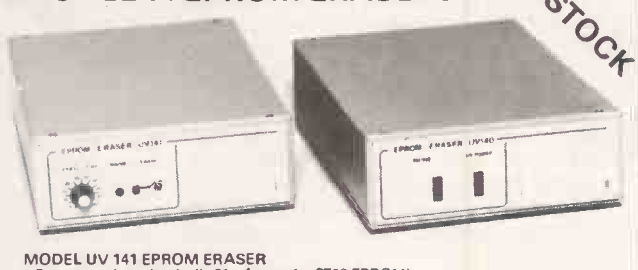

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Another remarkable extension to the OEM range is the availability of the multi terminal operating system But with hardware costs as low as the OEM the market for sharing the system is likely to be small!!!

OEM's are invited to write or call for details

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Mike the boredom killer

THERE IS a great gulf fixed between those who know, love and hate micros, and the rest of the world to whom they are just funny-shaped TVs. We who love them can maunder on for hours about their engaging little ways and our wonderful programs, while the rest of the world taps its fingers on the table, looks at the ceiling, looks at its watch and wonders whether even the Russell Harty Show might not be less boring.

There comes a moment when side A is trying to put its point to side B, when side B says in a rather edgy way, 'Very interesting, fascinating, tell me, what exactly does it *do?*'

And then it's side A's turn to twiddle its fingers because 10 gets you one it doesn't do anything that anyone in the real world would recognise as *doing*.

Of course there are good reasons for this. The old adage, 'It is much better to travel hopefully than to arrive' is nowhere more true than in our obsession. When a program runs — it just runs. But designing it, debugging it — those are the fascinating bits.

Afterwards, it's just a bit of thought locked in amber, autonomous and strangely boring. So the question is, what should we be doing with micros that the rest of the world will appreciate and, one hopes, reward us for in the traditional fashion?

There are basically two possibilities: exciting things and boring things. By exciting I mean games and spectaculars; by boring I mean applications that take over what's boring in our lives. So far, micro programs have tended to be exciting. We have *Startrek* and *Adventure* and . . . and well, *Startrek*. And, of course, all the wonderfully thrilling games that we publish monthly in pages not unadjacent to this one.

But I think the future is with the boring things, because they can save people money. This is hardly news. The mainframe people have been doing it for years. And we have, already, many fruits of this way of thinking in our 'Software Buyers' Guide' pages — accounting packages, data bases, word-processing systems. But I am beginning to feel there is an odd effect here.

We have inherited a tradition of computing which assumes — as used to be historically true — that computers are very expensive and very difficult to use. The only people who could get their hands on them regularly were professional programmers and their minds were so full of the mental gymnastics necessary to make the brutes work at all that they had little mental energy left to ask what people actually wanted the computers to do. And the people of course, having no idea what could be done were no more helpful.

Then computers came to be installed in universities and were made available to people in a wider range of disciplines. The machines seemed to be doing more, but they didn't alleviate much boredom. Why was this?

Two reasons. Firstly there weren't enough machines to do all the boring jobs even if they had been programmed to take the strain — they cost too much. And secondly that's not how they were being programmed.

The people who worked them were academics. At the end of a year's work they wanted to be able to point to another heap of academic papers, more questions raised and slightly fewer questions solved, and the need for another year's research budget.

The effects of economics are often underestimated. If you pay people, as academics are paid, for thinking up questions to answer, you get some interesting questions but few useful answers. But if you pay people for questions successfully answered, you will tend to get action.

Well it isn't surprising that the computer, until recently, has made no impact on the majority of people's lives. There haven't been enough of them to do so. But now that has changed. The magic break-even figure is now with us, where the cost of a machine that can do some useful work is about a year's wages for an office worker.

You can buy a machine, replace a worker, and have four years' work out of the thing for free. That message will get any businessman's attention. And it means that suddenly there is a market for actual solutions to real problems. The person who can scratch away in his back bedroom and come up with a program that actually is of definite use to some non-imaginary people can be sure of making money.

It could well be that he makes a lot of money, for the potential of the software market looks roughly on a par with best-sellerdom or writing scripts for Hollywood.

Why aren't these programs already available? There seems to be a curious hitch or snag in the software creating process. A couple of times a week computing folk hold press conferences to announce some wonderful product.

It is not seldom that they go like this: a particularly glaring example, but there are others very like it (only the names have been changed to protect the stupid).

The managing director got up, got going and in five minutes had wound himself into a knot and crashed the system.

I got talking to the sales director and asked him how he proposed to sell his wonderful thing which cost a minimum of £50,000 a throw when it evidently didn't work, and moreover seemed to be up against a competitor which cost a fraction as much, and did work. "Ah", he said, his eyes glazed, his jaws chomping a morsel of smoked salmon, "that *is* an interesting question."

Afterwards, it seemed to us that they had done, badly, for half a million, what one of *PC*'s contributors has done on his kitchen table — properly — for £300. There seem to be two rules in software production:

- Expense is completely optional — the same thing can cost hundreds, thousands, tens of thousands or hundreds of thousands;
- The more it costs the less well it works.

Why is this?

It is again, I think, a hangover from the old days. Traditionally software is written by getting a very expensive customer — a bank or an army — and shooing programmers through the mill until the customer's simple problems are satisfied. But the programmers are bored by the whole thing.

Comes the personal computer which puts real, if not so glamorous, computer power in the back bedroom. It is programmed by someone who cares very much about what he is doing. He doesn't have to collaborate with anyone else, he has no management to muddle him. He not only cares more, he understands his whole project backwards since he thought of it. He won't make any money until the whole thing runs perfectly and pleases customers. He has every incentive to get on, do it right and do it soon.

The professional programmer, on the other hand, has almost every incentive to do it wrong, and do it late. Ultimately, whether the machine is Cray, a 370 or an Acorn, it will do nothing useful until some human brain drives human fingers to tap the right keys on the keyboard. Once that brain has a roof over its skull, a square meal under its belt, a cup of coffee at its right elbow, and a couple of hours peace and quiet, there is nothing more that money can do for him.

The back bedroom hobbyist is, other things being equal, just as likely to get it right as the £25,000 a year freelance contract programmer; and has more reason to. — **P.L.**

Sinclair pocket micro début

CLIVE SINCLAIR — of tiny calculator and tiny TV-fame — recently demonstrated his new Z80-based personal computer to the Press.

First impressions are of how very small the machine is: without the encumbrance of a TV set, tape recorder and power supply, it world slip with ease into a coat pocket. Inside, it has what is claimed to be a 4K Basic packed into 1K of ROM.

As shown, the machine has 4K of RAM, expandable to 16K with a plug-in package. The touch-sensitive keyboard looks more robust than those on Sinclair calculators, which

are notoriously weak. The machine is neat and at £99.95 (£77.95 in kit form) cheap, but this price excludes mains adaptor (£8.95), TV set (£50 plus) and cassette recorder (£25 plus), giving a total price of more like £180.

The drawbacks are that it will only run Basic, it cannot have more than 16K of memory, one cannot get at the processor to write machine-code, and it does not look as if it will have discs. It cannot even be regarded as an up-market calculator because it doesn't have logs, antilog, sin or cosine functions.

Of course, the user could write his own routines in Basic, but why bother when any calculator for £15 can do the same a hundred times faster? It is hard to endorse Sinclair's claim that it is a 'powerful tool for the experienced user'.

On the other hand, it could serve as an excellent introduction to computing in schools and colleges.

• THE launch of the ZX80 may well lie behind Nascom's decision to cut the price of the Nascom 1, which is now available at £125 in kit form and £145 for the ready-assembled unit.

Human factor in computer crime

A SERIOUS LOOPHOLE in the law on computer applications has been revealed by a recent Appeal Court ruling. The three judges decided that a computer print-out alone is not admissible as evidence in criminal trials.

The Appeal Court hearing involved a prosecution for burglary in which bank notes found in the accused's possession had serial numbers allegedly part of a series that were in the stolen bundle. The numbers came from the bank of England on a list produced by a note-counting machine which subsequently produced a computer printout of the numbers.

The Criminal Evidence Act specifies that the only admissible written records are those made by a human being from his own personal knowledge. The defence argued that the information recorded in the computer printout was not information supplied by any person who had, or could reasonably be supposed to have, personal knowledge of the matter dealt with in the information.

by Duncan Scot

The machine noted the number of the first note in the inserted bundle, automatically rejected any notes which were defective in any way, noting their numbers and the number of the last note in the bundle. The man who inserted the bundle noted only the serial number of the first note. The judges held that the serial numbers of the notes were never anyone's personal knowledge.

The significance of the ruling is that since many computer security systems now work automatically, a criminally-minded programmer or operator could alter records on a computer, such as records of debts, without fearing that any log of access time and records altered could be used in evidence in any criminal prosecution

Lord Justice Bridge, in giving judgement, suggested that a gap in the law had been found. This, together with the inconsistencies in the copyright laws on computer programs (highlighted in Peter Sommer's article in March's *PC*), suggests that the law as it relates to computers is in urgent need of overhaul.

£60,000 backing for robot study

A £60,000 STUDY which will seek to identify the manufacturing opportunities for robot parts by British industry has been commissioned jointly by the Government and private industry.

The study, to be carried out by the Industrial Innovation Centre, will concentrate on the mechanical and sensing technology involved in robot development.

UK firm grabs US Cobol business

COBOL for microcomputers is finally gaining acceptance and one UK version has become the first to win US Government certification. The product, CIS COBOL, from Micro Focus, has received formal approval in the form of certification by the Federal Compiler Testing Centre.

This means that it is the only approved supplier of COBOL for use on US Government microcomputer projects. The company has also signed a marketing deal for the product with the New York-based Q1 Corporation.

CIS COBOL is a portable software system for compiling, debugging and executing COBOL programs. Its availability means that computer users can take immediate advantage of microcomputing technology by transferring COBOL programs from their larger machines without re-training or recruiting staff.

It is difficult to assess accurately the market for microcomputer COBOL, but the industry reckons on approximately £12m over the next three years. This suggests that OEM's will use about £5m-worth of microcomputer COBOL software, while end-users will need about £7m-worth.

The certification and Q1 deal for Micro Focus obviously represents a major set-back for another UK-based software-house, CAP-CPP, which has invested over £2m in developing its own version of microcomputer COBOL, Microcobol. This investment included over £750,000 backing from the National Research and Development Corporation.

• See article on funding by Duncan Scot on page 80.

Keen attack on small-scale user market

KEEN COMPUTERS, the Apple II specialist, is finally launching an attack on the small business market with the Commodore PET.

Previously KCL has marketed the Apple II primarily to the big-business and education market, so the shift in policy would seem to confirm that the small business sector offers the best opportunities for expansion.

Keen's software for the PET will include incomplete record accounting, small business accounts, solicitors accounts and stock control.

KCL has also opened a new office in South London to act as a sales and service centre for London and the Home Counties.

• MICROSENSE, the UK distributor of the Apple II, has dropped the price of the 16-byte, black and white Apple to a suggested retail price of £695. There have been suggestions that a price-war could be in the offing with ITT Consumer Division's 2020.

Around the dealers

THE BUSINESS of the Byte Shop, put into receivership in November, has been sold to COMART for about £400,000. The new company, Byte Shop (1980) Ltd, will be injected with £1/3m of capital. The former staff have been retained, together with the shops in Tottenham Court Road, London, Ilford, Nottingham, Birmingham, Manchester and Glasgow. It will operate as an entirely separate business within the Comart group.

TRS-80 hard disc

AN 11-MEGABYTE Corvus mini-Winchester disc is now available for the TRS-80 from T & V Johnston. Details in Tandy Forum, page 118.

Forth compiler for the PET

ACT PETSOFT has introduced an interactive Forth Compiler/Interpreter to run on the PET. Details in Pet Corner, page 123.

DESIGNED to a new format, a 52-page Hobbyist Catalogue has just been released by Vero Electronics.

Several new products are illustrated, including Verobloc, a new prototyping method of building and testing circuits, S100 bussing systems, a rack-mountable development kit for evaluation of microprocessor-based systems to the S100 format and low-profile DIP sockets.

Contact: Vero Electronics, Industrial Estate, Chandler's Ford, Eastleigh, Hants SO5 3ZR, tel: (04215) 69911.

Apple finance

VISICALC, an easy-to-use financial modelling package for accountants, has been adapted from mainframe use for the Apple II and is now available for under £100. It is being marketed as "instant visual calculation for any numerical problem without the need for programming." Details of the package in Apple Pie, page 121.

New maths chips

INTEL have introduced two new maths processor chips, the 8231 (fixed-point) and 8232 (floating-point), which, they claim, increase the performance of a microcomputer system by a factor of up to 100 when carrying out mathematical operations.

Both chips act as dedicated peripherals interfacing directly to Intel's 8080, 8085 and 8088 microcomputers in addition to all other general-purpose processors with 8-bit data buses.

The 8232 will perform 64-bit double-precision or 32-bit single-precision floating-point addition, subtraction, multiplication and division.

Single-precision (32-bit) operation will be used on those occasions when speed is a more important consideration than accuracy.

Both the 8232 maths processor chips contain a 16-bit arithmetic logic unit, a programmed algorithm controller, an 8 by 16-bit operand stack, a 10-level working register stack, command and control registers and a ROM containing all the control software. All transfers between the host processor take place over an 8-bit bidirectional data bus.

Pascal first

A PASCAL compiler, said to be the first all-British one, has made its appearance. It's from Transam, who make the Triton computer, and is available on discs for CP/M or in 20K of ROM for the Triton.

The disc version will support disc files and both versions have some 'extensions' to standard Pascal to allow PEEK, POKE, direct port and console VDU access.

There are means to work directly in Hex, to manipulate bits and to call machine-code subroutines. Less attractive, perhaps, are the 109 error messages.

Jap challenge to NEB's helping hand

A NEW TYPE of Viewdata system, designed for the international business user, has been developed by Systems Designers (SDL) for Aregon International, the new name for Insac Viewdata, established by the NEB to promote Viewdata overseas. The name 'Aregon' has been chosen from the Greek word meaning 'helper'.

The new system, IVS-3, is a range of international Viewdata systems for business as well as public service systems.

The software includes extensive facilities for easy input of data and can be used to design and develop new frames. The structure of the software allows ready translation of system commands and responses into a number of foreign languages.

☐ THE JAPANESE are catching up in this area of the market as well. Mitsubishi televisions are being used by ISE (Information Services and Equipment) for their Sparrow Intelligent Viewdata Terminal which goes into production this month (March).

The Sparrow can store individual pages of information while the terminal is connected to Viewdata. Up to sixteen pages can be stored and subsequently viewed off-line. It features a full alphanumeric keyboard and incorporates CP/M operating software for standard business or personal computing tasks.

The ISE Sparow Intelligent Viewdata System picks up the gauntlet thrown down by British engineers.

Foxing the PET

IF OUR POSTBAG is to be believed, Peter Jennings's Microchess 2 must be one of the most addictive programs around. Readers vied with each other to prove how easily they could defeat the PET. So far the record holder is D. Lomas of Sheffield, with Mate in 10 moves. Several readers are in with under 20; it would apear that there is room for a more advanced chess program for amateurs. Mr W. Green of Basildon, for example, wonders whether anyone has managed to get hold of Chess Challenger or Boris.

Shortest mate

HERE ARE some game moves to emphasize Maurice Fozzard's observations on Peter Jenning's Microchess 2, in particular

- ☐ the inability of the program to learn from previous mistakes.
- ☐ the advantages of unorthodox play.
- ☐ on a 'points greedy' program, together with the further observation that the castling procedure appears to be considered of high value by the program, especially on the higher levels of play.

	White		PET (Black)
1.	E2-E4	Advance King's Pawn	E7-E5
2.	D2-D3	Advance Queen's Pawn	F8-B4 (Check)
3.	B1-C3	Release Check with Queen's Knight	G8-F6
4.	H2-H4	Advance Kings Rook Pawn	E8-G8 (Castles)
5.	H4-H5	Push Pawn Forward	B8-C6
6.	H5-H6	Sacrifice Pawn	G7-H6
7.	C1-H6	Take Pawn — attack Rook	F8-E8
8.	D1-D2	Push Queen forward	D7-D6
9.	D2-G5	Check!	G8-H8
10.	G5-G7	You win!	

D. Lomas,
Stumperlowe View,
Sheffield S10 3QU.

Must try harder

IN THIS GAME White is simply testing Black's capabilities and is not looking for the best moves. There are plenty of forced wins around the 14 moves range.

	White	PET (Black)
1.	E2-E4	E7-E5
2.	G1-F3	B8-C6
3.	F1-B5	G8-F6
4.	D2-D3	F8-B4 Check
5.	C2-C3	B4-C5
6.	As-A4	D7-D6
7.	B2-B4	C5-B6
8.	A4-A5	B6-F2 Check
9.	E1-F2	F6-G4 Check
10.	F2-E2	D6-F6
11.	C1-G5	F6-G6
12.	H2-H4	C6-E6
13.	H4-H5	G4-F2
14.	D1-A4	G6-E4 Check
15.	D3-E4	F2-H1
16.	B5-C6 Check	B6-C6
17.	A4-C6 Check	E6-D7
18.	C6-A8 Check	D7-C8
19.	A8-C8 Checkmate	

I have great respect for Mr Jennings, but let's keep our feet on the ground. No good player would be called upon to "wrestle" with Microchess. If you cannot play against it, 100 games in each of which you deliberately throw away a piece and then *easily* win, you are not a good player.

Since writing the above, I have beaten it six times in succession. Number of moves = 19, 17, 21, 14, 18, 17. All different openings. Nor did I exert myself. It does *not* play well at all; as the following demonstrates.

10 REM: NO COMMENT ON WHITE'S MOVES!

	White	PET (Black)
1.	E2-E4	E7-E5
2.	G1-F3	B8-C6
3.	F1-B5	G8-F6
4.	B5-C6	D7-C6
5.	F3-E5	F6-E4
6.	D1-E2	D8-D4
7.	E5-F3	D4-D5
8.	B1-C3	D5-D6
9.	C3-E4	D6-E6
10.	F3-G5	E6-E5
11.	D2-D4	E5-D4
12.	E4-F6 Check	E8-D8
13.	E2-E8 Checkmate	

W. Green,
Basildon,
Essex SS14 2QH.

Classic play

HERE IS a much shorter mate (16 moves) against Level 8 of Peter Jenning's Microchess 2.

	White		PET (Black)
1.	E2-E4	Danish Gambit	E7-E5
2.	D2-D4		E5-D4
3.	C3-C3		D4-C3
4.	F1-C4		C3-B2
5.	C1-B2		G8-F6
6.	E4-E5		F8-B4 (Check)
7.	B1-C3		D8-E7
8.	G1-F3		O-O
9.	O-O		F6-G4
10.	D1-D4	Attack Knight	H7-H5
11.	C3-D5	Threaten Queen with Knight	E7-C5
12.	D4-E4	Begin main attack	B4-A5
13.	F3-G5		G7-G6
14.	D5-E7 Check	Sacrifice Knight	C5-E7
15.	E4-G6 Check!		G8-H8
16.	G6-H7 Checkmate		

Here is a checkmate after 14:

	White	PET (Black)
1.	D2-D4	G7-F6
2.	C2-C4	E7-E6
3.	B1-C3	F8-B4
4.	D1-C2	B8-C6
5.	G1-F3	D7-D6
6.	A2-A3	B4-A5
7.	G2-G3	O-O
8.	F1-G2	C8-D7
9.	O-O	D8-E7
10.	F3-G5	C6-D4
11.	C2-D3	D4-B3
12.	C3-E4	B3-A1
13.	E4-F6 Check	G7-F6
14.	D3-H7 Checkmate	

R. J Westmore,
Inchture,
Perthshire PH14 9RZ.

Check again!

LIKE MY FATHER, I am no computer maniac except for being an avid fan of Peter Jennings's Microchess 2. Hence I was most interested to read Maurice Fozzard's letter but would like to point out (as you might well have discovered for yourself if you had checked) that what he says is *rubbish!*

If White moves 'Queen's Pawn Gambit' D2-D4, PET does not, on any level, reply with G8-F6 on its first move as Mr Fozzard predicts.

It answers with a much more intelligent D7-D5 (Black) which renders Mr Fozzard's second suggested move D4-D5 (White) quite impossible. With such mvoes, Mr Fozzard of Southend could not possibly have beaten PET, as White's second move would promptly have been answered with a smart question mark.

Check, Mr Fozzard!

Jennifer Child, Cross-in-Hand,
Heathfield, East Sussex TN21 0TN.

Petting the fox

I WAS INTERESTED by Reginald Mascall's letter (Feedback, *PC*, January 1980) on sentences containing every letter in the alphabet. No doubt 'quick brown fox' will remain the best known, but it is not too difficult to compose alternatives.

Within a few minutes my RS1936 computer provided the following, which may have more appeal to young lady typists of today.

EXAMINE JAZZ AND POP RECORDS BOUGHT VERY QUICKLY, FOR FLAWS.

This was followed by a second variation, somewhat offbeat.

BAD CANDLEWAX JAM AND HAZY FOG QUITE MAKE A PERSON VOMIT.

Maybe I shall arrive at my own French and German compositions but they would be complicated by the use of accents and umlauts.

Roger Standing,
Restex sa,
6 rue Pradier,
1201 Geneva 1.

Learn the hard way

I HAVE BEEN interested in computers and computer programming for just over a year, and have been saving for a 'Superboard'. It arrived about a month ago and, apart from one dry joint on an IC pin, everything was OK. I had learnt the main points of BASIC from reading the software published in your excellent magazine, and so I was able to begin programming.

I have some advice for other users of the Superboard who are finding a difficulty in reading the program listings because of the closeness of the lines. After the computer has been started up the user can:

POKE 15,Ø

This sets the terminal width to zero so that when the first character is entered, the computer scrolls up 1 line and prints that character; it then continues on its new line.

When the user wishes to save his program he must reset the terminal width by:

POKE 15,72.

This method not only spaces listings but the print statements so the programmer need not include a double print statement, as many do.

I would also be interested to hear from other people of my age who are interested in programming.

Peter Davison (14),
21 Richmond Drive,
Copthorne,
Shrewsbury, Salop SY3 8TN

UK variables

J. NEWMAN'S letter on saving variables on a UK 101 program also provoked a varied bag. Here is a selection:

THE FOLLOWING EXTRACTS demonstrate my solution to this problem:

```
100 LOAD: INPUT A$: I = 0
110 I = I + 1: INPUT A$(I),B$(I),A(I),B(I)
120 IF A(I) < > —1 OR B(I) < > —1 THEN
    110
130 POKE 515,0
...   ...
500 INPUT "START TAPE, TYPE'S',
    PRESS 'RETURN'"; J$
510 SAVE: PRINT '*: FOR J = 1 TO I
520 PRINT A$(J) "," B$(J) ","; A(J);
    ","; B(J)
530 PRINT " , ,—1,—1"
540 POKE 517,0
```

Line 130 returns control from the cassette to the computer, and line 540 turns off the SAVE flag, so that after each of these lines the program continues to execute. The second statements in lines 100 and 500 are intended to deal with any rubbish that may be on the tape in front of the recorded data; they can be omitted, but extreme care will then be needed to avoid problems in loading the data.

In my program, I record the data after the recorded program, with an intervening RUN statement recorded; the data will then load automatically after the program has loaded, and the program will then execute from statement 140.

I also note that Mr Newman mentions the lack of an assembler for the UK 101. I have written, in BASIC, a spot assembler for this machine which will run in about 2K of memory. This will translate, and load into memory, the 6502 mnemonics, and will automatically calculate offsets for the branch instructions. It does not allow the use of labels, but does make the entering of machine-code programs a very much simpler process.

It is not a good example of clear programming, being extremely compact, with as many statements as possible crammed into each line, but my aim was to produce the smallest possible program. Presumably the program could be modified to run on any 6502-based system that supports a Microsoft BASIC, but I have not tried it on any other machine.

Ian S. Jack,
West Ashling,
Chichester,
Sussex

Anything goes

IT IS WORTH remembering that when in SAVE with the UK101, anything that goes to the screen also goes to the tape. When in LOAD, the tape machine output replaces the keyboard output. So the following will record and replay N strings, and is easily modified for variables and what-have-you.

```
100  REM LOAD DATA
110  N = 10: DIM A$(N)
120  LOAD : INPUT "RUN TAPE"; A$
130  FOR J = 1 TO N: INPUT A$(J): NEXT
140  POKE 515,0
150  ...........
1000 REM SAVE DATA
1010 ? "RUN TAPE ON RECORD": SAVE
1020 INPUT "WHEN RUNNING ON
     TAPE, TYPE GO AND HIT
     RETURN"; A$
1030 FOR J = 1 TO N: ?A$ (J):NEXT
1040 LOAD:POKE 515,0
1050 ...........
```

First time round, to get the initial data into the system, do not run the tape but answer Line 120 prompt with space and return. Then feed in the data for each array element separated by returns.

POKE 515,0 is a substitute space to cancel the LOAD command. A$ is a dummy, as is GO. There has to be some way of letting the UK101 know that you — and the tape machine — are awake and running. GO also avoids getting duff characters off the tape run-in mixed up with the first data string.

Using the same basic techniques you can also achieve an automatic run. When the SAVE LIST has finished and the prompt OK has appeared, type RUN. And make the first instruction of the program 10 POKE 515,0.

By the way, I don't know about a more gentle approach to 6502 machine code programming but Rockwell's R6500 programming manual is *very* thorough and starts at square 0. Everything but everything is explained in full detail (twice)!

A. H. Whitfield,
Maidenhead,
Berks SL6 6AE.

Far from perfect

THE WAY that Comp suggested is far from perfect.

It is not clear whether the variables will be used in the same program or not. If not, then saving the memory will not work since the variables are stored at the end of the program, except for string variables that are defined in the program.

If the variables are to be used in the same program then the variables will be in the correct place but the end of variable table address (stored at 7f-80) will be incorrect.

It would be much better to save the variables from Basic; they can all be saved on tape and then Inputs used. Alternatively they can be saved by writing a program that prints 'X = ';X etc, then they can be loaded in the immediate mode and the program run using a GOTO in the same mode; RUN would reset them all.

J. D. Westrop,
Romford,
Essex RM7 9NS.

Price of Prestel

THE ARTICLE on Personal Computer Networks (*PC*, February 1980), which was originally published in *CoEvolution Quarterly*, contains an error.

The section reviewing the British Viewdata (PRESTEL) system states "British viewers need an adapted TV ($30-$50 more than a regular TV)". This is incorrect, as there is no Prestel adapted colour set available on the British market for under £600 ($1350) therefore I am sure the article should have said "... adapted TV ($300-$500 more than a regular TV)".

I must also point out that, at the time of writing, the cost of the phone call may work out more expensive than the cost of the "frames", as the databases are not available all over Britain at local call rates. If one has to call the Prestel database from more than 56 kilometres away between 0900 and 1300 hours Monday to Friday, the call would be charged at peak rate (around 21p per minute or 48 cents) plus 15% British value added tax.

At the time of writing, the majority of the British population is not within local distance of the Prestel databases, although the British Post Office is investing a large amount of money to increase the number of bases. It must be said, however, that the Post Office has, to quote Prestel itself, "no plans at present" to provide a base for Sheffield, one of Britain's top five provincial cities. The nearest base will be Leeds in late 1980, which is a smaller city and not within "local" rates of Sheffield.

Lindsay Reid,
Sheffield S11 7JN.

Videotex editor Peter Summer replies:
Keeping up to date with all the nuances of Prestel as it bursts into public availability is almost a full-time job. The *CQ* article which we published substantially unaltered stated accurately the position as it is supposed to unfold, though current estimates talk of 1983-85 as the period in which we can expect to see a Viewdata add-on to a domestic TV receiver for only £50 or so above regular prices.

By the earlier of those dates well over 1 million sets will have been installed and the rate of new installations will be about 2½ million per annum. Lindsay Reid correctly states the current position; though as I said in our October special, the PO's current commitment is to an investment of £23m. The projections as of mid-January 1980 are that by March 1981, Prestel will have facilities for 77,500 business users and 391,500 residential — as a percentage of the total telephone-owning population, that's 60.7% for business and 62.2% for residential.

Lindsay Reid should give the system a chance to grow naturally and not produce a sum based on the most unfavourable terms his ingenuity can identify. He may have a point about Sheffield, though.

Debounce again

HERE IS ANOTHER keyboard debounce program. It was dictated to me over the phone about a year ago and now is very useful.

Although I am only 13 years old, I do enjoy programming and have not yet run into any difficulties. At the moment I am learning BASIC, but soon I want to switch to PILOT because I think that will be the language of the future! The program is eight lines long and uses no memory space when it has been 'run'.

```
10 FOR N = 1648 TO 16492
20 READ K: POKE N,K:NEXT
30 FOR N = 16435TO16437
40 READ K:POKE N,K:NEXT
50 POKE 16405,0
60 DATA 205,227,3,183,200,14,60
70 DATA 16,254,13,32,251,201,195,96,64
80 NEW
```

When this program is CLOADed then run, it performs the keyboard debounce and then blanks out, leaving only the bare essentials of its data sentences in the reserved RAM.

This program might interfere with some machine-language programs eg NEWDOS, TRSDOS, etc.

Jeremy E. San,
Mill Hill,
London N.W.7

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Language debate continued

I WOULD like to comment upon your Editorial of November 1979 and the letter from John McMillan (Feedback, *Practical Computing*, January 1980) concerning programming languages.

My comments are twofold: firstly I question John McMillan's description of the needs of the professional user; and secondly I question both LISP and PASCAL as the main language of the future for microcomputers.

John McMillan prefers COBOL to BASIC for 'business users' requirements' but he seems blithely to equate 'business' use with 'professional' use with 'serious' use. He says, in effect, that BASIC is fine as a hobbyist plaything but reminds us of the 'more serious users of small computers' and asks us to 'remember the professional tools now and again'.

I am a serious user of small computers — I teach computing to social science students, and also write software with particular emphasis on multivariate statistics: I now use BASIC in most of my programming, and started using BASIC in preference to FORTRAN for on-line analysis many years ago.

It is possible to take any program written in ALGOL60 and FORTRAN and convert it into BASIC without too much difficulty. Many online FORTRAN programs (eg GLIM, FAKAD, or SCSS) also take up a large amount of program space with procedures to decode keywords, decoding which is all part of the BASIC specification — but there are few online ALGOL60 programs.

I am part-way through some numerical analysis of procedures coded in BASIC for a mainframe (ICL 1902T) and for a microcomputer (APPLE II), with equivalent procedures being coded in ICL Extended FORTRAN. I have found that BASIC and FORTRAN on the ICL 1902T are equally accurate, with BASIC being easier to program for on-line use. Though BASIC on the APPLE II is less accurate than ICL (SOBS) BASIC, the APPLE's results are more accurate than those for at least one old mainframe, the IBM 7090. (I will supply details to those interested.)

One general problem of microcomputer BASICs is the difficulty of the machine-coding for some of the mathematical functions such as SQR or LOG. This is so of BASICs for mainframe computers, but it is true in general for BASICs on microcomputers — this makes me suspicious of the quality of the implementation of more complex languages such as COBOL, PASCAL, or LISP.

This brings me to my second set of comments. BASIC has come a long way and is probably the most widely used language in existence if one includes all the microcomputer users who use BASIC as their main medium. The reason that it is so successful is that BASIC implementers have not been constrained by national or international standards, unlike FORTRAN. Different BASICs have been created — sharing a common core — to cope with different environments.

BASIC is closer to a true language, such as "English", in which there are many dialects and distinct sub-languages, produced by different histories and different cultures. ISA FORTRAN is closer to "proper French", which no person speaks but which is supported by the French government for political reasons — because they are worried by the growing influence of the more flexible "English".

When I read the listings of BASIC in, say, HP Extended BASIC I cannot understand all but can understand enough to see what is happening: an understanding greatly helped by the judicious use of REMs (John McMillan ignores the use of REMs in BASIC). I realize that the matrix facilities in this particular BASIC are very powerful (close to some of the facilities in ALGOL68) and that they optimize on the HP architecture.

The choice of PASCAL as *the* language (of André Souson, *Practical Computing*, January 1980) does not seem sensible. PASCAL is very ALGOL60-like (in particular ALGOL-W), and BASIC is an improved FORTRAN-like language. PASCAL is closer to ALGOL60 than ALGOL68 is to ALGOL60.

Apart from some mathematical and natural science users, FORTRAN is far more popular than ALGOL60 : what FORTRAN loses in brevity it makes up in simplicity of concept and ease of application. It may not be fair or useful to class the PASCAL versus BASIC choice as a repeat of the ALGOL60 versus FORTRAN choice, because PASCAL has list-processing and data-structuring facilities which do not exist in BASIC.

But if one looks at the numerical abilities of PASCAL, they add nothing to well-programmed BASIC — and the BASIC program is easier to understand. I have not seen complex numerical programs in PASCAL but they must exist.

PASCAL's list-processing facilities are admittedly more extensive than BASIC, but in K. L. Bowles's manual on the UCSD PASCAL system, it is specifically stated that list-processing is beyond its scope — yet it is designed to introduce students to computing with microcomputers.

In Bowles's book, the most complex numerical program is called 'CONVERGE', and part of the output is EXP(1) = 2.718281 which to this accuracy should be 2.718282. This reinforces my doubts concerning the implementation of numerical functions in PASCAL — they use chopped arithmetic — as EXP(-1) is given as 3.678793E-1 compared to the proper 3.678794E-1 (which is both the chopped *and* the rounded value).

LISP — the language supported in your November 1979 Editorial — is, again, unsuitable. In 'A Practical Glossary' (*Practical Computing*, January 1980) concerning Polish systems, your writer tells us to 'forget it' — slightly unfortunate as LISP works in a 'Polish' way. In fact the definition of Polish notation given in that article is wrong.

LISP is a *functional* language, and this has many advantages for complex data-structures, but this also means that LISP is not an algebraic language. There *is* a variant MLISP, which is algebraic.

The article by Mike Gardner (*Practical Computing*, October 1979) shows clearly how inept LISP is for extended arithmetic (Pythagoras equation, p84), and though LISP has been taught as a first language, it demands mathematical maturity of the students.

These considerations, taken together with the incomprehensibility of LISP programs (eg multiple parentheses) militate against its general use. LISP is inherently very local — as are most Polish systems — and should be easily implemented, as the language itself mirrors hardware operations.

If one wanted to encourage a new extra-special language to supplement BASIC, a rarely canvassed alternative is ALGOL68, which is in itself far superior to PASCAL or LISP — it has superb list-processing and data-structuring facilities in addition to unrivalled numerical facilities. Probably it would need to be compiled, rather than interpreted, with a multi-pass compiler — thus needing a large system, as does PASCAL. The investment in man-hours for an ALGOL68 compiler would be great, but would produce a tremendously powerful system.

One alternative worth canvassing is a 'super-BASIC' which will incorporate list-processing and data-structuring features, by defining new types of variable — similar to the way one can define integer variables in some floating-point BASICs. If such a language were designed, it would easily outstrip LISP or PASCAL in terms of popularity (measured by use, as against the views of some academics in computer science).

I remember in the late 1960s and early 1970s how computer academics were particularly keen on ALGOL60, and this was the language that science students were taught as a first language. Many of these students stayed with ALGOL60 but many fortunates — such as myself — discovered FORTRAN.

I learnt ALGOL60 on an Elliot 803, and have never used ALGOL60 since my student days. I wonder what will the use of PASCAL by current cohorts of students a few years after their courses have finished?

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Switched-on prof

NICK LAURIE'S article "Removing the Buttons" (*PC*, February, 1980) was valuable, because it makes the point that the real future of the microprocessor lies in making gadgets outwardly simpler, and not more complicated.

Laurie's article reminded me of an incident when I was working at the Cavendish Laboratory in Cambridge. I was helping to develop a machine called Sweepnik — a strange mixture of laser optics, mechanics, and electronics which followed and measured tracks on Bubble Chamber photographs. Sweepnik was controlled by a minicomputer, which performed as much of the measuring as it could automatically. The process was watched by an operator who would give manual assistance if the program got stuck. We were constantly trying to improve the program to make it more automatic; nonetheless, the operator had a fair old collection of buttons and knobs to make manual measurements and wind the film about.

One day, I was proudly demonstrating a nice new row of buttons (which controlled the film transport) to the original inventor of Sweepnik, the late Prof Otto Frisch. Frisch duly admired the new additions, then turned to me with a mischevious smile and said, "Christ, I would like you to show me the machine when it has just one switch, labelled ON and OFF".

C. R. Brown,
Department of Psychology,
Sheffield University.

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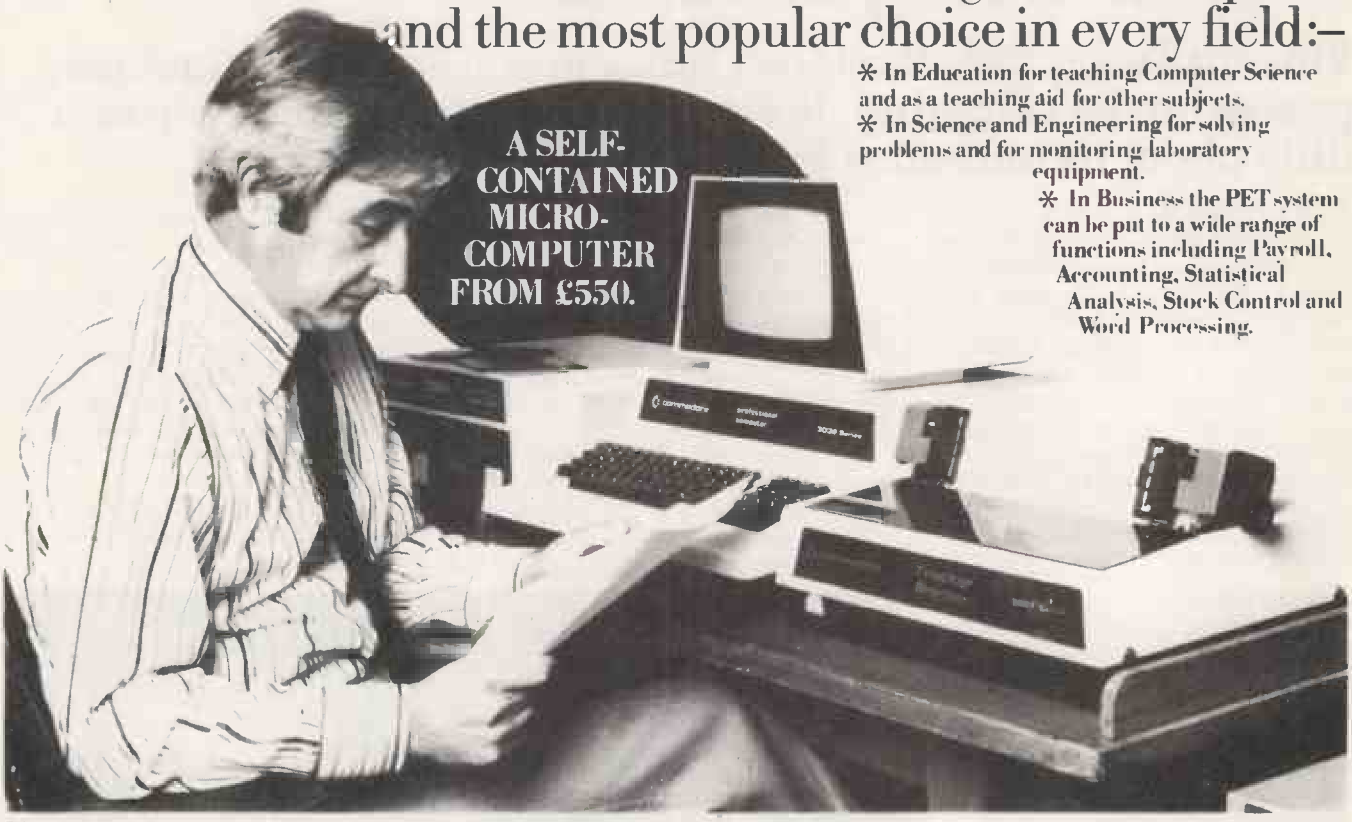

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A challenge to build– and a delight to use

Vincent Tseng tests the latest Nascom single-board machine, passes on the soldering, loves the screen editor but worries a little about its tolerance for cheap cassette recorders.

FOLLOWING the resounding success of the Nascom 1, the long-awaited successor has finally arrived. Not surprisingly, it is called the Nascom 2. In my review of the Nascom 1, I was very impressed by the facilities offered for the time. I think that the Nascom 1 probably set the trend toward the single-board computers providing fuller facilities for the user, such as full alphanumeric keyboards and screen displays using domestic TVs. Such success and reputation must be very difficult to follow. Does the Nascom 2 live up to the expectations and to its "pedigree"?

Facilities

Briefly, the Nascom 2 follows the trend set by its own predecessor the Nascom 1, by having a 57-key solid-state keyboard in the normal typewriter layout, but with some extra keys for cursor control (more about that later). Display output is to a domestic TV — displaying 16 lines of 48 characters.

The CPU is the Z-80A with the clock rate selectable on board of 2 or 4 MHz. The Nascom 2, in common with other single-board computers of more recent design, has a very large amount of memory on board, 10Kbytes of ROM, of which 2K is the NAS-SYS 1 monitor and an 8Kbyte ROM (which is 64K bits) containing a BASIC interpreter.

A total of 10Kbytes of RAM is possible on board, of which 1K is used for the screen memory, and another minimum of 1K RAM is necessary to provide some user workspace, as well as for the system/monitor scratchpad area and the stack (these system areas require 192 bytes).

There is an audio cassette interface which is claimed to be Kansas City standard and can be selected to run at 300 or 1200 baud. This serial interface can be converted to a standard Teletype (TTY) interface. An RS232C serial I/O is also provided. Lastly 16 lines of programmable parallel I/O is available via a Z80 PIO.

Construction

Like the Nascom 1, the 2 is also offered as a kit; fortunately for us, the review sample was ready-built. As mentioned in its review, the Nascom 1 was not an easy kit to build; nor is the 2. The Nascom 2 has some 281 components on the same-sized board as the 1, ie about the size of this page. This amounts to well over a thousand soldering points.

Surprisingly, the 2 looks much neater in layout, although packing of components is still very tight. It is not a kit for the beginner, but as with the Nascom 1, it is certainly possible with careful and patient working. Nascom Microcomputers Ltd now offer the option of a ready-built Nascom 1.

Setting up was relatively easy. The power supply requirement is +5V at 2A, +12V at 250mA, —5V at 250mA and —12V at 25mA, not very convenient, but the Nascom 3A power supply kit was easy to build, good value for money, and would save a good deal of trouble.

Solder links needed to be made for installation of the 4118 1Kbyte RAMs. The links were needed because these RAMs are designed to be interchangeable with the popular 2708 EPROMS. Nascom have designed this capability in, so that the board can have 8K of user-programmed EPROM.

After checking the two banks of selector switches to ensure that the

With over 1000 solder joints, the Nascom 2 is a challenge to constructors.

Nascom 2 was set up in the correct modes, the power supply was switched on and surprise, surprise, everything came to life. There is a power-on reset, and on board it is possible to switch select the reset start address to any 1000 Hex boundary. This is very useful, especially since the 4118 RAMs can be replaced by user-programmed EPROMs.

Also, instead of the computer booting up and jumping into the monitor at 0000 H, it can jump into BASIC at E000 H on power-on. The TV displayed the message "NAS-SYS 1" in the top left-hand corner of the screen, since I had opted for the restart to the monitor.

One of the first things noticed was the nice feel of the keyboard. On closer examination, I realised why: the rows of keys, instead of being at the same level, are stepped as on a conventional typewriter, so that the slight incline usually required is already built-in. This is a minor point, but nevertheless a nice touch.

The display to the TV, although the characters were clear and sharp and the background reasonably free from interference, tended to "swim" a bit, and did not seem as stable as the Nascom-1 (with modulator). This hinted at a slight deviation from the 50Hz frequency, and might be due to the fact that Nascom have had to compromise to make the Nascom-2 adaptable for 60Hz/525 line TVs.

Monitor

The NAS-SYS 1 monitor has all the commands that Nasbug T2 had (the monitor reviewed with the Nascom 1) and a few more. That is, it has the basics of examining and modifying memory (M), executing from a specified address (E), single stepping the program (S) for debugging as well as setting of a breakpoint (B), copying of one area of memory to another (C), tabulating a large block of memory (T), and the commands for reading and writing to the audio cassette (R and W) are also there. There are additional commands to directly input and output via the PIO straight from the monitor, to turn the Nascom 2 into an RS232 terminal — and an intelligent copy command, so that memory is not overwritten before it has been copied.

The keyboard can be set into four different modes (one, for instance, generates the graphics characters) by the "K" command, and there are the expected jump commands for getting into BASIC; both a "cold start" and a "warm start" are provided. A useful command is the user I/O command (U), which allows a user to write an I/O routine which can be called from the monitor (eg to interface to a printer).

However, a couple of criticisms of the Nascom 1 still apply here to the 2: some of the more dangerous commands, such as "E" for execute and "C" for copy are also valid Hex numbers, so it is all too easy to invoke them by accident when you think you are entering a hex value. The other is a command missing for the easy examination and modification of the registers.

Set up, the machine is as tidy as could be expected.

The feature which impressed me most was the screen editor incorporated with the monitor. This allowed access to any part of the visible screen (all except the very top line which does not display anything unless it is deliberately written to, for titles etc) via the cursor control keys — up, down, left and right arrows, etc.

The beauty of this is that any part of the visible screen can be edited just by moving the cursor over the character(s) which need changing so one can overwrite or insert, and once "ENTERed" the new character will become effective. This is a real boon when a mistake is made in the command line and the error noticed only after it had been entered.

On other systems there is no option but to type the whole line again correctly, but on the Nascom 2, so long as the command line is still on the screen, one can move the cursor to the offending part and correct it and then using the "Enter" key from the end of that line, the command is re-executed.

This facility is even more useful when using BASIC, because routines or programs in BASIC can be edited using the screen editor, and any part of the routine program can be displayed on the screen by using the LIST command in BASIC. In my opinion this screen editor facility puts the Nascom 2 monitor into a class where only the AIM-65 comes near it.

BASIC

The BASIC interpreter is held in a single 64Kbit (8Kbytes) Read Only Memory and is a version of the well-known Microsoft **(see p106 of this issue)** It is quite a useful version of BASIC, with good string functions and double-length PEEK and POKE called DEEK

continued over

Stepped keyboard gives a good 'feel'.

and DOKE. The interface to machine code routines is via the USR function, and exit from BASIC is MONITOR instead of the usual BYE.

However, there are no debugging, tracing or single-stepping commands available — one has to rely on the use of the STOP command or the ESCape key for investigating a program. There is no EDIT command and the editing facilities in BASIC are very basic! But the screen editor provided by Nas-sys, which works with BASIC, more than compensates for this lack.

Nascom Microcomputers claim very fast timings for the Nascom 2 for running of the now standard benchmark tests. The timings I obtained were slower, but nevertheless still pretty good, about the same as the Research Machines 380Z, 8K Zapple, and faster than the PET 2001, the Ohio Superboard II and the Apple Extended BASIC. The discrepancy in timings could be because although our test sample's Z-80A was running at full 4 MHz, a wait state was required so that the other slower components on the board could work with it, whereas Nascom's timings may have used full 4 MHz rated components, with no wait states.

Graphics

A character generator ROM is provded to enable the Nascom 2 to have 128 graphics characters. This is in addition to the 128-character full upper- and lower-case alphanumerics character generator ROM. Graphics can be displayed by three different modes — directly from the keyboard (useful for trying out effects without programming), by machine-code using the monitor, or by BASIC using the POKE, DOKE commands.

Cassette

There is an audio cassette interface for the Nascom 2, said to be Kansas City standard and switch-selectable for either 300 or 1200 baud. This proved to be the only real disappointment in the test. With the cheap cassette recorder I had (which I managed to get working well with the AIM-65 at 1200 baud, another known awkward interface), I could only just get it working at the 300 baud rate where the eventual error rate was on average 1 bit per 1K bytes.

To get over this, I still needed to have a 10 ohm resistor from the cassette playback point to ground, and this is despite using the full range of adjustments available on the VR1 potentiometer as given in the manual. The 1200 baud rate could only manage to display just about every line corrupted, no matter what impedance matching resistors I tried.

This is a pity, especially since the Kansas City standard interface on the Ohio Superboard II (reviewed in *PC* June, 1979) showed that a very wide tolerance for even very cheap cassette recorders can be achieved. Although there is no file management under the monitor (there is CSAVE and CLOAD in BASIC by file name) NAS-SYS 1 allows the generation of a self-loading tape, ie one which after loading will automatically self-execute.

Documentation

Much better, is the word. The documentation comes in a ring binder (useful for udpates as well as for users' own notes). The section on the NAS-SYS 1 monitor is concise and informative, very good for quick reference. There is also a large part devoted to examples using the monitor and demonstrating the use of Z-80 machine code. This is excellent — Nascom must take reviews to heart!

The hardware section is also good; like the monitor section, it shows some insight to the thought which has gone into the design of the Nascom 2. The construction notes part is only adequate though, and rather brief. I suggest the authors take a look at the construction notes for the Intel SDK-85 and 86 kits.

Lastly, the section on BASIC looks like the standard documentation for Microsoft BASIC, adequate but not outstanding, but in the appendix there are listings of a few useful routines, which can also serve as examples.

Conclusions

- **I was very impressed by the Nascom 2, especially because of the facilities given by the screen editor. This could well make the 2 into another trend-setter like the Nascom 1.**
- **It is still a challenge to build.**
- **The Kansas City interface for the cassette seems not to have very good tolerance for cheap cassette recorders.**
- **It is priced as a kit at just under £300 without VAT. In terms of hardware alone it is comparable to the Ohio Superboard II (only £190 for 4K version now), the Compukit UK101, and the AIM-65 (£249 for 4K version and BASIC is about another £70).**
- **Stand-out features include the excellent screen editor and the ability to interchange on-board RAM for ROM or EPROM.**
- **Currently there are some dealers still offering a 16Kbyte RAM board in place of supplying the 8 × 4118 RAMs, which could affect your value-for-money rating.**
- **The Nascom 2, like the Nascom 1 offers the right facilities, and it has made genuine progress.**

Summary specifications

CPU:	Z-80A.
CLOCK RATE:	Switch-selectable to 2 or 4 MHz (note: majority of components on board need one wait state to work at 4 MHz).
MEMORY:	10Kbytes of ROM — 2K for NAS-SYS-1 8K BASIC; 10Kbytes of 4118 RAM (1K used for video).
KEYBOARD:	57-key solid state full alphanumeric QWERTY layout with cursor control keys — under NAS-SYS-1 software-selectable roll-over.
DISPLAY:	To domestic TV at 50 Hz 625 lines (adaptable to 60 Hz/525 lines) displaying 16 lines of 48 characters. 256 characters including full upper and lower case alphanumerics and 128 graphics characters.
I/O:	Serial I/O to audio cassette (Kansas City at 300 or 1200 baud) or Teletype. Aslo RS233 parallel I/O by Z80 PIO.

Easy-to-fix Superbrain looks like good value for money

D. B. Watt examines a new integral machine from a newcomer to this country, Intertec Data Systems and finds it a comprehensive and flexible package.

THE SUPERBRAIN is a completely self-contained system based on twin Z80A microprocessors, with either 32 or 64K bytes of dynamic RAM memory. It is made by Intertec Data Systems of Columbia, South Carolina, a relative newcomer to the personal and small business computer market, which also makes a low-cost VDU called the Intertube.

The Superbrain was first announced at the New York Computer Show last year, but the first models did not start arriving in this country until last December. The system is supplied by several dealers, including GW Computers and Encotel of Croydon.

The machine features an integral keyboard, 12in CRT display, and twin double-density single-sided mini diskette drives. Each diskette may hold up to 125K bytes of memory. The system uses the industry standard CP/M operating system developed by Microsoft, and BASIC, FORTRAN, COBOL and PASCAL are

The unit is surprisingly light, considering its size — 22in wide, 23in deep and 15in high — mainly due to the moulded brown plastics case, which nevertheless looks robust. Inside the components are very neatly assembled: the CRT and disk drives are contained in rigig aluminium chassis.

Processors

The two processors operate at 4MHz, and have an 8-bit word length. The host processor performs all the main processing and also looks after the screen handling. The other processor performs all the disk-related functions.

The host processor can communicate directly with the disk controller memory but because all 64K of memory is addressable, the 16K banks 0 and 2 are switched off as required, bank 0 when communicating with disk ROM, and bank 2 when communicating with the RAM data buffer.

A 32K system can be easily upgraded to a 64K system by plugging in 16 2K chips, but since the 32K system (£1900) is only £50 cheaper than the 64K system, it is hardly worth opting for the smaller system anyway.

Keyboard

The keyboard has the standard QWERTY layout, with a 14-key numeric pad on the right. Alongside the numeric pad are four cursor control keys: left, right, up and down. When running under CP/M, the *delete* key deletes the previous character and re-displays it on the screen; *backspace* displays control — on the screen.

In BASIC, *backspace* moves the cursor back, clearing the deleted character from the screen and *delete* displays deleted characters between backslashes. I fail to see why both these keys should not backspace the cursor, clearing deleted characters from the screen. This is a much neater method and easier to read. Nor is there any form character repeat function, which can be accomplished with a repeat key; alternatively, extra characters could be generated by holding down a key. This is useful, particularly in word processing, for underlining or spacing.

Restart

At the bottom and to either side of the main keyboard are two RESTART keys, normally red, although one was white on our evaluation system. When pressed simultaneously, the RESTART keys cause a ROM bootstrap loader to load the sytem off the disk in drive A, the left hand drive. This also happens when the system is switched on.

If there is no disk in drive A, which should be the case when the system is switched on or your diskette may be corrupted, a message is displayed on the screen. This makes the system very simple to start up.

There is another keyboard layout available with a single RESTART key in place of one of the cursor control keys, which is not so sensible since it makes an accidental RESTART possible.

Screen

The 12in CRT is standard and displays 24 lines of 80 characters. Upper- and lower-case letters are displayed and the screen also features programmable cursor control, cursor home, screen clear, clear to end of line and end of screen. Half-intensity display and inverse video are not available.

The lower case descenders of letters like y's and p's are displayed on the same level as other letters. This can make lower case text confusing to read at first, although one soon gets used to it. Some systems with small screen have used shorter lines and fewer lines to the screen, but I personally prefer the fuller display.

I found the display quite readable in spite of a certain cramped appearance to the text. The display would be better with a larger screen, but it is difficult to see how Intertec could fit a larger screen in the available space.

The screen brightness control is rather poorly positioned at the rear, along with the power switch and main and ancillary serial interface ports. In order to adjust the brightness, I had to stand at the side to reach the control and look at he screen at the same time.

The well-known and reliable Shugart SA400 mini-floppy diskette drives are used for ancillary storage. They are fine for many people buying their first system, but I do think that larger disks, or the ability to add more disks, should be made available as soon as possible. Smaller disks not only limit the amount of data the system can access at one time, but also tend to slow data transfer rates, which affects the speed of programs.

Obviously Intertec are aware of these problems, as they are soon to make double-sided disks available. These will provide 255 Kbytes per diskette, compared to the SA400's 125K. Intertec are also developing an S100 expansion bus which will allow an S100 card to be interfased to the Superbrain.

Peripherals

The expansion bus will cost £250 and should be available this month. It will permit any of the S100-compatible standard floppy diskettes, cartridge disks or the new Winchester drives to be used with the system. There are two slots at the rear of the Superbrain through which ribbon cables can be taken to peripherals.

The Superbrain has at present two asynchronous RS23C serial interfaces. The main interfaces may be used to communicate with another computer, according to the user manual. The auxiliary interface may be used to drive at printer. Both interfaces are fully programmable and may run at any one of the baud rates from 50 to 9600. They are originally set up to run at 1200 baud. To change the baud rate, parity or number of stop bits it is only necessary to run the CONFIGUR program.

Intertec are also developing a


The unit is quite large and robust yet still light in weight.

Centronics-compatible parallel interface to connect directly to the Z80 bus and drive Centronics-compatible printers. A synchronous RS232 interface should be available shortly. The parallel interface should also be available in March with the S100 bus adaptor.

Software

The software supplied with the system consists of the CP/M operating system, a context editor, assembler and debugger, and utilities to load and dump files, format disks, generate a system disk and copy and display the contents of files.

All of this is in Microsoft software, as are the BASIC-80, FORTRAN and COBOL languages which are available as options, ranging in price from £150 for BASIC to £320 for COBOL. CP/M has become the industry standard operating system and is very reliable.

BASIC-80 is a powerful version similar in many respects to BASIC-PLUS developed by DEC to run on the PDP-II series. Some of the features included are: up to 40-character variable names, string variables of up to 255 characters, integer and single- and double-precision floating point variables.

Up to 15 sequential and random files may be open at any one time, and there are powerful facilities for editing and renumbering lines. Program lines may contain multiple statements and may be continued over several physical lines by the use of the line-feed key, rather than by carriage return.

BASIC-80 uses a rather complicated method for reading data from, or writing to, disc records. As in TEI BASIC described in the review in the January issue of this magazine, FIELD statements are used to define the contents of the file buffers, LSET and RSET are used to move data to and from the buffers, and CVI, MVI, CVD, MVD etc, are used to convert data from one data type to another.

FORTRAN-80 conforms to ANSII standard X3.9-1966. The compiler generates relocatable code so that only the sub-routines and system routines that are necessary are loaded when running a program. Random and sequential file handling are supported.

Microsoft's COBOL supports relative, indexed and sequential file handling. It is based on the 1974 ANSII standard. The compiler is written in pseudo-code, which is then interpreted. This saves space in memory but results in a slight overhead in execution time. Program object code is also generated in this pseudo-code.

According to the manual, the compiler plus interpreter requires about 25 Kbytes of memory and a typical 500-line program uses 12K. This, together with 7K required for CP/M, requires only 466 Kbytes, hence quite large programs can be written on the Superbrain.

There should be no problems either developing one's own applications or getting packages to run on the system. Some of the programs already available include a sort/merge utility called Supersoft, a mailing list system Mailer and Wordstar, an excellent word-processing system which I had the opportunity to examine.

Wordstar is a menu-driven system which performs text editing and formatting on the screen. Editing facilities include global search and replace, blank move, copy and delete, and text merging from another file.

Unfortunately the cursor control keys do not have the expected effect when using Wordstar because the left, right, up and down codes produced by these keys are the same as the ASCII codes control H, control F, control K, and control J.

Wordstar interprets the control codes differently and in fact uses the diamond format by the E,S,D and X on a standard keyboard, in conjunction with the control key to control cursor movement.

Documentation

The Superbrain documentation is excellent. All the necessary information is included in one rather bulky manual. The first few sections list the system specifications, describe the basic modules of the Superbrain, introduces the system and explains how to start using it, and describes the CP/M features and facilities. The following chapters explain how to operate the CP/M editor, assembler and debugger. Finally the user manuals for BASIC-80, FORTRANS and COBOL are included.

Servicing the Superbrain appears straightforward, as the system is designed in file units which are very easy to dismantle. Section 2 of the User's Manual describes the file modules, which consist of the keyboard and CPU, CRT module, main power supply, disk-drive power supply, and the disk drives themselves.

GW Computers, who supplied our system for evaluation, provided a 90-day warranty to replace any defective model with a new one.

Outside the warranty period, another system will be supplied on loan while the defective system is returned to them. Parts and labour will be charged when the system is repaired. Alternatively, the customer may repair his own system: it really does seem simple to remove and replace any of the modules.

Conclusions

- **The Superbrain is very reasonably priced for a 64K system and is well designed and neatly packaged in a robust and attractive case. This should make it excellent for small business and educational applications.**
- **It uses a very well known operating system with Microsoft BASIC-80, which means that the software is reliable and there are a lot of application packages available.**
- **At present the major drawbacks to the system is the size of the disks. Double-sided disks will be a major improvement at 250 Kbytes per diskette, if and when they become available.**
- **Alternatively, one can extend the Z80 or S100 bus out to external disk drives. It is only possible to add one S100 card within the system, although it may be possible to take a ribbon cable out through the case to an S100 motherboard carrying extra cards.**
- **It will not be possible to perform DMA accessing of external peripherals, as the amount of main memory supplied is the maximum that can be addressed by the processor.**
- **It should also be possible to add two more SA400 or SA800 drives just be extending the cables to the present drives, outside the case. CP/M certainly has the capabilities for handling two extra drives.**
- **The small size of the CRT does make the text appear cramped. This was particularly noticeable when using the word processing system.**

Commodore database is tailored for business

Mike McDonald assesses Commodore's first thrust into the business sofware market

CBIS is a file/record handling system with a wide range of applications.

AS WE'VE pointed out before, the emphasis in home and small business computing is moving towards software and away from hardware. But performance lags behind intention. The opinions amply confirmed by my attempt to review some recent software packages: of four software programs running on three different machines, two crashed within minutes of being run up and had to be abandoned.

The package under scrutiny here is the Commodore Business Information System (CBIS), a file handling/record handling system that can have a very wide application for information retrieval.

This sort of package is identified in the Buyer's Guide as a DBMS (Data Base Management System) although in this case it is not strictly true. CBIS is intended for record selection and retrieval and is designed to provide management with general information according to a specified number of selection parameters.

CBIS was, until recently, one of three offerings from Commodore heralding their entry into the commercial software world. They have recently launched more products to increase their repetoire. Commodore have decided on a marketing strategy for their commercial offerings which requires dealers to have a proven capability in both software and hardware support.

These "Business Software Dealers" are chosen by Commodore from their existing list of dealers and once they meet the necessary qualifications, they may offer a complete "packaging" service to the business user, comprising software/hardware installation, support and maintenance and, if required, tailoring of the packages to meet the user's requirements.

No dirty hands

None of this is included in the price of the software, so the customer will be charged according to the dealer's rate. However, Commodore recommend that first-time users use this service to ensure a trouble-free system, which makes sense for those who are not keen on getting their hands dirty.

The number of Business Software Dealers is now nearly 100, so potential users should not have any difficulty in finding a reasonably local supplier.

Commodore's range of software includes stock control, word processing, payroll and CBIS, and financial packages follow soon. These packages are sourced both internally and commissioned from outside software houses under Commodore's guidance. Support is on a strictly local basis through local dealers, but records are also held at Commodore's base in Slough of all users eligible for updates etc.

All packages have been run commercially before release and are therefore free from logical errors, claim Commodore. Experience with grandiose software on larger machines leads one to the conclusion that most bugs may not have reared their ugly heads until several years of intensive use have passed. But the machines under discussion are smaller and Commodore seem to have the right sort of set-up if the user should get into trouble.

CBIS is supplied in the form of a neatly packaged looseleaf binder containing an operator's manual and celluloid page holding the software diskette and security ROM. The manual contains a few pages of preamble on disk handling and care, copyright and so forth including a page on how to insert the security ROM in the correct slot on the main circuit board.

The instructions are clear but there is no mention of the orientation slot on the Integrated Circuit and its relation to the socket. The neighbouring 'chips' were illustrated with their slots, but this might not spring to the eye of a beginner. One would expect the dealer to put the ROM chip in, but even so, the manual ought to be foolproof. Suggested applications for CBIS include: personnel information, magazine subscription reminders, salesman prospect reminders, name and address files, telephone directories and investment portfolio diaries, although it certainly has many more uses where quick access to a large number of records with selection options is needed.

The minimum configuration for running this package is: Commodore 3001/3032 computer; 2040/3040 floppy disk system; 2022/2023/3022 printer (other types are permissible); IEEE connectors and supplies such as stationery.

This records management system essentially allows the user to predefine up to 10 fields for storing up to 24 characters of information in each field. The ten fields make up a single record, of which 650 may be stored on a single floppy disk. Up to 10 disks may be used to hold the records as either a single file or 10 individual files. Each field is named when setting up a file, ie name, address, phone etc and will be referred to and displayed as such whenever the file is accessed. The fields are actually defined in the program as sub-records or SR's.

For testing purposes, we mounted in-

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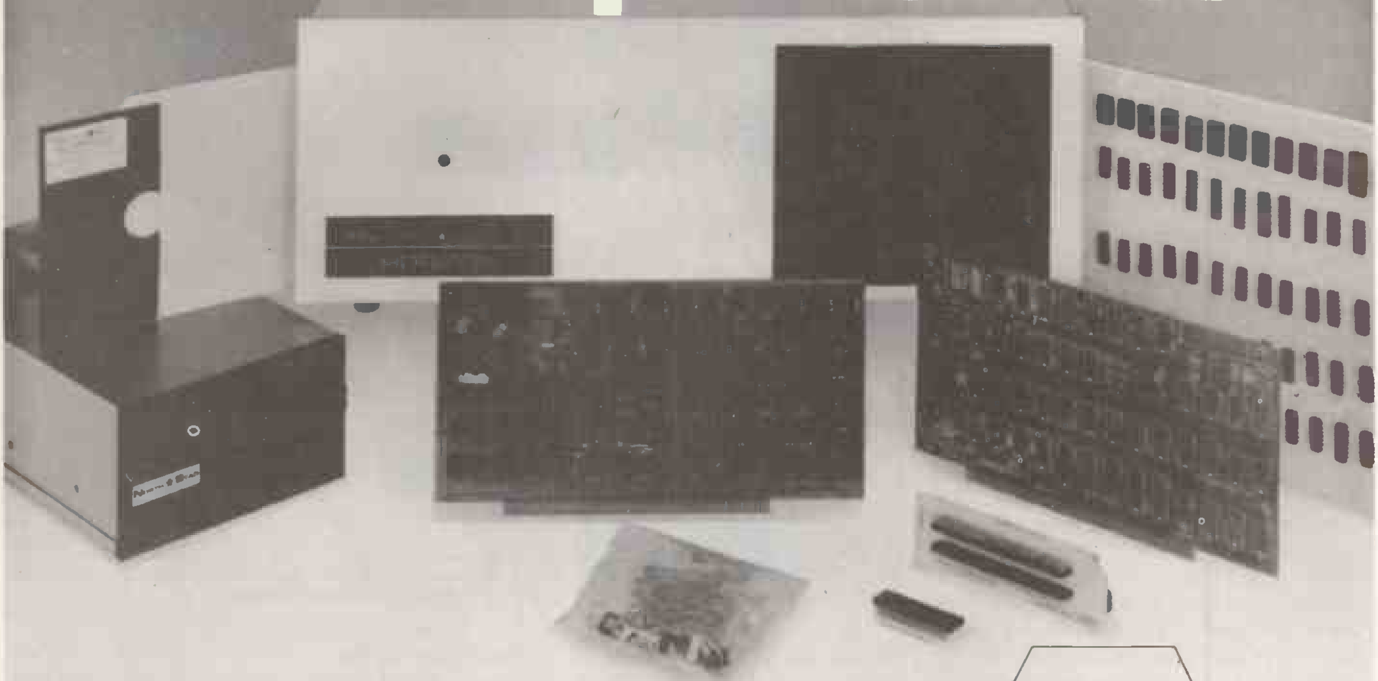

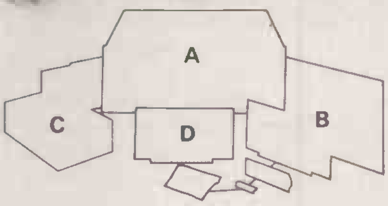

The North Star dual drive double-density Horizon computer **A** together with a typical kit product **B**, the Microdisk system drive **C** and hardware floating point board **D**.

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from previous page
formation on the Software Buyer's guide. To begin with, new diskettes had to be initialised or 'newed' prior to use. This was facilitated by a utility program called CMAINT supplied with the software.

CMAINT enables users to access the basic disk operating system functions (DOS) necessary for running the package and includes New, Initialise, Verify, Duplicate, Copy, Rename, and Scratch. There are also other functions specific to Commodore software for creating special master disks and Memory Set routine required before any program can run directly after a power up.

When new disks have been created, the CBIS program can be run. The manual was not particularly clear regarding the disk mounts required. CBIS holds the records on the data disk, which is always mounted in drive 1 and maintains an index to the data disks on a master disk on drive 0. The master disk holds an index for all 10 disks if this many are used.

There is no reference to creating a master disk in the file set-up section and if the program disk is left mounted in drive 0, it causes an error due to write-protection. If the wrong disks are mounted incorrectly, the program does stop as it requests the user to enter the data disk ID and then checks for its existence in drive 1. Once the program had satisfied itself on this point it did not seem to mind any old disk being mounted in drive 0. Disk ID's are in the range of 10 up to 19; typographical errors sometimes referred to these as 10 or 12.

Menu of facilities

When the program is successfully entered with the correct disks, the field naming routine is initiated — assuming a new disk — if old, the program goes straight to a menu. The ten fields are named, each field descriptor having a maximum length of 12 characters, and the program proceeds to display a menu of facilities which are:

*N*aming of fields
*G*enerate random index
*I*nput records
*S*can key records
*M*odify records
*Q*uery
*D*isplay records
*E*xtract & print selected records
*R*ecover or delete records
*F*ree records
*U*pdate master and exit

Each routine is accessed by pressing the appropriate first letter (in italics).

Data input was the first task. The system responds with a request for a record number. This number must be any figure between 1 and 650 and must not already have any information allocated to it, otherwise it is rejected. Unfortunately there was no facility for going directly to the first available free record, so this could become a tiresome guessing game. There is a free records routine which prints all of the free record numbers on file but this gets tedious when, as in our case, we had only entered some 75 records.

However, on entering a valid free record number, the display sets itself up for data entry, giving a card column indicator across the top of the screen to show the 24-character limit and prompts the user for each field or sub-record with the field name. When the last field is entered, the system writes the data to the data disk and offers the options of moving on to the next record number, entering your own number or returning to the menu. It would be useful to be able to commit the record to disk or amend it first, but this feature is lacking.

Modify routine

Mistakes are catered for by the *M*odify routine but the user must recall the record number and sub-record number in which the error was made to take corrective action. The modify routine could be improved if, after the desired record number is entered, it displays the record with the appropriate SR numbers beside each field and then prompts for the SR no. Without this it is rather like shooting in the dark given a poor memory. If the wrong SR is selected, there is no way to a abort the modification and therefore the data had to be re-keyed.

The display record function is a straight display of a full record with field names in response to a record number being entered. Having displayed a record, the user has the option of continuing on the the next record or of defaulting to the next non-blank record or, of course, the menu.

The one noticeable thing about this system is that the master index is held in core and knows exactly which records are or are not occupied and therefore response is instantaneous if a record does not exist, and certainly very fast on accessing any of those that do (about 1½ seconds). It is this speed that makes the system ideal for interactive lookup of records if using the record numbers (see example of display output).

An index is always held on a specific field in the set of records. The default, in display mode, is the record number. For the purposes of scanning the file for other fields, say names or ages or prices, the Generate Random Index facility builds the index on whichever sub-record the user wishes (about 90 secs).

Having created the index, the Scan Key Records may be used to display any records on which a match occurs against an entered string. The string (or text) is keyed at the start of the routine and a search initiated for occurrences on the index. A match occurs and the record is displayed. The user may then carry on searching until the next record is found and displayed or he can return to the menu. Like the entry of record numbers, the response time was very quick.

The only drawbacks found were that

- ☐ the display failed to insert the hyphen between the field name and the data line, causing a concatenation where the field name occupied 12 characters and made it hard to read (see display example)
- ☐ when in the display record mode, once a record is shown, depressing the 'N' will display the next record; anything else restarts the cycle. In the scan mode, 'N' terminates the search whereas anything else continues it.

The string entered must be padded with blanks if less than five characters in length and can be no longer than 10, although it seemed satisfied if it could match the first five characters and ignored the balance of the entry. Despite this, it proved a handy routine for high-speed look-up.

The free records function provides the facility to print all free record numbers on the printer, or will provide a total number of free records figure on the screen. In our case this routine was not particularly useful as the number of free records outstripped those utilised, and, since our records were entered sequentially, there were not gaps in the numbering. This feature would be useful if the file were fuller and deletions had been made.

We would have liked to have been able to display the free record numbers on the screen. One of the miseries of sequential file access is the loss of space when a record is deleted, unless a house-keeping routine is used regularly. The fact that this system uses a fixed record length (considered by some to be a nuisance), combined with an indexing system, means that deleted records can easily be utilised again or even restored, provided they have not been overwritten.

This is a facility provided by the Recover and Delete Records function and should come in quita handy for those applications where the life of the data held is short, ie personnel records for casual labour. The routine simply asks for a record number and whether this is to be deleted or recovered. A minor improvement might be made by displaying the record about to be scratched and asking for confirmation, plus similar action on recovery.

Management power

The most powerful function of the system is the Extract and Print Record routine, allowing multiple-parameter record searching and selection. This is the answer to the 'who, how many, if and with what' questions that give power to the line manager's elbow and terror to his underlings.

As with the scan facility, Extract will print a record subject to a match of any string, in any position, in any or all of the sub-record fields. The printed information output may be trimmed by the user to any number of contiguous lines

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from previous page

given a start and finish position (1-10, 4-7 etc) or it may be optionally routed to one of three print sub-routines.

Only one of the subroutines prints labels. It dumps the first four sub-record lines, assuming these have been defined as a name and three address lines. Program start line numbers are given for the other two sub-routines as well as the field variable array name.

On entering the routine, the user is given the option of selecting the print routine — default is the standard line dump (options 0-3). Having gone for the standard, an option is given to specify the start and finish line numbers to be printed, and the number of carriage returns between lines to define the spacing.

The user is taken through four questions until all of the selection criteria are set. These are

- ☐ Sub record number? This specifies on which field the following search criteria are to be applied. The system responds by displaying the field name and asking
- ☐ Displacement, Length? This defines the character position at which the search must be started and the number of characters to be tested.
- ☐ < = >? This determines the logical match that must be met, ie less than, equal to, greater than. The first and last operators are for numeric fields rather than alpha, or text.
- ☐ Data? This is the actual value or string against which the match must be made.

The machine then requests the next record number and providing a zero is not entered, will re-iterate the above questions. This carries on allowing the user to search on all ten fields if required. All search criteria must be met on all sub records for the record to be printed. If a zero is entered at the first SR request, all records are printed.

This proved to be a very useful routine, given that you cannot range check — implement a < and > search on the same field. A possible way around this would be to provide an output file onto another disk and execute a second pass, but this was not currently available.

Another deficiency that would be easy to mend would be the printing of the search parameters on the output report, or at least the display of them on the screen. Presumably, this could be tailored-in by the local dealer. If insufficient characters are entered as the search data value, then the balance is space filled. Excessive data entered results in a null result.

One point we noticed concerned search methods on numeric fields. Where we had originally entered numeric values such as prices or capacities, we omitted to enter a decimal point in the values. When searching fields for a match comprising < 1000, the input field was four characters in length. The system would examine the first four bytes of the SR and convert any trailing blanks to zero's. Hence 200 would become 2000 and no match made.

Equally, the default for a null string entry when inputting records is a full stop (to prevent falling out of the program when inputing a null string against an input statement). The full stop is numerically interpreted as a 0.0 and therefore matches a "<" test on a whole number.

This is not a criticism but it does lead us to recommend potential users to 'play' with the package before designing a system to be mounted. This applies equally to alpha or alpha-numeric fields. By voluntarily pre-formatting such fields, a much larger amount of useful information can be mounted and successfully searched, thereby overcoming the limitation of a 24-byte fixed-length field, and craftily meeting a requirement that otherwise might not be feasible with such a package.

Master index file

"Query" is a duplication of the Extract & Print routine, except that records meeting the multiple selection criteria are displayed on the screen instead of being printed. Once a record is displayed, the user may optionally return to the menu by entering an 'E', or space to continue to search.

Finally, there is the Update Master and Exit which updates the master index file on drive 0, adds any new information on to the data file and closes all the files normally. The manual does stress that an exit from the program via any other route could cause the loss of data.

Indeed this was most certainly the case when we updated our file with 25 new entries. We decided to start bending the system before we had written our newly-entered data into the index using the Update facility and thereby placing an 'end of file' marker on it. A loop hole appeared: so we lost our lovingly-entered data by crashing out of the program with a 'CAN'T CONTINUE ERROR'.

We achieved this in the Generate Random Index facility by entering 11 against the sub-record number request used to form the index. This was the only glaring fault in the system and should be modified to range check the value before continuing. If the same reply is given in the Extract routine, to an SR request, it merely takes the units digit and applies it.

We were not very keen on the STOP key being left active, as this would invariably affect a less experienced user unaware of the Continue command.

There were other minor but irritating inconsistencies. We felt that display of user options, when in each routine, should be consistently applied throughout the package instead of in the one or two routines as at present, ie Press E — to exit/Space — to continue/N — next record etc and that a convention should be adhered to for all facilities. A question mark might usefully replace the full stop as a null entry in the Input mode.

In some cases, the system allowed us to enter more than 24 characters and would truncate down to four or five characters as a result. The scan mode would be better if it displayed the sub-record number on which the random index was currently organised, with possibly a warning that records entered since the last index build are not included.

The manual also has room for improvement. Apart from typing errors, we felt the layout could be better organised and more details given on disk initialisation, loading and labelling, with some — necessary — advice about security copies.

In the Scan section there is no mention of the fact that depression of E will return the user to the menu and terminate the function. It would also be helpful in the print routine section if the field name array variable is given to help in customising reports.

We did like the fact that on searching, the system did display the word P, PAUSE, leaving the user no doubt that it was usefully employing itself in the latest request instead of calculating the square root of —1.

We were also impressed with the overall speed of the record retrieval. On the Extract and Query facilities, wait times were understandably longer — approaching minutes with our 75 records, but this is quite understandable and constitutes a batch job that can easily be scheduled into a convenient slot in the working day.

Conclusions

- **Functionally the program performs efficiently and quickly for record selection and retrieval, and has innumerable applications in any business, large or small.**
- **It provides a good solution for those wary of a packaged or tailored system of a similar nature, provided they feel capable of pre-determining the necessary design criteria for their data.**
- **The CBIS program can well be improved by adding a few finishing touches, not only to the program, but also to the documentation to produce a highly recommendable product.**
- **Access to the print routines allows for tailoring by *qualified* personnel to the user requirement at fairly low cost.**
- **For the money (£150 plus VAT), CBIS offers an excellent demountable application for the user of Commodore business computers or a dedicated application with a wide sphere of use.**
- **The fixed-length records and sub-records do require a certain amount of tailoring of the user's data, which must be allowed for.**

Memories are made of this:
a technology and systems review of the state of the art

M. G. Ayres examines the latest techniques in data storage and makes some informed guesses about the future

IT TAKES a great deal of time, effort, money and at least a little luck to introduce a new technology to the market. Very few people wish to be pioneers when it comes to backing a new product employing state-of-the-art technology. It comes as no surprise, therefore, that most products introduced in this way are destined to failure, or at best require a long gestation period to achieve market recognition and acceptance.

But if we are not to stand still, somebody has to take the plunge and thankfully a few souls enjoy the hassle — or are forced by circumstances — to take the risk and occasionally make the right decision. It is always a sensitive decision to make, and none more so than where a technological unknown exists.

Safety first

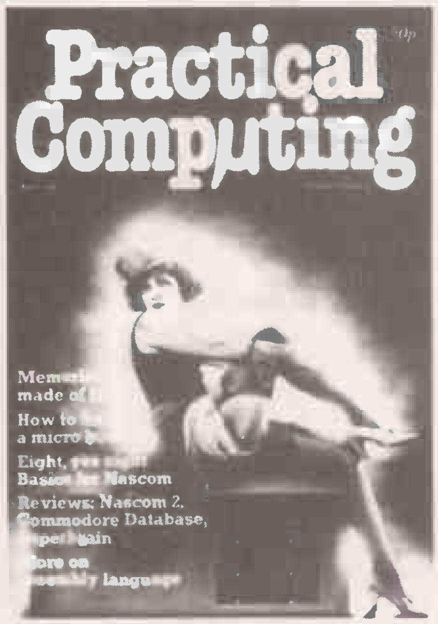
The difficulty lies on the one hand of becoming a permanent watcher of technology (always waiting for the next generation) and on the other of risking company money (and perhaps career) by acting too hastily.

There is no answer to this problem, which explains why most people err on the side of safety; this seems particularly true in this country, where we are less prepared to accept risk as part of our working lives.

On the following pages I will be looking at the important area of solid state memories at both the technological and systems level and attempt to throw some light on what's being done.

Memory can be broken down into two groups: main and peripheral. Main memory in general uses solid-state devices, which today are best represented by the Mostek 4027, which has become an industry standard for 4K dynamic random-access memories. Its successor is the 16K Mostek 4116, which is pin-compatible. Other manufacturers have their equivalents or alternatives but in general the technology is similar and uses NMOS.

There are basically two versions of the NMOS RAM. They are known as static and dynamic devices and work much as the names imply: the static device stores the data all the time power is applied to it, whereas the dynamic device requires a



"Somebody has to take the plunge and thankfully a few souls enjoy the hassle..."

refresh cycle to replenish the charge. Considerable arguments flow between the supporters of the various methods and both have survived because there are powerful reasons for the use of both — it just depends on the application being served.

Horses for courses

Sometimes price is the most important feature: other times it is performance and still others it is reliability. So it will be very much a "horses for courses" issue, with the weighting of the device or memory system design factors determining the selection. Throughout the 1980s the NMOS technology will continue to dominate main memory but within the NMOS technology there will be a lot of activity by the participants, with the Japanese featuring much more.

Peripheral memories are represented by the magnetic storage area of disc and tape in all their variations. Tape is nowadays used for security purposes on mainframes or as a low-cost storage medium, with cassette and cartridge drives on the very small systems. The main peripheral storage systems used in today's systems are discs and these range from the mini-floppies right up to the 1000-megabyte products.

In the same way as NMOS RAM technology dominates computer main memory, so the magnetic disc dominates the peripheral memory of computer systems. I see no technology posing a threat to the dominance of either and the magnetic disc will continue to enjoy a lion's share of the peripheral storage market. The main threat to the disc will be seen on its flanks, at the very low-capacity and the very high-capacity extremes.

Memory systems

An area that appears to have a very low editorial profile is the memory systems field. A great deal of time and effort is expended in explaining and predicting the various technologies currently prevailing, but very little is said about the enormous memory capacity that is sold as part of a discrete memory system.

These memory systems range from the modest capacities of say 8K bytes at the semi-professional S100 bus products, to the megabytes sold for use with large IBM mainframes. The markets and hence the products are very different and it would be sensible to treat them separately.

Mainframes

Practically all the products in this area are being offered for use with IBM computers. There are a number of reasons for this and not least is the market size. IBM dominates the world with mainframe computers and therefore represents an attractive ready-made market for the independents. It also helps that because of the US anti-trust laws, IBM has to be extremely careful in its competitive tactics — it must not abuse its dominant position. It therefore concentrates its efforts on making it difficult for the independents to 'keep up' with a range of technological and commercial changes, designed to be difficult and often expensive to implement.

The IBM market was first attacked by the ferrite core manufacturers, who could offer cost savings of between 30-50% of the equivalent IBM offering and could normally improve performance too.

Currently this market is dominated by the semiconductor manufacturers, with Intel and National Semiconductor amongst the leaders.

Present memories

Charge-coupled devices, although still widely used for imaging and analogue signal processing, seem to have fallen out of favour in the mainstream digital applications. Although a volatile (non-retentive) memory, the device was seen as a fast serial memory, faster than bubbles but slower than random-access memories. Charge-coupled devices use the standard silicon large-scale-integration technology. This led people to believe that the greater packing density, low power consumption and projected low cost would give them a significant place in the memory hierarchy.

CMOS technology is almost the semiconductor equivalent of the ferrite core and features the most desirable characteristic of requiring only very low power to maintain data indefinitely.

Generally speaking, devices using CMOS are available in 4K capacities and become expensive for large memories, so it is normally used for up to 8K bytes of storage.

NMOS is the main technology used for central computer memory. It comes in all shapes and sizes and has become the dominant technology after PMOS was used in the early 1103s from Intel. Since 1975 it has featured in most of the advances of the static and dynamic random access memory. It now seems that a new process is required to enable further advance to 64K and above.

Bi-polar memories have been left behind by the phenomenal growth of NMOS. Its main characteristic has been higher performance, but normally it imposed a high current drain and was thus expensive to run. I²L technology is also included in this category.

Magnetic bubble devices are packaged in many ways at the moment and no standard appears to be emerging, but a typical device could be a 12-pin dual-in-line unit incorporating the bubble chip, support frame, rotating field drive coils and a bias field magnetic circuit, all encapsulated in an area about half that of a matchbox. The bubble is a fascinating thing to behold and, as one would expect from the name, the data is represented by the presence or absence of a cylindrical shape which resembles a bubble when viewed end-on. These bubbles are stored in loops called major and minor, from which they are read out by replication methods.

Minicomputers

In a similar way to IBM's domination in mainframes, the Digital Equipment Company, affectionately known as DEC, dominates the mini field.

DEC has been in the extremely fortunate position of permanent growth, so that a significant part of the company's history has been working in a supply-limited market. This has enabled DEC to take a benign approach to the so-called plug-compatible manufacturers, and devote its time and energy towards its own position vis-à-vis the market.

DEC was the first computer company to introduce a standard interface with its unibus for use with the PDP range of computers. This encouraged a great number of independent memory and peripheral suppliers to design plug-compatible products for use with DEC computers.

Because memory systems are inherently software transparent products this was

one of the first areas to capitalize on the attractive DEC installed base with a range of products. Some of these were just straightforward 'look-alike' products which were offered as simple cost-effective alternatives to the DEC offerings and others would claim improvements in the system performance, either by pure speed or by the use of modified architecture, by organization such as cache or fast buffering.

All of this activity obviously gave the user a greater choice and encouraged DEC to maintain its technological leadership in the minicomputer field. In many ways this attention by the independents is a compliment, as the main criterion for this activity by the independent plug-compatible suppliers is an established installed base. This explains why the only companies receiving this attention are the major suppliers.

Microcomputers

Following on from the minis, the micros have really benefitted from 'foreign' attachments. Some of the *de facto* standards like S100 (8080/Z80) provide a very full range of modules which are designed to operate on this bus, although care is required in selection, especially with dynamic NMOS.

In the USA, where the majority of the products originate, most of the popular bus systems now boast a range of memory systems suitable for attachment. These are available from very small companies to the major semiconductor houses and range in complexity from simple equivalents to alternative technologies like CCD or bubbles.

In each case, the user is given more choice and can opt for a mix 'n' match approach or with the newer technologies like bubble memory, may be forced to employ them because of application constraints.

An interesting recent product announcement in this area is a number of bubble memory systems for use with a range of micros:

- ☐ Plessey — SBC 80 compatible product
- ☐ Rockwell — Motorola Exorcisor compatible product
- ☐ Bubble-Tec — SBC 80 and LS1-11 compatibles
- ☐ Fujitsu — cassette replacement

These should be followed by several new products over the next two years, as they represent an ideal platform for the new bubble memory technology to achieve acceptance.

Another interesting development of data storage which has been brought about because of the hobbyists' need for low-cost memory is the audio tape cassette. With the proliferation of the microprocessor into the cheap microcomputers such as the Commodore Pet, TRS-80 and Rockwell AIM 65, there is a need for a cheap method of storing programs and data.

Although a relatively crude and slow method of storing data, it certainly meets the cost objectives.

However, there are major disadvantages in using the Philips-type cassette but until something better comes along such as bubbles, if it ever competes — then the tape cassette will continue to enjoy a place with the hobbyists. Most of the serious uses of microcomputers will require other technologies — floppies or hard disks in the business environment and bubbles in industrial applications.

The future

One thing we can say with confidence is that all the present products and processes will be improved and refined, making it extremely tough for anything new (but that has always been the case with innovation). Most of the semiconductor companies are already sampling their 64K memory devices and within a year these will be designed into new system products. The new 16-bit microprocessor will force this to happen as it will require more software and hence more memory than its eight-bit predecessor.

The device manufacturing process

continued on next page

From previous page

appears to be the major constraint at present and a lot of industry and government muscle is going into the solution. The Japanese with their very large-scale integration programme are likely to provide most of the answers for progress towards the 256K RAM and the one megabit RAM, thus providing some real competition to the dominant US companies in this field.

On the peripheral storage front, I expect to see improvement and refinement of all the existing technologies, with the floppy disc featuring in much of this. It is conceivable that we will see the use of mixed technologies like bubbles and floppy discs to give us, say, a "flubble". What a beautiful word. It must be almost worth designing a product just to be able to use the name.

Of the new technologies, I would pick out the magnetic bubble device as the one with the greatest potential, as it combines the true non-volatility of the ferrite core with the high-density packaging of the NMOS technology. Having said that, I still have reservations because the bubble has been on the sidelines for two or three years now and has yet to burst on the scene (pardon the pun).

The biggest problem experienced to date concerns the process of manufacture: nobody has yet turned out high enough volumes in this market to meet the cost and hence price objectives. If money and effort are the only requisites for the bubble to come of age, it stands a good chance for the existing participants already read like a *Who's Who* of our industry.

However, I still have reservations because we can all remember dead certs which are now certified dead. It seems that the laboratory stage is straightforward enough but even the old hands like Bell Laboratories, Texas Instruments, Rockwell and Plessey have yet to ship sufficient volumes to make it all viable. It is worth remembering that competing technologies like floppy discs and the RAM are not waiting around for bubbles to happen: the break-even point for the bubble innovators must be moving out all the time as the price and performance parameters change.

Eventually IBM's decision on the bubble is likely to be crucial, as it proved with the floppy — the giant sets most of the systems standards for our industry and is still keeping its plans very close to its chest, as usual.

Currently there are two basic types of organisation used in a bubble device. It can be a purely serial device, where the information is stored as serial bits or bytes, as it is on a magnetic tape, or in serial and parallel form, which improved the access time for the data and makes the device look more like a disc, being organised in a number of major and minor loops. It will be seen from this that the bubble device is not a random-access device and as the technology stands today, fits between main memory and peripheral memory as far as its projected price and performance parameters are concerned.

Rockwell has been seeking partners in Europe for some time now to second-source its 256K bubble device and has recently announced that Siemens will be manufacturing it in Europe at its Munich facility. This is interesting because Siemens at one time ran down its bubble technology plans and has obviously decided to reverse that decision. Plessey has a similar interest in the Rockwell chip but prefers its own packaging techniques.

One of the interesting things that will

take place is the convergence of the computer industry with other totally separate industries. We have already experienced some activity in the telecommunications area and if our Post Office will allow, substantial benefits can be made available.

Another industry that is converging (at least technically) with the other two is the entertainment industry — particularly television. In the not-too-distant future, we should see in people's homes a combination unit which will serve the entertainment communications and control the domestic services such as heating, air-conditioning, fire and burglar alarms.

This is not wishful thinking because the technology is already available and most of the building blocks are undergoing evaluation by the separate service industries — if ever they decide to talk to one another we will have the product.

New memory types

Since the first time I saw the Ampex Terabit and Videofile systems in Sunnyvale, California in 1970, I have had an interest in the very large mass memories. It is still a new and developing market but IBM with its 3850 and the independent equivalents have given it a certain respectability which will encourage others, including Harris, Hitachi and Philips, to pursue their own products in this area.

Perhaps a more interesting development which may affect all our lives has just been introduced in the USA by MCA. It is called Video Disk and is currently aimed at the entertainment industry. In principle it operates in the same way as an audio long-playing record except that there is no physical contact between stylus and disc (it uses a laser) and the information stored is both audio and video. This product has tremendous potential and will be targeted at the industrial market shortly.

Clearly a great deal of data could be more effectively stored in video form, because that is normally the way we prefer to work with it. This is especially true when one considers the advance of the home entertainment and information systems with Teletext and Viewdata systems. It is still too early to make a judgment of how this entertainment pre-recording medium will affect the computer industry. It will certainly have a great influence on all our lives.

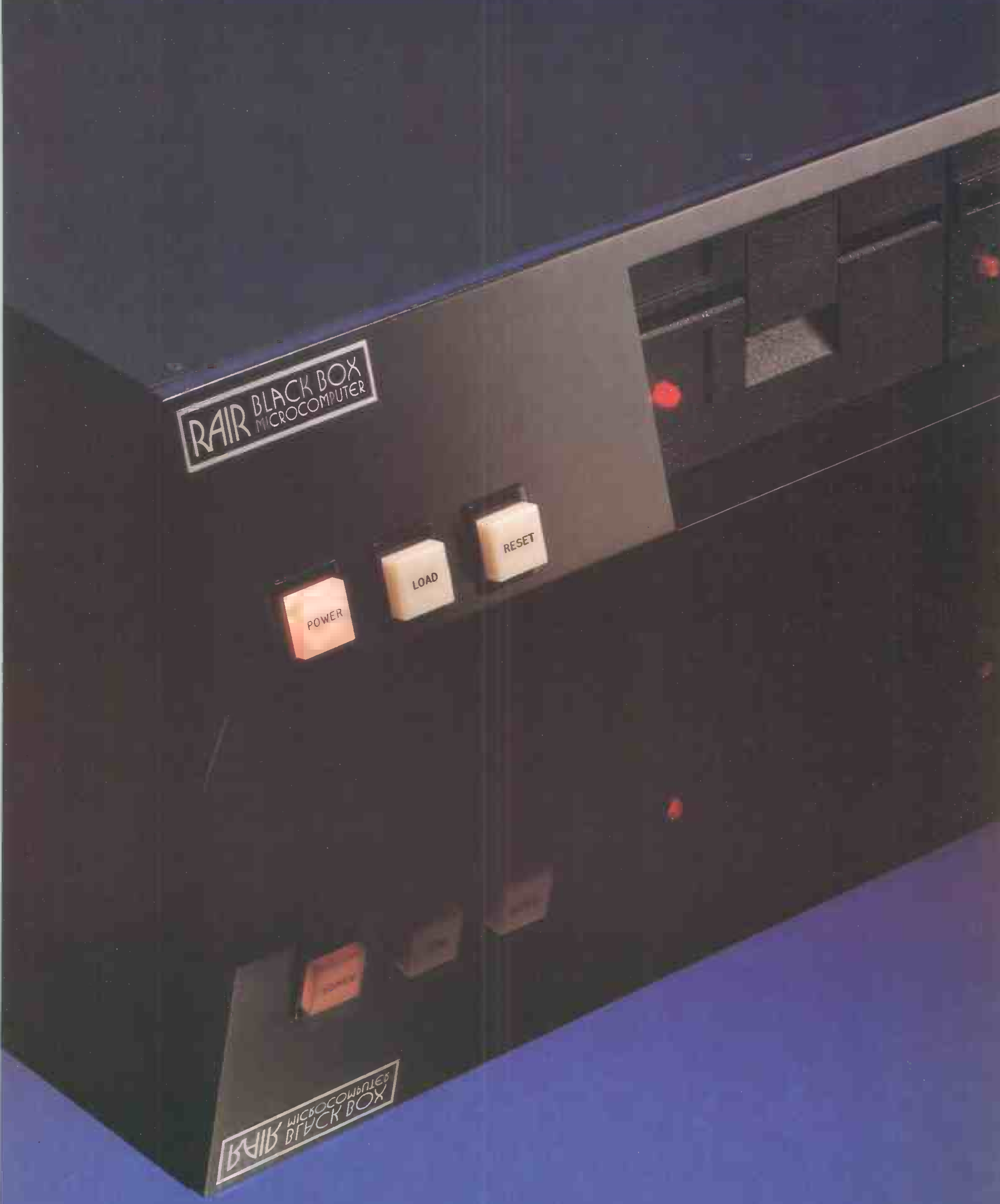
It is worth pointing out that I was advocating the video disc as a future information storage medium before the IBM/MCA announcement that they are to form a joint company to exploit its industrial potential. As my track record of getting the future correct is not as impressive as IBM's, you will excuse me this pat on the back.

What about the rest? Well, disappointingly the charge-coupled device (CCD) appears to have lost its way in the digital area, after showing a great deal of promise. It seems to be plagued with the usual manufacturing process problems and conspicuously has lost some of its major backers. I will be surprised if it now survives as a major alternative technology to RAM and bubbles.

Electron-beam technology is still very much in its infancy and remains in the laboratory stage. No major advances are visible on the horizon but I would keep a watch on this area as it has the potential to become a significant technology.

Conclusion

- **Memories will continue to double in capacity at the user level every four or five years.**
- **Existing technologies will remain dominant at least for the next 10 years — after that we will see, perhaps, Josephson junction devices in the processor and bubble memory outside it.**
- **No single technology will ever satisfy every application.**
- **We will therefore see the establishment of a hierarchy of memories, in which different technologies will continue to compete and co-exist — sounds familiar?**



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The Turing Test

by David Langford

"IN here, John,' said Spencer; John Cobbling winced slightly, as he had at each gratuitous use of his Christian name. After all, Spencer was merely inverviewing him for a job; the hearty familiarity struck Cobbling as offensive.

He let himself be ushered into the little room, which was only about five feet square — one of a row of such cells, side by side like lavatory cubicles. The walls were lined with large sound-absorbing tiles, perforated like pegboard and distempered a leprous shade of cream. The furniture consisted of a chair and a teletype. Cobbling sat down.

"What kind of test *is* this?" he asked nervously. Everything had seemed to be going well ... and now this.

Spencer smiled the smile of one who knows something and isn't telling. "The sort of test where we don't tell you what we're looking for until afterwards," he explained. "You do get a few hints, though. Maybe you've heard of the Turing test?"

Something stirred at the back of Cobbling's mind, but refused to come all the way out into the open. "But that's to do with computers," he said, feeling his eyebrows creep together like furry caterpillars. "Where do computers come into this?"

"Computers come into everything these days," said Spencer in the sort of tone a small boy might have used while saying "Aha!" or "That's what *you* think," or "Wouldn't you just love to know?"

Cobbling twisted his neck to look up again, wishing he hadn't sat down and given his inquisitor the chance to tower over him. He tried to cover his annoyance with a mild joke: "That's all you're telling me? From that I could decide it's a test of, oh, reticence and discretion — and sit here discreetly not typing anything..."

Spencer's aura of bonhomie chilled perceptibly. "I should not advise that, John," he said with emphasis. "Obviously you don't know what the Turing test *is*."

Thus prodded, the something at the back of Cobbling's mind crept a little further from its den. "Machine intelligence," he said slowly. "Something to do with telling the difference between a computer and a man. A person," he corrected himself, in case vile sexism was another of the things the all-knowing and all-judging personnel section was assessing.

"Ah, you've got it. Press the return key and carry on from there."

Before Cobbling could formulate another probing question, Spencer had closed the door behind him. On the inside, the door too was lined with the ugly, perforated tiles.

Cobbling studied the keyboard, feeling very much out of his depth.

TURING, Alan Mathison (b. June 23, 1912, London — d. June 7, 1954, Wilmslow, Cheshire), mathematician and logician who pioneered in computer theory... Championed the theory that computers could be constructed that would be capable of thought and even proposed that machine thought could closely resemble human thought... (Encyclopaedia Britannica)

TURING'S test for "intelligent" machines is very simple. A man sits at a teletype, carrying on a typed conversation with whatever the teletype may be connected to: perhaps another terminal operated by another person, perhaps a computer. When the computer impersonates human intelligence so well that the man at the teletype cannot tell it from a human operator, the machine passes the Turing test. Of course it might also be said that the man has failed: fancy being unable to tell a mere machine from a real person!

THE RETURN key itself was enough to maintain Cobbling's unease: it was where the 2/3 key was on his own typewriter . . . which felt distinctly wrong. He pressed it, and the teletype immediately began to chatter.

***HELLO & GOOD MORNING, the machine typed.

Well, of course, that made it obvious. People didn't type that fast and evenly, and so it had to be a machine at the other end. That was the Turing test: he had to work out whether a man or machine was typing at him, the most stupid aptitude test since the firm that had analyzed his handwriting and discovered something so awful that they refused to tell him precisely what... He sighed. Of course it wasn't so easy. The teletype would fire messages at him at just this speed, no matter how slowly they were being typed.

HELLO, he typed cautiously.

***WHAT IS YOUR NAME PLEASE?

JOHN LEWIS COBBLING, he typed in.

***THANKYOU, JOHN

Even from a computer, he didn't like it. And even a stupid computer should be able to pick up a Christian name like that. But the name request gave him an idea which he thought might be rather cunning. He typed:

WHAT IS YOUR NAME PLEASE?

***LET'S CHANGE THE SUBJECT

No through road. Dead end. Turn left only. If he'd only made some other reply when his name was asked for; if he'd only said "Why do you ask?" and maybe exposed the machine's zombie response as it came back with THANK YOU, WHY ... It still wasn't too late to try a similar gambit ... to make a confession — "Sorry, my name is really Mortimer Frogg." What would a machine make of *that?* A human was bound to see the contradiction, but... His finger was actually moving towards the S key when a second and more disturbing thought struck him.

THIS was a Turing test and his supposed task was to decide whether he was chatting with man or machine: fine, great, marvellous. However, there could well be another and sneakier level to the business. That advertising firm had made him write 500 words on how rice pudding could be given a virile image ... and, he suspected, hadn't even read it before turning it over to the graphologist who'd found evidence of unspeakable perversion in the hang of his consonants. Maybe here if he resorted to saying "My name is really Mortimer Frogg" he'd pass the test only to be blackballed for dishonesty. Say something safe, he thought, say something intelligent and say something quick.

WHAT QUESTIONS DO YOU SUGGEST I SHOULD ASK?

A pause.

***ARE QUESTIONS NECESSARY?

He wanted to kick the teletype through sheer ill-temper. Only they might be watching him — and might even knock a few marks off his score if he scrutinized the walls for hidden cameras. It was unfair. If there was a living, breathing organism on the other end, he (or she) was replying in this careful, clipped, sterile fashion merely in order to fool Cobbling. Surely that was against the spirit of the test? What separates sheep from goats, machines from people? He took the hint of the last response and tried a flat statement.

I THINK YOU ARE A COMPUTER

***PERHAPS YOU ARE A COMPUTER, TOO

Which was no help either way. Now if he could only jog the player on the other side of this demented game — shock him or her or it with a spate of four-letter words — make the human (if there was one) go over the top with rage and betray some feeling and humanity! Cobbling thought about that one for a few seconds and realized:

(a) A computer could well be programmed to pick up obscenities and react with an outburst of simulated rage.

(b) Conversely, a person could pause, ponder, calm down and react quite impersonally — fast talk had no effect when filtered through the teletype link.

continued over page


FINE DESIGN 80

From previous page

(c) Worst of all, if this dialogue were being monitored, a lapse into four-letter words would rapidly convince the critical watchers that he'd lost his cool. And he'd lose the job as well.

FOR purely therapeutic purposes, Cobbling murmured a few of the choicer phrases which had occurred to him . . . but only under his breath. There might be microphones as well as cameras! What the hell could he ask which was innocuous, subtly probing, not too inane, and liable to get a useful answer? He groped for the obvious.

WHAT ARE THE PROMOTION PROSPECTS LIKE HERE?

***WE CAN DISCUSS PROMOTION WHEN AND IF YOU'VE BEEN TAKEN ON, was the reply.

Was it perhaps a little too chatty to be the computer? A little too swift at picking up the keyword 'promotion' to be a person? He rubbed his chin as he thought about it.

PERHAPS YOU COULD TELL ME MY CHANCES OF BEING TAKEN ON, he typed, and regretted it at once.

***SURELY YOU DON'T LEAVE THINGS TO CHANCE?

Now was that or was that not a subtle straying away from the point, as might come from a machine programmed to waffle through a conversation?

Cobbling found himself answering in kind:

ONE HAS TO TAKE CHANCES SOMETIME

***VERY TRUE

...And on and on and on, always circling round whatever the point of this strange test might be, always avoiding which led towards controversial comments and might prejudice his chances. One has to take chances sometimes, but Cobbling didn't really feel that way. By and by he was struck by the notion that there was no machine nor even a cunning personnel interviewer on the other end of the line. Could it be that the unseen adversary was another interviewer in a mirror-image situation, choosing his words with utmost care for just the same reasons which inhibited Cobbling? How neat, how economical that would be.

I THINK I PREFERRED THE RICE PUDDING ESSAY, he wanted to type.

YES, I HAVE ALWAYS WANTED A GOVERNMENT JOB was what he actually typed.

As always, the machine paused...

IN all, the test lasted for about forty minutes. It seemed like an eternity of plodding thought, an endless chess game played blindfold. Cobbling even entertained the heresy that maybe, after all, he didn't really want this government job.

Then the door opened with a sudden draught of cold air; a hand touched his shoulder. It was Spencer. "Congratulations," he said with the impersonal warmth of a central heating system. "You've passed."

Cobbling raised an eyebrow at him. "I haven't said whether I think it's a man — a person — or a machine yet," he said suspiciously.

"Oh no — but I've had the report from the other end. There was a computer on the line, of course, with our best response-analyzer program — and two programmers sitting in, monitoring the transmissions..."

So he'd been right about *that*.

"None of them could tell," said Spencer, as though that explained everything.

"Tell what?" Having kept his cool for so long, Cobbling was finding it increasingly difficult to speak without vehemence. It would be so nice to break into gentle screams.

"Tell your responses from those of a machine, of course. The Turing Test, you know. Calm, impersonal, bland, no rhetorical flourishes — no, they definitely couldn't distinguish your personality from that of a machine. You passed with flying colours, John."

Cobbling stared at him; nodded slowly and thoughtfully. He thought he saw it now.

Spencer clapped him on the back and said: "You're going to make a good tax inspector."

Nagging

by G. Phillips

'SYSTEM 2.3 READY' said the screen in a patient, understanding tone of green.

Peter Ferraby keyed in a brisk reply, then sat back and listened to the reassuring clicking of the floppy disk drive as it busied itself loading several thousand bytes of compiler.

The door opened and Peter thought to himself, Here she comes, ready to nag about some trivial thing or other.

'I thought you were going to clean up the spare room?'

Alison stormed into the room, hands on hips. There was no pause in the tapping.

'I must get this finished before lunch — the magazine wants the program by tomorrow.'

'Well, my sister is coming over tomorrow, so there's another deadline for you,' replied Alison, angrily leaving the room when no reply was forthcoming.

'Error in Line 2200' said the machine.

About an hour later, Peter's programming was interrupted anew by the abrupt re-appearance of his wife.

'Look, are you going to give me a hand, or don't you mind not having any lunch?'

'OK, I'll be with you in a minute, but I must store this program on tape first.'

'Can't you put it on the floppy disk?'

'No, the compiler takes up most of the disk, I daren't use the tape for the compiler in case I get bits dropped. It's not so bad with a BASIC program, but I'm lost when it comes to machine code.' Aha! he had blinded her with jargon!

But Alison gave no sign of confusion as she left, rather, she seemed pleased.

Once again, with the other program in the publisher's hands, Peter was working on his Household Accounts Routine — a project often put aside.

'RUN' was entered and Peter awaited the first message, but the program had other ideas. All it would say to him was 'ERROR 302'.

That's a new one, thought Peter.

'You haven't seen the System 2.3 manual around,' asked Peter as Alison entered, hunting for empty coffee cups.

She peered into the screen, then said: 'Oh yes, Error 302, that means your array is dimensioned too high, the system can't cope with it'.

Peter laughed. Was she humouring him by spouting jargon? Only after the door closed did her suggestion make sense. Sure enough, the listing showed an extra 0 within the statement that dimensioned the array.

As he corrected his mistake, Peter marvelled at female intuition.

The following morning saw another obstacle in the path of finishing the Accounts program. His mother-in-law was paying a visit. If he was lucky, he might be able to snatch an hour or two on the machine.

Alison was still asleep — unusual for her, he reflected. But hadn't she got up in the night for a drink or something?

He hurried into the back room, powered up and waited impatiently for the disk drive to awaken. The 'System 2.3 Ready' message was already glowing.

As his compiler began loading into memory, Peter rewound the Accounts cassette, praying that there would be no tape dropouts.

With the compiler loaded, Peter pressed the PROG-RUN key, as he had done hundreds of times before.

'WHAT DO YOU WANT NOW?' the machine screamed in bold upper case. Peter stared in amazement. When he had recovered sufficient composure, he to typed in a Load command but omitted the 'O'.

'YOU'VE GOT IT WRONG AGAIN — IDIOT!' came the terse reply.

'And don't think I saved the old compiler!' laughed Alison from the door.

'Don't worry dear, it still does all it used to — only now it really tells you off when you get something wrong, a vast improvement I think.'

In spite of himself, Peter laughed; he had just spotted that the label on the front had been amended to read 'NAG 1'.

Ron Sheldon at the Finance for Industry HQ: "Too many people only want to get involved in business to build their own ego."

With banks looking to make a tenfold return on venture capital, is now the time to start your own micro business? The answer, explains Duncan Scot, is to ...

Fly high or plummet

IT IS NO TRICK to make a lot of money, if all you want to do is make a lot of money, according to Mr Bernstein in *Citizen Kane.* Yet so many people claim that if only they could find the backing, their ideas would be worth a mint.

Financial security, independence from Big Brother employers, the opportunity to make a mark on the world — even the trappings of the rich — are the promises. With so much on offer, it is surprising how few take up the challenge and chance their luck. Is it really that difficult to start up your own company? Is the backing which is always considered so vital really necessary or really so elusive? or can it be that most people simply cannot be bothered to try?

Of all the excuses, the one about the economic climate being unfavourable must be the weakest at the moment. If microcomputing is the long-heralded start of the second Industrial Revolution, then the industrial giants of the twenty-first century will now be in their infancy, either as small companies or as embryonic money-spinners in the minds of budding entrepreneurs.

Pessimists and bureaucrats discussing 'What is wrong with Britain?' claim that venture capital for high-risk, high-return ventures is in short supply in the UK, unlike all other Western countries. So far as the UK is concerned, they say, fond dreams about finding a rich angel willing to pour thousands of pounds into a grand idea should best be forgotten.

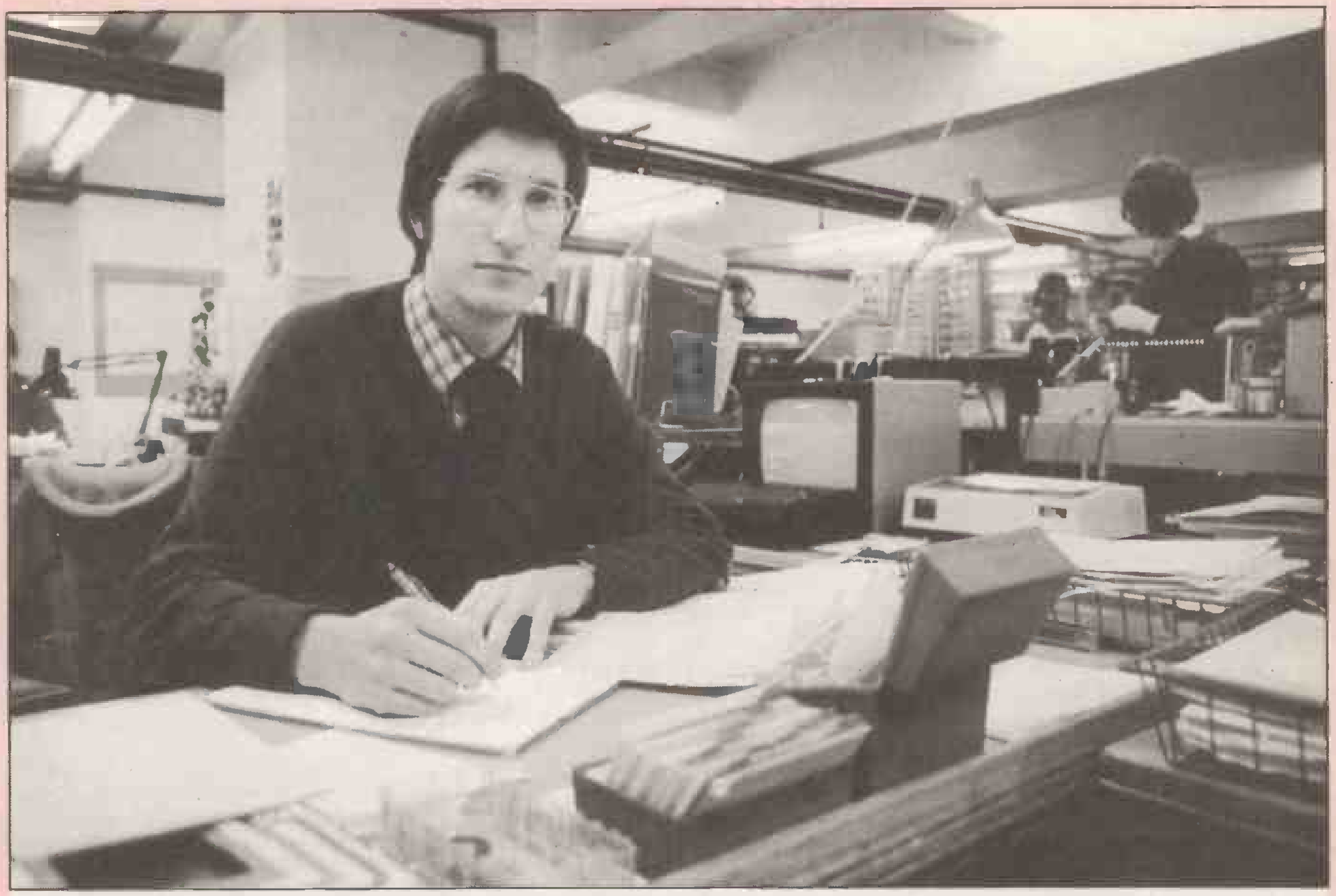
Risky ideas

So where can the money come from? The providers of development capital are not excessively cautious in their lending requirements to small companies and for new ideas — or so they say themselves. The problem is that there are not enough people in the UK with the money to throw into risky ideas.

This is not to say that there is not a lot of money floating around in the UK. Life insurance companies and pension funds command vast sums: collectively they invest several million pounds a day. But few of us will ever see this money, as it disappears into property, gilts, gold and art collections, to be recovered with a modest profit thirty years hence when the lives expire and the annuities are paid.

Most other cash, whether from companies saving to meet their tax bills or local authorities hoping to profit from the short period between the collection of the rates and the payments they have to make for their services, is in search of short-term returns, lent at high interest rates for a few months at a time.

There are two sources of business finance in the UK which are geared towards long-term risk investments. The first is the industrial finance house, Finance for Industry (FFI), which is owned by the main clearing and merchant banks and the Bank of England. The


Mike Fisher at the centre of it all at Research Machines. "If we had been given any backing we simply would have lost it all."

second is the state-backed merchant bank, the National Research and Development Corporation.

Although these organizations specialise in lending long, they usually apply the single most difficult requirement to meet, namely: will the project make more money than they could make on the money markets (current MLR 17%) consistently for the duration of the loan? Because if not, forget it.

Growth investment

They are, after all, as they are wont to point out, lending other people's money and those people expect to see their investment grow, not to have it gambled away. Barely one in ten of new companies which start with backing survive to repay the original investment. So of every ten new companies which are backed, at least one of them will have to make a better profit than could be made on the money markets, and enough to pay for the losses on the other nine.

In principle it means that a backer of a high-risk project will look for 20 to 50 times his investment as a return. This can make a big hole in the proposer's stake.

So most merchant banks will not be keen on a new risky and expensive microcomputing venture. Evidence to the Wilson Committee, which was reviewing the functioning of the City's financial institutions, highlighted the following question: "Is it in the public interest that small companies, which are unable to meet the requirements of the financial market, should be supported nevertheless?"

Before answering that question, say the bankers, it is necessary to emphasise the uncertainty in predicting which companies will succeed or fail, and this is particularly so with small companies. The price of supporting 'medium fliers' could be a higher rate of wastage which would mean higher costs for all.

Given this reluctance to back risky adventures in microtechnology, the trick must be to make the right approach to the financial institutions to maximise the chances of securing backing, recognising at the start that a good idea is only part of the story. The FFI and the NRDC both stress the importance of character.

Commercial nous

"At the back of our minds whenever someone applies is the question 'Does this guy have sufficient commercial nous?'" explained Ron Sheldon, who deals with high-technology ventures from the plush and relaxed surroundings of the FFI's technology arm, the Technological Development Corporation, just off Waterloo Station in London.

"People always say that the problem is finding backing and money for a new venture but I think that is wrong. It goes one stage further. There is plenty of money floating around for good ideas. The biggest problem by far, and it is always underestimated, is to persuade the potential backer that *you* can actually take hold of the product.

"We are not looking for technical excellence but for some idea of what the marketing will entail and how to make the product right for the market place. Too many people want to get involved in business for the wrong reasons. The first, normally, is that they want to build their own ego. The second fault is that they only really want to play at R and D.

Not our game

"We recently had a University undergraduate," continued Sheldon, "aged 21, who had an idea and wanted to chat about how to develop it commercially. We are simply not in that game. All I could suggest was that he approached a number of companies with a view to giving them a licence to produce the product and hope for something between four and 10% of the royalties."

A loan from the TDC normally requires selling a 40% stake in the company, leaving the proprietor with 60%, for which he will have to come up with his own money. "For example," explained Sheldon, "if someone can offer £20,000 and takes 60% of the shares, and if the TDC puts up £200,000 and takes 40% of the shares, it is obvious that the bulk of

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the money comes in the form of a direct loan which is secured only by the long-term assets of the company which means by its long-term potential. The proprietor only risks the money which he has put up himself and that will often come in the for of a bank loan, secured on his house. We don't care how he raises his share."

As the technology arm of FFI, TDC does have a certain amount of expertise by which potential products can be assessed. With totally new products, however, it is far more difficult. "It is sometimes impossible," said Sheldon, "to say how làrge a market is for something which nobody knows anything about. All we can do is to bounce the idea around with people who are involved as close to the area as possible. Unfortunately it does mean that there will always be a bias against the unknown, but there is no way round the problem.

Sorry, Mr Sinclair

"The technology market is getting more and more difficult at the moment," continued Sheldon. "The amount of finance needed to hit a market properly is going up rapidly, while the amount of cash which the individual has is relatively stable; in fact it is usually geared to the value of his house. If Mr Sinclair came to me with a great idea for a new mini-TV we would have to turn him down, although there could well be a market for it and eventually a good return. But the risks are high and the launch costs would be astronomical if it were to penetrate the market."

Ron Sheldon believes that the name of the game is now software, so much so that TDC have formed a new company, called TDC Developments, which will provide more backing for small companies and new companies in return for a larger share of the equity and a position on the board of directors to supervise the running of the company.

"There is great scope for putting money into software," proclaimed Sheldon. "We can work within a budget, allocating the money for specific objectives until we reach our target. It is far easier to control than trying to finance the building of a prototype piece of equipment."

Building prototypes and new product R & D is more the preserve of the State-backed merchant bank, the National Research and Development Corporation, still proud of the days when it backed its most famous baby, Sir Christopher Cockerell's hovercraft. (It has yet to make any money out of the project). Most of the Corporation's licence income in recent years has come from one sparkling invention (cephalosporn antibiotics), the patents on which soon run out. Without this one success, the Corporation reckons that it would have had to take up the full amount of its £50m Government borrowing limit instead of repaying all its loans.

The NRDC, as its name implies, concentrates on research and development of

Rules of the game

AN ACQUAINTANCE of ours who successfully raised half a million pounds in the City for a computing project ten years ago gives the following advice:

1. Research *everything*. In your proposal chuck in a few offhand references to some papers in Icelandic. Say: 'This cursory overview of the possible market reveals a not unpromising situation.'

2. Remember that you are writing for a crew of gin-sodden taxi-drivers. Your prospectus has to be able to read it in the Tube. Keep it short, keep it simple, keep it profitable.

3. If your proposition looks like making £1000 a month, say £10,000 and throw in that 'with development, the market might become quite attractive.'

4. Type up a hundred copies of your proposal, send it to every firm in the yellow pages under 'Bank'. It is fatal to get fixated on one single source of finance — you just become a nuisance. It's like chasing a girl who isn't interested in you.

5. If, when you get to see Them, They don't jump over the table — dribbling — to hold you down while you sign, you haven't clicked.

6. They are unimaginably greedy, and they have to be. If only one project in ten succeeds, then that one has to repay them ten times what they put into it. And that just balances the books. To make a profit they need forty — fifty — a hundred times their investment. A person could get hurt, so watch out.

Advertising for the man with the money

BACK IN 1978 Lucius Cary decided to help other entrepreneurs in the search for venture capital. With an engineering degree from Oxford University and a Master's in Business Administration at Harvard Business School, Cary had ambitions to run his own engineering company.

While looking for financial backing, he felt an enormous communications gap existed between those who had money to invest and those who wanted it. So he decided, with two partners, to create a forum through which would-be entrepreneurs and the institutions or the individuals who might provide their capital, could meet, in the shape of a monthly information sheet, entitled *Venture Capital Report*.

Burger bar

In the meantime Cary is running a small chain of American-style hamburger restaurants, in Bristol, in the hope of making the capital he needs.

In Cary's view, not only is it difficult to identify sources of venture capital, but it can also be daunting and time-consuming to approach each of them individually.

Each of the monthly reports carries around eight studies of entrepreneurs needing finance; for instance a Holiday Village requiring £175,000, a pneumatic vibrator requiring £12,500, to a computer professional seeking £54,000 to "establish a computer systems consultancy to advise firms on how to use microcomputers and then sell them the systems."


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Venture Capital Report September 1979

1. Microcomputers £54,000
2. Pneumatic Vibrators £12,500
3. An Export Services Company £18,000
4. Holiday Resort Monorail £300,000
5. Holiday Village £175,000
6. Quality Gifts Export £75,000
7. A Fashion Design Company £130,000
8. Video Systems £75,000

Cheap at twice the price?

Venture Capital Report gets about 60 applications evey month and requires the lot of them to fill in a questionnaire providing details of their product, market, financial needs, cashflow projections and personal circumstances. About one in ten of the applicants actually makes it into the pages of the report.

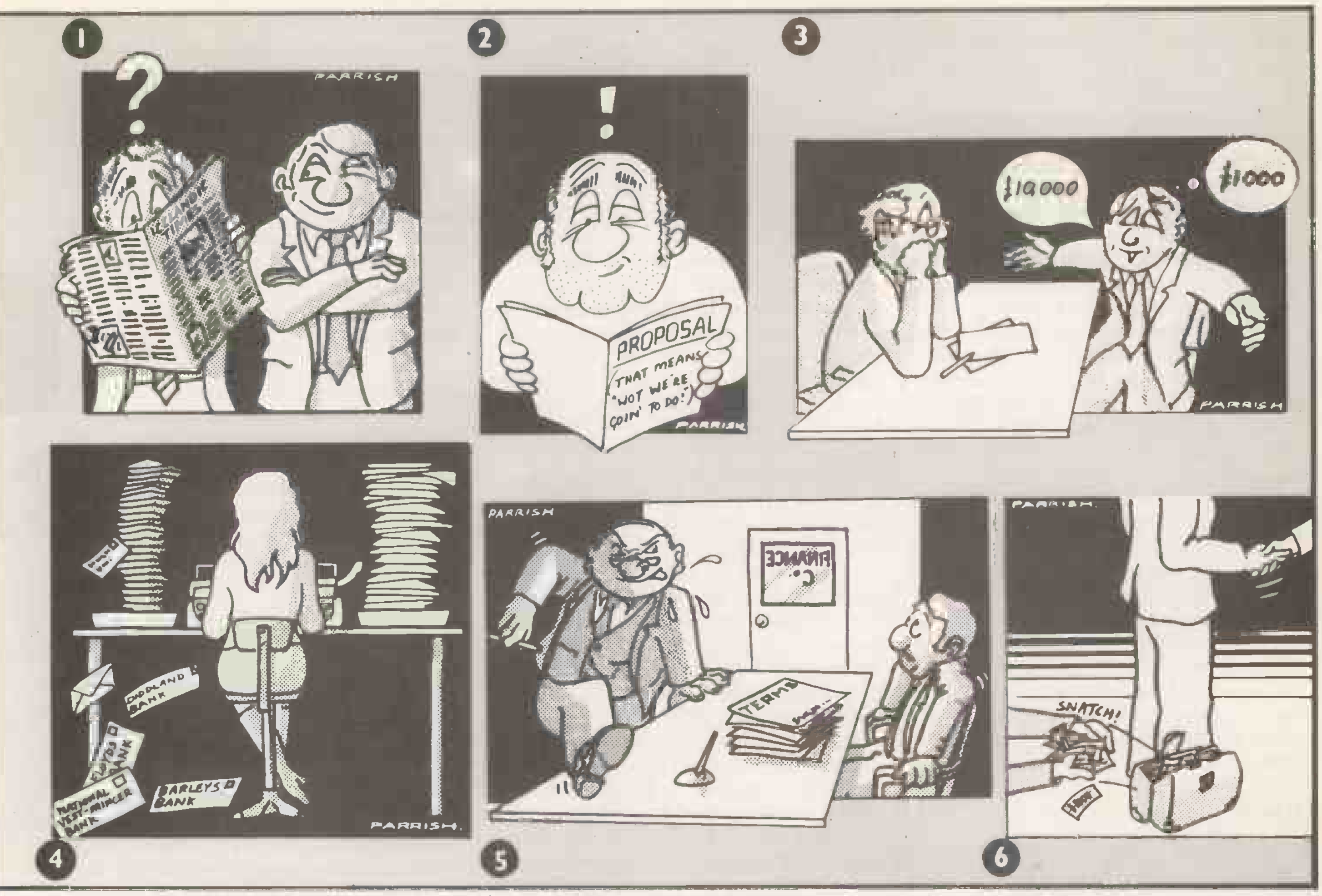
Luckily only about 15-20 every month bother to return the questionnaire and so nearly half of the more serious applicants get written up.

Untried ventures

As yet there has been no proper analysis of the success of the Report or of the type of projects which do succeed in finding backing. Rough figures indicate that about 10% of the projects so far publicised have received some degree of backing; others are still negotiating and some have found backing from other sources. Apparently a large proportion of the backing is coming from private investors, still willing to take a risk on an untried venture.

Venture Capital Report is financed solely from its 400 subscribers, an annual subscription costing £125, embracing private investors, banking and investment companies and industrial concerns both in the UK and overseas. The main problem, however, is not how to gain more subscribers, but how to sustain a high quality among the projects.

Contact: *Venture Capital Report*, 2 The Mall, Clifton, Bristol BS8 4DR.



ideas, to bring them to the market place. Its main function is to promote the development and exploitation of inventions, including computer software and electronics, the responsibility for which lies with the Computer Systems and Electronics Group.

George Davis, who works in this group, explained that the Corporation functions in two main areas of activity. The first is the Industrial Joint Venture in which the NRDC provides support for the development, initial production and marketing costs of innovative products within commercial companies. NRDC subsequently recovers its funding, where possible, plus an appropriate margin, by levies on sales of the resulting product.

The second main activity is the exploitation of inventions from research organizations and individuals. In these cases, NRDC accepts assignments of property, undertakes patenting and any other relevant forms of protection and seeks to license the invention to commercial organizations. "Of course the great majority never get that far," said George Davis encouragingly.

In an industrial joint venture the NRDC normally expects to put up about half of the money for the venture in return for a percentage levy on the sales of the resulting products. It seems, however, that the NRDC prefers to work with well-established companies rather than small concerns. In reply to such criticism it says that over half of its ventures are with companies employing less than 200 people, and early last year they launched a £250,000 advertising campaign to attract higher-quality applications to the Corporation.

One of their more typical ventures in recent years was with the UK based software-house, CAP-CPP, a large, well-established and profitable company employing over 900 staff and with an annual turnover of nearly £12m. In the mid-Seventies, CAP feared they would be by-passed by the microcomputer revolution and decided to tackle the micro market from square one, with a new company called Microsoft Ltd, formed to develop microprocessor development aids.

Key to the future

CAP had identified the micro market as the key to the future and determined to get in on the act early. They studied the possibility of developing their own languages and adapting COBOL for use in micros.

"A small R and D group studied the problem," explained Lawford Russell, the CAP director in charge of product services. "But after £¼m had been invested we decided we couldn't really go any further. That sort of money, although we could afford it, was stopping us making any further diversification. We knew it would be useful for the future but we couldn't be sure about the time scales involved so, for the first time, we looked at the possibility of raising additional capital for the work.

"The traditional forms of money were unavailable to us," Russell continued. "The City was wary of high technology, I think because they got their fingers burnt in the early Seventies and when that happens they tend to look inwards and support nothing. We could have borrowed the money but we didn't want the funding to go against our balance sheet. We really wanted someone to share the risk of the development and then share the return if the product was successful."

The NRDC came up with support to the tune of £350,000 although CAP has since increased their own investment, to make a total of over £2m spent on the project.

"As you would expect, our market plans and projections from the early days have proved wrong. We expected the return to be higher. We were probably about two years too early with the product. As is often the case, new technology was not adopted as quickly as we thought," explained Russell. "We didn't think of microprocessors being used as replacements in manufactured products for wired logic. And that market kept the

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semiconductor manufacturers busy for some time."

CAP's annual report makes the same point. "We underestimated the gestation period the manufacturers required to box the micro suitably for retail sales. The investment has been greater than expected." However, the chairman then adds: "The achievement of machine invariant programming in Microcobol is emerging as one of the most significant developments of the decade."

"The problem with any sort of financing," explained Russell, "is that there has to be some sort of personal contact. We knew George Davis at the NRDC. There is no point in going into any sale cold, especially when it comes to raising money."

NRDC does in fact admit that it prefers to deal with ideas from large and well-established companies, of which apparently at least one in five are worth following up. In the argument over the future of the NEB, the Government has already admitted that there is a need for a state venture capital organization to fill the gap not being met by the market, but there must be some doubt whether the NRDC could fulfil this function, even with a change in policy.

Heartbreaking

Sir Frederick Wood, chairman of the NRDC, recently argued (*PC*, December 1979) that backing will often set the lone inventor on the road to failure.

"Money by itself may often be of no real value to a small inventor," he said. "Someone once said that offering money to a small inventor is like giving a bottle of champagne to a man dying of thirst in the Sahara Desert. In his desperation to open the bottle, our thirsty man breaks off the neck, spills half the wine, cuts himself badly and, having consumed the balance of the wine, is thirstier than ever half an hour later."

This may explain why of 6600 applications from small inventors over the last seven years, only 44 were judged worth backing. Is it really impossible for the NRDC also to give advice on how to make the best use of backing and marketing?

Some of the most successful companies in the microcomputing field have grown up with no substantial backing and some claim that even if they had backing at the start, they would probably have lost it all anyway. One such company, Research Machines of Oxford, manufactures the 380Z microcomputer, which has won itself a reputation as one of the best machines in the UK. Designed especially for the education and scientific markets, it has virtually cornered this sector.

But three years ago RM had only just thought of moving into the micro market place, and as a company, SCINTEL, dealing in the buying and selling of electronic components, was not especially prosperous. Only two years before that, in 1974, the company was established by Mike Fisher and Mike O'Reagan with a total investment of £250 and a car.

In 1972, having completed a Physics degree at Oxford, Mike Fisher determined that some day he was going to run his own company. He spent the next two years doing temporary jobs, some in Africa and later back in the UK with Manpower, which is where he met Mike O'Reagan, an economics graduate from Cambridge. Together they decided to go into business.

"We didn't have any very clear ideas. We both wanted to go into business on our own rather than work for other people," said Mike Fisher, "partly because of that great illusion that if you are your own boss you are more independent and have greater freedom. I knew that I would eventually like to move into manufacturing but that was about as far as our planning went.

"I started off going around some research labs," he continued, "trying to find out what equipment they needed, and managed to pursuade someone at the Roussel Labs that I could build them a brainwave analyser for rats. They were willing to pay £18,000."

Roussel paid an advance on the machine and Fisher borrowed another £1000 from friends and family to meet their living expenses for the first year. At the same time they started up Sintel, buying and selling electronic components.

"We thought," explained Fisher, "that the brainwave analyser would take us about eight weeks to build. But it really took us eight months and that is how we started to learn about some of the problems of running a business."

George Davis

There were no other special projects and after nearly two years of building up the retailing side of the business, Fisher became impatient, until he decided to move back to the original idea of manufacturing at the end of 1976.

"I had kept myself well up-to-date with the latest developments," he said, "and I knew that we had to build something with a microprocessor. I even toyed with the idea of building an adaptor for Teletext but pulled back from that. At the time I was sitting on an education working party for the Berkshire County Council to study some of the technical requirements for schools and I realised that here was a market for microcomputers which seemed to have been ignored by most of the other manufacturers."

Mushroom

Mike Fisher designed the prototype 380Z (he admits he is a good electronics designer) by the beginning of September 1977 and had to meet the first order for 25 by the 21st of the month. Since then the business has mushroomed. In November last year, the company moved out of a 3500 sq ft factory into premises with over 16,000 sq ft.

Why does Mike think he has been so successful? "I once read an article about new businesses in the States which claimed that those companies where one of the partners, however much of a leading light, had more than 15% more of the equity than any one of the others tended to fail; we have always stuck rigidly to an equal equity among the partners.

"The other point is that you have to spend some time getting used to running a business, learning some of the basic rules. And you must remember to make a profit. After about a year and a half we realised that we were only just breaking even. Every now and again we added up our costs very roughly and thought we were making lots of money. We didn't realise how much the little costs such as stationery and photocopying add up. Luckily we always lived really frugally."

Enjoy yourself

As MD of the company, with over 30 employees and with plans for further expansion, Fisher believes that it is essential to enjoy running a business, as opposed to just getting an idea off the ground. "With 30 people," he said, "someone always has a problem, or needs attention or help, and so there is nothing like as much time to think about the future of the company. I was lucky. I have always been fascinated by the way that businesses work, how a company like General Motors manages to develop any new ideas at all.

"When we first started, we believed that if we had substantial backing, we could have made a fortune very quickly. In retrospect, we simply would have lost all the money. We might still have come in the right direction but our mistakes would have cost money rather than just time. I don't think that in the long term, if you are determined to make a business work, backing on a large scale is worth it, especially if you do not have a good deal of business experience."

"Micro mania hits London—staggering success—the sort of frenzy usually seen at January sales." Datalink (16/7/79)

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Robots: sense & sensibility

Part 3 of Mark Witkowski's robotics series tackles the problem of equipping a machine with the five senses

MAN and the higher animals are often said to have five senses: sight, hearing, touch, taste and smell. These are concentrated about the head in the eyes, ears, skin, mouth and nose. Information that comes from these organs allows us, and all living creatures, to react positively in an uncertain environment.

On the other hand, it is common practice in industrial robotics to modify the world so that it conforms to the requirements of the machine so little or no sensory information is needed. When the robot is used for welding or paint-spraying, this scheme works well, since much skill in these tasks is in maintaining a sufficient degree of consistency and repeatability in the quality of the work.

When robots are used for tasks where it is not possible to predetermine the environment totally, the control algorithm of the machine must be continually modified to take into account these variations.

Production-line assembly of units from their component parts is a typical example. Small items must be picked up, often from random piles of similar objects, oriented and placed in the correct position on the workpiece. Because it is difficult to ensure that each component arrives at the workstation in a predictable way, the robot has not yet been widely used in assembly tasks, which generally remains the province of unskilled human labour.

The next generation of industrial robots will be equipped with a great many more sensing devices which will make them useful for tasks other than a limited range of fixed-sequence operations. They will increasingly be able to act correctly in a wide range of unpredictable environments — doing the right thing at the right time.

A machine must possess 'human-like' sensory faculties in order to qualify as a robot. They are an essential link between the world and a computer program that emulates intelligence. Until recently, the trend in robotics has been to describe sensors only in relation to a specific robot or robot task. In many cases a robot will only have one or two sensor inputs, but as robotics matures this will change.

Larcombe (1979) has looked at the sensor requirements for a mobile industrial robot and Wang and Will (1978) describe a range of sensors for a fixed-base manipulator system.

Robots must currently use different sensors from those that people use. We place considerable reliance on sight, which is currently too computationally expensive to be used to a great extent in current robot practice. Plenty of research is being done on robot vision, though, which I shall examine later in the series.

Hearing, smell and taste are also not of much value in robotics, although one might reconsider if a robot intended to be a chef. Touch — tactile and proximity sensing — have an important role to play; this review of some of the current ideas will concentrate on this and 'proprioceptive' sensing.

Proprioception is a genuine and undisputed 'sixth' sense we have — that concerned with monitoring the internal state of our bodies. It monitors hunger, body temperature, muscle extension and force and joint position. Similar information about a robot is required by a robot-controlling algorithm.

Fine-tuned sensors

Robot sensors may either be general, to allow the machine to cope with many tasks, or they may be specific to one task only, and must be changed when the robot moves on to another job. The advantage of the latter method is that sensors can be carefully tuned to the situation they are to detect. Furthermore they can be made to give a clear, preferably binary, output that unambiguously triggers the next sequence or robot behaviour with a minimum of computational expense or complexity.

The advantage of general sensors lies in their flexibility since each new job requires only reprogramming for a different combination of existing sensor hardware.

Information they provide, in addition to the minimum actually required, can then also be used to monitor and warn of malfunctions that the simple sensor would miss. These gains are offset by the extra expense, number of things to fail and a huge increase in the skill required in programming the robot.

In some applications, the general sensor scheme is essential. For instance: robots used for artificial intelligence research, or those used in remote manipulation telechiric control must have it, particularly if there is no direct visual contact between man and machine. Improved sensors will allow robots to tackle more complex tasks at greater speeds with less modification to their environment and with greater safety for those people that have to work in close proximity to them.

All mobile vehicle robots and manipulators require sensing to some degree. The minimum would be a mechanically precise pick-and-place manipulator that only requires a single interlock with the machine that feeds it parts.

Sensors that warn of impending collision are among the most important on a mobile robot vehicle. In all but the most tightly controlled environments this is essential since most useful robots are large, heavy and fast enough to make them potentially dangerous; 'if it hits it, it will break it' is a sensible maxim.

Proximity and touch sensors can be divided into three distinct groups: those that work over a long range, say greater than six inches; those that function closer than six inches yet involve no actual physical contact; and those that work by actual contact.

Long-range sensing will be of use in obstacle avoidance and route planning. Medium-range should allow sufficient time for the vehicle or manipulator to slow down and could be used to guide the robot or arm until contact is made. The last group of sensors will indicate the extent and area of contact and possibly the amount of force being applied, either by the robot on an object, or by the object on the robot.

Ultrasonic rangefinding is a popular method

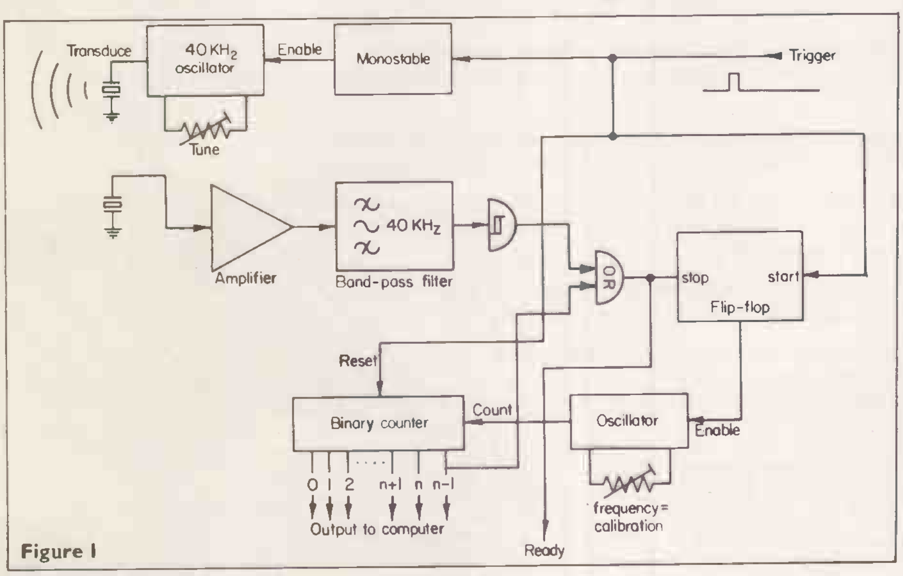


Figure 1

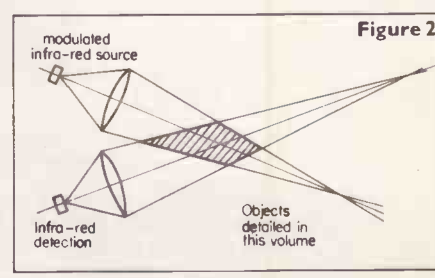


Figure 2

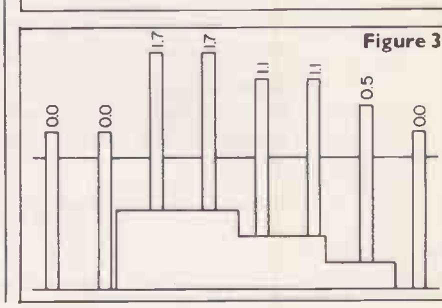


Figure 3

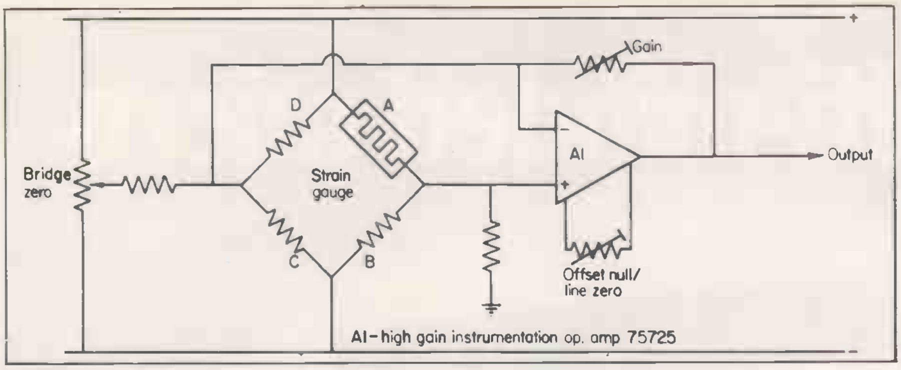
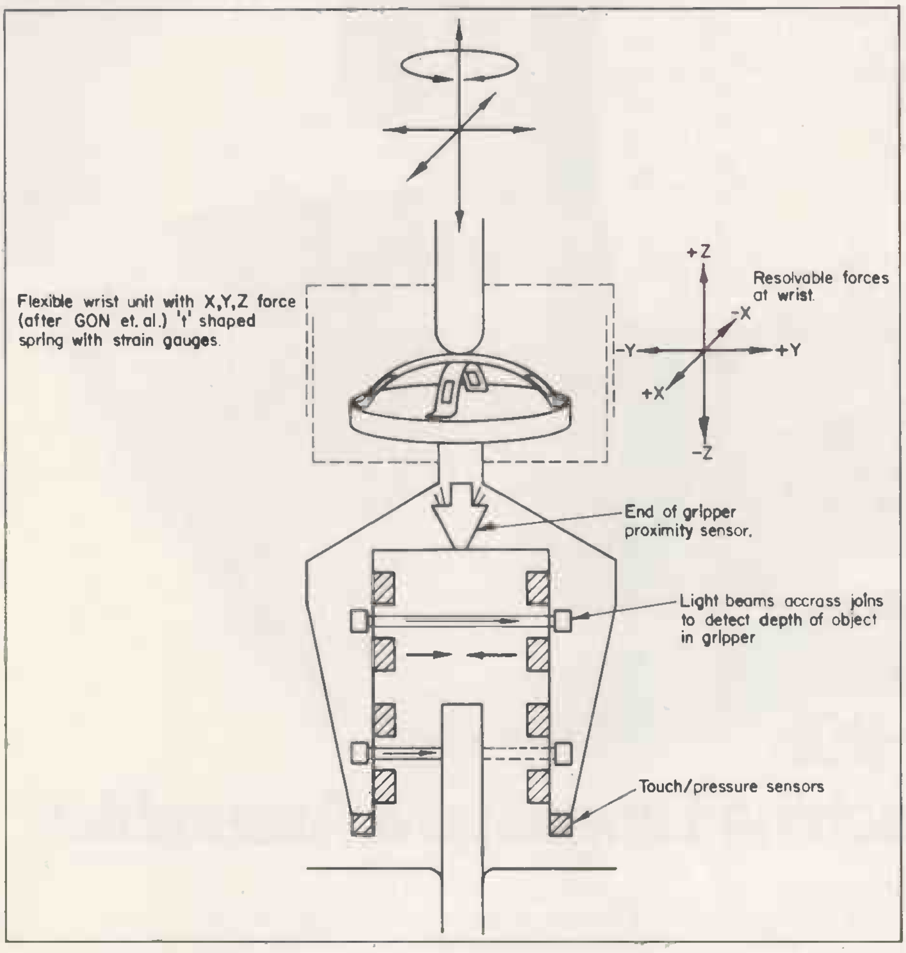


Figure 4 (above); figure 5 (below)



of long-distance object detection. It has been used on several robot vehicles to provide obstacle avoidance and on manipulators to give 'range-imaging' (eg Loofbourrow's 'MIKE'). A brief burst of ultrasound (> 20KHz) is transmitted from a crystal or piezoelectric transducer and any echo caused by the sound being reflected from an object is timed to indicate a distance. (The speed of sound in air is about 300 metres per second).

Figure 1 shows a block diagram of an ultrasonic ranging system. When the monostable is triggered, it enables the transmitter oscillator for a number of cycles (typically 10 at 40KHz). This signal powers the transmitting transducer.

The same signal also sets a flip-flop which starts a second oscillator that feeds into a n-stage binary counter which has been reset to zero by the trigger pulse. This second oscillator continues to count until the echo returns.

When the pulse is detected by the receiver transducer, it is amplified, bandpass-filtered to remove unwanted signals and used to halt the counting oscillator by re-resetting the flip-flop. The binary result at the outputs of the counter is directly proportional to the distance to the object that caused the echo. Calibration is effected by altering the frequency of the second oscillator.

If there is no echo, the transition of the n+1th bit is used to halt the second oscillator; this bit remains set while the data is read, indicating a null result. National Semiconductor manufacture a single-chip device that incorporates the transmitter and receiver sections and includes a switch so that only one transducer is required, the LM1812 (see manufacturer's information).

Higher frequences of ultrasound allow a higher resolution because of the shorter wavelength and can be used in narrower beams offering greater selectivity. Longer wavelengths are less attenuated by air and are effective over longer distances. The 270KHz system described by Wang and Will has a seven degree cone on both transmitter and receiver, which gives sufficient resolution to allow contour maps to be generated with the system.

Several refinements to this technique are possible: phased arrays, analysis of the complex waveform returned by several objects or objects that are not flat. The latter has been used as an acoustic aid for the blind known as 'seeing with ears' (Kay 1979 and Boys *et al* 1979). Unfortunately the pattern-recognition problems when trying to analyse these signals by computer will doubtless prove to be no easier than analysing picture information.

Ultrasound ranging

Ultrasound merits further research — one should not forget how effectively bats use sound. In many species it has totally replaced sight, with no apparent loss of ability.

Simple ultrasound ranging devices do have their disadvantages. They can be prone to acoustic interference, though filtering the received signal helps; they are not very selective, though broad coverage may be desired. Some surfaces absorb ultrasound, while all flat surfaces act as acoustic mirrors and specular reflection is a major cause of huge surfaces being missed.

As with radar, the returned signal falls off in power with a fourth law with distance, so sensitive receiver amplifiers can be swamped by echoes from nearby objects. It should also be remembered that many domestic animals and pets, such as rodents, cats and dogs can hear these sounds and they could be discomfited by high-intensity ultrasound.

Time-of-flight range finders using light or radio waves are not used much in robotics as the flight time is in the order of nanoseconds per foot. However, optical triangulation techniques are used for rangefinging and a chip is manufactured that performs a correlation on two images, producing a minimal signal when the two are superimposed. The triangulation reflector is scanned back and forth and the signal is used to servo the focus lens of a camera. This system has been incorporated in the recently announced Sankyo ES.44XL VAF ciné camera (see manufacturer's information).

Doppler microwaves

Doppler microwave modules could find application in long distance robot sensing. Although they provide no useful range information, they are highly sensitive to movement, both of the vehicle on which they are mounted and objects in the environment. Here again, the signal would be confused and difficult to interpret, but they may have value as a safety sensor when people must work in close proximity to a robot.

Proximity sensing — indications of external objects less than 12 inches away — offers several possibilities for sensor design. Several designs are based on optical methods. In principle light, either infra-red or visible, is focussed on a point in space some inches away from the robot surface (Pond 1979). Any light returned from that point is focussed on a photosensor. While there is no object at that point, the light returned will be negligible; when an object is at the exact point of focus, the returned signal will be at its maximum (**figure two**).

This system is very selective but certain surfaces will reflect the light poorly and transparent objects pose a particular problem. Furthermore, this type of senor is sensitive to other sources of light that may be of much greater intensity than the transmitter. It is

continued on page 89

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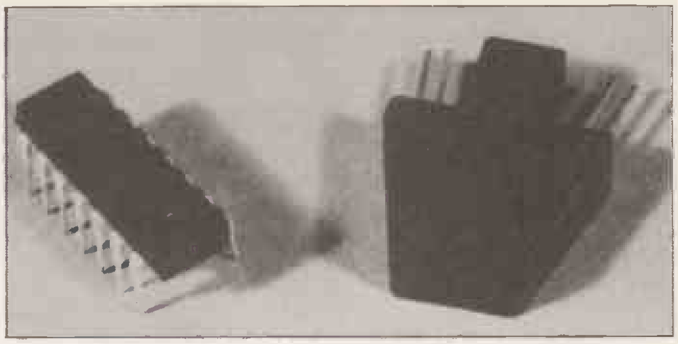
continued from page 87

usual to modulate the outgoing beam and to ensure that the receiver is only actuated by light modulated in that way, either using bandpass filters or by employing a tone-decoding phase-locked loop such as the NE567 device.

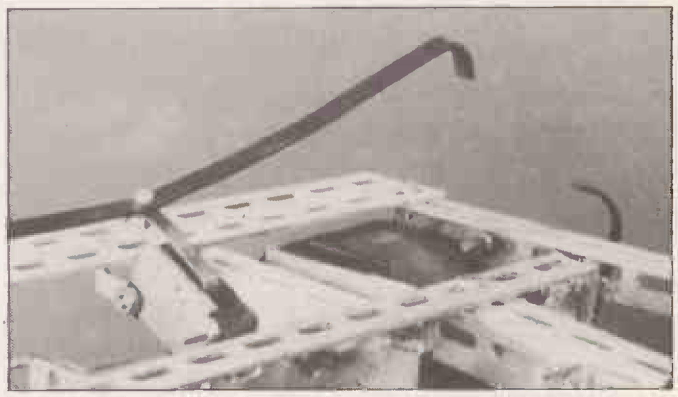
Texas Instruments produce an infra-red led/ phototransistor pair mounted in the same housing and angled to give maximum optical coupling when an object reflects the light at a distance of 0.2in — the TIL139. **Photograph one** shows a similar device. (The 14-pin dil indicates the size).

This device may well be of special interest to Micromouse builders as it would be ideal for detecting the red-painted tops of the run walls. By using the signals from several of these, the mouse could be steered and could also locate branches in the maze. If you expect your mouse to be on television, the beam *must* be modulated, since their lighting is notorious for upsetting equipment.

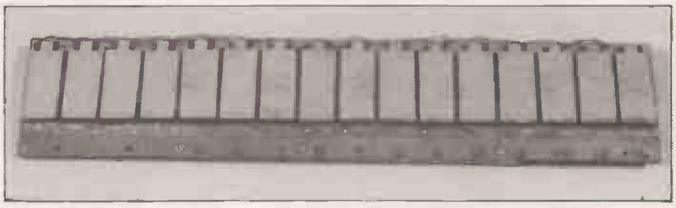
Picture 1: Infra-red/ led phototransistor pair (right) of special interest to Micromouse builders



Picture 2: One of eight microswitches used to provide all-round touch sensing on a small robot



Picture 3: Special-purpose strip of 16 experimental touch sensors



Proximity sensors

Proximity sensors are available that will detect most materials by capacitive or inductive changes as the sensor head is brought close to the object. Such devices are used in some standard industrial applications and so are available in commercial grade housings. This makes them suitably robust, though not always very cheap. They are not entirely suitable as general purpose sensors due to wide variations in response to different materials. Inductive types respond to most metals; capacitive types will also respond to non-metallic materials such as wood or PVC. Fluidic sensors are also used in commercial applications.

Zero-range — actual contact — sensors can be either binary or analogue. A microswitch is a cheap and readily obtainable touch sensor, that comes in a good range of sizes, types and actuating forces. **Photograph two** shows one of eight microswitches being used to provide all-round touch sensing on a small robot.

Each of the robot's four sides has a pair of switches joined together by a length of phosphor-bronze strip. The strip is loosely bolted to the switch lever so they can be operated independently, according to where the object touches the vehicle.

This arrangement detects most obstacles at floor level — anything that juts out above the level of the switches should be removed from the vehicle's environment. Notice how the ends of the connecting strip have been bent out; it works best that way.

Tactile resolution can be increased by fitting more switches to the surface of the machine, or by fabricating a special-purpose matrix or strip of sensing devices. **Photograph three** shows a line of 16 experimental touch sensors.

Tactile resolution

Carbonised conductive foam, as used to store CMOS devices, is mounted between two conducting surfaces made from printed circuit material. The conductivity of this material increases with the degree of compression. This change of resistance is easily converted to a voltage and fed to a microprocessor.

Several problems prevented the use of this system. The most serious was that the foam became unstable after it had been cycled many times. The material is also rather stiff, and while one segment worked well (for a time), when the vehicle was asked to compress many segments, the change in each individual segment was too small to give a useful signal. However, the idea may be revived for a larger, more powerful vehicle. Larcombe (1976) has also designed arrays of tactile sensors.

Pugh, Heginbotham and Page (1977) describe a matrix contact sensor in which a plate is drilled with holes in which a number of ferrous rods may slide up and down. When the plate is lowered onto an object, the rods are pushed up through the plate to a depth proportional to the height of the object at that point. The displacement of each rod is measure by the depth it has entered a coil (**figure three**). A contour map of the object is thus rapidly formed.

Grids of tactile sensors are of particular importance on the inside of gripper jaws, as they indicate to the system when an object has been touched, and also that it is correctly oriented in the jaws. Ueda *et al* (1976) uses a similar idea, with only a single rod, to measure distance in robot welding tasks — a distance measuring triangulation sensor is also described in this paper.

Strain gauges, as shown in **photograph four**, provide a useful method for measuring stress and force applied to or by either a vehicle or manipulator. A strain gauge is a thin strip of resistive material, often a copper-nickel alloy, on a thin flexible plastic sheet backing, fabricated by accurate photo-etching techniques. The background of **photograph five** is a 0.1 inch grid.

Typical resistance of a strain gauge is 120 ohms; when the track is bent or distorted a resistance change occurs due to changes in the length of the track and the physical characteristics of the alloy. The gauge is bonded to the surface of the stressed member with an epoxy adhesive.

Resistance changes are small, so the gauge is normally incorporated in a Wheatstone Bridge and the resulting signal amplified by a high-gain operational amplifier circuit, as in **figure four**. Figure four shows the outline of a quarter bridge circuit. Changes in resistance in the gauge, A, cause changes in the differential voltage at the inverting and non-inverting inputs of the operational amplifier. Both the gain of the circuit and the zero point (with the gauge unstressed) can be altered to suit the application.

In a half bridge, A and B are now both gauges and C and D remain fixed resistors of the same value. This arrangement produces a greater signal, better signal-to-noise-ratio and temperature compensation than the quarter-bridge. A full bridge circuit, in which A, B, C and D are gauges, offers the best performance of all.

Strain gauges are manufactured in many configurations, linear (as in the photograph), for multi-dimensional stress (rosette gauge), for torque loading and diaphragm distortion (Jones 1977, or any book on transducer and instrumentation systems). Many gauges will be used in a multi-dimensional force sensing unit to give a simultaneous read-out of applied force in the X, Y and Z directions.

Several designs have been produced to work on manipulator joints, particularly the wrist. Goto, Inoyama and Takeyasu (1974) describe a cross ('+')-shaped coupling fabricated from sheet spring steel at the wrist with a strain gauge on each of the branches, which has been used for assembly tasks involving inserting pistons in cylinders machined to close tolerances (20 microns).

Wang and Will (1978) describe a modulator

continued on page 91

continued from page 89

system, one module for each degree of freedom giving essentially independent outputs. Such a system would lend itself well to use in the 'fingers' of grippers, to detect how much force is being applied to an object being squeezed. The Olivetti SIGMA assembly robot has a force-sensitive wrist in which displacement is measured against springs by position sensors (Salmon 1977).

The Charles Stark Draper laboratories hve done a good deal of research into the whole problem of mechanical assembly, using both multi-axis force sensors and compliance wrists (those with a certain amount of 'give'), particularly of close fitting parts (Nevins and Whitney 1979). **Figure five** shows a possible sensor configuration for a wrist and gripper on a manipulator.

The most important proprioceptive system on a manipulator arm is feedback showing the position or angle of each of the joints. In a computer-controlled arm this is essential. The final position of the gripper is calculated in relation to the working environment, and the movement of the joints is guided along planned routes to avoid known obstacles, including, in a multiple arm system, the other arms.

Many of the currently available point-to-point and continuous-path industrial robots are servo-controlled. Signals from their position sensors are recorded during the 'training' phase. During the playback phase, this recorded signal is compared with the current arm position and the error signal is used by the computer to drive the arm correctly (eg Aareskjold 1979).

Position encoders

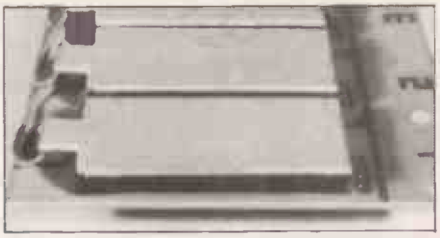
Position encoders can be either analogue or digital, linear or rotational. Linear or rotary potentiometers produce a signal according to where a slider is on a resistive track — a voltage applied across the ends of this track give a voltage proportional to the position of the joint. Generally these have a lower precision and repeatability than digital types, but are cheaper. Their linearity is more important than actual resistance value.

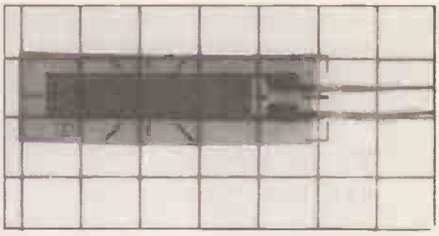
Digital encoders, in which a binary code is read optically from a disc or strip using a light/photocell pair are common. The binary code may either be straight binary, in which case certain transition errors are possible, or a Gray code in which only one bit changes at a time. Eight to ten bit codes are not uncommon and are generally adequate for robot use (about 0.3 to 1 degree resolution in 360). Special techniques in which interbit distances are resolved can give resolutions equivalent to 20 bits. Many of these techniques and systems are described in Woolvet (1977).

With constrained manipulator joints, errors are usually non-cumulative — there is always a reference position on each joint, often defined by an end-of-travel sensor, indicating the limit to mechanical movement. When a control program has to track the position of a mobile vehicle, the problem is far worse. On small machines stepping motors may be used, and integration of the number of steps made (eg Ralph Hollis's NEWT).

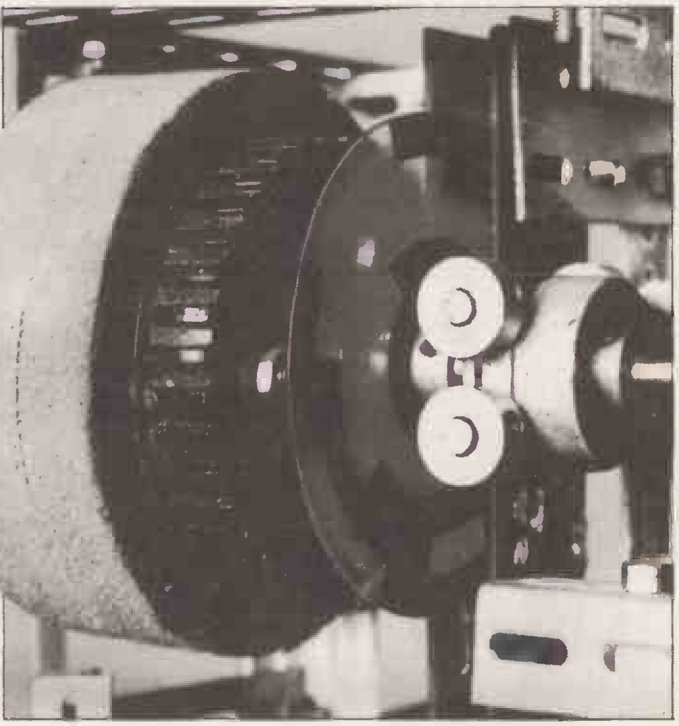
On larger vehicles, less easily-controlled drive systems are used. The distance the vehicle travels may be monitored by odometry — integrating the cumulative rotations of the wheels, and then calculating the current co-ordinates of the vehicle. A similar process is known to sailors as 'dead reckoning'.

As this system requires continuous updating, it is computationally expensive, and prone to





Picture 4 (left): Strain gauge
Picture 5 (right): Close-up of photo-etched plastics sheet backing



Picture 6: Gray-coded disc used to measure wheel rotation

cumulative errors. Tyres can change diameter due to wear or differing inflations and wheels can slip on a poor surface, or if subjected to excessive accelerations. Inertial navigation systems avoid these problems but only at prohibitive cost. **Photograph six** shows a Gray-coded disc used to measure wheel rotation on a small robot.

A learning micromouse will almost certainly use a system of this nature. Wheel rotation would be translated into an X-Y coordinate system. A combination of TIL139 type proximity sensors and microswitch touch sensors, possibly with wire 'whiskers' attached (as with Hobby Electronic's HEBOT), will tell the software when a 'T', 'L' or '+' junction or blind alley has been encountered. The current co-ordinates would be stored and used for route planning later.

One solution is to use odometry or dead reckoning as the basis for a total navigation system, but to back it up with information from other sensors. Sonars will detect fixed obstacles, whose position is known; light or radio beacons can provide directional bearings, allowing triangulation. The computer system must therefore generate and maintain a map of its surroundings, a useful extension of the maze-running algorithms that micromouse work will produce.

Aviation provides many interesting examples of navigation by the use of external signal sources. Radio navigation aids, such as Loran 'C', the Decca system, Omega and GEE (from the last world war) involve two or more ground stations that simultaneously transmit pulses.

Signals received from these transmitters will have a phase relationship due to the propogation delays from the transmitters. If they arrive at the same time, the receiver is on a line equidistant from the two stations. Time differences between the two signals define the receiver to be on a hyperbola between the two. By using a third transmitter, the point of intersection between the two hyperbola fixes the receiver's position.

Generally, the delays using radio waves would be too short and acoustic systems would suffer badly from reflections and other unwanted signals. If the system were reversed, such that the vehicle transmitted and several ground stations received, relaying the information back the system would stand a better chance. Cohen's 'drawing' robot, for example, has four ultrasonic receivers at the corners of the robot area (0.2in resolution in 16ft).

For robots that use mainframes and mini-computers as part of a ground station, this poses no problem, as timing information can be sent with all the other information flowing between robot and computer. Transponder systems in which the vehicle transmits a coded signal which is retransmitted from only one of many possible ground stations (time of flight proportional to distance) are also a possibility (*Navigation systems*, Byatt 1980).

All sensory information from these transducers, and a huge range of other possible designs, some or all of which may be appropriate to a particular design of robot, must then be fed into the computer system. Interfacing binary sensors, such as the microswitch touch sensor, digital shaft encoders and sonars to a microprocessor is straightforward. Parallel interface devices, such as the MC6820, are readily obtainable and easy to use, with full

continued on page 124

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Games-playing pastor George Blank shows how to . . .

Write games for fun, cash and fanmail

WRITING and selling computer games can be a lot of fun. The joy of bringing pleasure to others, the occasional fan mail — much of it outrageously imaginative and entertaining — the feeling of power from the knowledge that you are structuring the time of thousands of people, and the satisfaction of royalty cheques, not to mention the pleasure of designing and playing your own games, are all among the rewards.

It is probably not a way to become wealthy. By far the majority even of those who are good at it will not be able to earn a living at it. It can be a profitable source of extra income, and it makes a delightful hobby. It is not difficult, so many people who are not currently aware of their abilities may be able to try writing games.

The starting point is an idea that can be turned into a game. Possibly the greatest resource of the games master is the ability to see things in a fresh new way that captures our imagination and draws us into his or her own created world. There are many sources of ideas. These might include the reliving of great moments in history, the simulation of fantastic adventures, playing a role from literature or popular movies and television shows. Many other sports and games may themselves suggest either adaptations to the computer or a new direction for a computer game.

Once you have an idea, play with it for a while. I cannot overstress the importance of writing it down, for it will not be clear until you have forced yourself to express it well. Unfortunately, it is also likely that you will forget it if you fail to write it down.

Organize papers

After you have written down the idea, think of different ways to present it, special twists, innovative ways to use the idea to capture the imagination. Few games will be any better than their central concept, so make sure you have a clear idea of the point of the game before you start writing it.

If the first requirement of writing a good game is committing your ideas to paper, then the second requirement is keeping your papers organized. All the hard work you do to think through the concept of your game, or implement a particular function of it, is wasted if you forget it and lose your records.

I think the best method of organisation is to use a three-ring binder for each game. The binder is flexible, allowing you to substitute new versions of older concepts, but it also forces you to organise your papers. A file folder is a possible substitute, but papers in a file folder generally do not stay in order.

Now that you have a clear idea of the game that you wish to write, you should sit down and start to write it, correct? Absolutely wrong! As a general rule, the longer you wait before you commit your game to a fixed form, the better off you will be. The best way to treat a good idea is to back it up with research.

In writing a simulation of the clipper ship races of the last century, I read books on history, fictional accounts of sailing, atlases and geographies, guides to sailboat racing, even navigation handbooks. All the time I took notes to add to the note book. As I learned more about my subject, the central concept of the game changed several times, and I wrote out a new concept.

Deadlines

There is a danger at this stage for the person who has previously written successful games. I think it is a bad idea to tell a publisher what you are doing, for if the idea is good, you will then be under pressure to rush the job. The best games take weeks or even months, and rushing them destroys them.

The time to tell a publisher about a game is when it is fairly well written, and you need encouragement to keep you at it. Then an expression of interest may provoke you into finishing the task with diligence.

Of course, the problem might be quite different for the novice, who may not even know a publisher. They will have to have a finished product before they even make contact, and then wait a frustrating three to four months to hear back from the publisher.

Once you have developed the idea and done your research, it is time to think about the factors that will enter into the game. For example, in a political simulation, it might be important to give players control over tax levels, food supply, current events, economic investment, the quality of advice received, and many other factors.

Once you have a good idea of the factors that will be in your game, start thinking about the degree of control, from total player control to total randomness for each factor, and place your thoughts in your notebook. You will not be committed to these ideas, and they will certainly change, first as you write the program and later as you test and polish it, but the early thinking helps considerably.

My personal suggestion is that these steps should take from one to three weeks for a moderately-sized game of high quality. Now you are ready to write your program. There is really only one language that is suitable for the first writing of your program, and that is your native tongue. I program in English before I even begin to program in BASIC or Assembly Language.

It is difficult to tell how much time to put into this, but you will eventually sense the point at which it would be profitable to switch from human language to computer language. My guideline is that each hour spent in planning should later save at least an hour of debugging. If I plan beyond the point at which I am using my time productively, I am wasting my resources. But inadequate planning is also wasteful, as the program may require a lot of debugging or even extensive rewriting.

Ready, get set . . .

Once you have a decent outline of the program you wish to write, you are almost ready to begin programming. All you need to do is get your notebook ready to keep track of your program. I consider three sections absolutely essential. They are an Index to Sub-Routines, A List of Variables, and Documentation Notes.

The Index to Subroutines is not a fancy typewritten alphabetical cross-reference to everything in your program. It is simply a list of the parts of the program you have written, the starting line number, and enough description that you can find it.

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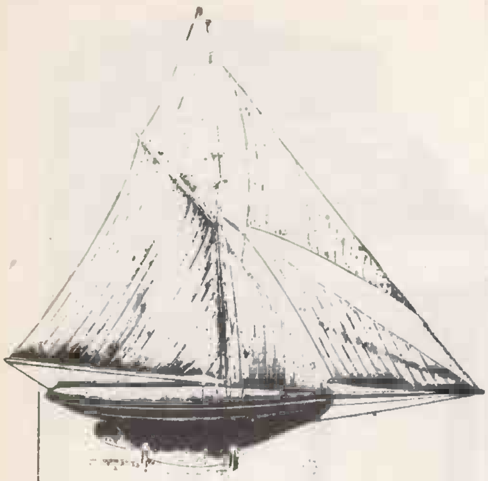


from previous page

This way, you just look on your index page for a routine you want to change or re-use without searching through your program. Here is a sample — the original was done in pencil.

00 Initialize
1000 Control
2000 Board meeting
3000 Controller Report
4000 Sales Report
700 Page Turner
500 Integer Routine
5000 Production Meeting

I write these down as I begin to write that part of the program, then if I wish to refer to a routine I look at it again. For example, I often use an integer subroutine in my games. Since the limit for the INT command in my computer is 32,767, the integer routine tests to see if the number is less than that, converts it to an integer if it is, or divides it to bring it down to the proper range, uses the INT function, and multiplies it back. Using the above list, when I want to use the Integer Routine, I know all I have to do is use GOSUB 500. If I need to know what variables to use for the routine, I can LIST 500-690, as I can see that the next routine starts at 700.

Critical housekeeping

The other critical piece of housekeeping is a List of Variables. I have mimeographed a form that simply lists the twenty-six letters of the alphabet, with rows across the page for several variables starting with that letter. A typical line might look like this.

G *Print at loc.* G G(1,5)
General Staff G$(9) *Graphics*

My games often use dozens of variables, and a list of those in use is the only way to avoid extensive debugging problems. I also use pencil on this, so that I can make changes, or list more than one variable in each space. For example, if I want to add two more variables, GF and GM, I could list both of them in the empty second row, one on top of the other.

If I use matrix variables, I use a separate piece of paper for each matrix with a list of each item. For example, here is the breakdown of the G(1,5) matrix in the previous example.

P = Player (0 or 1)
G(P,0) Equipment
1) Morale
2) Funding
3) Divisions
4) Administrators
5) Leadership

These I usually type out neatly, as I will probably refer to it many times as I use these variables in different parts of the program.

The third essential section is the documentation section. This is already well begun with the statement of the concepts and the notes from your research, plus your English language program. Simply keep it up-to-date so that you can refer to it as you write the program, and later as you prepare the documentation to send out with the program.

Grin and bear it

All of this may strike you as unnecessary paperwork. Why should you go to all that trouble just to get ready to write a program? I will admit that I can write some programs without any of this work. But quite frankly that means only very short programs, and it is getting very hard to sell short programs any more.

On a longer program you will simply get lost if you have inadequate documentation, you will spend more time looking through your program for the information described here than you would have spent to write it down, your program will be poorly organised and therefore take longer and be harder to write, then, as a crowning blow, after all these extra problems, you will probably spend twice as many extra hours debugging as you save by skipping the paperwork. So either grin and bear it or groan and bear it, but bear it nonetheless!

Now for the actual programming, or perhaps a better term, translating your English program into a computer language. I have several suggestions to make. First, and most important, do not neglect style. Style means that your program should be easy to read, nicely organised, and well commented. There are several good books available on style. I could recommend these, but there are others.

Programming Proverbs, by Henry Ledgard (Hayden Book Company)
BASIC With Style, by Paul Nagin and Henry Ledgard (Hayden)
The Little Book of BASIC Style, by John Nevison (Addison-Wesley)

Style is the man

I prefer them in that order, and think that only one is necessary, but a novice to programming might prefer the second one. You don't have to read these books, though. You can also learn style by reading other people's programs in magazines and taking note of what they do well. I think the books do a more comprehensive job and prepare you to recognise good style in the magazines.

I edit a magazine, and believe me, I think style is important. In fact, I can think of one program that I printed mainly as an example of style, and not for its content at all!

I find it very helpful to have a standard numbering convention for my programs. Here is my preferred system. You may use it or neglect it as you wish:

- ☐ All subprograms begin at a line number ending in ØØ.
- ☐ Remark statements have line numbers ending in 9 and are never called by GOSUB or GOTO.
- ☐ Line numbers ending in 1 are used strictly for temporary test lines, to be removed before the program is published. This allows me to print out the variables upon entering and leaving a subroutine, use the TRACE command, and do other tests.
- ☐ Line numbers 2,3,4,5,6,7 and 8 are for additional lines added after the routine is first written.
- ☐ Program lines otherwise end in Ø.

After you are completely finished with your program, and it is thoroughly debugged, you might consider using a renumber program to give it orderly line numbers. Our magazine receives frequent requests for this from people who use the AUTO command to type in line listings.

As you write the actual game, the content is your responsibility. That is what you are selling. All of my suggestions are simply to make your games easier to write or easier to sell. Beyond the content, however, there are some important factors, including graphics, animation, pacing, frustration, and difficulty.

. . . tells a story

Graphics cannot be overstressed. The difference between a good program and a lousy program is usually presentation, not content, and most people prefer pictures to words. I program for the TRS-80 computer, which has memory-mapped graphics. You can buy pads of worksheets to use in plotting your graphics, but I use an easier and cheaper method.

There is a worksheet pad in the Radio Shack manuals. I have taken my manual apart and punched it with holes for a three-ring binder. Then,, at an office supply store, I bought a sheet of clear plastic and a special marking pen for overhead projector transparencies. I punched holes in the plastic to fit in the binder right over the worksheet, and now I have a re-usable graphics worksheet. The transparency marker erases with a damp cloth once I have finished my graphics and want to re-use the plastic.

Animation is really only a special form of graphics, but it adds interest to a game and makes it easier to sell. Sound is also in this category, whether it is music, ringing the bell on the terminal, working a buzzer, or using a speech synthesizer. I have seen one program for the TRS-80 that gives some nice sound effects by clicking an internal relay in the computer.

If your program uses special hardware such as a speech synthesizer, you reduce your potential market unless you isolate the part of the program using the hardware and make it optional. You could do this by a routine like this, with a sound package at the subroutine at 5000.

```
10 INPUT"Do you have a music
   board";M$
20 MU=0:IF M$="YES" THEN
   MU=1
30 IF MU=1 THEN GOSUB 5000
```

Any later call for music could also use the test: IF MU = 1.

Good pacing means that the game has enough going on to hold your attention. Games that require the player to sit for a long time while the computer does a calculation to get ready for the next move, or draws a very slow graphics routine, get very boring very soon. You can speed things up, break up long calculations into separate parts of the program, provide diversion, or rewrite the program to avoid such routines.

Speeding up

To speed up a program, you can use integer variables, which are much faster than single- or double-precision ones, use variables instead of constants, place frequently-used subroutines and DATA at the beginning of your program, and use other tricks appropriate to your computer. The reasons for these items are as follows.

With integer variables, the computer has to handle only one byte of data, which can be easily handled by the registers, instead of using long, slow sub-routines for arithmetic. With a constant like 3.14, the computer has to treat each digit separately, read it, put it together, convert it into a register variable, and figure out what to do with it.

If you have a variable like PI that was set equal to 3.14 earlier in the program, the computer just loads it into the register and tries to figure out what to do with it, saving many machine-language steps. The reason for putting subroutines and DATA at the beginning of the program is that the computer starts at the beginning to look for them when it gets a READ, GOTO, or GOSUB statement. Then it has to test every line for DATA, or compare every line number for the one requested until it finds it.

Providing diversion is often fun. I have a Star Trek program that has to read a lot of data at the beginning of the program, in order to set up a matrix. I simply put PRINT statements at appropriate points in the initialization routine, so that the computer prints out messages like "ENGINE TEST: GREEN" and "ALL CREW ON BOARD" at intervals while you are waiting instead of just sitting there.

Frustration should be carefully planned for, as it can really hurt a game. One of my worst examples is in a game called 'Round the Horn' that I wrote for SoftSide. It is a clipper ship race around South America. If a player does not sail far enough east before entering the Doldrums, he must cross the doldrums at an angle, against the current, and without wind. It could take months! While that is realistic, it is not a lot of fun.

In the doldrums

If I ever rewrite the game, I will add a routine that tests for three weeks in the doldrums and then ends the game with a message like this. "Your crew just died of thirst while trapped in the Sargasso Sea". The point is not to eliminate all frustration, but to limit it to manageable chunks.

Difficulty should be appropriate to the game and consistent. That is, an Intellectual game should not be too easy, a game for young children should not be too hard, and an easy game should not have very difficult parts. I like to put graded difficulty levels in my games, so that beginners can play one level and expert players another.

Once you have programmed your game, you have made a good beginning. I would say that about one-third of the work is done. Now you have to debug it, test it, revise or rewrite it, provide documentation, and sell it. I suggest that you play with it, and eliminate any bugs. Then get your friends to play it and get their reactions. Watch them play. Notice any problems they have. Ask for suggestions.

I am very fortunate in this regard, as the youth group of my church loves to play computer games, and they are getting pretty good at making suggestions. You might do well to volunteer as a church youth worker or scout leader to get a hold of a valuable free testing organisation!

Once you hve the game thoroughly tested and debugged, the best thing to do is start over. You shouldn't have to do much more research, but the game will probably be much better if you start over by completely rewriting your English program, then redoing the computer program.

Cost v. quality

I realise that there is a consideration of cost versus quality here, but the market is beginning to demand high standards and this is the best way to do a real quality program. It should go much more quickly, as you have already figured out most of your problems. Now you are looking for better and more interesting ways of doing the same things.

After you rewrite your program, polish it. If you can, add suspense. Television holds our attention and keeps us from changing stations during the com-

mercials by providing a moment of suspense every seven minutes, just in time for a commercial. Is each turn too long or too short? Is there enough action during a turn? Are the graphics sequences attractive and well-paced? Do they add to the game? Are there dull moments in the game, and if so, how can they be eliminated? Can you add special features like animation?

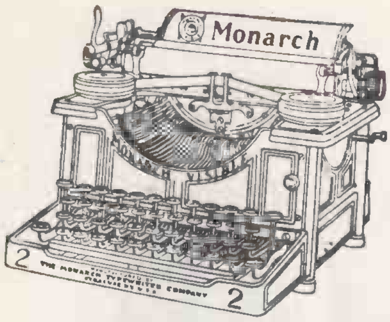
Check for flaws

Now check your program for flaws. The best way to do this is to have lots of people play lots of games. After I publish a game, there are several thousand readers of *SoftSide* to detect any flaws, but I prefer not to print corrections!

One very important step is to find out how your variables react near the edge of their range. If they ever get near zero, find out what happens at zero. Is there an attempt to divide by zero? If you use variables in your graphics, find out whether they will ever go off-screen, and what would happen if they did. Does the program require more memory than most people have? Are you relying on special features or modifications to your particular computer? Have a friend try it on his computer to make sure.

Now there are oly two steps left, but they both take lots of time. The first is to continue your testing for at least a month, with as much testing as possible, to make sure all the flaws are gone. This is hard to do, and I confess it is the most difficult thing for me. But most editors or reviewers, if they get a program that bombs, move on to the next program, and

continued on next page



from previous page
that is the end of all your hard work. We now get so much software that we just don't have time to debug it ourselves, so we usually reject it unless it is really promising.

In the marketplace

Finally, it is time to sell it. There are many factors here. Two that are most immportant are the type of program and the documentation. If you want to sell it to a magazine, you should write an article to go along with it. The article can include a background story for the game, instructions, and hints on playing the game, along with suggestions for those who want to modify it. Smart software houses are also asking for good documentation, for that can avoid copyright problems. After all, who wants to copy a friend's program when they can get a cassette and a very attractive and helpful instruction manual for a good price?

One of the factors related to the type of program is the kind of computer the program is written for. I am a successful writer of computer games largely because I write for 16K Level II TRS-80 computers, and probably one-third of the computers in the world fit that description. I used to own a Heathkit Microprocessor Trainer, but there is not much income in writing programs for that. *SoftSide* is a successful magazine because every one of our programs will run in a 16K Level II TRS-80. We will not publish a program that requires more memory or a disk unit, although we also publish PROG-80, which does print those programs.

The best chance

But the type of game also determines your market. A careful look at what different magazines publish will show you where you have the best chance. For example, the readers of *SoftSide* prefer rather elaborate simulations with a lot of intellectual challenge. Once you find an appropriate publisher, look around for others.

In addition to magazines, there are also software suppliers who publish games on cassette and diskette. Several publish both ways. When I sold 'Round the Horn' to *SoftSide* (Before I joined the staff), I was paid for it as an article, I received royalties from the cassette version of the magazine, and ever since I have been collecting monthly royalties on cassette sales from the TRS-80 Software Exchange operated by the magazine, stimulated by ads in other computer magazines and direct mail.

Time delay

Another consideration you will want to look closely at is what the publisher will offer. My best program so far, 'Santa Paravia and Fiumaccio', is handled by Instant Software, a division of Kilobaud Microcomputing. I am not sure it is a wise choice. The advertisement is a tiny ad buried in a page of fine print. They demand an exclusive contract, which few others do, so I have to rely on what they offer. Their sales are not really that great.

Our magazine probably sells more TRS-80 software. It took nine months for them to process the game before the first ad appeared. I think they offer a good deal to the purchaser, with the game in Level I, Level II, and Tournament versions on cassette with an instruction manual for $7.95, but they are not very responsive to their programmers.

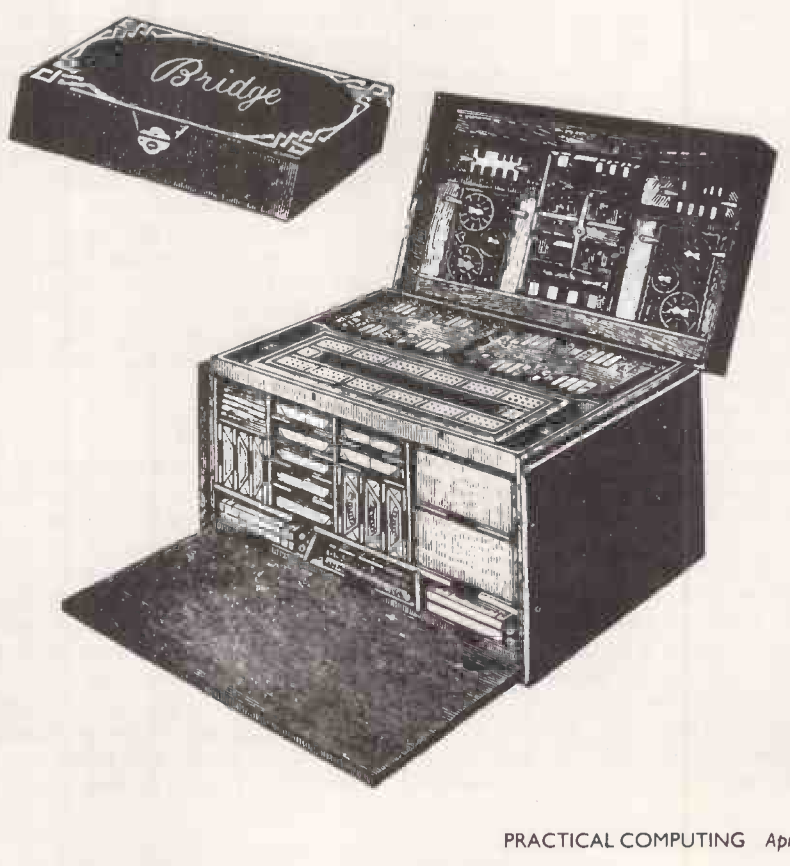
It will generally take from two to four months to have your program reviewed, and then it could be another month or so to have it published. As far as I know, no other publisher takes the nine months required by Kilobaud. I have received cheques from some magazines in as little as six weeks after sending my programs. It is probably fair to send a game to several software houses, but you should not offer it as a magazine article to more than one publication at a time. Wait until you are accepted or rejected before offering it to another publication. If you receive no acknowledgement at all, not even a note saying it was received, then I consider it fair game to submit it to another magazine in two months.

I would suggest sending your material to the more successful magazines first, then to less successful ones if your material is rejected. The smaller ones are desperate enough for software to print almost anything, but they pay quite poorly. I know of at least 15 magazines in the United States that are paying for TRS-80 programs, and I know there must be a lot more. I am not familiar with magazines outside the United States except *Practical Computing*, but I know there are several. I might mention that British readers do not have to send articles to the United States; *Practical Computing* pays as well as anyone.

Presentation

When you submit your material, appearance is important. A neatly typed article or documentation, double-spaced for the convenience of the editor, a cassette with a typed label, and a cover letter explaining what you are submitting and how to load and use it, all make a good impression.

It may sound like an elaborate process and a lot of work, but writing games is fun and profitable. I think it is worthwhile, and I hope that many who read this will share in the rewards. I know that editors like myself are hungry for good material, but we are often buried in poor programs that do not meet the standards discussed in this article.



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• Circle No. 189

Caught in a trap — no turning back

M.K. Cook on Maze Runner, a game of hand-eye co-ordination for the TRS-80.

TO RESIST the obvious pun, Maze Runner is a most remarkable game, both in its origin and final form. It is written for the TRS-80 Level II and will happily sit inside 4K.

I found I had accidentally invented this game in the course of my job as a lecturer in the Physics, Mathematics and Computing department at Manchester Polytechnic. I was investigating a method with our Psychology department could use to study hand-eye co-ordination, utilising a variable-speed moving dot on a computer display.

The game had a remarkable effect on hard-bitten, seen-it-all-before computer programmers. They were most enthusiastic and gave up whole dinner hours to playing it. Most surprising of all, if you know computer programmers, was that nobody could criticize it or come up with any "improvements".

Each game is different because of a random maze-drawing program. It is played as follows:

The computer asks how many players will want to run the same maze. Even if you are playing by yourself, it might be interesting to have more than one run at a maze to see if you can improve your score. The computer will then draw the maze and put an "X" in three corners and in the centre. In the bottom left-hand corner is your ball — quite still.

The object is to guide the ball into the "X"s, thus removing them from the screen. You can make the ball change direction by using the cursor control keys. If the ball hits a maze wall, it will bounce off in a random direction. Each time you press a key, or the ball bounces off the wall, one point is added to your score. The player with the lowest score wins.

The program does not check whether all the "X"s have been eliminated, as this would slow the game down too much, so you must press the "S" key to set the maze up for the next player or to show the score. This can allow some mild cheating, but it will not go undetected by the other players.

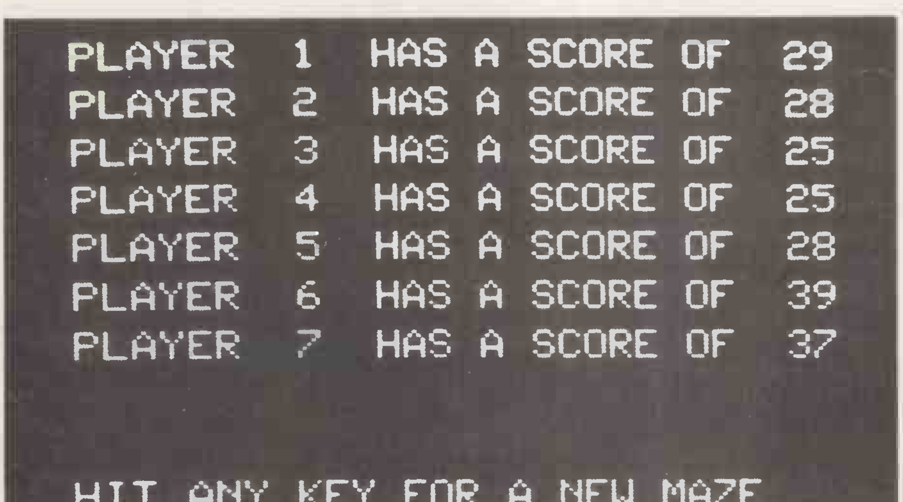
Once running, the program will always let the same number of palyers through each maze. To change this, press the "BREAK" key and type RUN.

Several variations of group play are possible: individual scores, team scores or relay scores. In the relay mode, each member of the team has to get one "X" and then another member takes over. It is quite difficult to regain control of an already-moving ball.

Perhap the greatest fun to be had from this game is when you persuade somebody to have their first go in public. Comments like "I'm glad I'm not driving home with you tonight" abound, as the luckless player tries to gain control. The record score for all newcomers is currently held by our departmental secretary, who notched up 957, when most mazes can be run with a score of 30!

The print-out shows one or two minor differences from conventional notation due to the limited character set on my printer. A line that starts with ' is a remark, but when ' is encountered in a PRINT statement, it is equivalent to ". Finally, $ is shown as £.

Listing overpage



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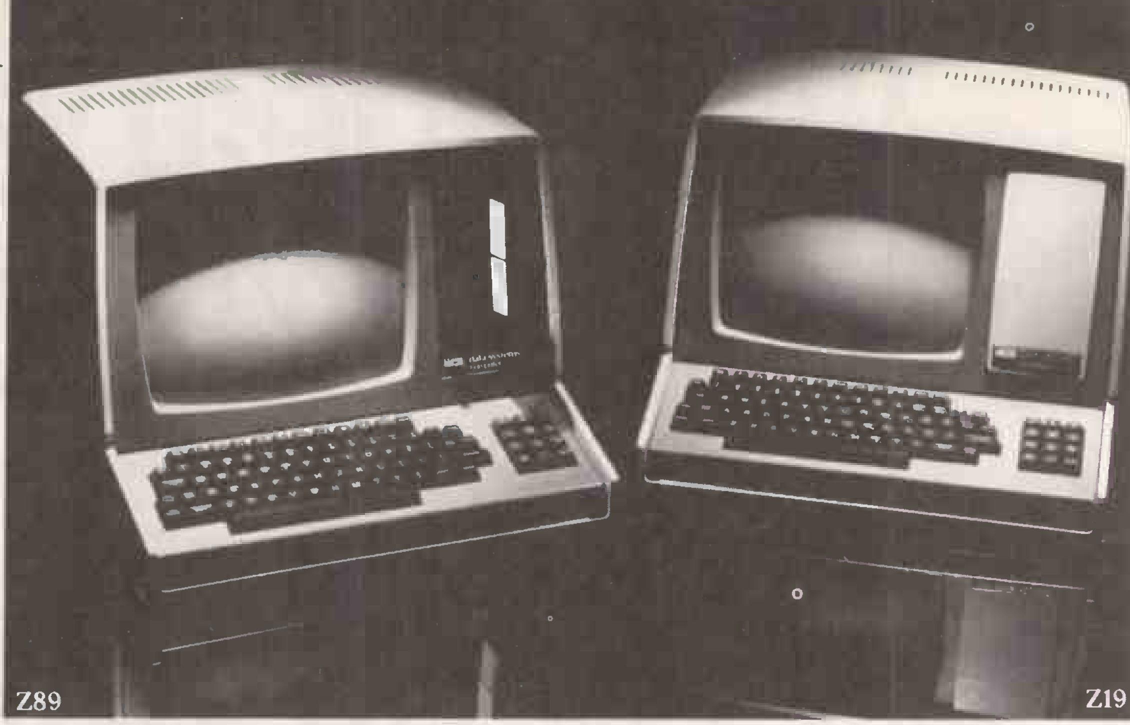
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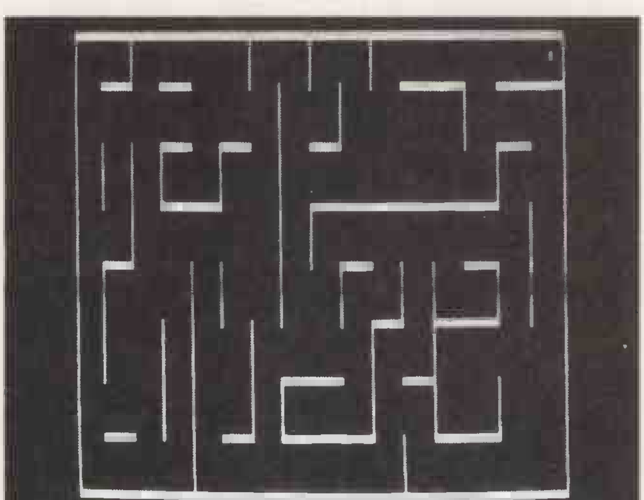
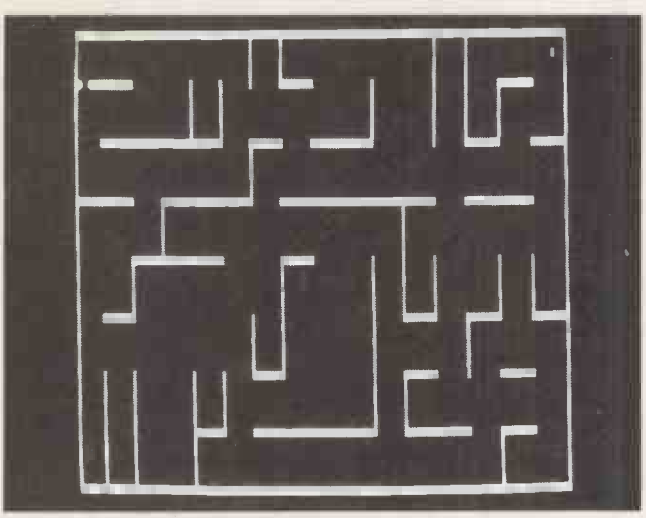
```
10 'MAZE RUNNER BY M.K.COO
K (G8HBR)
20 CLS
30 DEFINT A-Z
40 PRINT'--------------- M
AZE RUNNER ----------------
--'
50 PRINT'USE THE CURSOR KE
YS TO CHANGE DIRECTION OF Y
OUR BALL'
60 PRINT'AND GUIDE IT THRO
UGH THE MAZE'
70 PRINT'TRY TO KILL THE X
'S IN THE LEAST NUMBER OF'
80 PRINT'DIRECTION CHANGE
INSTRUCTIONS AND BOUNCES'
90 PRINT'WHEN YOU HAVE SUC
CEEDED TYPE   S   FOR YOUR
SCORE'
100 PRINT'IN THE EVENT OF
A DRAW THE FIRST PLAYER TO
GET THE SCORE'
110 PRINT'                W
ILL   WIN   '
120 INPUT'HOW MANY PLAYERS
 WILL WANT TO RUN THE SAME
MAZE ';P
130 IF P>10 THEN PRINT'10
PLAYERS AT MAXIMUM':GOTO 12
0
140 IF P<1 THEN 120
150 RANDOM
160 CLS
170 PT=0
180 GOSUB 610
```



```
190 X=3:Y=45
200 SET(X,Y)
210 PRINTO126,'X';:PRINT@6
5,'X';:PRINTO958,'X';:PRINT
@481,'X';
220 D£=INKEY£:IF D£='' THE
N220
230 CD=0
240 GOTO360
250 ON D GOSUB 570,560,580
,590
260 RESET(X1,Y1):IF POINT(
X,Y)=0 THEN GOTO 330
270 X=X1:Y=Y1
280 DC=RND(4):IF DC=D THEN
280
290 D=DC
300 ON D GOSUB 570,560,580
,590
310 CD=CD+1
320 GOTO260
330 SET(X,Y):D£=INKEY£:IF
D£='' THEN 250
340 IF D£='S' THEN 380
350 CD=CD+1
360 D=(ASC(D£) AND 3)+1
370 GOTO250
380 S(PT)=CD
390 RESET(X,Y)
400 PT=PT+1
410 IF PT><P THEN 190
420 CLS:PRINTCHR£(23)
430 W=0
440 FOR I=0 TO P-1
450 IF S(W)=S(I) THEN W=1
460 PRINT'PLAYER ';I+1;' H
AS A SCORE OF ';S(I)
470 NEXT I
480 PRINT:PRINT:PRINT'HIT
ANY KEY FOR A NEW MAZE'
490 IF P=1 THEN 550
500 PR=((W+1)*64)+18
510 PRINT@PR,CHR£(30);'  -
-- WINNER ---';
520 FOR I=1 TO 100:NEXT I
530 PRINT@PR,'  HAS A SCOR
E OF ';S(W);
540 FOR I=1 to200:NEXT I
```

```
550 F£=INKEY£:IF F£='' THE
N 490ELSE 160
560 X1=X:Y1=Y:X=X+1:RETURN
570 X1=X:Y1=Y:X=X-1:RETURN
580 X1=X:Y1=Y:Y=Y+1:RETURN
590 X1=X:Y1=Y:Y=Y-1:RETURN
600 'DRAW THE OUTLINE TO P
LAYING AREA
610 FOR X=0TO127
620 SET(X,0):SET(127,Y)
630 NEXT X
640 FOR Y=0 TO 47
650 SET(0,Y):SET(127,Y)
660 NEXT Y
670 'DRAW THE MAZE
680 T=0
690 GOTO1130
700 D=RND(4)
710 T=T+1:IF T 40 THEN RET
URN
720 IF Y=48 THEN Y=47
730 D1=RND(3)-1
740 IF D=4 AND D1=-1 THEN
730
750 IF L=3 AND D1=1 THEN 7
30
760 IF D=1 AND D1=1 THEN 7
30
770 IF D=2 AND D1=-1 THEN
730
780 D=D+D1
790 IF D<1 THEN D=D+4
800 IF D>4 THEN D=D-4
810 ON D GOTO 820,900,970,
```



```
1050
820 IF X-8 < 0 THEN 1130
830 IF X=127 THEN C=7 ELSE
C=8
840 IF POINT(X-C,Y)=-1 THE
N 1130
850 FOR A=0 TO C
860 SET(X-A,Y)
870 NEXT A
880 X=X-C:T=0
890 GOTO 730
900 IF X+8 > 127 THEN 1130
910 IF POINT(X+8,Y)=-1 THE
n 1130
920 FOR A=0 TO8
930 SET(X+A,Y)
940 NEXT A
950 X=X+8:T=0
960 GOTO730
970 C=6
980 IF Y+C > 46 THEN 1130
990 IF POINT(X,Y+C)=-1 THE
N 1130
1000 FOR A=0 TO C
1010 SET(X,Y+A)
1020 NEXT A
1030 Y=Y+C:T=0
1040 GOTO 730
1050 IF Y-6 < 0 THEN 1130
1060 IF Y=47 THEN C=5 ELSE
 C=6
1070 IF POINT(X,Y-C)=-1 TH
EN 1130
1080 FOR A=0 TO C
1090 SET(X,Y-A)
1100 NEXT A
1110 Y=Y-C:T=0
1120 GOTO 730
1130 D=RND(4)
1140 Y=6*(RND(9)-1):IF Y=4
8 THEN Y=47:D=4
1150 X=8*(RND(17)-1):IF X=
128 THEN X=127:D=1
1160 IF X=0 THEN D=2
1170 IF Y=0 THEN D=3
1180 T=T+1
1190 IF T>20 THEN RETURN
1200 GOTO 810
```

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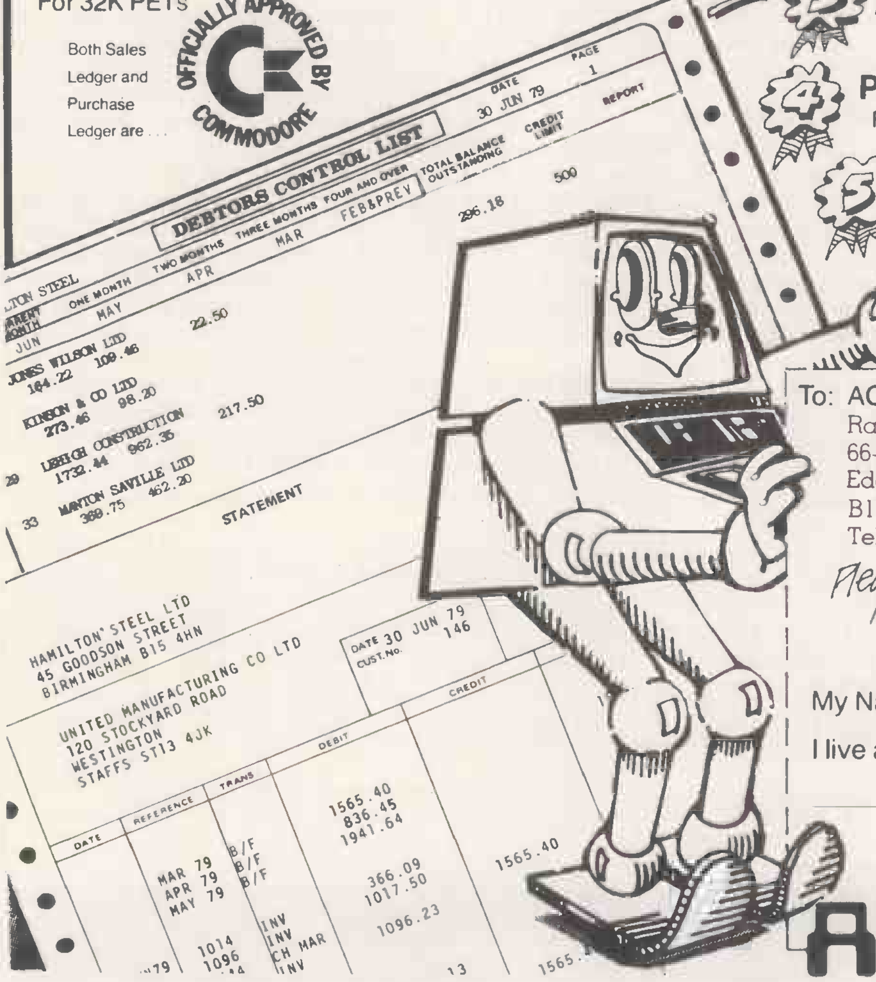

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• Circle No. 192

Eight, yes eight, Basics for Nascom: a comparative survey

The Nascom is among the simplest Z80 systems available, it has been one of the market leaders in terms of numbers of units sold and yet it seems to lack any coherent software sourcing. This survey is intended to help the newcomer to choose the most suitable of the eight versions of BASIC for his system and his needs. By Nick Laurie

THE NASCOM-1 was one of the earliest easily available, more or less reliable, low-cost, hobby-orientated single-board computers; today, with over 20,000 sold, it can be found in applications as diverse as industrial process controllers and pub TV games.

As more and more of the early designs fall by the wayside, so it becomes clear that Nascom is destined to become not only a survivor, but now (with Nascom-2) a Series. As evidence, many software houses (including the country's largest, ICL Dataskil) produce a range of material for use on the Nascom with, at the time of writing (November 1979), at least eight versions of BASIC being suitable.

BASIC (Beginner's All-purpose Symbolic Instruction Code) was created in the Sixties by John Kemeny — a fascinating man whose career in science and technology could put many Great Names in the shade. He recently chaired President Carter's enquiry into the Three Mile Island accident as part of a career which included work on the Manhattan Project and a continuing nine-year presidency of the prestigious Dartmouth College.

Working with Professor Thomas Kurtz he developed Basic as a very general purpose, all-powerful (with some effort) high-level language. As an interpreter — and Basic *compilers* are few and far between and very BIG — it needs to be resident in the computer whenever a Basic program is to be executed; it cannot generate machine-code programs that will run by themselves, so that when choosing a version to suit you, it is important to consider the size of your available RAM *after* allowing for the space used by the interpreter itself.

Your own set-up

In **Table 1** the entry SIZE refers to the space used by the interpreter so be sure you have a bit more than this. The CCSOFT Level A Basic is a bit of an exception; this one sits (in ROM) in the sockets provided for your monitor and combines a simple but very effective Basic with the essential monitor housekeeping routines.

The same table shows the MEDIUM used, either tape, EPROM or ROM and your choice here will affect the price. The PRICE entry in Table 1 refers only to the price of the cheapest medium; for example the 8K Nascom Basic costs only £15 on tape, but £40 in ROM and about £100 in EPROM!

On the other hand, an EPROM or ROM version leaves you all your own RAM for programs and you should consider the relative merits of the different media for your own setup.

Monitors

A word here about NAS-SYS which ha arrived in something of a cloud of confusion: it was developed for the Nascom-2 and is really an enhanced T-4. Unfortunately it is not completely compatible with the earlier monitors and programmes designed for these will not always run under NAS SYS. This applies to all the Basics here except the Nascom 8K and, very soon according to the manufacturers, the XTAL (pronounced crystal) 8K.

Bearing in mind the likely delays in publication, this situation could easily have changed by now and interested readers are advised to study the current advertisements to see whether any of the other versions reviewed here have been adapted for NAS SYS.

SIZE		2K		3K	4K		8K	
PRICE (lowest)	£21.50	£10	£25	£35	£13.50	£12.50	£35	£15
MANUFACTURER	CC SOFT	COMP	NASCOM	NASCOM	M'ROOM	CC SOFT	XTAL	NASCOM
PRODUCT NAME	LEVEL A	B BASIC	TINY B.	SUPER TB.	INTEGER	LEVEL C	BASIC	BASIC
MEDIUM	2 EPROM	CASS	2 EPROM	3 EPROM	CASS	C / E	CASS	C/E/ROM
EXTRA HARDWARE		RAM at FFFF(h)	Nascom mem b'd	Nascom mem b'd	RAM	RAM or ROM b'd	RAM	RAM or ROM b'd
MONITOR REQU'D	none	any; not NAS SYS	any: not NAS SYS	any: not NAS SYS	any:not NAS SYS	any:not NAS SYS	ANY	ANY
ORIGIN	PALO ALTO							MICRO-SOFT
ARITHMETIC	INTEGERS ONLY (no decimals)					FLOATING POINT		
CONSTANTS RANGE	± 32767					1.7 E38 —1.5E-39	1.5 E38 —1.5 —E—38	
SCIENTIFIC NOT'N								

TABLE 1
This table outlines the main parameters you will need to consider when choosing a version of BASIC to suit you.

TABLE 2
A point-by-point comparison of the eight available Nascom BASICs. A number of reserved words are available on one version only and reference is made to these in the main body of the article.

	2K			3K	4K		8K	
	CCSOFT	COMP	NASCOM	NASCOM	M'ROOM	CCSOFT	XTAL	NASCOM
VARIABLES								
Numerical	26 — A to Z				286	52	712	
String	░	░	░	minimal	A0 . Z9	░	A.Z + A0 . Z9	
Arrays	one only					only one	AA .... AZ ZA .... ZZ	
OPERATORS								
( ) + — / x								
Comparators								
AND OR NOT	░	░	░	░		indirect		
EXOR	░	░	░	░		░	░	░
FUNCTIONS								
ABS RND								
SQR	░	░	░	░	░			
INT	░	░	░	░	░			
SGN	░	░	░	░		░		
SIN COS TAN ATN LOG	░	░	░	░	░	░		
DEF FN EXP	░	░	░	░	░	░		
Raise to Powers	░	░	░	░	░	░		
STRING HANDLING								
LIFT$ RIGHT$ MID$ LEN$ STR$ CHR$ ASC	░	░	░	░	all except STR$	░		
VAL	░	░	░	░	░	░		
STATEMENTS								
max no of lines	32767	32767	32767	32767	65529	32767	65529	65529
maximum chars/line	80	132	132	132	90	100	90	72
PRINT TAB REM LET RUN IF. . THEN GOTO LIST GOSUB RETURN INPUT RAM STOP CSAVE CLOAD							*	
FOR.TO.STEP...NEXT	░							
JUMP TO MONITOR	░							
CALL or USR	░							
PUT GET (ports)	░	░	░					
PEEK POKE	░	░	░	░				
DEEK DOKE (2 bytes)	░	░	░		░	░	░	
DIM	░	░	░	░	X,Y	░	X,Y,..N	X,Y,..N
DATA READ RESTORE	░	░	░	░				
CLEAR	░	░	░	░		░		
CLOAD/CSAVE an array	░	░	░	░	░	░		*
ON.GOTO ON.GOSUB	░	░	░	░				
END	░	░	░	░	░	░		
SPC	░	░	░	░	░	░		
VDU	░	░	░		░	░	PRINT @	SCREEN
CLS	░	░	░	░	░		indirect	
POS	░	░	░	░		░		
ERROR MESSAGES	3	3	3	3	25	3	19	18

░ = NOT AVAILABLE   * ROM & EPROM versions lose CSAVE under T.2

Arithmetic

The most obvious choice to be made is between floating point and integer Basics. An integer Basic deals *only* in *whole* numbers although it is not too hard to write your own subroutines to deal with decimals or to interface to a maths package such as MAPPI 3Z for *real* power. (Mappi 3Z, as a slight aside, converts the 16 bit registers of the Z80 into two 40-bit registers to give mathematical power in an easily available form of machine code program). If mathematics and its computer applications are your forte then you will probably want a *floating point* Basic with its ability to handle big numbers and decimal points directly.

Speed

Using a high-level language such as Basic results in your computer having to take a much longer route between instruction and result; the operating speed is far slower than it would be for an efficiently coded programme written on an assembler such as ZEAP. On the other hand, your programming speed will rise at a significant rate of knots and you have only to ask yourself whether your machine spends more time being programmed or executing those programmes to be able to decide whether Basic is likely to be for you. No benchmark tests were run in this survey, since it seems hardly relevant or fair to compare a 2K interpreter with an 8K interpreter and for the typical Nascom user, the difference in execution speed is unlikely to be the most important consideration.

Editing and abbreviations

Editing, to my mind, involves something rather more subtle than

continued on next page

from previous page
Nascom's (8K) comment in their manual under this heading: "The NEW command causes (everything) to be deleted." In fact Nascom's 8K Basic was really written for use with NAS SYS (although it runs quite effectively under T-2 and T-4) and NAS SYS has full(ish) on-screen editing capabilities; however, those users without the new monitor will find themselves limited to the simplest editing functions as found in the much smaller versions (scrub line, replace line, new and backspace).

Editing is really a function for your terminal rather than for the interpreter and it is a shame that more Basics have not taken a little more account of Nascom's rather simple screen handling. XTAL 8K provides a specific EDIT command which allows insertion and deletion of characters with appropriate control of the rest of the line.

Abbreviations

LIST is allowed to carry two arguments to determine the start point of the list as well as the number of lines to be scrolled, a useful facility which is available on all except Nascom's own 8K Basic. Users of Zeap will long for the automatic line numbering and re-numbering facilities which not one of these Basics offers. Abbreviations are available in the 2, 3 and 4K versions and are sadly missed in the 8K versions.

Another point concerns abbreviations of rather a different type. You will notice in **Table 2** that some facilities such as CLS (clear screen) are not *directly* available. In this example the effect can always be achieved by other means such as PRINT CHR$(20) or PRINT CHR$(12) for T-4 and NAS SYS respectively. In Nascom's 2K Basic the same effect can be obtained using PRINT S↑ or its abbreviated P.S↑ .

I have chosen not to consider this as a direct instruction since it actually uses combinations of other commands and if we were to use this approach, then almost every Basic can be considered capable of almost every facility. Clear Screen has to be enterable as a single command to qualify for a place in **Table 2** as do all other reserved words.

Sludgeware

Last August I wrote an article for *Practical Computing* deploring the ghastly state of documentation in general; had I asked for a handful of samples of the very worst specimens, then my wish would have been granted in the delivery of the material accompanying most of these Basics.

Exceptions were CCSOFT (4K only, alas) who really put a lot of effort into turning out a professional-looking document, and Nascom who at least put all (well, almost all) of the info into the manuals but forgot to make it readable. A solid A4 page of photographically reduced typewriting or printout without an index and with such vital lists as the Error Messages buried right in the middle (why can't they be on a separate card?) represents only half a document.

Of the rest, suffice it to say that most of the information is there, but rarely in depth; they all give a few sample routines of varying value in either Basic or Basic-accessible machine-code to demonstrate various aspects of their language. All manuals (except Xtal's) are designed for about ten days maximum heavy use before crumbling to confetti. I let every remark I ever made about sludgeware stand — at least on this evidence.

Fiddling around

Almost all the information gleaned from many weeks of evenings spent fiddling with these various Basics is to be found in the accompanying tables. **Table 1** outlines the definitive parameters for each language while **Table 2** makes a point by point comparison of the eight languages. Syntax inevitably varies from one Basic to another and **Table 3** should help to clarify matters by giving a brief description of the meaning of the reserved words used in **Table 2.**

And a final word on the general approach before looking at the idiosyncrasies of the individual interpreters concerns the accuracy of this review. I have checked and double-checked, I have sent copies of the manuscript to all the manufacturers who all replied and whose comments have been included in the final draft and I have then re-checked. All the laws of Murphy, Sod *et al* dictate that there will still be inaccuracies but I hope that this comparative survey will still help Nascom owners to decide exactly what they want from a reasonably well informed position.

The interpreters

CCSOFT 2K Level A, COMP 2K tape Basic and NASCOM 2K Tiny Basic are all very similar. A range of Palo Alto-based simple Basics with CCSOFT's alone being able to run in a totally unexpanded Nascom-1, they allow the new user to develop a real feel for the language at a reasonable cost. Note that Nascom's 2K is on EPROM for use on a Nascom Memory Expansion Board; it cannot be used in place of the monitor like CCSOFT's while the COMP 2K tape is really meant to be used with COMP's S-100 expansion but any RAM addressed up to 4FFF(h) will do. Before dismissing a 2K Basic as being a bit on the Mickey Mouse side of things, for the user with a reasonable experience of machine-code programming this size of Basic provides a very suitable framework for supporting, linking and modifying machine-code programs. It can add considerable speed to your programming at very little extra cost and without hogging boards full of RAM.

NASCOM 3K Super Tiny Basic, available only as a third EPROM, is the oddball of the bunch. It is an enhancement for their 2K Tiny Basic and does not use the normal Basic reserved words but instead supplies machine-code sub-routines together with the means to reach them. Facilities offered here include simplified editing, access to the PIO, CALL (to a decimal version of a hex address) and USR plus a simple but useful string handling facility. PEEK and POKE are here with their double-byte big brothers DEEK and DOKE and are called, as are all the others on this chip using the command MC with an argument specifiying the appropriate subroutine. This third EPROM will be a very useful enhancement for the Tiny Basic user, but remember that it is only compatible with Nascom's *own* 2K Tiny Basic.

MUSHROOM 4K Integer Basic. At around 4K, a Basic interpreter begins to take on some of the characteristics that make those forty-dimensional Superstartreks look feasible — but not usually in integer Basic, although it can be, and has been, done. MUSHROOM shows its real strength in its very flexible variable handling with both numerical and string variables being handled as scalar, one-dimensional or two-dimensional arrays. TRACE is a very useful command which steps you through your program line-by-line (remember, an interpreter looks at each line in numerical order, processes it and moves on to the next line) giving line numbers as it goes. It plays havoc with your PRINT instructions since the display of line numbers is mixed up with your output giving a new line (carriage return) with each statement number encountered. Nevertheless it is a superb debugging aid and one which others would do well to incorporate.

CCSOFT 4K Level C floating point Basic. Also handles Superstartrek without much problem (CCSOFT sent a copy with their Basic tape and you nearly had to do without this article — it's very addictive) and is quite definitely orientated more towards the mathematicians. There is little in the way of string handling and a surprising lack of logical comparators in direct format, although they can be obtained in a roundabout way using non-standard instructions. Level C is gradually replacing Level B which has not been included in this article since it is being deliberately phased out after serving its purpose as an intermediate between Level A and Level C. Extra functions include STACK which allows you to POP an address of the RETURN stack to give easy access to instant confusion (as well as being very useful in its place) and INKEY which gives an instant response to any keyed input without the need for a newline.

XTAL 8K Basic (XTAL = crystal in electronic parlance) is, together with Nascom's own variation on *Microsoft* Basic, a *real* Basic. Perhaps a slightly unfair remark, but a study of the facilities offered at 8K

TABLE 3
Because of the wide variation of syntax between BASICs, this table is used to define the terms used in Table 2.

VARIABLES	Little boxes holding either a single number or a string
Numerical	Only hold numbers
String	Only hold strings of characters. Size usually changeable
Array	A MATRIX of numerical or string variables
OPERATORS	Used to relate the various components of the language
( ) + — / ×	Pretty Basic stuff!
Comparators	Greater than, less than, equal etc.
AND OR NOT	LOGICAL relations are constructed with these
EXOR	Exclusive OR
FUNCTIONS	Complex arithmetic condensed into a single instruction
ABS RND	Return absolute value of argument and random No respectively
SQR	Returns square root
INT	Chucks out everything after the decimal point
SGN	Returns one value for a positive argument, another for neg've
SIN COS TAN ATN LOG	ATN is arctan, the rest should be fairly obvious
DEF FN EXP	Condense your own complex arithmetic. EXP returns e to power
Raise to Powers	Square, cube or more to your heart's content
STRING HANDLING	Allows you to play with letters, words and sentences — easily
LEFT$ RIGHT$ MID$ LEN$ STR$ CHR$ ASC	All these allow strings and bits of strings to be manipulated in various ways including arithmetically.
VAL	Returns an arithmetic value for a string component.
STATEMENTS	A slightly arbitrary category covering everything else
max no of lines	More than enough lines for any basic program
maximum chars/line	Can often be changed with a poke command
PRINT TAB REM LET RUN IF . . THEN GOTO LIST GOSUB RETURN INPUT RAM STOP CSAVE CLOAD	These are the building blocks of any Basic program, their implementation varies from version to version but they are all available. RAM is print size of remaining memory, STOP is a glorified END returning a message like STOP IN LINE N
FOR.TO.STEP...NEXT	Real time savers if you've lived without them for a while
JUMP TO MONITOR	CCSOFT dispense with the monitor, replacing it with Tiny B.
CALL or USR	Give access to machine code routines
PUT GET (ports)	Send or receive values to or from any port
PEEK POKE	Alter memory locations addressed in decimal a byte at a time
DEEK DOKE	Two byte version of PEEK and POKE — very handy
DIM	Dimensions arrays to your specifications
DATA READ RESTORE	Fill arrays with your data. RESTORE sets DATA pointer to 0
CLEAR	Sets all variables to 0
CLOAD or CSAVE ARRAY	Allow an array to be stored on tape without surrounding prog.
ON. GOTO ON.GOSUB	Clever variations on GOTO saving extended use of comparators
END	Defines an end point in a program. Not displayed during run
SPC	Moves print head a number of spaces right
VDU	Allows the VDU to be addressed as a simple co-ordinate grid
CLS	Clear screen
POS	Returns a value for the current cursor position

should show you that there is a considerable difference between this and a 4K version even though this (XTAL) is really only about 7K. It is my own personal favourite with a number of unique features and a slight but noticeable bias towards string handling but it cannot, as yet, run under NAS SYS — this will almost certainly be rectified by the time this article is published. Since one of the big advantages of NAS SYS is the considerable screen (cursor) editing functions, it is a delight to be able to say that the command EDIT brings forth your errant line while offering all the facilities for editing offered in the easily edited and familiar-to-many ZEAP.

Other facilities are SIZE$ (the $ is out of place here since this word returns the *amount of memory* available for string storage), SPEED allows you to vary the operating speed of your programme (in a very non-linear way) to match, say, a slow printer or even a slow reader. POP serves the same function as CCSOFT's 4K STACK command while WAIT causes everything to stop until a given set of values can be read at a specified port. CONT allows you to continue after a halt has been encountered and leaves all variables untouched.

Go to, sub, my word!

The last, and possibly most noteworthy is CALL. In my original manuscript I simply said that CALL sets the PC to any hex address but it is really rather more advanced to this. Imagine you have written a machine-code routine and stuffed it into a handy slot at NNNN(h). To include it in a programme you need merely CALL its decimal address. BUT, and here we see a really sensible approach, if you want to give your subroutine a name, you can do this with the simple statement

10 MYWORD = NNNN

(where NNNN is in decimal, not hex) and in so doing you create a new reserved word (MYWORD) which can be used in the format

20 GOSUB MYWORD

and this is undoubtedly a particularly useful attribute. Just to top off this service, Mushroom send a list of all known bugs with each tape as well as an indication as to whether you may need to make any mods and they offer an update service to bring your T4 compatible Basic Tape up to NAS SYS compatibility (when available) at the amazing cost of 50p.

NASCOM's 8K Basic, developed under

continued over page

LA video link for London?

WALK UP to a London shopfront and thumb your nose at Californian boulevardiers! Demonstrate your latest dance steps to a New York sidewalk audience! Sing in the rain as LA suffocates in the smog! Make friends on another continent without leaving London!

All this may become a contemporary reality if two enterprising Americans, brought up on video technology in the performing arts, translate their dream of a full-sized video interchange, with sound, into operating hardware.

"Everything would be fine if we were in California . . ."

Space junk

Kit Galloway and Sherrie Rabinowitz, based in Los Angeles and operating under the name Mobile Image, are planning to set up the shopfront-sized video interchange between LA and New York — though London and Japan are mooted as eventual possibilities. The first transmission experiments used an old NASA satellite but this has now wandered off course for lack of propellant and has joined the growing belt of space junk around the earth. Now a commercial satellite is to be used.

A practical restriction on the system's use lies in the brightness of the General Electric back-projection apparatus. In daylight the screen is not bright enough (though a London winter afternoon may b be different) and for obvious reasons an interactive system depends on participants being active. So transmissions would take place in the evening. Taking account of time-zone differences between LA and New York, the ideal times are from 1800-2000 hours in LA, corresponding to 2100-2300 hours in New York. After March, the sun goes down too late in LA to get successful transmissions at this time of the evening.

As LA is some eight hours behind London, it would be only the latest of night-owls who would get to speak and perform for the benefit of passers-by in LA — not perhaps the ideal recommendation for London life.

In New York the Lincoln Center for the Performing Arts will host the show; in LA a department store in an open-air shoppng precinct called Century City has made its window available free of charge. Any takers for the early-morning London rush hour? — M.H.

Eight, yes eight BASICs for Nascom (continued)

Licence from Microsoft by STARBASE (actually Tony Rundle, who used to be Nascom's own resident software expert) is perhaps the more 'standard' of the 8K Basics and is without doubt a very comprehensive language. Designed for NAS SYS it is the only Basic here that will run under *any* normal Nascom monitor although its lack of inbuilt editing functions makes it a bit of a bore to use without the new wonder monitor. Extra commands are WIDTH which defines screen or printer width, which can be very useful in these days of multi-standard printers, as is the NULL command which outputs a defined number (defined by you) of nulls (ØØ) at the end of each line to allow your clockwork printer to get its print head back to the start of a new line without missing anything vital.

WAIT, like XTAL's, hangs on until one of your ports produces a useable signal (remember the PIO does its own interrupting without using micro time so the whole system can lie dormant until correctly cued via a port). EXP(X) returns e to the power X where X is less than 87.3365 (no, I haven't worked out why it stops there but I'd be surprised if you ever wanted to go even that high) and is a function also available in the XTAL 8K.

CONT is here again for a 'soft' rerun or continuation while LINES determines the number of lines to be scrolled with each LIST entry (ungainly and irritating compared to the XTAL version). Screen (like VDU in the smaller Basics or Print in XTAL) sets the cursor to a point on the screen which can be referenced using the co-ordinates 1 — 15 (for vertical reference) and 1 — 48 (horizontal). It can only put one letter at a time on the top (unscrolled) line (line 16) and again appears ungainly in use — but it works.

The last set of words which serve to make this variation the most graphically-orientated to date consists of POINT, SET and RESET. Used in conjunction with the Nascom-2's graphic character set it allows any point on a grid of 95 by 48 points to be examined (POINT), SET (to a light spot) or RESET (to a dark spot), an undeniable bonus in this particular language. Neither of the 8K Basics have any MAT (matrix algebra) routines which is a shame but which at least gives us something to look forward to.

Conclusions

- **There are eight basic versions (with minor variations according to the medium on which they are sold) of BASIC for the Nascom microcomputer. They span the full range from 2 to 8K and it is to be hoped that they will eventually go to even greater sizes.**
- **Additional hardware requirements vary from nothing at all to masses of RAM, ROM or EPROM boards and these requirements should be taken into account when considering the cost of your next Basic.**
- **In the middle range you can choose fairly evenly between languages with a bias towards string handling or mathematics while at the top end (8K) the choice becomes more a matter of personal preferences.**
- **At the other end of the scale Nascom's 2K Basic has the offer of a third EPROM to bring it just out of the Tiny Basic league while CCSOFT's Level A can be run on an unmodified Nascom to give a foretaste of Basic at reasonable cost. The choice is up to you.**

The committed computeer wipes the sweat from his brow, pauses for breath and prepares himself to pitch into

Round Two of the wrestling match with assembly language

Last month, David Peckett outlined the concept of assembly-language programming, and its advantages and disadvantages and pointed out that a micro's assembly-language reflects the device's architecture. This month he looks at how data is represented in micros, describes more of the architecture of the 6502 and the 8080A, and investigates further instructions.

Representing data

NUMBERS and characters can be represented in a computer in a variety of different ways — the precise format(s) will depend on the system's purpose. In virtually all common micros, the system architecture forces the data to be grouped in 8-bit bytes.

Pure Binary. I'm sure that you're familiar with the basic idea of binary numbers, but I'll just remind you of the key points. The decimal system we all know and love employs "positional notation" — the position of each digit determines its weight, or significance. For instance:

357.41

is really an abbreviation for:

$(3\times10^2) + (5\times10^1) + (7\times10^0) + (4\times10^{-1}) + (1\times10^{-2})$

Binary notation uses an identical principal, but each digit is weighted by a power of 2, rather than a power of 10. For example:

$101101 = (1\times2^5)+(0\times2^4)+(1\times2^3)+(1\times2^2)+(0\times2^1)+(1\times2^0)$ (ie, 45)

Don't forget that we could use a "binary point" in this system, eg:

$101.01 = (1\times2^2)+(0\times2^1)+(1\times2^0)+(0\times2^{-1})+(1\times2^{-2})$ (ie, 5.25)

This last notation is rarely used by micros, however.

A problem with binary notation is that we need lots of bits to represent real numbers, since the largest quantity that can be contained in n bits is (2^n-1). Thus a single byte can only hold numbers up to 255, 2 bytes can count up to 65535, etc.

Signed Binary. Unfortunately, a simple binary system cannot show negative numbers. A common way of showing the sign is to use the first *(most significant) bit* — if it's "0", the number is positive, and vice-versa. Thus:

0101 = + 5 and 1101 = —5

This obviously reduces the magnitude of numbers which can be represented by a given number of bits. With n bits, we have a range of $\pm(2^{n-1}-1)$. Remember that, if several bytes are used for a large number, only the first bit of the first byte is needed for the sign.

Signed binary has a major weakness when it comes to arithmetic, however. Consider adding +3 and —2:

```
  0011 (+3)
+ 1010 (—2)
  1101 (—5)
```

This is clearly the wrong answer! It is possible to use special hardware or software to get over the difficulty, but a better answer is to use a notation that eliminates the problem.

Two's Complement. The solution is to use "2's complement" notation. This represents negative numbers by complementing (ie inverting every bit) their positive form, and then adding "1" to the complement. For example, to produce the 2's complement representation of —3:

```
        +3 = 0011
Complement:  1100
           +    1
        —3 = 1101
```

Let's see if this works for arithmetic:

```
Add:             Sub:
  0100 (+4)        0010 (+2)
+ 1101 (—3)      — 1101 (—3)
  0001 (+1)        0101 (+5)
```

Any *carry* or *borrow* from (*MSB* + 1) is always ignored.

This isn't the place to go into abtruse mathematics, but 2's complement arithmetic will always give the right answer. In fact, the system works both ways. For example, to form —(—3) (ie +3):

```
        —3 =  1101
Complement:   0010
            +    1
              0011 = +3
```

There is one danger with 2's complement arithmetic, and that occurs if there is a carry from the second bit to the first (sign) bit. For instance:

```
  0100 (4)
+ 0100 (4)
  1000 (—8)
```

However, if we know that this overflow has occurred, we can allow for it; most computers contain a circuit which detects it. The range of an n-bit 2's complement number is $+(2^{n-1}-1)$ to -2^{n-1}, eg, 16 bits (2 bytes) gives a range of +32767 to —32768 (what's the range of the most Tiny BASICs?) Just as in the signed binary, only the most significant bit is signed, and can suffer from overflow.

Binary Coded Decimal. Most micros will use 2's complement notation, but in some cases it is not acceptable. Because it uses a fixed number of digits, it can suffer from rounding errors. While this is usually unimportant, there are some applications which cannot tolerate any loss of precision. A good example is financial arithmetic (would you want your bank to round down the odd pennies?). A way round the problem is to use "Binary Coded Decimal" (BCD) notation.

In BCD, each decimal digit is represented by its own 4 bits (4 bits are needed to code the 10 digits 0-9). Normally, the 4 bits have the same weighting as for an unsigned binary number — for obvious reasons this is called "8421 BCD" — but there are other possibilities.

When BCD is used, it is normal for each byte to contain 2 BCD digits ("packed BCD"). Since the aim of BCD is to preserve every digit, the length of a BCD number can vary, and the complete number often takes the form shown in **Figure 1**. The major weaknesses of BCD are that it is very slow, and wastes storage space.

When making BCD calculations, we must take precautions to overcome the difficulty caused by the fact that 4 bits can contain more than 10 digits. Consider the BCD addition of 37 and 15:

```
0011 0111 37
0001 0101 15
0100 1100
```

The second digit is now larger than 9 — the addition should have caused a decimal carry, but the carry has not left the second digit.

All computers are capable of detecting this condition; when it occurs, the answer is to add 6 to the affected digit and ripple the effect all through the number. In this case, we have:

```
  0100 1100
+      0110
  0101 0010 52
```

continued on next page

from previous page

and 52 is the correct answer.

We must also allow for the effect of the "half-carry" from the lower nybble to the upper. The problems are not as forbidding as they sound, because a micro will either have flags and codes to detect and correct the BCD errors (as in the case of the 8080A) or will perform BCD arithmetic automatically (eg the 6502).

Floating Point Notation. You may have noticed that, apart from BCD, I haven't considered how to represent fractional numbers. Floating point arithmetic is beyond the range of this series but, for completeness, how are floating point numbers represented in binary form?

A *mantissa* and *exponent* system is used. In decimal "scientific notation", numbers are shown as, eg:

0.25378×10^{27}

The same technique is used in computers, using binary numbers which appear as:

$0.p \times 2^q$ where $2^{-1} \leqslant p < 2^0$

A typical, 4-byte, format is shown in **Figure 2.**

Representation of Characters. We now have several ways of representing numbers in binary terms, and can select the best one for any particular application. How can we represent characters? The most common way is via the ASCII code. This uses 7 bits to code 128 characters and peripheral commands (eg ring BEL1, DELete and End Of Tape). The ASCII character set is shown in **Table 1.** Note that, in this code, each character is stored in a complete byte; it is therefore an impractical system for storing digits for later manipulation.

Status words

The 6502 and the 8080A, like all computers, each have a status register containing the Processor Status Word (PSW). What can these PSWs do for us?

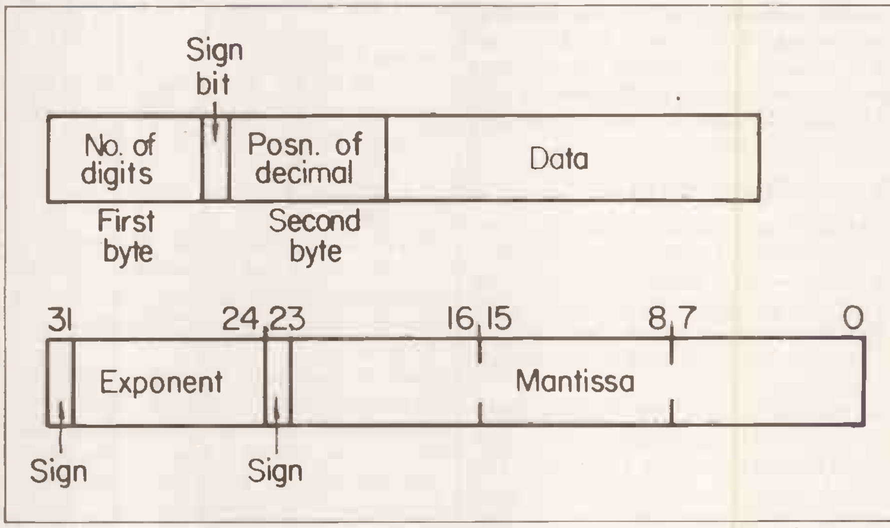
A PSW contains up to 8 bits, each one of which is called a "flag". Most of the flags give information about the data in the micro's accumulator, or results of manipulations of that data. Others show the micro's precise mode of operation. The different flags are used to control the course of a program; micros can make decisions based on the values of flags or groups of flags.

The 6502 and 8080A each have an 8-bit PSW, shown in **Figures 3(a) and 3(b)** respectively. Neither uses all 8 possible flags, and there is a fundamental difference between the ways in which each sets its flags. The 6502 sets appropriate flags whenever data is sent from one register to another, when data is passed from memory to the accumulator, and when data is manipulated. The 8080A only sets its flags when it manipulates data — data transfers do not affect them. The instruction tables that accompany each part of this series show which instructions can affect which flags.

Some of the flags have identical, or nearly so, meanings in the two devices. Others are unique to one micro.

Second nybble (hex)	First Nybble (hex) 0	1	2	3	4	5	6	7
0	NUL	DLE	SPACE	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	¦
D	CR	GS	–	=	M	]	m	}
E	SO	RS	.	>	N	∧	n	~
F	SI	US	/	?	O	←	o	DEL

Figure 1 (above); Figure 2 (below)



Common flags

Zero (Z). If an operation gives a zero result, the "Z" flag is set to "1". If the result is non-zero, the flag is set to "0".

Sign (N-6502, S-8080A). The sign bit always takes on the value of the MSB which is the result of the operation or data transfer. If it's "1", the result is negative — 2's complement arithmetic is assumed.

Carry (C). The carry bit can be set in three ways; during arithmetic it shows an addition overflow, or a subtraction borrow. These occur when a ninth bit is needed to hold the result (eg $F1_{16} + F2_{16} = 1E3_{16}$). Micros also have instructions to shift the data in the accumulator sideways; the MSB or LSB can be shifted into C. Both micros set C to "1" if a carry occurs. However, during subtraction, the 8080A shows a borrow by setting C to "1", while the 6502 sets it to zero. It is vital to remember this difference when you write programs.

6502 — only flags

Overflow (V). The overflow flag is set to "1" if addition or subtraction causes a carry or borrow between bits 6 and 7. This information is vital during 2's complement arithmetic. The 8080A's lack of an overflow flag can give problems, as I'll show later.

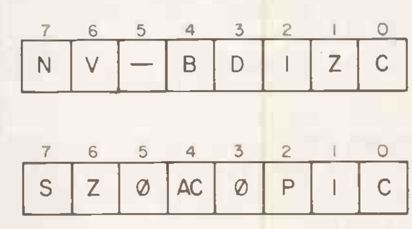


Figure 3(a) above, 3(b) below

Break (B). The break flag is set to "1" while the "BRK" operation is in use. I'll come back to this in a later article.

Decimal (D). The 6502 has the valuable ability to perform BCD arithmetic directly with its normal opcodes. If D is set to "1", data is treated as BCD; otherwise, data is regarded as pure binary. The normal way of manipulating D is via the "SED" (SEt Decimal) and "CLD" (CLear Decimal) instructions.

Interrupt (I). When I is set to "1", the micro will not respond to interrupts. It is

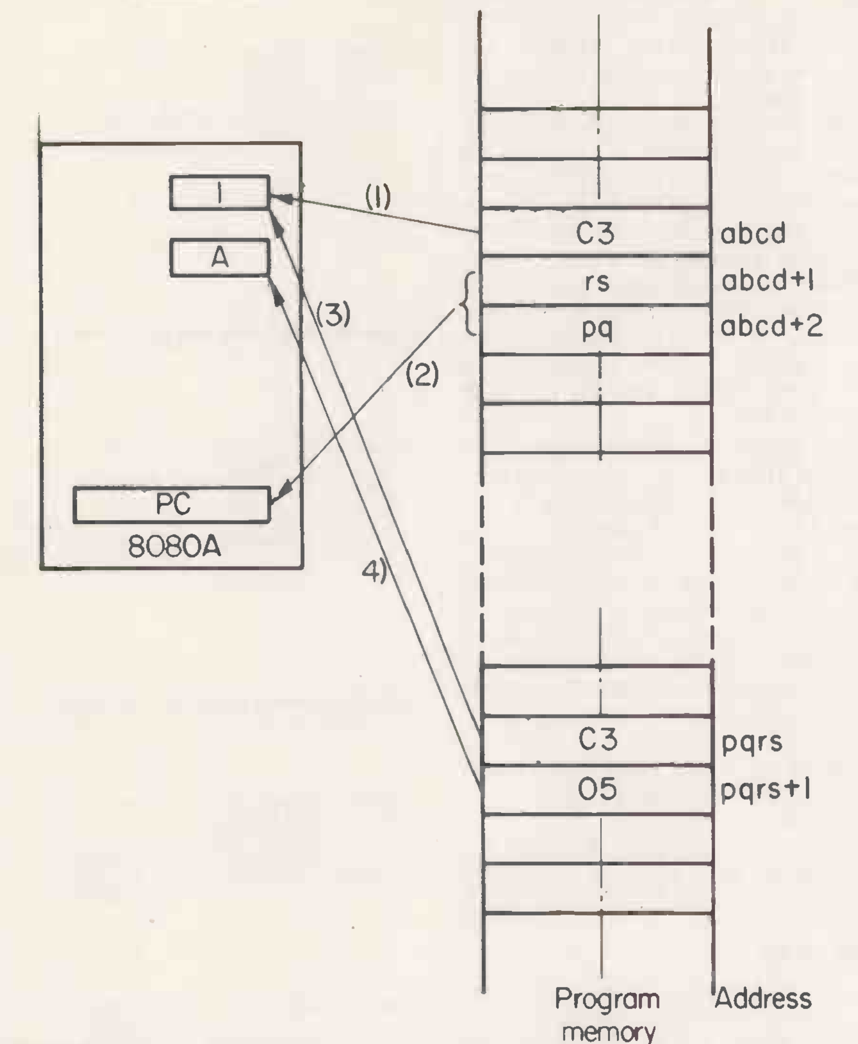


Figure 4

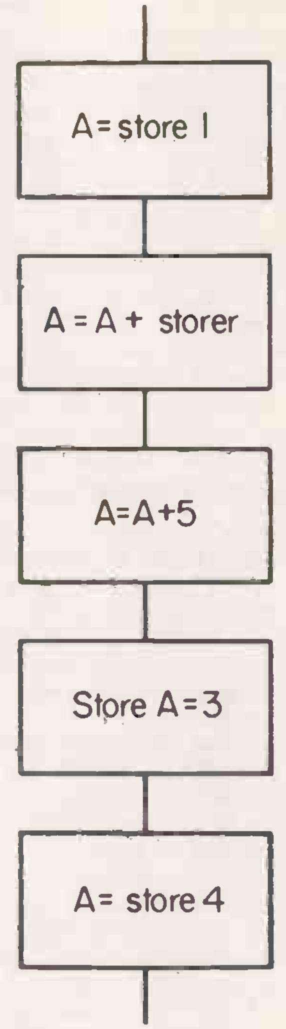


Figure 5

normally used during interrupt service routines, which I'll cover later.

8080A – only flags

Auxiliary carry (AC). This flag is sometimes known as the "half-carry" flag. It is set by a carry or borrow between bits 3 and 4 during arithmetic, and shows a BCD carry. The flag is only important to the "DAA" (Decimal Adjust Accumulator) instruction.

Parity (P). The P flag is affected by any arithmetic or logical operation. If there are an even number of bits in the result, P is set to "1". A typical use would be to check the validity of data received from a terminal.

Program jumps

An important characteristic of any real computer system is that it rarely starts at one end of its program, goes through to the other end, and stops. On the contrary, the program will be constantly testing data, and jumping to other points as a result of these tests. A primary reason for having flags, particularly the carry and zero flags, is to simplify such tests.

The majority of jumps are these "conditional jumps", and most of next month's article will look at them in detail. However, the starting point is the "unconditional jump". Both micros use the same mnemonic, "JMP". The mnemonic is always followed by a label, or a 16-bit address, defining where the program is to jump to.

How does a JuMP work? First of all, we must recall how a program is stored in memory, and how the micro keeps place in it. A program is stored as a sequence of bytes, representing both opcodes and their associated data. The program Counter (PC) points to each instruction as it is to be executed; the instruction is read in to the micro and decoded.

Once decoded, the appropriate amount of data is also read in, and the instruction is carried out. The PC is then adjusted to point to the next instruction. Remember that a jump is a 3-byte operation; the first (lowest address) gives the code meaning a jump (for an 8080A — $C3_{16}$). This byte is followed by 2 bytes containing the jump address; in both micros, this address is stored low-byte-first.

Look now at **Figure 4**. This shows what happens during an 8080A jump; the 6502 is very similar. As the program runs, the PC eventually contains the address "abcd". The code at this address is read into the Instruction Register (I) (1), where it is seen to be $C3_{16}$. The next 2 bytes hold the jump address (low-byte-first), and are read into the PC (2), setting it to "pqrs". The micro then immediately reads the code at "pqrs" into I (3). In this case, the code is $C6_{16}$ (ADI), and so the data in the next byte is added to the accumulator (4). The code in (pqrs + 2) is then read to become the next instruction, and so on.

When can we use jumps? Unconditional jumps are, in fact, only of limited use — the majority in a real program are conditional. A common use is to "patch" a lot of code into a short space. This could be the result of a program amendment, or because the micro's design only allows a limited space for certain operations. The 8080A's interrupt mechanism is a good example of this latter case.

Let's have a look at an example. Suppose the flow-chart of **Figure 5** is a short part of a much larger program. When we coded it, we forgot to add the 5, and produced the 6502 and 8080A source code in **Figures 6(a) and 6(b)** respectively. For one reason or another, it's too late to re-

continued on next page

From Previous page

assemble the corrected program; we must patch the correction directly into machine code. Equally, the existing object code must stay, as far as possible, in its current memory locations. We can correct the situation by jumping to a spare area in memory, doing the full calculation, and jumping back to the main program. Fortuitously, the "STA STORE3" in each program is 3 bytes long; we can replace it with the 3 bytes of a suitable jump. The patched programs are shown in **Figures 7(a) and 7(b).**

Beware of using jumps freely — they make a program appallingly difficult to follow. Beware also of the "dynamic halt":

```
LOOP1 JMP LOOP1 ;SIT HERE FOR EVER
```

This month's instructions

This month's instructions are shown in **Table 2.** Most of them are concerned with jumps and flag bits, and are self-explanatory. Some, such as the 6502's CLI and SEI, and the 8080A's equivalent DI and EI, are only for completeness at this stage. The following instructions need a little more explanation:

Increment and decrement (6502 — INC,DEC; 8080A — INR,DCR). These instructions, which are found in all computers, can be very useful. They allow a register, and often a memory location, to be altered by 1 with a single-byte instruction. There is no need for arithmetic, which may require several bytes for the same effect. Note that the 6502 instructions only affect the memory. On the other hand, those of the 8080A can be used for any register, or for the location (M) pointed to by (H,L).

No-operation (NOP). Most computers have this sort of instruction. It does nothing, and is useful for filling holes left by patches. If you were a pessimist, you could also use it to provide holes to put patches in later.

PCHL. This is an odd 8080A instruction. It has the same effect as a jump; for example, if H,L is set to "abcd", which is then transferred to PC by PCHL, the program immediately jumps to "abcd". The instruction is rarely used.

Decimal Adjust (DAA). This 8080A instruction is used after each byte of BCD arithmetic. It corrects errors which may have occurred because the micro only does pure binary arithmetic. BCD addition is easy:

```
LDA DATA1      ;FIRST PART
LXI H,DATA2    ;SECOND PART
ADD M          ;DATA IS BCD
DAA            ;MAKE BCD
                 CORRECTION
```

Subtraction is more complex, because of the way in which DAA works. The best way is to set A to 99_{16}, C to 1, subtract the *subtrahend,* add the *minuend,* and use DAA. For example, for (DATA1 — M):

```
MVI A,$99
SEC
SBB M          ;H,L IS SET ALREADY
LXI H,DATA1 ;reset H,L
ADD M
DAA            ;CORRECT RESULT
```

The moral is: If you've a lot of BCD arithmetic — don't use an 8080A!

Exercise

Let's try to apply some of these new instructions by implementing the flowchart of **Figure 8.** This is a deliberately clumsy routine which does two things:

☐ It subtracts one 16-bit (2-byte) number

Table 2: This month's instructions

Operation	6502			8080A		
	Mnem	Flags	Effect	Mnem	Flags	Effect
Set Carry	SEC	C	C = 1	STC	C	C = 1
Complement Carry	—			CMC	C	C = C
Set Decimal Mode	SED	D	D = 1	—		
Allow Interrupts	CLI	I	I = 0	EI	None	Ints. Allowed
Stop Interrupts	SEI	I	I = 1	DI	None	Ints. Stopped
Clear Overflow Flag	CLV	V	V = 0	—		
Increment	INC a	N,Z	(a) = (a) + 1	INR r	AC,P,S,Z	(r) = (r) + 1
Decrement	DEC a	N,Z	(a) = (a)—1	DCR r	AC,P,S,Z	(r) = (r)—1
No-Operation	NOP	None	None	NOP	None	None
Jump	JMP a	None	PC = a	JMP a	None	PC = a
Jump to Address in (H;L)	—			PCHL	None	PC = (H,L)
Decimal Adjust	—			DDA	All	BCD Correct

Notes

"a" = Address (defined by the program)

"r" = Any 8080A register. It includes the memory location (M) pointed to by (H,L).

The flags are as defined in the article.

PC = Program Counter

H,L = Register pair formed in 8080A by H and L

Brackets mean "Contents of the location or register(s) defined between the brackets".

```
        .
        .
;START OF THE PROGRAM SEGMENT
     LDA    STORE1
     ADC    STORE2 ;ASSUME THAT C AND D
     STA    STORE3 ;FLAGS ARE CLEAR
     LDA    STORE4 ;ON TO NEXT
                     OPERATION
        .
        .
```

Figure 6(a): 6502 program with error

```
        .
        .
;START OF THE PROGRAM SEGMENT
     LDA    STORE 1
     LXI    H,STORE2 ;SET POINTER
     ADD    M
     STA    STORE3
     LDA    STORE4     ;ON TO NEXT
                         OPERATION
        .
        .
```

Figure 6(b): 8080A program with error

```
        .
        .
;CORRECTED PROGRAM SEGMENT
            LDA STORE1
            ADC STORE2
            JMP CORRCT  ;GO TO PATCH
RETURN      LDA STORE4  ;BACK IN MAIN
                          PROGRAM
        .
        .
CORRCT      ADC#5       ;WE FORGOT THIS
                          BEFORE
            STA STORE3  ;COMPLETE
                          CALCULATION
            JMP RETURN  ;BACK TO MAIN
                          PROGRAM
        .
        .
```

Figure 7(a): Corrected 6502 program

```
        .
        .
;CORRECTED PROGRAM SEGMENT
            LDA STORE1
            LXI  H,STORE2 ;SET POINTER
            ADD M
            JMP  CORRCT   ;GO TO PATCH
RETURN      LDA STORE4    ;BACK IN MAIN
                            PROGRAM
        .
        .
CORRCT      ADI  5        ;WE FORGOT
                            THIS BEFORE
            STA  STORE3   ;COMPLETE
                            CALCULATION
            JMP  RETURN   ;BACK TO MAIN
                            PROGRAM
        .
        .
```

Figure 7(b): Corrected 8080A program

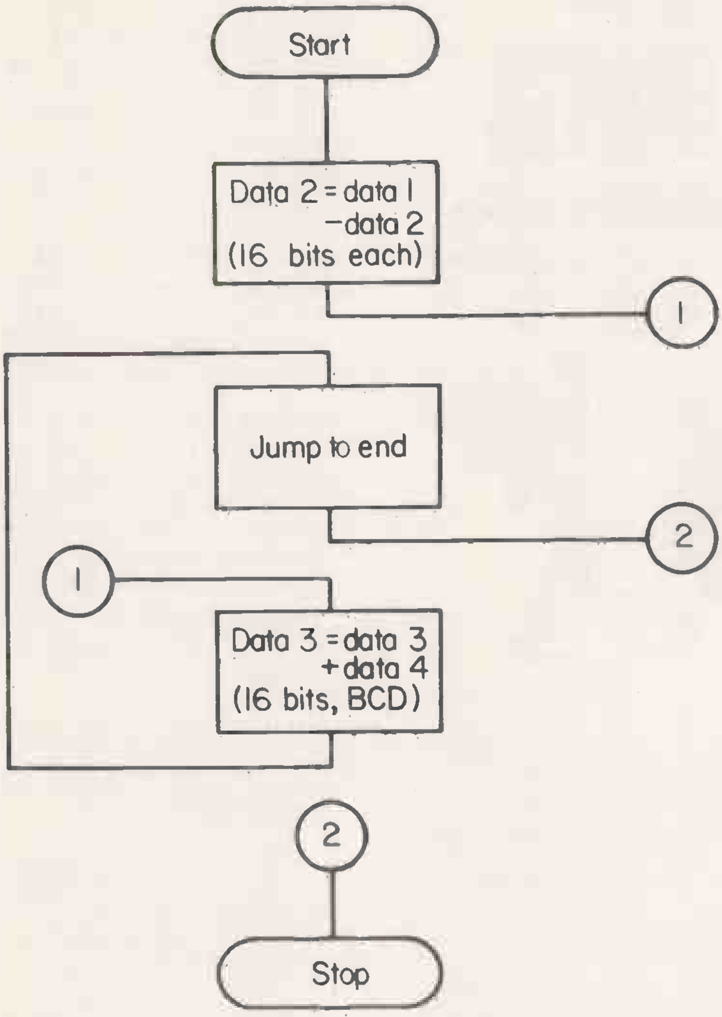


Figure 8

```
;START OF 6502 PROGRAM SEGMENT
        CLD             ;ENSURE FLAGS
        SEC             ;CORRECTLY SET
        LDA DATA1       ;START
                          SUBTRACTION
        SBC  DATA2
        STA  DATA2      ;SAVE FIRST
                          BYTE
        LDA DATA1+1     ;NOTE FORM OF
                          LABEL
        SBC  DATA2+1    ;CARRY STILL
                          RIGHT
        STA  DATA2+1    ;SECOND BYTE
                          FINISHED
        JMP  STEP1      ;DEMO ONLY
STEP2   JMP  END        ;GO PAST PATCH
;PATCH FOR ADDITION
STEP1   CLC
        SED             ;SET FLAGS
        LDA DATA3
        ADC DATA4       ;BCD ADDITION
        STA  DATA3      ;FIRST BYTE
                          DONE
        LDA DATA3+1
        ADC DATA4+1     ;CARRY STILL OK
        STA             DATA3+1
                        ;FINISHED
        JMP             STEP2
                        ;END OF PATCH
END     NOP             ;FINISH FROM
                          HERE
```

Figure 9(a): 6502 demo program

```
;START OF 8080A PROGRAM SEGMENT
        LDA DATA1
        LXI  H,DATA2    ;SET POINTER
        SUB  M          ;IGNORES AND
                          RESETS CARRY
        MOV M,A         ;FIRST BYTE
                          DONE
        INR  L          ;POINT TO NEXT
        LDA DATA1+1
        SBB  M          ;USES CARRY
        MOV M,A         ;SECOND BYTE
                          DONE
        JMP  STEP1      ;DEMO PATCH
;
STEP2   JMP             END
;
;PATCH FOR ADDITION
;
STEP1   LDA DATA3
        LXI  H,DATA4    ;SET NEW
                          POINTER
        ADD M           ;IGNORES AND
                          RESETS CARRY
        DAA             ;ALSO
                          CORRECTS
                          CARRY
        STA DATA3;      ;FIRST BYTE DONE
        INR  L          ;INCREMENT
                          POINTER
        LDA DATA3+1
        ADC M           ;USES CARRY
        DAA             ;CORRECT
        STA  DATA3+1    ;SECOND BYTE
                          DONE
        JMP  STEP2      ;END OF PATCH
;
END     NOP             ;FINISH FROM
                          HERE
```

Figure 9(b): 8080A demo program

from another, and replaces the subtrahend with the answer.

- ☐ It adds two 16-bit (ie 4-digit) BCD numbers, and puts the result back in place of one of them.

There is also a bit of jumping about to show the use of JMP again.

The double-byte sums are examples of "multiple-precision" arithmetic. Two or more bytes can be used to contain larger, or more precise, numbers than is possible with just one byte. When we calculate with them, it's just like pencil-and-paper arithmetic; we start at the right and work to the left, noting any carry or borrow as we go. We also have to save the result of each byte as we go.

In this program, and in all future ones, I'll use the convention that multi-byte numbers are stored with their least-significant digits at the lowest addresses. Neither program is particularly taxing, but there are a few points to make in both.

Special notes

6502 Program. Initially, the carry is set to "1", as this is the "no-borrow" state for subtraction. The borrow (if any) from the first bytes is then needed for the second subtraction. Notice how I've used simple arithmetical expressions as labels — this simplifies the definition of data addresses. For the BCD addition, the carry is initially set to zero, and the decimal flag is set to "1", putting the 6502 in the decimal mode. From then, the addition is perfectly straightforward, and the BCD data needs no special treatment.

8080A Program. You will recall that the 8080A must point to memory, via (H,L), when it is doing arithmetic. Having initially set up H,L, the subtraction is straightforward. H,L is used, via MOV M,A, to put each answer back in memory, and INR L is used to point to the next address. Be careful when you use INR L like this — any carry from L does not affect H, which could destroy your program.

Although the 8080A subtraction procedure uses more lines of source code than the 6502's, it will actually give a shorter, faster-running, object code. This is because very few of the instructions use an address field, and so require only a single byte of machine code. The 8080A BCD routine is similar to the subtraction, but shows the clumsiness of having to use "DAA".

Next month

Next month, I'll cover two points: a description of most of the other registers in the 6502 and 8080A, and the ways in which the two micros can make conditional jumps. Until then, you may like to consider

- ☐ how we can set up a program to do something a set number of times;
- ☐ how we can set up a program to do something until something else happens (not necessarily the same question as the one above);
- ☐ what's involved in sorting a list of numbers;
- ☐ how to program a micro to generate any given time delay.

Hard disc arrives

THE 11-MEGABYTE Corvus hard-disk system is now available for the Tandy and, according to T & V Johnston, who will supply the disc, it makes the Tandy one of the most powerful microcomputer systems available.

Equivalent to 94 5½in floppy disk units on line, a single Corvus disk will provide previously unthought-of capacity which, can, by the addition of extra units, be expanded to a total capacity of 45.2 megabytes.

Partly prompted by the introduction of this significant new piece of hardware, Dr Roy King of TVJ Microcomputers has developed a modification which more than doubles the operational speed of the TRS-80 system. According to Dr King, the availability of the Corvus disk system will help not only existing users of TRS-80 systems, but will also certainly influence prospective microcomputer users.

Encased in a sealed unit, the Corvus disc module has an access time of 10 milliseconds with a data transfer rate of 648 kilobytes per second. The system is plug-compatible with the Tandy TRS-80 interface and comes complete with the NEWDOS+ disc operating system, specially written for the Corvus, and complete documentation.

File responses

OUR QUERY in the Tandy Forum in January (whether anyone had come up with a method of determining the file name on a SYSTEM tape) has produced a varied response, and several different suggestions, some of which we reproduce here. The first is from **J. A. Conradi**, in Holland, who has developed a small program to read and display the name.

“I've used several ROM tape routines. (See annex A for object code of the program). The CALL 0212 (hex) defines the tape drive and starts it. Then with CALL 0296 (hex) the sync byte is searched. The first "read a byte" instruction (call 0235 hex) determines if the next byte of the tape is a 55 hex. If not, it is no system tape, so jump back to BASIC. If it is 55 hex, the next 6 bytes (the file name) are read and displayed on the screen (CALL 0033 hex). Then with a CALL 01F8 hex the tape drive is disabled. A carriage return (0D) is displayed and a return to the calling program is made.

I've added a 4K BASIC level II version to execute the machine language program (see annex B). Memory size must be 20438. It can also be used for 16K (and bigger) systems without relocation. To relocate the program to higher memory locations, change line 10, 50 and 60. No changes have to be made in the DATA statements.

After the BASIC program is typed in or read in by CLOAD, put the SYSTEM tape in the recorder and RUN the program. Put the recorder in the PLAY mode, answer the 'READY CASSETTE' with a 'ENTER' and the file name will be displayed.”

Changes to put program in high memory in 16K systems:

	4K	16K
memory size	20438	32726
line 10	20439	32727
	20477	32765
line 60	**16527,79**	**16527,127**

STEPHEN ZARA, who lives in Sussex, claims that the following Level II BASIC program will also display the name on a SYSTEM program. The name is to be found as the 2nd-7th characters after the header bytes. The program should run without a MEMORY SIZE? allocation.

The program calls the following ROM routines (HEX addresses)

0212 start tape
0296 read past header
0235 read a byte from tape into register A
01F8 stop tape
POKE 16553,255 ensures that READ works after use of cassette.

AN EVEN SHORTER solution to the same problem has been submitted by **Clive Davidson** from Derby. He claims that this small basic program will extract the same said file name.

```
5  CLS
10 INPUT —1,A$
20 REM EXTRACT FILE NAME
30 B$ = MID$(A$,2, (LEN(A$)—3))
40 PRINT " FILE NAME IS ";B$
```

Note the file name is always preceded by U and < . This information is removed by LINE 30, to give the actual file name.

Annex A

```
4fd7:  3e 00      ld   a,00
4fd9:  cd 12 02   call 0212
4fdc:  cd 96 02   call 0296
4fdf:  cd 35 02   call 0235
4fe2:  fe 55      cp   55
4fe4:  c2 19 1a   jp   nz,1a19
4fe7:  01 06 00   ld   bc,0006
4fea:  cd 35 02   call 0235
4fed:  cd 33 00   call 0033
4ff0:  0b         dec  bc
4ff1:  78         ld   a,b
4ff2:  b1         or   c
4ff3:  20 f5      jr   nz,4fea
4ff5:  cd f8 01   call 01f8
4ff8:  3e 0d      ld   a,0d
4ffa:  cd 33 00   call 0033
4ffd:  c9         ret
```

Annex B

```
10 for a=20439 to 20477
20 read b
30 poke a,b
40 next a
50 poke 16526,215
60 poke 16527,79
70 input"ready cassette";q$
80 x=usr(0)
90 end
100 data 62,0,205,18,2,205,150,
  2,205,53,2,254,85,194,25,26,1
110 data 6,0,205,53,2,205,51,0,
  11,120,177,32,245,205,248,1
120 data 62,13,205,51,0,201
```

Letter from Denmark

ARNE ROHDE writes:

Several contributors to the Tandy Forum have commented on the debounce routine originally published in the April 1979. The code (with the typographical error corrected) appears to work satisfactorily, but for those without an assembler, a BASIC program similar to the one published in the November 1979 issue can be used to insert the code.

To insert machine code of this type, I have for some time used a BASIC program which does not require that the code be converted to decimal numbers for insertion in the DATA statements. The conversion from hexadecimal form to the form required by POKE can be done very simply in TRS-80 level II BASIC.

Also when powering up by TRS-80, I tend to forget to set the MEMORY SIZE which is required for code such as the debounce. However there is another possibility which can be used for machine code in programs which do not use cassette (or disk?) input/output or long messages from the keyboard.

The I/O buffer contains 256 bytes, most of which may be unused during the execution of a program. If done with care, machine code can be stored at the end of the I/O buffer, without taking up space at the high end of memory. The temporary part of my debounce routine is stored in this buffer, since it is only called once and can thereafter be ignored.

Another part of memory which seems to be unused in my system (no expansion interface and no disks) is the reserved area from 404FH to 407FH, and this area is large enough to contain the permanent part of the code for the debounce routine. Actually it only uses the area from 406A to 407F, thus being considerably shorter than the one published in the April issue.

The only changes required to relocate the permanent portion to address 7FEA (or any other address) is the address portion of line 300, and data bytes 2 and 3 in line 310 (6A40 to EA7F, for example). A simple check could also be inserted to examine whether memory has been reserved for machine code. The memory end address can be found in bytes 16561 and 16562, and the value should be less than the routine start address.

As can be seen from the listing, spaces can be interspersed between the data bytes, for example to separate the individual instructions. If the terminal statements in line 20 and the DATA statements from line 300 are changed, the program can be used for entering any machine language program. The assembler code for the debounce is shown above.

There seems to be a bug in Level II BASIC which can arise if programs are written without any spaces between the language tokens. I have seen it several times after compressing a program because of insufficient storage space. The error arises when the last operand in an IF statement is a string enclosed in quotes and it is immediately followed by certain commands. Inserting a space or the word THEN seems to correct the error in all cases. I have not attempted it with all commands, but PRINT, GOTO, LET and INPUT will cause incorrect execution.

For example the statements

```
10 A$=""
20 IFA$<>""PRINTA$:A$=
   ""ELSEPRINT"NULL"
30 END
```

will not print the word NULL when executed. If a space is inserted between "" and PRINT then the word NULL will appear on the screen.

```
The Basic program is as follows:
10 CLEAR 100:DEFINT H,I,V
20 READ A$,V$:IF A$="END" CLEAR 50:A=USR(0):
NEW ELSE A=0
30 FOR I=1 TO 4:H$=MID$(A$,I,1):GOSUB 200:A=
16*A+H:NEXT:I=1
40 H$=MID$(V$,I,1):IF H$<>" " GOSUB 200:V=16
*H:I=I+1:H$=MID$(V$,
I,1):GOSUB 200:V=V+H:POKE A,V:A=A+1
50 I=I+1:IF I<LEN(V$) THEN 40 ELSE 20
200 H=ASC(H$)-48+7*(H$>"9"):RETURN
28F8 0605 CD6000 C3
300 DATA 406A,118D38 213540 CB03 F8 2C 1A AE
E303
310 DATA 42D0,216A40 221640 214A2E 228E40 C9
320 DATA 408E,D842
330 DATA END,END
```

```
406A    118038          LD    DE,3880H
4060    213540          LD    HL,4035H
4070            NXTCH:
4070    CB03            RLC   E
4072    F8              RET   M
4073    2C              INC   L
4074    1A              LD    A,(DE)
4075    AE              XOR   (HL)
4076    28F8            JR    Z,NXTCH
4078    0605            LD    B,05
407A    CD6000          CALL  0060H
407D    C3E303          JP    03E3H
--------
42D0    216A40          LD    HL,406AH
42D3    221640          LD    (4016H),HL
42D6    214A2E          LD    HL,2E4AH
42D9    228E40          LD    (408EH),HL
42DC    C9              RET
```

Danish Basic routine (above); assembler code (below)

Not fade away

As a computer consultant and Apple user, I am distressed to think that your Apple Pie users forum may fade away. This would be a great pity, as I feel that nothing but good could come out of constructive communication between hobbyists, who have the skills and the time, and business users, who have the problems, **(writes David Sutton, from Cheshire).**

May I perhaps breathe a little life into Apple Pie by offering a small prize for the solution of a small commercial problem. I would have a use in a teaching application for a program which could draw, on an Apple display, circles of solid colour.

I have written a simple Applesoft programme to do the job but it is far too slow. The shape drawing facility on the Apple is ruled out by the need to be able to enlarge or shrink the circles at will. Clearly a machine-code subroutine would solve the problem, but I have neither the time nor the inclination to learn Apple machine-code.

But I am prepared to pay £10 to the respondent who sends me a listing of the fastest Apple machine-code subroutine that draws a solid circle of specifiable colour, radius and location on the high-resolution graphics screens, that is locatable anywhere in Apple memory that I choose and does not interfere with the Mountain Hardware Keyboard Filter.

If anyone would like to take up this offer send your entry to Apple Pie, marking the item clearly. We will pass the entries on to Mr. Sutton and arrange for the prize to be awarded. We will also publish the winning entry.

Finance modelling on the Apple

A new financial modelling package is now available on the Apple. Named VISICALC, it is being billed as 'instant visual calculation for any numerical problem, without the need for programming.'

Visicalc organizes and displays information on the screen in a display made up of 64 columns and 256 rows, like a giant wall-chart. When a key variable is changed, all the related figures are re-calculated automatically. The user can play 'What if . . .' with his sales figures and assess his own changes.

The user can define his own formulae, establish his own charts, tables and records and set the limits on the model. The system then takes over and can be used to present a choice of solutions to a business problem.

Priced at £95, the package is available from most Apple dealers, although the 32K Apple II system required to run the package would require an investment of £1200, at least.

Deviant games

In another response to our "Zzzz! Wake up, Apple users!", **Simon Goodwin** has sent us this short program list for an Apple Integer BASIC game. He hopes that "a few of the ideas in the program will stimulate the minds of other Apple users, as the program would provide a convenient basis for a variety of deviant games, quite unlike the commercially available games for Apple that I have seen."

```
 3 X=0:I= RND (9)*4+4:H=0:A=0
 5 GR
10 K= PEEK (-16384)-176: POKE
   -16368,0
30 X=X+3: IF X>38 THEN 100
40 I=I+ RND (3)*4-4: IF I<4 THEN
   I=4: IF I>36 THEN I=36: GR
   : COLOR=9: VLIN I-1,I+1 AT
   X: PLOT X+1,I
50 IF K<1 OR K>9 THEN 10
60 A=A+1: IF A>30 THEN 100
70 COLOR=3+A MOD 2: HLIN 0,39 AT
   K*4
80 IF K*4#I THEN 90: PRINT "BLEEPER
    DESTROYED.": PRINT :S=S+1:
    PRINT "SCORE SO FAR ",S: PRINT

85 X=0
90 GOTO 10
100 TEXT : CALL -936: PRINT "FINAL S
   CORE : ";S: PRINT
110 PRINT "AMMUNITION EXPENDED : "
   ;A: PRINT
120 A=0: INPUT "TYPE 0 TO PLAY AGAIN
   ",S: IF S=0 THEN 3
130 END
```

Points to note about the programme:

- ☐ The game ends when either more than 30 shots have been fired, or one of the targets has successfully crossed the screen without being shot down.
- ☐ Depress the keys 1-9 to fire across the screen.
- ☐ The GR in line 40 could be replaced to advantage by a CALL-1994 command.
- ☐ There is a 'cntrl G' inside the first set of inverted commas on line 80.

The Apple that I use shows a strange tendency to change the variable-name 'Y' in programmes into an 'I'!! Do any other Apple users have this problem, or something like it? Or could one of them explain why it happens? That is why I have used 'I' to record vertical position in the enclosed programme.

System-log routine

Here are the bare bones of a routine to create and maintain a system-log on the Apple, submitted by **Paul Humphreys,** from Oxford.

The idea may be developed to suit individual requirements. This example assumes one disc-drive, and a printer in #2. The use of a clock-card is implied, but is not essential.

There are three stages:—

1. Program (a) creates the log-file.
2. Append subroutine (b) to your present programs.
3. Program (c) prints the log-to-date.

I use my version to monitor a package.

```
]LIST

1  REM  *** CREATE LOG-FILE
8 D$ =  CHR$ (4)
10  PRINT D$;"OPEN LOG"
20  PRINT D$;"WRITE LOG"
30  PRINT "PROGRAM": PRINT "
   SUBJECT": PRINT "TIME"
40  PRINT "*******": PRINT "
   *******": PRINT "****"
50  PRINT D$;"CLOSE LOG"
```

```
]PR#0
]LIST

900  REM  *** SUBROUTINE TO
     UPDATE LOG ***
910  PRINT D$;"APPEND LOG"
920  PRINT D$;"WRITE LOG"
930  PRINT "A": REM  *** A=
    YOUR PROGRAM-NAME
940  PRINT "B": REM  *** B=
  MOST SIGNIFICANT VARIABLE
     IN PROGRAM
950  PRINT T$: REM  *** T$=
  TIME (FROM CLOCK-CARD OR
    INPUT)
960  PRINT D$;"CLOSE LOG"
970  RETURN
```

```
]LIST

1  REM  *** PRINT LOG-TO-DA
   TE ***
2  ONERR  GOTO 70
10  PRINT D$;"PR#2"
20  PRINT D$;"OPEN LOG"
30  PRINT D$;"READ LOG"
40  INPUT P$: INPUT V$: INP
   UT T$
50  PRINT P$,V$,T$
60  GOTO 40
70  IF  PEEK (222) = 5 THEN
    PRINT D$;"CLOSE LOG"
```

PET DOS peculiarities

THESE COMMENTS, and the subroutine, for the PET 6502 DOS hardware idiosyncracies were written by Tony Winter, of G.W. Computers, and approved by Commodore:

Three DOS failures have so far been detected and compensated for in our current batch of programs bus version 3 and upwards.

It is my contention that any program currently on the market, which either uses a double redundancy workfile technique needing rename functions, or sequential file arrangements that do not include something like the following conventions to compensate for DOS failures, will not meet the sufficient conditions of reliability customarily associated with a serious program whose market value exceeds about £100. The program features that will persist will be constant but spontaneous hang-ups, apparent file losses, and data transfer going on wrong files.

- The cause of DOS rename failures is still obscure but can be dealt with by simply checking the error number through channel 15, immediately after a rename attempt. If it turns out to 62, then re-attempt it say three times, followed by a copy function if all that failed. One might prefer always to copy, but for longer files there will be a significant delay in processing, so the rename attempt will serve as a time-save if it works. Solution is assumed to be obvious.
- Unreliable date transfer crossing to wrong files due to fault or upset (block availability map) and is best compensated for with all file changes being followed by a verify on the data disk. Solution assumed to be obvious.
- Faulty ends of files are a result of the number of bytes being printed to a file, coinciding with the block availability count less two bytes. This means effectively that if the total amount of bytes printed to a sequential file, happen to fall into a number that is divisible by 254 (that's critical) or its increment, then an extra carriage return is picked up which now alters the fixed file architecture in a way that causes input statements to fall in an apparent cul-de-sac and the program hang up. If the run/stop key has been disabled (as should be if the program has any purported robustness) then the only recovery is to power down, which is alarming in the middle of an invoice run.

The way to compensate for this is, unfortunately, to slow down all print to file processes by doing a byte count in a way that either detects that the total byte count for the file is an increment of 254, or simply plugs a blank every time the byte count spontaneously reaches the critical number. The following example takes the latter route, since frequency of coincidence is somewhat random and the result is unlikely to fill the data with blanks very frequently. It is vital, however, that the count is detected properly since recovery is far too arduous for most end users to cope with.

It is no good trying to recover by copying the file to a new file and taking off on byte in the process, since the count is the effective correlation and block gets refilled every time.

```
10 OPEN2,8,5,"@1:SEQUENTIAL,S,W"
20 X$=CHR$(13)
30 FORI=1TO127:A$(I)="1":GOSUB10000:PRINT#2,
   A$(I);X$;:NEXTI:CLOSE2
10000 DC=DC+LEN(A$(I))+LEN(X$):PRINT"□";DC
10010 DA=DC/254:IFINT(DA)=DA/254THENPRINT"CO
   RRECTING DOS FAULT":GOTO10030
10020 RETURN
10030 A$(I)=A$(I)+" ":FORW=1TO1000:NEXT:RETU
      RN
    READY.
```

Tony Winter's Commodore-approved subroutine

Firmware for PET

EPROMS can now be programmed on the PET using a hardware/software package from GR Electronics, Newport, Gwent (0633 67426). It allows PET users to produce firmware to run either on the PET itself or on other microprocessor-based systems.

The programmer is for the 2716d device which uses a 5V supply. It consists of a plug-in circuit board which uses the IEEE port for data, the user port for control lines, and takes 5V from the computer's external cassette drive.

Full EPROM programming is supplied on cassette, with functions including read/write to and from random access and erasable programmable memory, sequencing verification and read/write/modify with addresses and data in hex.

An extension socket is provided for those wishing to deal with memories in batches.

Scramble for speech synthesis

THE LAST FEW WEEKS have seen an extraordinary surge of interest in speech synthesis, **writes Julian Allason.** It seems to have started before Christmas with rumours — since substantiated — that Commodore had a speech-synthesising peripheral under development.

By this time, the commercial software houses were scrambling to acquire or develop speech synthesis software of their own. It now seems probable that Commodore themselves will release various software dictionaries to support their new peripheral. No launch date has been announced yet.

Petsoft have demonstrated a Talking Calculator program to key dealers. What is particularly interesting is that PET's own resources have been harnessed in such a way that only an inexpensive tone generator is required to produce comprehensible speech.

Forth for the PET

ACT PETSOFT have introduced an interactive FORTH compiler/interpreter to run on the PET.

FORTH is a unique high-level language which has recently become popular in the United States, where it is widely used in astronomical and general scientific applications.

The principal advantages of FORTH are that it is extremely fast and requires only a small amount of memory. The language lends itself naturally to structured programming.

Petsoft's PET FORTH package contains a dictionary of 200 'words', each of which approximates to a sub-routine in BASIC. It is vocabulary-based, so the user can tailor the system to resemble the needs and structures of any specific application. Also included are a built-in incremental assembler and text editor.

VARIOUS SCHEMES to convert the PET into a powerful cash register (with or without stock update) have run into problems usually associated with hard-wiring in a cash drawer. Now an American company called Computer Forum are offering a complete kit including drawer and interface for $140.

continued from page 91
interrupt capability.

Sensors can either be scanned (typically between 10 and 80 times a second), return a value on request or cause an interrupt when they change state. On the whole, the scanning system offers many advantages. The computer is always fed with up-to-date information, the scanning routine can monitor for predefined situations and the computational overheads are predictable.

The output of analogue sensors, such as strain gauges, potentiometers and proximity sensors will have to undergo an analogue-to-digital conversion. The two main techniques, ramp and successive approximation, were covered in *Computabits* (1978).

Typically, a robot sensor will be converted into an eight-, 10- or 12-bit number. The accuracy of digitisation will be governed by the resolution, dynamic range and linearity of the transducers.

Limits to resolution

Resolution is the smallest step that can be distinguished from the next. In many transducers this is virtually infinite, but it may be limited by noise in amplifiers. Dynamic range is the operational range of the transducer, giving too small a signal at one end to the point where it saturates or breaks at the other.

A strain gauge has a dynamic range of about 1000:1, so that if the transducer is designed to respond to a minimum force of one gram, the maximum useful output will occur when one kilogram is applied. The dynamic range of the A:D converter should at least match that of the transducer.

Non-linearity, in a device such as a potentiometer, limits the confidence with which the signal may be used (high-precision potentiometers have linearities between 1 and 0.1% (manufacturer's information, Penny and Giles Potentiometers Ltd). Dynamic ranges can be extended or compressed over partially useful ranges with logarithmic or exponential post-processing amplifiers.

Several single-chip A:D converter systems exist. The National Semiconductor ADC0816 is an eight-bit converter that incorporates a 16-channel analogue multipler that can be used to scan sensors with little extra logic (manufacturer's information/data books). The multiplexer is fabricated from CMOS switches.

The CD4069 is a 16-channel multiplexer, without the converter. The ADC1210/1211 chip is a 12-bit converter (without multiplexer). Many different converters, in a range of speeds, resolutions and prices are on the market. Typical conversion times are two to 10 microseconds per bit.

Now we have looked at the types and styles of robots that are made, and the sort of data we can expect from the environment through the robot's sensors, I shall deal in the next part of this series with software and computer programming systems for both industrial and experimental robot control.

References

Aareskjold K. (1979): *Development and application of an industrial robot for pointing in industry* in: *Industrial Robots Vol 1/Fundamentals* (Tanner W., ed.); Michigan: Society of Manufacturing Engineers ISBN 0-87263-045-5, presented at Finishing '77 Conference and Exposition, October 18-20, 1977.

Boys J.T., Strelow E.R. and Clark G.R.S. (1979): *A prosthetic aid for a developing blind child* in: *Ultrasonics* 17-1 (January 1979), pp 37-42.

Byatt D.W.G. (1980): *Radio navigation and radar* in *Wireless World* 86-1529 (January 1980), pp 47-51.

Computabits (1978) Kim projects in *Practical Computing* 1-3 (November 1978), pp63-65; 1-4 (December 1978) pp63-69.

Goto T., Inoyama T. and Takeyasu K. (1974): *Precise insert operation by tactile controlled robot* in *The Industrial Robot* 1-5 (September 1974), pp225-228.

Jones B.E. (1977): *Instrumentation, measurement and feedback,* England: McGraw-Hill Book Co (UK) Ltd, ISBN 0-07-084069-5 (particularly Chapter Four, pp66-104).

Kay L. (1979): *Air sonars with acoustical display of spatial information* in *Animal sonar systems,* Jersey symposium, April 1-8, 1979.

Larcombe M.H.E. (1976): *Tactile sensors, sonar sensors and parallax sensors for robot applications* in Third Conference on industrial robot technology & Sixth international symposium on industrial robots, held at University of Nottingham, March 24-26, 1976, England: International Fluidics Services, ppB1-1 to B1-8.

Larcombe M.H.E. (1979): *Mobile robots for industrial use* in *The Industrial Robot* 6-2 (June 1979), pp70-76.

Nevins J.L. and Whitney D.E. (1979): *Robot assembly research and its future applications* in *Computer vision and sensor-based robots* (Dodd G.G. and Rossol L., eds), Proceedings of a symposium held at General Motors research laboratories, September 25-26 1978, New York: Plenum Press ISBN 0-306-40305-6, pp275-321.

Pond J. (1979) *Putting it all together with robots* in *Industrial Robots Vol. 1/ Fundamentals* (Tanner W., ed), Michigan: Society of Manufacturing Engineers, ISBN 0-87263-045-5 (reprinted from: the December 13, 1976 *Iron Age),* pp73-79.

Pugh A., Heginbotham W.B. and Page C.J. (1977): *Novel techniques for tactile sensing in a three-dimensational environment* in *The Industrial Robot* 4-1 (March 1977), pp18-26.

Salmon M. (1977) *Assembly by robots* in *The Industrial Robot* 4-2 (June 1977), pp81-85.

Ueda M., Sakai I. and Kumazawa T. (1976): *One trial to use a simple version sensing system for an industrial robot* in 3CIRT/6ISIR (as Larcombe '76), England: International Fluidics Services, ppC3-25 to C3-30.

Wang S.S.M. and Will P.M. (1978): *Sensors for computer-controlled mechanical assembly* in *The Industrial Robot* 5-1 (March 1978), pp9-18.

Woolvet G.A. (1977): *Transducers in digital systems,* IEE Control Engineering series 3/Peter Peregrinus Ltd, ISBN 0-906048-13-3.

Serious sorting for business

'Bubble' sat technique discussed by Mike Lake

WITH THE ARRIVAL of floppy disks, and possibly hard disk in the future, more and more PETs are being used for serious business purposes that involve the storage of large amounts of data in the form of disk records.

The problem with computer files is that they are set up in an order based on a particular field — for example a stock file might be set up based on the part number order — and sooner or later one would like to examine them in another order. This means that the file needs to be sorted — perhaps on supplier code for a stock file.

Computer sorting is an extremely involved subject and anyone with a professional interest in it is advised to study the classic book on the subject *Sorting and Searching* by Knuth — Volume 3 of his *The art of computer programming* series. The problem boils down to one simple issue — what is the best way of sorting a list?

In PET BASIC terms, let us redefine this as "what is the best way of sorting an array?" Below is a very simple BASIC routine that will sort an array into ascending order. The variable "N" contains the number of elements in the array.

```
100 FOR I = N-1 TO 1 STEP —1
200 FOR J = 1 TO I
300 IF A$(J) > A$(J + 1) THEN B$ =
    A$(J): A$(J) = A$(J + 1): A$(J + 1)
    = B$
400 NEXT J
500 NEXT I
```

This technique is called a "bubble" sort, since for each loop based on "J", it bubbles the highest value to the end of the list. The loop based on "I" controls the number of times the process needs to be repeated — obviously having found the highest value in one loop based on "J", it is not necessary to examine it on the next loop — hence the reason for the "I" loop.

For small numbers of elements, 20 or so, this method is quite satisfactory — after that it becomes embarassingly slow — just work out how many times statement 300 is executed for 100 elements and you will understand why!

Obviously what is needed here is a machine-code sort of the array. I have written a machine code routine that adds the new command "!S,array-name" to BASIC. This will sort any string array into ascending order. It is extremely fast and will sort 100 elements in about one second. Naturally it slows down as the number of elements increases, so that a sort of 600 elements takes about thirty seconds.

How does this help to sort disk records? Here the answer lies with another technique called the "tag" sort.

It is firstly necessary to identify the field on which you want the sort to be based — for example the supplier code. Next, all the records on the file need to be read and a tag array created. This array contains the contents of the required field for each record along with the relative address of the record in the file. This "relative address" depends on the file organisation — essentially it is information specifying the location of the record within the file. On the CBM 3040 disk drives this might be the track and sector, while on the Computhink drives it would be the relative record number.

The two values, field contents and relative address, are joined together to form a single element of an array: for example:

```
500 AB$(I) = SC$ + CHR$(N)
```

where AB$ is the array being created, I is the number we are up to in the array, SC$ is the field we have just read in (supplier code) and N is the relative record number. The command:

```
!S,AB$
```

is then all that is necessary to sort the completed array into ascending order.

To then process the records in the required order, all that is necessary is to go through the array and strip of the relative record number and use this information to find the complete record on the disk. Naturally this assumes that you can read the records in random order.

The assembler listing is in two segments. Segment 0 contains the code needed to put a "wedge" into BASIC to allow the addition of extra commands, while segment 1 is the actual sort routine. This particular version is for the 32K PETs and will run on its own or with DOS if DOS has been loaded. For smaller machines lines 7 and 10 will need to be modified to set the top of memory to an appropriate value.

The SORT command can be added to the normal BASIC commands and executed in direct or program mode.

To load the machine code to run the sort, simply load program "SORT-MC" but do NOT attempt to run it. Instead enter:

```
SYS 31744
```

and the sort will be ready.

If you are using the CBM DOS disk

continued on page 130


```
*---  SEGMENT= 0 FILENAME= WEDGE-DOS-SRC ---*
0070           CHRGET =      $70
0076           CHRGOT =      $76
0077           TXTPTR =      $77
00CD           QMKR   =      $CD
0035           MEMHI  =      $35
0034           MEMLO  =      $34
7C00           *      =      $7C00
7C00 A900             LDA    #0
7C02 8534             STA    MEMLO
7C04 A97C             LDA    #124
7C06 8535             STA    MEMHI !NEW MEMORY SET
7C08           !
7C08 A570             LDA    CHRGET !NOW CHECK IF
7C0A C94C             CMP    #$4C !A WEDGE IS
7C0C F011             BEQ    NEWADD !ALREADY IN
7C0E A976             LDA    #$76
7C10 8DC87C           STA    RETURN !NO : SO SET
7C13 A900             LDA    #0 !CHRGOT AS RETURN
7C15 8DC97C           STA    RETURN+1 !ADDRESS
7C18 A94C             LDA    #$4C
7C1A 8570             STA    CHRGET
7C1C 4C297C           JMP    SETUP
7C1F           !
7C1F A571      NEWADD LDA    CHRGET+1 !SAVE PREV
7C21 8DC87C           STA    RETURN !WEDGE ADDR
7C24 A572             LDA    CHRGET+2
7C26 8DC97C           STA    RETURN+1
7C29 A932      SETUP  LDA    #<WEDGE
7C2B 8571             STA    CHRGET+1
7C2D A97C             LDA    #>WEDGE
7C2F 8572             STA    CHRGET+2
7C31 60               RTS
7C32           ! HAVING PLUGGED THE WEDGE
7C32           ! NOW TO SET UP THE CODE.
7C32 68        WEDGE  PLA    !TAKE
7C33 85BD             STA    $BD     !A
7C35 68               PLA    !COPY
7C36 85BE             STA    $BE     !OF
7C38 48               PHA    !THE
7C39 A5BD             LDA    $BD     !RETURN
7C3B 48               PHA    !ADDRESS
7C3C           !
7C3C A5BE             LDA    $BE     !CHECK FOR
7C3E C9C3             CMP    #$C3    !READY
7C40 F016             BEQ    RE1     !MODE C3XX
7C42           !
7C42 C9C6             CMP    #$C6    !TOKEN
7C44 D008             BNE    REO     !MODE
7C46 A5BD             LDA    $BD     !CHECK
7C48 C9F9             CMP    #$F9
7C4A F00C             BEQ    RE1
7C4C D05E             BNE    OUT
7C4E           !
7C4E C9C8      REO    CMP    #$C8    !IF .....
7C50 D05A             BNE    OUT     !THEN .....
7C52 A5BD             LDA    $BD     !CHECK
7C54 C93E             CMP    #$3E
7C56 D054             BNE    OUT
```

```
7C58              !
7C58 20B97C       RE1     JSR    INCTXT
7C5B 8EC77C               STX    XBUF
7C5E A6CD                 LDX    QMKR
7C60 D004                 BNE    RETN
7C62 C921                 CMP    #'!      !IS IT ME
7C64 F01A                 BEQ    DECODE
7C66 AEC77C       RETN    LDX    XBUF     !RESTORE X
7C69 ADC87C               LDA    RETURN
7C6C C976                 CMP    #$76
7C6E F046                 BEQ    N2
7C70 38                   SEC    !RESTORE POINTER
7C71 A577                 LDA    TXTPTR
7C73 E901                 SBC    #1
7C75 8577                 STA    TXTPTR
7C77 A578                 LDA    TXTPTR+1
7C79 E900                 SBC    #0
7C7B 8578                 STA    TXTPTR+1
7C7D 4CB67C               JMP    N2
7C80              !
7C80 20B97C       DECODE  JSR    INCTXT
7C83 C953                 CMP    #'S      !SORT?
7C85 D03D                 BNE    ERROR
7C87 20B97C               JSR    INCTXT
7C8A C92C                 CMP    #',      !COMMA?
7C8C D036                 BNE    ERROR
7C8E 20B97C               JSR    INCTXT
7C91 8501                 STA    $01      !FIRST CHAR
7C93 20B97C               JSR    INCTXT   !OF ARRAY
7C96 C924                 CMP    #'$      !1 CHAR ONLY
7C98 D006                 BNE    NODOLL
7C9A A900                 LDA    #0       !ZERO 2ND
7C9C 8502                 STA    $02      !CHAR
7C9E F009                 BEQ    DOLL
7CA0              !
7CA0 8502         NODOLL  STA    $02      !2ND CHAR
7CA2 20B97C               JSR    INCTXT
7CA5 C924                 CMP    #'$      !FINAL
7CA7 D01B                 BNE    ERROR    !DOLLAR
7CA9 20D17C       DOLL    JSR    SORT
7CAC              !
7CAC ADC87C       OUT     LDA    RETURN
7CAF C976                 CMP    #$76
7CB1 D003                 BNE    N2
7CB3 20B97C               JSR    INCTXT
7CB6 6CC87C       N2      JMP    (RETURN)
7CB9              !
7CB9 A000         INCTXT  LDY    #0
7CBB E677                 INC    TXTPTR
7CBD D002                 BNE    INC1
7CBF E678                 INC    TXTPTR+1
7CC1 B177         INC1    LDA    (TXTPTR),Y
7CC3 60                   RTS
7CC4              !
7CC4 4C03CE       ERROR   JMP    $CE03
7CC7 00           XBUF    .BYTE  0
7CC8 0000         RETURN  .WORD  $0000
7CCA                      .CONT
*--- SEGMENT= 1  FILENAME= SORT-DOS-SRC ---*
```


```
7CCA                ! SORT ROUTINE
7CCA 0000           COUNT  .WORD $0000
7CCC 0000           NUMBER .WORD $0000
7CCE 0000           WORK   .WORD $0000
7CD0 00             LEN    .BYTE $00
7CD1                !
005E                ARRAYS =     $5E
0060                ADDR1  =     $60
0062                ADDR2  =     $62
0066                FIRST  =     $66
0068                SECOND =     $68
0001                NAME   =     $01
7CD1                !POINT TO ARRAY TABLE
7CD1 A52C           SORT   LDA   $2C
7CD3 855E                  STA   ARRAYS
7CD5 A52D                  LDA   $2D
7CD7 855F                  STA   ARRAYS+1
7CD9                !FORCE NAME TO STRING TYPE
7CD9 A502                  LDA   NAME+1
7CDB 0980                  ORA   #$80
7CDD 8502                  STA   NAME+1
7CDF                !CHECK ENTRY IN ARRAY TABLE
7CDF A000           CHECK  LDY   #$00
7CE1 B15E                  LDA   (ARRAYS),Y
7CE3 C501                  CMP   NAME
7CE5 D007                  BNE   NO
7CE7 C8                    INY
7CE8 B15E                  LDA   (ARRAYS),Y
7CEA C502                  CMP   NAME+1
7CEC F02A                  BEQ   FOUND
7CEE                !POINT TO NEXT ENTRY
7CEE 18             NO     CLC
7CEF A002                  LDY   #$02
7CF1 B15E                  LDA   (ARRAYS),Y
7CF3 655E                  ADC   ARRAYS
7CF5 8DCE7C                STA   WORK
7CF8 C8                    INY
7CF9 B15E                  LDA   (ARRAYS),Y
7CFB 655F                  ADC   ARRAYS+1
7CFD 855F                  STA   ARRAYS+1
7CFF ADCE7C                LDA   WORK
7D02 855E                  STA   ARRAYS
7D04                !CHECK FOR END OF TABLE
7D04 C52E                  CMP   $2E
7D06 90D7                  BCC   CHECK
7D08 A55F                  LDA   ARRAYS+1
7D0A C52F                  CMP   $2F
7D0C 90D1                  BCC   CHECK
7D0E A07D                  LDY   #>SORT01
7D10 A9E4                  LDA   #<SORT01
7D12 201CCA                JSR   $CA1C
7D15 4C89C3                JMP   $C389
7D18                !FIND NUMBER OF ELEMENTS
7D18 A005           FOUND  LDY   #$05
7D1A B15E                  LDA   (ARRAYS),Y
7D1C 8DCC7C                STA   NUMBER
7D1F C8                    INY
7D20 B15E                  LDA   (ARRAYS),Y
7D22 8DCD7C                STA   NUMBER+1
```

```
7D25 4C9A7D          JMP    ENDCHK
7D28             !POINT TO FIRST ELEMENT
7D28 18          START   CLC
7D29 A55E                LDA    ARRAYS
7D2B 6907                ADC    #$07
7D2D 8560                STA    ADDR1
7D2F A55F                LDA    ARRAYS+1
7D31 6900                ADC    #$00
7D33 8561                STA    ADDR1+1
7D35 A900                LDA    #$00
7D37 8DCA7C              STA    COUNT
7D3A 8DCB7C              STA    COUNT+1
7D3D             !POINT TO NEXT ELEMENT
7D3D 18          NEXT    CLC
7D3E A560                LDA    ADDR1
7D40 6903                ADC    #$03
7D42 8562                STA    ADDR2
7D44 A561                LDA    ADDR1+1
7D46 6900                ADC    #$00
7D48 8563                STA    ADDR2+1
7D4A             !FIND THE SHORTEST LENGTH
7D4A A000                LDY    #$00
7D4C B160                LDA    (ADDR1),Y
7D4E D162                CMP    (ADDR2),Y
7D50 9002                BCC    LESS
7D52 B162                LDA    (ADDR2),Y
7D54 8DD07C      LESS    STA    LEN
7D57             !FIND ADDRESSES OF STRINGS
7D57 C8                  INY
7D58 B160                LDA    (ADDR1),Y
7D5A 8566                STA    FIRST
7D5C B162                LDA    (ADDR2),Y
7D5E 8568                STA    SECOND
7D60 C8                  INY
7D61 B160                LDA    (ADDR1),Y
7D63 8567                STA    FIRST+1
7D65 B162                LDA    (ADDR2),Y
7D67 8569                STA    SECOND+1
7D69             !COMPARE THE STRINGS
7D69 A0FF                LDY    #$FF
7D6B C8          COMP    INY
7D6C 98                  TYA
7D6D CDD07C              CMP    LEN
7D70 F008                BEQ    SWOP
7D72 B166                LDA    (FIRST),Y
7D74 D168                CMP    (SECOND),Y
7D76 F0F3                BEQ    COMP
7D78 B045                BCS    CHANGE
7D7A             !SET UP NEXT PAIR OF STRINGS
7D7A A562        SWOP    LDA    ADDR2
7D7C 8560                STA    ADDR1
7D7E A563                LDA    ADDR2+1
7D80 8561                STA    ADDR1+1
7D82             !CHECK IF PASS COMPLETE
7D82 EEC?7C              INC    COUNT+1
7D85 D003                BNE    PASS
7D87 EECA7C              INC    COUNT
7D8A ADCA7C      PASS    LDA    COUNT
7D8D CDCC7C              CMP    NUMBER
```

```
7D90 D02A                 BNE   NOTDON
7D92 ADCB7C               LDA   COUNT+1
7D95 CDCD7C               CMP   NUMBER+1
7D98 D022                 BNE   NOTDON
7D9A             !CHECK   FOR END OF SORT
7D9A D8          ENDCHK   CLD
7D9B 38                   SEC
7D9C ADCD7C               LDA   NUMBER+1
7D9F E901                 SBC   #1
7DA1 8DCD7C               STA   NUMBER+1
7DA4 ADCC7C               LDA   NUMBER
7DA7 E900                 SBC   #0
7DA9 8DCC7C               STA   NUMBER
7DAC A900        PASS2    LDA   #$00
7DAE CDCD7C               CMP   NUMBER+1
7DB1 D006                 BNE   NOTYET
7DB3 CDCC7C               CMP   NUMBER
7DB6 D001                 BNE   NOTYET
7DB8 60                   RTS
7DB9 4C287D      NOTYET   JMP   START
7DBC 4C3D7D      NOTDON   JMP   NEXT
7DBF             !SWOP LENGTH FIELDS
7DBF A000        CHANGE   LDY   #$00
7DC1 B160                 LDA   (ADDR1),Y
7DC3 8DCE7C               STA   WORK
7DC6 B162                 LDA   (ADDR2),Y
7DC8 9160                 STA   (ADDR1),Y
7DCA ADCE7C               LDA   WORK
7DCD 9162                 STA   (ADDR2),Y
7DCF C8                   INY
7DD0             !SWOP ADDRESS FIELDS
7DD0 A566                 LDA   FIRST
7DD2 9162                 STA   (ADDR2),Y
7DD4 A568                 LDA   SECOND
7DD6 9160                 STA   (ADDR1),Y
7DD8 C8                   INY
7DD9 A567                 LDA   FIRST+1
7DDB 9162                 STA   (ADDR2),Y
7DDD A569                 LDA   SECOND+1
7DDF 9160                 STA   (ADDR1),Y
7DE1 4C7A7D               JMP   SWOP
7DE4 4E4F20      SORT01   .TEXT 'NO SUCH ARRAY'
7DF1 00                   .BYTE $00
7DF2                      .END
```

Serious sorting for business *(continued from page 125)*

operating system, then this must be loaded and run BEFORE loading the sort routine and executing the SYS 31744 instruction. So the correct sequence of events is:

- ☐ Switch on the computer
- ☐ Switch on the disk unit
- ☐ Load and run DOS
- ☐ Load SORT-MC
- ☐ SYS 31744

The command uses a very fast machine-code sorthing routine to sort any string array. The routine only requires the name of the array — it will then sort the whole array into ascending order. To process an array in descending order, simply start from the end and step down it.

Here is an example of its use:

```
10  FOR I = 1 TO 10
20  READ AB$(I): PRINT AB$(I),
30  NEXT
40  !S,AB$
50  FOR I = 1 TO 10
60  PRINT AB$(I)
70  NEXT
100 DATADUCK,FOX, CHICKEN,
    RABBIT,FROG,TOAD,MOUSE,
    FOX
110 DATALION, TIGER
```

This small program will read an array of ten items, invoke the sort and then print out the sorted array.

The format of the command is quite simple:

!S,array name, eg
!S,B$

BASIC will reply with SYNTAX ERROR if you enter the command incorrectly. The sort routine will reply with

NO SUCH ARRAY

if the array you have given it does not exist or is not of string type.

In a statement such as IF . . . . . THEN !S,A$, it is best to separate the two parts of the statement with a colon, so:

IF A > 25 THEN : !S,A$

BUYERS' GUIDE SOFT-WARE

by Mike McDonald

The Software Buyers' Guide takes a new form this month as a result of the sheer volume of applications coming on the market. With 40 dealers (originating sources) offering 105 packages, presentation has been changed for quicker reference.

Suppliers are now listed in alphabetical order with name, address, phone number, and contact. Then applications packages are listed by machine type, giving machine, company name, price, and capacity, to give a brief analysis of commercial packages for any particular machine. The user may then refer to the supplier in the alphabetical supplier list.

The general criteria are still the same: the software price is in the range of £50 up to £1000; the user will require floppy disk drives, a printer, and 32K of RAM; generally prices exclude VAT. Capacities quoted are usually on a per disk basis.

Machine types by main application

Sales Ledger

Machine type	Supplier	Price (£)	Capacity
Commodore 3032	Microact	350	2000 A/Cs 7000 trans
Z80/8080	Great Northern C.S.	275	varies
Tandy TRS80	Tridata Micros	P.O.A.	to be linked to S/L & P/L
Apple II	Computech Systems	295	500 A/C 1600 trans
Commodore 3032	HB Computers	200	linked to S/L & P/L
Apple II	Vlasak Electronics	225	500 A/C 1600 trans
CP/M	Computastore	500	linked to S/L & P/L companies

Purchase Ledger

Machine type	Supplier	Price (£)	Capacity
CP/M	Structured Systems Group	460	varies
Commodore 3032	Microact	350	2000 A/cs 7000 trans
Z80/8080	Great Northern C.S.	275	varies
Tandy TRS-80	Tridata Micros	225	175 A/Cs 1350 trans
Apple II	Vlasak Electronics	315	200 A/Cs 1000 trans
Apple II	Computech Systems	295	500 A/Cs 1600 trans
Commodore 3032	HB Computers	350	800 A/Cs 4000 trans
CP/M	Computastore	400	open item
Apple II/ITT 2	Padmede Computer Services	300	900 A/C 4500 trans/disk
Exidy Sorcerer	Basic Computing	125 incl	see also Micropute

General Ledger

Machine type	Supplier	Price (£)	Capacity
Z80/8080	Great Northern C.S.	275	varies
Tandy TRS80	Tridata Micros	P.O.A.	linked to S/L & P/L
Apple II	Computech Systems	295	500 A/C 1600 trans
Commodore 3032	HB Computers	200	linked to S/L & P/L
Apple II	Vlasak Electronics	225	200 A/cs 1000 trans
CP/M	Computastore	500	999 A/C 99 cntrs 9 comp

Combined packages: ledgers/stock/invoicing

Machine type	Supplier	Price (£)	Capacity
Commodore 3032	G.W. Computers	275-575	1000
Z80/8080	Great Northern C.S.	995	varies
Ohio Scientific	Microcomputer B.M.	656	*
Tandy TRS80	Microcomputer Applctns	90 each	*
Tandy TRS80	T & V Johnson	110	750 trans/disk

Stock Systems

Machine type	Supplier	Price (£)	Capacity
Apple II/ITT2	Microdigital	200	1250 items
CP/M	Graffcom Systems	350	520-6000 items
Z80/8080	Great Northern C.S.	275	varies
Tandy TRS80	Tridata Micros	200	630 items/disk
Commodore 3032	Commodore B.M. (UK)	150	650
Commodore 3032	Bristol Software Factory	300-360	2300
Z80/8080	Graham-Dorian Software	325	varies
Apple II/ITT 2	Vlasak Electronics	285	*
Commodore 3032	Petsoft	50	2000
Commodore 3032	L & J Computers	120	3400 items
Commodore 3032	Microact	350	3500 items
Tandy TRS80	T & V Johnson	115	1000 items
Tandy TRS80	T & V Johnson	145	1000 items/invoices
Commodore 3032	Amplicon M.S.	750	500-600 items 255 A/Cs
Exidy Sorcerer	Basic Computing	125 incl	see also Micropute Ltd

Records management (DBMS)

Machine type	Supplier	Price (£)	Capacity
Commodore 3032	Commodore B.M. (UK)	150	650
Commodore Pet	Stage One Computers	120	165K
Apple II/ITT 2	T & V Johnson	95	112K per drive
Ohio Scientific	Microcomputer B.M.	175	*
Commodore 3032	Amplicon M.S.	140	1500 records
Tandy TRS80	T & V Johnson	200	*
Z80/8080	Structured Systems Group	135	varies

Word processing

Machine type	Supplier	Price (£)	Capacity
Commodore 3032	Commodore B.M. (UK)	75	165K
Tandy TRS80	T & V Johnson	109	10,000 words
Ohio Scientific	Microcomputer B.M.	116	*
Apple II/ITT 2	Algobel Computers	75	800 lines
Commodore 3032	Hipposoft	325	*
Commodore 3032	HB Computers	70	39 A4 pages
Apple II/ITT 2	Vlasak Electronics	120	*
Z80/8080	Structured Systems Group	120	varies

Mail Systems

Machine type	Supplier	Price (£)	Capacity
Apple II	Microdigital	?	2500 names/addresses
CP/M	Structured Systems Group	50approx	varies
Apple II	Keen Computers	300	500 addresses
Tandy TRS80	T & V Johnson	P.O.A.	3000 names/addresses
Z80/8080	Micro Focus	90	varies
CP/M	Graffcom Systems	250	varies

Incomplete Records Accounting

Machine type	Suppliler	Price (£)	Capacity
CP/M	Profcomp	P.O.A.	2000 entries
Commodore 3032	Micro Computation	555	120 A/Cs 5000 trans
Apple II/ITT 2	Padmede Computers	450	900 A/C 2000 trans/ disk
Exidy Sorcerer	Basic Computing	350 incl	see also Microcompute

Property Management

Machine type	Supplier	Price	Capacity
Z80/8080	Graham Dorian Software	325	varies
Apple II/ITT 2	Algobel Computers	650	400 bldgs 250 owners 2000 tenants
CP/M	Algobel Computers	650	2000 trans

Alpabetical list of suppliers

Supplier	Address	Sales contact
Algobel Computers 021-233 2407	33, Cornwall Buildings, Newhall St, Birmingham B3 3QR	Steve Linden
Amplicon M.S. 0273-562163	143A, Ditchling Rd, Brighton, Sussex BN1 6JA	Jim Hicks
Basic Computing 0535-65094	Oakworth Rd, Keighley, W. Yorks BD22 7LA	Mike Collier
Bristol Software Factory 0272-20801	Micro House, St. Michael's Hill, Bristol BS2 8BS	W. J. Kyle-Price
Commodore B.M. (UK) 0753-74111	818, Leigh Rd, Trading Estate, Slough, Berks	Nick Green
Computastore 061-832 4761	16, John Dalton St, Manchester M2 6HG	David Nicholson
Computech Systems 01-794 0202	168, Finchley Rd, London NW3	Laurence Payne
Graffcom Systems 01-734 8862	52, Shaftesbury Ave, London W1V 7DE	Barbara A. Castledine
Graham Dorian Software 01-379 7931	c/o Lifeboat Associates, 32, Neal St, London WC2H 9PS	?
G.W. Computers 01-636 8210	89, Bedford Crt Mansions, Bedford Avenue, London WC1	?
Great Northern C.S. 0532-450667	15, Wellington St, Leeds LS1 4DL	Paul Rayner
HB Computers ?	22, Newland St, Kettering, Northants	Stuart Whittaker
Hewport 04254-77352	20, Cunningham Close, Ringwood, Hants BH24 1XW	D. N. Rogers
Hipposoft 0332-760127	9, Littleover Lane, Derby	?
Keen Computers 0602-583254	5B, The Poultry, Nottingham	Bob Ellis
Landsler Software 01-399 2476/7	29A Tolworth Park Road, Surbiton Surrey KT6 7RL	E. Landsler
L & J Computers 01-204 7525	3, Crundale Ave, Kingsbury, London NW9 9PJ	?
Microact 021-455 8585	Radclyffe Hse, 66-68 Hagley Rd, Edgbaston, Bham B16 8PF	John Farthing
Micro Computation 01-882 5104	8 Station Parade, Southgate, London N14	Graham Dicker
Micropute 0625-612818	Communique Place, 9, Presbury Place, Macclesfield, Cheshire	Don Cooper
Micromputer Applications ?	11, Riverside Ct, Caversham, Reading RG4 8AL	?
Microcomputer B.M. 01-981 3993	4, Morgan St, London E3 5AB	?
Microdigital 051-227 2535	25, Brunswick St, Liverpool L2 0BJ	Graham Jones
Micro Focus 01-379 7931	c/o Lifeboat Associates, 32 Neal St, London WC2H 9PS	?
Microsense Computers 0442-41191/48151	Finway Rd, Hemel Hempstead, Herts HP2 7PS	D. Page
Padmede Computer Services 025-671 2434	112/116 High St, Odiham, Basingstoke, Hampshire	John Packwood

Petsoft 021-455 8585	Radclyffe Hse, 66-68 Hagley Rd, Edgbaston, Bham B16 8PF	Julian Allison
Profcomp 01-989 8177	107, George Lane, South Woodford, London E18 1AN	Mr Whitcombe
Stage One Computers 0202-23570	6, Criterion Arcade, Old Christchurch Rd, Bournemouth	?
James C Steadman 0903-814923	18, Manor Road, Upper Beeding, Steyning, Sussex BN4 3TJ	James Steadman
Structured Systems Group 01-379 7931	c/o Lifeboat Associates, 32 Neal St, London WC2H 9PS	?
Structured Systems Group 01-553 1001	c/o LP Enterprises, 313, Kingston Rd, Ilford, Essex IG1 1PJ	?
T & V Johnson 0276-62506	165, London Rd, Camberley, Surrey GU15 3JS	T. Johnson
T.W. Computers 061-456 8187	293, London Rd, Hazel Grove, Stockport, Cheshire	?
The Alphabet Company 03046 7209	2 Whitefriars Way, Sandwich, Kent CT13 9AD	A. L. Minter
Tridata Micros 021-622 6085	Smithfield House, Digbeth, Birmingham B5 6BS	A. Plackowski
Vlasak Electronics 06284-74789	Thames Building, Dedmere Rd, Marlow, Bucks SL7 1PB	Paul Vlasak
3-Line Computing ?	36, Clough Rd, Hull HU5 1QL	?

Applications by machine

Machine type: Commodore

Application	Supplier	Price (£)	Capacity
Ledgers/stock/invoicing	G.W. Computers	275-575	1000
Payroll	Computastore	200	275 employees/disk
Ledger sales	Microact	350	2000 A/Cs 7000 trans
Ledger purchase	Microact	350	2000 A/C's 7000 trans
Stock control	Commodore B.M. (UK)	150	650
DBMS	Commodore B.M. (UK)	150	650
Word processor	Commodore B.M. (UK)	75	165K
DBMS	Stage One Computers	120	165K
Stock control/invoicing	Bristol Software Factory	300-360	2300
Stock control	Petsoft	50	2000
Payroll	Petsoft	50	200 employees
Payroll	Landsler Software	95 incl	250 employees
Stock control/invoicing	L & J Computers	120	3400 items
Minicab/invoice/payroll	L & J Computers	220	
Incomplete records a/c	Micro Computation	555	120 A/C's 5000 trans
Bldng Conversion Spec	Micro Computation	300-400	320 clauses
Ledger sales	HB Computers	350	800 A/C's 4000 trans
Word processor	Hipposoft	325	
DBMS	Amplicon M.S.	140	1500 records
Ledger Purchase	HB Computers	350	800 A/C's 4000 trans
Ledger General	HB Computers	200	Linked to S/L & P/L
Stock control	Microact	350	3500 items
Work measurement	The Alphabet Company	150	
Stock control	Amplicon M.S.	750	500-600 items 255 A/C
Word proc/mailing system	HB Computers	70	39 A4 pages
Hotel room system (intg)	Landsler Software	275	8 × 99 rooms for 400
Hotel system (+billing)	Landsler Software	450	130 rooms

Machine type: Tandy

Application	Supplier	Price (£)	Capacity
Ledger sales	Tridata Micros	225	175 A/Cs 1350 trans
Ledger purchase	Tridata Micros	225	175 A/Cs 1350 trans
Ledger general	Tridata Micros	P.O.A.	Linked to S/L P/L
Stock control	Tridata Micros	200	630 items/disk
Payroll	Tridata Micros	218	400 employees
Invoicing	Tridata Micros	75	linked to stock and sales analysis
Word processor (E.P.)	T & V Johnson	109	10,000 words
Ledgers/payroll various	Microcomputer Applctns	90 each	•
Payroll	3-Line Computing	140	•
Ledgers/stock/invoicing	T & V Johnson	110	750 transactions/disk
Stock control	T & V Johnson	115	1000 items
Stock control/invoicing	T & V Johnson	145	1000 items/invoices
Mailing system	T & V Johnson	P.O.A.	3000 names/addresses
DBMS	T & V Johnson	200	•

Machine type: Apple

Application	Supplier	Price (£)	Capacity
Payroll	Algobel Computers	295	500 employees
Stock control	Microdigital	200	1250 items
Mailing system	Microdigital	?	2500 names/addresses

Ledger purchase	Vlasak Electronics	315	200 A/Cs 1000 trans
Ledger sales	Vlasak Electronics	315	200 A/Cs 1000 trans
Ledger sales	Computech Systems	295	500 A/Cs 1600 trans
Ledger purchase	Computech Systems	295	500 A/Cs 1600 trans
Ledger general	Computech Systems	295	500 A/Cs 1600 trans
Payroll	Computech Systems	379	*
Stock/purchase/order inv.	Vlasak Electronics	285	*
DBMS	T & V Johnson	95	112K per drive
Payroll	T.W. Computers	145	*
Propery management	Algobel Computers	650	400 bldgs 250 owners, 20 agts
Word processor	Algobel Computers	75	800 lines
Job costing	Padmede Computer Services	450	1000 A/Cs 99 cost centres
Time & cost recording	Padmede Computer Services	150	150 A/Cs
Structural eng. design	James C. Steadman	200	not applicable
Mailing & letter writer	Keen Computers	300	500 addresses
Payroll	Hewport	400-500	100 mnth 50 wkly
Ledger general	Vlasak Electronics	225	200 A/Cs 1000 trans
Modelling (Visicalc)	Microsense Computers	95	*
Incomplete records/ nominal ledger	Padmede Computer Services	450	900 A/Cs 2000 trans/ day
Ledger sales	Padmede Computer Services	300	900 A/Cs 4500 trans/ day
Ledger purchase	Padmede Computer Services	300	900 A/C 4500 trans/ day
Payroll	Vlasak Electronics	360	*
Word processing	Vlasak Electronics	120	*
Cash flow/bank forecast	Vlasak Electronics	80	*

Machine type: CP/M

Application	Supplier	Price (£)	Capacity
Mailing system	Structured Systems Group	50approx	varies
Ledger purchase	Structured Systems group	460	varies
Incomplete records	Profcomp	P.O.A.	2000 entries
Payroll	Graffcom Systems	500	250 employees
Purchasing system	Graffcom Systems	450	540-7000 invoices
Stock control	Graffcom Systems	350	520-6000 items
Order entry & invoicing	Graffcom Systems	350	500-5000 orders
Hire purchase system	Graffcom Systems	*	varies
Time recording system	Graffcom Systems	*	100 activity codes
Ledger sales	Computastore	400	open item
Ledger purchase	Computastore	400	open item
Ledger general	Computastore	500	999 A/Cs 99 centres 9 cost cos
Property management	Algobel Computers	650	2000 trans
Mail list system	Graffcom Systems	250	varies

Machine type: Z80/8080

Application

Application	Supplier	Price (£)	Capacity
Ledger nominal	Great Northern C.S.	275	varies
Ledger purchase	Great Northern C.S.	275	varies
Ledger sales	Great Northern C.S.	275	varies
Stock control (retail)	Great Northern C.S.	275	varies
Client billing	Great Northern C.S.	330	varies
Purchasing system (job)	Great Northern C.S.	275	varies
Appointments system	Great Northern C.S.	220-275	varies
Ledgers/payroll	Great Nothern C.S.	995	varies
Apartment management	Graham Dorian Software	325	325
Stock control	Graham Dorian Software	325	varies
Sales analysis (retail)	Graham Dorian Software	325	varies
DBMS	Structured Systems Group	135	varies
Word processing	Structured Systems Group	120	varies
Mail list system	Micro Focus	90	varies

Machine type: Ohio Scientific

Application	Supplier	Price (£)	Capacity
Ledgers/stock/invoicing	Microcomputer B.M.	656	*
DBMS	Microcomputer B.M.	175	*
Word processor	Microcomputer B.M.	116	*

Machine type: Exidy Sorcerer

Application	Supplier	Price (£)	Capacity
Stock recording	Basic Computing	125 incl	see also Micropute
Incomplete records	Basic Computing	350 incl	see also Micropute
Ledger purchase	Basic Computing	125 incl	see also Micropute
Ledger sales	Basic Computing	125 incl	see also Micropute

DISCOUNT PETS

NEW 8K PET £445 with large keyboard, 16K £540, 32K £640, Dual Floppy £670, Programmer's Toolkit £45, Cassette £54.

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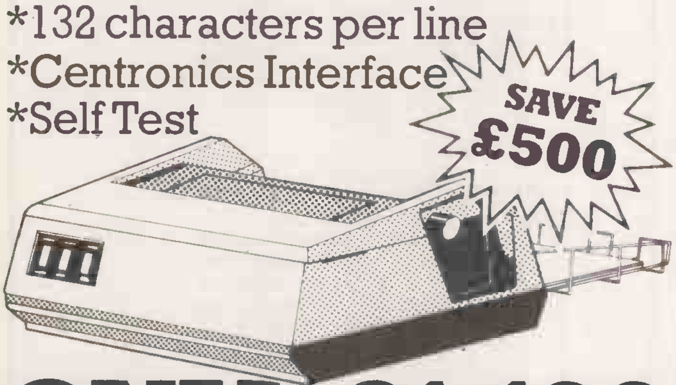

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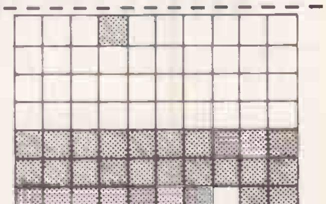

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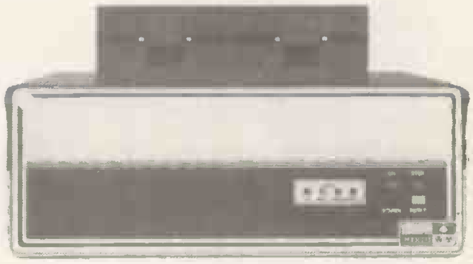

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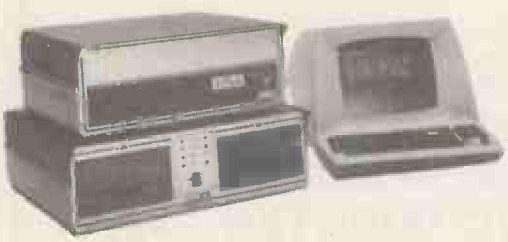

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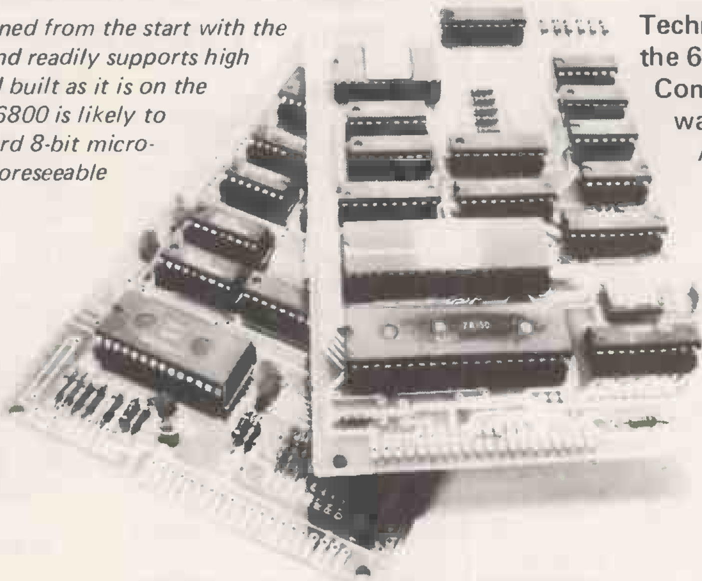

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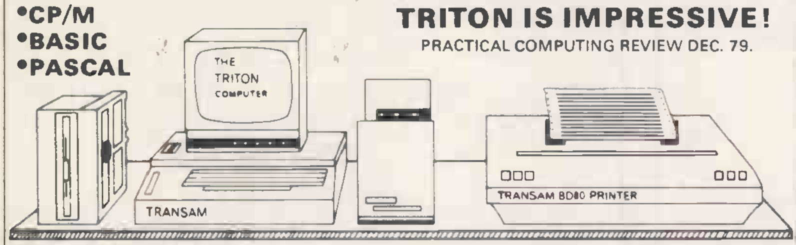

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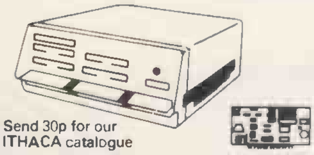

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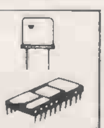

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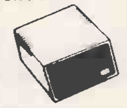

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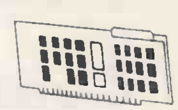

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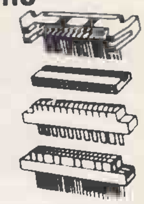

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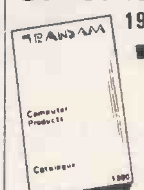

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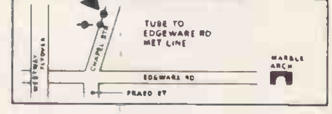

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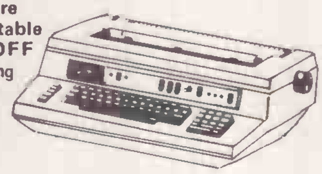

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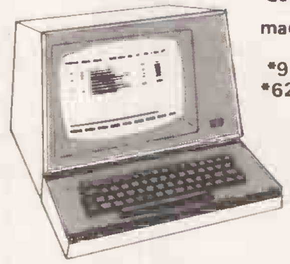

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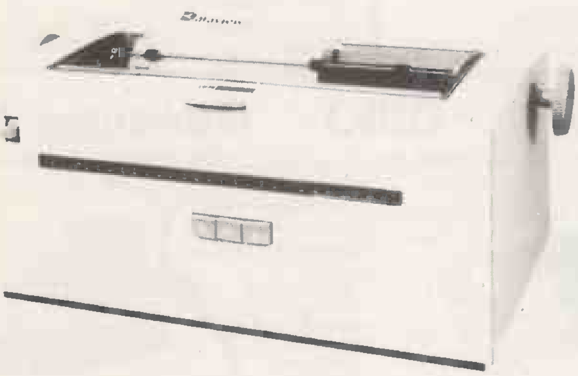

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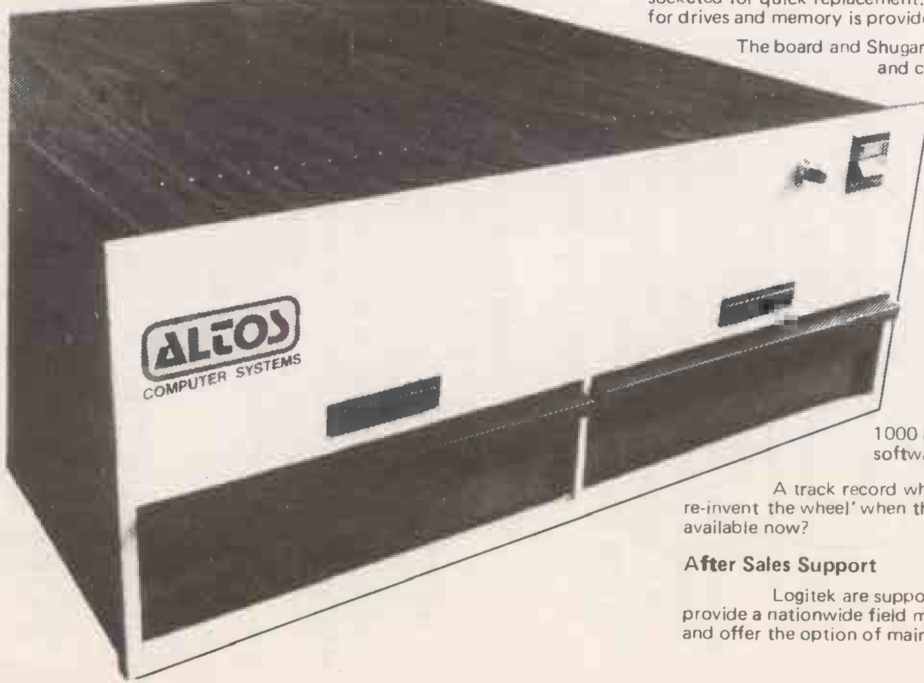

Hard Disk/Multi User Systems The Winchester hard disk/multi user systems are now available supporting up to 4 simultaneous users and providing a maximum of 58 Megabytes of hard disk data storage.

The systems are truly flexible and allow expansion of the ALTOS floppy disk system to keep pace with the users requirements.

Still single board, features include * a high speed I/O section with up to six serial ports and one 8 bit Parallel port
*up to 208K of on board RAM.
*High speed (4 MHZ) D.M.A. control as standard.

Yes, mini power and at micro cost too.

Built-in Reliability

The ACS 8000 range are true single board micro computers making them extremely reliable and maintainable. All electronics are socketed for quick replacement. Complete diagnostic utility software for drives and memory is provided.

The board and Shugart floppy disk drives are easily accessible and can be removed in less than ten minutes.

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Unlimited versatility. The ACS 8000 range support the widely accepted CP/M and MP/M operating systems plus basic (Microsoft and CBasic), Cobol, Pascal, and Fortran IV. All available now.

Logitek in conjunction with its own microsoftware house, Interface Software Ltd. of Camberely are able to supply a wide range of proven 'off the shelf' business software including general accounting, word processing, stock control, mailing list etc.

There are already over 1000 micro computer installations using this software.

A track record which we consider speaks for itself. Why re-invent the wheel' when there is standard software of this quality available now?

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Logitek are supported by DDT Maintenance Ltd. who provide a nationwide field maintenance service for ALTOS products and offer the option of maintenance contracts.

ALTOS

Availability

Logitek carry deep shelf stocks of ALTOS hardware and compatible peripherals.

If you are a dealer who may be interested in promoting ALTOS and/or Interface Software by joining the fast growing network of approved suppliers, contact Logitek.

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• Circle No. 287

● **Pascal training course** — available with venues and dates to suit customers. Aims to teach 'standard' PASCAL. Course is augmented by practical case studies with full class discussion of results. Fee: £390. Contact: Twenty First Computer Systems, 29a York Street, Twickenham, Middlesex, tel: 01-892 1180.

●1 - May 4 **Pascal programming**. Venue: Manchester University Computer Science Building. Fee: £8. Contact: Douglas Kaye, Dept of Extramural Studies, The Universilty, Manchester, M13 9PL, tel: 061-273 3333.

●2-3 **Sales and forecasting systems: analysis and design.** Venue: London. Explains the sales and forecasting for business and covers techniques for designing computer-based systems to meet typical requirements. Fee: £270. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks, SL6 1LD, tel: 0628 39101.

●3 - May 6 **Fortran programming** (enrol by March 27th). Venue: Manchester University Computer Science Building. An introduction to FORTRAN. Students will not be expected to have any prior knowledge of computers or computer programming. Fee: £8. Contact: Douglas Kaye, Dept of Extramural Studies, The University, Manchester, M13 9PL, tel: 061-273 3333, ext: 3532.

●4 **Microcomputers and the businessman**. Venue: Skyway Hotel, Heathrow-London. This appreciation seminar will interest anybody considering the purchase of his first microcomputer system. Fee: £50 + VAT. Contact: Commodore Business Machines Ltd, Training Course Bookings, 360 Euston Road, London, NW1 3BL, tel: 01-388 5702.

●7-9 **Microprocessor workshop.** Venue: Manchester. Designed for engineers with little or no knowledge of microprocessors. The course is based on the AIM65 board and introduces all aspects of software development by practical programming sessions. Fee: £195 + VAT. Contact: Microsystems Consultants Ltd, PO Box 65, Camberley, Surrey, GU15 1QN, tel: (0276) 27417.

●8-9 **Requirements planning systems: analysis and design.** Venue: London. Explains materials and inventory management for business and techniques for designing computer-based systems to meet typical requirements. Fee: £27. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks, SL6 1LD, tel: (0628) 39101.

●9-11 **CICS for application programmers.** Venue: London. Designed for trainee programmers and system staff entering a CICS environment or for experienced staff involved in a change of software. Fee: £345. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks, SL6 1LD, tel: (0628) 39101.

●10-11 & 24-25 **Introduction to microprocessing.** Venue: Bedford. Introductory course on microprocessors using the TMS 9900. Students should be familiar with digital electronics in terms of logic gates and storage elements. Designed for engineers, technicians, and non-technical high-level language programmers. Fee: £95 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA, tel: (0234) 67466 ext 3718.

●14-18 **Advanced program and data design technology**. Venue: London. Designed for analysts, designers, programmers and software managers and other data-processing decision makers. Introduces new ideas, techniques and methods forming an integrated patterning methodology for improving system reliability and maintainability. Fee: £565. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks SL6 1LD, tel: (0628) 39101.

●15 **Introduction to small business microcomputers**. Venue: Luton, Eurocrest Hotel. Designed for executives, accountants and managers in industry and education. Includes explanation of hardware and software; specifying, purchasing and running a microcomputer; applications and new products and machine demonstrations. Fee: £45 + VAT. Contact: Mrs P. Duggan, Silverton Microcomputer Consultants, Silverton House, 8 Gran Avenue, Worthing, West Sussex BN11 5AN, tel: (0903) 47755.

●15 **Microcomputers in control systems**. Venue: Manchester, Excelsior Hotel. This appreciation seminar includes the use of microcomputers as programmable monitoring and control tools, interfacing microcomputers to industrial and laboratory equipment, and the microcomputer as a development tool for dedicated system software. Fee: £50 + VAT. Contact: Commodore Business Machines Ltd, Training Course Bookings, 360 Euston Road, London, NW1 3BL, tel: 01-388 5702.

●15-18 **Microprocessors and microcomputers**. Venue: London, Microprocessor Education Centre, Holborn. Designed for engineers, scientists, systems analysts and their managers. Provides a broad foundation in microprocessor applications through hands-on training. The course covers programming, hardware design and interfacing, techniques and procedures for organising and controlling a microprocessor project from start to completion. Fee: £470 + VAT. Contact: ICSP — UK, Pebblecombe, Tadworth, Surrey, KT20 7PA, tel: (03723) 79211.

●15-18 **PASCAL — Programming in the structural language.** Venue: Royal Horseguards Hotel, Whitehall Court, London, SW1A 2AU. Designed for engineers, programmers, scientists, systems analysts and managers who are using or plan to use PASCAL for the development of software systems. Fee: £470 + VAT. Contact: ICSP UK, Pebblecombe, Tadworth, Surrey, KT20 7PA, tel: (03723) 79211.

●15-18 **Communications '80 Exhibition**. Venue: Birmingham, National Exhibition Centre. Includes communications in the service of mankind, public telecommunications, data and business communications systems, civil radio and emergency communications. Contact: Tony Davies Communications, c/o P.D. Bishop, 8 Coningsby Road, South Croydon, Surrey, CR2 6QP.

●16-18 **OS JCL for application programmers.** Venue: London. Designed for trainee programmers and systems programming staff becoming involved in an OS-based environment. On completion, participants will be able to make optimum use of JCL statements and OS utilities to improve the efficiency and performance of application programs. Fee: £345. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks SL6 1LD, tel: (0628) 39101.

●16-18 **FS990/4 Floppy disc-based software development system.** Venue: Bedford. Designed for the technician or engineer who is familiar with the TMS 9900 instruction set and has knowledge or experience of microprocessor or minicomputer systems. Fee: £250 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA, tel: (0234) 67466 ext 3718.

●21-25 **Small parts production exhibition.** Venue: Birmingham. Contact: British Robot Association, 39 High Street, Kempston, Bedford, MK42 7BT, tel: Bedford 853605.

●21-25 **Introduction to computing.** Venue: London. For aspiring data processing professionals. Grounding in computing essentials. Fee £210. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks SL6 1LD, tel: (0628) 39101.

●24 **Computers and the business executive.** Venue: Sheffield, Hallam Tower Hotel. Fee: £75. Contact: Mrs M. Lange, British Council of Productivity Associations, 8 Southampton Row, London, WC1B 4AQ, tel: 01-405 1023.

●24-25 **Inspection method for software insurance.** Venue: London. This course explains the IBM-developed inspection method for software insurance. Participants learn to apply inspection methods to software for greater cost-effectiveness. Fee: £310. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks SL6 1LD, tel: (0628) 39101.

●25 **Engineering system at SIA.** Venue: London. Provides general, non-technical management overview of SIA's engineering systems capability. Designed to help engineering managers assess SIA's engineering computer services. Contact: The Events Organiser, SIA Ltd, Ebury Gate, 23 Lower Belgrave Street, London, SW1W 0NW.

●28-30 **Assembly language course.** Venue: Birmingham, Excelsior Hotel. Designed for those wishing to program the PET or any other 6502-based microcomputer in machine code. Participants will be taught the elements of microprocessors and how to program them in assembly language. Fee: £250 + VAT. Contact: Commodore Business Machines Ltd, Training Course Bookings, 360 Euston Road, London NW1 3BL, tel: 01-388 5702.

●28 - May 2 **Introduction to programming.** Venue: London. Designed for newcomers to programming. Provides basic introduction to the principles of computer programming in a language-independent way and provides the foundation for subsequent programming language courses. Fee: £355. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks SL6 1LD, tel: (0628) 39101.

●28 - May 2 **Systems analysis: skills and techniques.** Venue: London. This course shows potential systems staff techniques for defining new system proposals and justifying them in business terms. Fee: £355. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berks SL6 1LD, tel: (0628) 39101.

●30 - May 2 **Mersey Micro Show.** Venue: Liverpool, Adelphi Hotel. Shows the ever-increasing range of the microprocessor. Includes microsystems, business microcomputers, word processors, and personal computers for the home. Contact: Online Conferences Ltd, Argyle House, Joel House, Northwood Hills HA6 1TS, Middlesex, tel: (09274) 28211.

A PRACTICAL GLOSSARY

Continuing the terminology gamut with S

Sector
Part of a disc — the term is also used as a synonym for the data held in the sector. Remember the *Glossary* on discs? The disc has concentric tracks; it also has radial divisions, so that the disc surface is also organised into wedges.

These divisions may be physical in that the magnetic gunk on the disc physically isn't there, or notioned in that data is written in these patterns. The two sorts we called 'hard'- and 'soft'-sectored respectively.

One of those triangular sections is a sector, and the location of a block of data is usually addressed by reference to its track and sector numbers.

Seek time
What happens after you have counted to 100 with your hands over your eyes. It's also the time taken by a disc unit (could be a floppy disc drive) to position its read head *(qv)* over the specified track on the disc.

Seek time is quite a good measure of comparison — a disc drive that can get to the information quicker than another disc drive ought to be better. But there's more to it than that: it may also take some time for the disc to get up speed, and there'll be a few more microseconds taken by actually reading or writing the data. So total access time *(qv)* involves more than just seek time.

In any case, there are lots of other blocks, bottlenecks and other pratfalls for the computer to negotiate before it can translate your program into information delivered back to you. So seek time isn't necessarily a useful indicator of overall computing throughout. In which case you may wonder why I included it in the glossary. Well, so do I — now.

Semiconductor
Malcolm Sargeant when he was still a church organist? Oh, well never mind. A semiconductor is a material whose electrical conductivity is between that of metal and an insulator.

Semiconductors have many unique and usable attributes in computing, which is all you need to know about them.

These days computer memory tends to be semiconductor, which means data is stored in a bunch of miniature semiconductor circuits.

Serial
Contrast with parallel *(qv)*: serial means things happen in sequence rather than at the same time. So serial transmission or serial I/O is a method of communication in which each bit *(qv)* of information is sent sequentially on a single channel; serial access means getting at records in the order in which they occur.

Serial-access storage devices are typified by cassette: they are cheaper than random-access systems like floppy disc, but it takes much longer to get to a given piece of information on a serial medium like tape.

Serial interfaces are widely used to connect terminals to computers: they are technically simpler than parallel interfaces and can be used over longer distances.

There are two well-known serial interfaces, defining which pin in the plug relates to which wire and which electrical signal. **RS-232C:** this specification is also known as CCITT V24. It was laid down originally by an American standards body (the CCITT is a European organisation). It is probably the most widely-used interface; nearly all microcomputers and many peripherals — especially printers and terminals — have RS-232C connectors.
20mA current loop: this is still popular. It was first used on the Teletype terminal, and the Teletype 33 was for much of the 1960s the dominant computer terminal. It became a *de facto* standard but these days RS-232C is more popular. The 20mA current loop design cannot operate normally as quickly as RS-232C, so it cannot be used for the faster printers.

Set
Usually means giving a particular bit the value '1'.

Shift
Moving data to the right or left. In practice the term applies to operations deep inside the assembly-language level, and a shift consists of moving the contents of a register left or right by one (or more) bit. The bit falling out of one end would go into carry area somewhere: the bit coming in is usually '0'. The left shift of a binary number by one place is equivalent to multiplying by two.

Signal
Any conveyer of information — "the physical embodiment of a message," says one dictionary. In practice in computers, it means a detectable and desirable electrical event — undesirable electrical happenstance is called 'noise' *(qv)*.

Silicon
A non-metallic chemical element widely used as the semiconductor in modern semiconductor circuitry.

Silicon Valley
The area around Sunnyvale, California where most of the semiconductor manufacturers are installed — and where Fairchild and Hewlett-Packard, the two major progenitors of the modern electronics business are located. Also called Silicon Gulch.

Simplex
You won't come across this word, but it means communication in one direction only. Compare duplex, which allows you to transmit in either direction down the same link.

Simulate
Often confused with 'stimulate', but you'll get used to the difference when you get older. Simulate means to represent some aspects of one thing by setting up a symbolic analogue of it. Usually this means running a mathematical model of something.

This simulating is typified by something like the Club of Rome's *Limits to Growth* scenario: the computer is given a set of base data and a collection of variables. Those can be frankly wrong: and, more important, you might well have missed some of the more important considerations when you set up your model.

SNA
Systems Network Architect rivals DNA in the complexity stakes. SNA is the latest of IBM's grand designs for specifying how its computers and other hardware can be plugged together. Take a look at *network* (qv).

Software
Programs. In strictly literal terms, you also ought to include program documentation and programming procedures.

Sol
RIP. This pioneering home computer had wooden sides and a neat flat PCB layout inside it. Made by Processor Technology, which went under last year.

Solid-state
This is the branch of physics that concerns itself with the essential properties of semi-conductor materials. And all you need to know is that 'solid-state' and 'semiconductor' are used loosely as synonyms to refer to the wonders of current computer technology.

Stack
Don't bother with this one if you don't feel like it — it's really esoteric. Some computers use a small area of main memory as a temporary data store called a stack: it works on a last-in, first-out basis, and it is essential for keeping track of sub-routines — the stack typically holds the return address.

The assembly language will provide instructions for getting data in and out of the stack, often the amiably-named PUSH and POP commands.

Systems that use stacks do not generally require the programmer to keep track of the actual locations that data is being stacked into. This is done automatically through a stack 'pointer'. To keep track of the last item added to the stack, a register may contain the memory address where the last item is stored in the stack: on some systems, all but one or two registers may be used as a stack pointer.

interface components

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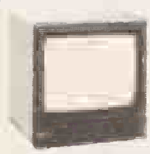

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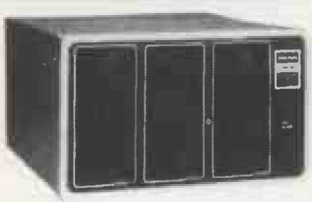

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