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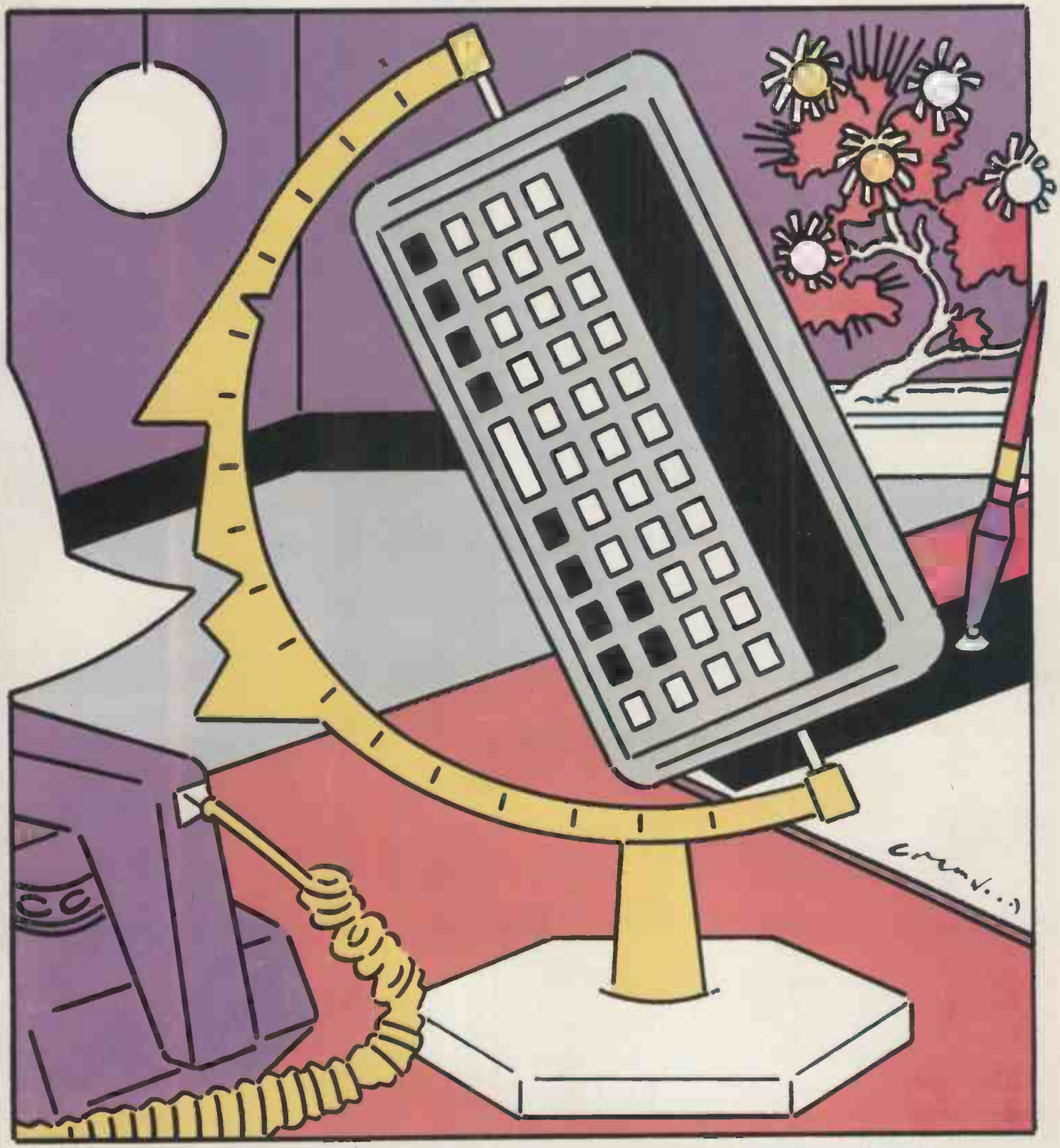

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Photo features Cromemco System 3 computer, 3101 VDU, and 3355 daisywheel printer.

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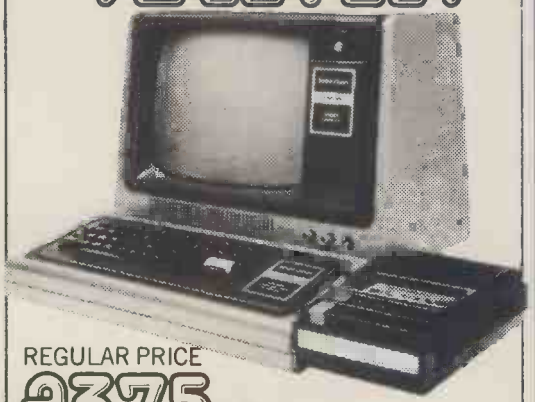

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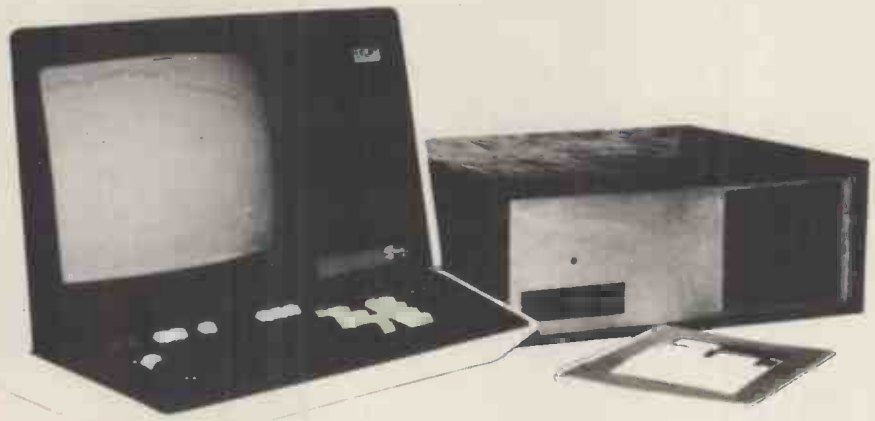

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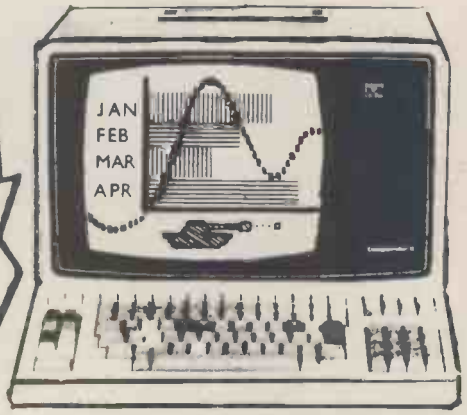

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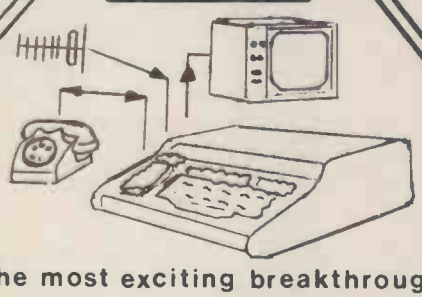

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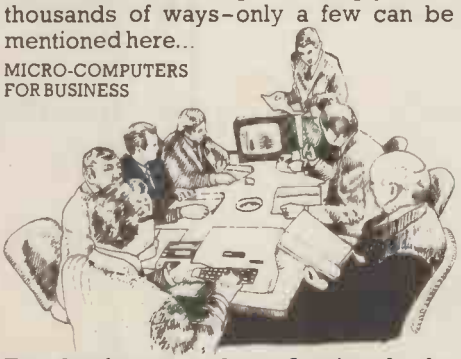

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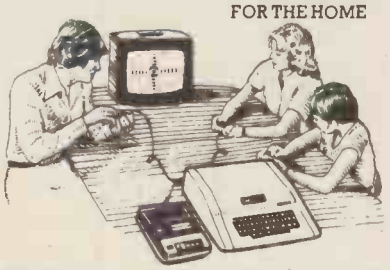

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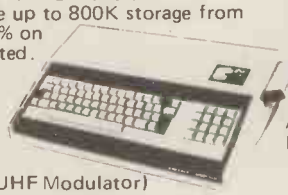

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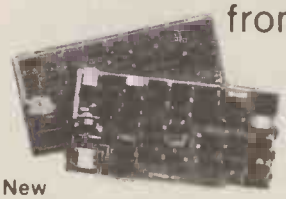

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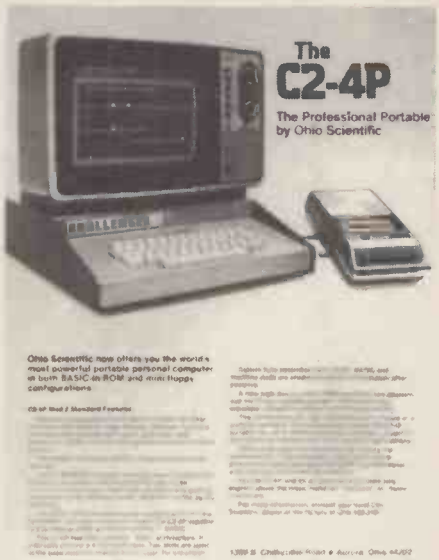

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☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. Parameter file created, optionally with interactive program which requires CBASIC. Parameter file may be generated with CP/M assembler utility **£50/£12**

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☐ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables etc **£75/£10**

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☐ **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC. Supplied in source code **£300/£25**

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MICRO FOCUS

☐ **CIS COBOL** — Version 3 is ANSI 74 subset with extensions which offer powerful interactive screen formatting and built in cursor control. Version 4 additionally offers full level 1 ANSI for Nucleus, Table Handling, Sequential Relative and Indexed I-O, Inter-Program Communication and Library.
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☐ **FORMS** — Interactive utility to create CIS COBOL source code to perform CRT screen handling in application programs. Supports full prompt text, protected fields and input validation against data type and range expected **£65/£10**
When purchased with CIS COBOL **£55/£10**

OTHER

☐ **tiny C** — Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings **£45/£30**

☐ **BDS C COMPILER** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie **£60/£10**

☐ **WHITESMITHS' C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX*** Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Compiler output in A-Natural source. Supplied with A-Natural (see below) requires 60K CP/M **£325/£20**

☐ **A-NATURAL** — Narrative assembler with linking loader, librarian, extensive 8080 subroutine library in A-Natural relocatable format and translators from A-Natural source to Microsoft MACRO-80 source and from A-Natural rel to source **£180/£10**

☐ **POLYVUE/80** — Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual. **£70/£12**

☐ **POLYTEXT/80** — Text formatter for word processing applications. Justifies and paginates source text files. Will generate form letters with custom fields and conditional processing. Support for Daisey Wheel printers includes variable pitch justification and motion optimization. **£45/£10**

☐ **ALGOL 60 Compiler** — NEW — Powerful block-structured language featuring economical run-time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling, direct disk address I/O etc. Requires Z80 CPU **£110/£12**

☐ **C Compiler** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie **£65/£10**

☐ **Z80 Development Package** — Consists of: (1) disk file line editor with global inter and intra-line facilities. (2) Z80 relocating assembler, Zilog Mostek mnemonics, conditional assembly and cross reference table capabilities. (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, DDT or SID facilities **£50/£12**

☐ **Z80 Debugger-Tracer** — NEW — Trace, break and examine registers with standard Zilog Mnemonic disassembly displays. Facilities similar to DDT. Free when ordered with Z80 Development Package **£30/£7**

☐ **DISTEL** — Disk based disassembler to Intel 8080 or TDL Xitan Z80 source code, listing and cross reference files. Intel or TDL Xitan pseudo ops optional. Runs on 8080. Standard CP/M and TRS-80 CP/M versions available **£35/£7**

☐ **DISILOG** — TEL to Zilog Mostek mnemonic files. Runs on Z80 only **£38/£7**

☐ **TEXTWRITER II** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Ideal for contracts, manuals, etc. **£45/£3**

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☐ **POSTMASTER** — A comprehensive package for mail list maintenance. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Requires CBASIC **£75/£15**

☐ **WHATSIT?** — Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC **£70/£15**

☐ **XYBASIC** Interactive Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in Integer, Extended and ROMable versions.
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☐ **CPM/374X Utility Package** — has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files **£125/£7**

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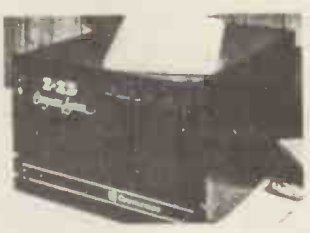

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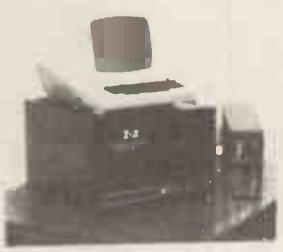

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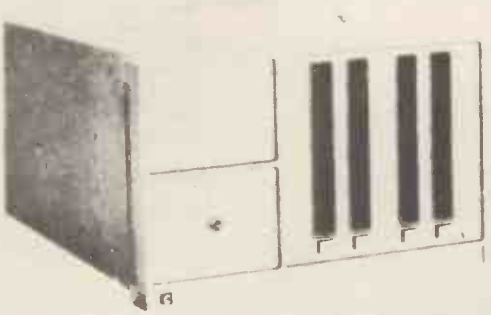

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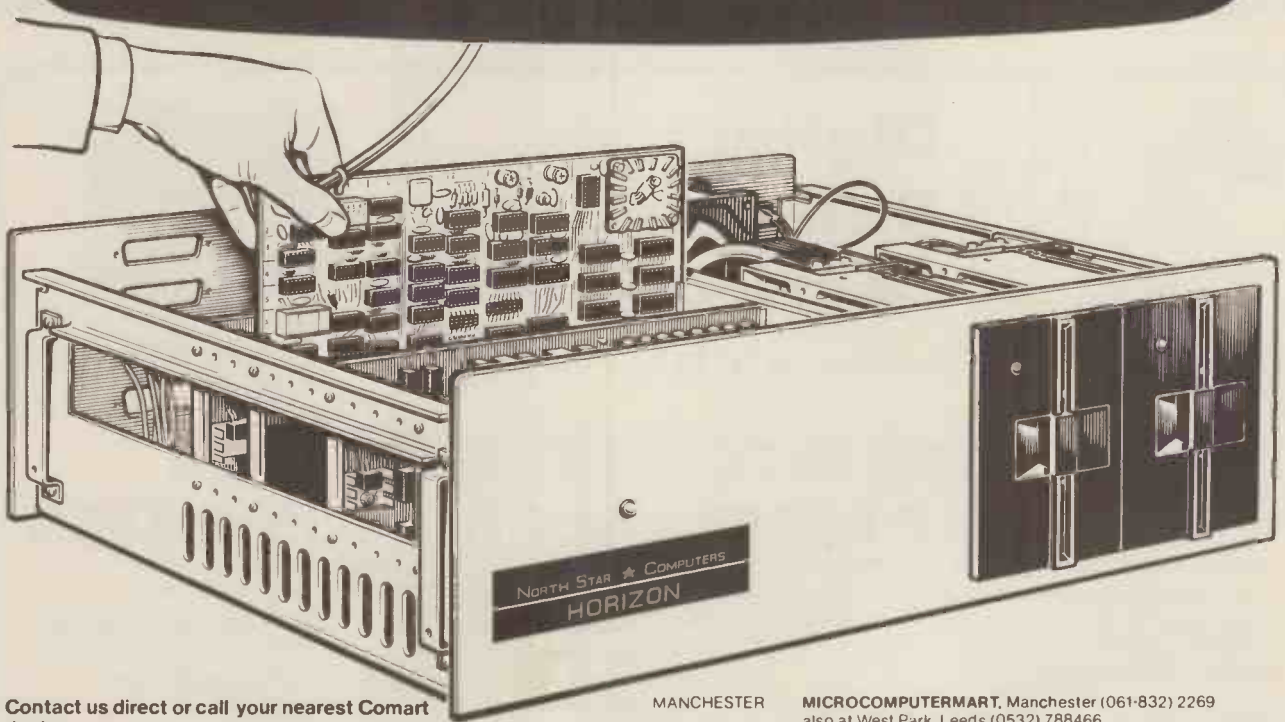

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Versions of BASIC are available with the 380Z which automatically provide controlled cassette data files, allow programs to be loaded from paper tape, mark sense card readers or from a mainframe. A disk BASIC is also available with serial and random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

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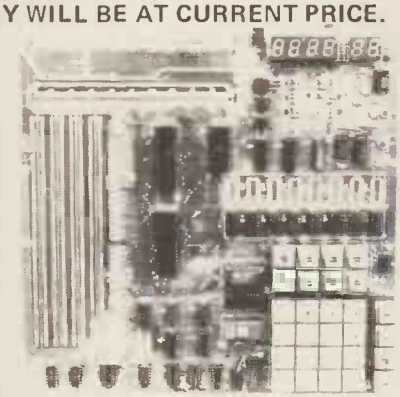

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NEWSPRINT

Newsprint (now incorporating What's New) is where Guy Kewney *reports the happenings of the micro world. Product news, rumours, gossip, prediction and speculation. . .read Newsprint and stay ahead of events.*

GIVE ME A RING

A development in the technique ofconnecting computers together. According to Logica, the company which is spending nearly £90,000 (£50,000 odd of which comes from the Government) on putting the Cambridge Ring together, the result could be to kill floppy discs.

The Cambridge Ring is like a bucket chain of data, with every computing machine in a closed network being able to pass data to every other one, round the chain. The result, says Pat Coen at Logica, is that any device from the largest mainframe to the dumbest terminal can use the mainframe's disc store for the cost of only the wires in the Ring, and a connection device.

Unlike many networks, this one is the simplest thing to explain. The connection is a twin cable — no coaxial screening, nothing fancy — with occasional amplifiers in case the cable needs to go more than a few hundred yards. Each device 'holds its bucket out', so to speak, to the device on its left, from which it receives a pail-full of data — a dozen or so bytes. If the data is meant for itself, the device takes it away and processes it, and passes an empty bucket down the line to its right. If it is for someone else, the device pours the data into the next bucket. If it is an empty bucket, it can fill the bucket or just pass on nothing.

What makes it special is the fact that four million characters a second can be passed down the line — faster than many hard discs can accept or release data from a computer, and very much faster than a 500K byte floppy can work, even on a single track.

The cost of the node — the bucket handler — can be gauged from the fact that a suitably programmed Acorn microcomputer board, costing £35 without its display, is being considered as an ideal device in Cambridge. Once your local computer using company has installed a Ring, the theoretical cost of using its big disc is £35 plus the necessary bell wire.

Logica has already wired its building for data, and has started first tests. It aims to have a half-dozen or so devices attached by the end of the year.

The effect on the private user should be obvious. Even if the Post Office prevents us from hanging a hundred yards of wire out of our windows to swap disc files with our local Data Bank (and as the law stands, it can), enough big users will follow Logica's experimental footsteps for competition to bite hard at floppy disc suppliers.

Unfortunately, there's no way of knowing whether it will force very low prices even quicker than anticipated, or whether it will put them all out of business; either way, users of micros should be severely affected.

NASCOM news

Surprises were the order of the month in November for Nascom buyers. A quiet time for followers of Britain's top-selling kit, the Nascom-1, is nearly over, with the first deliveries of the Nascom-2 going out at the same time as an independent supplier announces packaged versions of both Nascom -1 and -2.

Ever since Pan Am recently refused to fly a Hewlett Packard disc drive over from New York on the grounds that it was magnetic, it has become fashionable to refer to magnetic media as 'crashware'. Crashware comes in more sizes than you would believe: 3M sent us this pic of its complete range, on show at the recent Compec exhibition.

And Nascom itself is about to announce a £325 printer which it is building in the USA.

The biggest surprise for recipients of the Nascom-2 — apart from the surprise of getting it at all from a company which will never become notorious for early delivery — is the fact that the single board computer kit is most likely to be a two-board kit.

Kerr Borland had found himself in something of a corner, with the world shortage of memory chips providing him, as marketing manager of the new £300 kit, with a ready-made excuse for not delivering more than 500 boards before next summer. He didn't want it!

The trouble is simple: when memory suppliers tell you blandly that they 'can supply memory chips off the shelf' the question to ask is "which memory chips?"

Not the memory chips used on the Nascom-2, is the answer. The kit was designed with 10 chips number 4118, a Kbit static memory which is essential to the kit: well, two at least are essential. . . they are used for providing the image of the video display which is output to a TV screen.

Borland says that he could get 5,000 of these — enough for 500 kits (which were already on order, and saleable in a day, no doubt).

"We could have supplied the kits with only two chips, for the video, but we didn't want to do that", Borland observed laconically — and understandably, since if users had found themselves with a BASIC interpreter on board and no 8K bytes of memory to put BASIC programs for interpretation, they would have jammed the switchboard at Nascom.

The solution was, instead, to buy dynamic memory chips, of which Mostek, Nascom's supplier for the Z80 micro itself, had plenty. However the circuitry for keeping the memory capacitors on the chips charged, every millisecond or so, was not on the board. This was natural enough, since the board expected static chips, which retain data without refresh. So Nascom was compelled to design a 32K byte add-on board and supply it, free, with 16K worth of chips, also free — leaving eight of the static chip slots empty on the main board. The advantage then is that these chip locations are useable as 2708 ultra-violet eraseable memory.

So the next surprise will be that Borland will be able to go into the market offering the ZEAP assembler in four of those chips, leaving two sets of two chips for each of a 2K byte text handler and a 2K byte disassembler. It all brings system firm ware up to the level of the remarkable Aim 65 from Rockwell, with the Nascom ahead in having a video output, and the Aim ahead in having a small printer and lower price.

And the printer is the next surprise. At £325 for an 80 column matrix printer which uses ordinary paper, has a bi-directional head and variable data rates, it sounds like good news indeed.

Meanwhile on the ready-built systems side, Portable Microsystems has beaten Nascom to the punch on two packaged versions — a trick which it has already done, by coincidence, for Rockwell's Aim.

Cost of a packaged Nascom varies: a simple Nascom-1 in a desktop case, fully assembled (called DTC 80) is £330; the same box costs £460 with the Nascom-2 inside. Then there is a briefcase version of each, at £405 or £535, to which can be added a £200 acoustic coupler to allow the machine to use the telephone.

Details from Mike Ayres on 0280 702017.

Electric mechanic shock horror

What all users want in a personal computer is a machine which works perfectly as soon as it is plugged in, and never goes wrong. According to the manufacturers, that is exactly what they supply.

Yet the retailers do spend a considerable amount of mental effort convincing prospective customers that they will be able to service what they supply when it does go wrong, and some of them go futher, and state categorically that their competitors will not be able to provide such service.

If such suppliers uniformly charged more for the equipment, than the suppliers they brand as cowboys do, it would be easy to deduce that the higher price covered

service, and that paying a higher price guaranteed that the machine would be working at least as often as not. Unfortunately the proof of the pudding is only in the eating.

On the desk at PCW are several angry letters from suppliers, referring to anonymous or even named rivals who, say the letters, refuse to provide service. Just occasionally, when you contact the slandered party he will state clearly: "I only sell to qualified engineers who can convince me they have an oscilloscope and know how to use it". Equally, the reply is often "No, it isn't me who refuses to support what he sells, it's the bloke down the road", and the bloke down the road makes exactly the same claim about his rival. They lie about the prices each other charges, too.

None of the above is news. The news is that the time has come to start getting the facts made known. And the way to do this is to consult our readers — that's you — about your experiences on after-sales service. If you are just buying a machine, keep a diary, showing dates of faults, symptoms, and the salesman's explanation, and what is done to repair it. If you already own a faulty machine, tell us who supplied, and who fixed it, and how much it cost.

Think about it

John Godfrey is a man who likes computer adverts. They used to pay his salary when he worked as advertising supremo for Computer Weekly, so he should like them. Now he is setting himself up as a judge of computer ads, by running a competition.

Advertisers who feel they have produced copy more informative, sensitive and aesthetically satisfying than: 'Tom Watson said "THINK" — so we did' (the entry from Altergo which won last year) should submit them. The entry fees go to the Disabled Group of the British Computer Society and an engraved trophy goes to the winner. Entries go to John Godfrey, Managing Director, Couchmead Limited, 42 Great Windmill Street, London W1V 7PA. The phone number is 01-437 4187.

Sharps the word

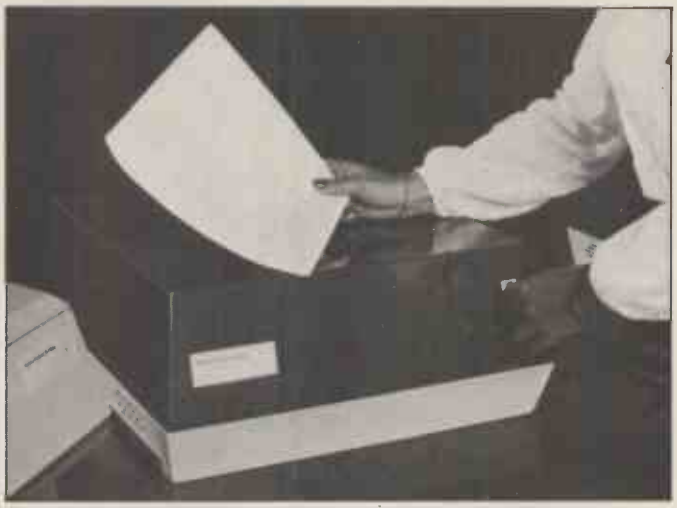
Everybody in the micro business is, naturally, scrupulous about service backup. Everybody else, of course, is slipshod and pays only lip service.

It seems, nontheless, that the cautious attitude adopted by industry observers to Sharp's pronouncements on the subject, was not justified. Sharp has been turning down prospective dealers for its new microsystem, and feathers have been ruffled on birds who thought themselves above criticism.

Paul Streeter at Sharp has weighed into existing micro suppliers in no uncertain terms: "We feel that a lot of the problems in this industry over the past 18 months have been due to suppliers who have appointed distributors without checking their ability to back up the equipment." And he is insisting on software back-up skills to go with hardware maintenance ability.

The result is the highly amusing spectacle of dealers who ring up to tell us that they "will almost certainly be stocking the Sharp micro, it's great", and who, a week or so later, express surprise at your insolence in supposing they would ever dirty their hands on a Japanese machine.

At press time, only HB Computers of Kettering — also an Apple dealer — had been formally announced as a Sharp dealer.



The Intel 8086 16-bit micro has moved from Leeds to Croydon. Modular Business Systems, builder of the first 8086 based computer, has appointed Instar Business Systems as London distributor for the Elite range, in which the top machine uses the 8086. MBS is on 0532 505719.

Ingenious

The world of printers is just starting to emerge from its completely unreal state. The first real sign that somebody knows what's going on is the announcement of a £500 matrix printer by the Japanese firm Oki, selling through a company called X-Data in the UK.

Established printer makers can be heard complaining of the Japanese threat, and muttering that, somehow, it isn't fair. This printer is high quality, produces graphics as well as print, needs no routine maintenance, and is able to print for hours on end without overheating — yet it is something like 50% cheaper than anything comparable, even than many printers using thermal print heads. Bad news for competitors; it uses very clever new technology. If the news is bad for established printer makers, it is going to get worse, because the Oki machine is going cheaper.

The logic behind this is simple. A manual typewriter driven by a clockwork motor can be bought for under £50. It has several hundred parts, most of them requiring precision manufacture. A matrix printer has a matrix head, a head positioning mechanism, a paper feed mechanism, and about £30 worth of electronics in a box.

The technology used in Oki's machine centres around an ingenious matrix print head. In a normal matrix head, the five or seven needles in a vertical line that form the matrix of dots by striking the paper are 'fired' at the paper by magnetic solenoids. The needles have to hit the paper hard, and quickly, which means the solenoids have to be powerful; this implies they be both big, and use high power. The size of the solenoids means that they have to space themselves out. For the needles to hit the paper vertically, they therefore have to be bent, or hit with heavy hammers.

Oki was faced with the need to print Japanese characters — infinitely more complex than our alphabet.

To get 22 needles pointing into a character matrix area required ingenuity. On its larger printers, the company solved the problem by putting the needles horizontally, right across the page, and printing a line at a time — a similar technique can be seen in the thermal print heads on Rockwell's Aim 65 micro.

On a printer, designed to be cheap, that was too many needles. Instead, Oki devised what it calls 'stored energy ballistic needles'. These are fired at the paper by springs. As they bounce back, the solenoids pull the springs back, relatively slowly, with the rebounding needles helping them. The result is a print head so light and small that X-Data guesses it to cost around £10 — you don't have it fixed when it has finished its 200 million characters lifetime, you replace it.

X-Data is in Slough, at Mary's Wharf, St Mary's Rd., Langley SL4 1HE.

Soft sounds

You may have seen, at micro exhibitions, a video screen full of androids going 'GEEP GEEP GEEP PZPZPZ PZPZPZ PZPZPZ PZPZPZ' or words to that effect. It's a game called Android Nim, and according to a court judgement in August, the sounds reproduced (roughly)

A bar-code reader will turn the PET into a point of sale calculator for supermarkets. Such a device has just been launched by Machsize of Leamington Spa; details on 0926 312542.

above are Music.

This emerged when the Comp Shop found itself in hot water for copying the software which makes the noise.

It happened at the Online Micro Show, says Keith Jones, who runs the company, The Softwarehouse (a company name approved you may care to note, by the same ignoramuses at Companies House who turned down the name Cavendish Computing as an infringement of Royal prerogative, and Business Technology as too general) which held the copyright.

Jones holds it on behalf of the US group 80NW, and showed the program at the Online show, where Comp Shop representatives bought a tape at dealer rates (40% discount) to sell. Somewhat to Jones' surprise, copies "including our copyright notice which appears on the screen" began to be sold off the Comp stand at around half price; when asked to stop, Comp refused.

The intriguing legal point raised could prove the breakthrough for which software writers have been looking. "Because the program contains sounds", said Jones, "we did them under the 'passing off' bit of the act dealing with performing rights".

The question which has not yet been resolved is whether the sounds made actually have to be audible. The point is important because any computer is a small radio transmitter. I have found that the easiest way to monitor software which is prone to go down on a micro, is to stand a transistor radio on the circuit board. The program will generate a very recogniseable sound as it runs; if it gets into a tight loop or 'halt and catch fire' mode, (see PET LOOPS) the sound is equally recognisable, and one can detect the point at which the program dies.

So, if you run my software, you are broadcasting the sounds my program makes, and anybody with a radio receiver can pick them up — a fact which has closed pirate radio stations before.

Jones said: "It cost us £1,000, and it has stopped a couple of others who thought they had our permission to copy the software. The important point is that we will do it again, if we have to, and now people know we mean it".

Miss-uselass

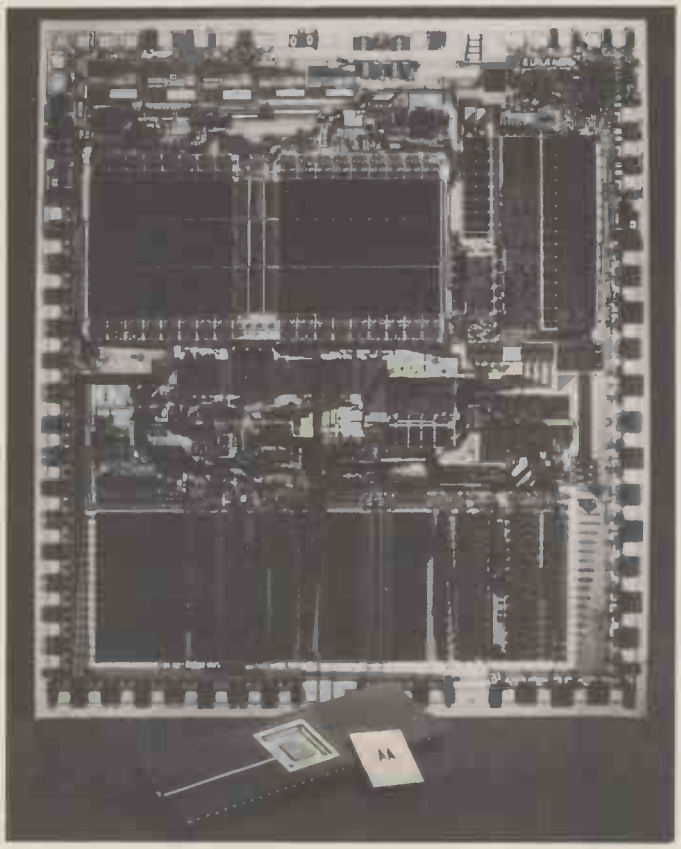
Graeme Pybus is marketing boss for ITT's micro, the 2020 which is a licensed copy of the Apple.

His wife has an attractive bottom. This can be freely stated because Pybus himself said so when talking about micros on the local radio in the North West area of Britain. In context of his remarks, this observation was in quite acceptable taste.

The same cannot be said, however, of people who send pictures of their product to this magazine for mention on these pages, with a photograph illustrating no more than the beauty of some anonymous female model. There may be many arguments, for and against the practice, but at the end of the day, what counts here at PCW is the fact that hundreds of our readers are women who regard this as sexism, and find it offensive.

Send a photograph, by all means, but try to illustrate something important about the machine; failing that, show us one of the people who we may talk to when we ring up and enquire about it. Even the dullest of 'black box on table' pictures will at least mean that next time we see the equipment we'll know what it is. Tired cracks about 'software' and 'floppies' are only funny the first time, and that was years ago.

Oh, Graeme Pybus? He was suggesting that a computerised list of the contents of the average home freezer was a good example of how useful the ITT 2020 computer was. His own wife, he says, forgets what's at the bottom "and then I see her vanishing head first into its depths. . ." And the interviewer suggested that keeping the data on the computer was easier than swinging over the edge of a chest freezer 'risking the grave danger of plunging into the depths'. And Pybus said: "Yes, but it does look nice..."



The world's biggest micro: Motorola's 6800, shows its face at last: nearly 70,000 transistors, almost ten times the size of the 6800. Meanwhile back at Intel, a rumoured 32-bit micro prepares for 1980 — just a year away from stardom. Enjoy it while you can, 68000.

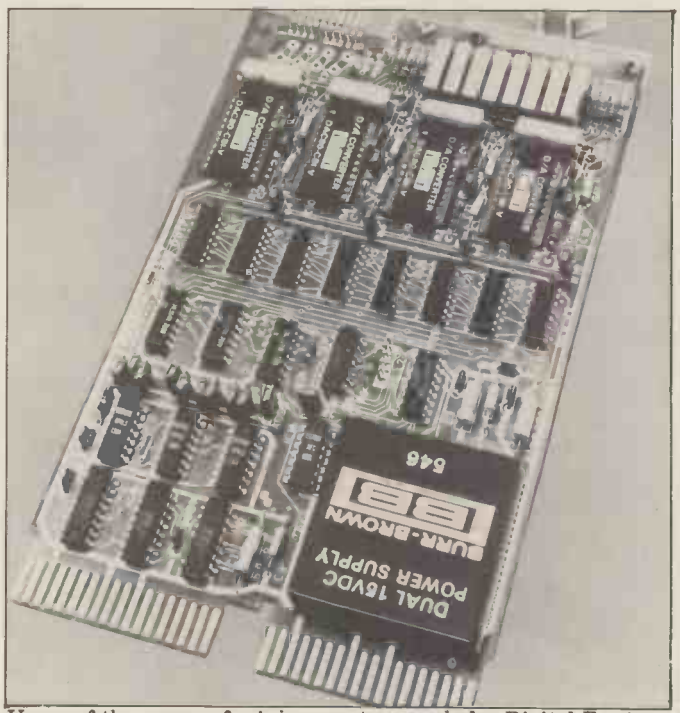
Chip mod

Like the tortoise which carries its home on its back, Zilog's Z80 chip carries its program permanently designed onto its chip. Users found that this made for problems in developing the program; so Zilog has announced a version with an extra 24 pins to control and read data from external read-only memory — only 4K bytes of it, so this isn't a chance to get excited about building a personal system round one. The interesting feature to note is the 64 pin package. Unlike the normal package with dual rows of pins in line, this one can't be plugged in back to front.

Proper price persuasion

There is a great divide between the opinion of the Computer Industry and the rest of us, about things like computers. In particular, the Computer Industry thinks that computers used for automatic letter writing should be called Word Processors, and, most important, should be expensive. This viewpoint, however, came in for a severe bashing recently from somebody the Computer Industry takes rather seriously; a consultant called David Butler of Butler, Cox & Partners.

The Computer Industry sells Word Processors to the hapless — that is, executives with Management Science



Users of the range of minicomputers made by Digital Equipment are offered a new board that will fit into DEC's micro range by using the Q bus, in the same way as S100 boards fit on the S100 bus. Maker is Burr-Brown, which describes this system, for driving continuously-variable dials, machines and heaters, as 'four 12-bit digital to analogue converters'.

backgrounds — by saying that the machines can do the work of a great many typists, for rather less than the salary payments. This, David Butler told a group of Datapoint users, is silly. He quoted figures to show that secretarial costs amounted to rather less than 10% of office expenses; and that typing productivity was relevant only for some 40% of a secretary's time, because the other 60% was devoted to assisting the boss with administration.

Butler suggested that the way to sell equipment was to maximise the most expensive resource — managerial expertise. And, in summary, he pointed out that the way to make equipment useful to managers was to make it cheap enough for the manager to feel happy about buying it, even if he couldn't have it working 24 hours of the day.

This small dose of good sense may not be the sensational news story of the year, or even of the month. However, at a time when an American software house has launched a document written in the Pascal computer language, designed to allow the buyers of this software to write programs in the Fortran language — a Fortran compiler, in fact — and is asking $125,000 for this marvel, readers could be forgiven for thinking that everybody in the Computer Industry is barmy. It's nice to find signs that they are not.

Cost of this matrix printer is £745: it prints at 120 characters per second, the head prints in both directions, it will go up to 132 columns, it is called the Micro Printerm 879. It's supplied by Leeway Data Products in Feltham, tel: 01-894 5511.

PET loops

One of the 'hidden strengths' of Commodore's PET computer is the fact that many of the first hobbyists cut their teeth on the 6502 microprocessor that it uses. The result is that people like Jim Butterfield, author of First Book of Kim, wrote software for PET.

Butterfield was recently in London at the invitation of the North London Poly's hobby computer club, to demonstrate code written by himself and associates in Canada, whence comes much of the best PET software.

Butterfield decries any adulation of what he calls the 'pyrotechnics' of what his code does. He prefers to say: "Look at the growing maturity of the PET; tools which you have devoutly wished for, are now coming into your hands".

Modesty apart, Butterfield and friends have written some remarkable code, derived from the intimate understanding of the micro inside the PET — which, of course, they learned on the Kim. The Kim, (still sold by Commodore who took over its builder, MOS Technology, to get the 6502 micro) could (and can still) only be programmed in machine code, by entering the hexadecimal numbers for each separate instruction.

As it happens, machine code programming for the PET is still a nightmare, even despite the seven assemblers now available for the machine (that's Butterfield's count). The most intriguing part of his code was designed to overcome a serious problem with PET: the fact that it can get itself into two sorts of 'loop' from which escape is possible, normally, only at the cost of wrecking all the software held in the machine.

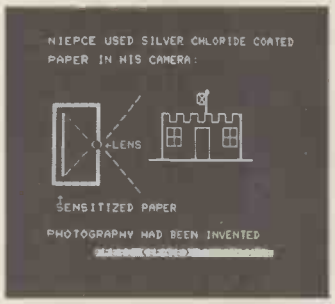
According to Butterfield, there are two ways to 'crash' the PET. First is the obvious one; you give it an instruction to perform the previous instruction, and, rather like the dunce with a piece of paper saying 'Please Turn Over' on both sides, this can keep it happy for hours.

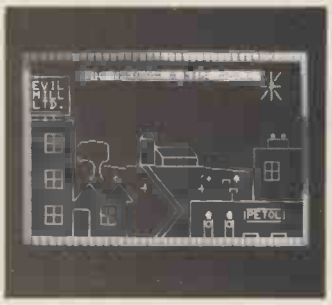
The other way of crashing it involves giving any one of fifteen instructions for which the mnemonic code should be HCF — Halt and Catch Fire. This is all too easily done. Several machine instructions occupy either two or three bytes (or characters) of memory, depending on the exact context; it's a simple matter to change the context when amending a program, ending up with a new opcode that is only two characters long, where the old one was three. In this case, the third character will be left in memory, and the micro will take it seriously as an instruction, rather than as the fag-end of an old instruction. If it ends in 2, then, with the exception of A2 (hex), that is an HCF instruction; the micro goes into 'race mode' and chases its own gates around the chip.

Fortunately, the designers of the 6502 put in a wire called RESET to pull it out of this and make it start running its program again. Unfortunately the program it starts running again, in PET, is a memory test program. It tests by writing AA into every byte and seeing if it reads back correctly. After that, you will search in vain for your program.

To avoid calling in the AA, Butterfield demonstrated a routine, which involves some soldering work, some complex keyboard work, and requires a new PET (it doesn't work on the old one).

He also demonstrated a program to sort any number of items into order, a new monitor called Superman, with various routines to do clever tricks — such as renumbering any section of BASIC code; and several new games, all of which are captured by North London Hobby Club on video tape, thus I am relieved of the need to tempt the printer's devil by giving them here. Queries to the Club at North London Poly, care of Robin Bradbeer.





Animated cartoons generated by a piece of software are used in a new instruction program called 'The Petsoft Photography Course' — costing £12 from ACT Petsoft. Can it be a coincidence that Petsoft director Julian Allason is a camera freak? Details from 0635 201131.

Infinite basic

A claim that a piece of software 'will almost certainly make the TRS-80 the most powerful micro on the market' has been made by Optronics in Twickenham.

The software is Infinite BASIC, which was mentioned in the last edition, and incorrectly attributed to a distributor, A.J. Harding. Optronics boss Freddie Nicholls reports that the software, together with a great deal of other Tandy TRS-80 code, is written by a US company called Racet Computes.

Samples that catch the eye include a disc conversion program, which takes 'nearly any machine language program' from tape source, and converts it to a disc program; cost £10.00.

Optronics publishes (using the Electric Pencil program on a Teletype 43 printer) a newsletter listing available software (as it becomes available), together with hints, tips, and dire warnings about buying expansion memory cheap from other sources. Details from 50 Holly Road, Twickenham, Middx. Tel: 01-892 8455.

All things to all men

If, in the early days of motoring, someone had devised a protocol which allowed drivers to go safely on both the left and right hand sides of the road, the effect on traffic would have been as marked as devising a microcomputer bus that let users run Motorola, Intel and Texas micros in the same box, simultaneously. In the case of the microcomputer bus, the Amateur Computer Club has sponsored, or initiated, or inspired, a specification called the E78 microcomputer bus.

According to Alan Secker, who was secretary of the committee which drew up the E78 specification and has now published it, the aim has been achieved; it allows both 8-bit and 16-bit micros, of all makes known today and known to be planned for tomorrow, to run in the same system 'interactively'. This means that the system does more than tolerate the differences between the various control signals generated by the various chips; it actually reconciles them.

From my limited point of view, it seems apparent that some compromise must have been necessary, probably slightly limiting the operational speed of the processors themselves if and when they are interacting. The limiting factor probably has a trivial effect on system performance.

It would be useful, I

know, to illustrate this by publishing such details as memory delay times needed on this bus; however, the committee is evidently much more proficient at engineering than publishing; and from a copy of the E78 spec which has pages (i) to (v) and 1 to 4 twice at the beginning, with a corresponding duplication at the back of pages 41 to 50, and nothing in between, little could be salvaged for this page by press time — sorry!

A correctly bound copy of the spec, costing £2.50 (post free), can be obtained from Alan Secker at Avante House, 9 Bridge St., Pinner, Middx HA5 3HR. Overseas costs are higher, up to £3.25.

Secker says: "In order to assist small would-be manufacturers in producing various E78 compatible components, I am setting a register, and will arrange to co-ordinate between them so as to arrange for most of the components to be available, and complete systems to come onto the market quickly".

Muse confusion

A recent reference by Sheridan Williams to 'MUSE' appears to have confused some readers. It is Minicomputer Users in Secondary Education, a body which runs courses, publishes Computers in Schools, co-ordinates educational use of computers, and supplies programs from its software library. Would-be members should send £5 to R. Trigger, Treasurer, 48 Chadcote Way, Catshill, Bromsbrove, Worcestershire B61 0JT; or write to MUSE at Oundle School, Oundle, Peterborough.

New from Transam

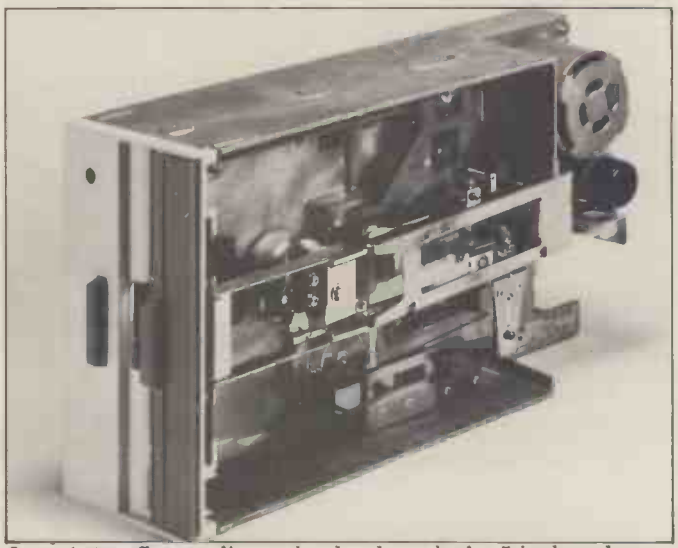
People who want to write assembler language programs for the Intel 8080 micro are very often users of Transam Components' Triton kit. This machine now has a resident assembler program in 8K byte worth of eraseable permanent memory (EPROM) as the latest firmware option. The list now incudes three different monitor programs, three different Levels of BASIC, and, with this assembler package, an editor and disassembler as well as single step and trace routines "with breakpoints for serious development of user machine code programs". Let no-one henceforth offend Triton users by saying that it does not offer a single step.

Transam also informs us that it has acquired a dealership for Ithaca's range of micro boards and other products. That makes them one of the few London sources of cheap S100 components and Apple, Tandy and PET memory upgrades. Finally, the shop has taken on the Stanford range of connectors. Details on 01-402 8137.

Relay applications

All these pipe dreams of remote control and computer control switches around the house, founder if the pipe dreamer doesn't understand relays. Once relays were magnetically switched reeds in a glass tube; today they can be solid state, and the solid state sort is the sort that Hamlin makes, and explains in an applications manual. Its strength is that it successfully warns of such dangers as triacs which switch themselves back on if driving inductive loads such as transformers or motors. Its drawback is its attempt at 'scientifically unambiguous definitions'. For example: Electromechanical Relay — a relay with isolated input and output that mechanically opens or closes electrical contracts by utilising an electrical input to create an electromagnetic force to perform the mechanics of moving the contacts. It's all there, but what it's trying to say is 'a switch physically operated by an electromagnet'. Somehow it doesn't come across. Published by Hamlin, at Lake and Grove Streets, Lake Mills, Wisconsin 53551 USA.

Prototype version of Sanyo's PMC3000 personal computer, unveiled at the IBS show (see last newspiece).



Japan's top floppy disc maker has launched a 5-inch and an 8-inch drive in the UK. The agent is DRG Business Machines of Weston Super Mare, Avon. Details on 0934 415398.

ITT gets the message

It is now over six months since the Post Office officially opened its Prestel domestic information supply, and nearer two years since ITT Consumer showed a working Prestel television (together with its announcement that it would build the Apple). As a result of the disparity between the two dates, it is surprising to find the same Prestel television announced as 'to be in production by the end of the year'. And it becomes apparent why Prestel information provider Rex Winsbury of Fintel gives it as his opinion that the TV set makers have let the Prestel community down by not making Prestel sets, despite promises that they would have thousands out by now.

ITT has redeemed itself somewhat by going a bit further than just producing a Prestel set, however. It has announced a 'domestic keypad' designed to allow non-business users to put in messages; and it has announced a Prestel printer. ITT says too that next year it will build and sell a Prestel adaptor for ordinary TV sets. It has also announced a major 'first' in business television — mains isolation to allow safe attachment of peripherals.

Hang on. . . Message pad? Prestel doesn't have a message facility. Or does ITT know something the Post Office hasn't said yet?

IBS jottings

PCW's very own David Tebbutt and Steve England visited the IBS in Birmingham. Here are extracts from their notes:

. .Hewlett Packard didn't have any calculators on display. .

. .Sanyo were showing a prototype of their forthcoming personal computer. TMS 9900 based, the new machine has been christened the PMC 3000. .

. .Sharp showed us their recently translated BASIC and engineering manuals for the MZ-80K. They look very clear as well as being quite quaint in places. .

. .Texas Instruments were showing off their 99/4 — running on an expensive dual standard television set. The imported demonstration program announced many features, the most memorable being the fact that it runs on 110-115 Volts at 60 Hz.

. .CPS and Teletronics were showing the new Panasonic JD-800U and JD-840U personal computers. Review coming soon. .

Finally, not quite an IBS jotting, but it is loosely connected:

A member of the PCW team overheard this (half) of a telephone conversation while standing in a computer shop:

"What do you want?"
"Da service?"
"Can't a do da service"
"Dat's because dere ainta no-one here"
"Dere won't a be no-one for two a days"
"Dat's cos dey're all at a da IBS"
"I'm a sorry, I can't a help dat"
"Well dat's da way it is"
"OK good a bye"

Would the person on the other end of the 'phone care to identify him/herself so that we can hear the other half of the conversation. All claimants write to Da Conversatione, PCW, 14 Rathbone Place, London W1P 1DE. Thank you.

COMMUNICATION

PCW welcomes correspondence from its readers. Be as brief and concise as possible and please add "not for publication" if your comments/questions are to be kept private.
Address letters to: "Communications", Personal Computer World, 14 Rathbone Place, London W1P 1DE.

VAT–what VAT?

I was most interested to read, in last October's issue of PCW, a letter from Mr. Daines stating that computers are subject to a luxury rate of VAT. I was just about to pen a waspish little letter to my M.P. when I recalled that the last budget had abolished the separate luxury rate and brought in a single rate of 15%. Perhaps, I thought, Mr. Daines was thinking of the pre-budget situation. However, on turning up a pre-budget invoice for supplying and fitting some RAM it showed VAT at 8%. Thus I am left wondering what Mr. Daines was thinking of.
J.S. Linfoot, Oxford
We loved the idea of abolishing VAT . . . Perhaps next time we'll check the details — Ed.

MK 14

I have been following your articles about the MK.14 (On your Mark get set), and found them very helpful. However, I have been trying to print, say, 'Error' on the display and instead of having a jump to go through the process again and keep the display apparently continuous, I am wanting to follow the 'word' with a delay, and follow the delay with another 'word'; thus one will see one word printed up then after the delay has run the display will show the next 'word'.

If one uses a normal '8FFF' instruction it will only delay the last digit of the 'word'. How can I get a delay of a few seconds on a multi-digit print out?
David N. Clarke, Sheffield.

Quicksort 1

To answer Mr. Barker's query (PCW October), yes, I used Dr. Samson's Quicksort algorithm; in fact, had I had Mr. Adenwalla's classical education, I would probably have shouted "EUREKA!" when I saw it in your magazine. However, my education did not include a grounding in Greek so I merely said "GREAT!" (to my shame I'd always thought Eureka had something to do with Archimedes needing a bath). It took only an hour to incorporate the quicksort routine into a program to calculate the Wildoxon rank sum statistic, and I can think of other uses of the routine. Programs of that type are a boon to programming beginners such as myself. Many thanks to PCW and Dr. Samson.

With regard to the rank sum program, it merely generates a statistic which you then look up in a set of tables. Do any of your readers know of a formula which could be used to give the final answer directly in the program?

In conclusion I would just like to say that I enjoy reading PCW and the cover of the October issue is splendid.
John F. Cowie, Fife.
I can but applaud your excellent taste — Ed.

Quicksort 2

I should like to thank Pete Barker for his comments on my article (PCW August 1979).

I can assure him that several readers have used my quicksort algorithm with some success and have been in touch with me personally regarding this. I think perhaps he is overstating his case when he says that incorporating this routine in a program requires a 'great deal of effort'. There is not really any need to change the line numbers if this is being incorporated in a new program — BASIC subroutines can appear anywhere. I agree, of course, that it would be more difficult to incorporate it in an existing program whose line numbers and variable names are already fixed.

I support Pete Barker in his promotion of PASCAL but I fear that if I had published my algorithm in PASCAL it would have been available to far fewer readers, as the editor said in his footnote.

It was not my intention, as Pete implies, to give a full discussion of the algorithm, but simply a do-it-yourself guide to using it. I referred readers to Knuth for a full analysis of the algorithm.

May I ask Pete how well his procedure performs with REALS?

It seems to me that history is repeating itself. About 10 years ago we had a similar controversy over languages, viz. ALGOL versus FORTRAN. The more enlightened academics extolled the virtues of ALGOL 60, including its recursive properties, while the vast majority of installations continued to use FORTRAN quite happily. The reasons for this were manifold but as I see it there were two primary ones —

1. FORTRAN was well established before the first ALGOL compilers started to appear.
2. Few manufacturers of computers gave much support to their ALGOL software (Burroughs and Elliott were the two exceptions).

It appears to me that BASIC and PASCAL are in much the same situation today. BASIC is, of course, the inferior language but there is a dearth of good manufacturer-supported versions of PASCAL around. This is sad, but I fear the outcome is inevitable.
Dr. W.B. Samson, Dundee, Scotland.

Teacher appeal

I should like to appeal, through the columns of your magazine, to any teachers who have used a micro for school administration or management.

I am working on a research project which has been set up under the supervision of the University of Bristol Department of Education, and with the backing of the Department of Education and Science. This project will investigate the use of low-cost microprocessor based computer systems in school administration and management. We aim to review such relevant work as has already been undertaken and to identify all tasks and management information areas which might be carried out or assisted by school micros. Later we hope to analyse these tasks and areas and to specify, and possibly develop, software which could be used on micros by those with little or no knowledge of computers. Finally we shall monitor the reaction to change which might be brought about in selected schools when the software packages are introduced.

Any teacher or school administrator who has designed or used any micro software for school administration or management is invited to contact me at the address below. Should they be willing, their work can take its place in the review mentioned above, and its importance and potential for wider use in schools can be assessed.
P.J.Bird, Hengrove School, Petherton Gardens, Bristol.

Survey

We are carrying out a survey into the development of microprocessors and their applications in the community, with particular reference to the ways in which this new technology will assist the disabled and in education. Our aim, in brief, is to collate all available literature and documentation from research bodies, manufacturers and suppliers, in order to produce a catalogue of materials available. This will provide a comprehensive source of reference for both present and future users of microprocessors.

We should be pleased to hear from any of your readers who feel they may have a relevant contribution to make to our survey, and ask them to contact us at the Department of Mathematics and Computer Studies, Sunderland Polytechnic.
J. Winton (Mrs.), Research Dev: Officer.

Taking account

I am an undergraduate at Sheffield University taking a degree course in Business Studies. For my final year I have chosen to write a dissertation concerning the likely effects of mini- and microcomputers in the field of accounts and accountancy.

I am particularly interested in small businesses being able to purchase a small computer and using it to prepare their own monthly/yearly accounts. This, of course, could mean the end of traditional accountants, especially if, like other E.E.C. countries, audits are replaced by reviews.

It would, therefore, be a great help if you could assist me by providing information that you may regard as relevant to my research into this area. Costs and capabilities of present, and future, mini- and microcomputers would be

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COMMUNICATION

extremely useful, as would any particular instances where firms are producing accounts by computer already.
M.R. Mayes, 46 Mona Road, Crookes, Sheffield 10.
Please address replies direct to Mr. Mayes — Ed.

Raw state

I am a science teacher in a secondary school and I am keen to explore the world of personal computers both in connection with my job and personally. I bought the September issue of PCW in the hope that I could receive guidance, but I find myself in a new world of RAMs, PROMs, etc. . Can you please offer some assistance? I have enrolled in some computer programming evening classes, but ideally I should like to have my own personal computer. However, even the PET, which appears to be among the cheapest, is beyond me at the moment. Is it possible to get kits?

If you could point me in the right direction I should be grateful particularly with regard to the appropriate reading matter and reasonably priced hardware and software.
D.L. Davies, Shrewsbury, Salop.
Check out MUSE (see Newsprint) It's dedicated to computer education in schools. Kits-wise you'll find it useful to look through the Single Boards section of In Store. Ed.

Revas rollicking

Before Personal Computer World changed ownership it was running a series entitled 'Parkinson Revas'. I am unable to find any mention of it in the two issues published since the changeover and I am wondering whether it is your intention to complete it.

I am sure you will agree that an incomplete series is worthless and unless an assurance can be given that all the series will be completed there does not seem to be any point in buying your magazine.
E. Lawson, Great Yarmouth, Norfolk.
Sorry to hear that, apparently, your only reason for buying past issues of PCW has been for the Revas! Actually, we thought long and hard about continuing to publish such a very lengthy (and, therefore, page-consuming) program — it is, after all, available on tape for a trifling sum. Reader pressure, however, has twisted my arm and having obtained a duplicate (the 'original' got lost in the changeover) we re-commenced the series last month — Ed.

Surprise surprise

I have recently purchased a Casio FX120 scientific calculator. I find on the back two removable plates. When removed, one of them reveals the batteries, and the other a small edge connector, on the main PCB. I wonder if you or your readers know what this is for. Does it mean I can use the calculator as a number cruncher for my micro system? Or is it only a test point? Or do CASIO plan future expansion, e.g. plug in modules like on the TIs? Please send any information you can get, as I am most intrigued and cannot obtain an answer from Casio themselves.
Merlin Klisse, Chudleigh, Devon.
I'm sorry to say that the news isn't all that exciting. After drawing a blank from official sources our 'ear against the factory wall' tells us that the edge connector is for factory testing — Ed.

On your marks

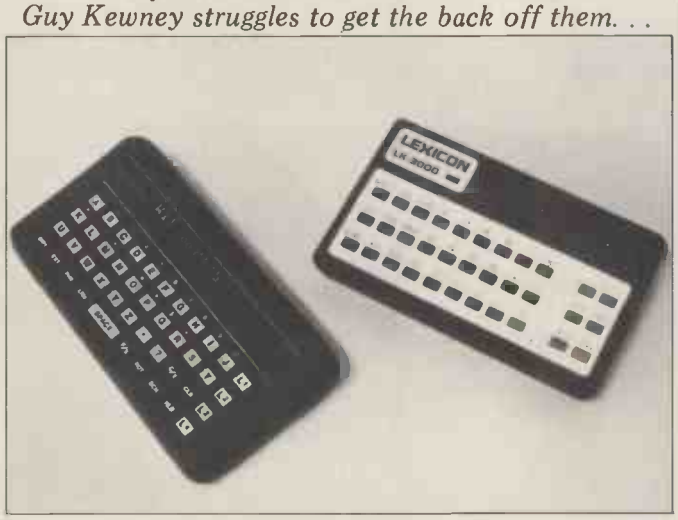
In the various home and small computing publications frequent reference is made to the 'Standard Benchmark Tests' and times quoted for the completion of same by various microcomputers. Your publication has consistently used eight such Benchmarks, named imaginatively BM1 to BM8, for comparison of machines using BASIC.

What are the eight Benchmarks? A listing of each would give the time quoted for its completion more meaning and allow readers to carry out their own benchmarking for their own systems.
L. Rickwood, Crostwick, Norfolk.
There's information on Benchmarks contained in this month's Benchtest — Ed.

TODAY TRANSLATORS TOMORROW THE WORLD

Greater things in store for Craig and Lexicon

Two inocuous looking pocket calculators, with a few more buttons than most, have appeared on the market. With them come the twin shocks of a dismayingly high price — well over £100 — and inflated-sounding claims from the manufacturers that they are the forerunners of 'a new type of personal computer — the portable information system'. They are mini electronic dictionaries. Guy Kewney struggles to get the back off them. . .



The microcomputer industry has a blind spot. It thinks of a computer as something that can be programmed. Accordingly, microcomputers that cannot be programmed have failed to catch the attention of micro experts, except for the few in industry who can afford to buy them; and these micros are now quietly creeping up on the blind side of the computer business, with some surprises.

A micro that cannot be programmed is not the contradiction in terms that it sounds. It is merely a micro which has its program printed onto the silicon chip together with its logic circuits. These machines are ideal for running short programs in portable devices such as hand-held calculators, since a short program can be very powerful. They can be found inside the Matchbox computer-controlled remote drive car, inside the Chromachime door bell, and in other devices which involve calculations.

And the word calculations brings us to another blind spot; we think of computers as computers, which they are not. They are very fast decision makers, capable of looking through a long list of possibilities and picking the right one with near infallibility. And neatly, that brings us to the pocket translator. Two of these arrived almost simultaneously for evaluation, having crept up on both these blind spots and surprising everybody. To the complete astonishment of all, they uncovered a third blind spot — by working!

The idea that the translation machine won't work is perhaps the most cherished myth of all, no doubt dating back to the early attempts to build such things. It must be twenty years since the first rumours of failure reached the school playing fields, with teachers explaining to fascinated pupils that attempts to translate phrases such as 'out of sight, out of mind' had disastrously ended in the nonsense 'invisible, insane'. And is there anybody who has not heard of the attempt to send Russia the 2,000 water sheep it had ordered (in the belief that it was requesting hydraulic rams)? Or the wartime convoy which sailed without life jackets, but with a bulk consignment of "ladies upholstery" because of American inability to cope with "brassieres de sauvetage"?

The two machines now available in Britain are the Lexicon, and the Craig M100. Sportingly, the importer of the Craig M100 has renamed it the Brainbank — sporting because it eliminates any benefit the machine might have gained from US publicity. After all, it would have been an unfair advantage since the Lexicon, equally confusingly, is going to be called the Nixdorf personal computer.

There is another machine in the offing; it is being prepared by Texas Instruments, and is profoundly different from both Nixdorf/Lexicon, and the Brainbank/Craig in that it speaks.

The non-speaking machines are remarkably similar. Both have a full alphabetic keyboard with a long line of display above the keys and neither puts the keys in conventional typewriter layout, so the ability to touch type is wasted on them. In fact, it is hard to see what advantage it would have offered, since you need one hand to hold the device anyway. And it is worth recalling the fact that the conventional qwerty keyboard is designed to be clumsy. The first typewriters would not have been mechanically capable of operating at the speeds which skilled fingers would have tried to drive them, had they been ergonomically laid out. The qwerty layout was designed to hamper typing fluency.

Price varies a trifle; the Lexicon is cheaper, at £150 and the Brainbank is £170.

Where the machines differ violently is in their internal system design. The microprocessor used is the same for both, and so is the memory size, but both the software which operates the translation, and the way in which it is loaded, are totally different.

For its UK launch, the Lexicon comes with six different plug-in language modules. Each is about half the size of a standard audio tape cassette, and offers a single language — Spanish, French, Italian, German, and Greek — with a final module offering 'person-to-person' communication with a restricted vocabulary in several languages.

The Brainbank, on the other hand, comes with three of a possible six language modules mounted simultaneously. Each offers upwards of 1,200 words in its own language.

The first indication of the differences in the software comes in the speed of reverse translation. On the Lexicon, translation from English is noticeably faster than translation into English. On the Brainbank, however, translation is equally fast in either direction.

It is also noticeable that the data stored in the Brainbank is indexed in a more sophisticated way than on the Lexicon, which is almost definitely based on alphabetical order of the English. Words can be found on the basis of the initial letter, or initial two, or three letters, but there is more; they are also defined according to groups. Up to 50 groups are provided, in categories such as Travelling, Clothing, Time and Food. The unit is also programmed with 25 complete, and 25 partial phrases which can be added to full sentences — examples are "May I introduce. . ." and "I'd like to say. . ."

The Brainbank automatically corrects spelling errors, identifies and explains ambiguous words, and gives six language options, three at a time. The full list comprises of English, French, German, Spanish, Italian and Portuguese: Japanese and Arabic are due in the next few weeks, according to the importer.

That would be almost the end of the matter, were it not for the excited claims made by the makers for future versions of these devices.

The Brainbank is imported by Leeds company Ring Group; the claim made at press time by Ian Lenagan, marketing director of the went as follows: "It represents a new generation of pocket companions following on calculators and mini TVs. It's a learning aid, phrase book and translator for foreign languages, a library of general knowledge, education and entertainment topics; and a personal filing cabinet in one".

The full potential of the Brainbank, says Lenagan, lies in recent technology which enables the storage capacity of the additional memory cell modules to be increased to as much as 9,600 words. Since the average 'educated' English speaker probably uses between 3,000 and 5,000 words at most, this leaves room for what he summarises as: "uprated language cells with more sophisticated vocabulary and phrases".

As an information centre, the Brainbank has a built in metric conversion feature. Cells containing comprehensive details on diet and nutrition programs, first aid, taxation, and a thesaurus are on the way. The list of future titles reads like the worst excesses of a personal software catalogue writer's nightmare — a cocktail mixer

guide, spelling guide, and various word games and puzzles.

The punchline is that next year, the Brainbank appears in a MkII format. It virtually has to. By then the Lexicon will have appeared with blank 'language' cells for the user to fill up with his own details — addresses and phone numbers of lovers/business contacts, or subject file references for office work — anything that requires cross referencing of a few thousand items.

The reason that the Lexicon can do this without changing format is simple: it has no micro in it. The Lexicon language modules, unlike the Brainbank's memory cells, actually include a microprocessor as well as a very large read-only memory chip containing the language data. It makes the modules more costly than the Brainbank's, but it means that the overall design of the Lexicon is that of a terminal; once a 'personal programmer' module is available — within weeks, says the London agent, Bernard Amps — it will be possible to use the Lexicon terminal to enter data to that module.

Amps says that 'in the very near future' (which means before Christmas, he hopes), it will be possible to buy four special interfaces for the Lexicon. There will be a parallel wire interface to a hobbyist breadboard, or the choice of three serial terminal interfaces — serial RS 232, serial 20 mA current loop or serial 60 mA current loop.

The man who designed the Brainbank is an American millionaire called Ron Gordon, a singularly unhelpful person to turn to for an explanation of how it works, because he has gone to considerable trouble to keep it all secret. He did reveal to PCW that a new version would be out in January, to provide blank cell data entry. He told the American magazine Fortune recently that he was designing telephone interface which would let the user access data which his company, Friends Amis, holds on its central computer; all they'll have to do is phone his computer up. And he has mentioned plans to release a portable printer to go with the machine.

Not only does Gordon refuse to discuss his indexing software, he has built hardware and software which prevents the curious from prying.

For instance, although Friends Amis does almost no manufacturing of the machine itself, it does put the innards into the plastic case, so that it can control the final step in assembly. This final step is the programming of encryption codes to ensure that only a Friends Amis memory cell can get data into or out of the Craig/Brainbank; rivals should not be able to copy either software or hardware. Taking a Peek at PET BASIC is childs' play by comparison.

The Lexicon threat which provoked this secrecy and probably caused Gordon to hurry the Mark II version, has already hit Friends Amis, and caused the company no end of problems. According to Fortune's analysis of events, Gordon had to rush the device to market when he heard of the Lexicon development in autumn last year. The result was that early Craig/Brainbank devices were flawed, says Fortune — a claim borne out by the sticking buttons on the PCW device. There were serious software problems too — apparently successfully ironed out now — with words being rejected 'not found' by the searching algorithm even though they were in the memory cell.

In the end, the rush to be the first in the market put both companies under severe strain, with Lexicon being obliged to accept $2.5 million of German computer company owner Heinz Nixdorf's money, in exchange for manufacturing and sales. At Friends Amis, Gordon was more successful; not having any manufacturing side to sell he couldn't lose it, so to get money needed to finance the race for world markets, he signed a deal with Japanese equipment. The machine will appear under that label soon. It will include the Texas Instruments feature of a voice synthesizer, next year. For Gordon, so far it has worked. He has three-quarters of the 400,000 unit world market for 1979.

Little is known about the Texas machine here: in the US it is said that it will sell for $300 plus language modules at $60 each. It has only 1,000 words, 500 spoken, 500 displayed, plus 50 commonly used phrases.

The micro inside Texas' machine is not known yet. The micro inside the Lexicon is the rarely encountered Mostek chip, the 3870. Oddly enough, the same chip is found inside the Brainbank.

There is a little story here, no doubt apocryphal. When Intel announced its single-chip computer family, the MCS 48, there were Intel executives who raged about an accidental leak of the chip family a few months earlier, in France.

One of the important details released was the fact that Intel's chips, the first on the market, had 1K byte of read-only memory on the chip. When Mostek finally produced a single-chip version of a quite different micro (the 3870 is based on a micro called the F8, made by Fairchild, though not designed there) it announced that it would have twice as much read-only memory — and Intel executives have quoted this ever since to illustrate the importance of keeping tight mouthed.

Whatever the cause, the fact that the Mostek chip had 2K bytes of memory was important, because Ron Gordon said that he chose the chip 'because it was the only one with 2K bytes at the time we made our choice". The same fact influenced Lexicon. Had they been able to wait a year, they could have used the Zilog Z8 with 4K bytes.

The fact that the Mostek 3870 memory is measured in bytes is important, because you need at least 5-bit words to reproduce an alphabet. Previous single chip micros were the TMS1000 from Texas, and, er, and that was it, with 4-bit words. Enough for arithmetic, not for an alphabet.

As to how the program works, anybody's guess will do. Ian Lenagan's opinion at Ring Group is that 'some sort of index table seems to be involved. I think it's some sort of index sequential file handler'.

If it is, the machine could indeed signal the breakthrough that the personal computer business has waited for. The point of having a computer is not to process things, but to retrieve information; and computers with chips that you can program are useless compared to £150 devices that will recall what you told them months earlier.

Finally; we tried a quick user evaluation of the two devices. This was a mistake. Two independent evaluation people fell for the translation joke. . . they didn't start their reports with ' There's this Englishman and this Irishman and this Russian,' but they might just as well have done.

The person who tested the Lexicon said: "I tried it at the Frankfurt Book Fair. It slows one down in trying to communicate: I couldn't talk to anyone about publishing with it, and the fuss required to ask someone 'which way to the information booth' is out of proportion to the problem. I tried it: you can say 'which way to the. . . ' all right, but it doesn't have information, or enquiry, or question. It does have help. It doesn't have booth or stand, but it does have place."

So our lost tourist found the phrase "Welcher Weg zu der helfen platz" which gave anybody who spoke German the necessary information — that here was someone who did not speak German.

I doubt there is a word of truth to the second report! According to Julian Allason (head of Petsoft) the Craig/Brainbank has managed to render even the most innocent sentence as an inuendo-loaded insult — starting with negotiations for its purchase, conducted in Spanish with a Puerto Rican shop assistant in A Fifth Avenue New York store. After using the machine in Germany, Allason claimed to have insulted a stewardess, two policemen and a taxi driver and finally, to have used the machine to complain to the hotel manager about the non-operative central heating radiators in his (the manager's) office. The machine assisted Allason to convert 'The radiator in your office needs attention' into 'The waterworks in your private parts require very special treatment'. Ah well, they say the old jokes are the best.

My own evaluation of the machines is as follows: the single line display is next to useless, even with the ability to slow down the rate at which the translated phrase flickers past. In use, it will be necessary to type in the word you are not sure of, so as to show it to the native you are addressing. The following story (it happens to be true, and so it isn't funny) illustrates:

My father was in London for the first time, admiring St. Paul's Cathedral, when he was approached by a foreigner who failed to notice that my Dad was as much a tourist as he. "Where, please; where Shay Ap Siddy?" asked the more foreign of the two gentlemen. His attempt to spell the place/person's name was frustrated by his inability to pronounce the letters correctly. We might never know where Shay Ap Siddy is, but for the blinding intuition that human brain cells are capable of. It came to my father in a flash as he studied the exits from the Underground nearby. . . Cheapside.*

I shall wait for the speech synthesis versions, especially for Russian. Let's just hope that the machine doesn't speak with an awful Yankee accent.

**Editor's note: it seems possible that Julian doesn't have the exclusive on old jokes. Candid Camera enthusiasts will remember Jonathan Routh asking bewildered passers-by the way to 'Kee Apsidy'.*

BENCH TEST

THE MICROMATION Z-PLUS

In the early days of personal computing, standards of any kind were next to non existent. . . now, however, all that has changed. But competition is getting sharper and with bankrupt companies already starting to fall by the wayside, the survivors will be those who manufacture compatible equipment. No doubt in view of this, Rostronics have decided to carry Micromation's Z-Plus. This is a system that meets all the de facto standards. It has an IEEE S100 bus, Digital Research's CP/M and Microsoft's BASIC.

BY SUE EISENBACH

Hardware

The Z-plus is contained in a long (29 inches), narrow (10 inches), 65 pound box with walnut veneer sides. As the box sits in a desk it's unimportant what it looks like, but the wood is very easily scratched removing it from its home. One screw secures the top which can be hinged up, revealing a disc drive in the front half of the box and a ten slot S100 bus and boards in the back half. The side panels are also held on by screws allowing access to the bottom disc. The CPU board contains a Z80A running at 4MHz as well as 64K dynamic RAM.

The disc controller is Micromation's Doubler card. It was designed to interface with CP/M directly and sounds very versatile. It can be used with mini or full size floppies, at single or double density for single or double headed drives. The controller uses IBM 3740 format for single density and a modified IBM 2D format for double density. Also on the Doubler board is an RS232 port for the console terminal. The controller needs 2K bytes of address space, 1K byte for EPROM and 1K byte for scratchpad RAM. The disc drives are Shugart's SA800 and the discs, from Control Data, hold 509K bytes each (that is in double density format on 8" discs). Unfortunately, three of the discs caused repeated 'bad sector' error messages. Presumably, this could have been caused by faulty discs or by poor formatting. Unfortunately, there was no way of telling which.

An Interfacer board from Godbout provides RS232C input/output ports (two of each) and along with two UARTS, it contains a crystal controlled baud rate generator as well as conversions to TTL and current loop. The standard Z-Plus is described as having three boards and seven free S100 slots. The system provided only had the three boards I've described. The standard system has two parallel ports.

The basic system comes with an Elbit DS 1920-X terminal. This is a large (15 inch CRT), heavy (55lbs) VDU with detachable keyboard. The keyboard has 95 keys including full cursor controls, address field positioning and a numeric keypad. Although basically QWERTY in layout, the non standard keys are in pecular

The Z-PLUS with custom desk

positions. For example the ?/ key is in the upper right hand corner while ¼ ½ is in the upper left. I found the shift keys too small and don't like having control keys on both sides of the space bar where I expected the shift. Of course anyone can get used to this layout in a few hours but, let's face it, I'm paid to be fussy. Rostronics have put a reset button on the terminal since the button on the Z-Plus is inaccessible when the machine is located in its desk. The display is 80 characters by 24 lines of very clear, large (including lower case with true descenders) characters.

As well as the basic Z-Plus, Rostronics lent me a Multiwriter III. This is a daisy wheel printer that I must admit I grew quite attached to. It runs at 55 characters a second.

System Software

On powering up, CP/M is automatically booted in with '60K CP/M — MICROMATION Ver 1.4'. Under CP/M, on any computer both main memory and disc memory are divided into two parts. . . one for the operating system, the other for the user. CP/M takes up the lowest 256 words, the highest 4.25K of RAM and the first two tracks of a system disc. The system I had came with a spooler program which required a further 2K of RAM at the top of the address space. CP/M will only boot in from drive A and prompts with "A>". A user can move to another drive by specifying it (with "B:", "C:", or "D:") and CP/M prompts with the appropriate letter. Any command typed in response to the prompt is interpreted by a system program called CCP (Console Command Processor). If it is a built in function (part of CP/M), a utility or user COMmand file name, the command is executed. Otherwise the unrecognized word, followed by a question mark is displayed, followed by the CP/M prompt.

The internal functions provided include ERAse, DIRectory, RENname, SAVE and TYPE. ERA, which deletes one or more files from a disc, provides no diagnostics. When the directory is full it fails to carry out simultaneous file deletions. It would be desirable if ERA warned the user when it had not erased anything and listed what it had erased otherwise. Because of the complete lack of messages, in practice ERA must be followed by a DIR to see what has actually taken place. The DIRectory can have up to 64 entries. This may be sufficient for minifloppies or single density floppies but is too few for double density discs, especially for development work. I filled up a directory when almost half my disc was empty. I've been told that CP/M Version 2 (for hard discs) allows larger directories.

TYPE lists programs on the screen. If used on a file that is located on a bad disc sector it sometimes locks out the keyboard, requiring the VDU to be turned off and on in order to continue processing.

In any computer system there are tasks that users need to run regularly to keep their system operating smoothly. The Z-Plus has not only the standard CP/M utilities (STAT, ASM, LOAD, PIP, ED, SUBMIT, DUMP), but also POLPRINT for using a printer, and several utilities for double density discs (including formatting and testing). Considering that floppy discs are not the most reliable of media there ought to be included in the formatting procedure, a test of all the disc sectors that locked bad sectors out and was transparent to the user (except for the disc space available).

I wasn't pleased that PIP, the utility

Technical Data

CPU:	Z80A, 4MHz
Memory:	64K dynamic ram
Keyboard: Screen:	Elbit DS 1920
Cassette:	N/A
Disc Drives:	2 drives, 8", double density, single sided
Printer:	Multiwriter
Bus:	S100
Ports:	3 serial, 2 parallel
System Software:	CP/M
Languages:	CBASIC, BASIC 80, CIS COBOL, PASCAL/Z, 8080 assembler

for moving files, did not inform me when it wrote a file to a bad sector of the disc. SUBMIT, a program that allows commands to be batched together for automatic processing, now accepts parameters, thus making it far more versatile than previous versions.

I regret to say that Rostronics' utility POLPRINT has not had all its bugs removed. It's designed to allow the user to print and process simultaneously (a good idea in theory although if the printer is close to the terminal, it's too distracting to type while the printer is running). Unfortunately it also has the ability to wipe the disc that it's on. I ran the FILES utility (that checks what is on a disc after wiping) and the missing files were not found. These utilities, unlike the built in commands, take up user disc space and run in user RAM, as do user written COMmand files. The language translators (numerous BASICs, CIS COBOL, PASCAL and two assemblers) are also supplied as COMmand disc files and are therefore accessed by typing the appropriate name.

It is unfortunate that the industry standard operating system, CP/M, and the industry standard BASIC were not produced by the same software house; there are inconsistencies between them in the way they accept input from the terminal. This is probably most irritating to the new user, but I hope Digital Research decides to adopt Microsoft's approach to input. In particular CP/M is particularly poor for deletion of errors. Backspace causes an error message whereas rubout repeats the characters that have been rubbed out. (As a result of this observation, Rostronics say that they have updated CP/M to use the destructive backspace). Microsoft's BASICs allow one to use the backspace for deletion and put slashes around any characters that have been rubbed out. Another difference between the two is that CP/M does not differentiate between upper and lower case whereas BASIC does.

Since CP/M is such a popular operating system and on the whole, very good system software, I hope that it's just a matter of time until these relatively minor irritations are cleared up.

BASIC

The review machine came with *five* BASICs: BASIC E, CBASIC, OBASIC, interpreted BASIC 80 (version 5) and compiled BASIC 80. As BASIC E and OBASIC are old versions of CBASIC and BASIC 80, respectively, I did not examine them. The purchase price of the machine includes CBASIC, which was written by Software Systems and is fairly unusual (although it will execute standard ANSI BASIC programs). Any program must be created using the editor and then converted to an intermediate code by running a program called CBAS2.COM. If this process is successful, the next stage is to execute the intermediate code — which takes 7.2 seconds. Intermediate code ought to execute faster than BASIC code, but as can be seen from the benchmarks, this language is surprisingly slow.

Looking at CBASIC's more positive features, it is quite a powerful BASIC (if one can call a language that has optional line numbers, BASIC). The first 31 characters of identifiers are significant and numeric variables can be held as integers as well as reals. Constants can be held as hexadecimal or binary as well as the usual decimal. There are nice constructs such as a WHILE. .WEND and IF. .THEN. . ELSE. . (although it cannot be nested). Functions can be multi-line and can have several parameters. There are CHAIN, %INCLUDE and COMMON commands that allow for transferring control from program to program (or subroutine) and random and sequential files of ASCII characters are provided. Sequential files can contain variable length fields and are not padded. Finally, random access files must have fixed field formats.

More interesting than CBASIC were Microsoft's two version 5 BASIC 80s. Microsoft has completely rewritten its BASIC as can be seen in the dramatic speed improvements alone. The BASIC interpreter was designed to be used in development work while the compiled BASIC creates programs that will execute very quickly. Using the compiled BASIC is similar to using CBASIC except that at translation stage,machine code rather than intermediate code is produced, and there is a rather long wait (95 seconds) to load and link the machine code before execution begins. Fortunately an immediately executable module can be saved as a COMmand file.

The language BASIC 80 is supposed to be the same whether compiled or interpreted — with a few obvious exceptions (commands like AUTO; LIST, RUN etc. are not implemented in the compiled version). Unfortunately CHAIN and COMMON have not yet been implemented either. The compiled BASIC has a switch /C that seems to have been designed to allow the execution of some CBASIC programs (it allows optional line numbers) although not all as the file access instructions are not the same.

The list of BASIC reserved words indicates the power of the new BASIC 80. My overall impression was of a language that executed rapidly and incorporates the features of the previous Microsoft BASIC with the good features of CBASIC.

Program Development Instructions
AUTO
DELETE
EDIT
KILL
LIST
LLIST
LOAD
NAME..AS
NEW
REM
RENUM
RUN
SAVE
TRON
TROFF

Initialization and Assignment
CLEAR
DIM
ERASE
LET
NULL
OPTION BASE
WIDTH

Control Structures
END
FOR..NEXT
GOSUB..RETURN
GOTO
IF..THEN..(ELSE)
IF..GOTO
ON..GOSUB
ON..GOTO
STOP
WHILE
WEND

Input/Output Instructions
CLOSE
DATA
FIELD
GET
INPUT
INPUT#
LINE INPUT
LINE INPUT#
LPRINT
LPRINT USING
LSET
OPEN
OUT
PRINT
PRINT USING

```
PRINT#
PRINT# USING
PUT
READ
RESTORE
RSET
WAIT
WRITE
WRITE#
```

```
Functions
ABS
ASC
ATN
CDBL
CHR$
CINT
COS
CSNG
CVI
CVS
CVD
DEF FN
DEF INT
DEF SNG
DEF DBL
DEF STR
EOF
EXP
FIX
FRE
HEX$
INP
INPUT$
INSTR
INT
LEFT$
LEN
LOC
LOG
LPOS
MID$
MKI$
MKS$
MKD$
OCT$
POS
RANDOMIZE
RIGHT$
RND
SGN
SIN
SPACE$
SPC
SQR
STR$
STRING$
SWAP
TAB
TAN
USER
VAL
VARPTR
```

```
Machine level
CALL
DEF USER
PEEK
POKE
```

Disc Tests

I tested the discs with routines similar to those I have run previously. Unlike the benchmarks, these tests are liable to deviation depending on what else is on the disc being used. Nonetheless, they do give some indication as to the speed of disc access. In these tests I had to use 200 records because the maximum size of a record is only 128 characters (in previous tests I used 100 records of 256 characters). The first test creates, opens and closes a file, the second also writes 200, 128 character records to the file, while test five is similar to test four except it starts at the end of the file and reads until it has read the first record. Test three and five are designed to test the 'directness' of the random access and as can be seen from the figures, it isn't very direct. I used interpreted BASIC 80 for these tests. Considering the small record size — requiring double the number of disc accesses — the system did extremely well.

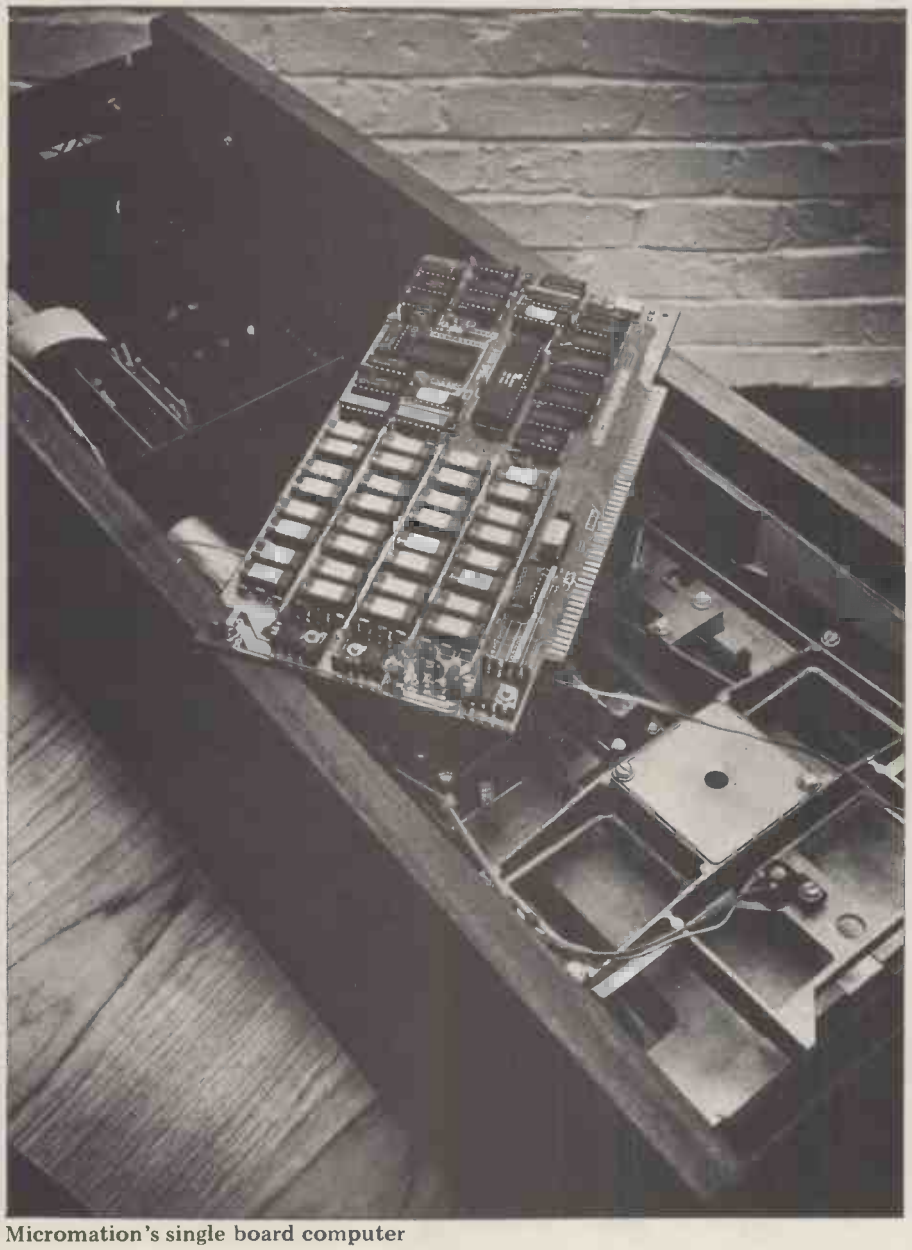
Disc test 1	0.2 sec
Disc test 2	9.6 sec
Disc test 3	32.8 sec
Disc test 4	7.9 sec
Disc test 5	25.9 sec

Other Languages

The basic price of the Z-Plus includes, as well as CBASIC, an 8080 assembler. As the machine runs under CP/M it is possible to buy translators for virtually any language that is currently available on a personal computer. In particular, anyone who wants to write assembly language programs can purchase a Z80 assembler to fully utilize the Z80 microprocessor. Rostronics provided me with Ithaca's Pascal/Z compiler and Microfocus' CIS Cobol.

Having several Pascal programs I wanted to run, I looked to the Pascal compiler — and was disappointed. I'd say Ithaca has made a mistake in releasing this version as I believe it has severe limitations. Most importantly there are no real (floating point) numbers. Also missing are pointers, variant records and the ability to pass procedures and functions as parameters. Input/output has been altered — so there's something odd about the way the first READLN instruction encountered in a program is executed. Type matching is far more restrictive than it should be and subrange checking is ineffective.

Not being a Cobol expert I showed the



Micromation's single board computer

CIS Cobol to a friend who has used Cobol in a variety of mainframes and minis. She was impressed and said that it looked better than any Cobol she has seen — except for implementations on Cobol orientated machines. She was pleasantly surprised to see CIS Cobol's FORMS2 package which enables the user to design, create and edit interactive screen layouts for use in application programs. Although quite comprehensive she felt FORMS2 would be complicated to use. Actually, that was her overall impression of the language as well. In particular she thought the indexed sequential files would be difficult to use and that the random access files didn't provide for fast random access (they only read single records). I believe these faults also exist in other Cobol compilers for personal computers, ones which have far fewer features.

Business & education potential

Without doubt this computer was designed with the businessman in mind. Aesthetes may object to the unusual combination of a teak desk and a walnut computer. The rest of us will find it quite attractive.

Thanks to the standards adopted for the hardware and software, the prospective user will find no shortage of application software or peripherals to add on. The machine runs the standard CP/M operating system which, as well as allowing the running of a wide range of existing programs also supports a number of different versions of BASIC, several COBOLs, assemblers, FORTRAN and so on. The machine also has the standard S100 bus to which many commonly available devices can be added.

Meeting both hardware and software standards may be a necessary condition for the purchase of a system but other factors such as adequate capacity, reliability and attractive and robust packaging must be taken into account. For the money, I've not seen a system with larger capacity — 64K RAM and twin double density 8" disc drives. I found the entire system reliable with two exceptions: a printer program (which isn't necessary for printing and will almost definitely be improved) and some of the discs. If the number of "bad sector" messages I experienced is representative, any user will have to back up all files with greater frequency than might otherwise be necessary. Looking at the packaging of the system, it certainly seemed robust and was very smartly packaged in its customized desk.

Games

Rostronics supplied me with a copy of Adventure. I was surprised how fast it executed having only seen it on a (slow) mainframe computer before. There is a large collection of games in the CP/M library for anyone wealthy enough to buy this system with a view to game playing.

Documentation

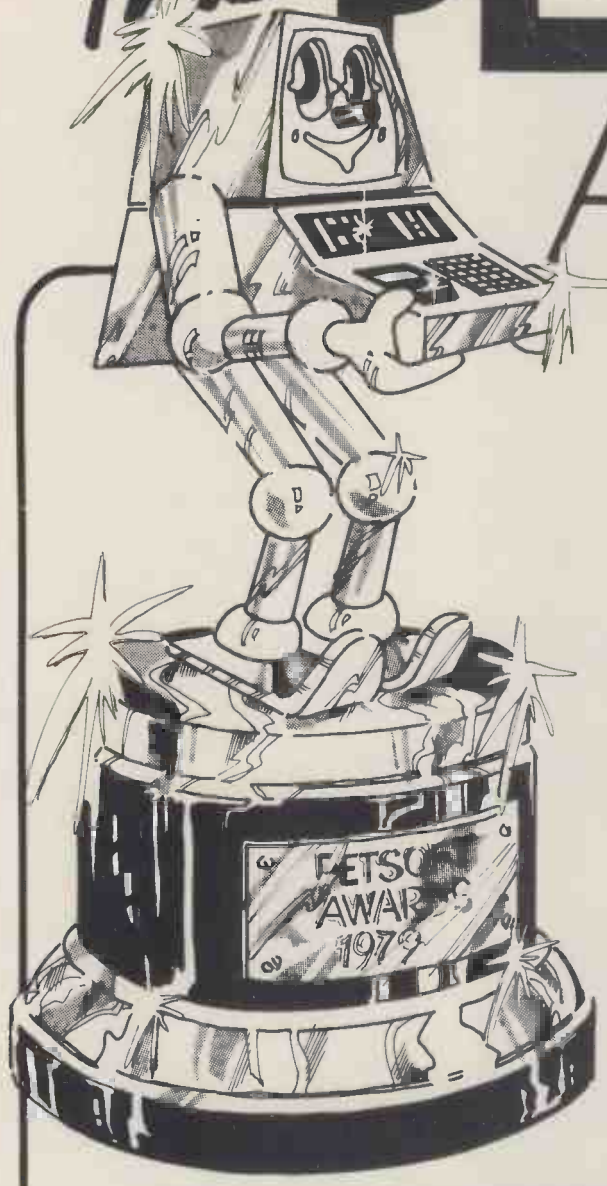
The documentation, like the software, came from a variety of sources and was therefore not of consistent quality. For the user this means a longer period before the information within the manuals is easily accessible. The problem, however, is inevitable as users want software from a variety of sources.

Digital Research's documentation for CP/M is certainly of a professional standard. Each manual is short, clearly written and filled with examples. I would add, though, that they are not for the novice computer user. My one complaint is that the manuals do not mention any of the software necessary for double density. This is left to the Micromation manual that deals with their double density disc controller. With the basic system, the one other manual you will get is for CBASIC. It, too, is a good manual although a bit chatty for my taste.

The organisation of the Microsoft BASIC 80 manual leaves a little to be desired, even if the contents are satisfactory. It has three chapters and thirteen appendices, and is in need of a scissors and paste job. In many ways, however, it is an improvement over their previous manuals and especially nice is chapter two, entitled 'Commands and Statements'. Each reserved word has its own page showing format, purpose, a description of its use and examples. All of these are clearly written, but require frequent reference to appendices.

The CIS Cobol manual certainly

the PETSOFT AWARDS



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looks well organised, comprehensive and clearly written. For Pascal, Ithaca provide the Wirth and Jensen book on Pascal and a list of exceptions. Rostronics have just informed me that more comprehensive manuals are now available.

Expandability

The basic system comes with a disc controller that can manage up to four drives. Unfortunately the Z-Plus box does not have the room for two more drives. Rostronics say they will be selling hard discs that can be added onto this system. The machine also offers two unoccupied serial and parallel ports. To attach more than two peripherals onto these ports would require having the box cut out for additional

cables. The basic system is comparatively large and though expandable because of the seven free S100 slots, expansion much beyond the basic system would result in an untidy collection of boxes and wires.

Conclusion

The Z-Plus is a standard Z80, S100, CP/M system that comes with a VDU and purpose built desk. When choosing a standard system secondary features assume a greater importance. Looks, price, reliability and after sales service come more into the decision. The Z-Plus is certainly a smartly packaged, competively priced system. The hardware seems robust with the exception of the previously discussed disc problems. I found the people at Rostronics friendly, knowledgeable and anxious to please.

Prices

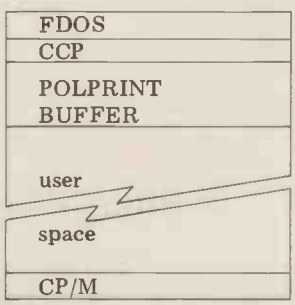
Z-PLUS (basic)	£3,750
2M Byte version	£4,150
Multiwriter printer	£2,300
10M Byte of hard disc	£3,100
20M Byte of hard disc	£3,700

At a glance

FIRST IMPRESSIONS	
Looks	****
Setting up	****
Ease of use	***
HIGH LEVEL LANGUAGES	
BASIC	****
COBOL	***
FORTRAN	N/A
PASCAL	*
System Software	***
PACKAGES	
Business	****
Education	**
Home	***
PERFORMANCE	
Processor	****
Cassette	N/A
Disc	***
Peripherals	***
EXPANDABILITY	
Memory	**
Cassettes	N/A
Discs	***
Bus	****
COMPATIBILITY	
Hardware	****
Software	****
DOCUMENTATION	***
VALUE FOR MONEY	****

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

MEMORY MAP



Bench marks

Many readers have written in asking for an explanation of our eight *Kilobaud* Benchmarks. We reproduce here the list that was originally published in the first edition of PCW (Feb 1978).

```
BM1   300 PRINT 'S'
      400 FOR K=1 TO 1000
      500 NEXT K
      700 PRINT 'E'
      800 END

BM2   300 PRINT 'S'
      400 K=0
      500 K=K+1
      600 IF K<1000 THEN 500
      700 PRINT 'E'
      800 END

BM3   300 PRINT 'S'
      400 K=0
      500 K=K+1
      510 A=K/K*K+K-K
      600 IF K<1000 THEN 500
      700 PRINT 'E'
      800 END

BM4   300 PRINT 'S'
      400 K=0
      500 K=K+1
      510 A=K/2*3+4-5
      600 IF K<1000 THEN 500
      700 PRINT 'E'
      800 END

BM5   300 PRINT 'S'
      400 K=0
      500 K=K+1
      510 A=K/2*3+4-5
      520 GOSUB 820
      600 IF K<1000 THEN 500
      700 PRINT 'E'
      800 END
      820 RETURN

BM6   300 PRINT 'S'
      400 K=0
      430 DIM M(5)
      500 K=K+1
      510 A=K/2*3+4-5
      520 GOSUB 820
      530 FOR L=1 TO 5
      540 NEXT L
      600 IF K<1000 THEN 500
      700 PRINT 'E'
      800 END
      820 RETURN

BM7   300 PRINT 'S'
      400 K=0
      430 DIM M(5)
      500 K=K+1
      510 A=K/2*3+4-5
      520 GOSUB 820
      530 FOR L=1 TO 5
      535 M(L)=A
      540 NEXT L
      600 IF K<1000 THEN 500
      700 PRINT 'E'
      800 END
      820 RETURN

BM8   300 PRINT 'S'
      400 K=0
      500 K=K+1
      530 A=K↑2
      540 B=LOG(K)
      550 C=SIN(K)
      600 IF K<100 THEN 500
      700 PRINT 'E'
      800 END
```

	BASIC 80 interp.	BASIC 80 interp. with integers	BASIC 80 compiled	CBASIC2
BM1	1.4	0.9	0.6	4.6
BM2	4.4	3.4	0.5	8.2
BM3	11.2	11.2	3.6	30.5
BM4	11.3	10.5	1.8	48.1
BM5	11.5	11.2	1.8	48.4
BM6	21.2	18.0	4.7	61.6
BM7	34.9	28.9	13.5	96.2
BM8	3.9	3.7	4.9	68.7

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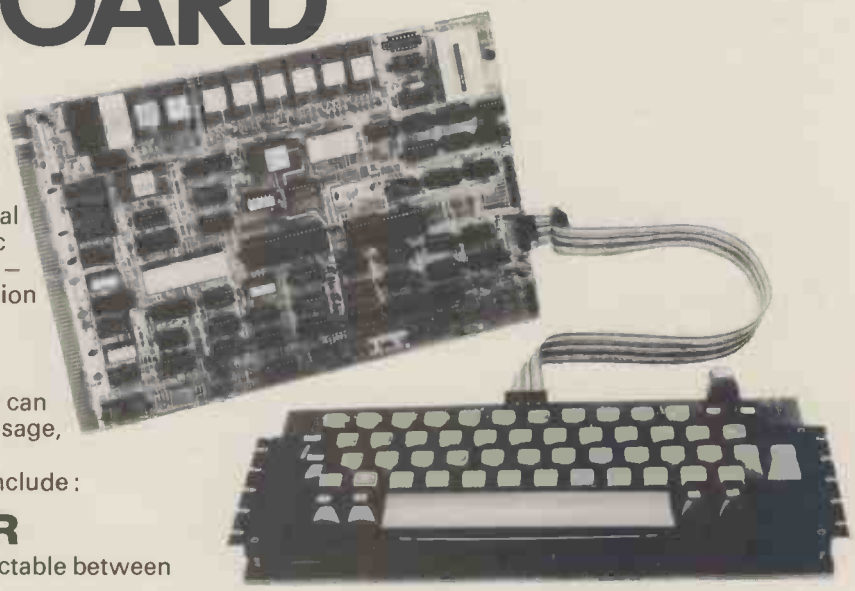

The lack of availability of the MK4118 RAMs has seriously delayed the launch of the Nascom 2, so we have decided to relaunch the product with an offer few will be able to refuse.
The Nascom 2 will be supplied without the optional user 4118s. Instead, we will supply a 16K dynamic RAM board and the interconnect for the NASBUS – absolutely FREE. This board allows further expansion to 32K. Also, when the 4118s become available, customers taking advantage of this offer can have the 8K for just £80 (plus VAT).

Meanwhile, the empty sockets on the Nascom 2 can be filled with 2708 EPROMs allowing dedicated usage, now with 16, or 32K of extra RAM. All the other features of the Nascom 2 are available and these include :

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12" × 8" PCB through hole plated, masked and screen printed. All bus lines are fully buffered on-board. PSU : +12v, +5v, −12v, −5v.

MEMORY

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- 8K Microsoft BASIC (MK 36000 ROM)

INTERFACES

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NASCOM DISTRIBUTORS

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Eley Electronics (Leicester)
Target Electronics (Bristol)
CC Electronics (Torquay)
Camera Centre (Barrow-in-Furness)
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INTERRUPT

Interrupt is the place in PCW where readers can unburden their grievances and air controversial views. New subjects are always welcome; the 'right of reply' shall be wielded at the discretion of the Editor. Please hold all contributions to within 800 words.

A chance for the disabled

It is rare for a day to go past without one coming across some item of headline news concerned with people being seriously injured. When injuries on the roads are counted along with the many disabling conditions that exist — like multiple sclerosis — it's not difficult to see that a large number of people, including young children, suffer by being severely physically handicapped.

For many, living and working relatively normally can be achieved by their using the aids available (coupled with a stubborn personality) but for many others life is currently very empty and frustrating. However, the microcomputer, that awful technology which is to cause mass unemployment and other problems, will revolutionise the world of aids for the disabled and provide a wealth of new opportunities associated with severe disability.

It is in the area of being able to solve many problems with one box that the microcomputer becomes a most valuable aid.

Disabled people in specially adapted cars or with guide dogs are a familiar sight. The mobility problem is easy to see, but what of other, less obvious difficulties? Most people take the ability to scribble on paper or read for granted. However, an inability to manipulate papers or turn pages makes such simple everyday tasks next to impossible. No scribbling facilities are available for many disabled people who have to rely on good memories and adapted typewriting equipment for note taking and writing. It is surprising that, as yet, no cheap and reliable page turner has been developed to assist with reading. The problems of the extremely disabled are highlighted when watching a severely spastic child who probably cannot communicate, cannot manipulate toys, cannot play games and cannot explore the surrounding world, although input to the brain is unimpaired. Life for such children is very frustrating and for their parents, both heartbreaking and trying. The list of problems for the severely disabled is endless and so is the list of expensive attempted solutions.

A wide range of aids are presently available ranging from fat handled spoons for those with poor grip to complex print reading machines for the blind. A severely disabled person very soon accumulates a house full of gadgetry, each item being very useful to assist with one particular problem. It is in the area of being able to solve many problems with one box that the microcomputer becomes a most valuable aid. However, giving all disabled people a boxed microcomputer and a terminal would not solve the problems and certainly would not be a popular policy for a somewhat 'thrifty' government.

There are basically two approaches to using microcomputer technology for aiding the disabled. Firstly, available microcomputer based equipment can be adapted to suit a particular disability and secondly, purpose built systems can be produced. Both approaches to building computer based aids have different applications and market. Neither approach produces inexpensive aids which means that, at present, it is often difficult for an unemployed disabled person to improve his/her quality of life.

Adapting existing computer based equipment for use by a severely disabled person is a skilled job requiring understanding of the problems associated with a particular disability. Many users, given the appropriate hardware, are only too willing to produce their own software. Usually, the biggest problem is to find a suitable terminal device which can be operated by people with very little movement. Special switching systems or breath tubes may also have to be interfaced and the necessary software written. There are currently disabled people successfully running small businesses from home using their personal computer for letter writing, accounting, filing etc. This, of course, is not an unusual application for a boxed microcomputer system — the difference, in this case, is that it enables someone to work who might be otherwise unemployed and probably very bored.

Microcomputer based, purpose-built aids for the disabled are also appearing increasingly. These aids are usually designed with a particular set of problems in mind. For example, machines that will scan printed text and give a spoken word read-out are currently being produced by two companies in America, a significant advance for those who cannot read braille or blind people who need to read material that has not been transcribed into braille. A portable braille word processor has also been developed, called the VersaBraille. Development of aids is not limited to America, work is also progressing rapidly all around the world. In Britain, Medelec have just launched a communicator for stroke victims — SPLINK, and Ferranti are manufacturing a microcomputer based personal information and control system — MAVIS, which is currently undergoing field trials. A word-store terminal, in which depression of a single key causes a whole word or phrase to be generated, called MATE, has been developed at Essex University.

So what of the future? As microcomputer technology advances it will become increasingly valuable to the disabled. One only needs to read books like Chris Evans' The Mighty Micro and use a little imagination to see what computer-based aids could appear soon.

Julia Howlett, Twickenham.

Editorial Comment

You could play a part in this future. If you would like to help, please write in with your comments and outline your area of interest. PCW will, in the first instance, compile a register. This will be made available to the British Computer Society's Committee for the Disabled; we hope other groups in this field will also be interested. Please write to: PCW Register, 14 Rathbone Place, London W1P 1DE.

Illustration by Paul Simmons

Which micro-toy?

A seasonal evaluation, by David Tebbutt and the PCW "kids."

'Tis Christmas in the late 70s and living as we do in a rising tide of silicon, it's hardly surprising that this year our most festive of seasons brings with it new demands from the eager young recipients of our bountious generosity. "Dad, gimme one of those spaceship things that blows up aliens". . . "Mum, I don't wanna boring old train set, I want to blast green meanies with phaser guns". To those of you living in the 'Scrabble-ised' backwood of children's home entertainment, beware, there may be a nasty surprise lurking under the counter of your local toyshop. This year, the electronics industry has struck at the very heart of our children's pleasure. You want to know more? (You should, because the kids certainly will). Then read on and stay one step ahead of this year's notes to Santa.

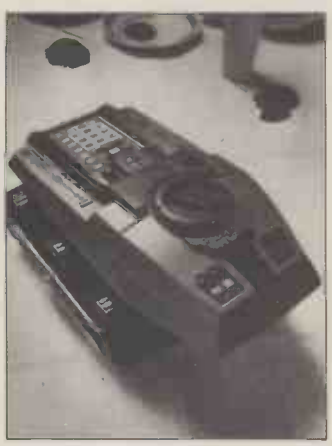
Whapp . . . dringg . . . whirr . . . freep . . . whoop, whoop, whoop — somehow things weren't turning out as planned! The idea had been to get twelve children (aged variously between four and thirteen years) to spend roughly ten minutes playing with each of twelve micro-controllable toys. The plan also suggested that we cull the testers' opinions at the end of the session — via a tape recorder — and also that each of them complete a simple questionnaire.

So much for the plan . . . actually, the result was — er — chaos! Well, maybe not quite . . . we did gather up eleven of the twelve children, twelve of the twelve toys and the questionnaires were, believe it or not, duly completed.

Toys under test

Alphie: This looks like a robot and can play five tunes, set simple tests and be used in special board games.

Amaze-A-Tron: This particular 'gizmo' challenges players to find their way round invisible mazes.



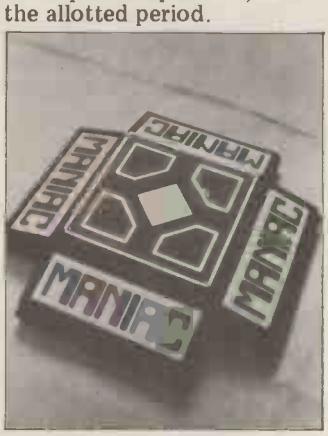
Big Trak: A tank which can be preprogrammed with details of direction, distance, pauses and the firing of 'phaser' guns.

Digital Derby: Race your way round a two-lane track without hitting other cars. A lap counter measures your performance.

Electronic Battleships: Exactly what it says — an electronic version of the pencil and paper game, plus sound effects.

Photography by Ian Dobbie

Hit and Missile: Fire rockets to hit as many aeroplanes and helicopters as possible, within the allotted period.



Maniac: Tests reaction times and various memory skills.

Merlin: Contains six functions — noughts and crosses, plays music, blackjack, magic square, echo and mindbender.

Simon: Based on the game 'Simple Simon Says' — the game tests a player's memory.

Super Marksman: An owl with a target painted on its stomach! The player fires a light gun and the owl hoots if a bullseye is scored.

Pegs: Several games based on a double-sided peg board. Two players insert pegs and if the holes chosen coincide then the device warbles.

UFO Masterblaster: Flying saucers descend towards the player's rocket launcher. They must be blown up before they land.

First impressions

Anyone with experience of young children will know how difficult it is keeping them amused for any length of time. Well, not any more, for the solution is at hand. Many of these toys and games hooked our young testers' attention so well we almost had to tear them away at the end of the day. Every child found at least one of the twelve units to be totally absorbing. The review lasted about three hours and, if it hadn't been for frantic parents ringing up in search of their offspring, they'd still be playing now.

The main attractions of the toys seemed to be their sounds and their intelligence. Most played merry tunes or blew raspberries, depending on the state of play. Some of the toys met with mixed success in their attempts to imitate the sounds of gunfire, shellfire, explosions, car crashes and owl hoots.

Mostly, the noises were fun — for a while, anyway! As for intelligence, well, if it's anything to go by, I know people who play noughts and crosses worse than Merlin. Perhaps THE indisputable benefit of micro toys is their infinite patience. They'll merrrily keep on playing the same game until the child tires (or the batteries run out). Compare this, dear parents, to being asked to play your fifteenth game of, say, Bulls and Cows.

The three most popular games were Digital Derby, Simon and Big Trak, the least popular being Pegs, UFO Masterblaster, Merlin and Maniac. By the end of the review, however, it had become clear that some of the more complicated games had not been given a fair test and so, the following weekend, we picked up where we had left off. On this occasion Battleships, Big Trak and Hit and Missile turned out to be the star attractions, while Pegs and Maniac remained unpopular.

Analysis

Alphie: A lovely little game for the very young, say up to six years old. The repertoire is limited but I understand extra quiz game cards are available from the makers.

Amaze-A-Tron: A game for older children — say from nine years old. Only one of our test group liked it, the others had a go but quickly lost interest. It was probably not visual enough.

Big Trak: A super toy this — universally liked. Dads also should have a great time with this one. It's extremely well-made, but one of the most expensive.

Digital Derby: This turned out to be an electromechanical toy — no micro, no electronics! Despite this it did prove popular during the first review but eventually it got overtaken by Hit and Missile.

Electronic Battleships: If your children like playing Battleships, they'll love this. A continual 'sonar' sound can be irritating, but the shells whining and the 'wumph' of explosions more than make up for this. Highly recommended, although rather more expensive than pencil and paper.

Hit and Missile: Mentioned earlier, this is also an electro-

mechanical game; for all that, however, it's great fun. With numerous cogs and gears I would be a bit concerned about its durability.

Maniac: Universally unpopular and also the most expensive of the twelve. We did spend an hour or so on Saturday trying to enjoy it, but just couldn't — sorry Maniac.

Merlin: After a shaky start (due to its complexity), this picked up in the popularity stakes. It is, in fact, six games in one, well packaged, sturdy and quite good fun.

Simon: Very popular with all age groups (including some adults). Four levels of skill are tested. To be fair, I suspect that the novelty might wear off quite quickly.

Super Marksman: No actual micro in this one — just discrete components that cause a binary counter to advance and an owl to hoot when a bullseye is scored with a light beam. The bad news is that the gun packed up within half an hour of the review starting. Although poorly made, it did prove very popular while it lasted.

Pegs: This went down like a lead balloon. We all tried to like it — but couldn't. I doubt if this is micro-controlled — all it did was twitter if pegs were placed in corresponding holes in each board. There was a book of games that could be played based on this feature but, by comparison with the other games, it was . . . well, you know . . . boring.

UFO Masterblaster: The grown-ups loved this one. The children quite liked it too but I suspect they scored it down through a lack of exciting noises and visual effects. It was extremely well-made.

Conclusions

Without a doubt, the age of the intelligent toy is upon us. The sounds of bleeps, whistles and jingles will be a part of our lives very soon, in the same way as we remember the rattle of hoops, the clatter of clockwork and the whirr of electric motors.

Confusion obviously exists, however, as to which of these new toys are actually micro-controlled — and which are simply disguised versions of the old-style 'mechanicals'. In some cases, without prior knowledge (or perhaps a screwdriver), it would be hard to decide which side of the fence a suspect fell. With toys, reliability is clearly an important factor and it's very much in the customer's interest to know the true facts — particularly when shelling out to the tune of £30. As many retailers are unlikely to be sufficiently technically equipped to make such judgements, the onus must fall on the manufacturer to include the relevant information.

PCW wishes to thank the following children for their help with this review: Craig Finn, Gavin Finn, Karl Finn, Anthony Ford, Nicola Ford, Catherine Galley, Heather Galley, Philip Galley, Karen Rumsey, Mark Rumsey, Nicola Rumsey, Michael Skinner, Jacqueline Tebbutt and Robin Tebbutt.

Our thanks must also go to Landau Electronic Wonderland, Tottenham Court Road, London for the loan of all the toys tested.

RESULTS CHART

Name of Toy	Maker	Approx retail price	Availability	Value for money	Fun rating	Quality	Age rating
Alphie	Milton Bradley	£19.95	Limited	***	****	***	4-6
Amaze-A-Tron	Coleco	£16.95	Large Stores	***	***	***	9+
Big Trak	Milton Bradley	£29.95	Limited	***	*****	*****	6+
Digital Derby	Tomy	£14.95	Large Stores	***	****	**	4+
Electronic Battleships	Milton Bradley	£27.95	Widespread	***	*****	**	9+
Hit and Missile	Tomy	£18.95	Limited	**	****	**	8+
Maniac	Ideal Toy Corporation	£32.95	Limited	*	*	***	?
Merlin	Parker Brothers	£19.95	Widespread	****	***	*****	8+
Pegs	Parker Brothers	£13.95	Large Stores	*	*	***	?
Simon	Milton Bradley	£22.95	Widespread	***	****	***	4+
Super Marksman	Made in Hong Kong	£10.95	Large Stores	**	***	*	8+
UFO Masterblaster	Bambino	£22.95	Large Stores	***	***	*****	8+

***** Excellent; **** Very good; *** Good; ** Fair; * Poor

10 PART PASCAL SERIES

THE COMPLETE PASCAL

BY SUE EISENBACH AND CHRIS SADLER

CHAPTER 4 DATA STRUCTURES: 1, SIMPLE DATA TYPES, ARRAYS AND SETS

In this series it has been frequently asserted that PASCAL represents a successful compromise between human readability and efficient compilation. This approach forms one of the cornerstones of PASCAL philosophy. Last month it was shown to be inherent in control structures and for this chapter we shall apply it to the storage and manipulation of data within the program.

During the execution of a program, data is stored as bit patterns at addressable locations within memory. In this form, however, it is very tiresome to access and even more awkward to manipulate and so high-level languages provide various devices for referencing specific memory locations and for organising and interpreting the data contained therein. In PASCAL, perhaps the most striking device is the incorporation of a specific declaration part which gives the programmer a chance to specify data storage and access requirements, and the compiler a chance to organise the memory in the machine to cope with the flow of information, once the action part starts executing.

In addition, PASCAL provides for different types of data (alphabetic, numeric, etc.) to be referenced by arbitrary variable names for different items of data to be associated with one another in a variety of ways, either out of logical necessity or for convenience. The assocation of one data item with one or more other items is known as a *data structure* and can be an extremely powerful tool to the programmer.

When data is badly organised, the amount of additional processing required to access and evaluate a given data element is increased, lengthening the execution time and worsening the likelihood of errors. Having a declaration part in a

program forces the programmer to devote time and energy to considering the organisation of data — and data thoughtfully and skilfully organised can be manipulated more efficiently and reliably. Most languages provide for one or more types of data structure. Scientific languages must have good array handling whereas any business language needs record and file structures. Interactive languages should have good string handling facilities.

While PASCAL offers all of these, perhaps its most powerful feature is the element of freedom offered in the definition of any *data type* or structure. As a programmer's skill develops, this freedom will be used with increasing sophistication in the creation and use of highly complex and efficient data structures.

Clearly there have to be some limits to the freedom of definition offered to programmers and two of these limits are imposed by the architecture of the hardware on which PASCAL is to be implemented. Firstly, the word-length (and bus width) of the system dictates the size of the numbers which can be held in a 'natural' way, either in two's complement (for integers) or floating point format (for reals). Secondly, the particular subset of the ASCII character set which the system (or terminal) will recognise, limits the number of characters and symbols available to the programmer. For example, the preferred comment delimiters " { " and " } " (not "[" and "]" as misprinted in an earlier chapter) are frequently omitted from terminal keyboards and are hence not accessible.

It is in recognition of these implementation-dependent requirements that PASCAL provides the four basic standard data types INTEGER, REAL; CHAR and BOOL. The range, storage characteristics and, in some cases, the position in memory for variables declared as these types have been decided in advance by the people who have designed the processor, the data bus or the PASCAL compiler, and not by the PASCAL programmer.

Subrange types

The advantages of defining one's own data types are twofold. Firstly, the particular form and structure of the data has to be thought through in advance, which often means that the problem becomes better understood and hence more effectively programmed. Secondly, if the limits and restrictions imposed on the data are known in advance, checks can be built into the program to ensure that no particular calculation or other process can go out of control. Classic examples of unchecked data include inadvertently dividing by zero (thus crashing the system) or sending a customer a Final Demand on a bill of 0.00 Pounds.

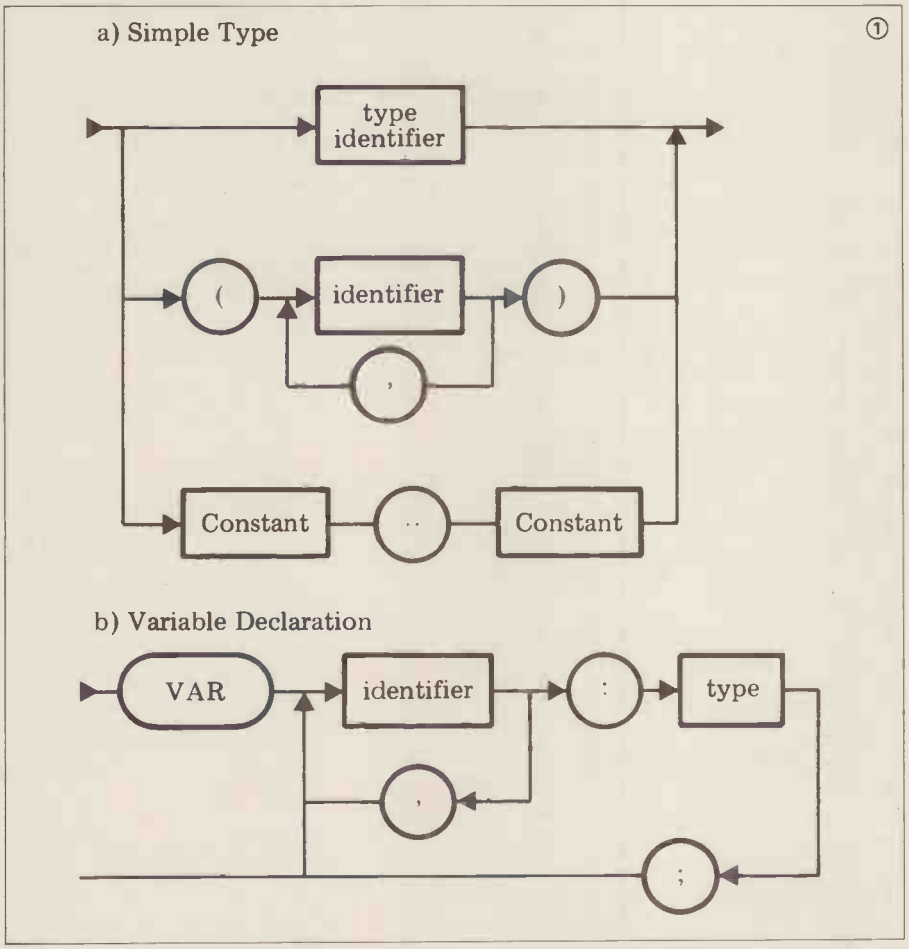
Both of these types of programming fault can be avoided in PASCAL by declaring a variable as falling within a *subrange* of one of the standard data types (except REAL). This device is predominantly used with integer and sometimes character variables. Suppose one is writing a program to accumulate and store table-tennis scores. No-one can get a negative score, nor a score greater than 21 so a sensible limitation on the integer variables ASCORE and BSCORE would be declared as follows:
VAR ASCORE,BSCORE:0 . . 21;

Now if anything goes wrong while this data is being input or during a calculation, the program will stop and the system will give an error message which draws attention to the particular variable which has moved 'out of range'. The next chapter will outline some explicit safeguards available to the programmer faced with the prospect of designing a program where data input is likely to contain errors.

Similarly, in a program which deals with A-level grades, one might declare a character variable as follows:
VAR GRADE: A . . F;
where A to E are the pass grades and F is a fail. Once again, if something goes wrong and GRADE becomes corrupted, the program will exit with an error message. It often seems a nuisance having to think out reasonable subranges for variables simply in order to give the program more ways of crashing — but the pay-off is improved data-integrity and hence more reliable processing.

The syntax diagram for subrange definition is shown in Box 1 as a variation of the 'simple type' definition. This is employed in a program through the VAR declaration, also shown in Box 1. In a chapter largely about data and the declaration part, it is difficult to provide full-program examples which are truly illustrative. Nevertheless, program CLASSAVERAGE in Box 2 is an attempt to show how subrange types can be used in a program to calculate the average test mark of a class of students. In line 3 COUNTER is declared within the range 0 to 50 which implies that the program won't work for classes with more than 50 students. Line 2 shows that MARK must be less than or equal to 100, which is reasonable when marks are given as a percentage. If a teacher sets a test out of 50, the program would still work as it stands — but it would be safer to amend Line 2 to reflect the new maximum before running the program. Note the -1 value which MARK can have — this is the rogue value to allow an exit from the loop when all the data has been input. AVERAGE is declared as REAL in Line 5 because it is the result of a division (Line 20).

In Line 7 the variables COUNTER and TOTALMARKS are initialised — i.e. set to zero in this case, since we require them to be zero when the data input starts. Many computer systems automatically set everything to zero before the program starts anyway, but a good programmer wouldn't depend on this, and in any case the initial value need not always be zero in every case. Line 8 gives the operator a brief description of what to do to get the data into the program. This is done in Lines 12 to 19, and Line 21 gives the answer. Note that the use of a WHILE-DO loop forces the first



②

```
 1:  PROGRAM CLASSAVERAGE ;
 2:  VAR MARK:-1..100 ;
 3:      COUNTER:0..50 ;
 4:      TOTALMARKS:REAL ;
 5:      AVERAGE:REAL ;
 6:  BEGIN
 7:        COUNTER:=0 ; TOTALMARKS:=0 ;
 8:        WRITELN ('TYPE EACH MARK AS REQUESTED, ',
 9:                 'TYPE -1 WHEN THE LIST IS COMPLETE.') ;
10:        WRITELN ;
11:        WRITELN ('MARK:- ')  ;
12:        READLN(MARK) ;
13:        WHILE MARK>-1 DO
14:        BEGIN
15:            COUNTER:=COUNTER+1 ;
16:            TOTALMARKS:=TOTALMARKS+MARK ;
17:            WRITE ('MARK:- ') ;
18:            READLN(MARK)
19:        END ;
20:        AVERAGE:=TOTALMARKS / COUNTER ;
21:        WRITE('THE AVERAGE OF THE MARKS IS ',AVERAGE)
22:  END. (*CLASSAVERAGE*)
```

datum to be read in before the loop has been set up (Lines 11 & 12). This can be avoided by slightly different coding and more complex initialisation.

EXERCISE:
Rewrite CLASSAVERAGE using a REPEAT-UNTIL loop.

Scalar types and data structuring

Anyone who has ever had to handle largish amounts of information will know that in order to classify data it is often necessary to codify it. Suppose one was collecting information on a group of people. Apart from totally individual data like names and addresses, there are usually a variety of categories into which one may want to subdivide the group e.g. sex, age group, socio-economic class, part of the country etc. If the group were small, one might have an entry as follows:

Lady Godiva, female aged 22 years, aristocrat of Coventry.

However, if the group were larger, several hundred entries, say, you'd pretty soon start codifying the data something like:

SEX:	MALE=0
	FEMALE=1
AGE	16 - 35 = 1
GROUP:	26 - 35 = 2
	36 - 45 = 3
	46 - 55 = etc.
CLASS:	Aristocrat = 1
	Professional = 2
	White Collar = 3
	Blue Collar = 4
	Labourer = 5.
REGION:	South East = 1
	South West = 2
	Midlands = 3 etc.

and thus — Lady Godiva; 1,1,1,3

This is quicker to write down and it becomes easier to search through for particular features or characteristics — but you can see how easily someone becomes 'just a number'. In addition, there is a likelihood of making mistakes whilst encoding or re-interpreting a previously encoded datum, and these mistakes are difficult to spot. Somehow

Lady Godiva, Male, etc.

strikes the eye more than does

Lady Godiva, 0,1,1,3.

The more categories there are, the more likely such encoding errors become and the less readable each entry (and the whole block of data) becomes.

The above remarks apply to most sorts of information gathering and analysis activities, but when it comes to programming, the temptation (and necessity) to use code numbers as a shorthand is greatly increased. Firstly, the memory (in the shape of the variable identifiers) can hold numbers like 1 or 0 more compactly than words like MALE and FEMALE. Secondly, these numbers can be manipulated much faster and with less programming effort than such strings of characters, which require special routines to enable searching and sorting rather than comparatively straightforward arithmetic. However, the two problems of encoding errors and poor readability (including that of of the program itself!) still remain. In order to ensure against these, a great deal of cross-checking between the data entries and the code-lists has to be done. This is irritating for the programmer because that's just the kind of job the compiler should be doing.

It is in response to this sort of requirement that PASCAL provides a means of getting the machine to do all the encoding and decoding, allowing the programmer to retain the descriptive names for the different categories of classification. The trick is to allow the programmer to define new data types (called scalar types) which consist of a sequence of 'values' whose names are just those categories the programmer wants to use. A variable declared as belonging to one particular scalar type can take any of the values mentioned in the list. Lady Godiva and her friends could have been dealt with thus:

```
TYPE    GENDER=(MALE;FEMALE);
        AGEGROUP=(YOUNG,
        INTERESTING, MATURE,
        MIDDLEAGED, ELDERLY);
        CLASS=(ARISTOCRAT
        PROFESSIONAL,
        WHITECOLLAR,
        BLUECOLLAR, LABOURER);
        ORIGIN=(SOUTHEAST,
        SOUTHWEST, WALES,
        MIDLANDS, EASTANGLIA,
        NORTHEAST, NORTHWEST);
VAR     SEX: GENDER;
        AGE; AGEGROUP;
        GROUP, FAMILY, FRIENDS:
        CLASS;
        PLACE, ADDRESS:ORIGIN;
```

So SEX is a variable which can take a 'value' of MALE or FEMALE — and so on. Lady Godiva herself thus becomes:

LADY GODIVA, FEMALE, YOUNG, ARISTOCRAT, MIDLANDS.

which presents no confusion to the writer (or reader) of the program. The PASCAL compiler makes the switch to the number set whose precise values need never bother the programmer. Also instructions like:

```
WHILE ADDRESS.=
    NORTHWEST DO — — —
```

will pick out the relevant individuals and

```
FOR GROUP:-LABOURER
DOWN TO ARISTOCRAT DO — — —
```

will cycle through the loop taking each member of CLASS in turn.

The computer uses numbers for these operations, ensuring no loss of efficiency in execution, but the secret of the encoding and control of these numbers is locked in the PASCAL compiler and need never worry the programmer.

Two points need to be made here. Firstly, the standard data type BOOL is a special predefined scalar type. It can take values FALSE and TRUE — i.e. there is an implied declaration of the form

TYPE BOOL = (FALSE,TRUE); in every declaration part of every program. The second point is that the order of the elements in the list is important. It is this that enables GROUP to be used as a loop counter above. Two reserved words exist which allow one to change position within a type list. These are SUCC (for successor) and PRED (for predecessor) such that;

SUCC(MATURE) is MIDDLEAGED,
PRED(EASTANGLIA) is
MIDLANDS, in the declaration example given above.

As a demonstration of a scalar type at work in a complete program, look at program OLDMANRIVER in Box 3. The scalar type is WEEKDAY (Line 2) while DAY (Line 3) is a variable which can take any value listed in Line 2. Lines 5 to 10 and 12 to 16 define procedures used in the main program, and it is the overall readability of this main program (Lines 18 to 22) that is the important feature. If you think that the output sounds more repetitive than you remember, then you've never worked on a cotton plantation!

Sometimes the implied order in a scalar type list becomes a nuisance because the programmer needs to connect up the different categories in

③

```
 1:  PROGRAM OLDMANRIVER ;
 2:  TYPE WEEKDAY=(MON,TUE,WED,THU,FRI) ;
 3:  VAR DAY:WEEKDAY ;
 4:
 5:  PROCEDURE WORK ;
 6:  BEGIN
 7:      WRITELN('TOTE THAT BARGE') ;
 8:      WRITELN('LIFT THAT BALE') ;
 9:      WRITELN
10:  END ; (*WORK*)
11:
12:  PROCEDURE PLAY ;
13:  BEGIN
14:      WRITELN('YOU GET A LITTLE DRUNK') ;
15:      WRITELN('AND YOU LAND IN JAIL. ') ;
16:  END ; (*PLAY*)
17:
18:  BEGIN (*MAIN PROGRAM*)
19:      FOR DAY:= MON TO FRI DO
20:        WORK ;
21:      PLAY
22:  END. (*OLDMANRIVER*)
```

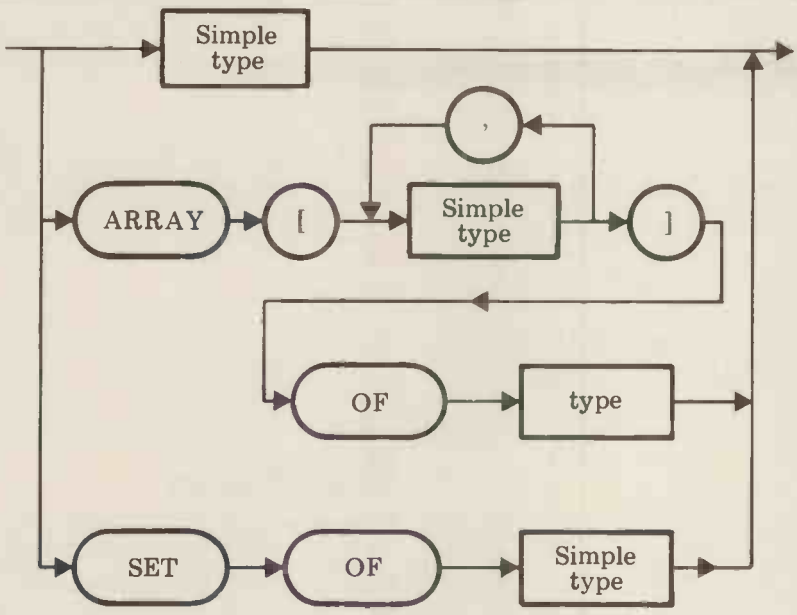
④

```
 1:  PROGRAM MISSISSIPPI ;
 2:  TYPE DAY=(MON,TUE,WED,THU,FRI,SAT,SUN) ;
 3:       WEEK=SET OF DAY ;
 4:  VAR WEEKDAYS,WEEKEND : WEEK ;
 5:      TODAY : DAY ;
 6:
 7:  PROCEDURE WORK ;
 8:  BEGIN
 9:      WRITELN('TOTE THAT BARGE') ;
10:      WRITELN('LIFT THAT BALE ') ;
11:      WRITELN
12:  END ; (*WORK*)
13:
14:  PROCEDURE PLAY ;
15:  BEGIN
16:      WRITELN('YOU GET A LITTLE DRUNK') ;
17:      WRITELN('AND YOU LANDS IN JAIL. ')
18:  END ; (*PLAY*)
19:
20:  BEGIN (*MAIN PROGRAM*)
21:      WEEKDAYS:=[MON..FRI] ;
22:      WEEKEND:=[SAT,SUN] ;
23:      TODAY:=MON ;
24:      WHILE TODAY IN WEEKDAYS DO
25:      BEGIN
26:          WORK ;
27:          TODAY:=SUCC(TODAY)
28:       END ;
29:      TODAY:=SUN ;
30:      WHILE TODAY IN WEEKEND DO
31:      BEGIN
32:          PLAY ;
33:          TODAY:=PRED(TODAY)
34:      END
35:  END. (*MISSISSIPPI*)
```

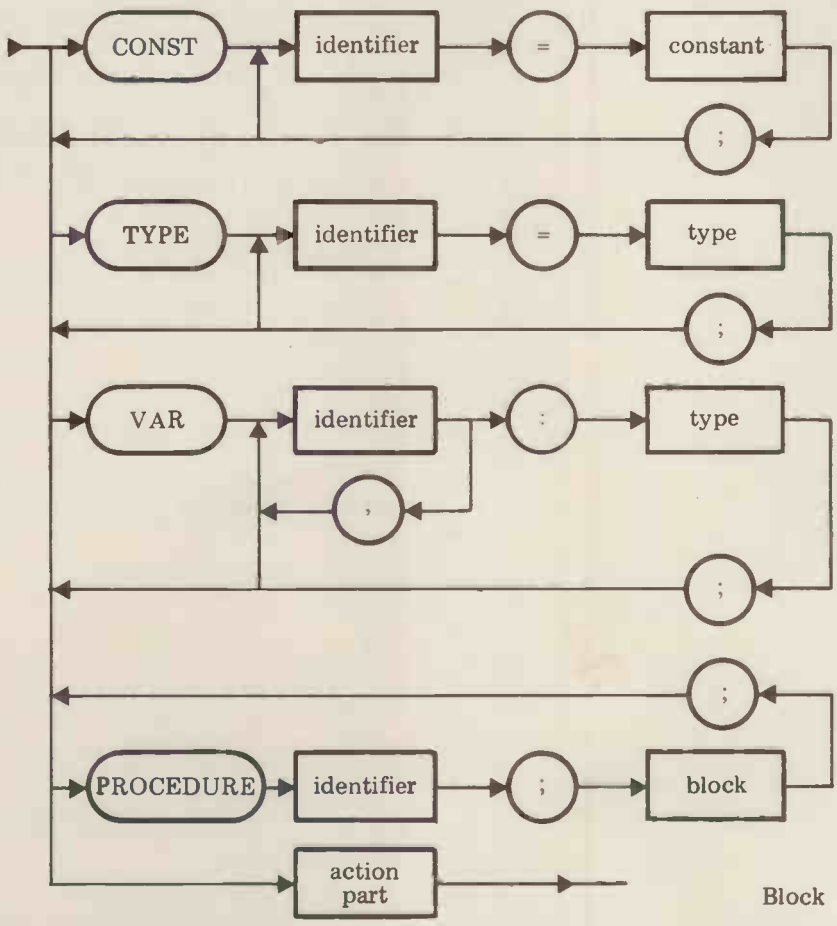
⑤

```
 1:  PROGRAM COUNTDOWN ;
 2:  TYPE STRING=ARRAY[1..80] OF CHAR ;
 3:  VAR  WORD:ARRAY[1..6] OF STRING ;
 4:       I,J :0..6 ;
 5:  BEGIN
 6:       WORD[1]:='OH   ' ;
 7:       WORD[2]:='PAT ' ;
 8:       WORD[3]:='LETS' ;
 9:       WORD[4]:='NOT ' ;
10:       WORD[5]:='STOP' ;
11:       WORD[6]:='HERE' ;
12:       FOR I:= 6 DOWNTO 0 DO
13:       BEGIN
14:            FOR J:= 1 TO I DO
15:              WRITE(' ',WORD[J] ) ;
16:            WRITELN('....') ;
17:            WRITELN;WRITELN
18:       END
19:  END . (*COUNTDOWN*)
```

⑥



⑦



Block

another way. Alternatively, the programmer might need to use only a few numbers of the list for one particular procedure — these could be a subrange or they could be dotted all over the list. This can also happen with the standard data types. For instance, the full set of A-level grades should be A . . F,O,U (O for "O-level" pass and U for "unclassified"). It's impossible to specify this set of requirements in terms of subranges and so PASCAL provides the SET declaration as a solution to the problem.

The way in which this works can best be seen by looking at the sample program (PROGRAM MISSISSIPPI) in Box 4. Firstly, DAY is declared as a scalar type in Line 2, and the list of values (MON etc.) is enumerated. Then WEEK is declared as a SET OF the scalar type DAY (Line 3) and finally the variables WEEKDAYS and WEEKEND are declared to be of type WEEK (Line 4). The action taken by the PASCAL compiler at this stage is as follows: for every variable declared as of type WEEK, a structure is created containing an element (of type BOOL) for each value appearing in the list DAY.

i.e. WEEKDAYS — 7 BOOL elements, etc.

Then, when the assignment to these variables is made (Lines 21 and 22), the compiler checks which elements of DAY should appear in WEEKDAYS and sets each corresponding BOOL variable to TRUE. The remaining elements are set to FALSE so that

WEEKDAYS contains (T,T,T,T,T,F,F)

WEEKEND contains (F,F,F,F,F,T,T)

Now a variable like TODAY which can take any single value in the list DAY can either be a member of the set WEEKDAYS or not, depending on the value we assign to it. This gives a great deal more control over these types of variables than would normally be the case since set membership can be checked through the set membership operator IN as illustrated in Lines 24 and 30. The improvement in readability should be evident from the program as a whole, although this version is a little more clumsy (and longwinded) than the last version. (This is partly to demonstrate the application of PRED and SUCC.)

Arrays

The variables WEEKDAYS and WEEKEND of the previous section represent a departure from all other variables so far defined since they contain information about several different items (i.e. whether or not they include each day of the week) rather than about one single item (like TODAY). Any linkage of more than one datum into some sort of organisation (like a set) is known as a data structure and the variables WEEKDAYS etc. are examples of a rudimentary form of data structure. In fact they consist of a series of TRUEs and FALSEs which have to be related back to the list of words (MON etc.) defined in the declaration part.

Another data structure which will be familiar to most programmers is the array which can be considered as a set of elements, all of the same type and each of which can be referenced by means of one or more indices. The prototype array has only one index and is often called a vector. This can be considered as a simple list of objects, (of the same datatype). If one particular object needs to be accessed, it can be found via its index which marks its position in the list, and since the program can go directly to this element (without searching through preceding members of the list), the array is con-

sidered to be a direct-access (or random-access) structure.

In PASCAL, the array as a whole is given a variable name and is declared (in the case of a vector) as follows:

VAR DAYS : ARRAY [1. . 12] OF INTEGER; where DAYS is the array name and ARRAY [ ] OF forms the 'reserved word'. Whatever appears in the [ ] is the index type — this is a subrange of scalar type. Integer type is never used because this would imply that the precise size of the array would be decided in the action part (when the integer would take on some value) rather than in the declaration part (when the boundaries are more clearly defined). The last word, in this case INTEGER, defines the base type. The above declaration instructs the compiler to set aside 12 successive integer locations within memory. In the action part these will be referenced in turn as DAYS [1], DAYS [2] etc., where DAYS [1] might hold the number of days in January and so on.

An alternative approach could be

```
TYPE  MONTH=(JAN,FEB,MAR,APR,
   MAY,JUN,JUL,AUG,SEP,OCT,NOV,
   DEC);
VAR DAYS : ARRAY [MONTH] OF
   INTEGER;
```

Here the array of DAYS has a previously declared scalar type (i.e. MONTH). as an index type permitting statements of the form DAYS[JAN] : = 31, and thus offering improved readability. A third alternative, which is useful when a number of identical arrays is required, lies in declaring an array type in the TYPE section and then, in the VAR section declaring a list of variables of that type.

An example of this technique can be seen in program COUNTDOWN, Box 5, where the type STRING is declared as a character array up to 80 characters in length (Line 2). Then the six 'words' are declared as being of type STRING (Line 3). Lines 6 to 11 initialise the array WORD while the rest of the program produces the output shown. Strings are a standard method of dealing with words and phrases (i.e. textual data) in a program, and UCSD PASCAL actually includes the string as a standard data type. The applications of string variables and the associated string operations will be discussed in a later chapter.

EXERCISE:
Replace Lines 6-11 in COUNTDOWN with a procedure which reads in any 6-word expression, one word at a time, from the keyboard.

The syntax diagram for a type is shown in Box 6, suitably amended to include both SET and ARRAY declarations. Likewise, the syntax diagram for a block on Box 7 provides a convenient summary of the aspects of the declaration part dealt with so far. Note that any block can only have one CONST, TYPE and VAR statement although any number of PROCEDURE statements is allowed. This is reflected in the positions of the returning arrows on the main stalk of the indicated syntax diagram.

The last example of this chapter shows the use of a two-dimensional array (Box 8). The idea of the program is to output a sales graph of pairs of jeans sold in a shop in a day. The two-dimensional array (QUANTITY) is declared as an 'array of an array', although it could equally have been declared as

```
QUANTITY : ARRAY [28 . . 34,SIZE]
   of Ø . . 40;
```

which looks more like the way it is referenced — i.e. QUANTITY [28,L] stands for the number of 28 inch waist, long leg jeans sold. The procedure INPUT serves to get the data into the program; in a suite of data-processing programs this data would normally be gathered as sales occurred so that the array would be prepared by some other program and passed to this program — probably via a data file, rather than being created in this way.

Procedure DRAWGRAPH contains two integral procedures, HEADING (Lines 29-34) and PRINTLINE (Lines 36-44) which are called from within its own main body. Note how PRINTLINE controls the size of each row of *s as it turns up.

EXERCISE:
(1) Tidy up this program, using type declarations for all the subranges and eliminating the empty lines between rows of *s in the output.
(2) Rewrite the program to output in columns up and down the page.

```
 1:  PROGRAM JEANSGRAPH ;                                          (8)
 2:
 3:  TYPE SIZE=(R,L,X) ;
 4:       ALFA=ARRAY[1..10] OF CHAR ;
 5:
 6:  VAR  WAIST  :  28..34 ;
 7:       LENGTH :  SIZE ;
 8:       LEG    :  ARRAY[SIZE] OF ALFA ;
 9:       QUANTITY : ARRAY[28..34] OF ARRAY[SIZE] OF 0..40 ;
10:
11:  PROCEDURE INPUT ;
12:  BEGIN
13:      WRITELN ('PLEASE TYPE IN THE NUMBER OF JEANS OF EACH SIZE SOLD.') ;
14:      FOR WAIST := 28 TO 34 DO
15:      BEGIN
16:          WRITELN('WAIST ',WAIST) ;
17:          FOR LENGTH := R TO X DO
18:          BEGIN
19:              WRITE('LEG ',LEG[LENGTH],'- ') ;
20:              READLN(QUANTITY[WAIST,LENGTH])
21:          END
22:      END
23:  END ; (*INPUT*)
24:
25:  PROCEDURE DRAWGRAPH ;
26:
27:  CONST TAB='          ' ;
28:
29:  PROCEDURE HEADING ;
30:  BEGIN
31:      WRITELN(TAB,TAB,'TODAY''S JEANS SALES ') ;
32:      WRITELN(TAB,TAB,'------- ----- -----') ;
33:      WRITELN;WRITELN
34:  END ; (*HEADING*)
35:
36:  PROCEDURE PRINTLINE ;
37:
38:  VAR I:INTEGER ;
39:
40:  BEGIN
41:      FOR I:= 1 TO QUANTITY[WAIST,LENGTH] DO
42:        WRITE('*') ;
43:      WRITELN
44:  END ; (*PRINTLINE*)
45:
46:  BEGIN(*DRAWGRAPH*)
47:      HEADING ;
48:      FOR WAIST := 34 DOWNTO 28 DO
49:      BEGIN
50:          WRITELN (WAIST) ;
51:          FOR LENGTH := R TO X DO
52:          BEGIN
53:              WRITE(TAB,LEG[LENGTH]) ;
54:              PRINTLINE
55:          END ;
56:          WRITELN
57:      END
58:  END ; (*DRAWGRAPH*)
59:
60:  BEGIN (*MAIN PROGRAM*)
61:      LEG[R] := 'REGULAR  :' ;
62:      LEG[L] := 'LONG     :' ;
63:      LEG[X] := 'EXTRALONG:' ;
64:      INPUT ;
65:      DRAWGRAPH
66:  END .
67:
```

Conclusion

This chapter has expounded the basic PASCAL philosophy of data handling, which is to permit data items to be associated with one another in a wide variety of ways (through codes, lists, structures, etc.) but at the same time to provide a set of built-in checks to help maintain control. Two of the four PASCAL data structures have been described.

The next chapter will continue with more explicit control mechanisms for manipulating both program and data flow in the action part. The chapter which follows that will return to the remaining data structures, the RECORD and FILE.

Look up table

CHAPTER 4 JARGON

Data Structure
Data Type
Subrange
Scalar
Initialised
Array
Vector

PASCAL RESERVED WORDS

TYPE
SUCC
PRED
SET
OF
IN
ARRAY

EXERCISE SUMMARY

1. Rewrite CLASSAVERAGE
2. Expand COUNTDOWN
3. Tidy Up JEANS
4. Print Out a Vertical Histogram

UCSD Deviation

Strings are standard data types
TYPE STRING = PACKED [1 . . 80]
OF CHAR

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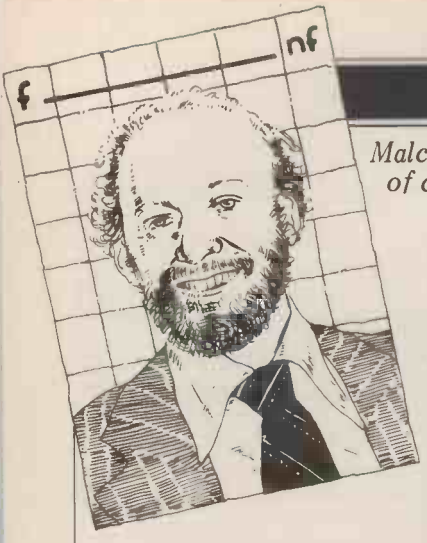

BOOKFARE

Malcolm Peltu has made his name writing and lecturing about the nature and impact of computer-related technologies.

The mythical maths fog

Like a child with a scalpel, the personal computer movement has uninhibitedly cut through much of the fake mystique and jargon junk which for so long had enabled the computing profession to shroud itself in a smoke screen of (generally unwarranted) clever-cleverness. Some myths, however, still remain. Like the belief that you 'must be good at maths' in order to be a programmer.

Recently I met a 12 year old boy in the States who demonstrated a program he had written to teach maths; a program used by his school and by half-a-dozen others who had been sufficiently impressed to buy it. While demonstrating the program, its inventor made a simple arithmetic mistake. "Damn it, my maths is really bad. I always use a calculator nowadays."

In the US he is but one of an army of programming kids; an army that is being joined daily throughout the world by children who have missed out on the introductory course that teaches the intricate patterns of the programming emperor's new clothes.

Much of the mathematical mystique which created this artificial barrier came, understandably, from the nature of the mathematical origins of the technology. This has been followed, less understandably, by the perpetuation of the myth in the very books and lectures which are supposed to enlighten the newcomer to the subject.

Binary arithmetic usually looms prominently in many of the introductions to computing, ready to pounce on the unwary victim and quickly inducing a state of glassy-eyed incomprehension and inadequacy. Processor architectures, punched cards, machine code instructions, flowcharts — even circuit diagrams — are other weapons in the armoury of those wishing to cause grievous mental confusion on novices entering the computer world without the protection of at least A-level maths and preferably a degree in computer sciences.

It wasn't always like that. When I joined International Computers and Tabulators (now ICL) in 1965 there were people on the initial course with qualifications ranging from a PhD through to failed degrees and even a scraped O-level or two; as far as I can judge there has been little correlation between the level of qualification and subsequent career success. In fact, much of the successful British software business was built up by people with little, if any, qualifications for the job; there was even a joke going the rounds a few years ago that there were only two people in one of the largest software houses without a degree — the managing director and his deputy.

Now, an important study by the National Computing Centre has highlighted the preservation of the maths belief, giving further proof that it is indeed a myth, based on prejudice rather than fact. Two new introductory books have also confirmed my own prejudice against the old fashioned school of computer education while a couple of year-old books have boosted my faith in the ability of the personal computing movement to revitalise and popularise the most important technology of our micro-time.

The NCC study, *Data Processing Staff Selection — a Validation Study* by *George Penney and Tony Lazzerini* is based on research into the first three years of operation of the Threshold scheme, an idea sponsored by the Manpower Services Commission, and run by the NCC to help alleviate unemployment amongst school leavers. It also attempts to solve the acute shortage of skilled computer staff.

It analysed 1,639 applicants to the course, which runs for 42 weeks and includes practical experience in industry. The study then looks at the performance of 452 trainees who went on the course and the first 100 who subsequently got a job.

The best single school predictor of performance on the course was success in O-level English Language. According to the authors, "The study confirms a point that NCC has been making to schools and careers officers — but with seemingly little effect — for some years. It is that ability in mathematics is *not* the most important criterion in selecting data processing staff. Another surprising result was that success or failure in A-levels, or in particular A-level subjects, is irrelevant to programming ability."

Threshold is open to 16 to 19 year olds. Trainees are chosen purely on the basis of special tests and an interview, regardless of academic qualifications. Of the first 100 who became programmers as a result of Threshold, 46% had fewer than four O-levels, which would have excluded them from even starting most computer courses, while the vast majority had fewer than two A-levels, which is the minimum standard for most jobs; many require at least a degree.

Although it is still too early to judge the performance of Threshold programmers in their jobs, Penney and Lazzerini comment ironically that when comparing these high minimum qualifications with the fact that so many 'unqualified' graduates of Threshold have actually got jobs, "we cannot but wonder what the difference is between the programming to be done in these (high-qualification) organisations and that to be done in installations employing Threshold staff".

The NCC study is not exactly a light read but it is of great value to anyone concerned with the training or selection of computer staff. By understanding the message of the study, many publishers and authors could also avoid what I regard as a seriously imbalanced general approach to introducing computing concepts.

Two recent books, typical of their rather old fashioned ilk, are *Microcomputers — their use and programming* by *Eric Huggins* and *Minicomputers — theory and operation* by *Donald Eadie*.

The Huggins book gets into assembler programming by page 12 and is into full binary swing by page 16; Eadie, on the other hand, waits until page 15 before launching into the binary coded system — but that's after a whirlwind and superficial round up of the history of computers and 'computers and society'.

Although both books claim to cover the fundamentals of the subject, they fail to give any serious weight to *the* fundamental of computer usage — i.e. how to organise the information which is of direct relevance to a user application. What they do is to focus on components of computer systems, such as programming methods, peripherals, terminals, processor structure, etc without ever truly relating them to the real world (as opposed to the world that exists in the mind of the data processing professional).

Both books illustrate a confusion of purpose. The Huggins one is essentially about programming techniques which, as he says, apply to ali computers. But it doesn't go into sufficient detail on microprocessors to satisfy someone whose primary interest lies in micros . . . it also uses a special programming language in its examples that's been designed for the book and therefore fails to even offer the reader an insight into a major, real world language.

Eadie's book concentrates far more on nitty gritty hardware, including quite detailed description of the Interdata 7/16 and Honeywell H316. Its emphasis on minicomputers, because of what Eadie says is the "widespread use of such systems since 1968" appears insufficient justification to prefer minis to micros and seems to relate to the pre-micro era when minis and not micros were seen as the great deliverer of cheap computing power. He has tacked on a chapter about micros that includes diagrams of the architecture of the Intel 8080A and Motorola M6800 — which seems to indicate that the technology had moved quicker than his conception and writing of the book.

Huggins and Eadie both seem to have a conception of their reader as someone who will become an expert in computer systems rather than an expert *user* of the system. They intimidate the casual reader and although in their

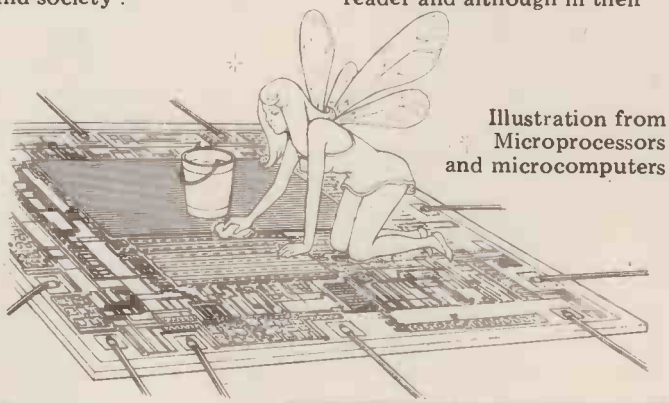

Illustration from Microprocessors and microcomputers

BOOKFARE

component descriptions of hardware and software techniques they do offer reasonable basic disciplines, it's insufficient for a computer scientist and too much for a user.

The best part of Huggins' book, which begins to move it towards the personal computer style of publication, are the drawings which illustrate some of the basic concepts — such as the ELFFIN (Electronic Fetcher and Filer of INformation) which helps out the DEMURE DAMSELS (an acronym too long and too arch to spell out) in the central processor.

This technique of bringing computers alive through the use of wit (or at least attempted wit) and imagination have long been recognised in the personal computer world. Two books which provide a refreshing contrast to the old fashioned approach are *A Gentle Introduction Using Fortran* by *Richard Conway* and *James Arthur* and *The Mind Appliance: Home Computer Applications* by *T.G. Lewis*. *A Gentle Introduction* is part of a series (there are also ones on PL/1 and BASIC) that's misleadingly called *Programming for Poets* — misleading because the book should be for the use of everyone, not just poets. The title derives from a practice at Cornell University (where the authors work) for dedicating to 'poets' the least technical introduction to a subject.

Significantly, the authors state clearly in the preface to the book that its approach is entirely non-mathematical. It is also fun to read and full of interesting examples and applications which provide the reader with far better insight into the nature of computing in general and a universally popular computing tool (Fortran) in particular than either the Huggins or the Eadie book.

The Mind Appliance is also misleadingly titled. It is in fact one of the endearingly irritating habits of many personal computing writers to try to come up with the most mind-blowing title, whatever the contents.

Using BASIC rather than Fortran, *The Mind Appliance* covers some similar applications territory to *A Gentle Introduction*, including language and linguistic routines, poetry-writing programs, games and information retrieval examples. It is quirkily structured around the home, with schizophrenic chapter headings like The Living Room (Simple Retrieval) and the Bedroom (Word/Text Processing). Each chapter is introduced with an anecdote, typically like the one for The Bedroom which tells about how Harold and Ariel came to the author after their 15-year marriage went on the rocks. Harold has fallen in love with a personal computer — he even brings it into the bedroom. Lewis gives them what he calls 'therapy' which consists of getting Harold to write a program that Ariel could 'talk to' to tell her woes — and even one which catered to her fetish for rude four-letter words.

In other chapters Lewis saves marriages by teaching programming to 'personal computer widows' and satisfies his own fantasies in the Living Room with voluptuous Alice who dreams of stepping onto a pure white egg-shaped computer, dressed in black leather trousers and boots.

All this story-telling is really a bait (which will be swallowed according to taste) to entice the reader into enjoying and understanding the potential of using computers. For in every example is a lesson which illustrates an important information processing technique — one that is applicable to any computer of any size.

A Gentle Introduction is the most substantial of all the books mentioned because of its wide range of applications examples — from basic programming statements and expressions, through program testing to uses like detecting palindromes, literary analysis, statistical programming, interactive retrieval and conversational programs and games. It also intelligently examines wider computing issues such as artificial intelligence, computer crime, privacy threats and the nature of programming languages.

The evangelical, populist zeal of the new generation of computing mind-openers, like *The Mind Appliance* and *Programming for Poets*, is touchingly summarised by the author's dedication to *The Mind Appliance*. Aptly, it is a poem:

In Memory of My Father
Would it have been
that you could see
the tomorrows you lost
Yes, and were it possible
to tell you
of their splendour,
I would.

Books discussed in this month's Bookfare have been:
Data Processing Staff Selection — a Validation Study by George Penny and Tony Lazzerini (National Computing Centre, £5.00);
Microcomputers — their use and programming by Eric Huggins (Macmillan, £4.95);
Minicomputers — theory and operation by Donald Eadie (Prentice-Hall/Reston, £11.00);
A Gentle Introduction Using Fortran by Richard Conway and James Arthur (Prentice-Hall/Winthrop, £8.00);
The Mind Appliance: Home Computer Applications by T.G. Lewis (Hayden Book Co., £4.20).

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Words and music by NASCOM

Don Finlay of the City University Department of Electronic and Electrical Engineering describes how to make a Nascom 1 play tunes. Sound parameters are controllable and lyrics are displayed simultaneously with the music.

Illustrated by George Snow

Most musical demonstrations using 'personal' computers are somewhat primitive, taking perhaps one line from an output port, which gives a variable-frequency square wave, to an audio amplifier and loudspeaker. These give the characteristic sound of a cheap electronic organ, but are even less interesting as they are only monophonic.

With the aid of an interface which takes a little more building, we can get much more interesting sounds. The one I have built for a Nascom 1 system, although still monophonic, can give any desired waveform shape, with any attack and decay characteristics. It does this by taking the eight binary digits from each of the output ports: one set is used to represent a waveform sample and the other the volume level. These are multiplied together by the interface hardware, making it possible to achieve a sampling rate of 20 kHz. This makes possible investigation into the nature of repetitive waveforms.

When working on the programming for this project, I realised that the VDU would be doing nothing useful once a program for making sound had been developed. It is not possible to display music in conventional notation with the limited character set of the Nascom, but there are very nice upper and lower case letters available. So I decided to make it print out the words of a tune, syllable by syllable, as the tune is played. The resulting display now makes a very good demonstration for visitors, open days and exhibitions.

This article, therefore, is about the development of 1) a multiplying digital-to-analogue (DAC) converter board, and 2) a program to play a tune and print its words. The tune I chose for demonstrations, and which is listed here, was the well-known one from the end of Brahms' "Academic Festival" Overture; this seemed appropriate for use in a University demonstration. The words are in Latin, suggesting uses in the teaching of languages, music, reading or computer programming. As it turned out, I was just able to get the program and data into the basic Nascom 1 system with only 4 bytes of RAM left unused.

The whole program was developed using only the Z80 mnemonics and instruction codes, and assembled by pencil and paper methods. This is a recommended exercise, as it makes one

aware of what is happening, and what is possible, in a micro-processor system. The relationship between music and mathematics is also illustrated; any tune can be defined by, and played from, just a sequence of numbers.

The DAC board

Audio waveforms always have positive and negative values, so consideration must be given as to how to represent both. If, in addition, a change of waveform is to be made at times, the representation must make calculations as easy as possible, so that the microprocessor can calculate its own waveform samples as needed. Hence 2's complement coding is chosen; this has the advantage of being 'analytic', i.e. negative values can be added directly to positive values to give the correct result.

```
    TEST PROGRAMME FOR DAC

3E0F            LD A,0FH    ;SET PIO
D307            OUT 07,A    ;  TO
D306            OUT 06,A    ;OUTPUT
3E00            LD A,00
D304            OUT 04,A    ;WAVEFORM=0
D305    LOOP    OUT 05,A    ;"VOLUME" PORT
3C              INC A       ;INCREASE VOL.
18FB            JR LOOP
```

Progam 1: While this program is generating a sawtooth waveform at the 'volume' DAC, the trimmer resistance in Fig 1 is adjusted so that the audio output is zero.

It wasn't easy to find published circuits for 2's complement DAC's, especially those which multiply two digital numbers, so I developed the one shown in Fig. 1, with the aid of ideas from the data sheets for the DAC chips.[1] Each of these chips is a multiplying type i.e. its output current is proportional to the product of the analogue reference voltage between pins 14 and 15, and the binary number input on the 8 lines using pins 5 to 12. The volume signal (always a positive number) is fed out to port 05 in the PIO, and thence via SKT A to DAC1, which has a fixed reference voltage from the + 12V supply and gives an analogue output current proportional to the volume. This output now goes to control the output level of DAC2, which accepts 2's complement sample signals from port 04 and SKT B but with the MSB inverted. The output of DAC2 goes to a current-to-voltage converter, formed by the 741 operational amplifier, while an offset compensation is subtracted by feeding it to the non-inverting input at pin 3.

An explanation of 2's complement numbers, and justification for the circuit, are given in the Appendix.

The offset compensation must be adjusted by the trimmer resistance, as it is compensating by an amount equivalent to the MSB of the sample, and needs to be accurate. If a variable input is applied to DAC1 and a constant zero applied to DAC2, the output should be zero. Program 1 provides this test signal; the trimmer is adjusted until no sound is heard or, if a cathode ray oscilloscope (CRO) is available, the trace remains horizontal.

Software

The starting point is a data table, corresponding to a vocal score, from which the micro-processor fetches one byte at a time, and takes action according to programs stored elsewhere.

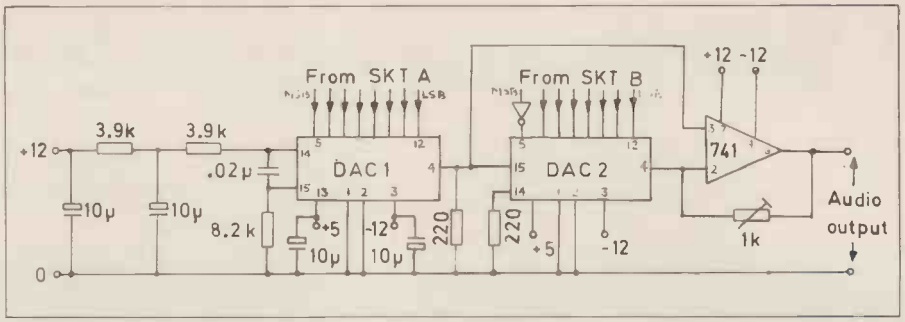


Fig 1
The digital to analogue converter circuit takes the 16 data line signals from the Nascom P10 (sockets A and B) via a ribbon cable. DAC's 1 and 2 are MC 1408L8 and the inverter is one element of a 7404. Values shown are in ohms, Farads and volts. Component costs amount to about £5.

DATA TABLE FOR "GAUDEAMUS IGITUR"

ADDR	LRS	VDU	LTR CODES	NOTE	DUR	REMARKS	
0C50	53					START	
0C51	03	09 5A	47 61 75	D1	E5	GAU DQ	C
0C59	02	09 5D	64 65	CB	DF	DE SQ	G
0C60	01	09 5F	61	CB	DB	A C	G
0C66	03	09 60	6D 75 73	D1	DB	MUS C	C
0C6E	01	09 64	69	CD	DD	I Q	A
0C74	02	09 65	67 69	CD	DD	GI Q	A
0C7B	03	09 67	74 75 72	CD	E3	TUR DC	A
0C83	00			E7	DD	- Q	-
0C86	02	09 9A	4A 75	CF	DD	JU Q	B
0C8D	03	09 9C	76 65 6E	D1	DD	VEN Q	C
0C95	02	09 9F	65 73	D3	DB	ES C	D
0C9C	03	09 A2	64 75 6D	CF	DB	DUM C	B
0CA4	02	09 A6	73 75	D1	DD	SU Q	C
0CAB	00			D5	DD	- Q	E
0CAE	03	09 A8	6D 75 73	D1	E3	MUS DC	C
0CB6	00			E7	DD	- Q	-
0CB9	52					REPEAT	
0CBA	04	0A 17	50 6F 73 74	CF	DD	POST Q	B
0CC3	02	0A 1C	6A 75	D1	DD	JU Q	C
0CCA	03	0A 1E	63 75 6E	D3	DB	CUN C	D
0CD2	03	0A 21	64 61 6D	D3	DB	DAM C	D
0CDA	02	0A 25	6A 75	D5	DD	JU Q	E
0CE1	03	0A 27	76 65 6E	D1	DD	VEN Q	C
0CE9	02	0A 2A	74 75	D3	DB	TU C	D
0CF0	03	0A 2C	74 65 6D	D3	DB	TEM C	D
0CF8	04	0A 57	50 6F 73 74	CF	DD	POST Q	B
0D01	03	0A 5C	6D 6F 6C	D1	DD	MOL Q	C
0D09	03	0A 5F	65 73 74	D3	DB	EST C	D
0D11	02	0A 62	61 6D	D3	DB	AM C	D
0D18	03	0A 65	73 65 6E	D5	DD	SEN Q	E
0D20	02	0A 68	65 63	D1	DD	EC Q	C
0D27	02	0A 6A	74 75	D3	DB	TU C	D
0D2E	03	0A 6C	74 65 6D	D3	DB	TEM C	D
0D36	03	0A DA	4E 6F 73	D1	DD	NOS Q	C
0D3E	02	0A DE	68 61	CF	DD	HA Q	B
0D45	02	0A E0	62 65	CD	DD	BE Q	A
0D4C	00			D7	DD	- Q	F
0D4F	03	0A E2	62 69 74	D5	DD	BIT Q	E
0D57	00			D3	DD	- Q	D
0D5A	02	0A E6	68 75	D5	DB	HU C	E
0D61	00			D3	DB	- C	D
0D64	03	0A E8	6D 75 73	D1	DB	MUS C	C
0D6C	03	0B 1A	4E 6F 73	D1	DD	NOS Q	C
0D74	02	0B 1E	68 61	CF	DD	HA Q	B
0D7B	02	0B 20	62 65	CD	DB	BE C	A
0D82	03	0B 22	62 69 74	D3	DB	BIT C	D
0D8A	02	0B 26	68 75	D1	D9	HU M	C
0D91	00			CF	DB	- C	B
0D94	03	0B 28	6D 75 73	D1	E1	MUS DM	C
0D9C	00			E7	E7	END	

Table 1: Data for one verse of words and music. The first column after the memory address shows the number of letters to be displayed; this is followed by the VDU address, the ASCII-coded letters, and the frequency and duration codes.

Table 1 gives the complete hex coding for one verse of 'Gaudeamus Igitur'. To keep the table as short as possible, data for the note frequency (skip) and duration are compressed into 1 byte each, which is used as part of an address where a 2-byte number, needed for precision, is found. For this tune, only 7 different frequencies and 7 different durations are needed, so these can be stored in 28 bytes; however, two extra are loaded with zeros to give codes for pause and end of data. These are shown in Table 2. Derivations are given later.

In a system with unlimited memory, bigger tables for skip and duration would allow for other tunes, transposition and variable speeds.

Program 2, PLAY, makes the microprocessor fetch and deal with the data in 'Gaudeamus'. The first byte is 53, which is the ASCII code for S. This is because the first two lines of tune are repeated. We put in S for start, and later, when the micro-processor finds a corresponding R for repeat, it will go back to this point, where it has stored the starting address. The second time an R is encountered, it is ignored. The S and R may be placed later in a tune table, if required.

The next byte, 03, is loaded into the B register, ready for use in the LINE subroutine which is now called Program 3. This tells how many letters are to be printed and so is used as a counter. The next two bytes give the starting address, on the VDU screen, for the first letter. Choice of address is open to the programmer, using the VDU memory map. This must be worked out for each syllable, not forgetting spaces between words, and a pleasing vertical alignment, as in ordinary type display.

Then follow the ASCII codes for the letters. It is possible, with B-Bug monitor, to enter these by typing the letter while the space bar is held down, which is easier than looking up the code each time.

The note code D1 tells the microprocessor, in conjunction with instructions at addresses 0D9F, 0DBE, 0DBF and 0DC0, to fetch two bytes controlling the frequency from locations 0FD1 and 0FD2 and load them into register DE.

Finally, E5 is the code which causes a two-byte note length from addresses 0FE5 and 0FE6 to be loaded into the alternative register BC[1].

This completes a line of data. No sound has yet been produced, but the note data has been entered into appropriate registers ready for the NOTE subroutines to use.

There are variations in the lines:

1 If the first byte is 00, there are no letters, so LINE jumps straight to the frequency and duration codes.

2 If the frequency code is E7, then there is no note and the program jumps to a pause routine, the length of the musical 'rest' being controlled by the duration code.

3 If the duration code in the pause routine is also E7, then the program has ended and we return to monitor.

A more elegant ending would be to clear the screen slowly, ready for another playing. We could also clear the screen, or scroll upwards, for a repeated section. Both have been omitted here, so as to compress the program into the basic Nascom.

Sound generation

Real-time calculation of samples would be far too slow, so the method is to use a 'look-up table', in which a waveform is stored in the form of a series of numbers representing the amplitudes at equal time intervals. These correspond to the numbers printed in trig. tables, which we all used to look up before the advent of the scientific calculator. The micro-processor is made to fetch appropriate samples, not necessarily the next one in the table each time, and feed them out to port 04.

In an 8-bit system, 256 samples make a convenient table length, since continuous incrementing of a register which carries the low-order byte of the sample address gives automatic jumps from the end of the table back to the beginning. For many purposes this is adequate, although at low frequencies samples may have to be repeated, effectively reducing the sampling rate. Any sequence of 256 memory locations which has the same high-order address byte throughout is called a 'page'. In the Nascom 1 there are two complete pages available: 0D00 to 0DFF, and 0E00 to 0EFF. The page from 0F00 to 0FFF is not usable because the top addresses in it are used as a stack by the monitor, and running a program destroys any data in them. The better choice from the two possibles is page 0E, because this leaves a longer block of memory available from 0C50 (the starting address of user RAM) to 0DFF, for words and music data.

Table 3 gives the values for a 2's complement sinewave stored in page 0E. This is useful for initial experiments, as it gives a waveform which is easily recognized on a CRO or in a loudspeaker; it also enables calculation of new waveforms by adding harmonics. The values correspond to the sine at the middle of each step of 90/64 degrees, starting from zero.

Getting the right frequency

One way of controlling the frequency would be to output successive samples from the table at varying rates. Although this is done in the Allen computer organ[2] the software needed for the Nascom could be difficult. Instead, we use a variable number of samples per cycle. If alternate samples, instead of every sample, are taken from the table, the frequency of the resulting waveform is doubled, giving a note one octave higher. In-between notes need a 'skip' which is worked out as an integer plus a fraction. This skip is added to the address of the previous sample, which also has a fraction from previous calculations. If the sum of the two fractions gives a carry, then the next sample is taken from a point in

```
                    "VOLUME" DATA

0DEB  1C 38 5C 80 A4 C8 E4 FF  ;ATTACK
0DF3  E4 C8 A4 80 5C 38 1C 00  ;DECAY


                    "SKIP" DATA

0FCB    05 05  ;NOTE G, 392.00 HZ
0FCD    05 A2  ;NOTE A, 440.00 HZ
0FCF    06 52  ;NOTE B, 493.88 HZ
0FD1    06 B2  ;NOTE C, 523.24 HZ
0FD3    07 85  ;NOTE D, 587.32 HZ
0FD5    08 70  ;NOTE E, 659.26 HZ
0FD7    08 F1  ;NOTE F, 698.46 HZ


                   "DURATION" DATA

0FD9    75 30  ;MINIM, 1.5 SECONDS     M
0FDB    3A 98  ;CROTCHET, 750 MS       C
0FDD    1D 4C  ;QUAVER, 375 MS         Q
0FDF    0E A6  ;SEMIQUAVER             SQ
0FE1    AF C8  ;DOTTED MINIM           DM
0FE3    57 E4  ;DOTTED CROTCHET        DC
0FE5    2B F2  ;DOTTED QUAVER          DQ
0FE7    00 00  ;PAUSE/END CODE
```

Table 2: Data for the three note parameters. Skips are calculated for 20-kHz sampling, and durations for 80 crotchets/min. The volume figures give slower changes at beginning and end of the attack or decay cycles than in the middle.

```
                    ROUTINE "PLAY"

0000'                0001          ORG 0F79H
      (0D9F)         0002 LINE     EQU 0D9FH
0F79  3E0F           0003          LD A,0FH        ;SET PIO TO OUTPUT
0F7B  D306           0004          OUT 06,A
0F7D  D307           0005          OUT 07,A
0F7F  DD21500C       0006          LD IX,0C50H     ;DATA POINTER
0F83  DD4600         0007          LD B,(IX+0)     ;1ST. BYTE OF DATA
0F86  3E53           0008          LD A,53H        ;IS THIS AN S?
0F88  B8             0009          CP B
0F89  2031           0010          JR NZ,DTLN3     ;IF NOT, GO TO DATA LINE 3
0F8B  DD22FE0D       0011 STDTA    LD (0DFEH),IX   ;IF IT IS, STORE DATA POINTER
0F8F  DD23           0012          INC IX          ;NEXT DATA BYTE
0F91  DD4600         0013          LD B,(IX+0)
0F94  CD9F0D         0014 DTLN1    CALL LINE       ;PLAY LINE OF DATA
0F97  DD23           0015          INC IX          ;NEXT DATA BYTE
0F99  DD4600         0016          LD B,(IX+0)
0F9C  3E52           0017          LD A,52H        ;IS THIS AN R?
0F9E  B8             0018          CP B
0F9F  20F3           0019          JR NZ,DTLN1     ;IF NOT,LOOP BACK
0FA1  DD2AFE0D       0020          LD IX,(0DFEH)   ;IF SO, RELOAD START ADDRESS
0FA5  DD23           0021          INC IX          ;GET NEXT BYTE AFTER S
0FA7  DD4600         0022          LD B,(IX+0)     ;& BEGIN REPEAT PROGRAMME
0FAA  CD9F0D         0023 DTLN2    CALL LINE       ;PLAY NEXT LINE OF DATA
0FAD  DD23           0024          INC IX          ;NEXT DATA BYTE
0FAF  DD4600         0025          LD B,(IX+0)
0FB2  3E52           0026          LD A,52H        ;IS THIS AN R?
0FB4  B8             0027          CP B
0FB5  20F3           0028          JR NZ,DTLN2     ;IF NOT, GET NEXT LINE
0FB7  DD23           0029          INC IX          ;IF SO, IGNORE R THIS TIME
0FB9  DD4600         0030          LD B,(IX+0)     ;NEXT DATA BYTE
0FBC  CD9F0D         0031 DTLN3    CALL LINE       ;PLAY LINE OF DATA
0FBF  DD23           0032          INC IX          ;NEXT DATA BYTE
0FC1  DD4600         0033          LD B,(IX+0)
0FC4  3E53           0034          LD A,53H        ;IS THIS AN S?
0FC6  B8             0035          CP B
0FC7  28C2           0036          JR Z,STDTA      ;IF SO, GO BACK TO "STORE"
0FC9  18F1           0037          JR DTLN3        ;IF NOT, LOOP BACK
```

Program 2: Repeats are allowed for in this program, which calls the subroutine LINE as needed.

the table one further on than it would be for a sum which had no carry. Apparently, we are using 24-bit arithmetic (for a 16-bit address plus 8-bit fraction), but since the highest order byte doesn't change it is really only 16-bit.

The skip needed is 256ft, where f is the required frequency and t is the sampling time. It is just possible to get this time down to 50 microseconds (100 T cycles in the Z80), limiting the output audio frequency to a maximum of 10 kHz. For instance, to get 440 Hz output requires a skip of 256 x 440 x 50 = 5.632 decimal or 05.A2 hex. The fractional part of the hex number is obtained by multiplying the .632 by 256. Since the sampling frequency is above the audio range at 20 kHz, no output filter is needed.

Durations

These are simply the number of 50 microsecond sampling periods required, and those in Table 2 are for different note lengths at 80 crotchets to the minute. The pause routine uses the same duration table as its timing loops are adjusted to occupy 50 microseconds.

Attack and decay

It is possible to fill a register gradually with either 1's or zeros, using the Z80 instructions RR or SRL respectively, and if these instructions are used at the end of successive cycles and fed out to port 05 we have an attack or decay occupying 8 cycles. This is very similar to the technique used in the Allen computer organ,[2] and gives an acceptable sound without clicks.

However, for versatility, subroutine NOTE (Program 4) stores two sequences of volume levels in memory and uses them as needed for attack and decay. Again, cycles are counted rather than samples; this is justified on the basis that large musical instruments producing low frequencies take longer to sound and to die away than small ones. Data for these volume levels, giving a roughly S-shaped rise and fall over 8 cycles each, are also shown in Table 2.

Sample timing

Much trial and error was needed in NOTE so as to get each sample to occur 100 cycles after the previous one, regardless of tests and jumps. This resulted, for instance, in some of the WAIT blocks being split into two. Some of the instructions within these blocks are not NOP, which takes 4 cycles, but are chosen for longer times or odd numbers of cycles. The original program was worked out with pencil and paper, although an assembler with printout could save laborious, large-scale re-writing of program material. Figures in the remarks column are timing cycles.

The choice of registers is important. In NOTE, speed is essential. Examination of the timing for the instructions using the Z80 index registers IX and IY shows that use of these for sample pointers would be very slow. For instance, a simple accumulator load from an address specified by IX or IY takes 19 cycles, whereas if we use BC, DE, or HL for a similar load it takes only 7. Even when we use the alternative set of registers BC^1, DE^1 and HL^1 and have to use instruction EXX to bring them into operation, there is considerable time saving.

The main registers are therefore used as address calculators and pointers. The skip is loaded into DE, and added to HL which now holds the low order plus fraction bytes of the sample address. The integer is taken from H and loaded into C, while B is left permanently with the page number 0E.

BC^1 is used to test whether the sustained portion of the note should end, being decremented after each sample. HL^1 is treated as two separate registers H^1 and L^1 for counting the attack and decay cycles respectively. To point to the current volume address, we use DE^1.

The large number of registers available is a very great advantage of the Z80. I have used them all in this program.

Running the program

To initiate performance, we execute from the beginning of PLAY by typing EF79. PLAY tests for start and repeat and calls LINE. LINE prints the words on the VDU and calls NOTE, which then produces the sound.

During a run, the monitor stack corrupts all data from 0FEA to 0FFF. Since the duration data table ends at 0FE8, there is one spare byte at 0FE9.

```
                    SUBROUTINE "LINE"

0000'                0001          ORG 0D9FH
      (0F00)         0002 NOTE     EQU 0F00H
      (0286)         0003 PARSE    EQU 0286H
0D9F  260F           0004          LD H,0FH        ;SKIP/DURATION TABLE PAGE NO.
0DA1  3E00           0005          LD A,00         ;IF NO LETTERS, JUMP
0DA3  B8             0006          CP B
0DA4  2813           0007          JR Z,FREQ
0DA6  DD23           0008          INC IX          ;VDU ADDRESS INTO DE
0DA8  DD5600         0009          LD D,(IX+0)
0DAB  DD23           0010          INC IX
0DAD  DD5E00         0011          LD E,(IX+0)
0DB0  DD23           0012 NXTLET   INC IX          ;WRITE LETTER ON SCREEN
0DB2  DD7E00         0013          LD A,(IX+0)
0DB5  12             0014          LD (DE),A
0DB6  13             0015          INC DE          ;NEXT LETTER ADDRESS
0DB7  10F7           0016          DJNZ NXTLET     ;DO REMAINING LETTERS
0DB9  DD23           0017 FREQ     INC IX
0DBB  DD6E00         0018          LD L,(IX+0)     ;"SKIP" CODE
0DBE  56             0019          LD D,(HL)       ;          MSB
0DBF  23             0020          INC HL
0DC0  5E             0021          LD E,(HL)       ;          LSB
0DC1  DD23           0022          INC IX          ;"DURATION" CODE
0DC3  DD6E00         0023          LD L,(IX+0)     ;          MSB
0DC6  46             0024          LD B,(HL)
0DC7  23             0025          INC HL
0DC8  4E             0026          LD C,(HL)       ;          LSB
0DC9  C5             0027          PUSH BC
0DCA  D9             0028          EXX
0DCB  C1             0029          POP BC          ;    FROM BC TO BC'
0DCC  D9             0030          EXX
0DCD  7B             0031          LD A,E          ;IS DE ZERO?
0DCE  B2             0032          OR D
0DCF  2804           0033          JR Z,PAUSE      ;IF SO, THIS IS A PAUSE
0DD1  CD000F         0034          CALL NOTE
0DD4  C9             0035          RET
0DD5  D9             0036 PAUSE    EXX             ;GET DURATION FROM BC'
0DD6  78             0037          LD A,B          ;TEST FOR END CODE 0000
0DD7  B1             0038          OR C
0DD8  CA8602         0039          JP Z,PARSE      ;IF SO, GO TO MONITOR
0DDB  60             0040          LD H,B          ;TIMING LOOPS
0DDC  69             0041          LD L,C
0DDD  11FFFF         0042          LD DE,-1
0DE0  0604           0043 PSLP1    LD B,04         ;7
0DE2  05             0044 PSLP2    DEC B           ;4
0DE3  20FD           0045          JR NZ,PSLP2     ;12  7
0DE5  19             0046          ADD HL,DE       ;   11
0DE6  DBFF           0047          IN A,0FFH       ;   11 (NO OP.)
0DE8  38F6           0048          JR C,PSLP1      ;   12  7
0DEA  C9             0049          RET
```

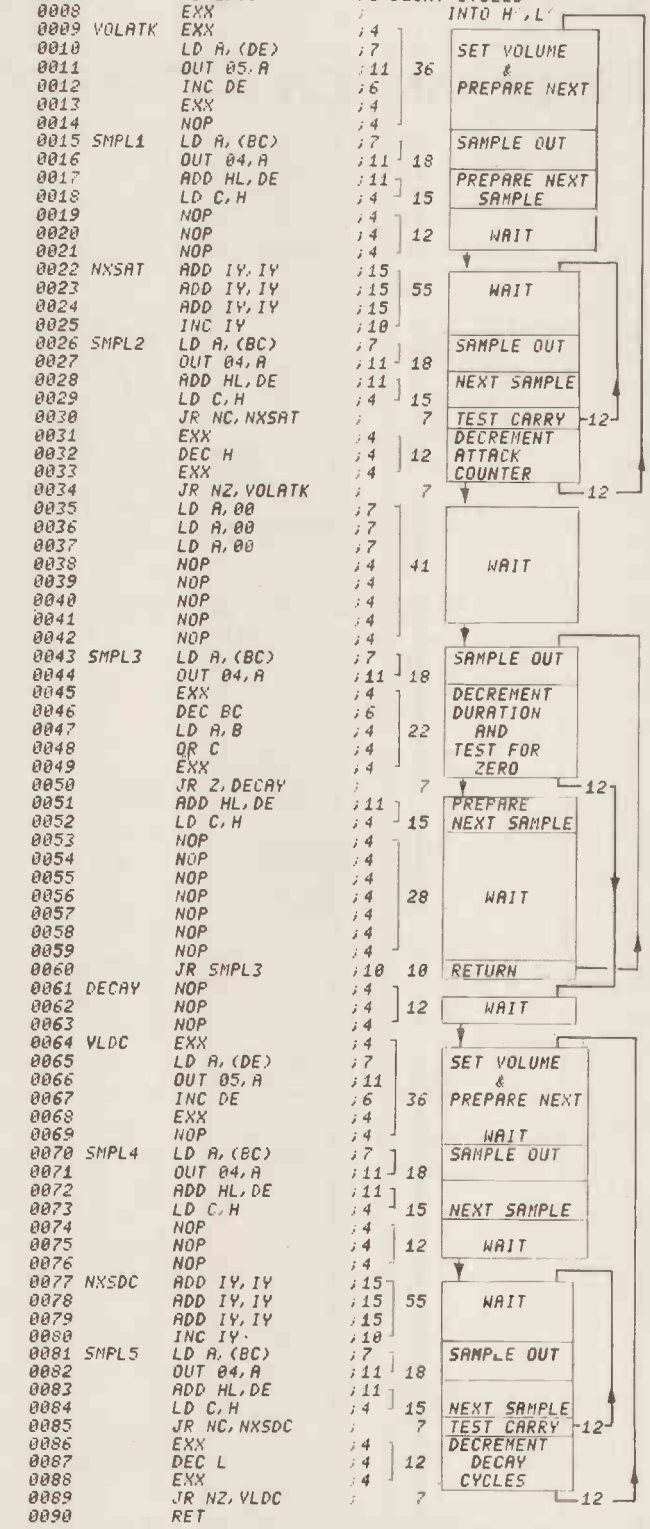
Program 3: Letters are printed on the VDU and the data for note generation is fetched by this subroutine.

SINEWAVE DATA TABLE

```
0E00 02 05 08 0B 0E 11 14 17 1A 1D 20 23 26 29 2C 2F
0E10 32 35 38 3A 3D 40 43 45 48 4A 4D 4F 52 54 56 59
0E20 5B 5D 5F 61 63 65 67 69 6A 6C 6E 6F 71 72 73 75
0E30 76 77 78 79 7A 7B 7C 7C 7D 7D 7E 7E 7F 7F 7F 7F
0E40 7F 7F 7F 7F 7E 7E 7D 7D 7C 7C 7B 7A 79 78 77 76
0E50 75 73 72 71 6F 6E 6C 6A 69 67 65 63 61 5F 5D 5B
0E60 59 56 54 52 4F 4D 4A 48 45 43 40 3D 3A 38 35 32
0E70 2F 2C 29 26 23 20 1D 1A 17 14 11 0E 0B 08 05 02
0E80 FE FB F8 F5 F2 EF EC E9 E6 E3 E0 DD DA D7 D4 D1
0E90 CE CB C8 C6 C3 C0 BD BB B8 B6 B3 B1 AE AC AA A7
0EA0 A5 A3 A1 9F 9D 9B 99 97 96 94 92 91 8F 8E 8D 8B
0EB0 8A 89 88 87 86 85 84 84 83 83 82 82 81 81 81 81
0EC0 81 81 81 81 82 82 83 83 84 84 85 86 87 88 89 8A
0ED0 8B 8D 8E 8F 91 92 94 96 97 99 9B 9D 9F A1 A3 A5
0EE0 A7 AA AC AE B1 B3 B6 B8 BB BD C0 C3 C6 C8 CB CE
0EF0 D1 D4 D7 DA DD E0 E3 E6 E9 EC EF F2 F5 F8 FB FE
```

Table 3: 2's complement values for a sinewave of maximum possible amplitude in a 256-byte table. Other waveform tables may be calculated using this as a starting point.

```
0000'                   0001          ORG 0F00H
0F00  210000            0002 NOTE     LD HL,0000H     ;ADDRESS CALCULATOR
0F03  01000E            0003          LD BC,0E00H     ;ADDRESS POINTER
0F06  D9                0004          EXX
0F07  11EB0D            0005          LD DE,0DEBH     ;VOLUME POINTER DE'
0F0A  2608              0006          LD H,08         ;8 ATTACK CYCLES
0F0C  2E08              0007          LD L,08         ;8 DECAY CYCLES
0F0E  D9                0008          EXX             ;   INTO H',L'
0F0F  D9                0009 VOLATK   EXX             ;4
0F10  1A                0010          LD A,(DE)       ;7
0F11  D305              0011          OUT 05,A        ;11   36
0F13  13                0012          INC DE          ;6
0F14  D9                0013          EXX             ;4
0F15  00                0014          NOP             ;4
0F16  0A                0015 SMPL1    LD A,(BC)       ;7
0F17  D304              0016          OUT 04,A        ;11   18
0F19  19                0017          ADD HL,DE       ;11
0F1A  4C                0018          LD C,H          ;4    15
0F1B  00                0019          NOP             ;4
0F1C  00                0020          NOP             ;4    12
0F1D  00                0021          NOP             ;4
0F1E  FD29              0022 NXSAT    ADD IY,IY       ;15
0F20  FD29              0023          ADD IY,IY       ;15   55
0F22  FD29              0024          ADD IY,IY       ;15
0F24  FD23              0025          INC IY          ;10
0F26  0A                0026 SMPL2    LD A,(BC)       ;7
0F27  D304              0027          OUT 04,A        ;11   18
0F29  19                0028          ADD HL,DE       ;11
0F2A  4C                0029          LD C,H          ;4    15
0F2B  30F1              0030          JR NC,NXSAT     ;     7
0F2D  D9                0031          EXX             ;4
0F2E  25                0032          DEC H           ;4    12
0F2F  D9                0033          EXX             ;4
0F30  20DD              0034          JR NZ,VOLATK    ;     7
0F32  3E00              0035          LD A,00         ;7
0F34  3E00              0036          LD A,00         ;7
0F36  3E00              0037          LD A,00         ;7
0F38  00                0038          NOP             ;4    41
0F39  00                0039          NOP             ;4
0F3A  00                0040          NOP             ;4
0F3B  00                0041          NOP             ;4
0F3C  00                0042          NOP             ;4
0F3D  0A                0043 SMPL3    LD A,(BC)       ;7
0F3E  D304              0044          OUT 04,A        ;11   18
0F40  D9                0045          EXX             ;4
0F41  0B                0046          DEC BC          ;6
0F42  78                0047          LD A,B          ;4    22
0F43  B1                0048          OR C            ;4
0F44  D9                0049          EXX             ;4
0F45  280B              0050          JR Z,DECAY      ;     7
0F47  19                0051          ADD HL,DE       ;11
0F48  4C                0052          LD C,H          ;4    15
0F49  00                0053          NOP             ;4
0F4A  00                0054          NOP             ;4
0F4B  00                0055          NOP             ;4
0F4C  00                0056          NOP             ;4    28
0F4D  00                0057          NOP             ;4
0F4E  00                0058          NOP             ;4
0F4F  00                0059          NOP             ;4
0F50  18EB              0060          JR SMPL3        ;10   10
0F52  00                0061 DECAY    NOP             ;4
0F53  00                0062          NOP             ;4    12
0F54  00                0063          NOP             ;4
0F55  D9                0064 VLDC     EXX             ;4
0F56  1A                0065          LD A,(DE)       ;7
0F57  D305              0066          OUT 05,A        ;11
0F59  13                0067          INC DE          ;6    36
0F5A  D9                0068          EXX             ;4
0F5B  00                0069          NOP             ;4
0F5C  0A                0070 SMPL4    LD A,(BC)       ;7
0F5D  D304              0071          OUT 04,A        ;11   18
0F5F  19                0072          ADD HL,DE       ;11
0F60  4C                0073          LD C,H          ;4    15
0F61  00                0074          NOP             ;4
0F62  00                0075          NOP             ;4    12
0F63  00                0076          NOP             ;4
0F64  FD29              0077 NXSDC    ADD IY,IY       ;15
0F66  FD29              0078          ADD IY,IY       ;15   55
0F68  FD29              0079          ADD IY,IY       ;15
0F6A  FD23              0080          INC IY          ;10
0F6C  0A                0081 SMPL5    LD A,(BC)       ;7
0F6D  D304              0082          OUT 04,A        ;11   18
0F6F  19                0083          ADD HL,DE       ;11
0F70  4C                0084          LD C,H          ;4    15
0F71  30F1              0085          JR NC,NXSDC     ;     7
0F73  D9                0086          EXX             ;4
0F74  2D                0087          DEC L           ;4    12
0F75  D9                0088          EXX             ;4
0F76  20DD              0089          JR NZ,VLDC      ;     7
0F78  C9                0090          RET
```



Program 4: Each sample occurs exactly 100 cycles after the previous one, giving a 20-kHz sampling rate with the 2-MHz clock. The remarks column is modified to act as a flow diagram, with timing information. During attack and decay, the volume is altered after each cycle of the waveform.

The only other unused memory bytes in this whole program are at 0DFB, 0DFC and 0DFD, and even these three could be used to extend the attack and/or decay cycles slightly.

Improvements and developments

A slight defect of the program is that notes at different frequencies do not have the same total durations when their duration codes are equal. This is because the duration excludes the attack and decay periods, which vary in length of time. It is not noticeable in 'Gaudeamus', but tests over a 5-octave scale reveal a marked slowing down of the lower notes. It would not be difficult, in principle, to make the microprocessor subtract a compensating number from the duration count.

Continuously changing volume level could be useful, as in tremolo or percussive sounds. It should be possible to modify the 'sustain' part of NOTE to do this.

Polyphony is more difficult. Four-part harmony has been achieved in a Kim-1 system[3] but without attack and decay control and at a sampling rate of under 9 kHz. The solution must lie in duplication of hardware, leading to a synthesiser with digital modules. These do exist, but are very expensive.

Other useful facilities would be playing from a musical keyboard, and synthesiser operations such as frequency modulation, ring modulation and filtering. All are possible, and can lead to fascinating work with hardware and software, and a new generation of musical instruments. There is no doubt that the field of music offers tremendous scope for anyone interested in microprocessor systems.

References

1. Motorola Semiconductor Library, Volume 6 Series A: "Linear integrated circuits' — data on MC1408 series.

2. Ralph Deutsch: 'Digital organ' (U.S. Patent No. 3,515,792).

3. Hal Chamberlin: 'A sampling of techniques for computer performance of music' (Byte, September 1977, Vol. 2 No. 9, pp. 62-83).

Acknowledgements *are due to the Centre for Arts of The City University for financing the equipment, and to the Department of Electrical and Electronic Engineering for the use of a Cromemco system and Trend printer in producing the printouts for this article.*

Appendix: 2's complement numbers and the DAC

The following table shows the form of 2's complement, 8-bit numbers.

Decimal number	Binary digits A7	A6	A5	A4	A3	A2	A1	A0
+127	0	1	1	1	1	1	1	1
+126	0	1	1	1	1	1	1	0
.								
.								
+ 3	0	0	0	0	0	0	1	1
+ 2	0	0	0	0	0	0	1	0
+ 1	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0
- 1	1	1	1	1	1	1	1	1
- 2	1	1	1	1	1	1	1	0
- 3	1	1	1	1	1	1	0	1
.								
.								
-127	1	0	0	0	0	0	0	1
-128	1	0	0	0	0	0	0	0

If a number is negative, the high level in the MSB, A7, shows that we must subtract 128 from the value that we would have with a low MSB. But a DAC cannot subtract a quantity unless there is provision for reversing the polarity of the reference voltage for one or more bits. We can get a similar effect, however, if we add 128 to the positive numbers instead, which is done by inverting the MSB; and then subtract 128 from the analogue signal externally, which is done by the trimmer resistance connection to pin 3 of the 741. Normally, the 128 would correspond to a fixed reference, but here it is the 'volume' signal.

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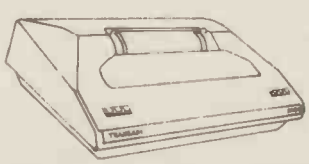

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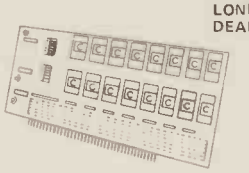

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DISASSEMBLER	TRACE
SYMBOL TABLE	PROGRAMME LOAD
CREATE	MONITOR

SEE CATALOGUE FOR FURTHER DETAILS

COMPONENTS 74LSXX

SN74LS00N	18	SN74LS54N	21	SN74LS138N	75	SN74LS195AN	.85
SN74LS01N	18	SN74LS55N	21	SN74LS139N	75	SN74LS196N	1 20
SN74LS02N	20	SN74LS63N	50	SN74LS145N	1 20	SN74LS197N	1.20
SN74LS03N	18	SN74LS73N	35	SN74LS148N	1 75	SN74LS221N	1 25
SN74LS04N	.20	SN74LS74N	40	SN74LS151N	85	SN74LS240N	2 20
SN74LS05N	26	SN74LS75N	46	SN74LS153N	60	SN74LS241N	1 90
SN74LS08N	20	SN74LS76N	35	SN74LS154N	1 60	SN74LS242N	1 90
SN74LS09N	22	SN74LS78N	35	SN74LS155N	1 25	SN74LS243N	1 95
SN74LS10N	18	SN74LS83AN	1 15	SN74LS156N	1 25	SN74LS244N	2 10
SN74LS11N	26	SN74LS85N	1 10	SN74LS157N	60	SN74LS245N	3 60
SN74LS12N	25	SN74LS86N	40	SN74LS158N	99	SN74LS247N	1 25
SN74LS13N	55	SN74LS90N	65	SN74LS160N	1 15	SN74LS248N	1 95
SN74LS14N	89	SN74LS91N	99	SN74LS161N	1 15	SN74LS249N	1 30
SN74LS15N	25	SN74LS92N	.90	SN74LS162N	1 15	SN74LS251N	1 45
SN74LS20N	20	SN74LS93BN	65	SN74LS163N	.90	SN74LS253N	1 25
SN74LS21N	26	SN74LS95AN	1.20	SN74LS164N	1 50	SN74LS257N	1.40
SN74LS22N	26	SN74LS96N	1 75	SN74LS165N	1 70	SN74LS258N	.95
SN74LS26N	29	SN74LS107N	.39	SN74LS166N	1 75	SN74LS259N	1 45
SN74LS27N	35	SN74LS109N	39	SN74LS168N	1.95	SN74LS260N	.39
SN74LS28N	35	SN74LS112N	39	SN74LS169N	1 95	SN74LS261N	3.50
SN74LS30N	25	SN74LS113N	44	SN74LS170N	2 50	SN74LS266N	.39
SN74LS32N	27	SN74LS114N	44	SN74LS173N	2 20	SN74LS273N	1.85
SN74LS33N	39	SN74LS122N	79	SN74LS174N	1 15	SN74LS279N	.79
SN74LS37N	29	SN74LS123N	90	SN74LS175N	1 05	SN74LS280N	1 75
SN74LS38N	29	SN74LS124N	1 50	SN74LS181N	2.75	SN74LS283N	1 80
SN74LS40N	25	SN74LS125N	65	SN74LS190N	1 75	SN74LS290N	1 80
SN74LS42N	79	SN74LS126N	65	SN74LS191N	1 75	SN74LS293N	1 80
SN74LS47N	95	SN74LS132N	75	SN74LS192N	1.45	SN74LS295AN	2 20
SN74LS48N	95	SN74LS133N	39	SN74LS193N	1 75	SN74LS298N	2 20
SN74LS49N	1 09	SN74LS136N	40	SN74LS194AN	1 69	SN74LS324N	1 80
SN74LS325N	2 55
SN74LS326N	2 55
SN74LS327N	2 55
SN74LS352N	1.35
SN74LS353N	1.50
SN74LS365N	65
SN74LS366N	65
SN74LS367N	65
SN74LS368N	65
SN74LS373N	1 75
SN74LS374N	1 70
SN74LS375N	72
SN74LS377N	1 75
SN74LS378N	1 32
SN74LS379N	1 40
SN74LS381N	3 65
SN74LS386N	.57
SN74LS390N	1 96
SN74LS393N	1 50
SN74LS395N	1 80
SN74LS396N	1 70
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8216	2 20	2102L-4	1 20	74S472	12 00	LM748CH	0 46	7924K	1 80	CMOS	
8224	2 80	2111	2 32	74S70	8 00	LM1458N	0 72	OIL SKTS		CD4011	0.25
8226	2 20	2112	2 46	74S473	12 46	LM1458N 8	0 48	8DIL	0 14	CD4040	0 79
8228	4 20	6810	4 08	74S474	12 48	LM1488D	0 85	14DIL	0 15	+ full range	
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8245	11 00	2114	5 50	2513	7 50	LM1489AD	1 25	18DIL	0 24	2513	7 50
8246	11 00	2102L-3	1 60	96364	10 95	LM1495N-14	0 99	20DIL	0 27	TMS6011	5 00
8251	5 00	74C920	11 00	14412	12 90	LM3302N	0 65	24DIL	0 30	MC14411	12 00
8253	11 00	74C921	11 00	LINEARS		LM3401N	0 65	28DIL	0 36	MC14412	12 90
8255	5 00	74C929	11 00	LM301AH	0 39	LM3403N	1 20	48DIL	0 50	96364	10 95
8257	11 00	4027	11 00	LM301AN 8		LM3900N	0 54	CRYSTALS		CPUs	
8259	12 50	4044	14 70	LM (MINI DIP)	0 30	TL061CP	0 69	100k	3.00	8080	6.33
8292	18 00	4045	9 15	LM308N	0 99	TL081CP	0 69	200K	3 70	6800	10.00
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M57109	12 43	Z80AP10	14.00	LM339N	0 54	7815	0 90	3MHZ	3 05	9900	30 00
M57160	10 00	Z80ACTC	14 00	LM555N	0.30	7824	0 90	4MHZ	2 10	W/WRAP SKTS	
M57161	10 00	EPROMS		LM556N	0 75	7805k	1 50	4 43M	1 00	8DIL	0 20
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81LS96	1 80	2708	9 00	LM723CN	0 43	7824K	1.50	7MHZ	2 70	18DIL	0 60
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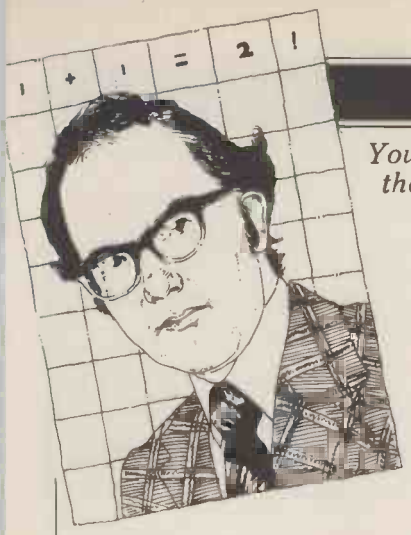


YOUNG COMPUTER WORLD

Young Computer World is the place where, each month, John Coll highlights the thoughts, ideas and contributions of PCW's younger readers.

Many thanks to all of you who have kept me so well supplied with programs and ideas. I'm delighted to see such a wide range of interest. Firstly to our youngest contributor this month. Quentin Harmer of Helston, Cornwall is aged 8 and he wrote this program for his father on his birthday. He had no adult help (so I am assured) and he also did the printout (see below).

Schools

I remember a couple of years ago being asked by my headmaster whether pupils of 13 could really master programming. It's good now to see the computer so readily accepted. But there's no question that there are problems involved in introducing computers into classwork. Teachers are understandably rather 'frightened' by the machines. One way that helps to reduce that fear is for pupils to *do* the actual program writing, with the teachers just explaining what needs doing and commenting on the program at each stage of its development. For example at my school we have a sixth form boy who is studying Economics, English and History, but he can also program. He is now writing a number of 'Packages' for those three departments. I imagine that several of you must have done the same sort of thing; write and tell me anything you have done.

Jobs

I have had 8 replies from school leavers looking for temporary jobs before going off to university and so far Pronto and Research Machines have agreed to take people on. I am hopeful that we will be able to place the others, too, before long. My thanks, by the way, to those companies for their support.

I'm still looking for small but useful project suggestions. One that we are doing here is to build a light pen bar code reader. You've probably seen bar codes on quite a number of things in shops recently — for example Coke and Batchelors Peas use them. These days it's quite easy to make a reader, using the Hewlett Packard HEDS 1000 unit which contains both the LED and the detector. A suitable circuit was published in Byte some time ago and the software is quite straightforward too. The only real problem is in getting the bar codes printed. Our school printing society took one look at the problem and decided they had better things to do! I suppose we will have to try an ordinary, commercial printer. Actually, the whole purpose of the exercise is to automate our Electronics Stores so that we can look up the prices of components very quickly. It sounds suitably impressive for parents and so on but really the whole thing is quite simple.

Words

I suppose I had better own up to the fact that I am actually typing this — an almost unforgivable sin in these days of word processors. I've got strict instructions to write 800 words this time and there is even a command WORDS on my 6800 which tells me how many words there are in a file. That must be quite simple to write, even in BASIC I would think. . . any offers? I must use it next time!

Voice synthesis

Stephen Schofield has written to me from Southampton University (must be too old really!) to ask for some help with his project on 'The microprocessor aided synthesis of speech'. Has anyone at school done any work on this? We haven't I'm afraid it sounds like too many hundreds of pounds for me. I suppose most of it could be done in software but there again, that would make it too slow on most computers.

Control

Determined to take control of the world, three sixth form pupils have told me about their 8 channel input output board. They've designed and built a printed circuit board with 8 opto coupled inputs and 8 relay outputs and a self contained power supply. The circuit can be driven from any computer with an I/O port but they want to sell it with some software and are currently writing material for the 380Z. At last you can turn on the kettle, open the door or wait for a light beam to be cut. When the Post Office permit people to connect equipment to the telephone lines it will even be possible to dial a call automatically — but the three haven't tried that yet. Would sixth formers do anything wrong? Of course not!

Data links

Talking of telephones reminds me that some friends of mine are starting to exchange programs over acoustic couplers. Nothing new in that of course, but they have been concerned to ensure that the data is sent free of errors. I wonder if any of you have tried any experiments along those lines (oh, sorry!).

Life

Finally I would like to congratulate David Caballero on a really well-written outline of Conway's Game of Life. I know that PCW have received versions of the game of life from other pople so I am not sure whether it will be printed. Thankyou anyway David for a very well produced document.

Birthday program

```
10 REM BIRTHDAY
20 PRINT"HAPPY BIRTHDAY DADDY
30 PRINT"
40 PRINT"      TOP SECRET MESSAGE
41 PRINT"PRESS R WHEN READY
43 GET A$
45 IFA$=""THEN 43
46 PRINT"3
50 PRINT"
60 PRINT"THERE IS A STOCKING HIDDEN  BEHIND
70 PRINT"YOUR CHAIR UP-STAIRS
80 PRINT"
90 PRINT"GO AND GET IT NOW!!!2
95 PRINT"
100 PRINT"            LOVE FROM
110 PRINT"             QUENTIN &
120 PRINT"               JENNY
125 PRINT"          &&
130 PRINT"          &&
140 PRINT"          &&
150 PRINT"          &&
160 PRINT"         &&&
170 PRINT"       &&&&
180 PRINT"       &&&&
185 PRINT"  THE STOCKING
190 END
200 PRINT"3"
220 FORA=1TO20000:NEXT
230 GOTO10
240 END
```

STOCK CONTROL

Compiled and Edited by Mike Knight of Mike Rose Micros

At the heart of almost any business is the stock of goods that it sells. It is essential for profitability that enough stock is held to meet the major demands, but overstocking of slow moving items can lead to substantial losses. Getting this delicate balance right is one of the secrets of most successful companies. Not surprisingly, we have chosen stock/inventory control as the first subject to be covered in our regular software feature.

Objectives

The objectives of an inventory/stock control system are to mantain and update an inventory of stock items used in the manufacture, supply or repair of goods offered to the public, business or industry.

One of the hardest things about stock control is how deceptively simple it is to state its objectives. Of course any stock control system must be able to add, remove or change information contained on any item but probably far more important is the system's ability to provide management information and to link with other business functions.

Functional requirements

The requirements of a stock control system may be summarised as follows;

1 Concerning the stock items themselves we must be able to create new items, delete redundant items and amend the detail of any existing items. In addition, all movements of stock both in and out must be catered for.

2 If our business depends on the transportation of goods to our customers then we would expect to find details of the location, weight and size of stock items and to use this information during the production of despatch notes, delivery plans etc.

3 Whether we manufacture our own or buy in items from outside we would probably expect to find information on the source of goods and to use this to create or initiate purchase or manufacturing orders.

4 If our business is concerned with taking orders for finished goods off the shelf then we would demand that our system contains details of orders taken. This information would then be used in the allocation of products to our customers.

5 If we do manufacture then we probably want details of the relationships between parts, sub-assemblies and assemblies. Even if we don't manufacture we may need to group our products for analysis purposes.

6 Probably the most important links are with accounting functions. We would almost certainly need prices, VAT and discount to be included in the information held. This we would expect to see used in stock valuation, invoice production etc.

7 Finally, we would expect to find enough detail to enable us to produce analytical management information reports so that if things do go wrong we know about them and can quickly put them right.

In the next two sections we shall see how six typical packages measure up to these functional requirements.

Tasks and volumes

	Petsoft Cassette	Petsoft Disc	Petact	Computer Workshop	Graffcom	Apple
TASKS						
Create new item	*	*	*	*	*	*
Delete old item	*	*	*	*	*	*
Amend existing item	*	*	*	*	*	*
Write-off missing item				*		
List all items	*	*	*	*	*	*
Stock check list			*		*	
Issue stock	*	*	*	*	*	*
Receive stock	*	*	*	*	*	*
Allocate stock		*	*		*	*
List allocated stock			*			
Stock valuation report			*	*	*	
Stock enquiry	*	*	*	*	*	*
Stock shortages list			*	*	*	*
Purchase invoice list			*			
Purchase orders						
Selected product group list					*	
Stock adjustments list			*			
Movement analysis report			*		*	*
Period end procedures			*		*	
Forward orders				*		
Stock orders				*		*
VOLUMES (N=numeric,A=alphabetic,X=alpha-numeric)						
Size of description		16X	16X	26X	20X	24X
Size of Quantity fields	5N	7N	6N	5N	6N	5N*
Size of price fields		7N	6N	7N	6N	6N
Size of product key	3N	3N	3N	9X	12X	9N
Size of group key			1A		5X	
Items per master file min.	150	200	300	700	450	800
Items per master file max.	255		7800		6200	
COSTS						
Package cost (£)	12	25	350		400	
Machine cost (£)	595	2000	2000		2600	
Total cost (£)	607	2025	2350	3400	3000	3000

**limit 32767*

Evaluations

PETSOFT CASSETTE STOCK CONTROL

This is available from Petsoft Microcomputer Software (021 454 5348) or any of their 180 dealers throughout the country. Cost is £12 and there are approximately 1000 users. The system works by holding limited details of stock items in store and is a stock recording rather than stock control system. The system will run on a basic 8K PET costing £595. Documentation is limited to operating instructions and only one program is used. Information held is limited to Item code: In stock quantity: On order quantity.

PETSOFT DISC STOCK CONTROL

This also comes from Petsoft and is effectively a disc version of the cassette

SYSTEMS

package mentioned above. Cost is £25 and there are approximately 100 users. The system allows more details of items (10 fields) to be held on disc but it's still basically a stock recording system. One additional feature, compared with the cassette version, is the ability to make stock enquiries. The cost of the necessary hardware is £2000. Documentation is once again limited to operating instructions. For both this version and the cassette version any error 'bugs' found would be corrected free of charge; no customisation is done by PETSOFT, but their dealers are usually in contact with software houses and could recommend customers accordingly.

PETACT BUSINESS SYSTEMS STOCK CONTROL
Once again this is available as stated above for the PETSOFT packages. Cost is £350 and as the system is only just becoming available there are but few users at present. The system runs on a 32K PET with an 80 column line printer and Computhink discs (cost £2000). The system uses a sectional master file with up to 26 sections, each of 300 items depending on disc capacity. It is considerably more comprehensive than the PETSOFT packages and systems and operating documentation is provided including details of the disc files. Once again 'bugs' are corrected free of charge but customisation is not offered by PETACT.

STOCKPACK STOCK CONTROL SYSTEM
This is available from COMPUTER WORKSHOP (01-491 7507) and has about 20 users. The minimum hardware required is a 40K SWTPC (6800) system, twin floppy disc drives, a CT-64 VDU and a Centronics 779 Printer. The cost of the minimum hardware together with the software *and* two days on-site installation support is £3,400. At present only operating documentation (including some systems information) is available but a system and user manual is in the course of preparation. Bugs are corrected free of charge if documentary evidence is provided. If hardware corrupton of the software disc occurs it is replaced at a nominal cost. The package is written in standard BASIC so users may, if required, customise it themselves.

GRAFFCOM STOCK CONTROL SYSTEM
This is available directly from GRAFFCOM (01-734 8862) but would normally be obtainable from their dealers (including RAIR and LIFEBOAT). It is written using CP/M and the cost is approximately £400, depending on which dealer is approached. The system runs on a 48K store together with a VDU, printer and two disc drives costing approximately £2,600. A well produced system write up is provided giving examples of all reports produced together with operating instructions for each of the modules. Maintenance is effected by using a 'Hot Line', to GRAFFCOM and patches are supplied over the phone. The system interfaces with GRAFFCOM's Order Entry and Invoicing system. One omission from the documentation is a detailed layout of the master file; however, most details can be obtained from the documentation which is provided. Customisation can be negotiated.

APPLE STOCK CONTROL SYSTEM
This is available from MICROSOLVE (01-951 0218) and runs on a 48K APPLE II, TV set, 2 Apple II floppy disc units and a printer. The total cost including customisation is £3000 and there are three users — all of whom have had customisation. It's supplied together with an invoicing system and the two are linked completely. The systems and operating documentation supplied is excellent, giving a very clear view of the package. However, no sample layouts of reports are included since it is in this area that customisation generally takes place. 'Bug' correction is provided free of charge for the first year of operation and thereafter at a mutually agreed price.

Feedback

If you are selling or using stock control, sales ledger, purchase ledger or word processing packages, then we'd like to hear from you. Suppliers! — we'll notify our readers, but be sure that they *are* packages and not systems designed for just one user. Users! — any observations or comments on the package you are using would be helpful. Write to: PCW Systems, 14 Rathbone Place, London W1P 1DE.
Next month we shall be looking at Sales Ledger packages.

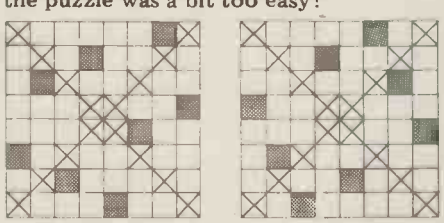
Suppliers
Other sources of stock control packages that we know about are:

Byte Shop	Challenger	01-518 1414
Compelec	Compelec Series	01-636 1392
Commodore	PET	01-388 5702
Bytronics	Megamicro	0252 726814
Data Efficiency	Microstar	0442 57137
Windrush Micro Designs	Smoke Signal Chieftain 1	0692 45189
Comma	Comma VO3	0277 811131
Dynabyte UK/Europe	Dynabyte DB8/1	0723 65559
Micropower	Zilog MCZ1/05	0256 54121
Memec	Zilog MCZ1/05	084421 5471
Millbank	Challenger C3	01-549 7262

LEISURE LINES

With J.J. Clessa

Thanks, everyone, for a very good response to Leisure Lines number 2 — over 100 entries — which just goes to show how many of our readers are bursting to receive a free copy of the Oxford Dictionary. On the other hand, maybe the puzzle was a bit too easy!



There were two possible solutions. We accepted either, although many people submitted both.

The two solutions are as shown here and the first correct entry drawn from the bag came from Mr. W.J. Hill of Manchester, together with a beautiful postcard picture of an Arabic plaster carving (I don't know what that had to do with the puzzle, but it was appreciated!).

Congratulations Mr. Hill . . . you will soon be as literate as what we is.

TIME FOR A QUICKIE
No prizes, no answers.
Only one of these five statements is correct — which is it?
1 Only one of these statements is false. 2 Only two of these statements are false. 3 Only three of these statements are false. 4 Only four of these statements are false. 5 All five of these statements are false.
Hm...I think I should move quickly on to this month's prize puzzle.

A certain number ends in the digit "a". When the "a" is taken from the end of the number and placed at the beginning, a new number is formed which is "a" times the original number.

What are the original numbers if:

1 "a" = 2	5 "a" = 6
2 "a" = 3	6 "a" = 7
3 "a" = 4	7 "a" = 8
4 "a" = 5	8 "a" = 9

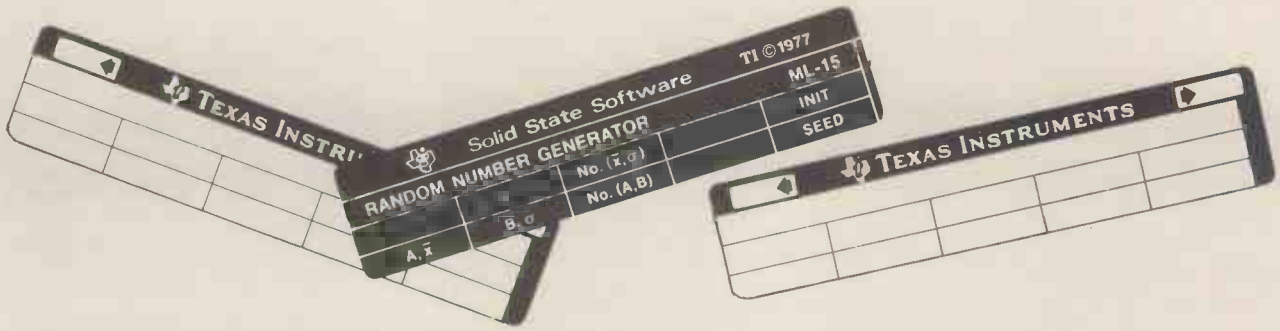
To illustrate, suppose we consider problem 1. If the number you are considering is 1312, then "a" = 2, and the new number formed by moving the digit "a" from the end to the beginning is 2131. Unfortunately, this result is not 2 times 1312, and hence 1312 is NOT the correct solution.

8 separate answers are required and, if necessary, the prize will be awarded to the entrant giving the most correct answers.

Answers please on a *postcard* to Puzzle No. 4, Personal Computer World, 14 Rathbone Place, London W1P 1DE. Christmas is catching up on our schedules . . .sorry, but that means all solutions must arrive by December 20th.

PRIZE FOR THIS MONTH
Courtesy of Buckingham Vintners International Ltd, Berks, the winner of this month's puzzle will receive a bottle of Bollinger extra quality, very dry, special cuvée champagne.

Dick Pountain examines and reports on the micro-associated world of programmable calculators



ANALYSING THE TI~59

Up until a couple of months ago, it could have been said without contradiction that the TI-59 was the most powerful hand held calculator in the world. Now that Hewlett Packard's HP41-C is upon us, the issue is no longer as clear and one could argue for weeks over which is the more powerful and, come to that, what 'powerful' means anyway.

Let's merely say that the TI-59 is a very powerful, hand held calculator which, with the optional printer (PC 100B), verges on a microcomputer system.

In hardware terms very little differentiates the TI-59 from some of the smaller microcomputers currently available. The 59 has almost 1K of user RAM on board which is more than some single board computers.

This RAM may be partitioned at will between program memory and data registers — from 960 program steps and no data registers, to 160 program steps and 100 data registers.

One difference from a micro is that the data registers have two digit addresses whereas program steps have three digit ones — program and data are rigidly segregated in memory.

In addition to this sizeable amount of user memory, the 59 accepts plug-in pre-programmed ROM modules, which go by the trade name of 'Solid State Software'. These contain 25 ready to run programs which may also be used as subroutines in a users program. The module supplied has an assortment of general purpose math statistics and financial programs, but other specialist modules can be purchased for applied statistics, navigation, electronic engineering and more.

Storage of user written programs is by magnetic cards, the reader for which is built into the body of the calculator; one up on the HP which has the card reader as an optional extra.

The cards are two-sided, each side storing one quarter of memory capacity; two cards are required to store the full contents of program and data memories. Card writing is easy and reliable which is just as well since the TI-59 does not have continuous memory and so work in progress *must* be card written before you switch off the calculator. Since the rechargeable batteries only last about 2 hours it also makes it advisable to carry the mains adaptor at all times!

To complete the system, hard copy output is obtained via the PC 100B print cradle. The calculator plugs onto the cradle with the battery pack removed; the batteries slot into a recess in the cradle and are recharged while the calculator is being used with the printer. The calculator actually locks to the cradle with a removable key, for security. The printer is a 20 column, thermal type; it's almost silent in operation and runs from the mains supply.

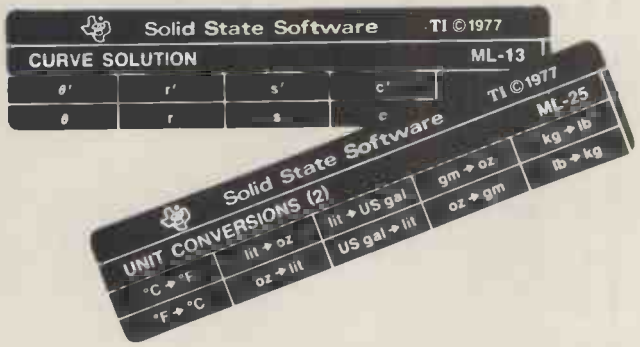
Alpha characters are available on the printer, but since they are not provided on the calculator keyboard, they can only be entered as numeric codes, which becomes very tedious. To print one line of alpha characters requires over 60 keystrokes so you will not be tempted to transcribe the Old Testament in this fashion. In fact, this alpha facility is only intended for occasional prompts and titles — not for extensive text.

What of the programmed operation system itself? the 'language' is similar to that of the cheaper TI-57, differing only in being more extensive. In particular it features 10 user defined keys which are for use as labels in programs, 10 user settable flags and a test to cause branching if flag set, and a series of 40 'Special Operations' which are defined by an OP key plus a 2 digit code. These operations include printer formatting, alpha character generation, partitioning memory area, error testing, linear regression and correlation analysis, and listing of all labels in current use.

Printer controls are provided on the keyboard for use in programs; they are PRINT, ADVANCE and LIST. The latter lists the program with step numbers and mnemonic codes for the instructions which are far more comprehensible than the numeric codes used in the display.

For editing and debugging

CALCULATOR CORNER



I found it preferable to LIST first and work with the listing. Debugging is provided for by a single step function in the Run mode which displays intermediate results at each step. Using the printer, the even more useful TRACE mode is available which prints instruction and intermediate result alongside one another as it steps through the program.

Indirect addressing is permitted on all memory functions and on conditional and unconditional jumps, flag set and test and subroutine calls. Full memory arithmetic including multiply and divide is provided.

Three modes of jump destination labelling are possible; absolute address (which gives fastest execution), user defined key, and 'common labels'. The latter are merely the maths function keys which may double as labels in a program, so that instructions such as LBL SIN or GTO x^2 are valid. This gives you over 70 available labels.

In effect, the TI-59 has all the capabilities and complexity of a microcomputer and to extract its full potential will require a lengthy familiarisation period. Anyone already versed in assembly language programming will be immediately at home here.

It is a professional's instrument, intended for use in the research laboratory or design office and very little concession is made to ease of use by the layman, for whom in any case much of its power will not be fully exploitable.

I found the TI-59 inconvenient and frustrating to use in several ways.

Firstly the display (LED — small, red and traditional) is very fatiguing on the eyes, and also very limited in the information conveyed (10 digits or 8 digits plus 2 digit exponent; no useful indicators such as angular mode, etc).

Secondly the editing functions don't operate in an obvious way. The step you have just entered is not displayed. A correction overwritten is not displayed. A new step inserted is not displayed. In each case a backstep is necessary to inspect the new entry. Furthermore, many instructions are not fully merged and may occupy two or more steps — which causes much anguish if they have to be edited. In short, I found editing programs to be tiresome and error prone, and this after 2 months practice. Perhaps, given a year, it may become natural.

Thirdly execution is very slow. At first I thought this was merely my imagination, but an experiment showed otherwise. Five 'benchmark' tests were written, covering a wide selection of functions. These tests were run on the TI-59 and a Casio FX502P (reviewed in a previous issue). In all cases the Casio was at least 30% faster and in the worst case, the TI took *five times* as long to run a test.

Fourthly there are some snags and idiosyncrasies in the operation of subroutine calling, which the excellent and comprehensive instruction manual identifies, but which nevertheless will trip up the beginner and expert alike; for instance any program which requires interruption of processing while control is in a subroutine is particularly tricky.

Of course, from my rather dilettante position as a reviewer, it's easy to make this sort of criticism. The people for whom this machine is designed will learn to live with such things in return for the immense calculating power on offer; power which is only otherwise available in the HP41-C (which is itself no walkover to master) or in a full scale micro system — which will probably need to be a rather expensive one to match the purely mathematical abilities of a TI-59.

Upgrade your PET...

. . . with the ACT PETSOFT PROFESSIONAL DISK SYSTEM

A complete stand-alone system for the Commodore PET allowing up to 800,000 bytes of mass storage online. Designed by Compu/Think for business use, this powerful double density system offers complete random or sequential file access and support.

The Disk Operating System is in a ROM which plugs directly into 16K and 32K (new ROM) PETs, or via an Expandamem memory expansion board for 8K PETs. The Disk Operating System adds 16 extra easy-to-use commands to PETs BASIC. The Disk unit comes with a complete set of utility programs and a comprehensive manual.

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- More memory power for your money
- Reliable and easy to use
- Languages supported include BASIC, 6502 Assembler, FORTH, FIFTH, PLM, PILOT, CESIL and soon FORTRAN and PASCAL
- Wide range of PETSOFT programs including Payroll **£50** + Stock Control **£25**
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		MRP
800K	Dual headed double density dual disk for 16K and 32K (new ROM) PETs	**£1,095**
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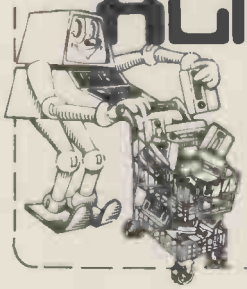
24K	Expandamem internal expansion memory board	**£320**

Prices exclude VAT.
PET is the trademark of Commodore who recommend PETACT Business Systems.

Try the ACT PETSOFT Professional Disk System and software at your PET dealer or write to us for full details and the name of your nearest stockist.

ACT Petsoft

Radclyffe House, 66-68 Hagley Road, Edgbaston, Birmingham B16 8PF. Telephone: 021-455 8686 Telex: 339396



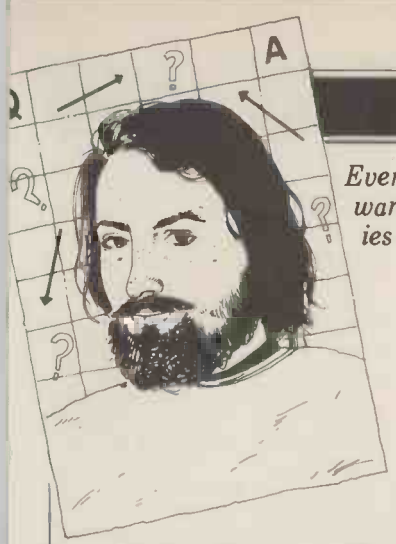
Please send me details of the PETSOFT PROFESSIONAL DISK SYSTEM

My name is .....

I live at .....

..... Postcode .....

I have a new/old ROM PET



COMPUTER ANSWERS

Every month in PCW, Sheridan Williams assists readers with their hardware, software and systems difficulties. Some questions he deals with himself, other enquiries are directed towards members of his consultancy panel.

After BASIC?

Although I program in BASIC fairly well, I would like to consider another language that is more powerful than BASIC. Can you suggest any that are worthwhile trying, and would I find them difficult.

As you have written to PCW I will assume that you only want languages that are available on microcomputers. This does restrict you considerably, but it may not be a bad thing because only the most common languages have been implemented on micros so far. The main problem with implementing languages other than interpreted BASIC on micros is that as the majority are *compiled* they require a disc system to give of their best. They also require more than 16K in order to support the compiler and operating system. I have assumed that you are only interested in high-level languages not assembly languages.

FORTRAN — is the most widely used language in the scientific field. There are a great many programs already written in FORTRAN and hence this library should be available to you, saving you a great deal of programming time. FORTRAN has well defined input/output routines, and is universally defined, enabling programs to be as portable as possible. FORTRAN is, however, not a structured language, and this in many people's eyes it its main failing. FORTRAN has many niggling limitations that make programming tedious — for example DO loops (The FOR loop equivalent) will only work for integers greater than zero.

ALGOL — is the other main scientific language with a first class structured approach; algorithms are written using ALGOL-like statements, making translating into ALGOL particularly easy. Library routines are readily available, and techniques such as 'recursion' are possible. ALGOL's main failing is the lack of defined input/output routines. Both ALGOL and FORTRAN have very limited string handling routines.

COBOL — is a business language which needs a fairly large amount of storage. Programming in COBOL takes some time to master, but as this language is the world's most popular the rewards for learning it are worthwhile. COBOL is an English-like language using words rather than symbols — example: HTCMS=2.54 * HTINS would be MULTIPLY HTINS BY 2.54 GIVING HTCMS. Note that COBOL is not particularly appropriate to scientific applications.

PASCAL — is a recent attempt to marry all the advantages of other languages and remove all their restrictions. It is structured like ALGOL. As long as PASCAL is defined to a universal standard then it is probably one of the best languages to learn. It promises to be available on most micros eventually. Read the articles in previous PCWs for more detail on PASCAL.

FORTH — is available on several systems (sometimes in a version called FIFTH). FORTH is a 'threaded' language ideally suited to microcomputers as it only requires around 5-6K for the interactive FORTH compiler. FORTH requires no extra area for symbol tables, overlays or any other software. FORTH is very fast, certainly faster than any of the above languages, and allows assembler inserts if it is still not fast enough for your application. FORTH is ideal for compiler writing as well as 'ordinary' programs. All routines in FORTH operate using a stack and every time a new 'primitive' (key word) is defined it can be incorporated permanently in the language.

Sheridan Williams

Operating systems

I have heard the name CP/M used a lot in connection with operating systems. What is an operating system, perhaps you could enlighten me as to its purpose.

As long as a computer comprises the CPU and VDU only, there is very little point in having an operating system. Once the computer becomes the centre of a computer system i.e. surrounded by peripherals such as magnetic tape, magnetic disc, printer, and maybe even paper tape and punched card input/output, it then becomes increasingly useful to have an operating system.

An operating system is a group of programs designed to increase the productivity of a computer system. Some of the programs may decrease the amount of idle time, especially on a multi-user system and others reduce the amount of programming that needs to be done by a computer user. Strictly speaking there is an 'Executive' program that resides in store calling other parts of the operating system as and when necessary, from disc.

As you have asked specifically about CP/M I will use this as an example. CP/M will reside on disc and parts of it may be called in when required. There will be a number of system commands and here are a few of them: ERA will erase specified files, DIR lists filenames present on the directory, REN renames specified files, TYPE will type the contents of the specified file on screen or printer. There are also what are called 'transient' commands. These can be extended by the user but several are supplied with the CP/M package, these include: STAT which lists statistical data about free space on disc, PIP which allows transfer operations between peripherals, DUMP will dump the contents of a file in hexadecimal etc.

CP/M will use a couple of tracks on the disc, but you would expect it to, as it *is* a program.

Sheridan Williams

Programming worries

I have recently started a part time business writing programs for microprocessors (M6800 etc). There seems to be a lot of activity in the 16-bit microprocessor field. I am wondering how long you think it will be before these machines are on the market? I am also worried that the programs I am writing will need to be re-written to run on these machines.

Congratulations on having the initiative to set up your own business, I am sure a large quantity of software for the microprocessors will be written by people like yourself. As you say, there are a number of 16-bit chips coming onto the market; these are very powerful devices but still very much in the development stages. I expect it will be two years or so before we see these chips appearing in Pet-like machines, and available over the counter. The Z8000 (Zilogs 16-bit) is currently available in the States, and the M68000 (Motorola) is due to be released in Nov/Dec of this year. However, these are evaluation kits only, not complete working systems which have been tested and neatly packaged.

On your second point, of software portability, you hardly provide me with enough information on your application areas to give a comprehensive answer. First, if most of your programs are of the editor/word processor type you may not get any advantage in changing up to larger machines, or making your software available on them. It will only cost the end-user more to get the same facilities. However, if your programs are "number crunchers" these new devices will undoubtedly save you time and effort. The simplest way of making your programs portable is to write them in a high level language (BASIC, Pascal??). If for some reason you cannot do this, and you must write in machine code, the area where most incompatibilities arise is in input/output sections, and whatever solution you choose, packaging your I/O system into well documented stand-alone routines will save you a lot of trouble. Intel have recently shown another method of achieving a "pseudo compatability" — write a cross-assembler, which reads in source code for machine A (8-bit) and outputs code for machine B which (although not very efficient) will produce the same result. This cheap method is worth considering.

Jon R. Malone

Pet protection

I have had a lot of trouble with the cassette tapes on my PET 'losing' data. I use the tapes to hold lists of names and addresses, and I have to keep re-typing them. This

is very time consuming, can you suggest a (cheap) cure?

The first obvious suggestion I can make is — have you read the PET manual; this gives a number of rules for using the tapes which help minimise the problems you are getting. As tape dropout occurs with many people I will summarise them here.

1 Use only C30 cassettes, the mylar tape backing is thicker, and runs past the heads better
2 Clean the heads frequently by, for example, using a conventional cassette cleaner; the recommended frequency is every five hours of use.
3 Don't leave cassettes in the halted position with the play button down for long periods of time. This causes the rubber drive capstan to become temporarily dented, thus leading to frequent errors.
4 Where possible use the verify command to check the tape is OK when initially written.

As two further suggestions of my own, don't try to cram too much data onto the one cassette — split your data over a number of tapes. Although it may take time to load and unload during a program run, it's much better than having to re-type all your data. Don't store your cassettes near a magnetic source (VDUs, televisions etc) as the magnetic flux can erase the information on the tapes. An advantage of using multiple tapes is that, should a tape dropout occur, then only one of your tapes need be re-written.

The real solution to your problem (unfortunately it's not cheap) would be to buy a second cassette recorder for your PET and "backup" (keep double or triple copies of your data). It is very unlikely that two tapes containing data would both go wrong at the same time.

Jon R. Malone

Bank-selectable

I've seen reference to bank-selectable memory boards — what is 'bank-selectable'?

'Bank-selectable' memory boards are usually found on S-100 systems (though that is not a pre-requisite). Most 8-bit micros have a limited addressing capability of 64K bytes. Bank-selecting allows you to extend that limit — usually by a factor of 8. This system is particularly suited to Z80 or 8080 based systems that generate special I/O control signals. Each bank selectable memory board has an associated port and a selection switch for Banks 0-7. If the board is to respond to Banks 1 & 2, for example, then switch positions 1 & 2 would be closed. When the appropriate data word is outputted to the necessary port, the data is latched into the port and used to decode the switch settings — thus enabling that board for a selected bank. Outputting a different data word to the port can effectively enable and disable bank selectable boards all under software control.

Mike Dennis

Vague on vectors

I'm feeling confused. Could someone please tell me, what are I/O vectors?

I/O or input/output vectors are generally related to a method of 'patching' programs into a system. Most programs make frequent access to I/O devices and these are usually done using separate I/O driver sub-routines. Therefore, if I have to change (relocate) the address of my I/O routines due to re-arrangement of a program, for example, then I will also have to go through the entire program altering the 'called' addresses whenever a call to I/O is made — very time consuming without an assembler. Also, due to hardware differences, my driver routines may be different from yours so transportability is a problem. The solution is to pass all I/O calls via I/O vectors. These can be conveniently located at the start of the program thus:—

```
0000          C3 09 00
   Jump to start
0003 Charin   C3 XX XX
   Jump to input sub-routine
          (Z-80 code)
0006 Charout  C3 XX XX
   Jump to output sub-routine
0009 Start    XX XX First
   instruction of program
```

It will return to the correct point in the program automatically. Should I have to alter the address of my I/O sub-routines then I only need to change the address at 0003 and 0006. Similarly, if you want to patch the program to suit your own hardware environment then all you need do is insert the relevant address of your I/O drivers, in aforesaid, 0003 and 0006. Simple!

Mike Dennis

All Systems Are Not Created Equal

Your computer application is unique. It differs from all others. It is because not all applications are equal that MSI has developed a variety of computer systems.

At the heart of every MSI System is the powerful MSI 6800 Computer, one of the fastest and most versatile available. Depending on the System you select, the MSI 6800 has from 16K to 56K of RAM. Mass memory storage in MSI Systems range from 315K bytes in the System 1 to over 10 megabytes in our most powerful System 12.

In addition to the computer and memory subsystem, MSI Systems include a CRT terminal and high speed character printer. The System 12 is housed in a compact desk unit.

As with hardware, computer software is not always created equal. Since there are a myriad of programs available, MSI offers a choice of Operating Systems for use with your MSI Computer System. Of course, our favourite is MSIDOS, but we offer the powerful SDOS operating system as well. All MSI Systems will support the other software products associated with each operating system.

MSI also has a variety of software programs including a Multi-User Basic program capable of supporting up to four users.

MSI Systems are currently being used in a broad spectrum of personal, scientific, educational, professional, and business situations. In addition to our Systems, we can supply you with individual components for personal and OEM use. All MSI System components are available, some in kit form.

Write or call us for more information about MSI Systems and products and the name of your nearest MSI dealer.

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Rostronics present the

THE MOST INNOVATIVE, RELIABLE S-100
MICROCOMPUTER SYSTEM.

Dual Floppy Microsystem

MICROMATION'S Z-PLUS

Z-Plus Microcomputer System

Over One Megabyte Disk Storage • 4 MHz Z-80 Processor
Two Serial and Two Parallel I/O Ports • 64k Memory
An alphanumeric keyboard • Including System Desk

Price **£3750** plus VAT

DISK CAPACITY:

The proven, industry-standard Micromation Doubler controls the two-drive floppy disk sub-system. The disk sub-system stores one megabyte. The Micromation Hard Disk Controller is available too, so you can add a hard-disk sub-system based on the Shugart 14" SA 4000 family Winchester disk. (12.5 and 24.8 Megabytes).

CPU/MEMORY:

Micromations's innovative Z-64 Board delivers 64K Dynamic RAM memory and the Z-80A microprocessor running at a full four MHz with no wait states.

SERIAL/PARALLEL 1/0

The Complete 1/0 Board provides 2 serial ports with full handshake, and RS-232 interface, to drive most terminals and printers.

There are 6 parallel 1/0 ports, plus optional interface and software drivers for parallel daisy wheel printers.

POWER SUPPLY:

The constant voltage power supply assures reliable operation under all power conditions. The system is fully ventilated, for cool, dependable operation.

TERMINAL:

An alphanumeric keyboard with 95 keys and numeric pad, character display (24 lines of 80 characters per line) on a 15 inch screen.

BUS:

With the flexibility of the S-100 Bus you can select from a variety of components, such as real-time clocks, memory management boards modems to expand your system.

There are seven extra slots on the shielded S-100 bus motherboard. Active termination – of course.

OPERATING SYSTEM:

The Z Plus utilises the latest version of **CP/M 2.0** the industry standard floppy and hard disk operating system. MP/M will also be available in the near future. There is no easier system to use, you need never worry whether you are operating in single or double density – the system takes care of it.

SYSTEM SOFTWARE:

The 2-Plus supports a full range of software including **CIS COBOL** and forms, **MBASIC, FORTRAN, APL, PASCAL.**

APPLICATIONS SOFTWARE:

Word processing, payroll, inventory, all accounting functions are just some of the application packages available. **SAIL** a main frame software house are at the stage of completing the full range of accounting packages for the Z-Plus. **SAIL** will also undertake any specialised systems work as will Rostronics.

TRAINING:

Training courses are available on system operating and application software.

INSTALLATION AND MAINTENANCE:

For an additional charge Rostronics will undertake delivery and maintenance of the systems throughout the U.K.

PERIPHERALS:

A full range of printers, specialised terminals, computer stationery, and peripheral furniture are also available.

FOR DEMONSTRATIONS CONTACT ONE OF OUR OFFICES:

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THE ALPHA MICRO COMPUTER

Multi-User, Multi-tasking, Timesharing, Memory Management

Basic 64K RAM, 2·4Mb Floppy Disk System: £6,496.00
Basic 64K RAM, 10Mb Hard Disk System: £9,965.00
(Terminals & Printers to be added to user specification.)

ALPHA MICRO gives a new meaning to the words "Cost Effective." It combines a powerful 16 Bit processor with a proven time-sharing disk operating system to give you data handling and software sophistication parallel to that of high performance commercial minicomputers. It can be upgraded from a simple 64K single terminal floppy disk system up to a 24 terminal, multi-printer, system with 2400 Megabytes of disk storage and 1·02 Megabytes of Random Access Memory without any hardware redundancy.

ALPHA MICRO in Business

A fully integrated Accounting System is available "off the shelf." It includes Order Processing, Automatic Invoicing, Stock Control, Accounts Receivable, Accounts Payable, Nominal Ledger, Payroll, and Sales Analysis by Customer, Product or Salesman.

ALPHA MICRO Word Processing

Comprehensive word processing software is available which can run simultaneously with the accounting system (or any other program for that matter). It will handle anything from standard letters up to large and voluminous documents with automatic Index/Table of Contents generation.

ALPHA MICRO in Research & Education

Since the system can handle up to 24 terminals, where each user terminal has its own 32 or 48K memory partition, it is ideal in education or research since each user can do his own application, i.e. one can be running the BASIC Compiler whilst another runs LISP; again another can do programming in PASCAL or ASSEMBLER etc.

ALPHA MICRO Standard Features

* Multi-User, Multi-Tasking, Time-sharing Disk Operating System
* Memory Management from 64Kb-1·02Mb
* Disk storage from 2·4Mb-2400Mb
* Powerful WD16 16-Bit Processor
* S100 Bus Compatible
* Expands from 6-24 terminal ports
* Multi-Printer Spooler
* Adaptable to most RS232 peripherals
* Sequential, Index Sequential and Random Access files supported
* Comprehensive disk file management system and utilities
* Multi-User structured file system with programmer/project number and password protection
* Command file interpreter with parameter substitution
* Multiple level DMA and vectored interrupt system
* Multiple pass assembly programming system with linking loader
* ALPHABASIC Extended compiler and re-entrant runtime package
* Index sequential files supported in both Assembler and ALPHABASIC
* File management system with logical file I/O calls
* ALPHAPASCAL, one of the best UCSD implementations
* ALPHALISP, a textual data manipulation language

THE ALPHA MICRO COMPUTER

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Company
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DIRECT ACCESS

Britain's most up-to-date and comprehensive guide to the selection of microcomputer equipment, compiled for PCW by Richard Olney *of Heuristic Consultants.*

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software	Documentation	Miscellaneous
ABC 80 (£790)	CCS Microsales: 01-444 7739 (TBA)	16-40K RAM: Z80A: C: 12", 16x40 b&w VDU: 4680 bus: IEEE 488: RS232 port: option — dual 5¼" F/D (160K, own DOS), £895	DOS: BASIC: games: *W/P: Database: Engineering & construction prog*	S	Graphics loudspeaker with 128 effects: Viewdata compatible.
ALPHA MICRO (£5,700)	Alpha Micro Systems UK Ltd: 01-930 1991 (TBA)	64K-16M RAM: W/L 16 bits: Dual 8" F/D (1.2MB): 6 S/P: modular	multi-user O/S: BASIC: M/A: PASCAL: T/E: U: *B/P*	E	Expands to 1200 MB, 32 terminal system: average 10MB H/D system — £1,100
APPLE II (£810)	Microsense: 0442 63561 (80+)	16-48K RAM: 6502: 8 I/O slots: 15"x18"x5": options — single 5¼" F/D (116K), £425; C, £33; RS232 int, £110; 16K RAM, £110	O/S: BASIC: *PASCAL: games*	S	280x192 high resolution graphics: integer BASIC in 6K ROM
ATTACHE (£7,000)	R. H. Thorpe Ltd: 0276 29492. R. J. Spiers Ltd: 0603 416573 (TBA)	48K RAM: 8080: dual 8" F/D (616K): 9", 16x64 b&w VDU: 180 cps printer	ExBASIC: B/P: *FORTRAN*	S	W/P package available soon
CBS Mk I (£4,900)	Compelec: 01-636 1392 (n/a)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 132 col, 30 cps printer: 2 S/P: 1 P/P: options — 150cps bi-directional printer, £2,000: 55cps W/P printer, £2,000	CP/M: BASIC: *W/P: U: B/P*	S&H	Mk II available with 2MB F/D, £5,900. Can upgrade to Mk III. Desk mounted.
CBS Mk III (£8,150)	As above	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 132 col, 30cps printer: 11MB H/D: 6 S/P: 1 P/P: options — 150cps bi-directional printer, £2,000: 55cps W/P pointer, £2,000 12", 24x80 VDU, £655.	CP/M: BASIC: *W/P: U: B/P*	S&H	Up to 44MB H/D possible, £4,500 extra. Multiuser system with 280K RAM, £10,150.
CHALLENGER — 1P (£238)	Mutek: 0225 743289 Byte Shop: 01-518 1414. CTS: 0706 79332 U-Microcomputers: 0606 853390 Microcomputer Business Machines: 01-980 3993	4-32K RAM: 6502: C int: RS232 port: 15"x16"x4": option — dual 5¼" F/D (160K), £550	O/S: BASIC: A: games: *ExBASIC: Data Man: B/P (limited).*	S	D/A conv: colour capability: 8K microsoft BASIC in ROM
CHALLENGER C2 (£404)	As above	4-48K RAM: 6502: C int: RS232 port: 15"x16"x4": options — dual 5¼" F/D (160K), £550; dual 8" F/D (1.15MB); 20MB H/D.	O/S: BASIC: A: games: *ExBASIC: Data Man: B/P (limited)*	S	Can run OSI business software if 8" F/D inc.
CHALLENGER C3 (£2334)	As above	32-56K RAM: 6502, 6800, Z80: dual 8" F/D (1.15MB): 2-16 S/P: 17"x22"x12"	OS65U: BASIC: *CP/M FORTRAN COBOL: B/P: W/P: Data Management*	S&H	Also C3B & C3P H/D modules: 74MB for about £10,000
COMMA VO3 (£4,200)	Comma: 0277 811131 (n/a)	32K RAM: LSI 11: dual 8" F/D (512K): 4 serial DLU11S ports: modular	*RT11 0/S (£750): BASIC: COBOL: FORTRAN: B/P (limited)*	H	Many configs possible: max 20 MB, H/D — about £27,000
COMPELEC SERIES (£2,400)	Compelec: 01-636 1392 (n/a)	64K RAM: Z80: dual 8" F/D (512K): 2 RS232 ports, 1 P/P	CP/M: A: CBASIC: COBOL: FORTRAN: PASCAL: *W/P: B/P*	S	Also with double density F/D, 1MB, £2,900; 1K EPROM

List of Abbreviations

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

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

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software	Documentation	Miscellaneous
COMPUCORP 625 (£6,000)	Compucorp: 01-952 7860 (15)	60K RAM: Z80: dual 5¼" F/D (700K): 9", 16x80 b&w VDU: 40cps printer 1 RS232 port: 20"x28"x10"	A: BASIC: U: *W/P: B/P*	B	Also available, 655 model with 315K F/D capability & 12", 20x80 VDU — £3,750
COMP WORKSHOP SYSTEM 1 (£1,600)	Comp Workshop: 01-491 7507 (n/a)	32K RAM: dual 5¼" F/D (170K): 9", 16x64 b&w VDU: modular	A: BASIC: FORTRAN: FLEX: PASCAL: PILOT: *B/P*	E	These systems are example configs from a fully compatible modular range
COMP WORKSHOP SYSTEM 2 (£11,000)	As above	128K RAM: 6809: dual 8" F/D (1.2MB): 3 intelligent 20x80 terminals; 80 col, 125cps printer: daisy wheel Sprint 3 printer	A: BASIC: FORTRAN: FLEX: PASCAL; PILOT: *B/P*	E	As above
COMP WORKSHOP SYSTEM 3 (£36,000)	As above	768K RAM: 6809: dual 8" F/D (1.2MB): 64MB H/D: 10 intelligent 20x80 terminals: 2 132 col, 120cps printers: 2 80 col, 125cps printers: 2 daisy wheel Sprint 3 printers: max 16 ports.	A: BASIC: FORTRAN: FLEX: PASCAL: PILOT: *B/P*	E	As above
COMPUCOLOUR II (£1,058)	Abacus: 01-580 8841 (6)	8-32K RAM: 8089: 13". 32x64 8-colour VDU: single 5¼" F/D (51K): RS232 port: 18"x15"x13"	ExBASIC (ROM): *A: personal data base: games*	I	16K module, £1,134; 34K, £1,137; maintenance & programming manual available.
CROMEMCO SYSTEM 2 (£1,995)	Comart: 0480-215005. Datron: 0742-585490. Microcentre: 031-225 2022 (20)	64K RAM: Z80: dual 5¼" F/D (180K): options — dual 8" F/D (512K), £1370; 11MB H/D, £3495; 22MB H/D, £5999	CDOS: *BASIC: COBOL: FORTRAN (£55): multi-user BASIC*	E	Expandable to multi-user system (2-7 users), £3,455-£6,400
CROMEMCO SYSTEM 3 (£2,995) (64K, £3,293	As above	32-64K RAM: Z80: dual 8" F/D (512K): options as above: extra dual F/D, £1,200	CDOS: *BASIC: COBOL: FORTRAN; multi-user BASIC*	E	As above
DIGITAL MICROSYSTEM DSC-2 (£5,395)	Modata: 0892 39591 (TBA)	64K RAM: Z80: dual 8" F/D (2.28MB): 4 RS232 ports: EIA port: 17"x21"x7"	CP/M: BASIC-E: *CBASIC: COBOL: FORTRAN: PASCAL: CAP B/P*	H	Up to 6 additional F/D units possible
DURANGO (£7,750)	Comp Ancillaries: 07843 6455 (12)	48K RAM: 8085x3: dual 5¼" F/D (1MB): 9", 16x64 green VDU: 132 col 165cps printer: N/P: options — add F/D £1,753; aux VDU £875	O/S: *DBASIC: B/P*	S	Takes up to 4 workstations: fully integrated system 15"x30"x24"
DYNABYTE DB8/1 (£1,500)	Dynabyte UK/Europe Ltd: 0723 65559 (6)	32-64K RAM: Z80: S100 bus; 2 RS232 ports: 1 P/P: 20"x18"x7": option — dual 8" F/D (1MB), £2,000	CP/M: *BASIC: COBOL: FORTRAN: PASCAL: W/P: B/P*	H	Expands to multi-user system: also DB8/2 with dual 5¼" F/D (400K), £3,000
EQUINOX 200 (£9,995)	Equinox: 01-739 2387 (n/a)	64-256K RAM: Z80: 10MB H/D: 15", 24x80 b&w VDU: 15cps printer	CP/M: BASIC: COBOL: FORTRAN: MVT/ FAMOS	S&H	
EQUINOX 300 (£11,750)	As above	64-256K RAM: W/L 16 bits: 10MB H/D: 15", 24x80 b&w VDU: 150cps printer: 6 S/P	O/S: BASIC: COBOL: M/A: PASCAL: *LISP: SNOBOL: T/P multi-user:*	S	Up to 1200MB of storage possible (4x300MB, Calcomp Tridents)
EUROC (£7,995)	Eurocalc Ltd: 01-405 3113 (TBA)	64K RAM: 8080A: dual 8" F/D (1MB): 15", 25x80 b&w VDU: 132 col, 140cps printer	CP/M: CBASIC: A: account system: U: *B/P*	S	A year's maintenance and stationary supply inc.
EXIDY SORCERER (£650) (16K, £760; 32K £859)	Liverpool Data Products Ltd: 073-670 6320 (27)	8-32K RAM: Z80: RS232: 1 P/P: S100 connector: 30x64 VDU I/O: options — dual 5¼" F/D (630K), £1,200; 12", 30x64 green VDU, £240; S100 chassis, £210	O/S: ExBASIC (ROM): *W/P: Editor: A: games*	I	High resolution graphics capability.
H11 Kit (£1,844)	Heath: 0452 29451 (n/a)	LSI 11: 16-32K RAM: 24x80 VDU int: up to 16 S/P or P/P: options — dual 8" F/D (512K), £1,325: 12", 24x80 VDU, £558	*O/S: BASIC: FORTRAN: A: games: T/E: U.*	S&H	CPU and VDU int boards sold as separate items.
H89 (£1,455)	As above	2xZ80: 16-48K RAM: single 5¼" F/D (102K): 12", 24x80 VDU: up to 16 ports: option — 135cps printer, £354	O/S: BASIC	S&H	

IN STORE

DIRECT ACCESS

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software	Documentation	Miscellaneous
IMS 5000 (£1,935)	Equinox: 01-739 2387 (20)	32-64K RAM: Z80: dual 5¼" F/D (320K)	CP/M: BASIC: COBOL: FORTRAN: *PASCAL: W/P*	S&H	3 drives option
IMS 8000 (£3,515)	As above	64-256K RAM: Z80: dual 8" F/D (1MB)	CP/M: BASIC: COBOL: FORTRAN: *PASCAL: W/P: CAP: Micro COBOL: MVT/FAMOS: multi-user*	S&H	4 drives optional
IMSAI VDP 42 (£3,900)	Computermart: 0603 615089. Corner Comp: 03727 41101 (2)	32-64K RAM: 8085: dual 5¼" F/D (400K): 9", 24x80 b&w VDU: 1 S/P: 1 P/P: 18"x27"x12"	IMDOS (CP/M comp): A: ExBASIC: U: *CBASIC: COBOL: FORTRAN*	H	Can support 8 additional F/D drives; also available, VDP 44 with F/D (780K), £4,400
IMSAI VDP 80 (£6,200)	As above	32-64K RAM: 8085: dual 8" F/D (1.2MB): 12", 24x80 b&w VDU: 1 S/P: 1 P/P: 25"x15"x25"	IMDOS: A: ExBASIC: U: *CBASIC: COBOL: FORTRAN: CAP B/P*	H	
ITT 2020 (£867) (32K, £931 48K, £995)	ITT: 0268 3040 (15)	16-48K RAM: 2020: 15"x18"x4": options — single 5¼" F/D (116K), £425, C, £33; 60cps printer, £825; 16K RAM, £110; RS232 port, £96	Monitor: A: ExBASIC: Dis-A: *games*	B	360x192 high resolution graphics: ExBASIC in 6K ROM.
MEGAMICRO (£6,080)	Bytronics: 0252 726814 (5)	256K: 8080A: dual 8" F/D (1MB): 12", 20x80 b&w VDU: 120cps printer: 2 S/P: 2 P/P: option — printer stand, £100	CP/M: U: *B/P*	H&B	
MICROENGINE (£2,080)	Pronto: 01-599 3041 (TBA)	64K RAM: MCP 1600: 2 RS232 ports: 2 P/P: 16"x13"x5": options — dual 5¼" F/D (1MB), £1,500; dual 8" F/D (2MB), £1,200	BASIC: PASCAL: File Manager: U	H&S	CPU has user written word set: PASCAL uses integral P code: available as board, £1,400
MICRONOVA (£12,000)	Digitus: 01-636 0101 (3)	64-1128K RAM: N601: 10MB H/D (5 fix, 5 rem): 12", 24x80 VDU: 132 col 60cps printer: 4 S/P: 1 P/P	DOS: M/A: U: T/E: I/S: debug: FORTRAN IV: *BASIC: PASCAL: W/P: B/P*	E	Larger configs usual: bus system for multi-user; smaller system possible with F/D
MICROSTAR 45 PLUS (£4,950)	Data Efficiency: 0442 57137 (TBA)	64K RAM: 8085: dual 8" F/D (1.2MB): 3 S/P: RS232 port: 17"x26"x8"	STARDOS: CP/M: BASIC: COBOL: FORTRAN: UPDATE (database): *B/P*	E	
MSI 6800 (£1,203)	Strumech: 05433 4321 (5)	16K RAM: 6800: C: (9", 16x64 b&w VDU: 1 S/P: option — PROM prog	BASIC: mini A T/E: U	H&S	Up to 8 serial or parallel interfaces possible.
MSI 6800 SYSTEM 1 (£2,175)	As above	32K RAM: 6800: dual 5¼" F/D (160K): 9", 16x24 b&w VDU: 1 RS232 port: option — dual 8" F/D (624K), £1,640	DOS, BASIC: U: *A: FORTRAN: T/E*	H&S	As above
MSI 6800 SYSTEM 2 (£7,500)	As above	56K RAM: 6800: Single 8" F/D (312K): 10MB H/D: 1 RS232 port: 9", 16x64 b&w VDU: options — dual 8" FYD (624K), £1,640 10MB H/D £4,250	DOS: BASIC: multi-user BASIC: A: *B/P*	H&S	Rack mounted

List of Abbreviations

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

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

SCIENCE FACT

The invention of the silicon chip by Texas Instruments, turned science fiction into science fact overnight. That was in 1965, but only now is the full potential of the 'chip' being realised.

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- ☐ Power Semiconductor Data £3.20
- ☐ Transistor and Diode Vol. I £3.50

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- ☐ Volume V £7.95
- ☐ Understanding Solid State Electronics £1.20
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- ☐ Calculating Better Decisions (SR51-II) £5.00
- ☐ Calculator Decision Making Source Book (TI-51 III) £5.00
- ☐ Calculator Analysis for Business and Finance (TI-42 MBA) £7.00
- ☐ Sourcebook for Programmable Calculators (TI-58/58C/59) £11.45

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Each pakette contains complete listings of programmes suitable for use with the TI Programmable 59 calculator £5.95 each

- ☐ Electronic Engineering
- ☐ Black Body Radiation
- ☐ Astrology
- ☐ Marketing/Sales
- ☐ Mathematics
- ☐ Production Planning
- ☐ TI-59 Fun (Games Pakette)
- ☐ Oil/Gas/Energy
- ☐ Printer Utility
- ☐ Programming Aids
- ☐ Fluid Dynamics
- ☐ 3D Graphics
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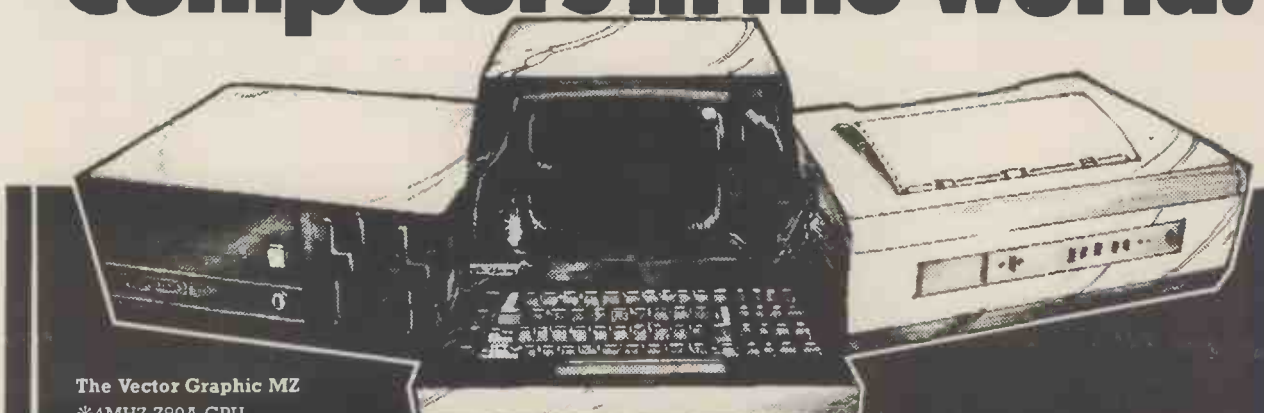

The Vector Graphic MZ

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

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

The Vector Graphic System B

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

ALMARC DATA SYSTEMS LTD

906 Woodborough Road, Nottingham. Telephone: (0602) 625035

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DIRECT ACCESS

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software	Documentation	Miscellaneous
NORTH STAR HORIZON (£4,650 for 48K)	Comart: 0480 215005. Comma: 0277 811131. Equinox: 01-739 2387 (20)	24-56K RAM: Z80A: dual 5¼" F/D (360K): 15", 24x80 b&w VDU: 150cps printer: 2 S/P: 1 P/P	DOS: BASIC: *CP/M: COBOL: FORTRAN: PASCAL: B/P*	E	
PET 2001-8 (£550)	Commodore: 01-388 5702 (150)	8K RAM: 6502: C: 9", 25x40 VDU: IEEE488 (non standard) port: options — dual 5¼" F/D (353K), £795; 80 col 93cps printer, £645; expand to 32K RAM, £249	O/S: BASIC: A: *FORTH: PILOT: games*	I	Graphics facility: BASIC in 8K ROM: also available, dual 5¼" F/D (800K), £995 + £30 for operating ROM
PET 2001 - 16/32 (£675) (32K, £795)	As above	16-32K RAM: 6502: C: 9", 25x40 green VDU: IEEE488 (non standard) port: options — dual 5¼" F/D (353K), £795; 80 col 93cps printer, £645	O/S: BASIC: A: *FORTH: PILOT: games*	I	As above but disc operating ROM included.
POWER-HOUSE 2 (£1,200)	Powerhouse Micros: 0442 48422 (TBA)	32K RAM: Z80A: 5", 27x96 b&w VDU: 1 S/P: 1 P/P: 17"x11"x7": options — IEEE488 int, £110; C, £170; G/C, £190	FDOS: BOS: BASIC: *games: C/P: ExBASIC (14K EPROM), £260*	I	
RAIR BLACK BOX (£2,300)	Rair: 01-836 4663 (n/a)	32-64K RAM: 8085: dual 5¼" F/D (160K): 2 RS232 port: 20"x16"x 5": option — dual 5¼" F/D (520K), £1,000	CP/M: BASIC: COBOL: FORTRAN: M/A: T/E: *B/P*	H	16K RAM expansion, £250.
RESEARCH MACHINES 380 - Z (£1,048) (56K, £1,654)	Research Machines: 0865 49791 (n/a)	16-56K RAM: Z80A: C: RS232 port: 19"x16"x6": options — dual 5¼" F/D (168K), £895; dual 8" F/D (1MB), £1,695 (fitted in machine)	Tiny BASIC: games: graphics: *A: ExBASIC: CBASIC: COBOL: FORTRAN: ALGOL: CP/M: U*	S	Designed for education: high resolution graphics being developed
SDS 100 (£4,290)	Airamco: 0294 57755 (11)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: S100 bus: RS232 port: N/P: 1 P/P	CP/M: A: ExBASIC: *COBOL: FORTRAN: CAP B/P*	E	Facility for 8K PROM
SEMEL 1 (£2,900)	Strutt Electrical: 0822 5439 (n/a)	16-64K RAM: Z80: single 8" F/D (250K): 12", 24x80 b&w VDU: RS232 port: options — single 8" F/D (250K), £500; light pen	BASIC: *COBOL: FORTRAN: B/P*	I	Supports up to 8 drives
SHARP MZ-80K (£520-£740)	Sharp UK: 01-571 2157 (TBA)	6-34K RAM; Z80: C: 10", 24x40 b&w VDU	BASIC: A: *games*	B	Graphics: loudspeaker: BASIC in 14K RAM
SIMPELEC Mk I (£6,900)	Compelec: 01-636 1392 (n/a)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 55cps daisywheel printer: 2 S/P: 1 P/P: options — 150cps bi-directional printer, £2,000; 55cps W/P printer, £2,000	CP/M: BASIC: W/P	S&H	Also available, Mk II with 2MB F/D, £7,900. Can upgrade to MkIII. Portable
SIMPELEC Mk III (£10,150)	As above	64K RAM: Z80: dual 8" F/D (1MB): 11MB H/D: 12", 24x80 VDU: 55cps daisywheel printer: 6 S/P: 1 P /P: options — 150cps bi-directional printer, £2,000; 55cps W/P printer, £2,000; W/P VDU, £900	CP/M: BASIC: W/P	S&H	Up to 44MB H/D possible, £4,500 extra. Multi-user system with 208K RAM, £12,150.
SIROCCO (£3,900)	Elvingate Computers: 069 24 5189 (TBA)	64K RAM: Z80: dual 5¼" F/D (740K): 12", 24x80 VDU: RS232 port: 19"x 14"x13": options — up to 3 ports; 10MB H/D, £4,000	CP/M: CBASIC: *COBOL: MBASIC: FORTRAN: PASCAL: LISP*	S	Direct memory addressing. Memory mapped VDU. Free standing keyboard.
SMOKE SIGNAL CHIEFTAIN 1 (£3,050)	Windrush Micro Designs: 069-24 5189 (TBA)	32-64K RAM: 6800: dual 5¼" F/D (160K): 12", 24x80 VDU: 112cps printer: RS232C port: option — 16K RAM expansion, £500	DOS: BASIC: *DBASIC: RBASIC: A: FORTRAN: U: T/E: B/P*	E	Also available, Chieftain 3 with dual 8" F/D (1MB), £3,950.

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software	Documentation	Miscellaneous
SOLITAIRE/ WP (£6,750)	Solitaire/KPG: 04252 71448 (TBA)	64K RAM: 8085: dual 5¼" F/D (700K): 14" VDU (with own CPU): 45cps printer: CPU	DOS: W/P: *BASIC*	S	All Solitaire systems are compatible: graphics on 11x13 dot matrix
SOLITAIRE/ BS200 (£7,950)	As above	64K RAM: 8085: dual 8" F/D (960K): 14" VDU (with own CPU): 45cps printer: CPU port	DOS: BASIC: W/P: *specialised B/P*	S	As above
SOLITAIRE/ HBS100 (£9,500)	As above	64K RAM: 8085: 10MB Fix H/D: 14" VDU (with own CPU): 200cps printer: CPU port: option — up to 40MB H/D	DOS: BASIC: W/P: *specialised B/P*	S	Up to 8 interface terminals can be used: also available, HBS200 with 20-80MB H/D.
SORD M100 ACE (£2,650)	Dectrade: 0602 861774 (TBA)	48K RAM: Z80: single 5¼" F/D (143K): 12", 24x64 colour VDU: RS232 port: option — single 5¼" F/D, £300	O/S: BASIC	I	With colour graphics: 8K ROM
SORD M223 (£3,500)	As above	64K RAM: Z80: single 5¼" F/D (350K): 12", 24x80 b&w VDU: S100 bus: RS232 port: option — extra F/D, £450	O/S: BASIC: *CAP B/P*	I	Other configs possible.
SUPER-BRAIN (£1,995)	Icarus: 0632 29593 (TBA)	64K RAM: 2xZ80: dual 5¼" F/D (320K): 12", 25x80 b&w VDU: S100 bus: RS232: TRS80 port: 21"x23" x14": options — dual 5¼" F/D (320K); dual 8" F/D (2.4MB); 8-120MB H/D	CP/M: A: *BASIC: COBOL: FORTRAN: APL: B/P*	H&S	Limited graphics: mainframe interface available
TAND-BERG EC10 (£5,000)	Tandberg: 0532 35111 (n/a)	50K RAM: 8080A: single 8" F/D (250K): 12", 25x 80 b&w VDU: RS232 port	ExBASIC (24K): multi-user BASIC: A: U: *COBOL*	H&S	Pascal available next year
TANDY TRS 80 LEVEL 1 (£380)	Tandy: 021 556 6101 (200)	4-16K RAM: Z80: C: 12", 16x64 b&w VDU	BASIC: games: A	I	BASIC in 4K ROM: upgradable to level 2
TANDY TRS 80 LEVEL 2 (£515-£1,005)	As above	4-48K RAM: Z80: C: 12", 16x64 b&w VDU: RS232 int: 1 P/P: option — single 5¼" F/D (78K), £478 (max of 4)	BASIC: games: *M/A: FORTRAN: B/P*	I	16K machines include N/P: 4-16K upgrade, £120; without pad, £85
TECS (£1,600)	Technalogics: 051 724 2695 (TBA)	16-56K RAM: 6800: 8K PROM: RS232 port: C int: option — dual 5¼" F/D (320K), £800	BASIC	H	256 char graphics: Prestel compatible: plugs into standard TV
TEI 208 (£4,400)	Abacus: 01-580 8841 (5)	32-60K RAM: 8080/8085: dual 5¼" F/D 320K: 9", 24x80 green VDU: 3 S/P: 3 P/P: 17"x18"10": option — 150cps printer, £1,250	CP/M: *BASIC: COBOL: FORTRAN: PASCAL: ALGOL: B/P*	H&S	
TEI 212 (£5,067)	As above	32-60K RAM: 8080/8085: dual 8" F/D (1MB): 15", 24x80 green VDU: 3 S/P: 3 P/P: 17"x20"x17": option — 150cps printer, £1,250	CP/M: *BASIC: COBOL: FORTRAN: PASCAL: ALGOL: B/P*	H&S	
VECTOR GRAPHICS MZ (£2,300)	Almarc: 0602 248565 Sintrom Microshop 0734 84322 (5)	48K RAM: Z80: dual 5¼" F/D (630K): 1 S/P: 2 P/P: 20"x17"x8"	DOS: BASIC: A: *CP/M: CBASIC: COBOL: FORTRAN: PASCAL:*	E	4K PROM
VECTOR GRAPHICS SYSTEM B (£2,850)	As above	48K RAM: Z80: dual 5¼" F/D (630K): 12", 24x80 b&w VDU: 1 S/P: 2 P/P: 20"x17"x8"	DOS: BASIC A: *CP/M: CBASIC: COBOL: FORTRAN: PASCAL*	E	With graphics and N/P

List of Abbreviations

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

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

IN STORE

DIRECT ACCESS

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software	Documentation	Miscellaneous
ZENTEC (£5,700)	Zigal Dynamics: 0753 71049 (1)	32-64K RAM: 2x8080: dual 5¼" F/D (280K); 15", 25x80 b&w VDU: RS232 port: options — dual 5¼" F/D (280K, £600; dual 8" F/D (1MB), £2,100 RS422 port, £105	O/S: A: U: *BASIC: micro COBOL: W/P*	S	User programmable character set
ZILOG MCZ1/05 (£4,200 - portable)	Micropower: 0256 54121. Memec: 084421 5471 (n/a)	64K RAM: Z80: dual 8" F/D (600K): RS232 port	Rio O/S: M/A: U: T/E: *BASIC: COBOL: FORTRAN: PASCAL: B/P*	H&S	Debug in 3K PROM: also available as desk top unit or R/M model, both £4,800.
ZILOG MCZ1/35 (£1,200)	As above	64K RAM: Z80: 10MB H/D (5 fix, 5 rem): RS232 port	Rio O/S: M/A: U: T/E: *BASIC: COBOL: FORTRAN: PASCAL: B/P*	H&S	Internal disc control with own Z80
Z-PLUS (£4,000)	Rostronics: 01-874 3665 (TBA)	32-64K RAM: Z80: dual 8" F/D (1MB): 2 S/P: 2 P/P: 10"x29"x11"	CP/M: A: U: *BASIC: COBOL: FORTRAN: PASCAL: Database: B/P*	H&S	

SINGLE BOARDS

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software/ Firmware	Documentation	Miscellaneous
ACORN (£65)	Acorn: 0223 312772 Microdigital: 051227 2535. Newbear: 0635 30505 (n/a)	1.1/8K RAM: 6502: EPROM socket: Hex K/B: C int: 8 digit LED display: up to 16 ports: options — Eurocard 64 way connector: VDU card: Full K/B card.	½K monitor: *Basic*	S&H	Kit: programmable address linking; on board 5V regulator: available assembled, £79.
AIM 65C (£265)	Pelco: 0273 722155 (4)	1-4K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: Cx2: RS232 port.	A: Dis A: T/E: 8K monitor in ROM	E	Available as S100 system with A or BASIC in ROM (£480) from Portable Micros (0280 702017): they also have briefcase version (£750)
CROMEMCO SC (£260)	Comart: 0480 30505 (17)	1K RAM: Z80A: 8K EPROM sockets: RS232 port: 3 P/P: option — S100 bus.	*Monitor and control BASIC in EPROM*	E	5 program interval timers: can put own BASIC programs in EPROM.
ELF II (£114)	Newtronics: 01-739 1582 (15)	1/4K RAM: RCA 1802: Hex K/B: 2 digit LED: TV int: C int: RS232 port: options — 4K RAM, £69; full K/B; VDU card	1K monitor: A: Dis A: T/E: *BASIC: games*	H	TTY, n-line decoders: low resolution graphics (high resolution available) kit.
EXPLORER (£295)	Newtronics: 01-739 1582 (15)	4K RAM: 8085: Hex K/B: RS232 port: S100 bus: C int: options — 6 slot S100, £32; 8K EPROM sockets, £50	2K monitor: *CP/M: BASIC*	S&H	Programmable 14 bit counter: kit
H8 (£262)	Heath: 0452 29451 (TBA)	4K RAM: 8080A: Octal K/B: 6 digit LED: speaker: options — single 5¼" F/D (102K), £399; 16K RAM, £314; C int, £72	1K monitor: *BASIC in RAM: FORTRAN: T/E: A: U: games.*	S&H	Kit
HEWART 6800S (£299)	Hewart: 0625 22030 (n/a)	16K RAM: 6800: full K/B: VDU int: 2xC int: 1 S/P: 2 P/P: option — 16K RAM, £90.	1K monitor: A: T/E	H	Can be upgraded with 6809.
HEWART 6800 Mk III (£152)	As above	1K RAM: 6800: VDU board: options — single 5¼" F/D (75K), £350; PROM programmer, £32: calculator board, £32	1K monitor	H	
Mk 14 (£39.95)	Science of Cambridge: 0223 311488 (n/a)	8060: 1/4-2K RAM: Hex K/B: 7 char LED: options — VDU int (32x16 with graphics), £29; C int, £6; PROM prog, £10, 2K memory expansion, £15	Machine code	H	Designed for control applications rather than high level computing expansion.
NASCOM 1 (£165)	Nascom: 02405 75155 (20)	4K RAM: Z80: full K/B: TV int: 2 P/P: 1 S/P	2K monitor: *BBASIC: tiny BASIC: A: T/E: U*	S&H	Now available as Nascom 2 with 8K RAM and 8K microsoft BASIC in ROM, £295

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software/ Firmware	Documentation	Miscellaneous
SBC 100 (£135)	Airamco: 0294 57755 (11)	1K RAM: Z80: 8K ROM: S100 bus: 1 S/P: 1 P/P: option — voltage regulator.	*1K monitor: DOS in ROM*	E	Kit: available assembled, £196
SUPER-BOARD (£188)	NBM: 01-981 3993 (n/a)	4-8K RAM: 6502: 10K ROM: full K/B: VDU int: C int: options — RS232; single 5¼" F/D (100K), £316; 8K RAM, £188	BASIC in 8K ROM: *games: B/P: Database*	S&H	Available with 32K RAM and single 5¼" F/D, £867
SYM-1 (£160)	Newbear: 0635 30505 (n/a)	1-4K RAM: 6502: Hex K/B: 244 bps C int: VDU int: 2x6522 ports: option — TV int.	4K monitor: *BASIC: A*	S&H	Can be expanded to 64K RAM
TRITON 4.1 (£286)	Transam: 01-402 8137 (n/a)	2K RAM: 8080: 3K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: option — 2K RAM, £30	1K monitor: 2K BASIC: U	S&H	64 character graphics: 8 levels interrupt: kit
TRITON 5.1 (£294)	As above	2K RAM: 8080: 4K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options — 8K RAM, £97; 8K EPROM, £97	1K monitor: 2K ExBASIC: U	S&H	Kit:assembled version, £393
TRITON 6.1 (£399)	As above	2K RAM: 8080: 4K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options — 8K RAM, £97; 8K EPROM, £97	2K monitor: 7K scientific BASIC in 8K EPROM or A: Dis A: U	S&H	Either firmware package available for extra £110: CP/M compatible disc interface available soon.
UK 101 (£219)	Computer Shop: 01-440 7033	4K RAM: 6502: full K/B: 16x48 VDU or TV int: C int: RS232 port: option — 4K RAM, £49	1K monitor: 8K BASIC: *Dis A: U*	S&H	Graphics: will run Superboard software.

List of Abbreviations

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

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

DIRECT ACCESS

USER GROUPS INDEX

User Group Index is Britain's major, up-to-date listing of clubs, user groups and societies. The details published here were correct at the time of going to press; if YOUR group hasn't been included, then please let us have all relevant information. Send it to: PCW, 14 Rathbone Place, London W1P 1DE. Updates on changes would also be appreciated.

NATIONAL

'11s Users Group. A sort of help service only. No meetings no newsletter. Contact: Pete Harris, 119 Carpenter Way, Potters Bar, Herts., EN6 5QB. Tel: 0707 52091 or 01-248 8000 Ext. 7065.

The 6502 Users Club. Hoping soon to hold regional and national meetings, they offer "support, encouragement and fellowship". Contact: Walter Wallenborn, 21 Argyll Ave., Luton, Beds LU3 1EG.

77/68 User Group. Quarterly Newsletter. Free membership for 1st year if you buy the 77/68 instruction manual, £1.50 thereafter. Contact: Newbear Computing Store, 40 Bartholomew St., Newbury, Berkshire.

9900 Users Group, TIMUG Contact: Chris Cadogan, 21 Thistle Downs, Northway Farm, Tewkesbury, Glos.

Amateur Computer Club. Membership now costs £3.50. Contact D. Ellis (the Membership Secretary), c/o 118 Cambridge Avenue, Gidea Park, Romford, Essex RM2 6RA.

UK Apple Users Group, Contact: Andy Witterick (Keen Computers), 5 The Poultry, Nottingham. Tel: 0602 583254/5/6.

Central Program Exchange. Full membership £25 Europe, £40 overseas), provides 30 free programs p.a. Small User Serivce £10 Europe, £20 overseas) provides 10 free programs p.a. Contact: Mrs Judith Brown, The Polytechnic, Wilfruma St., Wolverhampton, WV1 1LY.

Cosmac Users Club (proposed) For People using the RCA 1802, Cosmac ELF, ELFII, Super Elf etc. Those interested contact James Cunningham at 7 Harrowden Court, Harrowden Road, Luton LU2 0SR (enclose sae, please).

Exidy Sorcerer Users Group. Newly formed, and a division of the U.S. User Group. Fee is £5 p.a. Write, stating what hardware you own, to: Andy Marshall (Micro44), 44 Arthurs Bridge Road, Woking GU21 4NT (04862 66084).

UK Intel MDS Users Group. Contact: Lewis Hard, 29 Chaucer Rd., Bedford.

Ithaca Audio S100 bus UK User Group. Contact Dave Weaver, 16 Etive Place, Cumbernauld, Glasgow G67 4JE. Phone 02367 36570.

MK14 Club. Bi-monthly magazine called "Complement and Add". Contact: Geoff Phillips, 8 Podsford Rd., London NW9 6HP.

Independent PET users Group. Contact: IPUG, 57 Clough Hall Road, Kidsgrove, Stoke-on-Trent, Staffs.

Research Machines Ltd. National User Group. Contact: M.D. Fischer, PO Box 75, Oxford, OX4 1EY, for a registration form.

Sorcerer Program Exchange Club. No meetings. Regular newsletter. Members welcome worldwide £2 p.a. Contact: Colin Morle, SPEC, 32 Watchyard Lane, Formby, Nr. Liverpool

TRS-80 Users Group. Contact: Brian Pain, 40a High St., Stony Stratford, Bucks.

UK Pet Users Club. Contact: Commodore Systems Division, 360 Euston Road, London, NW1 3BL.

SOUTH

Independent PET Users Group — South. Free membership — meetings the first Wednesday of every month. £1.50 to receive monthly newsletter. Contact: John C Nuttall, 56 West Street, Shoreham-by-Sea, Sussex BN4 5WG.

NORTHWEST

Amateur Computer Club — North west group. Meetings 1st and 3rd Thursdays monthly at St. Peter's Chap-

USER GROUPS INDEX

DIRECT ACCESS

laincy, Precinct Centre, Oxford Rd., Manchester. Contact: Jane Lomas, 9 Crescent Court, Alderfield Rd., Chorlton, Manchester, M21 1JX. Tel: 061 881 1933

TRS 80 — North West Group. Subscription £5, Newsletter £3 (for 6 issues). Meetings last Wednesday monthly (not Dec) at the Stag Hotel, Garswood, Nr. Wigan. Contact: Melvyn D. Franklin, 40 Cowlees, Westhoughton, Bolton, BL5 3EG. Tel: 0942 812843.

IRELAND

Computer Education Society of Ireland. A voluntary organisation that consists of a national body and an expanding number of local branches. Their brief is to monitor computer education in Ireland *National CESI* (£3 p.a.) — Diarmuid McCarthy, 7 St. Kevin's Park, Kilmacud, Blackrock, Co. Dublin. *Cork branch* (£1 extra) — Michael Moynihan, Colaiste an Spioraid Naomh, Bishopstown, Cork. *Dublin branch* (£1.50 extra) — Jim Walsh, C.B.S. Naas, Co. Kildare. *Limerick branch* (£1 extra) — Sr. Lourda Keane, Convent F.C.J., Laurel Hill, Limerick. *Waterford branch* (£1 extra) — Mr. Hugh Dobbs, Newtown School, Waterford. *Kilkenny branch* (£1 extra) — Sr. Helen Lenehan, Presentation Secondary School, Kilkenny.

WALES

Gwent Amateur Computer Club. Covering the Gwent and Cardiff areas, the club has its own computer room and technical library. Meetings held once a week, Wednesdays, starting 7.30pm, at Room 149, Civic Centre, Newport. Contact: Peter Hesketh on Shirenewton 596.

AVON

Bristol Computing Club. £3.00 p.a. Meetings 3rd Wednesday, monthly. Contact: Leo Wallis, 6 Kilbirnie Rd., Bridge Farm Estate, Bristol, BS14 0HY. Tel: Bristol 832453.

Brunel Technical College Computing Club. The club divides into two sections . . .the "skilled" and the "not skilled". They share alternate Wednesdays at the College. Contact S.W. Rabona at 18 Castle Road, Worle, Weston-Super-Mare, Avon, BS22 9JW (0934 513068).

BERKSHIRE

The Thames Valley Amateur Computer Club. Meetings are on the first Thursday of every month and from November on, that will be at "The Southcote", Southcote Lane, off the Bath Road, Reading, Berks. Starting time, 7.00pm. Contact Brian Quarm (Camberley 22186) OR Brian Steer (Slough 20034).

CHESHIRE

Anyone interested in starting a Chester club please contact: Mr. W. Collins, 37 Garden Lane, Chester, Cheshire.

CLEVELAND

Cleveland Micro Computer Users Group. Meetings second Tuesday monthly. Bi monthly newsletter. Junior section. Contact: J.H. Telford, 63 Raby Rd., Ferryhill, Co. Durham

DEVONSHIRE

Exeter and District Amateur Computer Club. General meetings 2nd Tuesday monthly, specialist meetings 3rd or 4th Tuesday. £5.00 p.a. Contact: Doug Bates, 3 Station Road, Pinhoe, Exeter, Devon.

Plymouth and District Amateur Computing Club. Subscription £5.00 p.a. Meetings last Wednesday monthly. Contact: Keith Gould, c/o JAD Ltd., 21 Market Ave., Plymouth 62616; or 2 Brook Rd., Ivybridge 2399.

COUNTY DURHAM

Computer Club. Business & Word Processor section meets Fridays 7.30, Scientific & Recreational Saturdays 10.00. Contact: L. Boxell, 8 Vane Terrace, Darlington. Tel: 0325 67766.

Northeast PETS. Contact: Jim Cocallis, 20 Worcester Road, Newton Hall Estate, Durham. The group meets on the 3rd Monday of each month (at 7.30 pm.) in: Room A102, Ellison Bldgs, Newcastle Polytechnic, Newcastle-upon-Tyne.

ESSEX

TRS80 User Club (Chelmsford). Now part of the National TRS80 User Club. Contact Michael Dean, 22 Roughtons, Galleywood, Chelmsford, Essex.

The Colchester Microprocessor Group. Meetings held at the University of Essex on the second and fourth Wednesdays of each month — 7.30pm start. Membership is open to all, on payment of £5 annual sub £1 for full-time students). Contact the Information Centre at the University on the evening of the meeting.

GLOUCESTERSHIRE

Cheltenham Amateur Computer Club. Meetings, 4th Wednesday monthly, 7.30pm start. Microprocessor workshop starting October 2nd. Contact: Mr. M. Pullin, 45 Merestones Drive, The Park, Cheltenham, GL50 2SU (Cheltenham 25617).

HAMPSHIRE

Southampton Amateur Computer Club. Meetings 1st Wednesday monthly (not July, Aug. or Sept.). Contact: Paul Dorey, Department of Physiology, University of Southampton, Southampton, SO2 3SU or Tel: Paul Maddison on Winchester 4433 Ext. 6955.

HERTFORDSHIRE

Harpenden Microprocessor Group. They hold meetings every fortnight, cover a wide range of interests and attract members from the area around Luton, St. Albans and Welwyn. Contact: David James, 5 Ox Lane, Harpenden, Herts AL5 4HH (05827 5366).

KENT

Medway Amateur Computer and Robotics Organisation. Contact: Tony Aylward, 194 Balmoral Rd., Gillingham, Kent. Tel: Medway 56830.

North Kent Amateur Computer Club. Meetings, the second Tuesday of each month — usually at the Charles Darwin School, Jail Lane, Biggin Hill, Kent. The sub is £2.50 per annum (£1 for students). More members are needed . . .contact: Barry Biddles at 3 Acer Road, Biggin Hill, Kent (09594 71742).

LANCASHIRE

Merseyside Microcomputer Group. Several sub-groups . . .Contact: J.S. Stout, Department of Architecture, Liverpool Polytechnic, 53 Victoria St., Liverpool L1 6EY or Tel: 051 236 0598 or STEM Ltd., 19/23 Abercrombie Sq., PO Box 147, Liverpool University, Liverpool L69 3BX.

LEICESTERSHIRE

The Leicestershire Personal Computer Club. Meetings held the 2nd Monday in each month, at Leicester University and Loughborough University alternately. They start 7pm. Membership is £2 per annum (£1 for under 16s). Contact Miss Jill Olorenshaw (Club Secretary) c/o Arden Data Processing, Municipal Buildings, Charles Street, Leicester (0533 22255) OR Mr Dick Foden (Club Chairman) at 11 Gaddesby Lane, Rearsby, Leicester.

LINCOLNSHIRE

Lincolnshire Microprocessor Society. Various meeting-places. For up-to-date information, contact the Hon. Sec., Mr Eric Booth, Senior Common Room, Bishop Grosseteste College, Newport Lincoln.

LONDON

Southgate Computer Club. Meetings 1st Wednesday and 3rd Thursday monthly during term time. Newsletter. Contact: Paul Woolley, Southgate Technical College, High Street, London N14 6BS. Tel: 01-888 6521.

East London Amateur Computer Club. Meetings 3rd Tuesday monthly. £2.50 p.a. (½ price to school students). Contact: Jim Turner, 63 Millais Rd., London E11.

The North London Hobby Computer Club. General meetings held on a Wednesday evening, once a month — specialised topics on three evenings each week. Location: The Polytechnic of North London. Contact: Robin Bradbeer (Chairman) at the Dept, of Electronic and Communications Engineering, Polytechnic of N. London, Holloway, N7 8DB (01-607 2789).

MIDDLESEX

Harrow Computer Group. Meetings (term time) at the Harrow College of Higher Education and (other time) the "Traveller's Rest" Public House, in Kenton, Middlesex — on alternate Wednesdays at 7pm. Contact: Bazyle Butcher, 16 St. Peter's Close, Bushey Heath, Watford (01-950 7068) or P. Lecker, 23 Moss Lane, Pinner, Middx.

OXFORDSHIRE

Oxfordshire Microcomputer Club. £5.00 p.a. Contact: S. C. Bird, 139 The Moors, Kidlington, Oxford OX5 2AF Tel: Kidlington (08675) 6703

Microsoc, the Oxford University micro group holds shared meetings with the Oxford Microcomputer Club. Contact: M Bourla, St. John's College, Oxford.

SURREY

Richmond Computer Club. Held the second Monday of each month at the Richmond Community Centre (20p per meeting), members have the use of a good range of equipment. Contact: Robert Forster, 18a The Barons, St. Margarets, Twickenham, Middx (01-892 1873).

Surrey Micro-processor Society. (SUMPS) Covering Surrey plus bits of South London and other adjacent counties. Anyone interested in joining, call Mike on 01-642 8362.

WARWICKSHIRE

ACC (Midland) Group. They meet every 3rd Saturday in room P109 at Lanchester College, Coventry. . .no sub, no magazine. Contact: Roy Diamond (Chairman), 27 Loweswater Road, Coventry, Warks (0203 454061).

WEST MIDLANDS

Research Machines 380Z. West Midlands User Group. Further details from: Peter Smith, Birmingham Educational Computing Centre, Camp Hill Teachers Centre, Stratford Road, Birmingham, B11 1AR. Tel: 021 772 6534.

West Midlands Amateur Computer Club. Newsletter . . . meetings 2nd Tuesday monthly. £2 p.a., or £1 if under 18, or a full time student. Contact: John Tracey, 100 Booth Close, Crestwood Park, Kingswinford, West Mids DY6 8SP. Phone Brierley Hill 70097.

YORKSHIRE

South Yorkshire Personal Computing Group. (Please note, another publication has listed, incorrectly, a South Yorkshire Amateur Computer Club. It does not exist). For details of the SYPCG, contact Tony Rycroft, 88 Spinneyfield, Moorgate, Rotherham, S. Yorks, (Tel: Rotherham 74889, eve).

DIRECT ACCESS

DIARY DATA

Tokyo, Japan	Semicon Japan. Golden Gate Enterprises Inc., De Anza Office Center, 1307, So. Mary Ave., Suite 210, Sunnyvale, CA 94087 U.S.A.	Nov 28 - Nov 30
Bucharest, Romania	SYSTEMTECHNIK — International Electronics Exhibition & Trade Fair. Glahe. International GmbH & Co., Herler Strasse, 91-109, P.O. Box 800349, D-500 Cologne 80. W. Germany	Dec 3 - Dec 8
London, England	Breadboard Exhibition (Home Electronics). Trident International Exhibitions Ltd., 23a Plymouth Rd., Tavistock, Devon, PL19 8AU. Tel: 0822 4671	Dec 4 - Dec 8
Paris, France	International Electrical Equipment Exhibition. French Trade Exhibitions, 54 Conduit St., London W1. Tel: 01-439 3964	Dec 10 - Dec 15
Birmingham, England	TV MEX. Montbuild Ltd., 11 Manchester Sq., London W1M 5AB. Tel: 01-486 1951	Jan 15 - Jan 17
Wembley, England	Microsystems '80 Exhibition & Conference. Iliffe Promotions Ltd., Dorset House, Stamford St., London SE1 9LU. Tel: 01-261 8000.	Jan 30 - Feb 1
Leeds, England	BEX — Business Equipment Exhibition. Douglas Temple Studios Ltd., 104b Old Christchurch Rd., Bournemouth, Dorset. Tel: 0202 20533	Feb 6 - Feb 7
Milan, Italy	INTEL — International Electrical & Electronic Technology Exhibition. Intel, Via Luciano Manara 1, 20122 Milan, Italy	Feb 9 - Feb 13
Solihull, England	Mini Computers, Word Processors & Copying Machines Exhibition. Groundrule Exhibition Company, 7 Market Street, Altrincham, Cheshire WA14 2QW. Tel: 061 928 2227	Feb 12 - Feb 13
London, England	Business Computing, Word Processing & Information Mgt., Exhibition & Conference. BED Exhibitions Ltd., Bridge House, Restmor Way, Wallington, Surrey. SM6 7BZ. Tel: 01-647 1001	Feb 12 - Feb 15
Wembley, England	INFO EUROPE — European Information Management Exhibition & Conference. Clapp & Poliak Europe Ltd., 232 Acton Lane, London W4 5DL. Tel: 01-995 4806	Feb 18 - Feb 21
Bournemouth, England	BEX — Business Equipment Exhibition. Douglas Temple Studios Ltd., 104b Old Christchurch Rd., Bournemouth, Dorset, Tel: 0202 20533	Feb 20 - Feb 21
Swansea, Wales	OFFEX — Office Equipment Exhibition. Phoenix Exhibitions Ltd., 1st Floor, Burrows Crambers, East Burrows Rd., Swansea. Tel: 0792 460364	Feb 20 - Feb 22
Dortmund, W, Germany	HOBBYTRONIC — Electronic Hobby Exhibition. Westfalenhalle GmbH, Postfach 1130, Reinlanddamm 200, 4600, Dortmund, W. Germany	Feb 20 - Feb 24
Birmingham, England	IEA — International Instruments, Electronics & Automation Exhibition. Industrial & Trade Fairs Ltd., Radcliffe House, Blenheim Court, Solihull, West Midlands, B91 2BD. Tel: 021 705 6707	Feb 25 - Feb 29
Copenhagen, Denmark	TECHEX — World Fair of Technology Exchange. Dr Dvorkovitz & Associates, P.O. Box 1748, Ormond Beach, Florida 32074 U.S.A.	Feb 26 - Feb 29
Birmingham, England	Computermarket '80, Couchmead Ltd, 42 Great Windmill Street, London W1V 7PA. Tel: 01-437 4187	Mar 4 - Mar 6
Liverpool, England	Merseyside Business Efficiency & Office Equipment Exhibition. Gwen Shillaber Design, 81 Whiteladies Rd., Clifton, Bristol BS8 2NT. Tel: 0272 312850	Mar 4 - Mar 7
London England	Microforum Europe. Business Equipment Trade Association, 109 Kingsway, London WC2B 6PU. Tel: 01-405 6233	Mar 11 - Mar 13
Sheffield, England	Business Efficiency & Office Equipment Exhibition. Gwen Shillabar Design, 81 Whiteladies Rd., Clifton, Bristol BS8 2NT. Tel: 0272 312850	Mar 11 - Mar 13
Manchester, England	Computermarket '80. Couchmead Ltd., 42 Great Windmill St., London W1V 7PA. Tel: 01-437 4187	Mar 11 - Mar 13
Bahrain, UAE	Middle East Business Equipment Show. Arabian Exhibition Management 11 Manchester Sq., London W1M 5AB. Tel: 01-486 1951	Mar 16 - Mar 20
Glasgow, Scotland	Computermarket '80. Couchmead Ltd., 42 Great Windmill St., London W1V 7PA. Tel: 01-437 4187	Mar 18 - Mar 20
London, England	Computermarket '80. Couchmead Ltd., 42 Great Windmill St., London W1V 7PA. Tel: 01-437 4187	Mar 25 - Mar 27
London, England	Viewdata '80. Online Conferences Ltd., Cleveland Road, Uxbridge, Middx UB8 2DD. Tel: 0895 39262	March 26 - March 28
Paris France	International Exhibition of Electronic Components. French Trade Exhibitions, 54 Conduit Street, London W1R 9SD. Tel: 01-439 3694	Mar 27 - Apr 2

DIRECT ACCESS

TRANSACTION FILE

For sale

Warning — Do not read this!. . .PET 2001-8, only purchased (new) March 79, with original docs — £475. Owner unable to resist the 32N. DON'T LET IT HAPPEN TO YOU. Contact Steve Somers: 0296 83506. Computero Sum, Ergo Sum.

IBM Selectric printer. . .with golfball head, complete with service manuals. Simple interface and PSU required, details supplied. Upgrade your system to provide hard copy for only £275. Phone: 0234 851010.

32K Sorcerer. . .£820. S100 expansion box — £220. Video 100 — £80. Private sale, phone 01-920 8612 (office) or Sunbury-on-Thames 87206 (home).

Hitachi VM-129U Video Monitor. . .12" screen with manuals/boxed, brand new and unused — £195 o.v.n.o. Phone Chamberlain on Crawley (Sussex) 512201.

Dynamic RAM. . .4116P-4, 250 micro sec access time, 8 only for £50. Contact David Wright, 3 Forth Crescent, Dalgety Bay, Fife (0380 822099).

PET 2001-8K. . .as new, plus over £50 worth of cassette programs and several books worth at least £20 — only £500 and no VAT to pay. Phone Ivan on Bloxwich 79408 (after 7pm).

Cromemco Z-2D. . .owner going abroad. Must sell complete system consisting of: 5" disc drive, 64K static RAM memory, Lear Siegler VDU, Tuart interface and 80 col matrix dot printer, Fortran, BASIC and assembler compilers — £2,900. Phone 01-874 0509.

PET 2001-8. . .as new, one careful owner. With tapes, programs and literature — £495. Phone Julian Sandys on 01-242 5226 (office) or Godalming (04868) 22167 (after 7.30pm or weekends).

6800 Disassembler. . .a powerful disassembler requires less than 2K bytes to run. Program on cassette tape with full instructions, suitable for SWTBUG or MIKBUG — £6.00. SAE for details: write to J. Fung, 28 The Downs, Hatfield, Herts (Hatfield 68955).

Burroughs TD800 VDU Terminal. . .contains 5V P.S. @ 10A, +16V & -16V @ 600mA. Motherboard has spare slots for CPU boards etc. Motorola 12" video monitor, keyboard, 2,400 baud synchronous interface, diagrams. Working and in good condition — £80. Phone Andy Lawrie, Sunbury-on-Thames 88574.

System 68 VDU. . .cards A&B, socketed and wired, never used; teleprinter type 28 KSR, 115V; Bunker-Ramo type 1036A1 VDU, needs new mains transformer; high speed Opto. paper tape reader, 8 or 5 hole. Will sell or swop for interesting/useful bits. Contact Chris S. Warwick G8DSO, 44 Wellington Road, Birmingham B20 2SB.

Console. . .diecast case; Keytronics 1660 kybd (like Selectric + 20 keys); Mk2 'Petitevid' VDU modified to address 4 leds, buzzer, screen graticule & blanking (w/o clearing). Format switches: speed, 7/8 data, parity odd/even/off, 2/1 stop. Regulators & filters fitted, +8V & -16V. Home built to high standards, looks good. With Ceedata 1230 GHB Monitor (12" green), bought April. The pair — £380 o.n.o. Enquiries/inspection welcome. Phone Bourne End (06285) 20009).

8K PET. . .with antiglare screen, unique shift-lock, spare key tops, software if required — £375. Dennis Lyons, 86 Queens Road, Nuneaton, Warks (0682) 383212.

Nascom-1. . .8K, B-Bug, floating point BASIC (4 EPROMS), Music Box, KBD repeat, PSU, all in stylish black cabinet. Complete with assembler, de-bug, relocator, octal loader, revas, approx 50 games (inc superstartrek — 7K), Z80 technical/programming manuals, listings, news-letters, circuits etc. Bargain — £325 o.n.o. Also oscilloscope — £80. Phone Crawley (0293) 24504.

TRANSACTION FILE

DIRECT ACCESS

Fast Printer. . .electro-resistive printer, 80 chars/line, 120 chars/second, parallel PR40 compatible interface, spares and paper, full documentation — £100 o.n.o. Phone Mr. Morris on 01-954 2018 (evenings) or 01-353 4463 (days).

77-68 Micro. . .consisting of CPU, monitor, VDU, Cottis-Blandford cassette, interface and home made card frame. Cards in working order, but system needs building up — £100. Contact Mr L.J. Stubbs, 96 Coleridge Way, Crewe; phone 0270 581657.

PET printer. . .PR40P — £250 or Trendcom 100 (thermal) — £280. Both perfect; phone Woking 66585.

Professional Keyboard. . .78 keys, including numeric and cursor control. ASCII encoded, only requires +5V — £55. Power supply, multiple output, suitable for large micro installation — £44. Also a number of 4K DRAM chips — £2 each. Data sheet available. Phone 0594 562709 (Gloucestershire).

Casio Pro fx1. . .magnetic card calculator, complete with PSU, magnetic cards instructions, program manual — £100 o.n.o. Phone C. Robertson on 0632 745600 (evenings) or 0632 625242, ext 219 (days).

Apple & Disc Drive. . .bargain combined or separate, good reason for sale, willing to listen to any offers. Phone Jay on 01-368 1234, ext 2843.

S100 Marinchip 9900. . .16 bit CPU card, PROM, RAM. S I/O, RTC card, vast software on 8" disc and manuals (Pascal available). Upgrades any 8" disc based S100 computer to 16 bit — £650. Also Tarbell disc controller — £125. All brand new, details phone 0632 468041 (evenings).

Z80 "Starter Kit". . .assembled and tested, cost £225, asking £160. Also Softly development board (Videotime) assembled and tested; cost £135, asking £90. Both new and unused. I've bought a PET. Phone 0632 626186.

Atari Videocomputer. . .vgc, offered with 3 cartridges for £100 (retail value, £200). Phone Michael Ray-Jones in Manchester on 061-224 2374 (evenings and weekends) or Alan Ray-Jones in London on 01-580 6906 (after 18.00, Tuesdays, Wednesdays and Thursdays).

Hewlett Packard HP29-C. . .calculator, as good as new. In original box with mains adaptor/battery charger, all instruction books, plus four extra books of helpful programs. Cost over £100 a year ago — best offer. Contact Phil Lyddon, 59 Freshfield Road, Brighton, Sussex (0273 691770).

Wanted

1 computer. . .suitable for an enthusiastic young student, must have tape interface and be able to plug into domestic TV. Buyer willing to collect within 30 mile radius. Mr N.F. Ryman, 6 Highcliffe Drive, Otterbourne Gate, Boyatt Wood, Eastleigh, Hants SO5 4RB. If you're further away, contact anyway, we may be able to arrange something.

FAX

DIRECT ACCESS

THE Z80 MNEMONICS ARRANGED BY OP CODE Compiled by John A Coll.

MSB / LSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
0	NOP	DJNZ d *	JRNZ, d *	JR NC, d *	LD B,B	LD D,B	LD H,B	LD (HL), B	ADD B	SUB B	AND B	OR B	RET NZ	RET NC	RET PO	RET P	0
1	LD BC, nn	LD DE, nn	LD HL, nn	LD SP, nn	LD B,C	LD D,C	LD H,C	LD (HL), C	ADD C	SUB C	AND C	OR C	POP BC	POP DE	POP HL	POP AF	1
2	LD (BC), A	LD (DE), A	LD (nn), HL	LD A, nn	LD B,D	LD D,D	LD H,D	LD (HL), D	ADD D	SUB D	AND D	OR D	JP NZ, nn	JP NC, nn	JP PO, nn	JP P, nn	2
3	INC BC	INC DE	INC HL	INC SP	LD B,E	LD D,E	LD H,E	LD (HL), E	ADD E	SUB E	AND E	OR E	JP nn	OUT A,port	EX (SP), HL	DI	3
4	INC B	INC D	INC H	INC (HL)	LD B,H	LD D,H	LD H,H	LD (HL), H	ADD H	SUB H	AND H	OR H	CALL NZ, nn	CALL NC, nn	CALL PO, nn	CALL P, nn	4
5	DEC B	DEC D	DEC H	DEC (HL)	LD B,L	LD D,C	LD H,L	LD (HL), L	ADD L	SUB L	AND L	OR L	PUSH BC	PUSH DE	PUSH HL	PUSH AF	5
6	LD B,n	LD D,n	LD H,n	LD (HL), n	LD B, (HL)	LD D, (HL)	LD H, (HL)	HALT	ADD (HL)	SUB (HL)	AND (HL)	OR (HL)	ADD n	SUB n	AND n	OR n	6
7	RLCA	RLA	DAA	SCF	LD B,A	LD D,A	LD H,A	LD (HL), A	ADD A	SUB A	AND A	OR A	RST 0	RST 10H	RST 20H	RST 30H	7
8	EX AF, AF *	JR d *	JR Z,d *	JR C,d *	LD C,B	LD E,B	LD L,B	LD A,B	ADC B	SBC B	XOR B	CP B	RET Z	RET C	RET PE	RET M	8
9	ADD HL, BC	ADD HL, DE	ADD HL, HL	ADD HL, SP	LD C,C	LD E,C	LD L,C	LD A,C	ADC C	SBC C	XOR C	CP C	RET	EXX *	JP (HL)	LD SP, HL	9
A	LD A, (BC)	LD A, (DE)	LD HL, (nn)	LD A, (nn)	LD C,D	LD E,D	LD L,D	LD A,D	ADC D	SBC D	XOR D	CP D	JP Z,nn	JP C,nn	JP PE, nn	JP M,nn	A
B	DEC BC	DEC DE	DEC HL	DEC SP	LD C,E	LD E,E	LD L,E	LD A,E	ADC E	SBC E	XOR E	CP E	See Manual *	IN A,port	EX DE, HL	EI	B
C	INC C	INC E	INC L	INC A	LD C,H	LD E,H	LD L,H	LD A,H	ADC H *	SBC H	XOR H	CP H	CALL Z,nn	CALL C,nn	CALL PE, nn	CALL M,nn	C
D	DEC C	DEC E	DEC L	DEC A	LD C,L	LD E,L	LD L,L	LD A,L	ADC L	SBC L	XOR L	CP L	CALL nn	See Manual *	See Manual *	See Manual *	D
E	LD C,n	LD E,n	LD L,n	LD A,n	LD C, (HL)	LD E, (HL)	LD L, (HL)	LD A, (HL)	ADC (HL)	SBC (HL)	XOR (HL)	CP (HL)	ADC n	SBC n	XOR n	CP n	E
F	RRCA	RRA	CPL	CCF	LD C,A	LD E,A	LD L,A	LD A,A	ADC A	SBC A	XOR A	CP A	RST 8	RST 18H	RST 28H	RST 38H	F
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	

Note:
* means code not implemented on 8080
Flags are not affected by load, 16 bit increment and 16 bit decrement instructions
n means a single byte
nn means a double byte
d means a relative displacement in 2s complement form

Op codes CB, DD, ED and FD include all bit operations
JUMP and CALL mnemonics are conditioned by: NZ — non zero; NC — non carry; PO — parity odd; P — sign positive; Z — zero; C — carry; PE — parity even; M — sign negative (minus)
(HL) means that the contents of the address given in HL etc . . .

PROGRAMS

BUGGING THE 6800 - continued from last month, (sorry by the way to have left everyone hanging in 'mid-program').

```
FF15  20 F4          BRA OUT2
FF17  8D 1C  ENDOUT  BSR PUTVDU     Print final space
FF19  32             PULA
FF1A  33             PULB
FF1B  39             RTS
FF1C  36     HOME    PSHA           Routine clears screen & initialises cursor.
FF1D  FF F0 F8       STX TEMPX2
FF20  CE F8 00       LDX £$F800     First screen location
FF23  FF F0 FC       STX VDULOC
FF26  86 20          LDAA £'space
FF28  A7 00  HOME1   STAA X         Print space
FF2A  08             INX
FF2B  8C FC 00       CPX £$FC00     End of screen?
FF2E  26 F8          BNE HOME1
FF30  FE F0 F8       LDX TEMPX2
FF33  32             PULA
FF34  39             RTS
FF35  FF F0 F8 PUTVDU STX TEMPX2    Entry point for graphics
FF38  FE F0 FC       LDX VDULOC
FF3B  A7 00          STAA X         Print character
FF3D  36             PSHA
FF3E  37             PSHB
FF3F  8C FB F7       CPX £$FBF7     Last location?
FF42  27 04          BEQ SCROLL
FF44  8D 4D          BSR STEPLOC
FF46  20 3F          BRA CURSOR
FF48  CE F8 00 SCROLL LDX £$F800    First screen location
FF48  FF F0 FC       STX VDULOC
FF4E  B6 F0 FC SCR1  LDAA VDU HI
FF51  81 FB          CMPA £$FB      Last fifth of line?
FF53  26 14          BNE SCR4
FF55  B6 F0 FD       LDAA VDU LOW
FF58  43             COMA
FF59  85 E0          BITA £$E0      Line 8 or 16?
FF5B  26 0C          BNE SCR4
FF5D  C6 D8          LDAB £$D8
FF5F  09     SCR5    DEX
FF60  5A             DECB
FF61  26 FC          BNE SCR5
FF63  A6 00          LDAA X         From line 9 or 17
FF65  A7 D8          STAA D8,X      To line 8 or 16
FF67  20 04          BRA SCR6
FF69  A6 20  SCR4    LDAA 20,X      From succeeding line
FF6B  A7 00          STAA X         To this line
FF6D  8D 24  SCR6    BSR STEPLOC
FF6F  8C FA E0       CPX £$FAE0     Fill last line with spaces
FF72  26 DA          BNE SCR1
FF74  86 20  SCR2    LDAA £'space
FF76  A7 00          STAA X
FF78  8C FB F7       CPX £$FBF7     End of line?
FF7B  27 04          BEQ SCR3
FF7D  8D 14          BSR STEPLOC
FF7F  20 F3          BRA SCR2
FF81  CE FA E0 SCR3  LDX £$FAE0
FF84  FF F0 FC       STX VDULOC     Beginning of last line
FF87  A6 00  CURSOR  LDAA X         Transparent cursor
FF89  88 80          EORA £%10000000 Invert charcter
FF8B  A7 00          STAA X         and reprint it
FF8D  33             PULB
FF8E  32             PULA
FF8F  FE F0 F8       LDX TEMPX2
FF92  39             RTS            End of KBD, OUTEEE, & PUTVDU
FF93  B6 F0 FD STEPLOC LDAA VDU LO  Calculates next position on screen
FF96  16             TAB
FF97  43             COMA
FF98  85 1F          BITA £$1F      32nd column?
FF9A  26 15          BNE STEP1
FF9C  B6 F0 FC       LDAA VDU HI
FF9F  84 0F          ANDA £$0F      = 08, 09, or 0A
FFA1  48 48 48       ASLA x 3       = 40, 48, or 50
FFA4  1B             ABA
FFA5  8B A1          ADDA £$A1
FFA7  B7 F0 FD       STAA VDU LO
FFAA  86 FB          LDAA £$FB
FFAC  B7 F0 FC       STAA VDU HI
FFAF  20 29          BRA STEP2
FFB1  B6 F0 FC STEP1 LDAA VDU HI
FFB4  81 FB          CMPA £$FB      Column 33 to 40 ?
FFB6  26 1F          BNE STEP3
FFB8  17             TBA
FFB9  53             COMB
FFBA  C5 07          BITB £07       End of line?
FFBC  26 19          BNE STEP3
FFBE  53             COMB           Restore B
FFBF  C4 18          ANDB £$18      If 00 add FD19, 08 add FE11, 10 add FF09.
FFC1  10             SBA
FFC2  8B 19          ADDA £$19
FFC4  B7 F0 FD       STAA VDU LO
FFC7  07             TPA            Save carry bit
FFC8  54 54 54       LSRB x 3       0, 1, or 2
FFCB  06             TAP            Recover carry bit
FFCC  B6 F0 FC       LDAA VDU HI
FFCF  89 FD          ADCA £$FD
FFD1  1B             ABA
FFD2  B7 F0 FC       STAA VDU HI
```

PCW is always on the lookout for original programs

```
FFD5  20 03              BRA STEP2
FFD7  7C F0 FD  STEP3    INC VDU LO
FFDA  FE F0 FC  STEP2    LDX VDULOC      New position into X
FFDD  39                 RTS             End of STEPLOC
FFDE  47        JTABLE   'G
FFDF  FE A6              GO
FFE1  45                 'E
FFE2  FC 5B              EDIT
FFE4  4D                 'M
FFE5  FD EA              MOVE
FFE7  44                 'D
FFE8  FE 13              DUMP
FFEA  4C                 'L
FFEB  FE 38              LOAD
FFED  54                 'T
FFEE  FD 0F              TRACE
FFF0  5B                 '←
FFF1  FE B5              CONTINUE
FFF3  00                 00              End of table
FFF4  }                                  spare
FFF7  }                                  spare
FFF8  FE 82              IRQ vector
FFFA  FD B9              SWI vector
FFFC  FE C8              NMI vector
FFFE  FE 7C              Reset vector
```

NOTE:

```
F0B9 - F0BF    TRACE target stack
F0C0 - FDCF    TRACE host stack
F0D0 - F0E1    Control stack
F0E2 - F0E3    Target Start address
F0E4 - F0E5    Target End address
F0E6 - F0E7    Temporary stack pointer
F0E8 - F0E9    Mirror Instruction Address
F0EA - F0EB    Instruction Address
F0EC - F0ED    Mirror Start Address
F0EE           Byte Count
F0EF - F0F0    Destination Address, Memory Location
F0F1 - F0F2    Starting Address
F0F3 - F0F4    Ending Address, Ending Address + 1
F0F5           Checksum, Opcode space
F0F6 - F0F7    TempX
F0F8 - F0F9    TempX 2
F0FA - F0FB    Target Stack Pointer for GO & CONTINUE
F0FC - F0FD    VDU Location
F0FE           KBUFF 2
F0FF           Switches & Lights Register
```

PET bytes-easy feeding

By B. D. Grainger

This program inputs short machine code programs direct to PET without using DATA statements and enables minor modifications to large machine code programs without having to ASSEMBLE the complete program. In this context it is very useful in conjunction with a DISASSEMBLER/EXECUTER.

The program runs in about 450 bytes and includes the use of the following PET BASIC features:-

a. string functions
b. multiple statements on a line
c. relational operator expressions in arithmetic statements.

Conversion of the program will be required if it is to be run on other computers which do not support these features.

Instruction for use:

1. Type program into PET memory
2. Type GOTO 100 and press RETURN
3. The PET will respond ADDRESS? Type the value of the memory location to be changed.

— If the value is an ordinary number prefix with a # e.g. # 27 = memory location 27

— If value is in hexadecimal no prefix is necessary e.g. FA2 = memory location 4002

— If you want PET to automatically increase the memory pointer by 1 after you have changed the memory follow the value with a + e.g. 27+ or FA2+ If you do not type a + PET will ask for a new address value later.

— If you have finished changing memory just hit RETURN.

— If an address value given is too high the PET will tell you. In this case repeat this step.

4. When you have hit RETURN, PET will respond with the value (as an ordinary number) of the address to be changed together with BYTE? Type the value of the byte.

— If value is an ordinary number prefix with a #

— If value is hexadecimal no prefix is necessary

— When PET is automatically increasing memory location type * to stop the increase. PET will then ask for a new address.

— If a byte value given is too high PET will tell you. In this case repeat this step.

5. If PET is automatically increasing the memory pointer go to step 4. If not go to step 3.

```
100 INPUT"ADDRESS";A$:F= 1
110 IF RIGHT$(A$,1)="+" THEN
      A$=LEFT$(A$,LEN(A$)-1):F=0
120 GOSUB 200:M=N
130 IF M>65535 THEN PRINT
      "ADDRESS"M"IS OUT OF
      RANGE. REINPUT":GOTO 100
140 PRINT M;:INPUT"BYTE";A$
150 IF A$="*" THEN 100
160 GOSUB 200
170 IF N>255 THEN PRINT"BYTE
      "N"IS OUT OF RANGE.
      REINPUT":GOTO 140
180 POKE M,N:IF F THEN 100
190 M=M+1:GOTO 140
```

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PROGRAMS

```
200 N=0
210 IF LEFT$(A$,1)="$" THEN
    N=VAL(RIGHT$(A$,LEN
    (A$)-1)):RETURN
220 FOR I=1 TO LEN (A$)
230 A=ASC(MID$(A$,I,1))-48
240 N=16*N+A+7*(A>9)
250 NEXT:RETURN
```

FUN & GAMES

Air attack

by Peter Calver

A plane crosses the screen from left to right, passing over 'New York' and moving one line lower after each crossing. The plane has an inexhaustable supply of bombs, which are dropped by pressing the space key — however, there is a constraint in that a bomb may not be dropped until the previous bomb has exploded. This puts a high premium on accuracy. The object of the game is to demolish all of the 'buildings' by dropping bombs so that the plane can be brought in to land at ground level — which at first will seem impossible! The game ends when the plane hits a building — so to prolong the game and get a high score you must aim for the highest buildings. If you do succeed in landing the plane — and it's only been done once to my knowledge — the game restarts with your score carried over.

LISTINGS

If you have a PET with the new ROM, change PEEK(547) at line 370 to PEEK(166). An enhanced version of AIR ATTACK is available on cassette from SUPERSOFT at 28 Burwood Avenue, Eastcote, Pinner, Middlesex at a special price of £3 post free. This includes a four-coloured overlay which colours the buildings in layers thus adding a new dimension to PET games.

```
100 REM******  AIR ATTACK  *******
110 REM****  BY PETER CALVER  ****
120 POKE59468,12
130 SH=48:SD=48:SU=48
140 Y1$="
150 BK$="
160 SP$="
170 PRINT"
180 PRINT"
190 PRINT"
200 PRINT"
210 PRINT"
220 PRINT"
230 PRINT"
240 PRINT"
250 PRINT"
260 PRINT"
270 PRINT"
280 PO=32773
290 FORI=1TO3:PRINT"
300 POKE33746,SH:POKE33747,SD:POKE33748,SU
310 PRINT"
320 FORI=1TO40:T=TI+8:GOSUB330:GOSUB390 :NEXT:LL=LL+1:GOTO320
330 PRINTBK$;SP$;Y1$;
340 PO=PO+1:IF(PEEK(PO)AND191)<>32THEN490
350 IFPO=33607THENLL=0:GOTO170
360 IFB1THENGOSUB410 :IFB1THENGOSUB410 :RETURN
370 IFPEEK(547)<>6THENRETURN
380 B1=1:I1=I+2+40*LL:P1=32808+I1:Q1=50000:F1%=1+4*RND(TI):RETURN
390 IFTI>TTHENRETURN
400 GOTO390
410 POKEQ1,32:K1=PEEK(P1)AND191:IFK1=32THEN450
420 IFK1<>160THENF1%=0
430 IFF1%=0THENGOSUB460 :B1=0:RETURN
440 F1%=F1%-1:SS=SS+1
450 POKEP1,46:Q1=P1:P1=P1+40:RETURN
460 SU=SU+SS:SS=0:IFSU<58THENPOKE33748,SU:RETURN
470 SU=SU-10:POKE33748,SU:SD=SD+1:IFSD<58THENPOKE33747,SD:RETURN
480 SD=SD-10:POKE33747,SD:SH=SH+1:POKE33746,SH:RETURN
490 PRINT"
500 PRINT"                 PRESS ANY KEY TO RESTART
510 FORI=1TO200:NEXT
520 GETX$:IFX$<>""THEN520
530 GETX$:IFX$=""THEN530
540 RUN
```

Listing courtesy of Lion House.

Space Slalom

by Geoffey Salt
and Steve Withers

This program, for Apple][, is written in Applesoft, and makes use of the low resolution colour graphics facility.

The object of the game is to get a spacecraft from the bottom of the screen to the space station at the top, without being hit by any of the asteroids, and without hitting the sides of the space station. You move the spacecraft using paddle 1. The program interprets its value in one of three ways: with the control fully anticlockwise the craft will step left; with it fully clockwise the carft will step right; with it central it will not move horizontally at all. In addition, if the pushbutton on Paddle 1 is pressed the craft will move up.

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PROGRAMS

The program allows up to five craft to reach the space station, but this can be altered if desired by changing line 470. At each iteration the outline of the craft is checked to see if it has changed colour; if so, then it has been hit by an asteroid, or has collided with the space station. If the craft is hit it is destroyed and a new one must be launched. If there are none left then you are doomed. Moreover, each craft has only just enough fuel to reach the space station. The fuel level is shown by a red bar at the left of the screen. If this bar falls to zero then the craft will stop, and will be helpless until hit by an asteroid. (If it stops in the space station, but without docking, then the game is lost, as it cannot be removed in time).

The area in front of the space station is protected so that no asteroids appear there. Similarly, asteriods do not appear on top of the spacecraft at the start of the game.

```
10  GOTO 400
20  REM HIT CHECK
30  IF F4 = C0 AND PO = 19 THEN 720: REM DOCKED SUCCESSFULLY
40 X = SCRN( PO,F7) + SCRN( PO,F6) + SCRN( PO,F6 + C1) + SCRN( PO + C1,F4) + SCRN( PO + C1,F6)
50 X = X + SCRN( PO + C1,F6 + C1) + SCRN( PO + C2,F6) + SCRN( PO + C2,F6 + C1) + SCRN( PO + C2,F7)
60  IF X > = 135 THEN RETURN
70  GOSUB 850
80 SC = SC - C1: IF SC = C0 THEN 1220
90  TEXT : HOME : PRINT 'THE SPACECRAFT HAS BEEN DESTROYED.': PRINT
100  PRINT 'YOU ONLY HAVE '+SC+' SPACECRAFT LEFT.'
110  PRINT : PRINT 'PRESS ANY KEY TO LAUNCH THE NEXT ONE':
120  POP : GOTO 480
130  REM CRAFT PLOT
140 P = PDL (C0)
150  IF FU > 47 AND ABS (19 - PO) < = C1 AND F4 < = C3 THEN 1270: REM BLOCKING ENTRANCE
160  IF FU > 47 THEN RETURN : REM NO FUEL
170 VT = C0:HR = C0: REM MOVE DIRECTION
180  IF PEEK ( - 16287) > 127 AND F4 > C0 THEN VT = - C1
190  IF P < 50 AND PO > C1 THEN HR = - C1
200  IF P > 200 AND PO < 37 THEN HR = C1
210  IF VT = C0 AND HR = C0 THEN RETURN : REM NO MOVE
220  COLOR= C0: GOSUB 250: PLOT C0,FU:FU = FU + C1: POKE 878,150: POKE 879,20: CALL 880: REM ERASE FUEL/NOISE
230 PO = PO + HR:F4 = F4 + VT:F6 = F6 + VT:F7 = F7 + VT: REM NEW CRAFT LOCATION
240  COLOR= 15: REM FALL INTO CRAFT DRAWING ROUTINE
250  VLIN F6,F7 AT PO: VLIN F4,F6 + C1 AT PO + C1: VLIN F6,F7 AT PO + C2: RETURN : REM DRAW CRAFT
260  REM ASTEROIDS
270  FOR I = C1 TO AS
280  COLOR= C0: PLOT A(I,C1),A(I,C2)
290 A(I,C2) = A(I,C2) + SP
300  IF A(I,C2) > 47 THEN GOSUB 350
310  COLOR= A(I,C3): PLOT A(I,C1),A(I,C2)
320  NEXT
330  RETURN
340  REM NEW ASTEROID
350 A(I,C2) = INT ( RND (C1) * C3)
360 A(I,C1) = INT ( RND (C1) * 38 + C2)
370 A(I,C3) = INT ( RND (C1) * 14 + C1)
380  IF A(I,C1) < 23 AND A(I,C1) > 17 AND A(I,C2) < 7 THEN A(I,C2) = 7
390  RETURN
400  REM PROGRAM START
410 C0 = 0:C1 = 1:C2 = 2:C3 = 3: REM CONSTANTS
420  GOSUB 800: REM INITIALISE TONE ROUTINE
430  GOSUB 930: REM INSTRUCTIONS
440 SP = 3: REM SPEED OF ASTEROIDS
450 AS = 25: REM NO OF ASTEROIDS
460  DIM A(AS,C3): REM ASTEROID X,Y,COLOR
470 SC = 5: REM NO OF SPACECRAFT
480 F4 = 44:F6 = 45:F7 = 47:PO = INT ( RND (C1) * 36 + C2): REM INITIAL SPACECRAFT LOCATION
490  REM SET UP ASTEROID LOCATIONS
500  FOR I = C1 TO AS
510 A(I,C2) = INT ( RND (C1) * 48): REM RANDOM Y LOCATION
520  GOSUB 360: REM NEW ASTEROID
530  IF ABS (A(I,C1) - PO - C1) < 3 AND A(I,C2) > 30 THEN I = I - C1: REM NOT ON SPACECRAFT
540  NEXT
550  POKE - 16368,C0: REM RESET KEYBOARD READ
560  IF Y$ < > 'Y' THEN GET Y1$
570 Y$ = 'N'
580  HOME
590  POKE - 16304,0: REM SWITCH TO GRAPHICS
600  POKE - 16302,0: REM FULL GR SCREEN
610  CALL - 1998: REM CLEAR GR SCREEN
620  COLOR= 11: HLIN 18,19 AT C0: HLIN 21,22 AT C0: VLIN C1,C3 AT 18: VLIN C1,C3 AT 22: REM DRAW SPACE STATION.
630  COLOR= 4: VLIN C0,47 AT C0:FU = C0: REM FUEL
640  COLOR= 15: GOSUB 250: REM DRAW CRAFT
650  REM MAIN LOOP
660  GOSUB 140: REM MOVE CRAFT
670  GOSUB 270: REM MOVE ASTEROIDS
680  COLOR= 11: PLOT 18,C3: PLOT 22,C3: REM HIT ON SPACE STATION?
690  GOSUB 20: REM CHECK FOR HIT
700  IF PEEK ( - 16384) = 155 THEN GET Y$: HOME : TEXT : END : REM ESCAPE
710  GOTO 660
720  REM DOCK
730  GOSUB 1340
740  PRINT 'YOU HAVE DOCKED SUCCESSFULLY - WELL DONE'
750  PRINT 'YOUR SUPPLIES WILL BE SENT IMMEDIATELY.'
760  FOR I = 1 TO 3000: NEXT I
770  POKE - 16368,C0: REM RESET KEYBOARD READ
780  PRINT : PRINT 'ANOTHER GAME?': GET Y$: PRINT Y$: IF Y$ = 'Y' THEN POP : GOTO 470
790  END
800  REM SET UP TONE ROUTINE
810  FOR I = 880 TO 900: READ D: POKE I,D: NEXT
820  DATA 173,48,192,136,208,5,206,111,3,240,9,202,208,245,174,110,3,76,112,3,96
830  RETURN
840  REM EXPLOSION
850  FOR I = C1 TO 20
860  COLOR= INT ( RND (C1) * 13 + C2): GOSUB 250
870  POKE 878,50: REM SOUND PITCH
880  POKE 879,10: REM SOUND DURATION
890  CALL 880: REM PRODUCE SOUND EFFECT
900  NEXT
910  RETURN
920  REM INSTRUCTIONS
930  TEXT : HOME
940 S$ = '**********':S1$ = '*                                  *'
950  VTAB (7)
960  INVERSE : PRINT S$:S1$:'*': SPC( 13);'SPACE SLALOM': SPC( 13);'*':S1$:S$: NORMAL
970  VTAB (20): PRINT SPC( 4);'BY GEOFF SALT AND STEVE WITHERS'
980  FOR I = 1 TO 3000: NEXT I: HOME
990  PRINT 'YOU ARE A LONE OBSERVER ON A REMOTE MOON'
1000  PRINT 'AND ARE SHORT OF FOOD. THE FAILURE OF'
1010  PRINT 'YOUR RADIO MEANS THAT YOU WILL HAVE TO'
1020  PRINT 'SEND AN SOS IN ONE OF THE REMOTE-CONTROL'
1030  PRINT 'RECONNAISSANCE SPACECRAFT THERE TO THE'
1040  PRINT 'SPACE STATION. YOU MUST DOCK ACCURATELY'
1050  PRINT 'AND AVOID THE ASTEROIDS, OR THE CRAFT'
1060  PRINT 'WILL BE DESTROYED.'
1070  PRINT
1080  PRINT 'YOU ONLY HAVE FIVE SPACECRAFT AT YOUR'
1090  PRINT 'DISPOSAL. THE RED BAR ON THE LEFT SHOWS'
1100  PRINT 'THE SPACECRAFT'S FUEL LEVEL. IF IT RUNS'
1110  PRINT 'OUT OF FUEL IT WILL BE STRANDED. THE'
1120  PRINT 'AREA IMMEDIATELY IN FRONT OF THE SPACE'
1130  PRINT 'STATION IS PROTECTED BY A FORCE FIELD.'
1140  PRINT 'AND ASTEROIDS ARE DEFLECTED ROUND IT.'
1150  PRINT
1160  PRINT 'USE PADDLE (1) TO MOVE THE SPACECRAFT'
1170  PRINT 'FROM SIDE TO SIDE, AND PRESS THE PUSH-'
1180  PRINT 'BUTTON TO MOVE IT UPWARDS.'
1190  PRINT : PRINT 'PRESS "ESC" TO EXIT GAME.':
1200  VTAB (23): PRINT 'PRESS THE SPACE BAR TO START'
1210  RETURN : REM TEST FOR KEY PRESS AT LINE 560
1220  REM FAIL
1230  GOSUB 1340
1240  PRINT 'YOU'VE RUN OUT OF SPACECRAFT, AND SO YOU'
1250  PRINT 'WILL NEVER RECEIVE YOUR SUPPLIES.'
1260  GOTO 1310
1270  GOSUB 1340
1280  PRINT 'SPACECRAFT HAS RUN OUT OF FUEL BLOCKING'
1290  PRINT 'THE SPACE STATION ENTRANCE. IT WILL NOT'
1300  PRINT 'BE REMOVED IN TIME TO SAVE YOU.'
1310  PRINT : PRINT 'YOU ARE DOOMED!!'
1320  GOTO 760
1330  REM RETURN TO TEXT
1340  FOR Z = 1 TO 5: PRINT CHR$ (7)*1: FOR ZZ = 1 TO 10: NEXT ZZ,Z: TEXT : HOME : RETURN
1350  REM ##########################################
1360  REM ### SPACE SLALOM BY GEOFF SALT AND STEVE WITHERS ###
1370  REM ##########################################
1380  REM YOU CAN ALTER THE NUMBER OF SPACECRAFT OR ASTEROIDS
1390  REM BY CHANGING THE VARIABLES AT LINES 450 AND 470.
```

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PROGRAMS

Golf for Hewlett Packard 33E

Submitted by J. S. Corb

```
>RUN
>GOLF
>
>BY J.S.CORB
>5\10\79
>FOR HP 33E
>
>PROGRAM MODE
>
>00 F PRGM
>01 F FIX 1
>02 STO 2
>03 1
>04 STO+1
>05 6
>06 7
>07 RCL 2
>08 F X<Y
>09 GTO 29
>10 2
>11 ÷
>12 G FRAC
>13 G X=0
>14 GTO 21
>15 6
>16 0
>17 GTO 29
>18 5
>19 5
>20 GTO 29
>21 1
>22 STO-4
>23 RCL 4
>24 G X=0
>25 GTO 27
>26 GTO 18
>27 2
>28 STO+4
>29 F TAN
>30 F SIN
>31 6
>32 2
>33 0
>34 0
>35 X
>36 RCL 0
>37 -
>38 G ABS
>39 STO 0
>40 RCL 3
>41 F X>Y
>42 GTO 45
>43 RCL 0
>44 GTO 00
>45 F FIX 0
>46 3
>47 1
>48 0
>49 4
>(50 GTO 00)
>
>DISTANCE TO HOLE,STO
 0
>PAR FOR COURSE,CHS
 STO 1
>PROGRAM USE'S STO 2
>HOLE SIZE (.1
 YARDS),STO 3
>LOST BALL RATE
 (2),STO 4
>
>ONCE THE ABOVE
 AMOUNTS HAVE BEEN
 STORED THE GAME CAN
 BEGIN.
>TO PLAY YOU KEY IN A
 VALUE FOR YOUR
 'STROKE' AND PUSH
 THE RUN KEY
>THE DISPLAY WILL
 THEN SHOW THE NEW
 DISTANCE TO THE HOLE
 IN YARDS
>YOU THEN ENTER A NEW
 STROKE VALUE
>WHILE RUNNING THE
 GAME FEATURES 'LOST
 BALLS',SUBSTITUTION
 OF EXCESSIVE STROKES
 WITH ONE OF TWO
 LOWER VALUES.WHEN A
 BALL IS LOST YOU ARE
 AWARDED A NEW
 DISTANCE
 AUTOMATICALY AND CAN
 CONTINUE THE GAME.
>THE FOLLOWING TABLE
 GIVES AN APPROXIMATE
 GUIDE TO THE
 DISTANCE TRAVELLED
 FOR A GIVEN
 STROKE:(THE LONGER
 SHOTS WILL HOWEVER
 ACTIVATE THE LOST
 BALL AND SUBSTITUTE
 STROKE ROUTINES).
>S  D
>10 20
>20 40
>30 63
>40 90
>50 130
>60 190
```


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PROGRAMS

```
>70 300
>80 615!
>
>AFTER THE BALL HAS
 GONE INTO THE HOLE
 THE DISPLAY WILL
 SHOW 3104 ('HOLE'
 UPSIDE DOWN)
>TO PLAY THE NEXT
 HOLE JUST STORE THE
 NEW DISTANCE IN STO
 0
>AT THE END OF THE
 GAME YOUR SCORE WILL
 BE DISPLAYED BY
 RECALLING 1
>END AT LINE 32767
```

Parkinson's Revas

Continuing David Parkinson's Revas assembler program.

```
FCDF  0F              0779          RRCA              ;SHIFT ID DOWN
FCE0  0F              0780          RRCA
FCE1  E6 06           0781          AND   6           ;ISOLATE IT
FCE3  CD 2A F9        0782          CALL  FTADR       ;FORM ADDRESS
FCE6  C3 25 F9        0783          JP    COPY2       ;FINISH MNEMONIC
FCE9                  0784 ;
FCE9  4C 44 43 50     0785 OPTAB:   DB    'LDCPINOTI D IRDR'
      49 4E 4F 54
      49 20 44 20
      49 52 44 52
FCF9                  0786 ;
FCF9                  0787 ; ADC/SBC
FCF9                  0788 ;
FCF9  21 3D FA        0789 ADCSBC:  LD    HL,ARTAB+9;POINTER TO "SBC"
FCFC  79              0790          LD    A,C         ;LOAD OPCODE
FCFD  F5              0791          PUSH  AF          ;SAVE FOR "ADDHL"
FCFE  CB 5F           0792          BIT   3,A         ;SBC?
FD00  28 03           0793          JR    Z,*+3       ;YES,SKIP
FD02  21 37 FA        0794          LD    HL,ARTAB+3;POINT TO "ADC"
FD05  C3 70 F9        0795          JP    ADDHL+3     ;REST IN "ADDHL"
FD08                  0796 ;
FD08                  0797 ; EXTENDED DECODING
FD08                  0798 ;
FD08  CD DB F8        0799 EXTND:   CALL  BYTE        ;GET OPCODE
FD0B  FE C0           0800          CP    $C0         ;>=C0?
FD0D  D2 D8 FD        0801          JP    NC,NOTVAL   ;YES,NOT VALID
FD10  FE 40           0802          CP    $40         ;<$40?
FD12  DA D8 FD        0803          JP    C,NOTVAL    ;YES,NOT VALID
FD15  FE A0           0804          CP    $A0         ;>=$A0?
FD17  30 B0           0805          JR    NC,AUTO     ;YES,AUTO INC/DEC
FD19  FE 80           0806          CP    $80         ;>=$80?
FD1B  D2 D8 FD        0807          JP    NC,NOTVAL   ;YES,NOT VALID
FD1E  4F              0808          LD    C,A         ;LOAD OPCODE
FD1F  E6 07           0809          AND   7           ;ISOLATE LO BITS
FD21  47              0810          LD    B,A         ;PUT IN B
FD22  79              0811          LD    A,C         ;RELOAD OPCODE
FD23  0F              0812          RRCA              ;SHIFT DOWN
FD24  0F              0813          RRCA
FD25  0F              0814          RRCA
FD26  20 17           0815          JR    NZ,NOTIN    ;JUMP IF NOT "IN"
FD28                  0816 ;
FD28                  0817 ; IN R,(C)
FD28                  0818 ;
FD28  21 9E FB        0819          LD    HL,INM      ;POINT TO "IN"
FD2B  CD 25 F9        0820          CALL  COPY2       ;WRITE IT
FD2E  11 32 10        0821          LD    DE,BUFFER+32;SET POINTER
FD31  CD C4 F9        0822          CALL  SREG        ;WRITE REG.
FD34  21 3A FD        0823          LD    HL,BRCM     ;POINT TO ",(C)"
FD37  C3 21 F9        0824          JP    COPY4       ;WRITE IT
FD3A  2C 28 43 29     0825 BRCM:    DB    ',(C),'
      2C
FD3F                  0826 ;
FD3F                  0827 ;
FD3F  10 11           0828 NOTIN:   DJNZ  NOTOUT      ;TEST AGAIN
FD41                  0829 ;
FD41                  0830 ; OUT (C),R
FD41                  0831 ;
FD41  21 B8 FB        0832          LD    HL,OUTM     ;POINT TO "OUT"
FD44  CD 23 F9        0833          CALL  COPY3       ;WRITE IT
FD47  13              0834          INC   DE          ;SPACE
FD48  13              0835          INC   DE
FD49  21 3B FD        0836          LD    HL,BRCM+1   ;POINT TO "(C),"
FD4C  CD 21 F9        0837          CALL  COPY4       ;WRITE IT
FD4F  C3 C4 F9        0838          JP    SREG        ;WRITE REG.
FD52                  0839 ;
FD52                  0840 ;
FD52  05              0841 NOTOUT:  DEC   B           ;TEST
FD53  28 A4           0842          JR    Z,ADCSBC    ;JUMP IF "ADC" OR "SBC"
FD55  10 DE           0843          DJNZ  NOTLD       ;TEST AGAIN
```


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PROGRAMS

```
FD57                    0844 ;
FD57                    0845 ; LD PP,($NNNN)  LD ($NNNN),PP
FD57                    0846 ;
FD57  CD 06 F9          0847        CALL  WRLD      ;WRITE "LD"
FD5A  CB 59             0848        BIT   3,C       ;WHICH WAY?
FD5C  79                0849        LD    A,C       ;RELOAD OPCODE FOR LD/ST16
FD5D  C2 46 FC          0850        JP    NZ,LD16I+1;JUMP IF LOAD
FD60  79                0851        LD    A,C       ;RELOAD OPCODE FOR ST16I
FD61  F5                0852        PUSH  AF        ;AND PUT ON STACK
FD62  C3 3C FC          0853        JP    ST16I     ;JUMP TO  ST16I
FD65                    0854 ;
FD65                    0855 ;
FD65  10 0D             0856 NOTLD: DJNZ  NOTNEG    ;TEST AGAIN
FD67                    0857 ;
FD67                    0858 ; "NEG"
FD67                    0859 ;
FD67  FE 88             0860        CP    $88       ;CHECK VALIDITY
FD69  20 6D             0861        JR    NZ,NOTVAL ;INVALID
FD6B  21 71 FD          0862        LD    HL,NEGM   ;POINT TO "NEG"
FD6E  C3 23 F9          0863        JP    COPY3     ;WRITE IT
FD71  4E 45 47          0864 NEGM:  DB    'NEG'
FD74                    0865 ;
FD74                    0866 ;
FD74  10 12             0867 NOTNEG: DJNZ NOTRET
FD76                    0868 ;
FD76                    0869 ; RETN RETI
FD76                    0870 ;
FD76  FE AA             0871        CP    $AA       ;RETI/N?
FD78  30 5E             0872        JR    NC,NOTVAL ;NO,JUMP
FD7A  21 9F FA          0873        LD    HL,CJRTAB ;POINT TO "RET"
FD7D  CD 23 F9          0874        CALL  COPY3     ;WRITE IT
FD80  EB                0875        EX    DE,HL     ;GET ADDRESS TO HL
FD81  36 49             0876        LD    (HL),'I'  ;WRITE  "I"
FD83  0F                0877        RRCA            ;PUT I/N BIT IN CARRY
FD84  D8                0878        RET   C         ;DONE IF "RETI"
FD85  36 4E             0879        LD    (HL),'N'  ;ELSE OVERWRITE "I"
FD87  C9                0880        RET
FD88                    0881 ;
FD88                    0882 ;
FD88  10 16             0883 NOTRET: DJNZ NOTIM     ;TEST AGAIN
FD8A                    0884 ;
FD8A                    0885 ; SET INTERRUPT MODE
FD8A                    0886 ;
FD8A  E6 07             0887        AND   7         ;ISOLATE ID
FD8C  28 07             0888        JR    Z,IM0     ;JUMP,MODE 0
FD8E  3D                0889        DEC   A         ;ADJUST CODING
FD8F  28 47             0890        JR    Z,NOTVAL  ;NOTVALID IF 0
FD91  FE 03             0891        CP    3         ;>2?
FD93  30 43             0892        JR    NC,NOTVAL ;YES,NOTVALID
FD95  F6 30             0893 IM0:   OR    $30       ;MAKE ASCII
FD97  EB                0894        EX    DE,HL     ;NOW WRITE IT
FD98  36 49             0895        LD    (HL),'I'
FD9A  23                0896        INC   HL
FD9B  36 4D             0897        LD    (HL),'M'
FD9D  23                0898        INC   HL
FD9E  77                0899        LD    (HL),A
FD9F  C9                0900        RET
FDA0                    0901 ;
FDA0                    0902 ;
FDA0  FE EC             0903 NOTIM: CP    $EC       ;IR OR RRD/RLD?
FDA2  38 15             0904        JR    C,IR      ;JUMP IF IR
FDA4                    0905 ;
FDA4                    0906 ;  RRD RLD
FDA4                    0907 ;
FDA4  21 B3 FD          0908        LD    HL,RRDM   ;POINT TO "RRD"
FDA7  28 07             0909        JR    Z,WRRD    ;JUMP IF "RRD"
FDA9  FE ED             0910        CP    $ED       ;IS IT "RLD" THEN?
FDAB  20 2B             0911        JR    NZ,NOTVAL ;NO,JUMP
FDAD  21 B6 FD          0912        LD    HL,RRDM+3 ;YES,POINT TO "RLD"
FDB0  C3 23 F9          0913 WRRD:  JP    COPY3     ;WRITE IT
FDB3  52 52 44 52       0914 RRDM:  DB    'RRDRLD'
      4C 44
FDB9                    0915 ;
```

To be continued.

BLUDNERS

October Benchtest - 'At a glance' value for money rating for the Cromemco should have been four stars, not three.

October Programs - In 'Pet Breakout', 1,2 and 3 in the listing mean home, cursor left and clear screen respectively.

October - okay, okay, cardinal sin of the month.... we left our address off the Contents page.

November - Apologies for not adding 'to be continued' to John Moore's 'Bugging the 6800 (completed in this months programs).

November - Young Computer World had a bug or two. The TI-57 (not T157) program contained the following errors:
Line 7 redundant; line 25 should read INV X = T; line 27 should read RCL 1.

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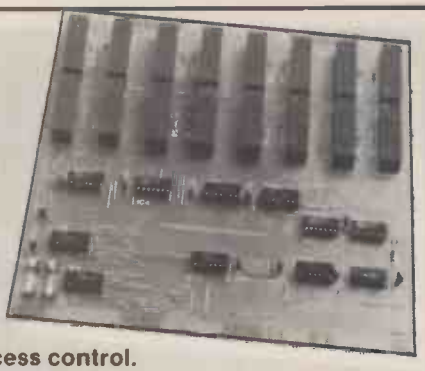

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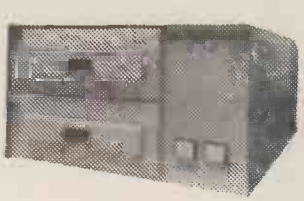

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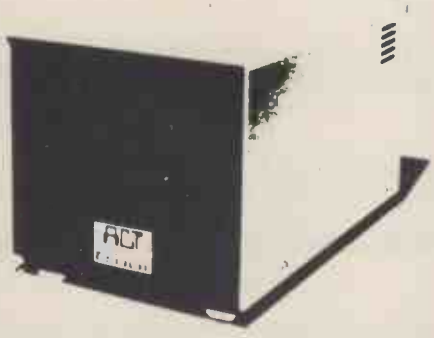

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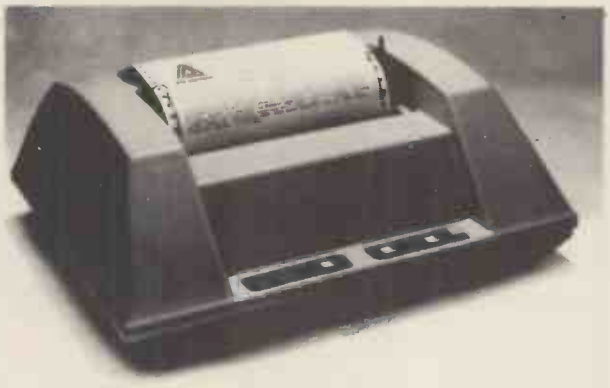

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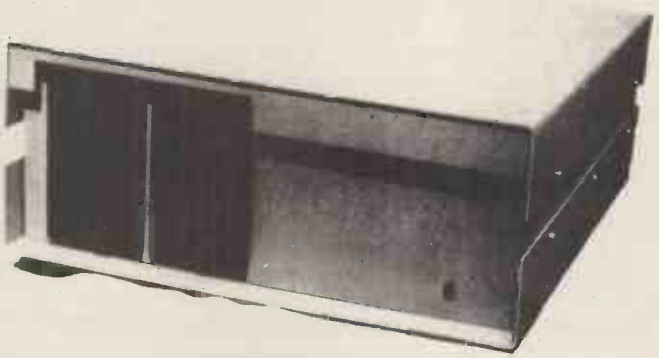

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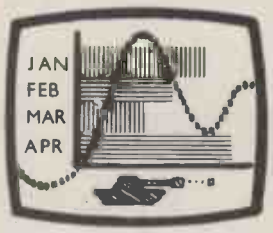

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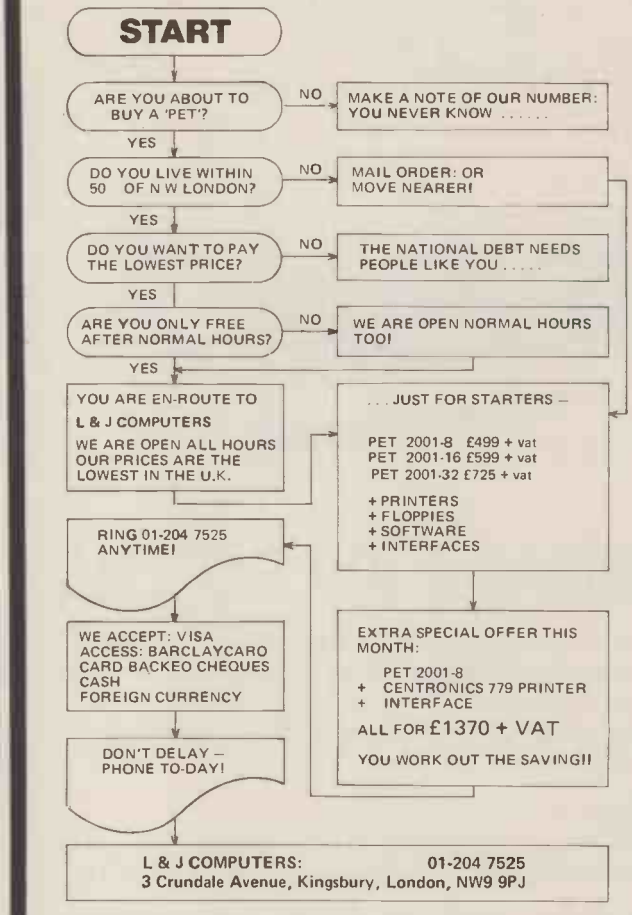

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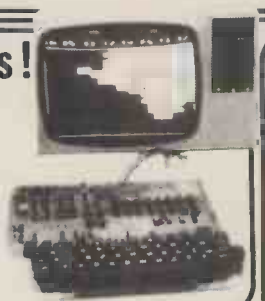

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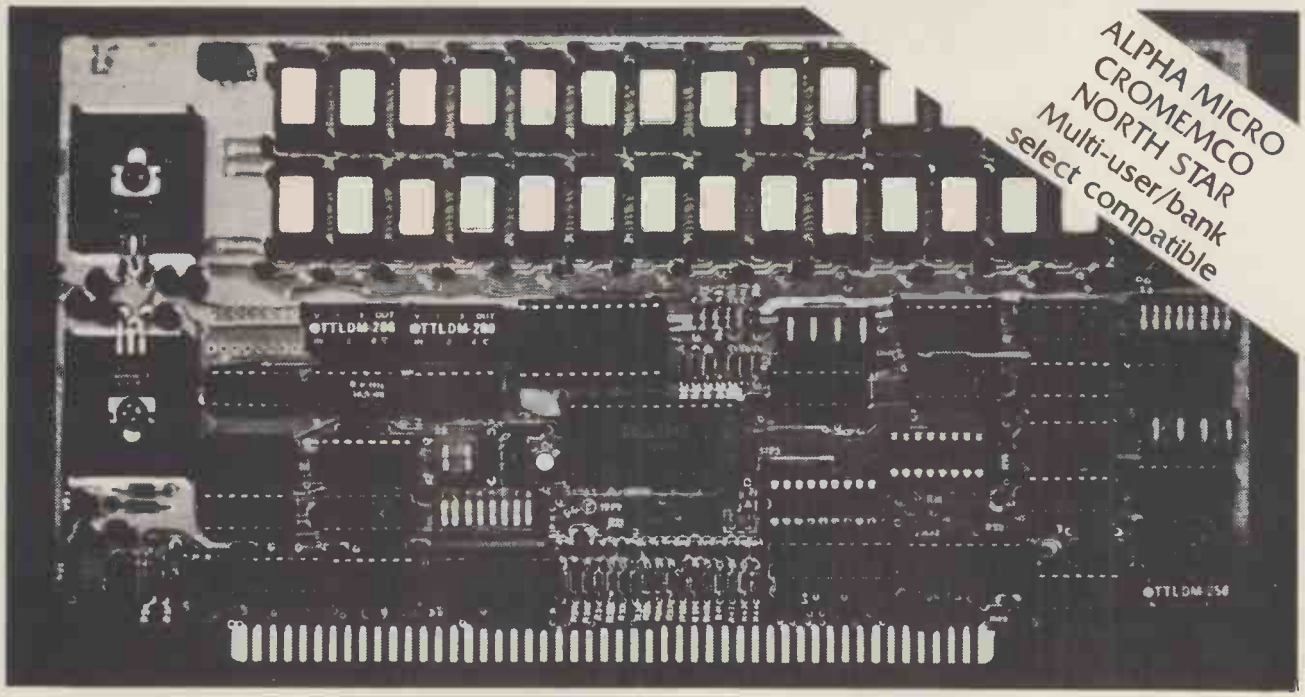

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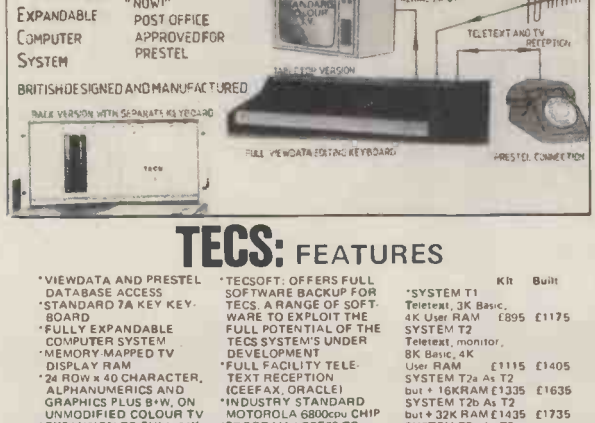

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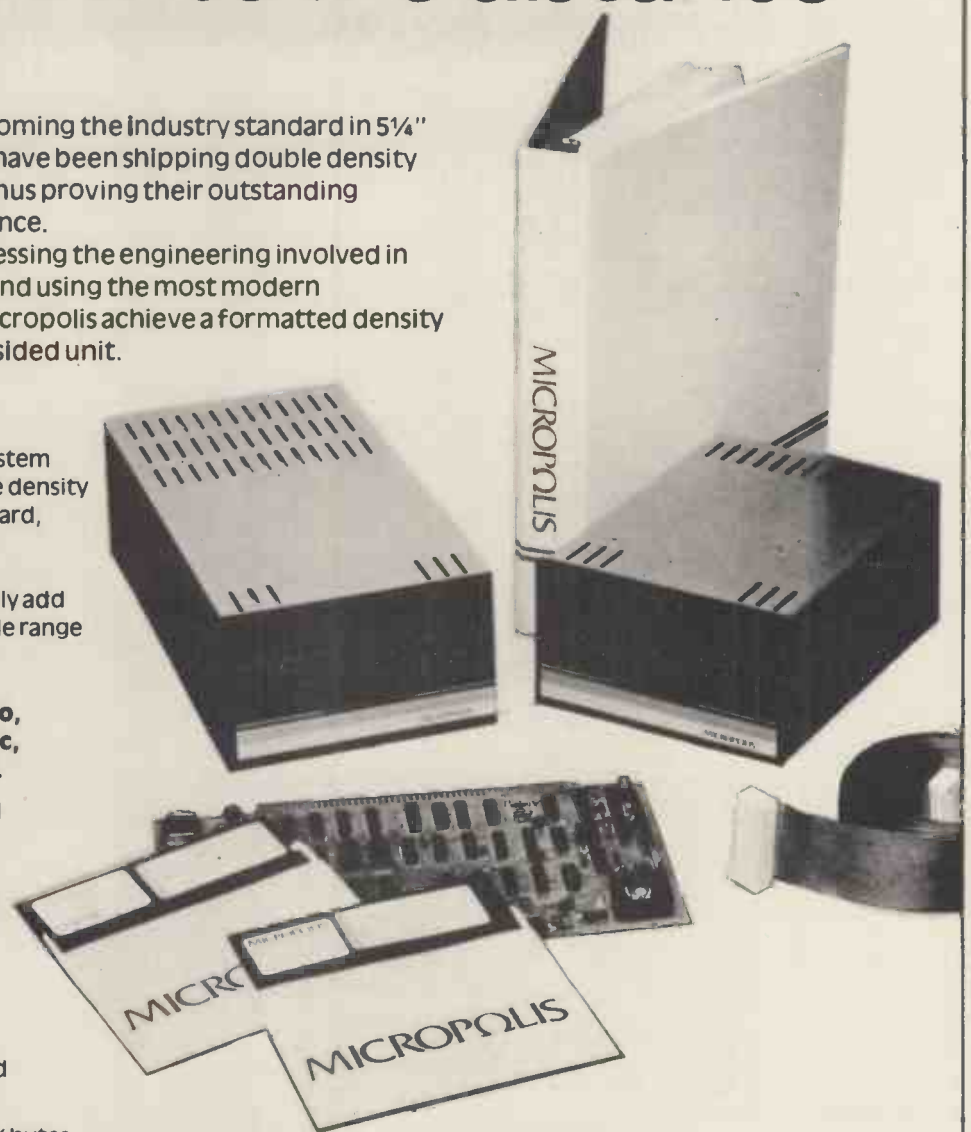

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I.O.
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The cassette interface is Kansas City standard at either 300 or 1200 baud. This is a link option on the NASCOM-2.
The RS232 and 20mA loop connector will interface directly into any standard teletype.
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The 1K video RAM drives a 2K ROM character generator providing the standard ASCII character set with some additions, 128 characters in all. There is a second 2K ROM socket for an on-board graphics package which is software selectable. Gives another 128 characters.

DOCUMENTATION
Full construction article is provided for those who buy a kit and an extensive software manual is provided for the monitor and Basic.

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COMMANDS

CONT	LIST	NEW	NULL	RUN

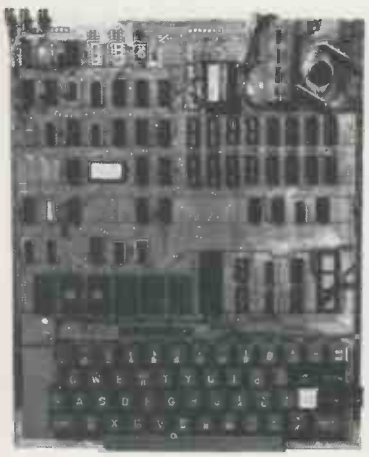
STATEMENTS

CLEAR	DATA	DEF	DIM	END	FOR
GOTO	GOSUB	IF..GOTO	IF..THEN	INPUT	LET
NEXT	ON..GOTO	ON..GOSUB	POKE	PRINT	READ
REM	RESTORE	RETURN	STOP		

EXPRESSIONS

OPERATORS
. + - / ↑ NOT.AND.OR. > < . <> . > = < = RANGE 10^{-32} to 10^{+32}

VARIABLES
A.B.C. .Z and two letter variables
The above can all be subscripted when used in an array String variables use above names plus $.e.g.A$



*8K Microsoft Basic means conversion to and from Pet, Apple and Sorcerer easy. Many compatible programs already in print.

SPECIAL CHARACTERS
@ Erases line being typed, then provides carriage return, line feed.
Erases last character typed.
CR Carriage Return — must be at the end of each line.
: Separates statements on a line.
CONTROL/C Execution or printing of a list is interrupted at the end of a line.
"BREAK IN LINE XXXX" is printed, indicating line number of next statement to be executed or printed.
CONTROL/O No outputs occur until return made to command mode. If an Input statement is encountered, either another CONTROL/O is typed, or an error occurs.
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FUNCTIONS

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

STRING FUNCTIONS

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

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