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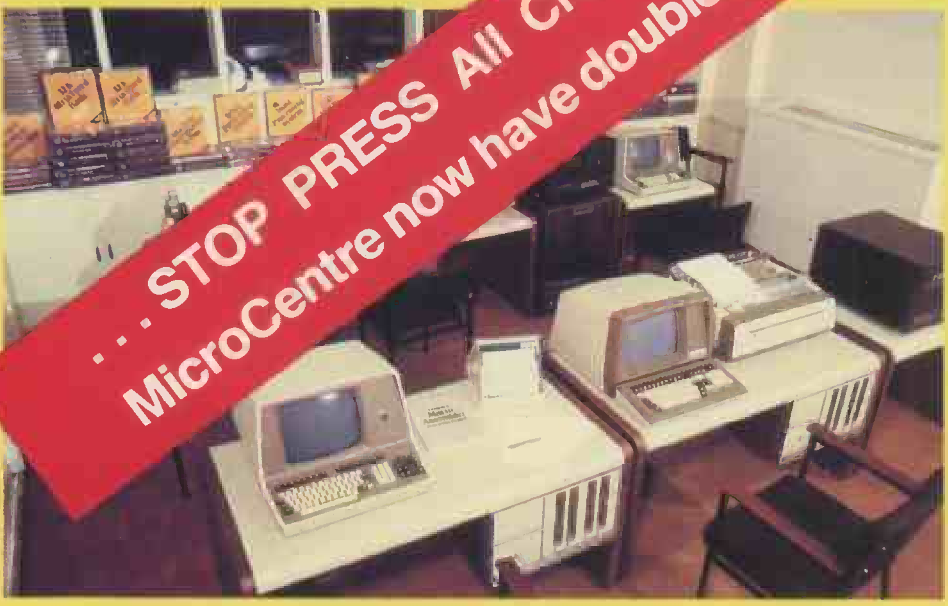

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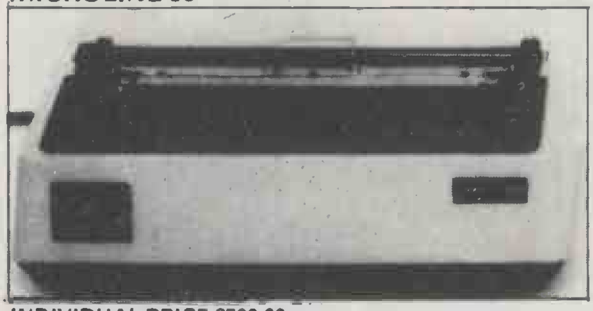

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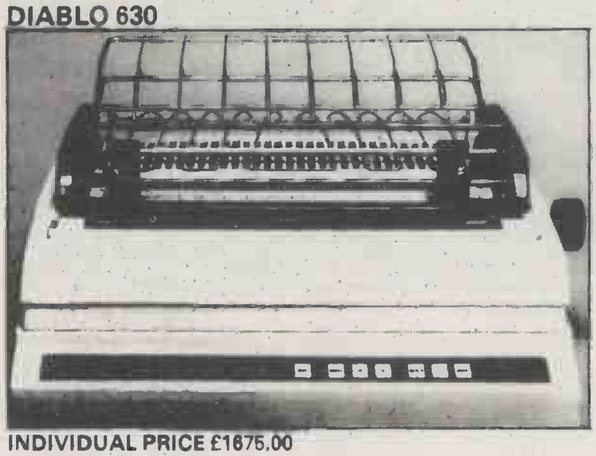

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Apple is providing FORTRAN for use by technical professionals and educators who are both familiar with the FORTRAN language and are using packages written in FORTRAN. Because FORTRAN is a well-established language, large libranes of FORTRAN programs are already in existence, particularly for engineering and scientific applications. Apple FORTRAN provides the sophisticated FORTRAN user with the capability to develop new and modify existing FORTRAN programs on an Apple. Apple does not recommend FORTRAN for the individual new to programming.

Apple FORTRAN...

- *offers enhanced features and capabilities because it supports the newest computer industry standard, ANSI X3.9-1978...*
- *provides a comprehensive software design environment including an editor, linker, file handler, assembler, Apple Pascal compiler, and system library, operating in the Apple Language System*
- *eliminates the need to recompile or reassemble existing code files when incorporating them into FORTRAN programs; compiled P-code and assembled machine code can be combined with a FORTRAN P-code file through the Apple Language System's linker facilities...*
- *allows you to take full advantage of Apple's Hires graphics capabilities by interfacing to graphics routines in the system library...*
- *gives programmers access to large libraries of material, since FORTRAN is a familiar, well-established language...*
- *provides access to special Apple features,such as sound generation and control paddles,through its system library routines...*
- *permits you to combine several source files in a single compilation through compiler directives in the source code.*

First, Some Words About FORTRAN '77

FORTRAN 77 contains significant additions and enhancements to the previous 1966 standard For example, mixed-mode arithmetic expressions are allowed Structured programming is supported through expanded IF statement constructs Logical IF, Block IF, ELSE IF, ELSE and END IF statements provide a vastly improved method of clearly and accurately specifying the flow of program control. CHARACTER data type replaces Hollerith, alphanumeric data can be represented as strings rather than array elements.

Some Specifics About Apple FORTRAN

Apple FORTRAN is the ANSI Standard Subset FORTRAN 77. It also supports enhancements and facilities from the full FORTRAN 77 language In particular

- Subscript expressions may include array elements and function calls
- DO statement limits may be defined by expressions, rather than just single variables.
- I/O units may be specified by expressions, rather than just constants or simple variables
- The I/O list of a WRITE statement may include expressions
- All combinations of FORMATTED/UNFORMATTED and SEQUENTIAL/DIRECT files are allowed, with the following restrictions:
  —BACKSPACE is supported only for files connected to the blocked devices, it is not supported for UNFORMATTED SEQUENTIAL files; —
  —DIRECT files must be connected to block devices

Apple FORTRAN contains a number of enhancements beyond the full FORTRAN 77 specifications In particular

- Compiler directives may be included in the source code For instance, the $INCLUDE directive allows you to insert previously-developed code into your program without having to repeat the code This is useful, for example, when you are writing many subroutines which use the same COMMON block You can write the COMMON block just once, and $INCLUDE it in every subroutine.
- An additional parameter to the OPEN statement allows you to specify whether the file is blocked or unblocked

There are two minor differences between the ANSI Standard Subset FORTRAN 77 and Apple FORTRAN They are

- Subprogram names cannot be passed as parameters
- INTEGER and REAL data types have different storage requirements—two bytes for INTEGER, four bytes for REAL

Apple FORTRAN is written in Pascal and produces P-code which runs in the Apple Pascal Operating System

Diskettes: 16 sector format

To use Apple FORTRAN, you will need:

- Apple II or Apple II Plus, each with the Apple Language System.
- Apple Disk II drive with controller*
- video monitor or television

*While a single drive system is adequate for very small programs, two drives are strongly recommended for ease of operation and more serious program development

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Literally thousands of CP/M based applications can be easily transferred to run on the Apple. It is simply a matter of converting programs from standard 5" and 8" CP/M disk format into CP/M disk format. This is done by transferring CP/M files from a CP/M machine to the Apple via a serial I/O port. You'll need an Apple High Speed Serial interface or an Apple Communications interface; a connecting cable; and, of course, a CP/M machine from which to transfer. Utilities that make this process easy are supplied with the Z-80 SoftCard.

USING PERIPHERAL WITH THE Z-80 SOFTCARD

A Z-80 SoftCard system will run with all standard Apple peripheral I/O cards and most independent peripherals including any printer that is supported by Apple printer interface cards. Since CP/M provides the same I/O environment as Apple Pascal, a good rule of thumb is that the SoftCard will interface with any peripheral that currently works with Apple Pascal.

The Z-80 SoftCard will support up to six disk drives. 24 x 80 column video cards such as the Videx and Sup-R-Term are supported as are most popular 80 column terminals such as those from Hazeltine and Soroc.

In addition, user I/O drivers can be easily added to CP/M.

WHY CP/M?

Next to the SoftCard itself, CP/M is the most important key to allowing a wide variety of Z-80 software to run on the Apple including version 2.2 of the CP/M operating system in the SoftCard package.

More soft-ware choices for the user. You have your choice of many sophisticated system, word processing, accounting, business and professional software packages when you have CP/M.

Unlike standard Apple DOS, CP/M supports many languages in addition to BASIC. These include FORTRAN, COBOL, BASIC Compiler.

And CP/M has many conveniences not found in Apple DOS. Such as easy interface to machine language programs; faster disk I/O simple file transfer; and wild card file-narning conventions that allow you to refer to multiple files with one name.

Included as standard with CP/M 2.2 is a complete set of system utilities that give you complete control of the CP/M operating environment. These include PIP, a general purpose file transfer utility and STAT, a program that lets you keep track of important system information such as disk space and file size. SUBMIT and XSUB allow you to execute batch processing jobs. And a powerful text editor, assembler, and sophisticated assembly language debugger, are also included.

The Z-80 SoftCard is not an emulator. It is an actual Z-80 chip plus interfacing circuitry on a circuit board that plugs directly into any of the slots on your Apple (except slot 0).

The Z-80 does not replace your 6502; it adds to it. You use Z-80 mode when you want to run Z-80 software. Switching back and forth is simple.

When you are in Z-80 mode, the Z-80 assumes all the processing tasks, but the 6502 continues to handle I/O. Thus, you can still use most Apple peripherals when you are in Z-80 mode.

MEMORY REQUIREMENTS

To run the Z-80 SoftCard requires a disk-based Apple II or disk-based Apple II Plus computer with at least 48K RAM memory. If used with a Language Card, 12K additional RAM can be utilized.

Whether you have a 48K system or a 60K system with Language Card. 4K of RAM is required to handle the Apple screen and CP/M sector read and write routines.

CP/M occupies 7K of RAM, 2K of which can be used by other programs, such as BASIC. The standard versions of Microsoft BASIC, which supports all Applesoft extensions except high-resolution graphics, requires slightly more than 24K RAM. So BASIC and CP/M together occupy just over 29K RAM.

The version of BASIC that supports high-resolution graphics is somewhat large because 8K of screen memory is necessary for high-resolution graphics. It occupies just over 33K, making a total of slightly more than 38K for both CP/M and the high-resolution version of BASIC.

BEYOND MICROSOFT BASIC

Microsoft 5.0 BASIC is provided with the Z-80 SoftCard. Microsoft FORTRAN, COBOL, BASIC Compiler, and Assembly Language Development System will be available and sold separately to Z-80 SoftCard users.

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Microsoft FORTRAN-80.Comparable to the FORTRAN compilers used on large mainframes and mini-computers. Microsoft's FORTRAN-80 brings the world's most popular science and engineering programming language to the Apple. Compilation is very fast (up to several hundred statements per minute) and less than 25K bytes of memory are needed to compile most programs. All of ANSI FORTRAN X3.9-1966 is included except the COMPLEX data type. Therefore, you may take advantage of the many application programs already written in FORTRAN:

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Microsoft COBOL-80. The most widely used language for business applications, COBOL is excellent for inventory, personnel, payroll, order entry, accounting and forecasting applications. Powerful use of disk files, CRT screen handling, easy-to-use syntax and readable programs give programmers the tools they need to meet the rising challenge of data processing. Microsoft's COBOL-80 is an ANSI standard COBOL with many enhancements.

Z-80 SOFTCARD PRODUCT SPECIFICATIONS

The Z-80 SoftCard is a plug-in processor card for the Apple II. The SoftCard package includes the CP/M operating system and Microsoft 5.0 BASIC.

The Hardware:
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Clock Rate
Addressing Options
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Power Consumption
Size
Selecting Z-80 Mode
Installation
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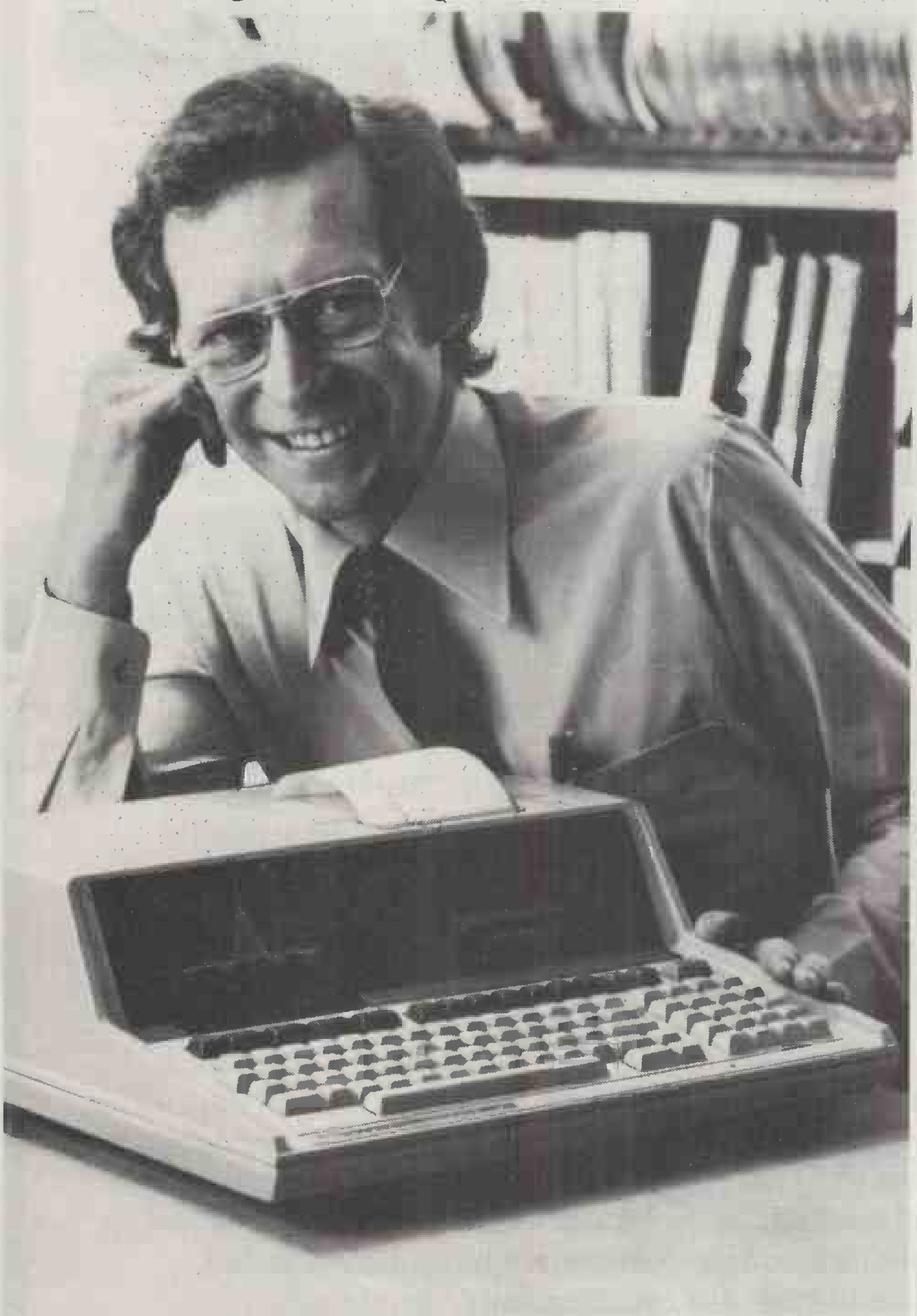

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03=*ENTER PURCHASES	15=*PRINT AGENT STATEMENTS . . . .
04=*ENTER A'C RECEIVABLES	16=*PRINT TAX STATEMENTS. . . . .
05=*ENTER A'C PAYABLES	17=GENERAL HELP. . . . .
06=*ENTER'UPDATE INVENTORY	18=ALTER VOCABULARIES. . . . .
07=*ENTER'UPDATE ORDERS	19=PRINT YEAR AUDIT. . . . .
08=*ENTER'UPDATE BANKS	20=PRINT PROFIT'LOSS A'C . . . .
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10=*REPORT PURCHASE LEDGER	22=PRINT CASHFLOW FORECAST . . . .
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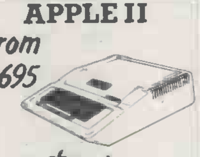

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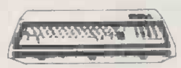

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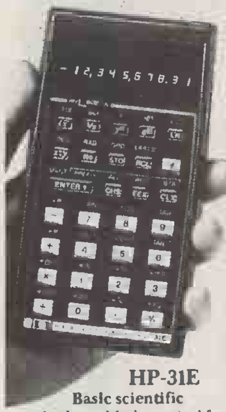

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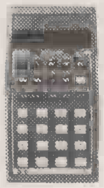

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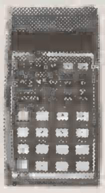

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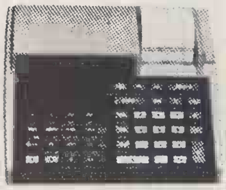

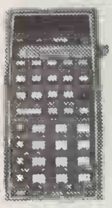

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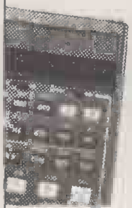

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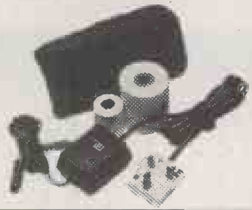

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For many people a disk machine is too expensive – but at least the 380Z approach will allow your students to advance.

380Z BASIC is not frozen in ROM. An enhanced BASIC could be loaded in mid 1980 and a BASIC with structured features sometime later.

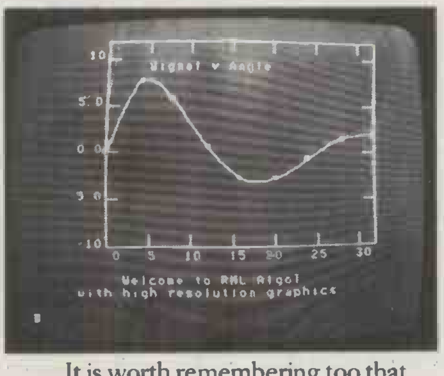
On the 380Z the memory used by a BASIC interpreter can also be used for other software.

Does our research-oriented design pay off in classroom hardware?

Our scientific graphics was produced for the professional user. Interest in it for classroom use has been surprising.

The 380Z has the best graphics now available on a microcomputer, allowing multiple resolutions, multiple paging, fading and accurate control over colour. All these features help bring excitement to efforts in computer assisted learning.

Our standard machine comes with low resolution graphics and support for this from BASIC allows you to plot a point directly with a plot command – useful for training and teaching.



It is worth remembering too that neither our low resolution graphics nor our optional scientific (high resolution) graphics has any limiting effect on your memory usage, and in both you can freely mix upper and lower case text and diagrams.

Mains noise can cause system crashes which result in loss of programs and data. All current 380Zs include a mains filter which significantly reduces the chances of this happening.

Don't buy a 380Z on patriotic grounds.

Please only buy it if you would have bought it anyway. But remember, because it is designed and manufactured here you are bound to have better access to us for influence and help than if we were on the other side of an ocean.

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- Plug in ROMPAC cartridges for programming languages, special applications (e.g. word processing) or creating a user's dedicated system. Sorcerer is supplied with 8K Microsoft BASIC ROMPAC
- Composite video output for video monitor or UHF output for use with an unmodified TV set at nominal extra charge.
- Z80 CPU with up to 48K RAM on-board.
- 4K power-on monitor in ROM allowing machine code programming, batch processing, memory transfers and copying, alteration of memory locations, use of cassette files.
- Dual 300 or 1200 baud cassette ports with motor control
- Parallel I/O port and serial RS232 port for direct connection to printers or use as a terminal to a larger computer - no expensive 'extra' communications interfaces
- Full upper/lower case ASCII characters plus 128 user programmable graphics (64 default to standard graphics symbols if undefined). Default graphics above ordinary characters on keytops.

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- 6 slot S100 expansion for memory up to 56K RAM, disc drives (5¼" or 8") etc. Standard bus means that you are not dependent on equipment from a single manufacturer **£240.00**
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  First drive (incl. controller card) single 315K **£690.00**
  Additional drives (max 4 drives/controller) 315K **£390.00**
- FDM 180 Disk Unit: Micropolis Disk Drive, plugs directly into Sorcerer, does not require S100 Unit:
  Single 315K Disk Drive (c/w CP/M and Microsoft BASIC) **£599.00**
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Programming Languages

The following programming languages are available for CP/M:

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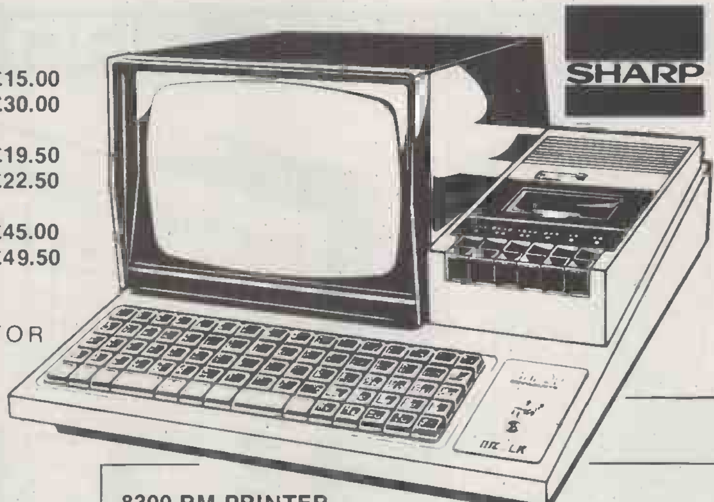

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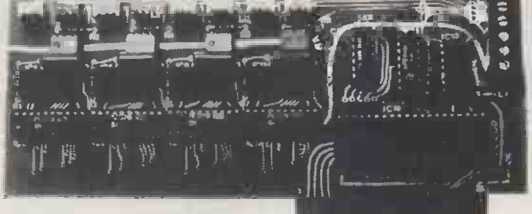

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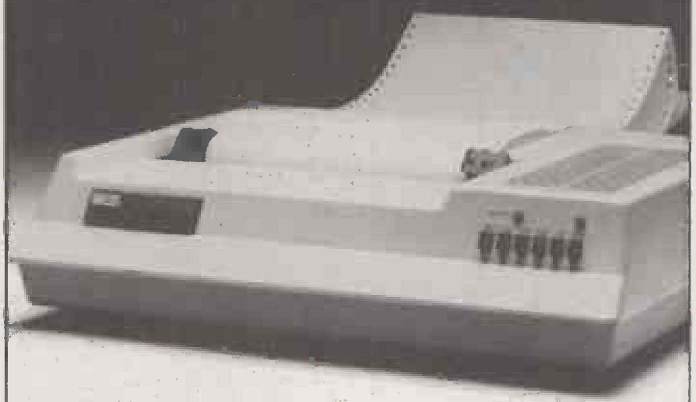

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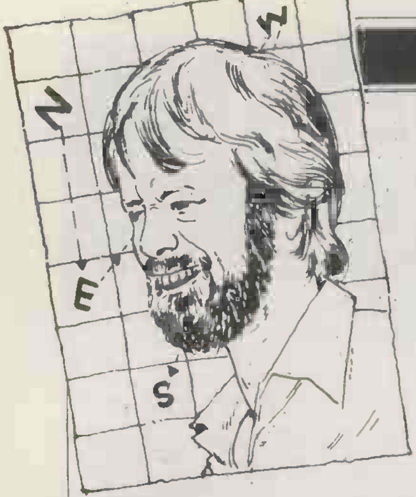


NEWSPRINT

Guy Kewney, Editor of Datalink, *brings his usual enjoyable assortment of news, rumours and gossip from the microworld.*

Why are we waiting

Loyalty to one's employer is admirable but I should like to take this opportunity of pointing out to Kit Spencer of Commodore that loyalty can also get your company into trouble.

At the time of writing, 90 days plus ten have elapsed from the date when I last spoke to Kit. An odd way of measuring time, you may think. It is not my choice, I would reply — it is the lovable Kit's. On that occasion I recall asking him, very politely, if he could let the world know when Commodore's new disk, number 8050 (pronounced AT50) would actually be available to buy, in shops.

It was an important question. Many people who write programs for the new SuperPET, wanted to sell these programs to users. To sell them, they had to prepare simple production plans: we will launch, they might say, in September, and we will make 1000 copies on the old disk and 2000 on the CompuThink drive, and maybe 500 on the new 8050. So they really need to know when the 8050 will be available.

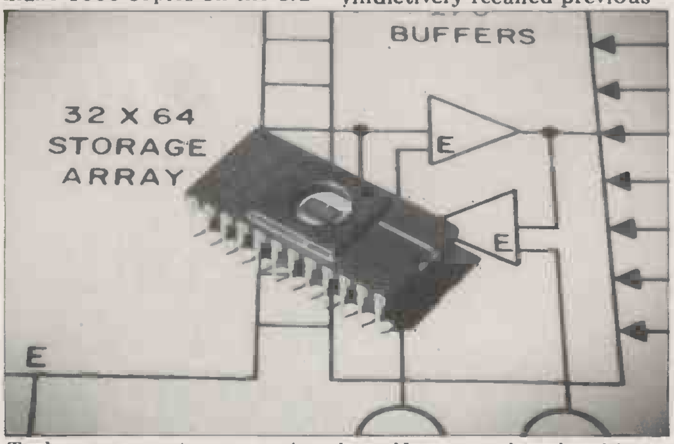
Kit Spencer's first lovable response was that the 8050 "was announced already," which wasn't quite what I was trying to find out. It had been officially announced a couple of weeks before, at the PET Show, but many people there had whispered anxiously of rumours that it would be delayed because of "problems".

I mentioned these rumours to Kit who told me: "There is no delay, it is on 90 days delivery, which means we'll be shipping them in the first week of September."

To cut a long story down to bearable length, I didn't believe him, and I believed the people who said "all the parts have been cancelled until Commodore irons out a bug in the drive," and who vindictively recalled previous Commodore delays on machines, software and peripherals. And I printed my misgivings here in PCW with an offer to withdraw them unconditionally as soon as I heard evidence that the bugs were indeed ironed out, that the parts were indeed ordered, and that production had started.

So, 90 days and ten days later, I have to report no evidence. Dealers both here and in America report that they are still being promised 90 day delivery on the 8050. And an inside source says he gathers that CBM ironed out the bug, or at least says it now knows how to fix it.

It seems such a small point. Yet, if Commodore could only concede such small points when they arise, all it would lose would be some small market advantage in the disk drive segment. Other people (like the hated CompuThink) could gear up for larger runs and supply drives (with a whole different set of bugs, of course) before Commodore, perhaps. On the other hand, if Kit Spencer could say, "Yes, we are bit late, but we'll give you all the warning we can," or even, "Sorry, I'm a marketing guy and I don't know what the production problems are, buddy," then software suppliers would not be left wondering what the hell to do over their launch plans. Instead, loyalty says: "The company is right."



Truly permanent memory is a drag. No sooner has the chip factory produced the 28,000th copy of a memory containing your clever code than the users all start finding bugs in it. Hence the well-known trick of using eraseable permanent memory (EPROM) until everyone is happy.

Put your hand on an EPROM chip while it's working and you will notice that it's not the sort of thing you want to connect to your average HP9 battery. It gets hot — it will drain the battery of power in no time flat (if I may use the word).

So that's why it is very clever of RCA to make a CMOS EPROM circuit, which uses very, very little power indeed. The RCA chip offers a measly 2 kbits, usable as 256 bytes, so don't try and load it with a Basic program. And it does cost £22 per chip (if you buy 100 or more). But it will fit in a battery powered system, which means a portable system so I predict RCA will sell a lot.

Going up and coming down

The silliest thing the micro business can possibly do is to go 'up market.' Tempting, rewarding and apparently lucrative though it may be, the people who today are investing in teak-topped desks, matt finish ironware, and 'quality business software' are the ones to avoid. They're all doing it because the computer industry wants it but they're mad. To illustrate how pernicious the dangers are, I'm going to quote from a well known scapegoat of the orthodox computer industry, International Computers Ltd, or ICL.

This company normally makes gigantic mainframe machines which have too few users to get the operating system sorted out in less than ten years. It has learned from its mistakes, up to a point, by launching a much smaller machine, called a 2903, now obsolete, and by replacing it with a still cheaper (but bigger) machine called the ME29.

In launching this machine, ICL has been very aggressive, and has informed its salesmen that it is better than the opposition — a tactic denounced as questionable by people in the orthodox computer business, who are obviously short of an exciting headline. It has also been denounced for including the following advice: "Do not offer software tailored to the customer's problem, but sell a ready-wrapped, sliced package."

The first temptation in the path of the micro retailer who is moving up market is to say grandly to his customer: "It can do exactly what you want. You don't have to buy one of those dirty little £20 packages, instead you can have customised software at upwards of £500 a shot — and if it isn't quite right, one of our professional" (and here you can hear the swelling chest, the modest polishing of fingernails on the lapel "software programmers will write some special code for you."

On a cheap machine, you can spend your £500 buying software if you must, but if you must spend £500, do it by buying ten £50 packages and choosing the best. Get your own special program and all you have guaranteed are your own, special bugs. In offering its customers packages, ICL is doing them a big favour, as scarred veterans of the small business computer boom of the early seventies will remember with cold shivers. ICL can afford to develop packages for the ME29 because it is big enough to make and sell 5000 of the beast over the next three years and because the packages are grotesquely overpriced by our standards — but their customers have yet to catch up with the 20th century. UpMarket Micros, however, cannot.

So I'm very pleased to see that the National Computing Centre is offering guidance for small businesses who are planning to computerise. It may be able to stop some small businessmen investing in a 'prestige' computer which will convey about as much prestige as a Rolls-Royce radiator on a Mini.

Basic start

Teach yourself Basic by all means — but don't imagine that you will become a clever user of Beginners' All-purpose Symbolic Instruction Code without being taught a few of the tricks. A flying start is offered by Agar Computer Services in London, in the shape of a £57, two-day course. It aims to teach people with a desire to know "what a computer is, and how to program one." Details on 01-328 9232.

PET aid

A really good programmer ought to be able to write a program good enough to replace him and sell that program for more than the programs he would otherwise have written. On PET computers an attempt to replace — or at least 'de-skill' — the programmer has been made by Stage One Computers in Bournemouth.

It has launched a product called Petaid, which does useful program-building operations such as creating files, manipulating them and displaying reports derived from them. Stage One quotes figures to claim that the use of this sort of program building aid can reduce the time needed to develop an application program by 70%, "or in specific application areas by 90%."

All screen handling, disk handling, error control and so on "is already built into this package in subroutines," says Stage One. "Petaid also uses standard variables to ease program modification and enhancement." Existing users have found considerable time savings, the company says.

"And obviously, the common structure between all suites of programs and sites on which the system (the combination of hardware and software) is to be used, is of considerable advantage for support and subsequent maintenance and modification." Details on Bournemouth 23570.

Micro/terminal

The price of a microsystem which is 'only' a personal computer can be raised quite a bit if it can be sold to data processing managers in large computer installations as a 'mainframe preprocessing terminal".

Millbank's new micro — see 'Micro/terminal'.

A "brand new micro-computer from Millbank Computers, which will be very good value at just under £3000," according to its supplier, is obviously trading on this. It is a microsystem, all right, with such obvious features as the micro operating system CP/M and, like competing systems (the SuperBrain, for example), it comes off the shelf with a full memory bank of 64 kbytes, and an unusually large 700 kbytes of disk storage built into the box with the video screen.

That said, it costs roughly twice as much as the SuperBrain and the price seems to buy a whole set of "computer room options". These include interfaces which would allow the user to attach printer, modem, networks — and mainframe computers.

Nice features of the machine appear to include a calculator keyboard on one side of the typewriter keys — but for the programmer writing in Basic it would be much more useful to include the function keys for addition, subtraction division and multiplication and so on — like Hewlett Packard has done on the HP85.

Another useful option is an HPIB interface, which is what the PET uses to drive things like disks and instruments. But it's only an option, as is the high speed arithmetic processor, and it costs extra. Details on 01-799 1083.

Anybody listening?

If someone has laid out the money needed for a modem, which allows his or her computer to transmit down a phone line to another computer, one would expect that person to want a wide range of other people to get in touch with.

So far, the most promising idea along these lines in this country is still PCN (Personal Computer Network) being established by David Hebditch on behalf of a mere 200 or so potential club users. His idea is to enable them (as we've mentioned before) to dial up a central computer, which would be a sort of noticeboard plus exchange, and find out who else is available for conversation.

But no central computer service company with adequate telephone lines has yet been found to provide this noticeboard service. The most promising steps include two orthodox computer bureaux, which normally sell time on their machines to remote users with dumb terminals.

The latest to offer this idea as a way of filling in the slack hours after normal office nine to five is Systemshare, the Edinburgh-based bureau, which is offering an after-hours cutprice Microlink service on a Honeywell Level 66 computer, at 5p per minute.

It's a nice move, but Systemshare needs to offer microprocessor software (assemblers, editors, emulators and so on) and libraries of Petappletandy software before we get really worked up about it all. Details on 031-552 7601. Alternatively, maybe somebody would like to give us a machine . . .

Calculator news

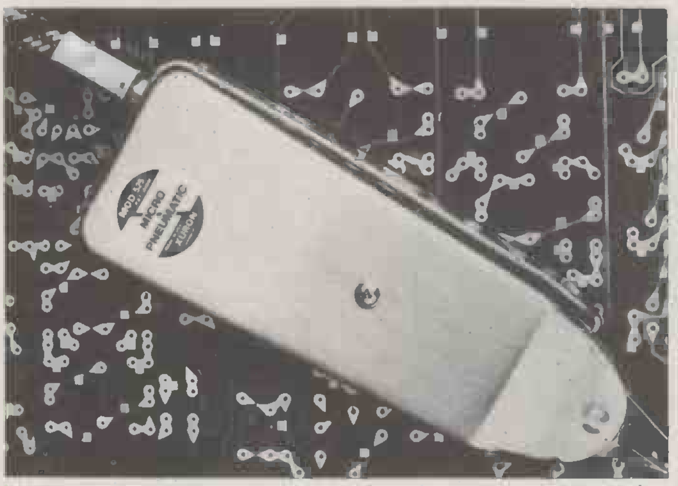
Following in Sharp's footsteps, National Panasonic has announced a pocket computer, using Basic, and of similar layout to the Sharp PC-1211.

Unlike Sharp, however, it appears that Panasonic intends to launch the RL-H1000 as a system, with plug-in modules for both ROM and RAM expansion, video interface, acoustic coupler and a printer. The machine should be available this autumn in the USA but no decision has been taken on UK sale and no prices are available.

And on the subject of Sharp, rumour has it that a printer will be available "soon" for the PC-1211.

Another contender in the pocket computer stakes is the Nixdorf LK-3000. This machine started life as a translator under the name of Lexicon (tested in PCW Dec 1979). Nixdorf is now offering the machine with modules other than translation modules. Those which may interest readers of this column are a calculator module, a "filing system" and an "electronic notepad" or "personal program" module, comprising 1k of CMOS RAM with its own processor and operating system enabling the storage

The reason the man in the picture looks so French is that he's using a French personal computer, made by Logabax. That configuration costs around £3500 and includes 64 kbytes of memory, 384 kbyte disk storage, separate video terminal and printer — a price which gives most petappletandy type systems a good run for their money. The video displays 2000 characters, for example. This is the model LX 500, now with more storage capacity, and billed as "the best selling personal computer in France, and selected by the French Government for its schools project, which will install one of the systems in every school in that country." Details 01-965 0061.



If you have pneumatic leads, then a pneumatic lead cutter, from Welwyn Tool, is just what you need for cutting them.

I think you blow like mad down the tube, and the cutters trim your pneumatics. Is that right? Have I missed the point? Why won't someone tell me what's going on? Details on Welwyn Garden 29121.

and retrieval of names files. In addition, an acoustic coupler and RS232C interface are available to allow the machine to be used as a portable terminal. The modules available, except for the "personal program", are all in ROM, and it does not appear at present that any facility exists for user-written programs. The basic machine is priced at £115.

Finally, some sort of prize for timeliness to Texas Instruments for announcing their newest Solid State Software module for the TI 58/59. This is a Pool Water Analysis Module which performs the calculations necessary for regulating the chlorine, etc, in your swimming pool. Those readers who are still employed and dissatisfied with the composition of their pool water will flock to buy.

Dick Pountain

Doctors' system

When doctors aren't being pestered by malingerers such as you or I, they spend a lot of time working out how much money they're owed by the DHSS. Not for them a regular paycheck at the end of each month but a hard slog working with a complexity of parameters which include how many patients they've got on their books and what they've done to them recently.

An obvious task for computerisation, you might think, and you wouldn't be alone in thinking that, for ABIES Informatics has launched a microcomputer system designed specifically for GPs, which "will revolutionise surgeries around the country, dramatically improving both business and clinical efficiency. . ."

It's based around an SWTP/09 system and costs from between £6000 and £9500 depending on whether you have floppy or hard disks; as well as doing the accounts and maintaining patient records — password protected, of course — it has a word processor which can print out specimen labels and prescriptions as well as circulars reminding patients that they need routine inoculations or tests. And, as an option, the system can support MICKIE, the medical interviewing package developed at the National Physical Laboratory. Details from ABIES on 01-491 7507.

Big spender

The man who will spend the Government's £9 million on education has been named. The name is Fothergill.

He has been appointed as director of the national development programme of microelectronics in schools and colleges, by the education departments of England, Wales and Northern Ireland (Scotland has its own ideas).

Now the interesting thing about Fothergill, apart from the fact that he is "well known in the field of educational technology," is the fact that is he currently head of Petras at Newcastle. This information comes to you from the Council for Educational Technology for the United Kingdom, who don't seem to think we ought to know what Petras is (are). Rather than spoil the illusion, I shall leave it like that: faintly mysterious, rather wonderful, and ever so significant. Don't you think?

Anadex cure

A couple of months ago I moaned in these pages about a fault in the new Anadex DP-9500 series printers — at high printing speeds characters tended to get 'lost'.

The people at Anadex weren't too happy when they read it, not because they're ultra-touchy or because they'd been trying to cover it up, but because in the interval between my writing that piece and the appearance of the magazine, they'd found a way to fix it — by modifying the software contained in the printer.

So, machines with serial numbers from D006670 onwards (for the DP-9500) and D003311 (for the DP-9501) have been modified. And if you've an earlier machine which loses characters at high speeds, contact your supplier and he'll fit a modified EPROM at no charge, says Anadex.

If you're thinking of buying a DP-9500 but you don't need its full 132-column printing width, you'll be interested to hear that Anadex is about to launch a series of 80-column dot matrix printers (designated the DP-9000 series) with high-density graphics, alphanumerics with descenders and underlining, and condensed and double-width printing. I assume they've been thoroughly tested at full speed. . .

Wizard utilities

In much the same way as Penguin paperbacks are boxed thematically, Liveport has packaged £370 worth of software for the Sorcerer.

The software is the sort of useful background programming that makes loading and running of programs easy: it includes the universal CP/M disk operating system for getting data and programs on and off floppies, plus two programs to interpret your own Basic code — versions 4.5 and 5.0 of Microsoft's interpreter — and assembler software to enable you to write in detailed machine level code. Then there is also a set of routines to let you copy disks and to load different programs and link them together, plus 'utility programs' enabling the user to convert cassette files into disk files, so that they can be used with the above software.

According to Liveport, of Ivory Works, St Ives, Cornwall TR26 2HF, this all costs £220. Details on 0736 798157.

PET pep

Assuming you have one of the nice, old PET disks, you can now go out and buy something to speed up your program writing power.

The idea on which this software product is based comes from traditional mainframe programming. Not all ideas derived from mainframe programming are useless — the mainframe programmer may be blinkered into thinking that his screen must be a ten characters per second teleprinter, or that other users sharing the computer may get in the way — but he has learned several tricks of writing his creepy programs and the basic one is: plagiarise.

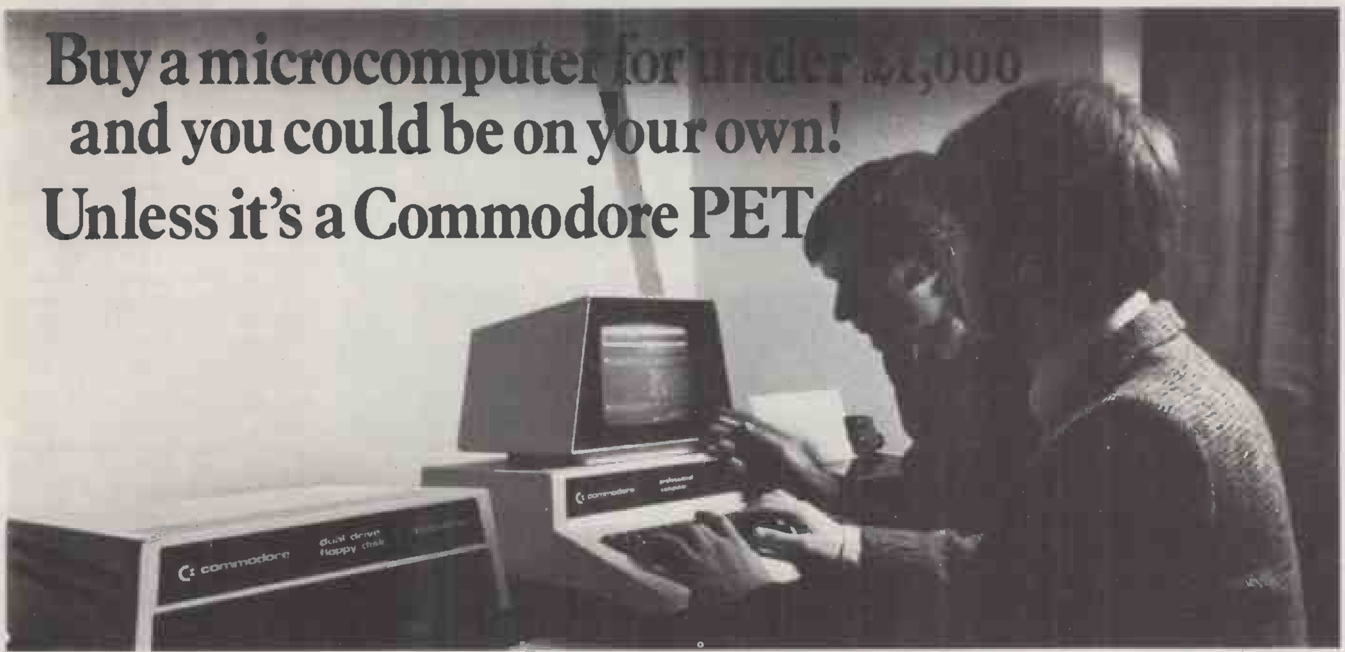
They all keep libraries of frequently-used routines in reserve, and whenever they need to do something they've done before, just call it up as a routine from the library.

'Linker' is now available on the PET to merge your commonly used routines into Basic programs. Things like random file accessing, sorting, report printing, matrix inversion, account interrogation and so on, can be pulled into your program without serious effort. Of course, it won't help until you've written all those routines . . . or borrowed them. Details from Dovetail Computer Systems on (0254) 665867.

It takes a good deal of nerve to submit a photograph of a PET saying "Hytruss".

It is apparently symbolic of the fact that Hydro-Air, which has "65 trussed rafter fabricating companies in Britain and Ireland," is using a PET to calculate the designs of its roof trusses. It provides the PET-based calculations to these companies. It is, in fact, a software announcement.

Buy a microcomputer for under £1,000 and you could be on your own!
Unless it's a Commodore PET.



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Our software range covers hundreds of applications. Business software includes Sales and Purchase Ledgers, Accounting, Stock Control, Payroll, Word Processing and more. In addition over 50 Petpacks are available covering such titles as Strathclyde Basic Tutorial, Assembler Development System, Statistics, plus our Treasure Trove and Arcade series of games.

Commodore Approved Products
Compatible products of other manufacturers with Commodore's mark of approval are also available.

Commodore Courses
Commodore offer a range of residential training courses and one day seminars. An excellent start. And when you have installed your system the PET User's Club Newsletter can keep you informed of new ideas and latest developments.

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Do you own a PET? YES☐ NO☐

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This list covers dealers participating in our advertising.

Software comparisons

Evaluating software packages is no easy task — it requires plenty of staff or lots of time, and there's always the chance that, unless you produce your report very quickly, the package will have been altered in some way or have become obsolete altogether. But the Small Systems Group, headed by Larry Press and based in Santa Monica, has embarked on this onerous task and has just announced its first report, an evaluation of word processing systems. The report looks at Auto Scribe, Electric Pencil, Magic Wand and Wordstar, and costs $12 from SSG at Box 5429, Santa Monica, CA90405.

Okay, I give up. I'm not even going to attempt to write a funny caption for this photo, which shows a person playing with a Nixdorf calculator/translator thing. If anyone cares to send in a suitable caption (in no more than ten paragraphs), I'm sure the Editor will think of a suitable prize for the wittiest — anyone sending in "I'm only here for the beer" will be shot.

MilSpec from Zilog

If you're building your own cruise missile in your garage but you're stuck for a suitable CPU with which to control it, then cheer up — Captain Zilog has come to the rescue with military specification versions of the Z80 and its supporting chippery. Now you can develop that intelligent guidance software in the comfort of your living room, using your TRS-80 or Nascom, knowing that it will transfer directly to the missile's CPU. And for you really advanced constructors, there are also war-going versions of the Z8001 and Z8002 16-bit processors.

If you haven't a suitable software development system, then Zilog can help with that too, for it has just knocked between 10 and 15% off its MCZ-1 microcomputers; end-user prices now start at under £3000 for the floppy disk system and at under £9000 for hard disk systems. Details on 0628 36131.

Soft music

One of the better-sounding computer music systems is the alphaSyntauri computer-controlled digital synthesiser. It's a keyboard-plus-electronics unit which plugs into a 48k Apple equipped with suitable tone generators, and its manufacturer, Syntauri, of Palo Alto, recently announced an expanded version.

The latest alphaSyntauri allows the musician to choose between an eight-voice waveform controllable synthesiser using Mountain Computer Music System hardware and a three to 15-voice polyphonic instrument based on ALF oscillators.

Syntauri vice president Scott Gibbs calls it "the soft instrument" because it "means flexibility and control for both accomplished musicians and beginners. Software and hardware are independent. . . you can define your own sounds, your own instruments and reproduce them accurately."

The player can digitally record live from the 61-note keyboard (which can be tuned for "velocity sensitivity") and play the recordings back. Details on 0101 (415) 494-1017.

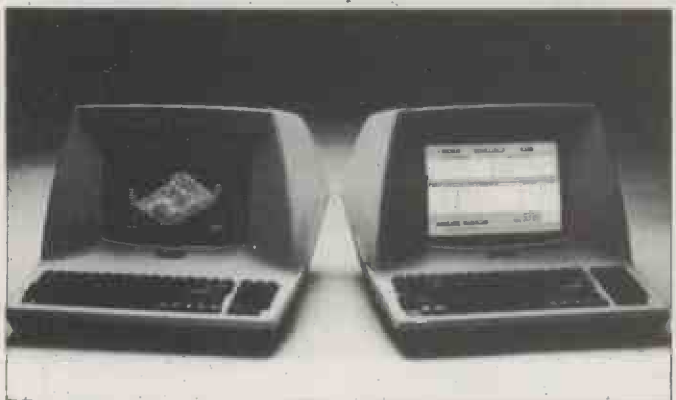
APL on Z plus

Users of the rather swish Micromation Z Plus system sold by Rostronics now have a new language in which to write programs. It is A Programming Language or APL.

Recently, a puzzled bystander asked (understandahly) *which* programming language. Any Programming Language? It is, in fact, a very nice language to use but not to see for the first time.

Its strength is that instead of long words like INPUT and PRINT USING, as provided by Basic, APL has instructions that are one odd-looking character long. It makes for opaque, esoteric looking programs which will scare off any casual onlooker, but then so will the body text of most Basic programs and you have to hit the keys a lot more often to type out PRINT USING or whatever, and it takes a lot more memory *and* it is also a lot less clever.

Details of this one (prices start at £3750) from MicroAPL Ltd of 19 Catherine Place, London SW1, tel: 01-834 2687. Rental costs about £280 per month.



Nice, aren't they? These are two new microprocessor controlled terminals from Data Type (the company which recently acquired Abacus), the DT2 and DT22. For alphanumeric displays, the terminals offer 12 x 10 character resolution on 24 lines by 80 columns and display the full 96 ASCII characters; there's a full qwerty keyboard with a 14-key numeric pad and the DT22 has a further 11 programmable special function keys plus six editing keys. With the graphics option — shown on the left here — you get 512 x 250 dot matrix plotting resolution; the display on the right shows the terminals' forms capability. Including the factory-fitted graphics option, the terminals start at £1300. Details on 063 33 69162.

A mixed up Bunch

Now here's a really earth-shattering fact: the company which publishes, PCW also publishes, among other things, a motorcycling magazine called *Which Bike?*

"So what?" I hear you chorus. Well, this would normally never get a mention on these pages, as the link between the two magazines usually goes little further than the Deputy Editor's futile attempts to scrounge free accessories for his Honda from his Which-Biking colleagues. But for Templeman Software Services of Stratford-upon-Avon (vendors of, among other things, 8inch floppy disk drives for the Apple/ITT 2020) the connection became a little more solid in their advert in last month's PCW; instead of inviting clients to meet them at the *Which Computer?* Show, the ad read: "See us at the Which Bike Computer Show".

Sorry! And yes, we've corrected it this month.

Confusing state

Michigan State University is not often found in Sidcup, Kent. The fact that it *was*, running a seminar on computer programming and education, is almost more stunning then the news that Tandy supplied 23 TRS-80 micros for the course.

The seminar was held in Loring Hall at the Goldsmiths College under the tuition of Dr Norman T Bell, an educational psychologist and professor in the college of education at Michigan State. He said: "Though it is possible to teach an entire course about computers without using machines, this course included continual use of computers, either large computers via terminals, or micros."

More importantly, 16 of the 23 TRS-80s were linked together under Tandy's new network system. That works very like the Ring that Acorn has announced on the new Atom — which is now past its first 1000 users after a long delay in getting deliveries going, by the way.

GINO on a micro

The GINO graphics family will soon be available on a microcomputer — the Research Machines 380Z for the first time. All facilities of GINO-F, GINO-2D and GINOGRAF will be included in the first release of the package which will be ready later this year.

Research Machines Ltd of Oxford is negotiating a licensing agreement with the CAD

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(Chess set and table not included) Code: CT

Centre in Cambridge. The CAD Centre implemented GINO on the 380Z using the Fortran IV Compiler already available on the system. Various peripherals will be supported. The system price of a Research Machines 380Z, including 1 Mbyte of floppy disk storage, to support GINO is about £4000. The GINO package will sell for £350. Details on 0865 49791.

Lost and found

Two hardware items were stolen from a car belonging to a director of Microtrend Ltd while it was parked outside the Cunard International Hotel during the PCW show in September. They were a Commodore 3040 dual disk drive unit, serial number 608041, and a Hazeltine 1520 VDU, serial number 300596-022. So if anyone offers you either of these items, or if they're brought into your shop for repair, contact either Jill Hebditch on 0423 711878 or DS Ball of Hammersmith CID on 01-741 6071.

And if anyone lost a computer at the show, they should contact the PCW office with details of its make, model number and serial number.

Educational starters

It is now possible to buy an awful lot of software for the PET but not, according to the British Computer Society at least, good educational software. "While this situation will no doubt improve in future," writes Trevor Lusty of the BSC Schools Committee, "the present problem still exists — some immediate aid is required."

Lusty's aid comes in the form of 'Starter Tapes', initially for the PET, but with software for other machines planned soon. The first tape contains "a number of games and educational programs from various areas. It is intended to help teachers who are new to computing to explore the capabilities of their machines."

Teachers may obtain a copy of this tape by sending a strong, brown SAE with a cheque for £2 to BCS, c/o The Upper School, Stirchley, Stirchley District Centre, Telford, Shropshire. Cheque payable to The Upper School, Stirchley.

"Many teachers are also unaware that they may seek assistance from their local BCS Schools Liaison Officer," Lusty adds. You can get the name of the local person by writing to the BCS at 13 Mansfield Street, London W1M 0BP. D W Harding is secretary general.

All or some

A new software booklet has been announced by Apple distributor Microsense which "now lists all programs for Apple." This somewhat extravagant claim is toned down to "lists some of the many" when you read the small print. It is in fact Apple's answer to the Commodore Book of Approval, listing many UK sources of many programs. It doesn't provide prices, which is an error I hope will be corrected on one of the "regular updates" promised. Details on 0442 48151.

Cheap EPROM board

It is possible to expand a Nascom microcomputer with additional memory by buying a memory board from several suppliers. The latest is something special — a permanent memory board, built by a bunch of Merseyside users.

The Merseyside Nascom Users Group has produced a small board for 8 kbytes of eraseable 2708 memory chippery at the small cost of £40 assembled. You have to supply the EPROMs. For users of the Nascom 1, this board will allow them to plug in the Microsoft Basic which comes as standard on the Nascom 2.

The 8 kbytes can be set up to appear at any 4 kbyte boundary throughout the memory map — even in the video, if that's what you really want. Details from Graham Myers on Pickmere (056 589) 3328.

Elbit has entered the micro market with this new Z80-based system called the Micropact. It is designed to "span the complete range of distributive processing," which means it's available in configurations ranging from an intelligent transaction-processing terminal to a multi-user interactive hard disk system. Prices range from £1000 to £8000. Details on 0753 26713.

Zaerix Electronics has announced this British-made miniature soldering iron, rated at 16-18 W. The copper bit totally enclose the heating element for better heat transfer and there's a range of six bits, including a desoldering bit. There are three models, for 220/240 V, 100/110 V and 11/12 V. More on 01-727 5641.

This is the new LRC M410 dot matrix printer mechanism from Impectron, which will print 40 columns at up to 120 characters a second bidirectionally onto single or multi-ply rolls of ordinary paper. Details on 0403 50111.

New factory

As Derek Rowe promised when his company, Abacus, merged with Data Type Terminals, a new factory has been set up to build a new range of micro-based terminals. The factory is in Cwmbran, and the terminals use the powerful 6809 microprocessor to drive them. Details from Gerry Tuffs on 063 33 69162.

DMS for SuperPet

Compsoft's Data Management System is now available to run on the CBM 8000 series — the 'SuperPET'. DMS "allows users to store any information they require in a format they specify themselves. These records can then be selected, using up to four search criteria, and either displayed on screen or printed." Calculations can also be performed on numerical data stored with DMS. Details on 0483 39665.

YANKEE DOODLES

Tom Williams reports from California on Tandy's new machines and on other new hardware developments.

Tandy's new range

Radio Shack (better known as Tandy in the UK) has finally released the long-awaited information on its new computer line — three new products in all. The one that will probably do the best in the marketplace is the TRS-80 Model III. Rumour had it that the Model III would be a colour unit, but Radio Shack has reserved a surprise on that point — it has introduced a separate colour computer as well as a very interesting hand-held unit.

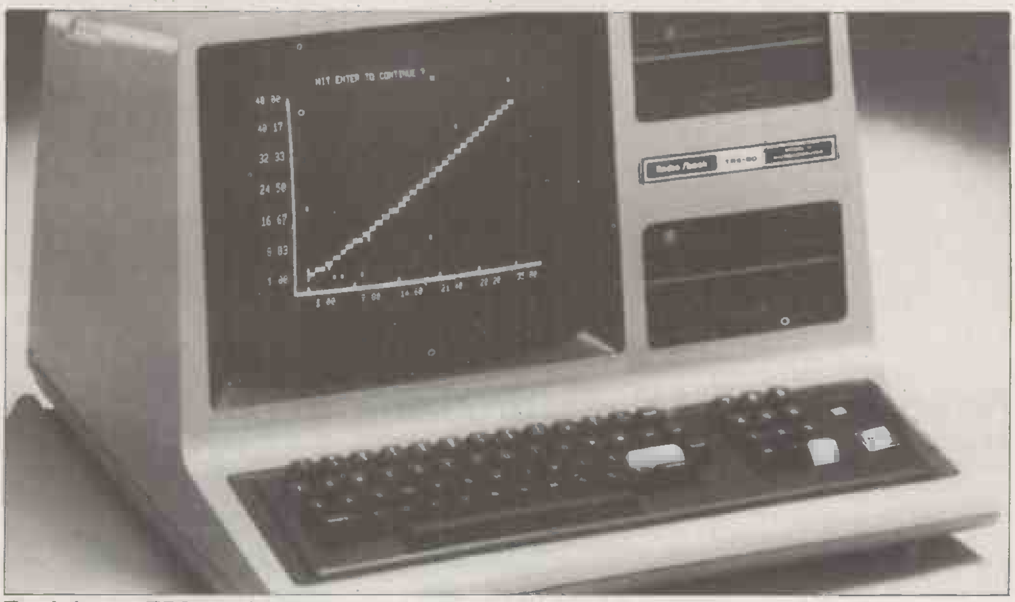
The TRS-80 Model III is essentially a TRS-80 in a single cabinet, except that the disks it uses are double density and it has a built-in RS232 communications interface, which is optional on the Model I. Two 178 kbyte disk drives can be mounted in the cabinet (a configuration is available without disks) and two more drives can be added externally for a total disk capacity of 670 kbytes.

Radio Shack says that Model III Basic has many more features than Level II Basic. These include a real time clock, expanded special character set and 500 or 1500 baud cassette operation. There's also provision for keyboard-controlled screen printing and printer/video routing. Model III TRSDOS additionally allows the creation of macros and has routines to operate the communications and clock features.

A 'bare bones' version of the Model III with 4k RAM and level I Basic is priced at $699; a 48k Model III with two built-in disks is $2495. It isn't difficult to predict that the TRS-80 Model III will be a real market force during the next couple of years.

At first impression, the TRS-80 Color computer appears disappointing. It's an obvious outgrowth of the TRS-80 Videotex terminal to which Radio Shack has added RAM and a Basic language which supports colour. It has a 53-key keyboard which is not nearly the same quality as those on the other TRS-80 models.

The 'Extended Color Basic' resides in 16k of ROM, and there will apparently be 'Program Pak' ROM cartridges available for instantly loading games and other types of programs. There don't appear to be any provisions for disks or printers, but there's a cassette interface and connectors for two joysticks. The computer connects to the 300 ohm antenna terminals of a colour TV set.



Tandy's new TRS-80 Model III

The display is limited to 16 lines of 32 upper case characters, but the colour graphics resolution ranges from eight colours at 32 x 64 to one colour at 196 x 256. Some machine language programs can give a higher resolution. There's also an optional RS232 port and the unit can be used in conjunction with Videotex software for network communication.

Radio Shack's third entry is a handheld computer which runs Basic and bears a striking resemblance to a pocket computer made by Sharp in Japan which was secretly displayed at the last West Coast Computer Faire in March of this year. In fact, it *is* made by Sharp. The TRS-80 pocket computer has a 24 character liquid crystal display and contains two 4-bit CMOS processors. One processor is dedicated to arithmetic operations while the other handles the Basic interpreter and keyboard I/O.

The operating software resides in 11k of ROM — 7k for the Basic and 4k for the monitor. There is an additional 2k of CMOS RAM for user programs. An optional cassette interface is available for storing programs and data; this is a somewhat larger unit that the computer nestles into and requires its own battery power supply.

It will be interesting to see how these new products fare, since they have all been introduced at the same time. It's my prediction that the handheld and colour units will do poorly because they appear to be rather inconvenient, but that the Model III will take off in fine style — check back in a year and we'll see.

The Winchesters are coming

Certain breakthroughs appear to be hastening the advent of low cost Winchester disk technology in relatively small and inexpensive computer systems. Some of the factors that have inhibited the widespread use of the Winchester drives had been the problems of backup and the cost of the controller. In the past, controllers have literally been more expensive to build than the Winchester drives themselves.

This is partly because such controllers should include features found on large systems such as error checking and correction and diagnostics. One solution to this dilemma has been found by Microcomputer Systems Corporation of Santa Clara. It has developed a controller module for Winchester drives that can be adapted to almost all the 8 and 5¼inch drives now available.

The module contains a microprocessor, logic and some ROM that is adapted to the given drive. Then interface logic can be built up from readily available LSI chips to mate the controller to the drive on one side and the host computer bus on the other. Using this approach, MSC has put together a controller that will run the new 5¼inch Shugart Technology Winchester on a Hewlett-Packard HP-85. This results in a system with close to six megabytes of disk storage for less than $7000 and which fits on a desktop.

Other drive manufacturers are jumping on the bandwagon. Memorex and MSC have sponsored joint OEM workshops with computer manufactuers to assist them in using the MSC controller module to adapt Memorex Winchester drives to a wide range of processors and buses. This trend will no doubt result in massive hard disk systems in places where it would not have been thinkable a short time ago — even in homes!

Local networks expanding

Nestar Systems, of Palo Alto California, makes a product called Cluster/One, which allows up to 64 Apples to share hard disk resources and do local processing. The computers are linked to the master unit with its disk storage by means of a high speed communications bus.

Recently, Nestar entered into an agreement with Zynar Limited under which Zynar will introduce Nestar's products in Britain and 16 western European nations. The two companies will also work together to develop hardware and software for further advanced systems using VLSI technology.

Nestar has already developed and is testing in-house a local network communications package which allows individual stations to communicate directly with one another over the systems bus. This allows the sending and filing of inter-office memos, conversations between groups or 'rings' of persons in an organization and routing messages to busy people who tend to be away from their desks a lot.

PCW welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add "not for publication" if your letter is to be kept private. Please note that we are unable to give advice about the purchase of computers or other hardware/software — these questions must be addressed to Sheridan Williams (see 'Computer Answers' page). Address letters to: 'Communications', Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Nascom cure

I believe I have found a cure for the string manipulation fault present on Nascom 2s. Basic 4 MHz with wait states reads strings wrongly and returns either part or none of the string. My cure is as follows — connect between the MREQ output on the edge connector socket (pin 27) and Ground (pins 1 to 4) a 47 pF capacitor. This works for my NASCOM and I can now run programs that before would churn out nonsense (Buzzwords, Anagrams).

I discovered this cure by accident. After extending the connector socket with ribbon cable, I had a screen full of black glitches which disappeared either when I touched the MREQ pin, or when the program was running (and printing). The capacitor solved this and the string problem.
Steven Weller, Southampton

BASF benchtest

We should like to take the opportunity of commenting about the review on our 7120 micro-system in the September issue of Personal Computer World.

Needless to say, the confusion between our last page and the last page of the 'SuperPET' deserves a big stick; conversely we felt that Mike Dennis wrote a very fair and well constructed review.

We are pleased to report that we are now operating Release 9.2. This release has improved disk processing time by 30% and makes available some new utilities, eg 'Menuform' creates parameter driven menus and 'COMPACT' compresses Basic statements.

The other points raised are in hand and will be resolved as soon as possible.
P Raggett, BASF UK Ltd

Name dropping

I don't really see how the person who writes the 'Chip Chat' feature in your magazine can go on about the unlikeliness of the names 'Diego Rincon' and 'Halina di-Lallo' (who are both meant to work for *Computnig Toady)* when the founder of PCW is called Angelo Zgorelec!
Jonathan J Dick, Bristol

Neither can we, Mr. . . er. . . Dick — Ed.

What a card

I am writing to offer you my long overdue congratulations on the consistently high standards achieved by your publication. The mixture of topics covered is not only well balanced, but makes your magazine the most informative, as well as the most interesting, on the market.

One additional thing I would like to see, however, are pull-out fact sheets. These could be on thin card and would contain facts on a different theme each month: summaries of Benchmark tests, Hex/Decimal conversion tables, ASCII/BCD/EBCDIC tables, summaries of the facilities offered by the various machines, instruction sets. . .

Most of these areas have been covered by you at one time or another, but it can be very difficult to find the information when you want it. Pull-out reference sheets would therefore be of immense value and I am sure many people would welcome them.
I L Fraser, Warrington

We'll try the idea out on our production manager — Ed.

New club

May I, through your magazine, inform readers that a computer club is being formed in the Worcester area with emphasis on personal and hobby computing?

Anyone who is interested is invited to phone Worcs 22704 after 8pm for further information. Beginners will be especially welcome. Keep up the good work with one of the best value mags around.
D J Stanton, Worcester.

Sharp replies

I have been using a 24k RAM Sharp MZ-80K for seven months now and have been experiencing some difficulty with the LIMIT MAX command. On three occasions this command issued in immediate mode and following tape SAVE and VERIFY operations has crashed the machine for no apparent reason. On other occasions, under nearly identical circumstances, the command has worked perfectly. I would be interested to hear if other readers, who use similar machines, have experienced such difficulties.
R L Tucker, Manchester

Sharp tells us that some MZ-80Ks are known to produce this problem. Its advice is to use BYE to get into the Monitor and then to type GOTO 1200. After a short pause, while a 'cold start' takes place, control returns to Basic just as if the LIMIT MAX had been executed successfully — Ed.

16-bit efficiency

Guy Kewney repeats a red herring about 16-bit processors. They do *not* need twice the memory size of that used by the eight-bit kind. In fact averaged over real programs they are likely to use less memory to complete a given task as each instruction is more efficient. The Z8000 uses only two bytes for those instructions likely to be used most. Typical eight-bit programs use around 1.8 bytes per instruction and more of them.

The S100 bus uses a memory technique that permits both 8 and 16 bit processors to use the same memory in a multiple processor system. The method could easily include 32 bit processors and so permit the same system to run programs written for all popular processors. The E78 bus has a similar facility.
R G Silson, Tring

Algol follow up

Following the recent letter in PCW on the subject of Algol 68 for microcomputers, I have been contacted by several people who were interested in my proposal for an Algol 68S implementation.

I would like to publicise the work presently being done in the hope of generating useful ideas and receiving advice from anybody doing something similar.

The implementation group currently consists of John Fairbairn, Stuart Wray and myself, all keen Algol 68 users. We have obtained an Algol 68S parse table (a set of rules for parsing the input) and we now have a working lexical analyser and most of a parser.

The compiler will produce a simple but compact intermediate code which could be interpreted, although a translator will be written for either the 6809, Z80 or GEC4000 for first implementations.

The compiler is single pass and will be overlaid by the translator to save space. It is written in the common subset of Algol 68S and Algol 68C, which basically means that there is little use of STRINGS.

This choice was made because I have written a translator to allow cross-compilation of Algol 68C from a larger host machine to the Z80 and give some idea of the final size of the implementation. Also, the compiler must be able to compile itself.

Incidentally, the numerous Z80s on the Cambridge University Ring are now mostly being programmed in Algol 68C because of its suitability for both low level systems work and description of complex algorithms.

I believe that the extra effort involved in implementing Algol 68S compared to that for a simpler language (eg Pascal) is worthwhile, considering the gains that result for the user.
Raymond Anderson, Dunstable

Language lessons

I am another Algol 68 fanatic! But it will do no good arguing about why it's so good until people know about it and argue back.

Today software is the most expensive part of a commercial computer system. Fortran, 20 years old, is now used for problems that it wasn't designed for, like Library Cataloguing packages. Isn't it time more people were informed about later and better languages so that, even if they don't change to them, they might consider new concepts and approaches that could only make them better at programming?

I suggest that PCW should be a channel for information on languages and the concepts and data types that distinguish them. It could give reviews on languages that readers may one day use, just as 'Benchtest' reviews machines. Instead of reflecting ideas it could give them.

It is only then that I could properly argue why Algol 68 is the best language to date, but then I wouldn't have to argue since we'd all know anyway!

It might also turn out then that "possession of this surname," Anderson, is *not* "a prerequisite for entering the correspondence." I'm as baffled as you are on this. . .
Alexander Anderson, London

This is an extract from Mr Anderson's long and interesting letter — Ed.

ZX80 tip

If Richard King (PCW, September) cares to insert the following line after his program:

```
9999 PRINT PEEK (16392)
+PEEK(16393)*256 −16461
```

entering RUN 9999 will then display the number of bytes occupied by the program. The figure given excludes the space taken by line 9999 itself, which can then be deleted.

Perhaps Richard might consider joining the National ZX80 Users Club where he would be able to exchange hints & info on the ZX80. The address to write to the club is 44-46 Earls Court Road, London W8 6EJ.
John Bloxham, Stratford-on-Avon

ACC own up plea

I am the 'operator/programmer' at the EMBL Outstation here in Hamburg, and have as my home computer a 44k Newbear 77/68 with mainly TSC software. I am of course a regular reader of PCW and look forward to getting it every month. *(What about PCW? — Ed.)*

As a computer hobbyist, I miss most of the club atmosphere and group activity that I had in England. For a long time I used to get the Amateur Computer Club news and I used to send them extracts from various trade and technical papers that appeared in Germany and hardware and software ideas that I had incorporated in my system. Then Mike Lord left.

I suppose I sent about ten more articles to ACC varying from 40 words to two pages. They were not acknowledged (I heard that the editor changed three times in six months) and then I stopped hearing from them. The ACC Newsletter got less frequent, and stopped altogether. My request (with IRC) to know where I must pay my subs was not answered. Now there are four letters outstanding. As there were supposed to be about 200 members there must be something happening. No AGM has been announced.

I would be grateful if you could publish a request from me, to ACC asking if they exist. Perhaps if you know the current leadership you would be so kind as to ask them direct? I would in all honesty like to continue as a member, but if they *don't* exist. . .
Peter Bendall, Hamburg

A question of accuracy

I'm sorry to say Mike Dennis is in error in his review of the BASF 7120. He stated that the 12-figure accuracy mode revealed a more accurate result for SIN (0.785398163) than the 30-figure option. Unfortunately the argument of the function has been rounded to nine places (it's 0.7853981634 to ten places by my SR56) and as it happens the 12 place option reveals an answer nearer to the expected $1/\sqrt{2}$. However, the 30-figure option has in my mind produced the correct answer, to 30 places of course.

Please remember that computers can only do what they are told to do so if you input to nine figures you can only expect eight figure accuracy results and both options give 0.70710678 to eight places. I suggest if you wish to do this test try using $45\ \pi/180$ to generate the radian. Please try to remember this point in future as it makes a mockery of the use of high accuracy devices, be they calculators, computers or whatever. So please, don't use a yardstick (metre) to measure to the nearest inch (25.4mm to one decimal place).

PS What's my prize? (No witty retorts please.)
D W Ainslie, Farnborough, Hants

No prizes given — not even when letters are grovelling, sycophantic, fawning and praising PCW to death. Sorry — Ed.

Cheap printout

In reply to the letter from H P Stern which appeared in the June issue of PCW, an article titled 'Interface Your Computer to a Printing Calculator' appeared in the December 1978 issue of *Byte*. This concerned the Texas Instruments 5050M printing calculator and the 8080 processor but I am sure a similar approach could be used for KIM.
John H Fyfe, Northwood

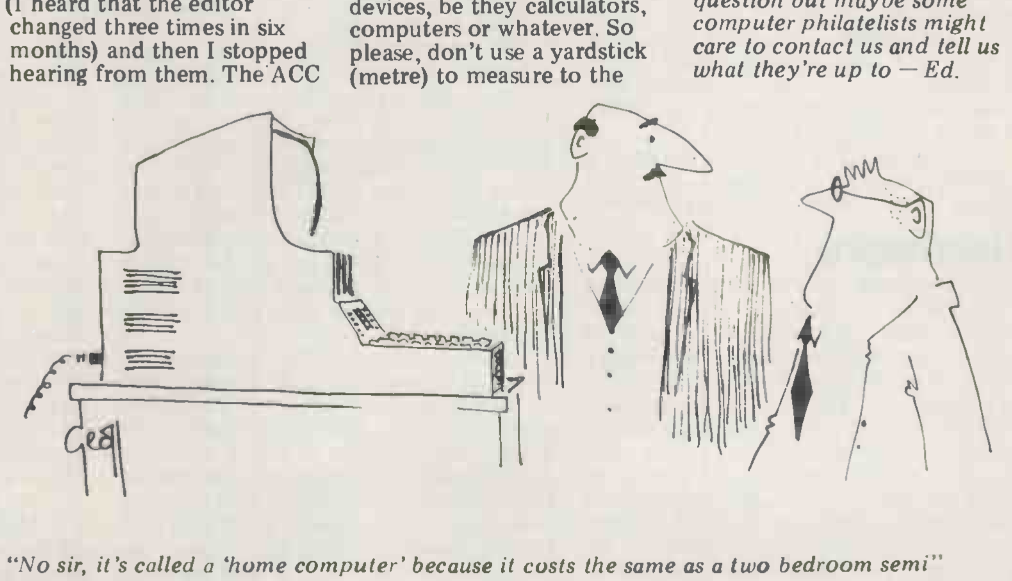
You may be interested to hear that next month we begin a four-part series on how to interface calculator printers to your micro — Ed.

Best of PCW

In view of the difficulty of getting back numbers of PCW would you not publish them as a book, or series of books, called, perhaps, *The Best of PCW Vol 1*?

Are there any people who are interested in philately as well as computing?
Neil Stokes (16), Gateshead, Tyne & Wear

Thank you Neil for the first suggestion — if Creative Computing *and* Byte *can do it then why indeed shouldn't PCW? We don't know the answer to your second question but maybe some computer philatelists might care to contact us and tell us what they're up to — Ed.*



"No sir, it's called a 'home computer' because it costs the same as a two bedroom semi"

BENCH TEST

SBS-8000

We've all been waiting for the Japanese to do with personal computers what they've already done with hi-fi and TV sets. Does this latest machine to arrive on our shores from Japan herald the start? Peter Calver and David Tebbutt investigate.

Manhattan Skyline is responsible for bringing this latest Japanese machine to Britain. Conceived primarily as a small business/education computer, the SBS-8000 offers much of interest to both groups.

At first glance you could be forgiven for thinking that you'd lost all sense of perspective because the monitor tapers inwards towards the front quite unlike most other machines. This, coupled with the fact that the lines are very square, makes the SBS-8000 look just a little ugly. As if to compensate for this the colour combination of orange, cream, rust and green is quite pleasant.

The TEAC disk drive looks very rugged and gives the impression of being solid and reliable. The printer is a fairly standard 80-column dot-matrix, built into a very smart case. It is also reasonably quiet, especially if mounted on a firm surface. Unusually, these days, the paper is pin fed instead of the more common tractor or friction feed.

One of the nicest aspects of this machine is the ease with which it can be set up. It shouldn't take a novice any more than about 15 minutes to get 'on the air'. The most difficult part is the connection of the disk and printer signal cables to the controller cards' edge connectors. They were somewhat fiddly and also seem a little flimsy, although we must have connected and disconnected them five or six times without breaking anything.

All in all, the machine presents a quietly pleasing package provided you're not averse to sharp corners.

Hardware

The black and white screen comprises 16 lines of 64 characters, a lot more useful than the 40-column screens which currently abound. The display also has a graphics mode which gives a resolution of 128 x 96, reasonable enough for business purposes and many educational tasks. Mixing text and graphics is possible but one should be wary of scrolling the screen as this can really mess things up. A plastic cover over the monitor may be removed to give a grey and white screen. We preferred black and white.

The keyboard is pleasant to use, especially for someone used to typing for a living. Several keys are provided in addition to the normal qwerty arrangement and numeric keypad — the ESC key enables program freezing, for example; the CONTROL key allows several keys to be used for special purposes. Eight keys can have functions assigned to them using the FKEY command and when used with the control key this gives a total of 16 special functions.

Inside, the machine is almost as novel as the outside — the memory may be divided into as many as 16 partitions, each capable of holding a separate program. The partition space is allocated dynamically, according to the size of the program being loaded. You may now realise the possible significance of the 16 special function keys — one per program perhaps? With a 32k memory (about 21.5k net when the DOS is loaded) we think the chance of all 16 partitions being used for separate programs is quite slim — unless we're talking about things like statistical functions. A more likely use would be to hold commonly-used subroutines in them so that they can be called from any partition which needs them. As only one partition can be in operation at a time there is no risk of multiple accesses and subsequent corruption. It will be interesting to see whether a multiple access system appears — in conjunction with multiple terminals perhaps? We know that the idea is being actively considered but no-one can say whether or not it will happen. If it does then it would certainly increase the educational appeal of the machine.

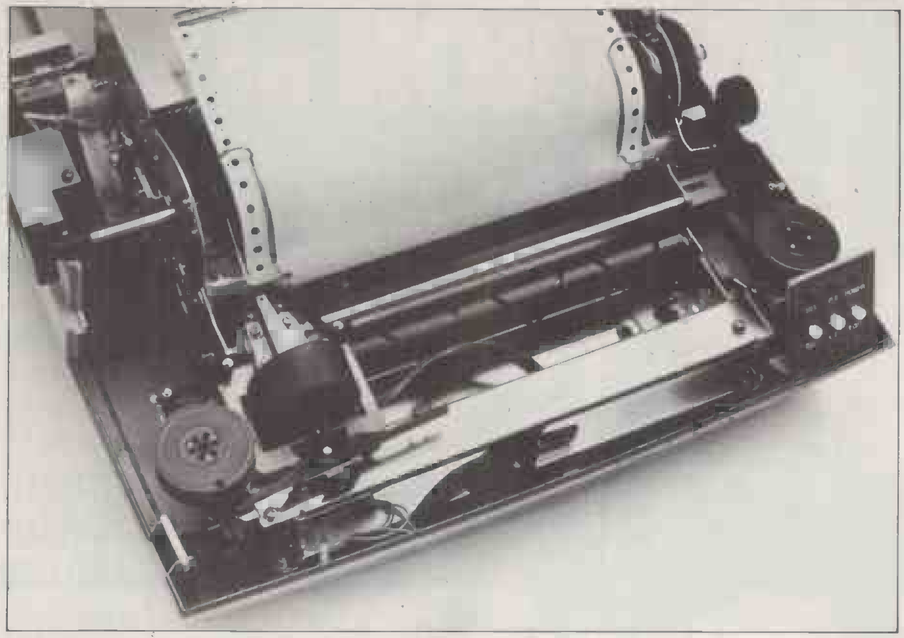
The processor in the SBS-8000 is a 2 MHz D780 which is entirely compatible with the Z80. Apart from the usual keyboard bits and pieces and a video monitor the SBS-8000 has a number of card slots designed to allow expansion. Not surprisingly the printer and disk drive occupy one slot each, leaving three spare for add-ons such as an RS-232C and 20 mA current loop interface, an S100 bus interface, an IEEE-488 interface, cassette, sound and D/A and A/D converters and a few more besides. In fact one add-on looks particularly interesting — called the 'Real Life Controller', it allows control of up to six 220 VAC and six 12 VDC devices. Manhattan Skyline is already committed to 8inch floppies and 10/20 Mb hard disks as well as a Z8000 motherboard and assorted character sets. With any luck one of these sets will contain true descenders!

In case you think the five-slot system is a limitation, you will be pleased to hear that a seven-card expansion cage is also available.

Up to two twin disk drives may be attached to the SBS-8000, giving the 5¼inch drives a gross capacity of some 736 kbytes and the 8inch drives 4 Mbytes. With the hard disks due in January it doesn't look as if disk storage will ever be a problem on this machine. Quite a reasonable disk operating system is provided and CP/M is also available should you require it. More about the software later.

The 80-column bidirectional printer is adequate, although not stunning. It can print double width characters but not graphics. The fact that it is bidirectional means it runs at a fairly constant speed (84 lines per minute) regardless of the number of characters in a line.

Overall, our impression was of a well-conceived machine which, with its expansion capabilities, would satisfy most people's hardware requirements.



A peek inside the printer housing.

Software

The SBS-8000 has 24k of ROM containing the operating system, and what Manhattan Skyline describes as 'Super Basic'. To make use of the floppy disk unit the 'File Control Processor' (FCP) must be loaded from the system disk provided. This occupies about 8.5k of user RAM, reducing the available memory from 30k to just 21.5k.

This 'Super Basic' includes most of the functions available on other micros, with some rather neat additional features. It must be said, however, that there are two notable omissions — neither LEFT$ or RIGHT$ is available for string manipulation. Nevertheless, MID$ may be used on either side of an assignment statement, and this must go some way towards redressing the balance. On the whole, the Basic dialect is reminiscent of Tandy's Model I Disk Basic — though the disk commands themselves are very different.

Two interesting additions are the MCOND statement which enables a series of conditional tests to be contained on one line and KILL which deletes an array, enabling it to be redimensioned. Even more exciting is the 'page' structure of memory which allows up to 16 programs to co-exist without any unwanted interaction. The SETPG instruction transfers control simply between pages and it is possible to CALL routines headed with a PROC statement whenever they are stored in memory. One obvious application would be to build a library of routines which can be called by a number of programs without actually being included in any of them. The FUNC statement allows parameters to be passed to and returned from a routine — in fact it's a multi-line function.

EXEC used in direct mode or as a program statement transfers control to a specified page and runs the program that it finds there. Unfortunately, variables are not preserved as they are when CALL is used, so it seems likely that EXEC will be used mainly in direct mode as a fast way to run a program in another page.

Variables in different pages may use the same names without interference. If parameters are to be passed, then this can be achieved by using the FUNC multi-line function call, or by writing the variables to a disk file which may then be read by a second program.

The NEW command may be used with a page number as a parameter whereas the CLEAR command zeros all variables, irrespective of the page which has generated them.

Program modification is possible only through the EDIT command and its parameters specifying one or a range of line numbers. Each line is displayed in full on the screen with the flashing cursor over the first digit of the line number; then, using the left and right keys to position the cursor the line is edited by overstriking and using the insert and delete keys. By the way, the delete key is strangely difficult to use, because it deletes the character under the cursor, instead of the one to its left. Hitting ENTER puts the edited line into memory, replacing the existing line — although it is possible to alter the line number, in which case the original line would remain.

Perhaps the biggest drawback of the Basic is the complicated syntax, which must cause problems for programmers used to PETs and Tandys. In many circumstances spaces are essential. Something that the documentation provided does not always make clear. It may be that this over-complexity is a side-effect of long variable names (up to 253 characters are allowed), but it certainly takes some getting used to.

Error trapping is made simple with an ON ERROR GOTO statement which can be used to pass control to a suitable error handling routine. The ERR function returns the error code of the latest error, while ERL gives the line number at which an error occured. RESUME can be used to continue execution from the point at which an error occurred, from the next line, or from a specified line number.

Debugging is aided by the TRACE facility — line numbers are displayed on the screen as they are executed. The speed of execution can be controlled using PAUSE — a delay of between half a second and ten seconds may be introduced between lines.

The 16 function keys can each be assigned a data string that is sent to the computer as if it had come from the keyboard. For example, function key 1 could be assigned the string "EXEC 2"+ CHR$(13). Then, whenever the key marked F1 waspressed "EXEC 2" would be displayed and the program in page 2 executed. One obvious use would be to display the disk directories using QUERY"*.F0" or QUERY"*.F1". The absence of a LINE INPUT instruction may cause programmers some unnecessary trouble. Typing a comma in response to an input gives an EXTRA IGNORED message — and it means what it says! Not too bad perhaps when inputting from the keyboard but if a string containing commas is written onto an ASCII data file the part after the comma is irretrievable. There's no way of inputting a single character from a file, which is the only way that the problem might be overcome; obviously character strings can be checked for commas before writing to disk — but with all the advanced features in Super Basic it's strange that such an essential function should have been omitted.

At first sight the disk commands are familiar enough but appearances can be deceptive. If there is any similarity with another micro then it is probably the PET! Five types of disk file may be created: Basic intermediate (tokenised); Basic source (ASCII); Hex object code; ASCII data and binary data. File space is pre-allocated at the time of creation, whatever the file type. DLOAD and DSAVE will function without

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Basic BASIC	Donald M. Munro	£2.50
The Little Book of BASIC Style	Nevison	£5.75
Some Common Basic Programs	Osborne	£7.95
32 BASIC Programs for the PET	Rugg & Feldman	£9.75
A guide to BASIC Programming	Spencer	£8.85
A guide to PL/M Programming	McCracken	£7.95
PASCAL An Intro. to Methodical Prog.	Findlay & Watt	£4.95
Introduction to PASCAL	Welsh & Eider	£6.95
Programming in PASCAL	Grogono	£6.95
Primer on PASCAL	Conway et al	£7.10
Struct. Prog. & Problem Solving with PASCAL	Kieburtz	£8.40
Problem Solving using PASCAL	Bowles	£7.95
An Introduction to Programming and Problem Solving with Pascal	Schneider	£5.20
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COBOL with Style	Chmura & Ledgard	£5.40
Learning COBOL Fast	de Rossi	£6.45
FORTRAN Techniques	A. Colin Day	£2.95
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Problem Solving & Struct. Prog. in FORTRAN	Friedman & Koffman	£9.95
An Intro. to Prog. & Applications with FORTRAN	Hull & Day	£8.45
Z80 Micro Handbook	W. Barden	£6.95
Z80 Programming for Logic Design	Osborne	£6.30
Z80 Micro. Prog. & Interfacing Bk. 1	Nichols & Rony	£7.75
Z80 Micro. Prog. & Interfacing Bk. 2	Nichols & Rony	£8.50
Z80 Instant Programs	J. Hopton	£7.50
Z80 Programs (cassette)		£10.00
Z80 Assembly language Prog	Leventhal	£8.15
Z80 Programming for Logic Design.	Osborne	£6.30
Programming the Z80	Zaks	£8.95
Mostek Z80 Micro Software Programming Guide		£6.00
6502 Assembly language Prog	Leventhal	£8.25
6502 Applications Book	Sybex	£8.95
Programming the 6502	Zaks	£7.95
Programming a Micro (6502)	Foster	£7.25
PET Work Books Vol. 1-6		£18.00
6502 Assembly Language Programming.	Leventhall	£8.25
The Best of Micro. Vol. 1		£5.50
Vol. 2		£6.50
The PET Revealed		£10.00
Intro. to Personal & Business Computing	Zaks	£5.45
Peanut Butter & Jelly Guide to Micros	Willis	£6.45
A Career in Computing	Penney	£4.25
Philips Guide to Bus. Computers & the Electronic Office	Enticknap	£3.50
Computer Games	Nahigian & Hughes	£8.40
Basic Computer Games	Creative Computing	£5.50
More Basic Computer Games	Creative Computing	£5.50
Game Playing with BASIC	Spencer	£5.50
How to Build a Computer Controlled Robot	Loofbourrow	£5.95
TTL Cookbook	Lancaster	£7.15
CMOS Cookbook	Lancaster	£7.50
TV Typewriter Cookbook	Lancaster	£7.25
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previously opening the file concerned, otherwise all files must be opened before they can be used, even with SSAVE and SLOAD. SLOAD is used to load a Basic source program and it is worth mentioning that this is merged with any program that happens to be in the loading partition at the time. Program files are automatically closed following a successful load or save instruction whereas all data files must be explicitly closed — the END statement doesn't close them for you.

The capacity of each diskette is 180 kbytes, though only 157.5k are available to the user. The disk has 40 tracks, each containing 18 256 byte sectors. Only binary files are assigned a record length which, according to the manual, must be between 4 and 256 bytes, though we found that 255 bytes was the maximum that the operating system would allow. Logical records cannot span sector boundaries so there may be some wasted space in each sector, depending on the record size. Direct access to a particular record in a data file is gained through the INDEX command, though if used with ASCII files (which have variable length records) it entails a sequential read, and could thus prove quite tedious. Data are written to ASCII files with PRINT#, and read back with INPUT#. The system automatically terminates each record with a carriage return and line feed. Data in binary files are written sequentially within a record using PUT, and read with GET. It isn't possible to access a field within a record directly — it is therefore necessary for the program to unravel the record contents to get at the appropriate field. Numeric variables are written to binary files in the form in which they are stored in memory, with integers occupying two bytes, single-precision variables four bytes, and double precision eight. An extra character is inserted by the system before each field to identify its type and thus its length. A string variable requires an additional byte to indicate its length. Although, in theory, it would be possible to reduce the overhead by converting numeric variables to strings and then concatenating the individual fields of a record to form one large string, in practice this could be quite difficult as there are no functions to convert numbers to strings or vice versa other than STR$ and VAL. (In Microsoft Basic the functions MKI$, MKS$ and MKD$ represent a number as a string — this being an image of the variable as it is stored in memory and is thus two, four or eight bytes long. CVI, CVS and CVD perform the opposite function, converting strings back into numbers.)

Although we found that the INDEX statement usually functioned correctly, locating a specific record in a data file, we sometimes encountered problems when attempting to access records in descending order. We got an END OF DATA error when there should have been no error at all.

No doubt Manhattan Skyline will be revising its operating system in due course, but it does seem that at present random access is a little more random than it should be.

Potential use

One thing is fairly certain and that is that Manhattan Skyline is aiming the SBS at the right markets — business and education. It is unlikely that many people would buy one for home use. The graphics are quite nice, better than most in fact, but definitely not high resolution. They would be suitable for business use and much of the less mathematical school work. The prospect of a multi-user system must appeal to the education authorities, although it is by no means certain whether SBS will definitely go ahead with this development. The Basic is pretty good and the strict syntax could well be regarded by teachers as sound preparation for the 'real world' of ICLs and IBMs, etc. Businessmen need software far more than they need a particular machine so they will have to look at the packages when they arrive towards the end of the year. Payroll, Ledgers and Production packages are among those expected to be ready in December and January.

The fact that CP/M is available means that a wide range of packages come within the SBS owner's grasp but the cost of installing CP/M may diminish their attraction.

Bench marks

Benchmark Timings (in seconds)	
BM1	1.8
BM2	9.4
BM3	29.0
BM4	29.0
BM5	31.6
BM6	44.0
BM7	82.5
BM8	11.2

Disk Timings (in seconds)	
D1	5.3
D2	25.2
D3	40.6
D4	44.0
D5	40.0

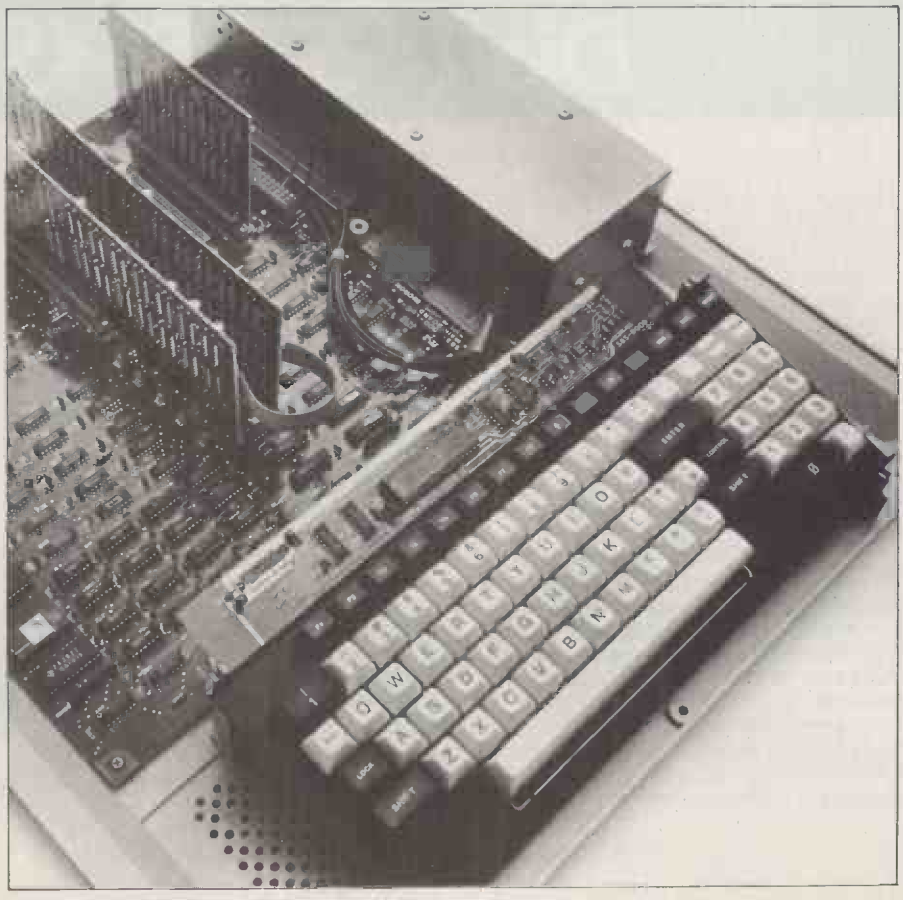
Documentation

Two manuals were supplied with the machine — a hardware manual and a Super Basic Language user's manual. Both were fairly comprehensive in that there was little that we couldn't learn from reading them. I'm sure that the hardware manual will not be supplied to potential buyers because it is primarily a guide for the engineer.

Not being engineers we aren't really qualified to comment, except to say that it is clearly written and easy to follow with only one or two translations getting messed up.

The user's guide is something we *are* qualified to comment on — first of all it must be said that a raw beginner would be in terrible trouble if this is all that's supplied with the machine. An operator's/beginner's guide is definitely needed — Manhattan please note. People with experience of programming should find few difficulties with the book although there are a fair number of misprints in it. Syntax rules on the SBS-8000 are pretty strict although not too difficult to follow. Unfortunately, the manual doesn't always get the syntax right itself which would cause problems for those new to computing.

Something which really ought to be in the manual is a full description of memory locations and their uses. This is absolutely essential when things go wrong and you're ferreting around to find out what's going on. We're sure that there are also a lot of jolly useful POKE locations tucked away that would prove most interesting. Error



Inside the SBS-8000 and a close-up of the keyboard.

recovery is something which needs explaining — from time to time we got into a nasty situation (usually with disks) from which we could not extricate ourselves except by shutting down the system and powering up from scratch. The fact that we were then able to carry on working with the disks shows that the FCS software or a pointer somewhere was at fault. The relevant explanation would help. Now don't get us wrong — the manual is, on the whole, pretty good but it has been spoilt by one or two smallish errors and omissions.

Memory map

Address	Contents
FFFF	
	Memory Mapped I/O
F800	
	Video RAM
F000	
	Super Basic (II)
D000	
	User's fixed memory. Optional ROM/RAM board
C000	
	Machine Language program Stack Free memory Program text
6A00	
	FCP (File Control Processor)
4800	
	System memory (RAM)
4000	
	Super Basic (I)
0000	

Prices

(All prices exclude VAT and carriage)

Full computer	£1449
Dual minifloppy	£795
80-col printer	£525
136-col printer	£945
Printer control card	£64
Printer cable	£34
Floppy control card	£237
Cable (2 drives)	£37
Cable (4 drives)	£59
8" dual-drive floppy (2 Mbyte)	£1900
8" control card	£380
RS232C interface	£133
Complete system: Computer, dual mini floppy, 80-col printer, all necessary control cards & cables	£2950

This combined price represents a saving of £191 over the cost of buying all the bits and pieces individually. Manhattan Skyline expects to be able to deliver SBS-8000s within 48 hours of order.

Conclusions

The SBS-8000 is a well-made machine which boasts a fairly powerful Basic language. The disk and printer also seem pretty robust although the disk handling software did hiccup occasionally. The system is unusual in that memory can be partitioned enabling several programs or routines to be held independently of each other and with a fairly simple method of passing control between them. It isn't possible to have more than one of these partitions active at any time but it does seem to be a step towards a multi-user system, an interesting development that Manhattan Skyline is actively considering. One limiting factor to this system's potential is the fact that by the time a disk operating system is loaded, together with some rather natty error reporting routines, the available RAM is down to less than 20k — not really enough to exploit the clever features to the full. Still, it's the only machine we know that has taken this approach and it will be interesting to see how things develop.

To sell to the businessman it is absolutely essential to have good packages. These are being developed at the moment and should be ready by the new year; until then it is difficult to assess truly the business potential of this machine, except to say that it performed very well throughout the review and that it should have no problems running business packages.

At almost £3000 the system is a little more expensive than its more obvious competitors such as the Tandy Model II and the Commodore 8000 series but if the (few) problems are solved and the business software made available then it has enough merits of its own to give the others a fair run for their money.

At a glance

FIRST IMPRESSIONS	
Looks	**
Setting up	****
Ease of use	***
HIGH LEVEL LANGUAGES	
Basic	***
Cobol	n/a
Fortran	n/a
Pascal	n/a
CBasic	n/a
System Software	**
PACKAGES	n/a
PERFORMANCE	
Processor	**
Disks	***
Cassette	n/a
Peripherals	****
EXPANSION	
Memory	**
Cassette	n/a
Disk	****
Bus	*****
COMPATIBILITY	
Hardware	****
Software	*
DOCUMENTATION	***
VALUE FOR MONEY	**

***** excellent, **** V. good, *** good, ** fair, * poor.

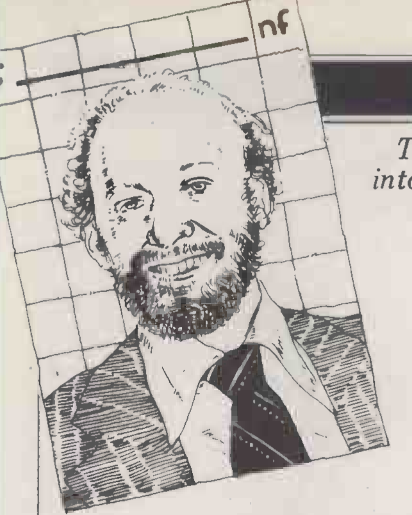
Technical Data

CPU:	16k, 32k or 36k RAM, (System uses 2k of RAM. FCP uses 8.5k), 24k ROM (Super Basic), 2k video RAM, 2k memory-mapped I/O.
Keyboard:	50-key ASCII; 17 control/edit keys; 2 blank keys; 11 numeric pad keys; auto repeat, upper/lower case with lock.
Screen:	16 lines x 64 chars (5x7 dot matrix); 96x128 resolution graphics; double size character/graphics.
Cassette:	Could be produced if demand high enough.
Disk Drives:	Up to 4 drives (2 units); 157.5 kbytes per disk; single-sided, double-density; 630 kbytes max (4 drives); 8" and hard disks planned.
Printer:	80 column, pin feed, Dot matrix; double-width chars option; 84 lpm, Bidirectional printing.
Bus:	Optional cards for S100 or IEEE-488.
Ports:	Optional cards for serial, parallel, RS232C, 20ma current loop.
System Software:	Own file control system; CP/M available.
Languages:	Super Basic, Pascal, Fortran, C-Basic, Cobol

Basic reserved words

+	—	*	/	↑	AND	OR	NOT
<	>	=	<>	<=	>=	AUTO	CLEAR
CONT	DEL	EDIT	EXEC	FKEY	LIST	NEW	PAUSE
REN	RUN	SETPG	TRACE	CALL	CLS	DATA	DEFDBL
DEFINT		DEFSNG	DEFSTR	DIM	ERL	ERR	END
FOR. . .TO. . .STEP		NEXT		FUNC	RETURN	GOSUB	
GOTO	IF. . .THEN. . .ELSE			INP	INPUT	KILL	
LET	ON ERROR. . .GOTO		ON. . .GOSUB		ON. . .GOTO		
OUT	PEEK	POINT(X					
OUT	PEEK	POINT	POKE	PROC	RESUME	RESUME NEXT	
RETURN	RETURN exp		RND	SET	STOP		
TAB	TIME	TIMES	PRINT	LPRINT	USING	ABS	
ATN	CDBL	CINT	COS S	CSNG	EXP	FIX	
INT	LOG	SGN	SIN	SQR	TAN	ERL	
ERR	MCOND	MEM	PAGE	POS	USR	ASC	
CHR$	INKEY$	INSTR	LEN	MID$	STR$	VAL	
LCTLC	LCTLP	LCTLS	LLIST	LPRINT		DSAVE	
CLOSE	COND	CLEAR	CREATE	DELETE	DLOAD	QUERY	
GET	INDEX	INPUT	OPEN	PRINT	PUT		
RENAME	SLOAD	SSAVE	SYSTEM				

PET SOFTWARE
— a guide



BOOKFARE

This month Malcolm looks at software design followed by a brief excursion into, wait for it, the micro revolution. A common theme is 'structure' — or lack of it, in the case of book three.

It's not just fun

A perennial topic of debate in the computer world is the argument over whether computing is a science or an art. The rise of personal computing has added a new twist to this saga — is computing fun or is it serious?

Before personal computing, computers cost so much that they just *had* to be taken seriously. They were all owned by large commercial, governmental or academic institutions and there was little opportunity to use computers for fun (officially). I can remember, however, that one of my first experiences of a computer was in about 1966 when I heard a very old ICL computer playing *A Taste Of Honey* on its console. And drawing by computer has been an art form for decades.

The cheapness and friendliness of personal computers have brought computer power into the mainstream of daily life. The ease of Basic programming has cut through the mystique that you had to 'know about maths' and be 'clever' in order to program. Most importantly, there are people who own computers for pleasure rather than business.

However, the fact that computers *can* be used for personal fun and games should not be allowed to obscure the serious body of theoretical research which underpins computing. The happy-go-lucky, unstructured, ill-disciplined, bug-ridden approach to programming that has been prevalent in all forms of computing does not suggest that there is no science behind the artful facade.

A significant new book has been published which should re-emphasise the importance of computing as a major science of the 20th century. Called *What Can Be Automated?*, it is essentially an encyclopaedia of modern (mainly American) research in computer sciences and is the result of a five-year study funded by the American National Science Foundation, known as the Computer Science and Engineering Research Study (COSERS).

The aim of this report is to describe to the 'technical layman' what has been accomplished under the headings of 'computer science' and 'computer engineering' research. It is not exactly a light read — over 900 pages — and cheap it isn't at £18.60. Some of it is also pretty heavy going — full of equations and things which require some mathematical or computing background. Yet, like any good encyclopaedia, it has a wealth of knowledge which can be dipped into and savoured when required.

Although computer science courses have become a part of the educational scene for many years, there is still much argument about precisely what activities it should cover — and even whether computing should be regarded as a branch of engineering rather than a science. The book's editor, Bruce Arden of Princeton University, faces this argument head-on in his introduction. He admits that there is unlikely to be any argument on a simple, succinct definition of computer science.

He suggests a definition of computer science as "the study of the design, analysis and execution of algorithms in order to better understand and extend the applicability of computer systems." But he accepts that this opens up more questions than it answers and that the only real way of describing this 'science' or 'engineering' discipline is via an operational definition of the research work that has been done in recent years under the umbrella of some form of computing.

To the personal computerist, all this might seem to be an obscure academic exercise with little relevance to the real world of Space Invaders and micro accounting programs. Personal computing seems to be all about *doing* rather than philosophising, programming rather than engineering, fun rather than science, business rather than mathematics.

However, without the rigorous and systematic research which has underpinned computing developments, the widespread growth of computing would be threatened and the personal computer revolution will dribble off into irrelevant games and sideshows. It is one thing to write a simple program to be used for personal fun or to solve a well understood and self-contained business task. But as soon as the task being tackled has any real complexity — in other words, most of the most interesting computing tasks — a more thoughtful and disciplined approach should be taken.

The importance of using a mathematically coherent discipline in programming is highlighted in one of the most interesting sections of the book, on software engineering, which is of direct relevance to personal computer 'amateurs', who program for pleasure, as well as 'professionals' who do it for money.

The panel of academics who produced the software methodology chapter summarise the current state of software play: "The data processing industry is one of the most spectacular byproducts of science in the history of mankind. But its practice leaves much to be desired; it has the growing pains of a new industry that has had no time to develop and select sound industrial practices. It is a mixture of great wisdoms and foolish folklore. It needs help from science and engineering . . . but the help it needs is not easy to provide."

The key software problem they identify is complexity. In the early days of computing, they point out, hardware started out expensive, limited in power and unreliable. The shortcomings were soon overcome, thanks to hardware research and development carried out by mathematicians, electronics and physics specialists within reasonably well-defined engineering and scientific disciplines. Meanwhile, the "debugging, patching and working to 2 am" which characterised early software "seemed natural and was enthusiastically accepted."

Here begins the déjà vu, because this 'programming ethos' of the forties and fifties is still alive and well in the personal computing world, except that Basic has replaced machine language as the lingua franca.

"The programmer's task (in the early days) was to 'code' simple, small algorithms — by today's standards — in the machine language of a particular computer, using as many clever tricks and techniques as possible to overcome restrictions on memory and speed," say the COSERS software engineering panel. "Programming was fun, just like solving a puzzle; but was not considered difficult if you were the right sort of clever person." So what's new?

High level languages, of course, were new. Although they made programming easier, they also made programming even more sloppy. "Little attention was given to readability, adaptability or even correctness; the main problem was thought to be coding for the computer and understanding its own notation. And a program was a personal communication between one particular computer and the programmer, rarely to be read by others." That sounds familiar, too, as do their next observations, which get to the crux of the software problem:

"As computers became more powerful and flexible, as the cost of hardware decreased, as the problems given to programmers became larger and more complex and as programmers discovered that clever tricks used earlier were not enough, emphasis slowly changed from hardware to software. Systems which people felt would be easy, but tedious, to build — the command control system, the information management system, the airline reservations system, the operating system, the world champion chess player — turned out to be extremely difficult or even impossible. Major undertakings often took two to ten times their expected effort, or had to be abandoned . . .

"What happened? The computers still had the same kind of instruction sets, the programmers still knew exactly how the machines worked and the designers still knew how to lay out a system and its development in a modular fashion. *What happened was complexity* *growing out of scale.*" (My italics.)

They identify four particular reasons for the worsening of the software problems; generally ill-educated (in software engineering terms) personnel developing and managing software; the lack of awareness of the underlying difficulty of programming complex tasks; continuing growth in the size and complexity of problems tackled; and rapid hardware developments which failed to give priority to producing hardware that makes software writing easier, rather than just improving hardware characteristics such as speed, reliability and cost.

A consistent theme emerges from the discussion of software engineering which encapsulates the three often-contradictory forces which continue to shape computing developments. Firstly, there have been the over-riding demands of the computer industry to sell more systems, which led to computers being sold to solve problems *before* systems developers had adequately analysed and resolved the underlying principles which could be used to build correct, reliable and efficient systems. The over-selling of computers created a sudden demand for software personnel, which led to the employment of staff and managers with inadequate training for carrying out the responsible jobs they were given.

As the COSERS panel says: "The industry has seen managers with no knowledge of the programming process manage large projects and programmers maintaining complex programs with only three weeks training." Could you imagine that happening in a branch of traditional engineering, like bridge building? Would you fly in an aeroplane designed and constructed in the way software has generally been developed? The commercial requirements of the computer industry to make profits (ie sell more systems) and to "maximise investment in the existing customer base" (ie to stick with poorly designed computer architectures because so many users have invested money in developing software to make the best out of bad products) has also led to a stress on improving hardware in ways that give straight price/performance benefits, rather than radically altering basic structures which would assist better software techniques.

The second main force has been the development of high level languages, like Basic, which has made programming easier and led to the belief that it was unnecessary to use any kind of mathematical or scientific discipline to construct software. Of course, there is nothing wrong with writing programs for personal use in the sloppyist way, provided the program meets a personal need. There can be little excuse, however, for having the same ill-considered techniques when developing systems for use by others; systems which must be maintained and changed over a long period; systems which are complex; systems which must be understood by people other than programmers.

Some high level languages, like Pascal, were designed to promote good software engineering techniques (structured programming, modular design, readability, etc). Other languages, such as Basic, Fortran and Cobol, gave little attention to software engineering needs. As the COSERS panel explains: "The simplicity and ease with which one could be taught to understand a small, simple program led to the idea that one did not need to have a scientific, mathematical background in order to be a professional programmer. Moreover, how could science be helpful to the average programmer when the application upon which he usually worked was not scientific but industrial, financial or administrative? This lack of understanding of the need for a scientific basis and discipline for programming, this misconception that programming is easy, has led to the sloppy and wasteful practices that one finds in the data processing industry today."

Hold on! do I hear the schoolkid Basic-freak saying? Programming *is* easy. What is all this guff from crabby old professors?

The COSERS comment seems wrong only because of the confusion about what is meant by 'professional'. COSERS regards professional programming as a fundamentally different activity from personal 'amateur' programming, which is what the schoolkid is doing. And they are stressing the importance of a third computing force which, unfortunately, has trailed rather than led the growth of commercial computing and of non-professional programming.

This third force is the body of work described in *What Can be Automated?* — the mathematical, scientific and engineering research into the theory and practice of computing. The book does not claim to be comprehensive but it does indicate the types of problems that are being tackled, the solutions that are being brought together as a coherent science and the areas still to be solved. Although the book's price may put it out of the reach of many individuals, copies should be available in any educational establishment teaching computers and it should, at

least, be scanned by every personal computer programmer.

The range of topics covered indicate the broad scope of what can be called 'computer science': numerical computation, logic, artificial intelligence, hardware, computational linguistics, operating systems, programming languages, database management and software methodology. There are also examples of some advanced applications.

It is interesting to note that COSERS (and Americans in general) accept artificial intelligence as an intrinsic part of computer science. At an artificial intelligence conference at Newcastle University a few months ago, there was still considerable doubt about whether artificial intelligence had anything to offer to computer sciences and whether artificial intelligence should even be regarded as a subject in its own right.

Given the continuing debate about the nature and value of computer science itself, those reactionary computer scientists who are still throwing rotten academic eggs at the artificial intelligentsia should remove their blinkers and look to sorting out their own rickety house before bitching again.

Pascal in wonderland

"Contrariwise," continued Tweedledee, "if it was so, it might be; and if it were so, it would be: but as it isn't, it ain't. That's logic." And that is one of the delightfully witty and relevant comments — many from Lewis Carroll — which are used to introduce the chapters of an excellent book on Pascal and good programming practices which takes up all the important software principles identified by the COSERS study (see above review).

Foundations of Programming With Pascal by Lawrie Moore, head of computing services at Birkbeck College, brings to life the academic principles of software engineering without pontificating or being abstruse. Not only is the text lucid and easy to follow but it is written with a lightness of style rare in books which aim to promote strict theoretical disciplines, although it is common in many US-based personal computing publications which have less regard to the scientific approach.

Moore provides his own apt summary of his book: "This book is about programming. The fact that it introduces the programming language Pascal is less important than what it has to say about programming itself. It is only natural, in a book intended for beginners, to choose Pascal as the programming language to teach, because Pascal is, without any doubt, the language which has won first place as the introductory teaching language of computer science. This is because it provides the means of expressing in simple and lucid terms all the more important constructions which, in any other languages, can be expressed only clumsily, inelegantly, or in a way which is difficult to understand."

Like Pascal, Moore's style is elegant and easy to understand, which makes it ideal not only as a text book in universities, polys, schools, etc, but also for self-study or even just as an enjoyable read to refresh jaded computing palates. The tone of the book is set by a quote from Jacob Bronowski which precedes the Preface: "It is important that students bring a certain ragamuffin, barefoot irreverance to their studies; they are here not to worship what is known but to question it."

The use of quotations at the start of chapters is a frequently used gimmick in books but I have seldom seen them used as aptly as Moore does. The Tweedledee quote about logic appears at the start of the chapter on logic operators, of course. Another Lewis Carroll quote illuminates the rather heavy-sounding chapter on advanced use of parameters: " 'That's a great deal to make one word mean,' Alice said in a thoughtful tone. 'When I make a word do a lot of work like that,' said Humpty Dumpty, 'I always pay it extra.' "

Moore also enlivens the text with anecdotes and a relaxed enthusiasm and enjoyment of the subject.

For example, did you know where the word 'algor ithm' came from? Moore explains: it "derives from the name of the ninth-century Persian mathematician Abu Ja'far Mohammed ibn Musa al-Kuwarizmi which means 'father of Ja'far, Mohammed, son of Moses, native of Kuwarizmi', and has come down to us through centuries of western culture as Al-Kuwarizmi and thence via Algorithmus to Algorithm."

Having colourfully placed the concept into its historical mathematical context and provided an interesting diversion, Moore then proceeds to explain program algorithms by comparing them to mathematical equations.

In explaining the tricky concept of recursion, Moore again lightens the prospect, this time by his obvious sense of enthusiasm: "A recursive definition is fun, just like the merry-go-round at a funfair. It allows us to indulge in that 'awful sin' we were taught to avoid by our English teachers at school, the definition that goes round in a circle and comes back to itself."

He is not afraid to tackle apparently 'difficult' concepts such as set theory and formal program language syntax. He manages to do this without inflicting pain because the explanations are carried out within this friendly context so that the ideas are explained almost before the reader is aware that he or she is being made to eat up all their 'nasty spinach'.

The last chapter summarises good programming practices, such as documentation and testing procedures. This is useful but it would have been more powerful if it had been inserted earlier in the book rather than as an afterthought, although the main principles of good practical program productions are instilled throughout the book. Moore's major contribution is to show that it is possible to teach programming in a way that is enjoyable and easy but which does not violate the disciplines of software engineering which have been developed in the apparently inaccessible citadels of computer science.

Too much

Not *another* book on the microelectronics revolution, I thought, receiving yet another book called *The Microelectronics Revolution.* This time it turned out to be more than just a book on the dreaded Micro-Shock but a collection of articles, lectures, chapters from other books and even a TV script.

It could have been called "All You Wanted to Know About The Microelectronics Revolution But Were Afraid To Ask — In Case You Have To Read Over 500 Pages To Find A Muddled, Contradictory Answer". Although the book's editor, freelance journalist Tom Forester, has provided a running commentary to link the articles together, his selections include so much material that is repeated — in various forms — that it turns out indigestible if read in large chunks.

However, because it contains a wide summary of the thinking of the late seventies on the impact of information technology it could be valuable as a teaching aid. Hours of educational time could be taken up, for example, in studying the contributions in the book to determine precisely what revolution is being talked about and the nature of the technology.

Some authors refer to the microelectronics revolution, others to an 'information revolution', the second industrial revolution, the third industrial revolution, a communications revolution, etc. The technology that is to trigger the revolution is also described, inconsistently, as microelectronics, information technology, telecommunications, computers, et al.

Because little editing seem seems to have been carried out on the original articles, introductions to the technology are unnecessarily repeated ad nauseam as well as reiteration of the basic thrust of microelectronics towards reduced costs, increased complexity, improved performance, smaller size, etc. The book contains very little new but then its appeal is that, like cheapo record collections, it provides a collection of golden oldies and good fillers as well as some dross, all packaged at a lower cost than the originals.

In terms of authority and coherence, Forester's selection is nowhere near as good as the MIT publication *The Computer Age: A Twenty-Year View* which I reviewed in an earlier Bookfare. In fact, some of the best pieces chosen by Forester come from *The Computer Age*, such as Daniel Bell on the 'postindustrial information society' and Joseph Weizenbaum's trenchant criticisms of the inhuman direction that seems to be being followed by some computing enthusiasts.

Forester would have performed a far more valuable task if he had been stricter in selecting his material — more does not mean better — and if he had tried to rationalise the threads of the various arguments into digestible and coherent introductions to each chapter rather than superficial one paragraph links.

For example, just one technical introduction should have been given, with all others removed from individual essays. Too many of the articles relating to employment rehash the by-now well-known numbers game debate of how many people will/will not be employed/unemployed because of the technology. In the section on industrial relations, instead of a hard look at questions such as changing skills requirements, technology agreements, impact on personnel and career policies, etc, Forester offers some well-aired *general* points made by trade unionists such as ASTMS research director Barrie Sherman and an article by Michael J Earl reprinted from *Management Today* which is typical of the 'top-of-the-head' superficiality disgorged by the micro debate and unworthy of reprinting here.

As an educational aid, the book's failure to provide a more coherent and informed framework means that its value will depend a lot on the

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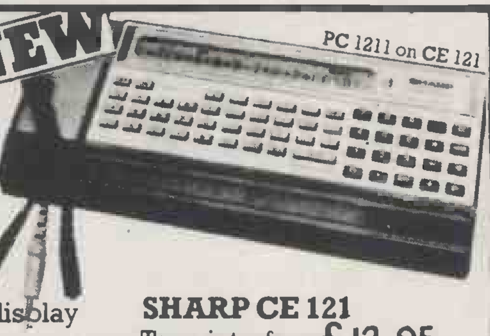

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teacher/lecturer's understanding of the subject.

For example, Forester's introduction describes Prestel as a teletext system. It isn't — it's a videotext (viewdata) system. This may seem a small criticism but it is indicative of the sloppy thinking which permeates the book's organisation and some of its contributions. After reading the 500-plus pages, more rather than less confusion is likely to prevail, unless the reader can discuss the issues raised with an informed person.

Despite my misgivings, however, I believe that the low price of the paperback version makes it good value for money and a reasonable starting point for somebody who wants to mug up quickly on this subject or who wishes to use it as the basis for a course on the implications of the 'new' technology. But it is a pity it is not half the size, minus the garbage while retaining the gems, wrapped in an informed summary of the story so far.

In Bookfare this month the following were reviewed: *What Can Be Automated?* (COSERS) edited by Bruce Arden (Massachussets Institute of Technology Press, £18.60); *Foundations of Programming with Pascal* by Lawrie Moore (Ellis Horwood/John Wiley, £14.50); *The Microelectronics Revolution* edited by Tom Forester (Basil Blackwell Publisher, £4.95 paperback, £16.00 hardback).

RECORD REVIEW

by David Tebbutt

What's a record review doing in PCW? Well, ever mindful of widening your horizons, we've dug out a recording of the *First Philadelphia Computer Music Festival* — an historic occasion and something I wish we'd thought of first.

The participating machines came in all shapes and sizes — in fact some didn't come at all but sent their recordings on an audio tape. Briefly, some eight computers entered: a 4k RCA Cosmac with a two-channel Super Sound board, programmed in PIN (Play It Now) -8; a 16k S100 system driving up to eight ALF boards; Solid State Music's 32k S100 system driving five SB-1 synthesiser cards and programmed via a MUS-X1 interpreter; an Ambilog mini (yes mini!) programmed in Notran (NOte TRANslation) — the fact it is a mini is forgivable because the recording was made in 1970; Software Technology's three-voice board plugged into a good old SOL-20 and programmed in MUSIC; Schertz's 20k S100 homebrew made of assorted kits and surplus parts; Newtech's S100 system using Basic to produce the music tables and machine language to interpret these into three voices; and finally, from 1962, Bell Laboratories' version of speech, music and song produced by a large, unspecified machine using a blend of punched cards, tape decks and three programs to produce an audio tape.

Now to the record itself. First, it must be said that the true value of this record lies in its ability to inspire awe when one considers the millions of numbers that had to be crunched to produce each piece of music. In fact one track stopped so suddenly it was as if the programmer just couldn't face the final few cadences — did he go mad?

Another reason for buying it is to own a record showing the development and variety of computer music over the years. You certainly wouldn't buy it for relaxation — some tracks are very pleasant but they are definitely in the minority and, anyway, who'd want to listen to the likes of *Yankee Doodle Dandy* or the *Mexican Hat Dance* after a hard day at work?

My major criterion for quality will be "is it pleasant to listen to?" So here goes.

The first track on side one is very good; it's *Mexican Hat Dance* programmed by Mel Richman and performed on the Cosmac. Another good one on the same side is *Yankee Doodle Dandy*, again on the Cosmac but this time programmed by Andrew Modia — in fact this was the one that stopped suddenly. Are you okay now, Andrew? Still on the same side is a Pachelbel's *Canon in D Major* programmed by John Ridges and played on ALF, which gets very close to a piano sound. There's a 'triangle' and several other unidentifiable instruments though the only slightly jarring notes come from what sounds like a flute — a bit too tinny for my liking. This was a problem on many tracks, especially when high notes were attempted. In fact the other six tracks on side one were a little harsh by comparison with those already mentioned.

Then came side two, which began with a very good stereo recording of *Flight of the Bumble Bee* containing a variety of instruments. Even better was track two — the same music played backwards — one of the neat little tricks which the Solid State Music system can perform. Programmers on both these tracks were Malcolm Wright and Steve North. They also did the next track, *It's A Small World* — only 47 seconds long but very sweet. The high-pitched notes on the SSM have "whistly" overtones.

The Notran system programmed by Hal Chamberlin (now a director of MTU) is worthy of mention because a) it was recorded in 1970 and b) Hal was responsible for it. It sounds a bit like an electronic organ and it took some 15 million 12-digit numbers to produce just eight minutes of sound. The computer took three-and-a-half hours to produce the tape of numbers which then had to be read in at 8000 numbers per second for output to a digital-to-analog converter. Since 32,000 numbers are needed for each second of sound, the recording of the output had to be speeded up by a factor of four to achieve the results heard on this record.

Bell Labs' offering has to be heard to be believed — it's horrible! But then we're talking about 1962 and music or speech on a computer was almost unheard (sic) of then. Can you imagine a computer singing — yes *singing* the words to *Daisy, Daisy* while playing an accompaniment on its electronic version of a piano. It's very, very weird but full marks to Bell Labs and D H Van Lenten, the programmer, for this remarkable effort.

Finally a brief mention of the other tracks on this side. David Ahl, the publisher of *Creative Computing*, managed to find his way onto the record with a rendering of *Yankee Doodle Dandy* (again) which sounded like a fairground organ playing in one of the Cheddar caves. One Donald Schertz playing Chattaway & Mills' *Redwing* sounded more as if his homebrew was operating in a dustbin (or maybe it was a trash can). The nicest one of all is Johann Wanhal's Rondo from *Sonata in B flat for Clarinet and Piano*. This was programmed by Dorothy Siegel on the Newtech and she accompanied the computer on her own (real) clarinet — very good.

And that's about it. It's a super record if you're fascinated by computer music. It's not the sort of thing you'd buy your Mum for Christmas, though.

It will cost you £3.50; contact *Creative Computing* at 27 Andrew Close, Nuneaton CV13 6EL.

TECHNICAL REVIEW

by Peter Rodwell

Z80 Microcomputer Design Projects, William Barden Jr, (Howard W Sams.)

Here's a handy book which could earn itself a place in any school wanting to teach microcomputing basics in a useful, practical way. Electronics enthusiasts, too, will find the book interesting as an introduction to the subject.

The book tells you how to build, program and use a basic Z80-based microcomputer system, called the EZ-80 (say it with an American accent — "Easy-80") and an EPROM programmer with which to burn in systems software for the EZ-80.

The book is divided into three sections — theory, construction and applications. The theory is dealt with reasonably well in that all the basic information is there but obviously some detail is rushed or avoided, inevitable when trying to cram it into one third of the book's 208 almost-A4 pages. But this section does contrive to cover the EZ-80 system components, CPU signals, memory, I/O (the EZ-80 has a four-digit LED display and a 12-key numeric pad), the Z80 instruction set and its addressing modes and assembler language formats.

The constructional section details the building of the EZ-80 system itself, using wire-wrapping, and the EPROM programmer, which can be used with either 2758 or 2716 EPROMs; I'd hate to have to use it to burn in a 2716 as the programmer is entirely manual — you have to set up the address and data for each location on a row of switches and press a pulse button to burn it in, a laborious and error-prone process.

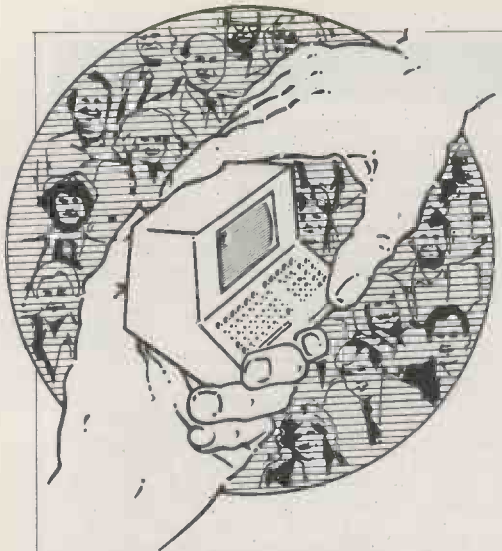
The final chapter in this section details a diagnostics program which will check out the EZ-80 system, including the memory, clock frequency and I/O.

The book really gets down to the nitty-gritty in the third section, however, with the projects you can carry out using the EZ-80 as a basis. These include a "microcomputer educator", which allows you to enter, check and run machine code programs, and the usual sort of projects which you find in this sort of book: a combination lock, a burglar alarm, a Morse code generator and sender, a telephone dialler (which British Telecom wouldn't like), a frequency counter/tachometer, a programmable timer and a simple music synthesiser.

The final chapter in the book is headed "Blue Sky Projects" and gives a few ideas for further projects using the EZ-80. These include D/A and A/D conversion, intelligent controller applications, and, interestingly, parallel processing using several EZ-80s sharing a common bus.

The book ends with an Appendix containing binary-decimal-hex conversion tables and a summary of the Z80 instruction set.

The book has plenty of explicit illustrations throughout and full assembler listings for all programs, making it quite easily-comprehendable for the novice. And I've a feeling that one or two design engineers might find the EZ-80 a handy device for prototype testing, etc. . .



COMPUTER TOWN UK!

Our future survival as a nation will depend on widespread computer literacy. In what is probably the most significant article ever published in PCW, Peter Rodwell and David Tebbutt explain how you can play a major part in taking computers to the people.

The Revolution has happened. Like it or not, we're now committed to the technological bandwagon and there's no easy way to get off.

There's been a lot of talk recently about what may happen to our society as a result of adopting the latest advances in technology — computers in particular. Different theories abound and, while they all seem to differ in their conclusions, they all agree that the changes to our society, whatever these may be, will be big ones.

We're not going to discuss the different theories here, because we have something much more important to talk about, something in which you personally can become directly involved, something we feel is of urgent importance.

Whether the introduction of microprocessor technology causes massive unemployment or whether it will require ultra-large-scale retraining, there's potential trouble ahead — the probability of widespread social unrest, to put it mildly.

Yet these changes are inevitable. It's too late now for us to forget about technology, to hide our heads in the bushy by-products of a dreamy agrarian economy, unless we want to go back to the Stone Age.

This is particularly ironic when we consider that it was this country, through the Industrial Revolution, which started the rest of the world on the technology bandwagon. Now the rest of the world — or at least the 'developed' parts of it — is well ahead of us and we'll have our work cut out to catch up — a difficult enough task without having to cope with social disorder as well.

For example, the Japanese are flooding our markets with good quality, low cost products — the result of their investment in automation. This is just one illustration of how we are allowing ourselves to become uncompetitive. These days we must compete or find unique products in order to survive.

Nobody likes change, especially when the new order is something unknown and unpredictable. Fear of the unknown is the greatest barrier to change and it can only be overcome by making the unknown into the familiar. As a country, we're remarkably ill-informed about modern technology; worse, many people are either hostile or utterly apathetic towards it — especially towards computers.

As a matter of interest, we've made large social changes in the past — from a nomadic to an agricultural society and from an agricultural to an industrial society. We're going to change again — very soon — so we'd better get used to the idea and prepare for it.

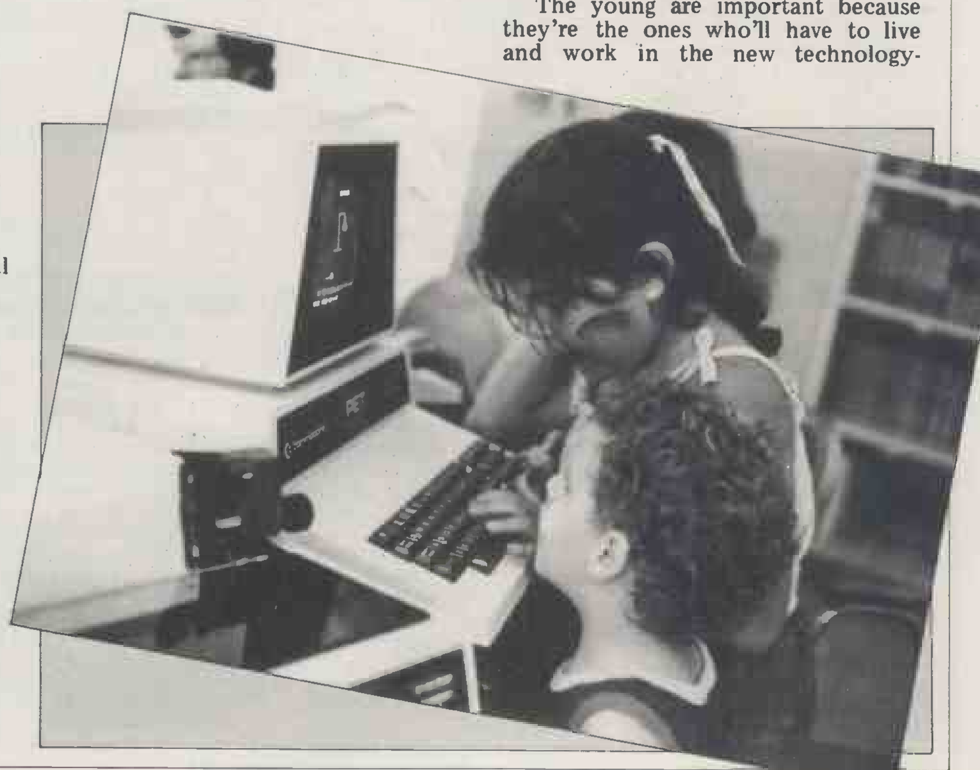
Computers in this country have a poor public image. We all know the myths and misconceptions: that you need to be an Einstein to even touch a computer; that computers are 'cleverer' than people; that soon computers will be running the world. We've all heard the horror stories about pensioners receiving £1 million gas bills or the apparently Byzantine cock-ups perpetrated by the DVLC computer at Swansea. There's little point in trying to explain away these phenomena, or in trying to differentiate between mainframes, minis, microcomputers and microprocessors. Even the control chip in a washing machine is a computer, but to the layman, they're all the same and they're 'nasty'.

If that's what it's like now, what's going to happen when we're surrounded by 'computers', albeit in near-invisible micro form? We believe that, unless something is done on a very wide scale to introduce the public to some basic truisms of computers, this country is in for a rough time.

We're concerned not only with spreading the microword among the adult population, however, but to children as well. Currently, computer education in this country is a dismal mess. Some schools are making brave, pioneering efforts against quite amazing odds and even a few Local Education Authorities are waking up to the subject but it's all pitifully little compared to what needs to be done.

There are two problems — shortage of money, and lack of centralised decision-making. Neither of these are likely to change in the near future as they depend, firstly, on national and international economic conditions, and secondly, on a deeply ingrained system which has evolved over a long time period. We're not in the fortunate position of the French, for example, where the decision has been taken by central government that every school *shall* have a microcomputer, and that *that* particular make will be used throughout the country.

The young are important because they're the ones who'll have to live and work in the new technology-



based society which will evolve before long. They *must* have a good grounding in technology to enable them to become useful citizens with a real contribution to make to the country. Let's face it, they're going to be our leaders one day. The very least we should do is to prepare them for the world they're going to live in. Among other things, they'll be able to help create the new industry that this country requires, one based on brainpower instead of on material products. We lead the world in software development and we'll have to work hard to keep that lead.

So, if there's no money in the kitty, a lack of a suitable, formalised central educational organisation, and a largely apathetic or hostile public, what can be done to overcome the problems we have described? The answer, we're convinced, can only be a voluntary organisation, manned by computer enthusiasts, who are prepared to spend a little time spreading computer literacy within their own communities. We're setting up this organisation and it's called ComputerTown UK!

How

CTUK! will work by 'subversion', or, rather, creative anarchy. One of its main obstacles is public apathy — go to Hyde Park Corner, stand on your soapbox, and see how many people fall asleep as you deliver your lecture on "The True Nature of Computers and their Role in Society"; the adult population just isn't very interested.

But children are, and ComputerTown UK! is all about children.

Children are free from the hangups which we adults carry around in our heads. Sit a child in front of a computer and s/he immediately uses it, relates to it, plays with it, laughs and cries over it, learns from it. When, and if, an adult layman approaches a computer, it's with an air of suspicion, hostility and often fear. Children represent the weak point in society's anti-technology mental block and CTUK! is designed to take advantage of this.

It works like this. Microcomputers are made available free of charge to any child who wants to come along and do something with them. At first nearly all the children will need some minimal introduction to the computers — how to switch them on, how to load a program from a cassette, that sort of thing — but they'll catch on very quickly. Some of the kids will learn more quickly than others and these will be encouraged to act as instructors for the slower learners. The children become well and truly hooked, and they then go home or to school and start baffling their parents or teachers with all this computer enthusiasm. Parents and teachers may at first dismiss it as some childish fantasy or a passing craze, but eventually many of them will want to find out what's happening for themselves so they, too, come along to the CTUK! centre.

Instead of being given a formal course or lecture on computers, the adults find themselves sitting in front of a machine, being given the same introductory talk (probably by a child) and being encouraged to learn for themselves with direct hands-on experience. Later, if there's sufficient demand from adults, some courses can be arranged for them to explain not only the more advanced aspects of programming, but to discuss some of the wider implications of microcomputer technology. If there's sufficient demand from adults, there might even be a whip-round at the end of each class to boost the centre's kitty. Just as the kids will have spread the word among their school friends, so the adults will talk to their adult friends, thus spreading the word about CTUK! and spreading computer literacy within the community.

It's important to realise that the aim of spreading computer literacy is certainly *not* to turn the whole population into programmers but to spread *awareness*.

Children take to programming very quickly, as do many adults once they've overcome their hangups, which isn't easy for many. So a certain proportion of both kids and adults will become quite proficient programmers and will probably want to buy their own machines to play with at home. Likewise, there'll always be a proportion who never grasp the fundamentals of programming but who derive enormous satisfaction from playing packaged games or using teaching programs. And there'll always be a few — from both age groups — who will never visit the centre at all.

This is why we describe CTUK! as a subversive organisation. We're bringing computer awareness to the community at 'grass roots' level, something almost heretical by tradition computer industry and teaching standards. And, even more heretically, we're doing it with the emphasis on fun, because we feel that people should know for themselves that computers *can* be fun.

In the States

Just in case you're thinking that all this theory is rather fanciful, let's look at the States, where ComputerTown USA! is alive and well in Menlo Park, California. Over a year ago Bob Albrecht and Ramon Zamora took their personal computers into local places such as pizza parlours and bookshops and simply made them available to anyone who was interested. Soon, so many were interested that they had to set up a permanent location in their local library where parents could bring their children (and children could bring their parents!) and get to know about computers. Within weeks hundreds of children had joined in. One-hour briefings on the basics of using computers were held; each child completing the briefing received a "My computer likes me" badge and certificate and was then allowed to explore the possibilities of computing.

Throughout, the emphasis of CTUSA! is on self-help; librarians are encourged *not* to help kids solve their problems — the kids are told to get other kids to help them.

CTUSA! has broadened its activities considerably from just introducing kids to computers. Adults, too, can enrol for classes, at which the teachers are often children who are paid for their work out of the proceeds from the classes. There's a Rent-a-Computer scheme which allows you to hire a computer to use in your own home for a week and there's even a Rent-a-Kid programme under which you can hire a "certified" kid to come to your home and teach you about your computer.

So far over a thousand children and adults have received their grounding in computer literacy from the Menlo Park ComputerTown USA! and the group is constantly expanding its activities.

How CTUK! works

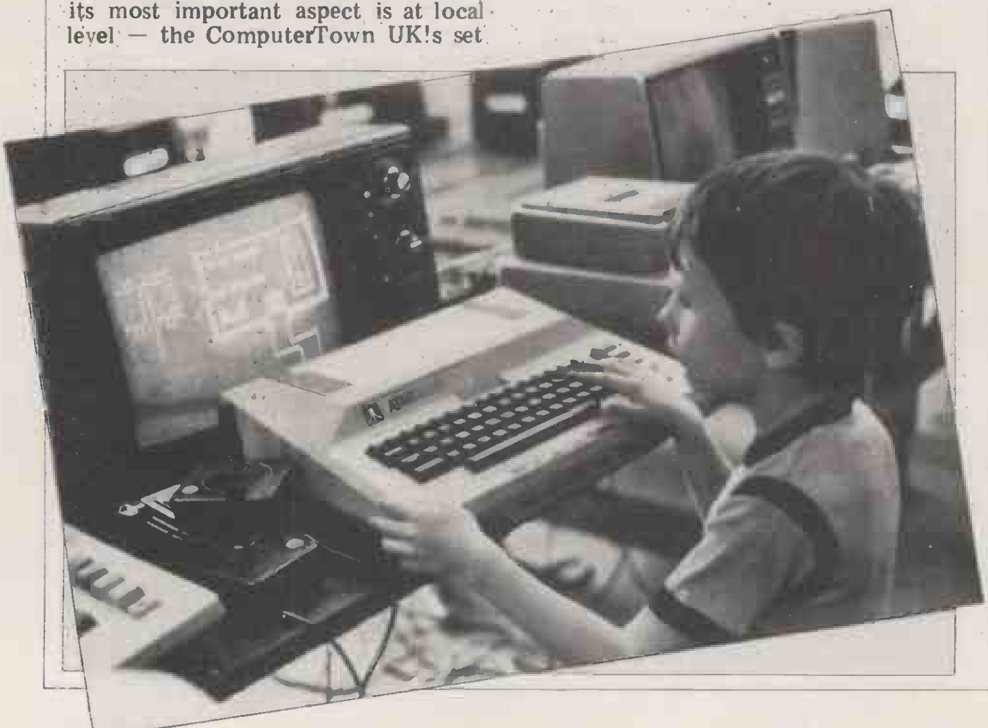
ComputerTown UK! is a strictly non-profit organisation (full charity status will be applied for). 'Organisation' is perhaps the wrong word, for we're determined not to let it become a formal, rigidly-structured outfit. The emphasis is on learning and fun and, while we may have to put up with certain formalities to satisfy the Charity Commissioners, these will be kept to the absolute minimum.

Although CTUK! has a national co-ordination centre (more on this later), its most important aspect is at local level — the ComputerTown UK!s set up all over the country. Set up by whom? Well, why not by *you?* That's right — anyone interested in spreading computer literacy in his/her community can set up a CTUK! centre — all you have to do is go out and do it!

To set up a CTUK! centre, you'll need at least one computer, some people to help you run it, and lots of enthusiasm!

Getting a computer is probably the easiest part — use your own to start with. If you're a member of a computer club, why not get together with one or two similarly-minded members to set up a CTUK! sub-group and pool both your machines and enthusiasm? That way you'll be able to handle a larger group of kids and, if you've a range of different machines, the children can gain a wider experience.

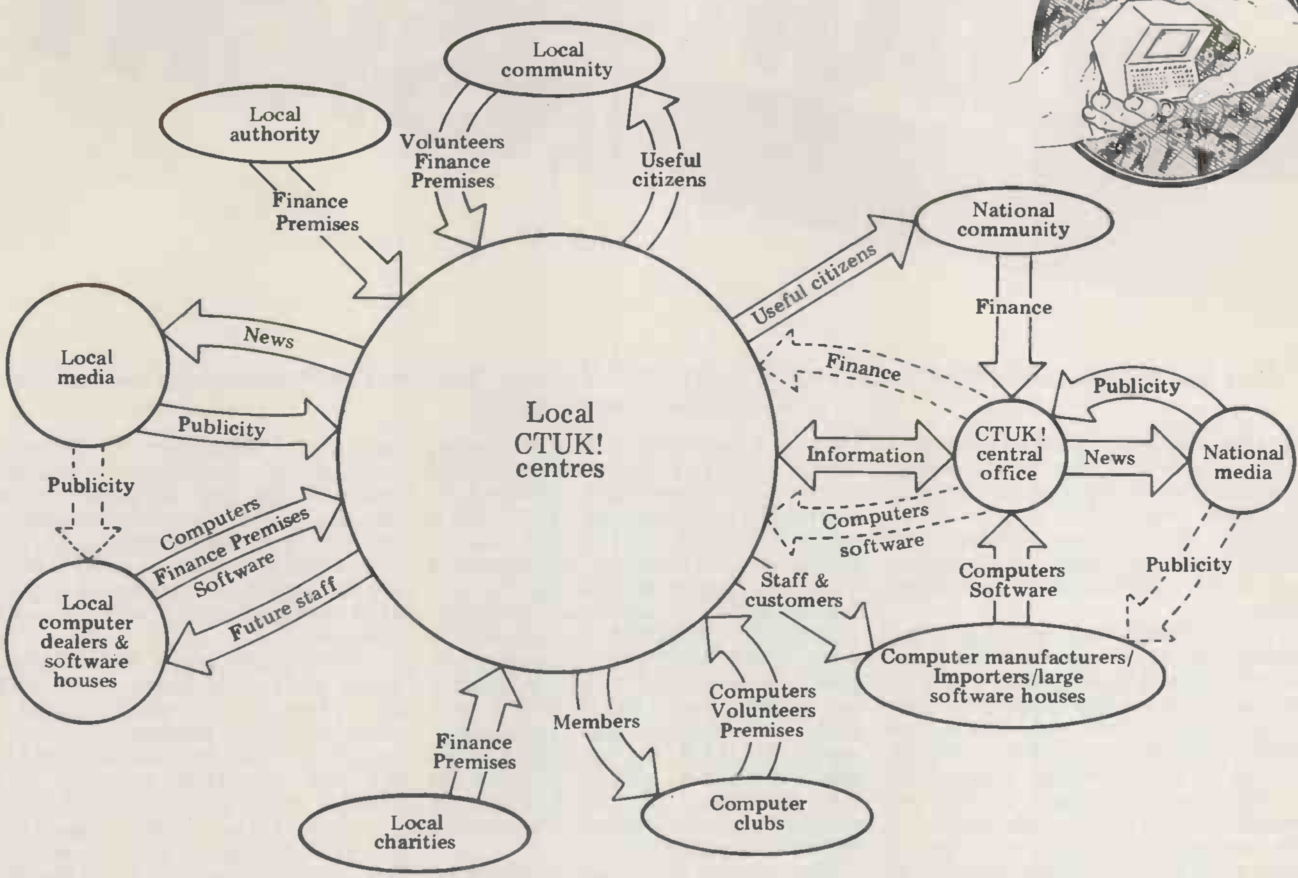
Some words of warning here: children can give computers a heavy time so you should use only commercially-built machines for your CTUK! group — don't let them loose on that cherished homebrew which took you a year to build! You really need to provide something like a PET, Atari or Tandy, something self-contained, cased and without a spaghetti of trailing wires. The machine must have a 'grown-up' Basic and have a useful amount of RAM left over — say 16k — with which to play. You'll also need a cassette player so that kids can bring along their own cassettes to save the programs they've written. We wouldn't advise disks for all the obvious reasons.



If neither you nor your friends own a suitable computer, try approaching your local computer dealers. They'll probably have read this article already — if not, wave it under their noses — so they should have some idea of what CTUK! is all about. Indeed, we're hoping that local dealers will themselves take the initiative in some areas — there'll be inevitable publicity and sales spin-offs from their involvement — but we must stress that hard selling is totally out of place in a CTUK! centre. If you should run into this problem just tell us and we'll help you sort it out.

We strongly recommend you to start your centre in a quiet way — don't go overboard and take on more than you and your colleagues can cope with. We'd suggest you start off with one evening a fortnight and as its popularity grows you can open more often. Once you've actually *started* you'll find plenty of committed, willing volunteers to help you, not least from among the children themselves! Remember that the centre will be even more popular at weekends and during school holidays. Getting extra volunteers to help is easy — word of mouth, notices pinned in your local library, community centre or newsagent's window, or even a small ad in your local newspaper will bring a good response.

At first glance you may think you need special premises but in every community there are places which can be used, such as church halls, community centres, bookshops or clubrooms. Try to avoid schools or colleges as they shut at weekends and during the holidays. Of course, wherever you set up your CTUK! centre, you'll need a power supply! If your local dealer is involved, he may be willing to let you use his shop, either permanently or until you outgrow it and find



larger premises.

You may be able to use the meeting room at your local library, along the lines of CTUSA!; if the local librarian isn't too enthusiastic about letting you have the room for free, get onto the chairman of the library committee — your local council will give you his phone number. If you're stuck for premises, you could always start off in your own home or garage, possibly rotating locations with other volunteers while you search for a suitable place.

Once you've conquered these challenges and you're ready to go, you'll need some way of attracting the punters. Word of mouth is excellent — putting notices in schools isn't so good at first as you'll probably be overwhelmed, and calling in the local press to publicise your CTUK! centre should definitely be left until it's running and you can cope with a lot more children and adults. Once you're ready to 'go public', contact us and we'll send you an information sheet on publicity.

Remember, your local CTUK! centre is autonomous — it's up to *you* to get things going in your community. Once you're established, with permanent premises, we may be able to help out further, depending on the central resources we have available — but *you've* got to get things moving first!

If your local dealer can't help with machines and premises, he may be willing to help with some of your costs. You should approach you local council as there are all sorts of ways in which they may be able to help, even in these times of austerity. Find out who your councillor is and ask for his help — that's what he's there for. And there is an amazing number of small local charities with money to hand out, provided you can locate them (start with the library) and convince them that you're a deserving cause. Some of these charities may also be able to help with premises.

As the central co-ordinators of ComputerTown UK!, we're probably best placed to approach computer manufacturers, major software houses and national sources of finance for their help. You, however, are far better placed to investigate sources of help within your own community.

We've printed here the nearest thing we'll ever have to an organisation chart, just to show you how we see it all fitting together and how the various elements interact.

You'll see that the local CTUK! centres form the most important part — we're here simply to act as an information clearing centre, to publicise CTUK! to the national media and in a regular CTUK! 'noticeboard' in PCW, and to wield the begging bowl at a national level. The rest hinges entirely around you, the local CTUK! groups.

One of your main challenges will be to convince others that teaching microcomputing is actually a useful thing to do — certainly it doesn't fall into most people's definition of a charitable activity, but this is possibly due to the lack of technological awareness or interest in this country which we described earlier. Probably the best way to convince anybody (apart from showing them a copy of this article) is to sit them down in front of a computer and let them have a go themselves! If you can 'hook' the chairman of your council's finance committee then you'll have made a really useful friend.

Whatever you're after — premises, machines or money — the possible donor will want to know how his involvement will benefit the community. We've marked this on the chart too: computer clubs stand to gain more members; dealers stand — *indirectly* — to gain publicity and possible future sales; the community stands to gain more useful, aware citizens who will be able to cope more effectively with a technology-based society. The country as a whole stands to gain much, for similar reasons. And the computer industry will gain a badly-needed source of new staff from among those children and adults who decide to become seriously involved in computing.

And what do you stand to gain from all this? Involvement, the satisfaction of knowing that you're making a real contribution to our society, and a hell of a lot of fun!

If you want to write to us at CTUK!, please send an SAE for a reply. Write to: ComputerTown UK!, 14 Rathbone Place, London W1P 1DE. *As we're running CTUK! entirely in our spare time, please* don't telephone the PCW offices.

Permission to reprint this article will be given free of charge to any organisation or publication willing to further the interests of ComputerTown UK! Please contact the Editor of PCW.

COLOUR INSIGHT

Ever had trouble with colour on your ITT 2020? In this article Malcolm Banthorpe reveals the secrets of successful colour plotting.

The high resolution graphics system of the ITT 2020, like that of the Apple, allows plotting in four different colours, plus black and white. Because of its simplicity, the system suffers from certain limitations, which, if improperly understood, can lead to disappointing results.

The inclusion of plotting, line drawing and shape manipulation commands in Palsoft Basic makes it easy to use the high resolution graphics but the use of colour is often neglected because of the potentially unpredictable results. An area of the screen can successfully be filled with a single colour but anomalies arise when single points or lines are plotted. Attempts to plot a single point in colour may result in its non-appearance or, if it does appear, its colour may not be as expected. A single point, plotted with the colour set to white, will in fact appear as a coloured point. A vertical line, intended to be coloured, may also fail to appear or, if intended to be white, may appear as either blue or red. All of these problems can be overcome to some extent if the way that the system works is understood.

In computing, as in most other things, an advantage is seldom gained without a corresponding disadvantage being incurred. In this case the price paid is the halving of horizontal and vertical resolutions (to 180 x 96 instead of the normal 360 x 192). In many applications, such as graph plotting, this is better than having some points not appear at all. There is an additional advantage in that 12 different colours plus black and white are available. On a monochrome display, black, white and three different half-tones are available.

To show just why the colour problems mentioned above should occur, let's look briefly at the ITT colour system. In the high resolution graphics mode the screen normally comprises 360 x 192 individually addressable points. Each of these points can either be off (black) or be lit in a single colour. For example, point 0,0 can be either off or yellow, point 1,0 can either be off or blue. No point can be lit in more than one colour. The points are arranged in groups of four — yellow, blue, magenta and green — as shown in Figure 1. Note that any two horizontally adjacent points are of complementary colours and if displayed together will appear white.

When the HCOLOR command is used in Palsoft Basic to set a plotting colour, certain of the points are enabled to be lit, if subsequently addressed by an HPLOT command. So if HCOLOR is set to 1, then all the blue and magenta points are enabled and will appear if addressed. Yellow and green points will fail to appear if addressed. Similarly, HCOLOR = 2 enables all yellow and green points, HCOLOR = 5 blue and green points and HCOLOR = 6 magenta and yellow points. HCOLOR = 3 or 7 enables all points and allows plotting in white. HCOLOR = 0 or 4 disables all points and allows plotting in black (in this condition, any point which is already lit and is addressed to be plotted will be extinguished).

The system works well in practice, where areas are to be coloured and the resolution is sufficiently high to make the areas appear of uniform colour rather than dots of two different colours. Problems occur when single points are to be plotted. For example, if you attempt to plot the point 0,0 (a yellow point) when HCOLOR is set to 1 (blue and magenta points enabled) then nothing will appear.

Similar problems occur with vertical lines. Either they may fail to appear at all or if, for example, HCOLOR is set to 3 (all points enabled) and the line passes through a yellow and magenta point (see Figure 1 again) then the line will appear just as if HCOLOR had been set to 6.

By now you're probably wondering why such a strange system should ever have been implemented in the first case. The most probable reason is one of memory economy. The system uses one bit for each addressable point. If it were to be made possible for any point to appear in any of the four colours, then an additional two bits would be needed to specify its colour. This means that 24k, instead of 8k, would be required for the screen buffer.

In the method given here for overcoming some of the system's limitations, the screen is divided into 180 x 96 pixels. Each pixel will contain one point each of yellow, blue, green and magenta. As each point can be either lit or off, there are 15 possible combinations of points which can make up a pixel. These combinations are shown in Figure 2. Number 15 will, of course, appear white. Numbers 5 and 7 will also appear white but of lower intensity since only half the points are lit and so are effectively grey. The other 12 pixels will each yield a different colour. In practice, perhaps not surprisingly, the colours exhibited by the 15 pixels are very similar to the 15 colours available in the low resolution graphics mode of the ITT 2020. If any single pixel is plotted on the screen, its appearance is guaranteed and its colour will be entirely predictable.

These pixels are easily achieved by using the Palsoft 'shape table' facility to define 15 very simple shapes. To draw any of the pixels anywhere on the screen, all that's required is a DRAW N AT X,Y command, where N is the number of the pixel and X and Y are its coordinates. The required shape table is shown in Figure 3. The addresses shown are for a machine with 48k RAM. For a 32k machine, the table should start at 7FADH and for a 16k machine at 1FADH. Once the table has been entered into the computer, its start address must be placed in locations E8H and E9H:

*E8: AD BF; or *E8: AD 7F; or
*E8: AD 1F

depending on RAM size. At this stage, it's a good idea to save the table on tape for future use. First store the table length in locations 00H and 01H:

*00: 52 00

then:

*0.1W BFAX.BFFFW;or *0.1W 7FAD.7FFFW; or *0.1W 1FAD.1FFFW

depending on RAM size, will save the table on tape. Once saved, it can in future be loaded from Basic by means of a SHLOAD command. This will automatically load the table at the top of available RAM and set HIMEN below the start of the table so that it cannot be corrupted by a Basic program or its variables On a 16k machine, set HIMEN to 8191 before loading the shape table from tape.

As mentioned previously, to plot a single point (pixel) in this system, a DRAW N AT X,Y command is required. To achieve consistent colour, X and Y must both be even numbers and so it may be more convenient to consider X and Y as coordinates in the range 0-178 and 0-95 respectively and then DRAW N AT 2*X, 2*Y. A few trials will show which shape numbers correspond to which colours. Be sure to set HCOLOR=3, SCALE=1 and ROT=0 before starting.

The normal Basic line drawing command (HPLOT X1,Y1 TO X2,Y2) cannot be used with this pixel system but a simple Basic subroutine may be

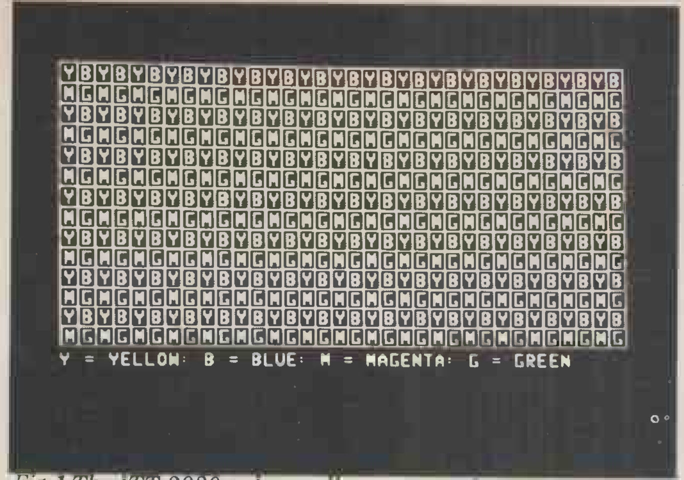


Fig 1 The ITT 2020 colour cell arrangement.

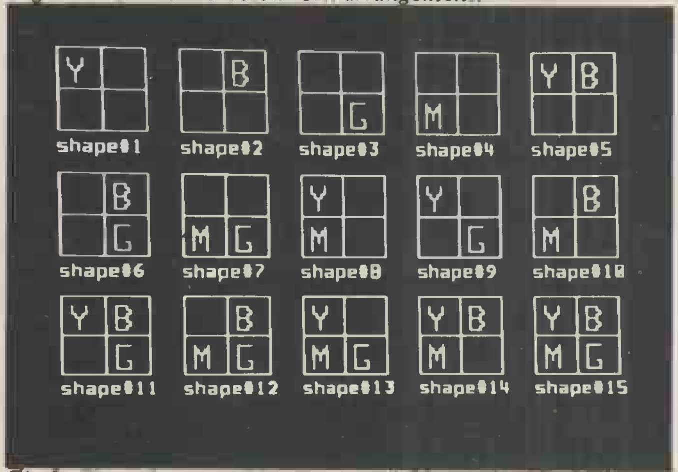


Fig 2 The colour combinations available on the 15 pixels.

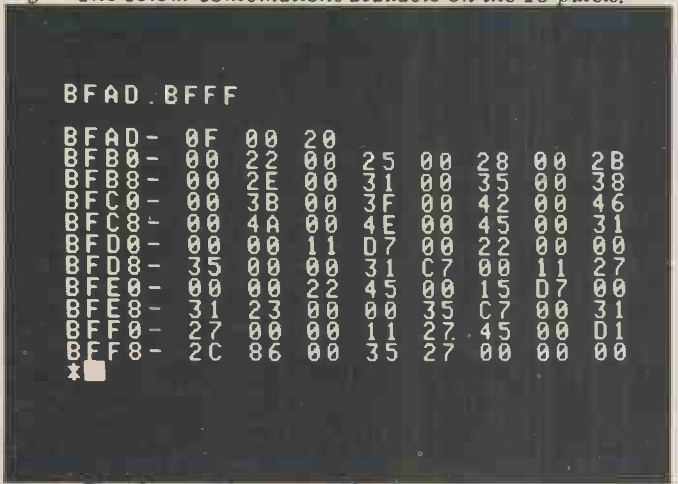
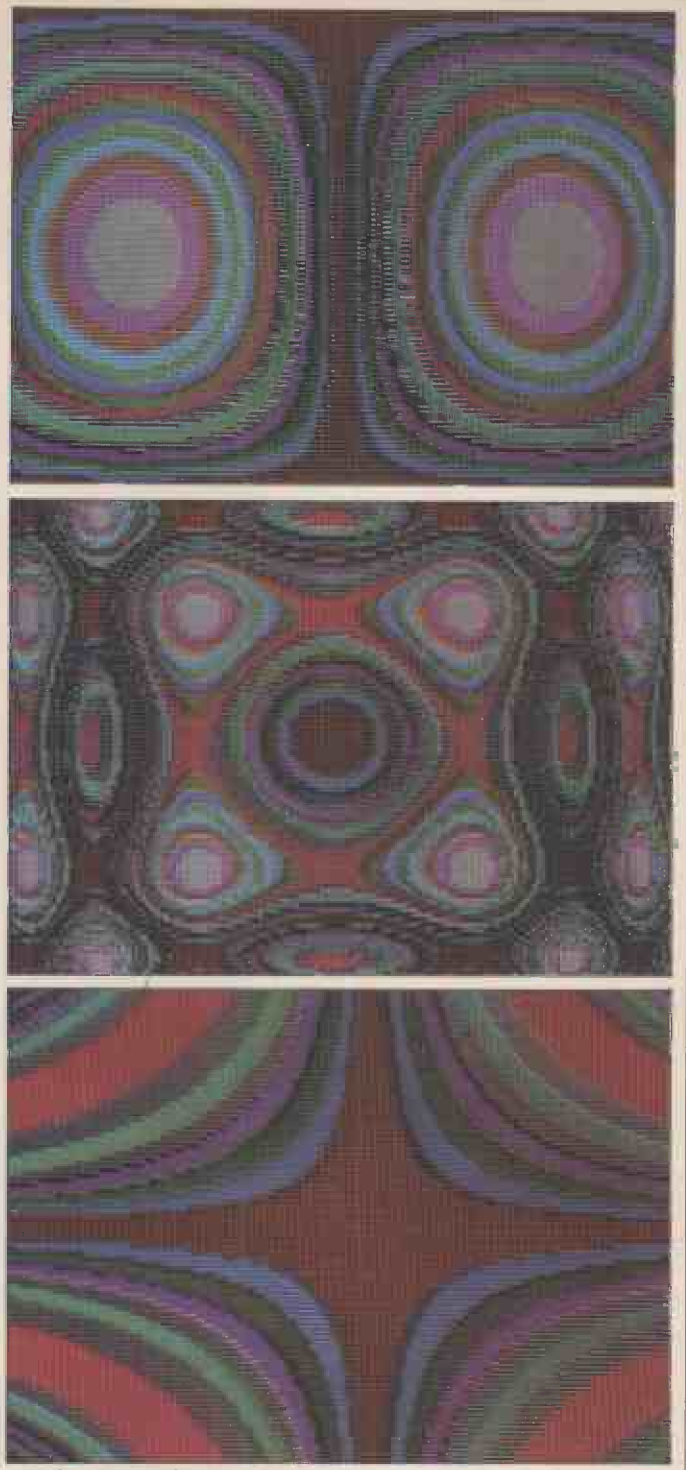


Fig 3 The shape table.



A selection of displays produced by modifying line 50 in the final program below.

used instead. X1 and X2 are integers in the range 0-178: Y1 and Y2 are integers in the range 0-95.

```
100 HCOLOR = 3: SCALE = 1: ROT = 0
1010 DX = X2 – X1: DY = Y2 – Y1
1020 IF ABS(DY) > ABS(DX) THEN 1080
1030 IY = DY / DX: Y = Y1
1040 FOR X = X1 TO X2 STEP SGN(DX)
1050 DRAW N AT 2 * INT(X),2 * INT(Y)
1060 Y = Y + IY * SGN(DX)
1070 NEXT: RETURN
1080 IX = DX / DY: X = X1
1090 FOR Y = Y1 TO Y2 STEP SGN(DY)
1100 DRAW N AT 2 * INT(X),2 * INT(Y)
1110 X = X + IX * SGN(DY)
1120 NEXT: RETURN
```

This subroutine can be called whenever it is required to plot a line between two points, X1,Y1 and X2,Y2. The colour of the line will be determined by the value of N, which specifies which of the 15 pixels will be used. N must therefore lie within the range 1-15. To plot in black, set HCOLOR to 0 or 4 and set N to 15.

Finally, here's a way of using this pixel system to plot in three dimensions, using colour as the third dimension. The idea is to make the colour of each pixel a function of its X and Y coordinates. Even in black and white, this form of plotting can be effective because the pixels have four different effective levels of brightness (depending on whether one, two, three or four points are lit). Additional contours are visible in black and white because of discontinuities in the dot pattern at the boundaries of different colours whose pixels have the same brightness values.

A suitable program to achieve this type of plot is as follows:

```
10 HGR2: HCOLOR = 3: SCALE =1:
   ROT = 0
20 FOR X = 0 TO 178 STEP 2
30 FOR Y = 0 TO 95 STEP 2
40 A = 180 + X: B = 96 + Y
45 C = 180 – X: D = 96 – Y
50 N = ABS(SIN(X/30) + SIN(Y/15))
   * 7.5
70 IF N<1 THEN 100
80 DRAW N AT A,B: DRAW N AT C,D
90 DRAW N AT A,D: DRAW N AT C,B
100 NEXT: NEXT
```

The function to be plotted is written as line 50. The function must be arranged so that N will be evaluated in the range 1-15. Line 70 ensures that black is plotted when N is less than 1.

To achieve a symmetrical plot and to speed up plotting time, the function is plotted as if the point 0,0 were in the centre of the screen. The program can be easily modified if a more conventional plot is required.

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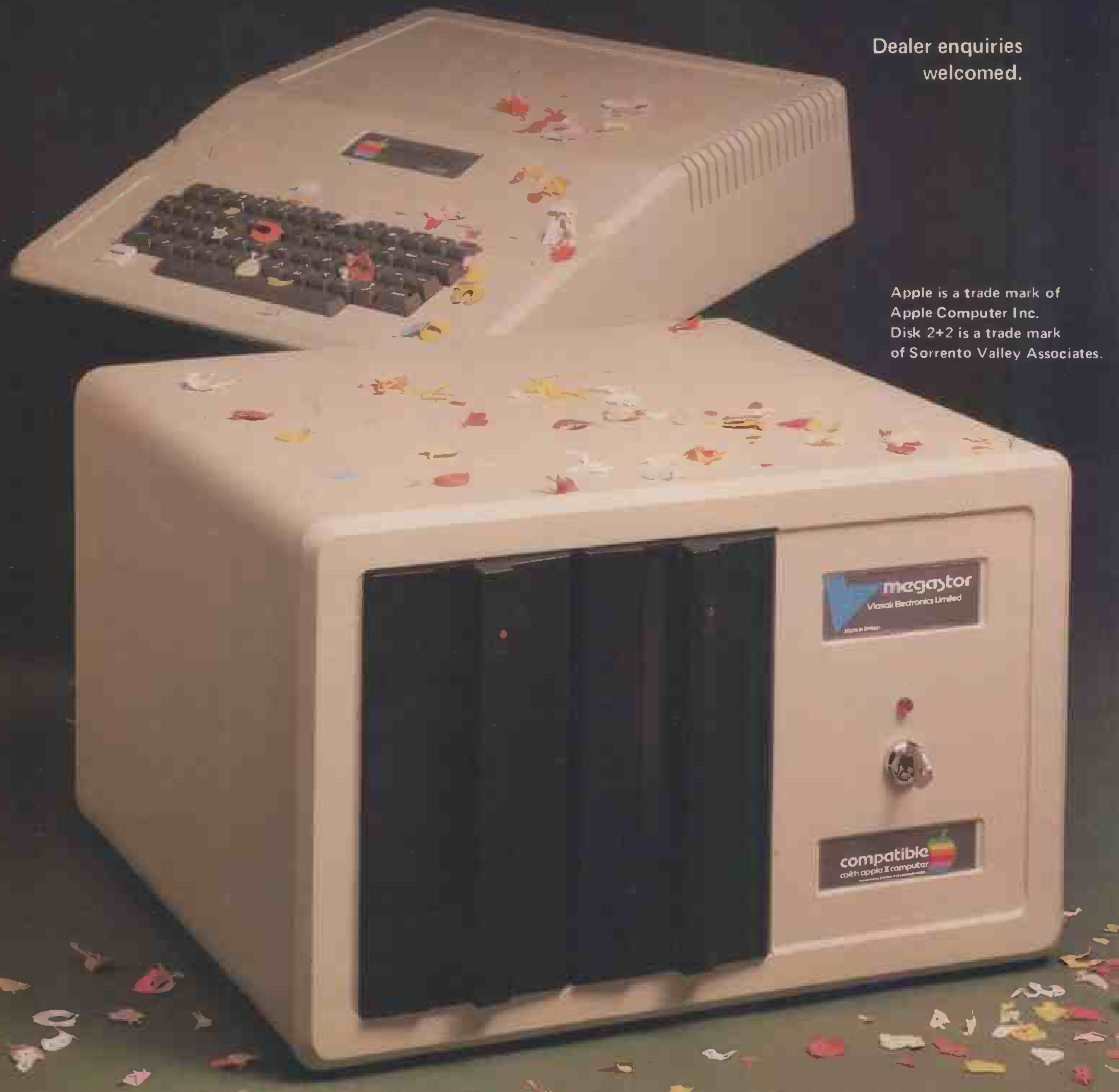

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GATEWAYS TO LOGIC

Derrick Daines continues his series on teaching others the basics of microcomputing.

CHAPTER 5, PART 1: THE TRANSISTOR AS A SWITCH

Around this time, students begin to wonder how the computer does it. If it's supposed to be a wonder-worker, how, in fact, does the silicon chip work its wonders? What's all the fuss about?

To answer the question 'how?' we must return our work on gates, since the most elaborate and powerful computers are at heart nothing but a bunch of gates. They're fast, of course — frighteningly so; indeed one sometimes wonders if the fear and awe of electronic gadgetry would disappear were they a little slower.

There's a student's binary adding machine commercially available under the name of Bobcat (see Appendix) which relies not on electronics but on rolled steel balls to knock plastic gates this way and that. The idea has much to commend it: students can watch the steady trundling of the steel balls in a way that they cannot watch electrons flowing down a wire.

A set of water-driven plastic gates used to be available (the gates don't actually move, but the water does). It was found many years ago that differently-shaped bowls produce changes in the flow of water that was analogous to binary operation; thus, this combination of bowl shapes and plastic tubing produces a simple logic machine. All you do is hook up your computer to the nearest water tap and, by manipulating tiny stop cocks here and there, binary outputs are produced according to the logic model. Water flowing in a tube represents binary 1, while no flow represents binary 0.

Such models of computer operation are, of course, severely limited but they have their place in aiding the student's understanding. It doesn't do much good for him to open up a computer and stare uncomprehendingly at hundreds of motionless bits and pieces but a device that moves is another thing altogether.

Electric gates

A good halfway stage between mechanics and electronics is the common-or-garden switch. An enormous variety is available: those sold by Woolworth are as good as any for our purposes. They can be screwed onto a flat board without the need to make any holes, are cheap and will take sufficient current to drive torch bulbs (Figure 1).

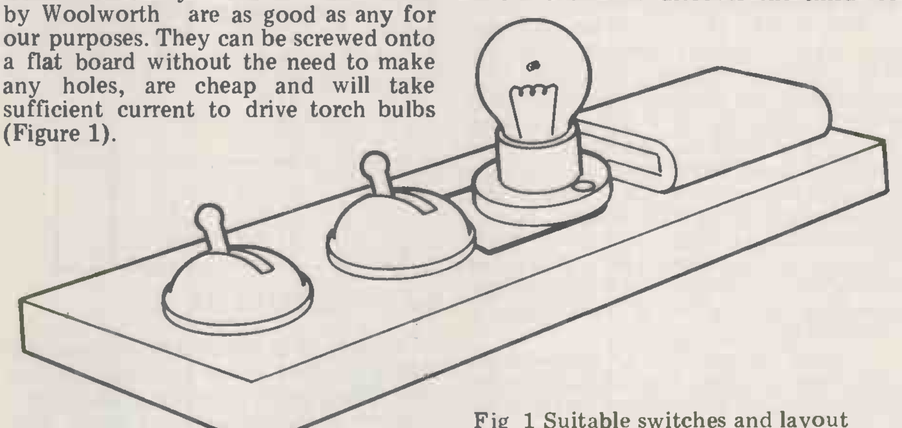


Fig 1 Suitable switches and layout

Any handiman can wire up the AND gate of Figure 2. The symbol is shown in Figure 3 and it's recommended that the circuitry be *not* shown to students — to prevent confusion with the gate, from which it differs on a couple of important points.

You'll note that the lamp will not light until both switch A AND switch B are on. Let the students play with it for a while before introducing a disciplined study. With two switches and only two positions possible for each switch, there is a total of four possible combinations. Draw up the truth table of Figure 4 and ask the students to discover if there are any other possibilities not listed. Alternatively, have them copy the first two columns of the table and discover the third for themselves. Of course, 0 represents a switch up or off, or a lamp unlit.

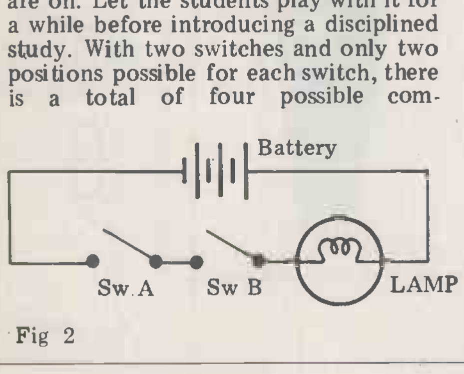


Fig 2

A duplicate set of switches and lamp should be prepared that appears to be identical in every way, but has a difference under the switch covers — the switches are wired as in Figure 5. This will be recognised as the Inclusive—OR gate and the lamp will light if either or both of the switches is on. This time the gadget is introduced to the pupils without explanation and with instructions to construct a truth table for themselves; from that, have them decide on the correct name for the device. The symbol for the Inclusive—OR gate is given in Figure 6, where the '1' indicates that any 1 input produces an output. The truth table is given in Figure 7.

These examples represent what is probably the practical limit of useful gates that can be demonstrated in this way. To proceed further we need to look a little into electronics.

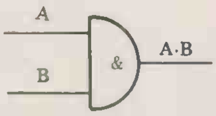


Fig 3 More inputs are allowed

Stripping a TV

Pulling a TV to pieces is an excellent way of removing some of the mystique of electronics. Old television sets are often available just for the asking and the carting.

Depending upon the age of his students, the teacher may like to do a little preparatory dismantling himself. Screwdrivers of different sizes will be needed, one or two small spanners and a pair of wire cutters. If the dismantling process is to proceed a long way, small pliers, side- or end-cutters and even tweezers will be handy in the later stages.

A	B	OUT
0	0	0
0	1	0
1	0	0
1	1	1

Fig 4 'AND'

First stages comprise dismantling the TV into its major component assemblies — case, tube, power pack and one or more printed circuit boards. Some sets will also have valves.

Two words of warning are in order here. One — on no account allow the tube to be roughly handled. It's surprisingly robust, but nevertheless it is made of glass and if it receives a hard blow, the resulting implosion could result in considerable injury to those nearby. It's probably best, in fact, if the teacher handles the tube himself. Two — stress earnestly that this is to be a dismantling operation, not a display of of demolition. Much of the value of the operation will be lost if indiscriminate destruction is allowed.

Snap off wires close to components and, where possible, snip off component leads close to the printed circuit boards. Carefully retain everything — it's important that students realise, that there is no 'magic ingredient' being kept from them. Eventually a small mountain of bits and pieces will have been collected to be sorted and examined closely; the components themselves may be dismantled too.

There are two main types of resistors. One is made of black graphite similar to pencil lead; the other is a coil of wire hard-baked onto a ceramic mounting. Capacitors come in a variety of shapes, sizes and materials. Disc and bead types cannot be dismantled, but the variable types enthrall students since they are usually beautifully-engineered sets of smooth plates sliding past each other, often on a ball bearing. Electrolytic capacitors are tubular and, if opened by turning up the sealing flange, the contents may be withdrawn. They are revealed to be nothing but a strip of paper with some (slightly poisonous) 'gooey stuff' on it, rolled up tightly with a strip of aluminium foil. Transformers may be unwound and even the core dismantled into a heap of thin metal plates. Sooner or later the teacher will feel that it's time to pose the question, "Where's the magic?"

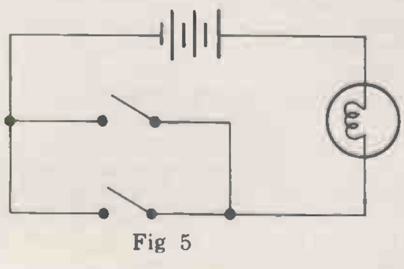


Fig 5

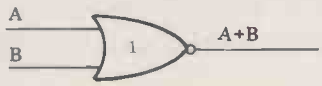


Fig 6

The teacher should select various examples of each type of component for display and turn the rest over for inspection. The case (possibly) and certainly the tube should, however, be witheld — the former for other purposes and the latter for safe disposal.

Space~age art

The average TV set will yield enough bits and pieces for everyone, enabling each child to make pictures, designs or models with his share of the spoils. The shapes of the pieces themselves often suggest ideas and sometimes I find groups pooling their resources in order to make something more elaborate — a space station, robot or what-have-you.

A	B	OUT
0	0	0
0	1	1
1	0	1
1	1	1

Fig 7 'INCLUSIVE-OR'

Pictures and other two-dimensional works are best made of very small or very thin pieces carefully cleaned and polished before being stuck down with Copydex or Uhu onto a matt black sheet of card. Some of the more awkward items may be stitched into place with short lengths of thin wire. Such pictures can look very fine when the outline is surrounded by bright copper wire from transformer windings — or thicker wire that's been stripped of its insulation.

Three-dimensional models often require a base and this is perhaps best made from a piece of hardboard on which has been applied a rough coating of Soffenbak or papier maché, suitably painted. The model itself can be either left as it is, or finished off with enamel paints to hide globs of glue and the over-size lettering on some components. Other models may be free-standing, while yet others look particularly fine when hung from the ceiling.

Not all models need glue. Sometimes various bits can be bent so as to grip each other while others will slot together — or can be bound by lengths of wire. As a very last resort the teacher may at his discretion use solder or Superglue, although, needless to say, such materials are not to be left in the hands of children.

Make no mistake — there is a lot of work in this project for a school teacher, but it does fulfil a vital role, especially I believe for the girls. It seems that boys quite frequently get their hands on radio bits and pull them apart. Girls, however, rarely do and they need the familiarity that such activity brings if they are not to be handicapped in their understanding of the wonderful world of tomorrow.

Miniaturisation

The teacher can now assemble a selection of pieces out of which he is able to make another very important point. The items he needs are: one TV tube, one valve, one transistor and one integrated circuit.

Using these he can indicate the TV tube as being just a little larger than the first valves made in the early part of this century (valves of this size are still in use in radio transmitting stations). Next he can show the gradual reduction in valve size — down to the humble audio 12AU7 that's still found in domestic appliances; on to the enormous size reductions with the invention of the transistor; and finally, the breathtaking packing of first hundreds and then thousands of transistors into the integrated circuit (see Figure 8). The student is therefore rapidly able to unlearn an earlier concept — that bigger means more. The integrated

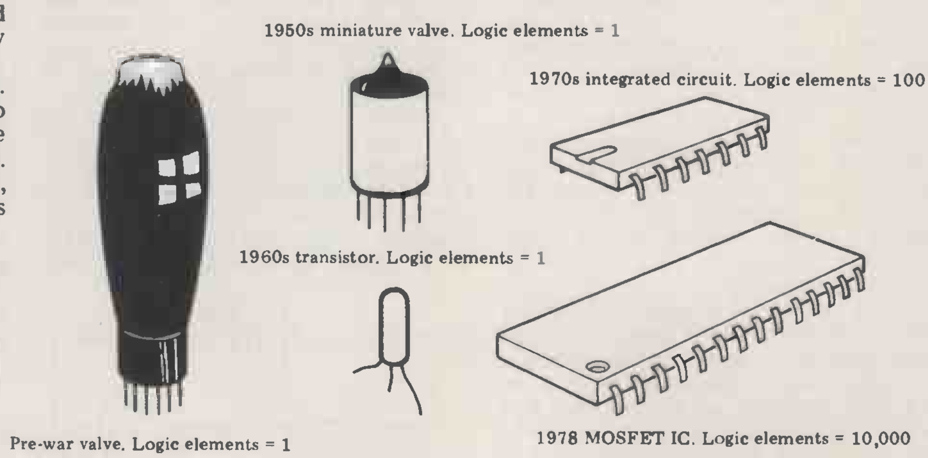


Fig 8 (Scale roughly accurate)

circuit can do far, far more work (in terms of operations completed) than the valve. Moreover, it can do it more reliably and without the need for a large and dangerous power-pack. The valve needs high voltages for the anode, intermediate voltage or voltages for the grid(s) and a 6.5 volt alternating current for the heaters; the integrated circuit will operate on just one 5 volt supply. Even without other far-reaching innovations, this one alone would have been enough to transform the world of science and communications.

The reducation in bulk is even greater than it appears. If you destroy a transistor by crushing it as gently as possible, you'll find that 95% of its bulk is just its black plastic body. Embedded within it is the working part — no bigger than a pin head — where the three wires meet. Similarly, with the latest integrated circuits, the working part of the microprocessor is about the size of a melon seed; the encapsulation has to be much larger to allow room for the mounting legs and connecting wires.

Strangely, the price for each item shown in Figure 8 (when new) remained approximately the same in real terms. Before the war, valves cost around 7/6d each (37½p), when the average wage was about £3 a week. Thus, to buy a valve one could expect to pay about 12.5% of the weekly wage. When transistors first appeared on the market, I remember buying one for 25/- (£1.25) and the average wage was about £25. The current price of a microprocessor is between £9 and £16, with the average wage £85; that makes the cost still between 10.5% and 18% of the weekly wage. (Other integrated circuits can be bought for as little as 20p!)

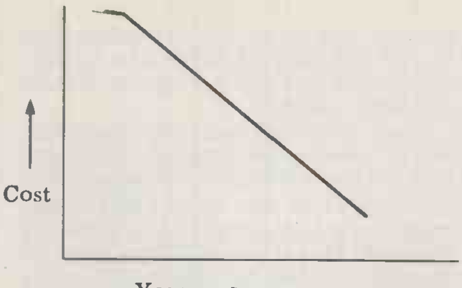


Fig 9

Taken in terms of logic units bought, however, it's clear that the price per logic element has plummeted (Figure 9). It's this fact that's brought the possibility of a computer in every home, just as in 1920 the thermionic valve allowed the introduction of a superheterodyne radio set into every home.

Transistor as a switch

It's perhaps difficult for newcomers to electronics to accept that the transistor works as a very good switch. The ubiquitous portable 'tranny' makes us all familiar with the idea of the transistor as an amplifier but somehow the idea of it switching seems a little alien. Nevertheless it is very good at it. There are no moving parts, it's lightning fast, silent and creates no spark hazard. The only point of caution is that the stated maximum electric current mustn't be exceeded or it will be destroyed. It may still look alright, but its usefulness will be at an end.

Now I do not wish to go over ground that's adequately covered elsewhere, nor do I particularly wish to make electronics constructors of my readers. However, the use of the transistor as a switch is so fundamental to the new technology that I cannot avoid the subject altogether. Only rarely is this aspect dealt with in such literature and it's rarer still for it to be treated simply, so I must include it here.

Luckily, soldering is not necessary and there are various kits available (see Appendix) that the reader may purchase. Some are better than others and they also have a habit of appearing and disappearing off the market. All, however, utilise some spring-clip method of connection and nearly all advertise (rightly) that one can undertake various projects with them and that they teach the fundamentals of electronics (not nearly so often right). Value for money varies of course but, unless the reader contemplates doing more work on electronics than is covered by this series, the purchase of any kit is not recommended. The complete list of components required to complete all vital experiments and demonstrations is contained in the Appendix and the reader will find that the total cost is less than £2.

The only equipment needed is a pair of nimble fingers, a few paper fasteners and a piece of thick card or perforated hardboard. The wires to be connected and gripped between the legs of a bifurcated paper fastener which is pushed through a hole in the perforated hardboard; the legs are then bent over (Figure 10). This form of construction is perfectly adequate for the demonstrations to follow, and students will manage it quite easily.

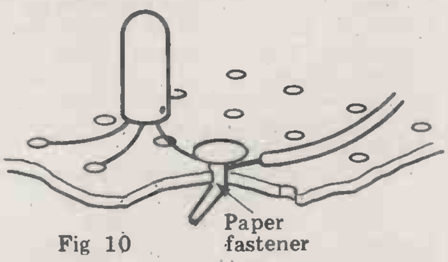


Fig 10

If something a little better is required I recommend an 'insertion block', which is a block of plastic some 5 inches by 3 inches by about ¾ inches thick. Embedded in the plastic is a series of tiny spring clips that match a matrix of holes above; all one does is to push a wire or component lead vertically downwards through the hole, where it is gripped by the spring clip (Figure 11). The clips are connected to each other in rows so that any wire in a hole is connected electrically to every other wire in the same row. Various types are available, including some designed especially for integrated circuits (see Appendix).

Of course, those of my readers who are adept with a soldering iron will be able to make a more permanent job by using a strip of Veroboard (Figure 12).

Examination of a transistor will reveal three wires sticking out of it — a fact that strikes many as very odd. After all, they say, a switch has only two wires, so why the third? They forget — the switch may have only two wires, but there is a third 'terminal': the lever or toggle that is controlled by hand. So with the transistor, the third terminal controls the switch. There is, however, one major difference . . . the transistor can be switched by another circuit and it in turn may control yet more.

Believe it or not, right there you have the entire mystery and gee-whizz of the modern technology. It's worth repeating! The transistor can be switched by other transistors and it, in turn, can switch yet more; and that's *it*. Quite obviously, something as fundamental and simple as this can and should be realised by every child leaving school today but I doubt if it is. Electronics, of course includes many other interesting, fascinating little Electronics, of course, includes many gadgets but even the microprocessor is, at heart, nothing but a mass of logic gates, each gate comprising one or more transistor switches.

Back now with our single transistor; of the three legs sticking out, the central one is usually (but not always, so ask at the shop where you bought it) the base — or in our terminology, the controlling terminal. This is indicated by a small 'b' in the diagrams to follow. The other two are termed collector and emitter and to distinguish them the collector is usually marked with a small dot (see Figure 13). On my diagrams I have indicated which is which by the use of a small 'c' and 'e'. One other distinguishing feature often employed is to have the collector positioned a little further away from the base than is the emitter.

One other interesting device that we need to complete our demonstrations is the light-emitting diode (LED). It has two interesting properties: (1) it allows current to flow through it in one direction only and (2) it shines while that current is flowing (Figure 13).

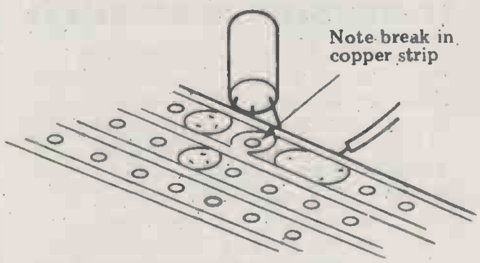


Fig 12 Veroboard underside

Make up the circuit of Figure 14 and when the battery is connected the lamp should glow. If it does not, check the transistor terminals or turn the diode round. If that doesn't work, either the battery supply is flat or one of the components is unserviceable. The wire from the 10k resistor, by the way, should be quite long and easy to transfer from point to point.

If the 10k base lead is removed from the positive rail the lamp goes out. Touch the earth (negative) rail — nothing happens. Touch the positive rail and the light comes on again. (Note — the LED won't give out much light; view it from the end and keep other very bright lights away.) At first sight, the phenonemon seems very odd. One would have thought that the electric current would flow through the 10k resistor to the base of the transistor and then, following the arrow, complete its path to earth. There's nothing in the circuit diagram to tell us why extra

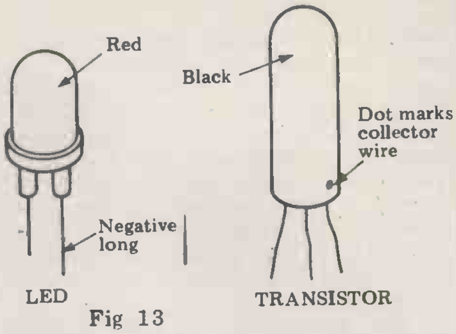


Fig 13

current is drawn through the LED in order to make it glow and this is not the place to go into great detail about it. Very briefly, however, what happens is that the flow of current through the 10k to earth 'pulls' other current through the emitter. Technically, the transistor is being switched on by the base current. The current through the 10k resistor must, of course, be very much smaller than the current through the 1k resistor, so a small current at the base of the transistor has controlled a large current from the emitter to the collector. Students interested in more details can be referred to a multiplicity of books on the subject — ones that cover much greater detail than we have need of here. Particularly recommended

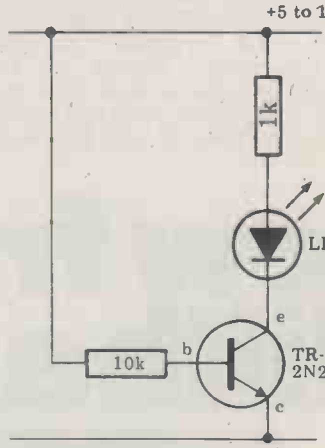


Fig 14

is G H Olsen's *Electronics — A General Introduction for the Non-Specialist*, published by Butterworth & Co, 1968.

The transistor in Figure 14 is termed an NPN type. It's just as easy for a manufacturer to make a transistor that works the other way round — a PNP (the circuit is shown in Figure 15). Notice that the arrow inside the transistor symbol is reversed and that the diode has also been turned round.

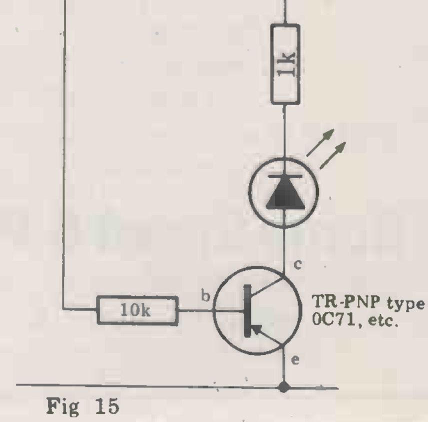


Fig 15

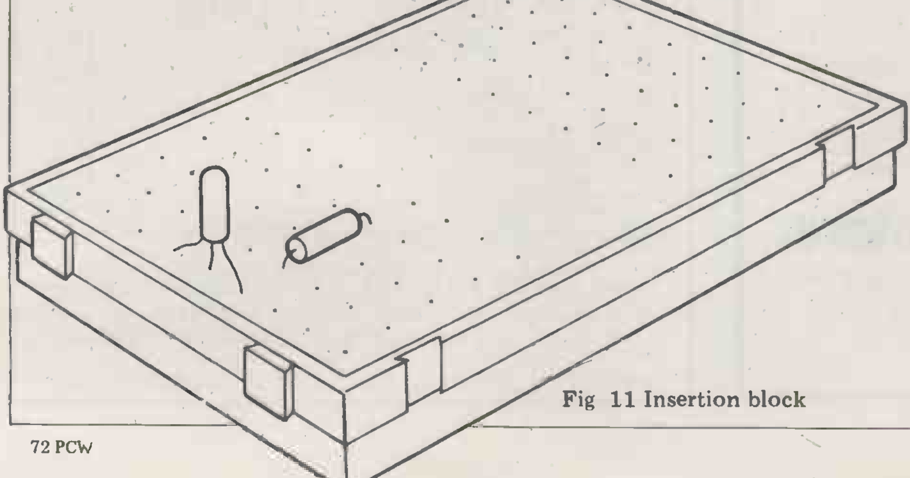
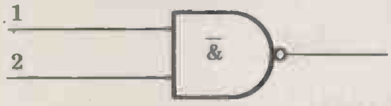


Fig 11 Insertion block

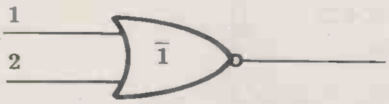
Again the lamp will glow when the base is connected through the 10k resistor to the top rail, but wait — the polarity of the supply has also been changed. This means that the lamp lights when the base goes negative — a completely opposite effect to the circuit shown in Figure 14.



1	2	OUT
0	0	1
0	1	1
1	0	1
1	1	0

Fig 16 NAND

A one-transistor gate wired as we have seen is termed a NOT gate and is used for that purpose — since the output is opposite from that expected.



1	2	OUT
0	0	1
0	1	0
1	0	0
1	1	0

Fig 17 NOR

A similar effect is obtained from mounting a toggle switch upside down; the lamp goes on when we expect it to go off and vice-versa.

If we follow an AND gate with a NOT, we have a configuration known as a NAND. . . one of the most useful of all logic gates. The symbol and truth table are given in Figure 16. Another duplex configuration is the NOR, a combination of OR and NOT. Symbol and truth table are given in Figure 17. It's most important students remember that NAND and NOR are duplex and that, when they are sorting through the logic, they should first work out the AND and OR, as the case may be, before inverting it for the NOT part.

At this point general students have been given enough insight into gating techniques. Certainly they've not been shown an electronic AND gate — just a mechanical or electric one — and the same goes for the OR gate; however it's my experience that this is sufficient. Given this much, other gating techniques may be taken as read. For the record, though — and you may well be asked to demonstrate it — Figure 18 shows the circuit of an electronic AND gate. Two transistors are needed and since they are in series, turning just one on will have no affect on the output. It has to be both and hence it operates in the AND mode.

Figure 19 gives the very simple circuit for an OR gate (this is inclusive — OR, by the way). The diodes placed at each input perform a special function. You may remember that a diode allows current to flow in one direction only; these diodes prevent any voltage rise that might otherwise be caused by one input ebbing back up another input, and perhaps adversely affect other circuitry.

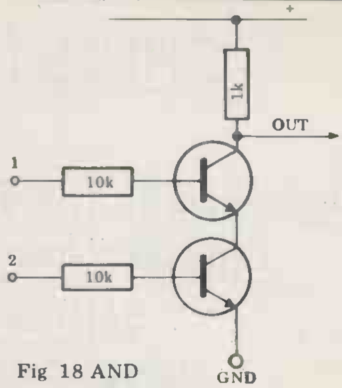


Fig 18 AND

You'll find other gates described elsewhere (for instance in the book by Olsen that's already been mentioned).

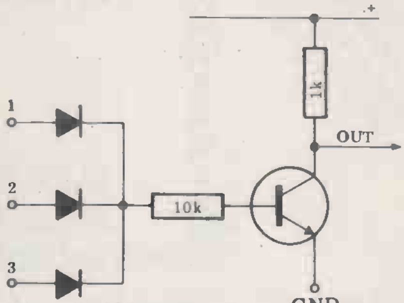


Fig 19 OR

Appendix

The Bobcat is available from the Open University. Components list: four 1k resistors; two 10k resistors; two LEDs; three small signal diodes; two transistors (ie, 2N296, 0C71, BC108 or BC109, etc). All capacitors are 0.2 F tantalum or polystyrene.

FORMATTED DIALOGUES PART 2

David Hebditch continues his discussion of the man/machine interface.

The 'form-filling' style of dialogue is based upon restricting the user's entry of data to certain designated areas of his screen. So, for example, if a product code is always six characters long, space for those six is reserved on the screen and when the last key is pressed the cursor is automatically moved to the first position of the next input field.

Clearly this will not work when we cannot pre-determine the length of the input. Alphanumeric text such as names and addresses have, in most contemporary DP systems, to be limited to some length, eg 30 characters. If the input field on the display allows for a maximum of 30 characters but (as will generally be the case) the actual input is less than 30, then the user will need to indicate to the system that the end of the name (or whatever) has been reached. This may be done by pressing the TAB, RETURN or ENTER key, thus forcing the skip to the next field.

On interactive display terminals attached to minicomputers or mainframes, this level of control over formatting and input is implemented through the functionality of the terminal itself. In other words, there are control characters which, when transmitted to the terminal at an appropriate point, will cause input or protected fields to be started or ended. In the case of microcomputers with separate VDUs (North Star, Cromemco, Rair, etc) it is, of course, quite feasible to use these built-in facilities. However, because the implementations vary so much, commitment to a specific display can seriously and adversly affect the portability of the software in question to other configurations. Of course, this can be overcome through some facility to 'patch' the program with the parameters of the VDU to be used.

But whatever approach is adopted, it seems clear that the best approach would be to maximise what is done in software and minimise what is performed by the display hardware. In the case of microcomputers which employ 'memory mapped' displays (such as PET, Apple, TRS-80, Superbrain) you probably do not have much choice. Such systems are usually designed on the assumption that the software will perform most, if not all, of the detailed control of the display.

So how do we go about implementing formatted display dialogues with a high degree of control over the user input on microcomputers? Well, step one is to forget all about the INPUT statement. From this point onwards, assume that it does not exist! What we need is a statement which enables the program to take each individual character from the keyboard and process it specifically within the context of that item in the dialogue.

This is achieved in many micro Basics through the use of the GET statement. This applies to the PET, Apple and TRS-80. However, 'standard' Microsoft Basic (MBasic) uses the INPUT$ function. The implementations obviously vary and we should be aware of these before we get into examples.

On the PET, the following statement is typical:

```
100 GET C$:IF C$= "" THEN 100
```

The GET obtains the next character from the keyboard buffer and places it in the string variable C$. If the keyboard buffer is empty, the next statement will be executed. In other words, there is no implied wait for the next keyboard character. If we cannot proceed further until the user presses some key or other then we have to put our own 'wait' into the program. This is achieved by checking to see if the C$ variable is still null and, if so, looping back to the GET, a standard technique on CBM machines.

By way of contrast, the Apple *does* have an in-built wait and the following statement:

```
100 GET C$
```

stays in effect until a key is pressed. In MBasic, the same objective is achieved with

```
100 C$ =INPUT$(1)
```

where the '1' indicates the number of characters to be accepted from the

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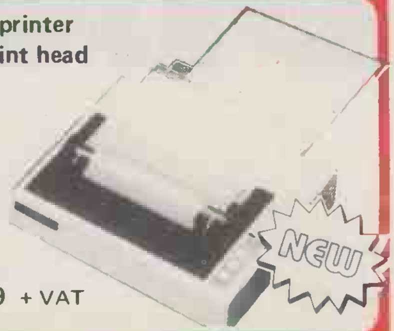

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keyboard.

Now there are two important things to note at this stage: 1. The character keyed has not appeared on the display and will not do so until we make it with a PRINT statement. 2. Although the input character is in the form of a string, that is not necessarily the best format for checking purposes. Try, for example, to see if it contains a RETURN or ENTER character!

At this point the ASC function comes into play. For example:

```
100 C=ASC(C$)
```

causes the ASCII number of the first character of C$ to be placed (as a decimal) in the integer variable C. So if the user *did* press RETURN then the following routine will trap it and transfer control to statement 200:

```
100 C$=INPUT$(1)
110 C=ASC(C$)
120 IF C=13 THEN 200
.
.
.
```

We will employ this technique later as a means of verifying complete input items. However, at some stage we are going to have to assemble our individual input characters into a self-contained item of information for final checking. Two techniques can be employed for this; one is suitable for numeric items and the other for both numeric and alphanumeric.

If the user is inputting a numeric value which then needs to be checked for range (eg it must lie between 0 and 1000) then we need to have that value in a suitable numeric form. The following routine does this (ignore the detail of statement 120 for the time being):

```
 90 C=0
100 C$=INPUT$(1)
110 C=ASC(C$)
120 IF......THEN 300:REM NOT 0-9
130 N=VAL(C$)
140 A=(A*10)+N
150 GOTO 100
.
.
.
```

If C$ is not a digit in the range 0 through 9 then control goes to statement 300 for further analysis. At statement 130 the VAL function is used to convert the string to a numeric form so that it can be 'accumulated' in A. Two things to note: firstly, A must be set to zero before we start getting the input digits and, secondly, we must check that C$ is in the range 0-9 *before* we use the VAL function. The result of putting anything else in the VAL could vary between getting zero out (by default) and the program crashing. Both of these are clearly undesirable and should be avoided by good programming.

The other technique we can employ is based on the concatenation of character strings:

```
 90 M$="" :REM NULL INPUT ITEM
100 C$=INPUT$(1)
110 C=ASC(C$)
120 IF......THEN 300:REM NOT
      VALID INPUT
130 M$=M$+C$
140 GOTO 100
.
```

In this case each valid input character is concatenated onto the end of the previous ones in variable M$.

Before we go into further detail, let us just break off for a moment to consider another important aspect of achieving formatted dialogues through program control of the keyboard and display. This concerns *cursor control*. Once more, implementations vary. On the PET, positioning of the cursor depends on the program PRINTing cursor movement characters on the screen. These are HOME, CURSOR LEFT, RIGHT, UP and DOWN. If you are not absolutely sure where the cursor is at a particular point in the dialogue, to reposition it precisely to a specific location requires that you perform something equivalent to the following:

- HOME the cursor.
- CURSOR DOWN repeated until you get to the required line
- CURSOR RIGHT repeated until you get to the required position on that line.

Indeed, it is a good idea to write a subroutine which, given the X, Y coordinates of where you want the cursor to be, will do the job for you once and for all.

On the Apple, the solution is more elegant. Applesoft Basic is equipped with HTAB and VTAB statements so that:

```
100 VTAB 10:HTAB 20
```

will put the cursor at line 10, position 20 directly.

In the case of micros controlling VDUs, it is necessary to know the control characters for cursor movement and employ a PET-like approach or, if cursor X, Y addressing is available, to generate the character strings for that. In either case, the procedure should be in a subroutine to aid portability and maintainability.

Once the cursor is in position, then we can, of course, use the PRINT statement to get the character on the screen. But watch out for the semicolon(;) at the end of the statement if you want to keep the cursor within the current field!

The simple example shown in Figure 1 enables an alphanumeric field to be entered. All control characters are ignored except for RETURN. The entry of a question mark clears the whole field and the backspace function is supported. Note particularly how the 'comma problem' associated with using INPUT has now disappeared. Be careful, though, because commas can also cause problems on disk files! The example is written in Applesoft.

Now you have this level of control over the interaction, all kinds of things become possible. For example, codes can easily be expanded:

```
100 C$=INPUT$(1)
110 IF C$<>"1" AND C$<>"2"
      AND C$<>"3" THEN 100
120 IF C$="1" THEN PRINT "RED    ";
130 IF C$="2" THEN PRINT
      "YELLOW   ";
140 IF C$="3" THEN PRINT "BLUE";
.
.
```

The user merely presses the number and the relevant word appears on the screen.

Similar interesting things are possible with numeric input. The entry of a number which appears on the screen, character-by-character, right justified (like on your electronic calculator) is also a nice facility.

By exploring the dialogue aspects of each new application you should be able to find all kinds of possibilities for an inventive approach. Consider particularly how you can make use of the data available on disk files which relate to the interaction taking place. For example, instead of bothering with self-checking account numbers (modulus 11 and so on) why not always display the customer name and address (or product description or whatever) back to the user as a standard response to any input of an account number or product code. This is merely a logical extension of the colour-code example shown above. Make sure, however, that reading the file record does not take too long; if it is more than a second or two then the interruption could disturb the smooth flow of the user's input.

Other possibilities include the ability to handle single-character errors in codes but we will discuss that in the forthcoming article on coding information.

In next month's 'Face-to-Face' we will look at the formatting of screens and related topics.

```
999  REM ************************************************************
1000  REM  SUBROUTINE TO ACCEPT ALPHANUMERIC INPUT
1010  REM  CP=STARTING POINT OF ITEM ON SCREEN
1020  REM  IL=MAX INPUT LENGTH
1030  REM  C$=SINGLE INPUT CHARCTERS
1040  REM  I$=FINAL ITEM STRING
1045 S$ = "                                   ": REM  STRING OF SPACES
1047  HTAB CP: REM  START OF INPUT FIELD
1050  PRINT  LEFT$ (S$,IL);:I$ = "": REM  CLEAR ITEM
1060  HTAB CP: REM  CURSOR BACK TO START OF FIELD
1070  GET C$: REM  GET SINGLE CHARACTER FROM KEYBOARD
1075  IF  ASC (C$) = 8 AND  LEN (I$) ) 0 THEN 1300: REM BACK -SPACE?
1080  IF  ASC (C$) ( 32 OR  ASC (C$) ) 122 THEN 1200: REM NOT ALPHA
1085  IF C$ = "?" THEN  GOTO 1045: REM ? ENTERED - CLEAR AND RESTART
1090  PRINT C$;: REM  DISPLAY INPUT CHARACTER
1100 I$ = I$ + C$: REM  FORM COMPLETE ITEM
1110  IF  LEN (I$) = IL THEN 1210: REM  INPUT FIELD FULL?
1120  GOTO 1070
1200  IF  ASC (C$) (  ) 13 THEN 1070: REM  IGNORE CHARACTER IF NOT RETURN
1210  RETURN
1300  REM  BACKSPACE CHARACTER
1310  HTAB CP +  LEN (I$) - 1
1320  PRINT " ";: REM  DELETE LAST CHARACTER
1330  HTAB CP +  LEN (I$) - 1
1335  IF  LEN (I$) = 1 THEN I$ = "": GOTO 1350
1340 I$ =  LEFT$ (I$, LEN (I$) - 1): REM CHOP LAST CHAR
1350  GOTO 1070: REM  GET NEXT CHARACTER
1360  REM ************************************************************
```

Fig1

Personal Computer World

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Apart from the star prize, we shall be giving away annual subscriptions to the next 25 names out of the hat. Don't worry — if you already have a subscription we'll simply continue supplying PCWs for a year from the expiry of your current one.

Perhaps we should explain why we have these surveys each year — it is the only systematic way we have of getting your reactions to the magazine. We obviously meet readers and receive letters from you throughout the year but we shouldn't really form judgements on these necessarily brief encounters. By analysing a survey we are much better able to plan the contents of PCW to reflect your real needs and tastes.

Another aspect of the survey concerns itself with the type of person that reads PCW. This is also quite necessary because it helps our advertising department describe our audience to potential advertisers, without whom there could be no PCW — unless we could persuade around 50,000 of you to part with a couple of pounds per issue!

So there you have it — in order to give you the best possible service and to give you a special opportunity to influence PCW's direction, we ask you to fill in the questionnaire without delay. The Grand Draw will take place in mid-December, just in time for the lucky winner to take the Sharp MZ-80K home for Christmas.

In case anyone doubts that these prizes really do exist, we asked last year's winner, Terry Rigby, to tell us what has happened in the ten months or so since he won his machine in our last reader survey. His story follows.

Once again, our thanks to Sharp for donating the machine and our thanks to you for completing the questionnaire.

I never won nuffin' before...

by Terry Rigby, winner of the Sharp MZ-80K in last year's PCW survey.

With about ten minutes to spare to get to an appointment some five miles away (London miles), the phone rang. "Should I ignore it? — can't be important," I thought, "must be a wrong number." "Yes, speaking," I replied to the stranger on the other end. The rest of the dialogue, concerning my winning the Sharp MZ-80K offered by PCW, left me speechless — and late. As I drove I considered all the possibilities now open to me: graphics, Z80 machine code, 14k of Basic, music function, FOR. . . NEXT, divorce. Yes, that aspect would need careful attention.

The presentation of the machine was accomplished in a whirl of C60 cassettes, focal plane shutters, and red (or white) wine — many bottles of it. They took me to lunch as well — didn't they know I wanted to get home and play with my new toy (sorry, computer)?

Eventually I *did* get home, staggering under the sheer size of the carton surrounding the MZ-80K, not to mention the not inconsiderable weight of the thing itself. It fired up immediately, and, armed with the excellent handbook and the applications tape, I began my first faltering steps in personal computing. Oh! I almost forgot, my wife was happy for me, and happy with the machine (it does look very smart) and just to prove it, we're expecting our first child in January.

The mathematicians among you may deduce that it took just four months for me to get fed up with computing, or that my wife's ultimatum took four months to mature. Not so — my interest in both remains high.

As time went on I began to discuss machines and techniques with colleagues who had various machines — Triton, PET, TRS80, Apple — and it soon became obvious to me that not only had I a machine that was as good as any but was better in nearly every respect. I won't bore you with details; if you don't believe me, try one for yourself.

Two criticisms: 1) keyboard not staggered or ramped; 2) variable dimensioning to a depth of two-ply only. The latter is a problem in the language and not the machine, as the Basic is cassette-based and could be changed in the next language issue. Don't groan about cassette-based Basic — it takes one-and-a-half minutes to load 14k, and if you're not using Basic you can use all that space for something else. Try that on a PET/Tandy/Apple/etc. I have used all the machines mentioned and have found all lack one or more facilities offered by the MZ-80K.

I wonder how many people like me have a computer but don't have a real application. Thank God for problem pages in magazines, typing errors in program listings and friends who think they can stump you by giving you a bizarre problem to sort out.

I took the machine to work once, just to show the lads. They clustered around watching Enterprise warp across the screen while listening to photon torpedoes howling past. A passing colleague was heard to remark, "I saw one of those offered in some computing magazine as a prize, huh, as if they would!" I had to explain — you should have seen his face. He inspired the following:

```
10 FOR A = 1 TO 100
20 PRINT "I MUST NOT SCOFF"
30 NEXT A
40 PRINT
50 PRINT "PCW RULES — OK?"
60 END
```

It's interesting to see the reaction of typists when they start playing. The fact that the screen stays still while the print 'head' moves confuses them no end. "New line?" they inquire. "Carriage return," I reply. " 'Syntax Error' — who wrote that?" they cry. However, any doubts about the machine's capabilities as a typewriter are soon forgotten when they see its processing and printing speed.

A girlfriend (of my wife) refused to have anything to do with it after one occasion when running my directory program. What she didn't know was that just before she arrived I had entered information (birthdate, telephone number, etc) concerning her latest boyfriend. Pretending not to know even his name, I invited her to interrogate the computer to see if there was any data on her latest conquest. . .

Another program that caused much interest was a simple game of NIM, written to trap all the silly things people enter in an attempt to cheat. Decimal quantities of matches are answered by "I've thrown the broken one away". Setting up a silly game of three matches with a maximum of two to be taken is answered by, "And you go first I suppose. . . no way!" I think I've thought of everything to the extent of about 5k of error messages with ½k of processing! You should see the concentration in an attempt to beat (or cheat) it. Incidentally, I've found the best way to debug a program is to let the wife try and crash it. She usually does!

In the ten months or so of owning the Sharp MZ-80K I must admit to becoming almost totally engrossed in the manipulation of Basic, while ignoring machine code. However, I'm slowly putting that right. I'm very impressed by the speed of machine code compared to Basic, but rather than write programs totally in machine code, I use it for repetitive routines, while the printing and general formatting of information on a screen are better handled in Basic. Anybody got any Z80 programs using relative addresses only? I look forward to the day when I can both justify and afford Sharp's floppies or until some nice magazine offers them as a prize for a questionnaire or something. But still, PCW is again offering an MZ-80K, courtesy of Sharp. I know at least one colleague of mine who will send in his entry double quick.

▶

Personal Computer World

READER SURVEY

Please use BLOCK CAPITALS throughout and/or tick appropriate boxes

1 Name: ______________________________

2 Address: ______________________________

____

3 Age group: under 18 ☐1 18-30 ☐2 31-45 ☐3 46-65 ☐4 over 65 ☐5

4 Sex: M ☐1 F ☐2

5 Occupation: ______________________________

6 If you work full-time in the computer industry, please complete the following; otherwise GOTO question 8:

Please indicate your *main* area of involvement: Mainframes ☐1 Minis ☐2 Micros ☐3

7 If you ticked 'Micros' above, please complete the following; otherwise GOTO question 8:

Please indicate your *main* area of involvement: Software development ☐1 Hardware development ☐2 Sales ☐3 Servicing ☐4 Other ☐5

8 Which of the following publications do you read?

	Regularly	Occasionally	Please indicate which *one* you think's best
Personal Computer World	☐1	☐2	☐1
Practical Computing	☐1	☐2	☐2
Computing Today	☐1	☐2	☐3
Educational Computing	☐1	☐2	☐4
Computer Age	☐1	☐2	☐5
Business Computing	☐1	☐2	☐6
Printout	☐1	☐2	☐7
Which Computer?	☐1	☐2	☐8
Computing	☐1	☐2	
Computer Weekly	☐1	☐2	
Datalink	☐1	☐2	
Computer Talk	☐1	☐2	
Infomatics	☐1	☐2	
Computerworld UK	☐1	☐2	

9 Please indicate your interest in the following sections of PCW:

	A lot	Some	Little	None		A lot	Some	Little	None
Newsprint	☐4	☐3	☐2	☐1	Network Notes	☐4	☐3	☐2	☐1
Benchtest	☐4	☐3	☐2	☐1	Chip Chat	☐4	☐3	☐2	☐1
Computer Answers	☐4	☐3	☐2	☐1	Newcomers Start Here	☐4	☐3	☐2	☐1
Interrupt	☐4	☐3	☐2	☐1	Gateways to Logic	☐4	☐3	☐2	☐1
Calculator Corner	☐4	☐3	☐2	☐1	Face to Face	☐4	☐3	☐2	☐1
Checkout	☐4	☐3	☐2	☐1	Secrets of Systems Analysis	☐4	☐3	☐2	☐1
Bookfare	☐4	☐3	☐2	☐1	In Store	☐4	☐3	☐2	☐1
Programs	☐4	☐3	☐2	☐1	Packages	☐4	☐3	☐2	☐1
Leisure Lines	☐4	☐3	☐2	☐1	User Groups Index	☐4	☐3	☐2	☐1
Case Studies	☐4	☐3	☐2	☐1	Diary Data	☐4	☐3	☐2	☐1
Yankee Doodles	☐4	☐3	☐2	☐1	Transaction File	☐4	☐3	☐2	☐1
Communications	☐4	☐3	☐2	☐1	PCW Sub Set	☐4	☐3	☐2	☐1
Micro Chess	☐4	☐3	☐2	☐1	Hardware features	☐4	☐3	☐2	☐1
Computer Games	☐4	☐3	☐2	☐1	Software features	☐4	☐3	☐2	☐1
Young Computer World	☐4	☐3	☐2	☐1	Advertisements	☐4	☐3	☐2	☐1

Please cut along this line

10 What other topics would you like to see in PCW? ______

11 What topics would you like to see deleted? ______

12 Are there any other comments you would like to make about PCW? ______

13 Do you use a programmable calculator? Yes □1 No □2

14 If your answer to 13 was no, GOTO question 16; otherwise please state which make of calculator you own ______ and state the main application for which you use it ______

15 Do you use a programmable calculator:
— because it suits your application better than a micro □1
— or because you can't afford a micro even though you might prefer one □2

16 Do you own a microcomputer?
Yes □1 No □2 If yes, which make? ______

17 Do you own disk drive(s)?
Yes □1 No □2 If yes, which make? ______

18 Do you own a printer?
Yes □1 No □2 If yes, which make? ______

19 Do you intend buying a microcomputer during 1981?
Yes □1 No □2 If yes, which make? ______

20 Do you intend buying disk drive(s) during 1981?
Yes □1 No □2 If yes, which make? ______

21 Do you intend buying a printer during 1981?
Yes □1 No □2 If yes, which make? ______

22 What is your intended total budget for the above purchases?
up to £499 □1 £500-£999 □2 £1000-£1999 □3 £2000-£2999 □4 £3000-£3999 □5 £4000-£4999 □6 £5000-£10,000 □7 over £10,000 □8

23 Do you intend to buy software during 1981?
Yes □1 No □2

24 What is your total budget for software?
up to £24 □1 £25-£49 □2 £50-£99 □3 £100-£249 □4 £250-£499 □5 over £500 □6

25 Do you intend to buy blank cassettes during 1981?
Yes □1 No □2

26 Do you intend to buy disks during 1981?
Yes □1 No □2

27 Do you intend to buy computer stationery during 1981?
Yes □1 No □2

28 Do you intend to buy computer books during 1981?
Regularly □1 Occasionally □2 None □3

29 What do you use your micro for (please tick the *main* use only)?
Home use/games □1 Business □2 Scientific/Engineering □3 Education □4

30 Apart from yourself, how many other people read your copy of PCW? ______

31 Do you object to your name and address being placed on a mailing list:
For PCW use only Yes □1 No □2
For other commercial users Yes □1 No □2

Thank you for taking part in our survey. The draw will take place in mid-December and the winners will be announced in our February edition. Please cut out this page and send it to: Readers' Survey, PCW, 14 Rathbone Place, London W1P 1DE

Please cut along this line

YOUNG COMPUTER WORLD

Compiled by Derrick Daines

Right at last?

Could it really be that the mandarins of Whitehall have got something right at last? It makes a very pleasant change to report that, yes, I think they have!

A cheering item of news reached me during our long wet summer, to the effect that the Government is to make a grant of roughly £30,000 available to MUSE out of the £9 million allocated for the development of computer education.

In case you don't know, MUSE is an acronym for Minicomputer Users in Secondary Education, and they intend to use the money to provide a central information service — with full-time expert staffing — secretarial assistance and research into software transfer between machines.

Loud and prolonged cheers all round! This cash is going where it will do the most good. If the Government intends to spend the rest of the £9 million as wisely, then we will certainly get our money's worth.

Incidentally, membership of MUSE costs £6 a year, which entitles you to newsletters and access to a good software library, among other things. Interested parties should write to MUSE, Freepost, Bromsgrove, Worcs B61 7BR.

A second cheering item appeared tucked away in the educational press. Apparently, the Government has, with much reluctance, finally announced the names of the committee advising it on educational computing matters and — lo and behold — one of the names was that of this column's original writer, John Coll! He has been going great guns at Oundle School for years, long before it was fashionable to teach youngsters with — or about — computers.

John was also a founder member of MUSE and is still its Chairman. I might be doing the rest of the Advisory Committee an injustice but I can't help thinking that with John sitting on it, they were bound to get their priorities right — and MUSE was bound to get its grant!

Why was the Government so coy about publishing the names, though?

Talking of names, I wonder if this might not be a good time for MUSE to change its name slightly? As I said, it was started long before educational computing became fashionable (or even feasible, unless you were an electronics whizz kid) but now anyone can own a computer or three. As a result, computers are becoming increasingly widely used in primary schools, too, and it seems to me that they will be reluctant to join an organisation with 'secondary' in its title, let alone infant schools, which are also beginning to take an interest.

Of course, there is no reason why primary teachers should not form their own MUPE, and infant teachers their MUIE, but (a) there is a danger that such organisations would be the poor relations, and (b) there would be much duplication of effort, not to mention that bugbear of education — different standards and aims between the various levels. No — much better to cater for all levels under the same umbrella.

What would it be called? Ah — there's the rub. MUSE has a happy ring to it and I for one would be reluctant to change it. MUE? No — too much like MOO. Besides, it's too sweeping in scope. MUED? Perhaps. If MUSE was kept, changing the 'secondary' to 'state', that would cut out a lot of private schools that are doing great work — Sevenoaks, for example, or John Coll's own school at Oundle. So, I dunno. I do, however, believe that just as the universities and colleges had to accept the fact of secondary computing, now it is the turn of the secondary schools to accept the fact of primary and even infant computing.

Standards

A chap in the Home Counties who does not want us to publish his name (but I can tell you he has a string of letters after it) tells me that his LEA has directed that schools may purchase only PET computers. He says that this is a rather short-sighted decision: "If my department purchased only one make of car for its apprentices to work on," he writes, "the local Advisory Committee would soon be asking questions."

I can see his point, I think. If a College of FE is turning out electronics or computer engineers, then obviously the wider the range of machines to work on the better. Of that there can be no doubt and I would exclude all such courses from my standardisation plea. In other cases, I'm not so sure.

If a College of FE is providing a secretarial course, does it have to provide umpteen models of word processor? Perhaps it *ought* to — but where does the expenditure stop?

What interests me is that the LEA in question has decreed that only *one* type of machine may be bought. What I have appealed for is one type of machine in each price range — quite a different thing, and one that may satisfy my correspondent. Above all, I appeal for standardisation in software — which is where MUSE comes in.

A self-confessed computer nut, Colin Higham of Macclesfield, writes in complaining that once a school has a microcomputer, nobody thinks about offering them a second. There'll be faint hoots of derision about that from all those schools without *any* computer (the vast majority) but Colin's case is that in order to do CSE, etc, one computer per school is grossly inadequate.

He is, of course, quite right. Any school wishing to do justice to its Fifth and Sixth formers requires at least a dozen — and even then the lower forms will hardly get a look-in!

It doesn't stop there, of course. If we provide a school with an adequate number of computers to teach the kids *about* computers, what about that small but ever-growing number of teachers who wish to teach all sorts of subjects *with* computers — as, for example, the secretarial course mentioned above? We're back on a favourite hobby-horse of mine; the only satisfactory end is a computer for every pupil. I don't think I'll live long enough to see the day, but I hope, mates, I hope!

Cash benefits

M B Mathison of King's Langley, Herts, asked for advice on gaining cash benefit from programs that he had written. This is a perennial question and one that will be of interest to others, so I'll answer it here.

The first point is that the program must *work*. No, I'm not kidding, it really must be faultless. A good test is to give it to someone else to play with; preferably someone who knows nothing about computers. Sit back with notebook and pencil and don't say *anything!!* You'll be amazed at the kerfuffle they get themselves into. The point is, if your program passes that test, it can be said to be foolproof and is ready for marketing.

The next point is that it must not be too much like other programs. Your program will sell better if it is totally unique or is better than anything else of the same kind. Besides, you will avoid a charge or lawsuit about plagiarism (copying) if you are successful in selling it. So — if it's another Maths Drill Test, Moon Lander or shooting game — forget the whole thing, unless it has something to lift it head and shoulders above all others.

There are several ways you can go about getting a cash return. Which one you choose depends upon you and your assessment of the worth and uses of the program:

1. You can send it to PCW; we're always glad to get new material to publish. You can expect from £5 upwards, depending on length, novelty, etc. Payment is one-off. That is to say, copyright usually passes to the magazine and if you wished to publish or market it later, you would have to get ▶

Ski Jump by Alec Moss

```
 50 PRINT "    SKI JUMP SIMULATION"
 60 PRINT "    =================="
 70 PRINT LIN\(2)
 80 PRINT "WE ARE AT THE TOP OF THE SLOPE."
 90 PRINT "THE HIGHEST GATE IS 120 METRES."
100 PRINT "NOBODY OVER 120 KG IS FIT ENOUGH TO JUMP "
110 LET S=INT(61*RND)+100
120 PRINT "THE MAXIMUM SAFE JUMP IS";S;" METRES"
```

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Business Systems, Audio, Video, Calculators, Cash Registers, Copiers, Microwave Ovens.

permission.

2. You can send it to one of the software houses. PET, Tandy and Apple, for example, market programs mainly — or exclusively — for their machines, but others are catered for. Find out which machines the software house is interested in before you submit your program. Your program will be thoroughly tested and evaluated. If approved, you may be offered a one-off sum for them to purchase the program outright, or you may be offered a commission on sales. That is to say, they will produce, advertise and market the program and give you a percentage of all sales. Copyright remains yours.

3. You can market the program yourself. Many people do this. The method is to put a small standing advertisement in one of the magazines — and wait. You will tape your own copies, mail them, deal with complaints, everything, including duplicated instruction sheets, etc.

There are other methods, but these are the main ones. Of the three, the last is best in terms of cash inflow, but greatest in terms of continuing effort. On the other hand, it may blossom into a regular business. The second method produces a small flow of cash over a long period, while the first produces the least cash but fairly quickly.

One word of warning — no matter which of the above three you choose, the Inland Revenue are going to take an interest — in more ways than one! It is earned income, you see, and as such is taxable. This requires a special income tax return and you would be wise to keep a special account of expenses in connection with the income — retaining all bills and receipts — because these can be set against the money received. Postage, paper, travelling, heating and lighting, etc, can be estimated.

If it all sounds like a bit of a drag, that's because I find it a hell of a drag, but that's the way the country is run. You earn it — they want some of it. For this reason — if no other — I usually recommend most folks to sell their programs to a magazine or do a quick sale and forget it. It's a one-off and HMG is not going to hound you to death.

Programs received

Asteroid Field, by Stewart Sargaison (14) of London; Fighter Attack, by Guy Whitby (12) of Wallasey; Boolean Algebra, by Ian Toyn of Lincoln (appropriately!); Ambush & Torpedo Run, by Martin Veasey (16), of Leicester; Zombies, Moon Landing, Ski Jump, Chessboard, Date, by Alec Moss (15) of Norwich (he's been busy!); Morse Code Tutor, by R Garland (13), of Sale, Cheshire; Wave Form Addition by Graham Kirby of Pitlochry; Bridge the Humber, by Andrew Roberts (13), of Lincoln; Simon, by Jonathan Dick (15), of Bristol; Sentence Writer by S Q Griffiths (16), of Canterbury; Snakes and Ladders by Mark Allan (9), of Stockport; Worms, by Daniel Brown (13), of London.

Honestly, my postman's started complaining since I took over this page! But don't worry folks — I'm delighted. More! More! Gimme more!

```
130 PRINT "WHAT HEIGHT GATE WILL YOU USE ?";
140 INPUT H
150 PRINT "WHAT IS YOUR WEIGHT (KG) ?";
160 INPUT W
170 LET V=INT((H*W/98.1)*1000)/3600
180 PRINT LIN\(2)
190 PRINT "THERE HE GOES......."
200 PRINT "YOUR SPEED IN METRES/SECOND IS";V
210 LET D=INT(10-(H*(1/V)))*(INT(11*RND)+15)
220 IF D>0 THEN 250
230 PRINT "**** YOU'VE CRASHED ON TAKE OFF ****"
240 GOTO 680
250 FOR A=1 TO 3
260 LET R=INT(4*RND)
270 IF R=0 THEN 310
280 PRINT "IT'S LOOKING GOOD......"
290 NEXT A
300 GOTO 360
310 PRINT "YOU'RE OVERBALANCING..."
320 LET O=INT(4*RND)
330 IF O=0 THEN 670
340 LET F=F+INT((INT(21*RND)+INT(21*RND))/2)
350 GOTO 290
360 IF D<=S THEN 390
370 PRINT "YOU'RE GOING INTO THE CROWD."
380 GOTO 670
390 LET L=INT(7*RND)
400 IF L>0 THEN 430
410 PRINT "**** YOU'VE CRASHED ON LANDING ****"
420 GOTO 680
430 PRINT "YOU'RE DOWN SAFELY!"
440 IF D<(S-15) THEN 460
450 PRINT "WHAT A JUMP!!!"
460 LET J1=INT(.5*((INT(51*RND))+(INT(51*RND))))
470 LET J2=INT(.5*((INT(51*RND))+(INT(51*RND))))
480 LET J=(J1+J2)-F
490 IF J<70 THEN 510
500 PRINT "WHAT STYLE!!!"
510 PRINT LIN\(2)
520 PRINT "     SCOREBOARD"
530 PRINT "     =========="
540 PRINT
550 PRINT "MAXIMUM JUMP...";S
560 PRINT "DISTANCE (M)...";D
570 PRINT "JUDGE 1 .......";J1
580 PRINT "JUDGE 2 .......";J2
590 PRINT "FAULTS.........";F
600 PRINT "-------------------"
610 PRINT "TOTAL POINTS"
620 PRINT "OUT OF 200 ....";J+INT((D/S)*100)
630 PRINT "=================="
640 PRINT
650 PRINT "CONGRATULATIONS !!"
660 GOTO 790
670 PRINT "**** YOU'VE CRASHED ****"
680 PRINT
690 PRINT "THE DOCTOR SAYS YOU'VE BROKEN YOUR;"
700 PRINT
710 FOR I=1 TO 9
720 LET B=INT(2*RND)
730 READ K\
740 IF B=0 THEN 760
750 PRINT "      ";K\
760 NEXT I
770 PRINT "      PRIDE"
780 PRINT
790 RESTORE
800 LET F=0
810 PRINT "WANT ANOTHER JUMP,(YES/NO)";
820 INPUT A\
830 PRINT LIN\(2)
840 IF A\="YES" THEN 110
850 DATA "R.LEG","L.LEG","R.ARM","L.ARM","RIBS"
860 DATA "BACK","NECK","SKULL","SKIS"
870 END
```

COMPUTER GAMES

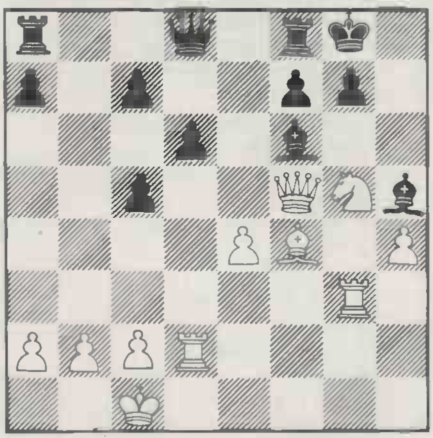
This month David Levy continues his look at computer chess by examining some of the games played in the first World Microcomputer Chess Championship.

My two previous articles have discussed the most important milestones in computer chess since the time Claude Shannon's famous paper was first published in 1950. This month I shall survey the current state of the art in microcomputer chess programming, as typified by the play in the first World Microprocessor Chess Championship which was held as part of the 3rd Personal Computer World Show in London, in September of this year.

We shall be examining some of the critical moments of the games, and I shall give a deep analysis of a key game between Boris Experimental and Chess Challenger. I hope that from these episodes the reader will learn of a number of important pitfalls that should be avoided in writing chess programs. Remember — it is not necessary to be a strong chess player yourself, but you should get some advice from someone who is at least club strength.

Checkmate!

We all know that the object of the game of chess is to checkmate your opponent's king, that is to say attack it in such a way that it cannot avoid capture on the next move. One might think that it is a trivial matter to avoid being checkmated (provided that some method of escape exists), but in fact many programs are susceptible to a snap mate. Why can this be?



Auto Response Board v Princhess

In this position it is Black to move. It is threatened with mate at h7, which can be prevented in a number of ways (. . .g7—g6, . . .h5—g6 are the best). But instead Princhess played 22 . . .Ra8—b8, allowing 23 Qf5—h7 mate.

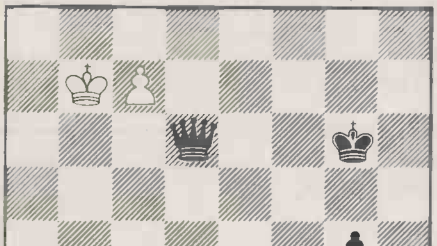
There are two possible explanations for this oversight, apart from a simple programming bug. Those who read my previous article will recall the Technology chess program, which performed only one ply of strategic evaluation. Let us suppose that Black evaluates all the positions at one ply, then performs one more ply of full width search followed by captures at deeper levels. It considers the move 22 . . .Ra8—b8 and puts it high on the list because it adds an attacker to the White pawn on b2, and puts the rook on a half-open file. The program then considers all second ply moves, and notices the White reply 23 Qf5—h7. From now on the program only examines captures, and since the move 23 . . .Kg8—h7 is an illegal capture it rejects it, but it does not realise that something must be done about the check. Since Kg8—h7 is rejected, the program does not realise that its king must be captured on the next move because the next move (Qh7—g8) is not considered. Thus the program completely ignores the mate and looks only at third ply moves that are legal captures.

Another possible explanation is that the Black program 'saw' the following possibility: 23 . . . Ra8—b8 24 Qf5—h7 Bf6—b2 25 Qh7—g8 (capturing the Black king) 25 . . .Bb2—c1 (capturing the White king). Now Black has won a king and a pawn in return for a king, and is therefore a pawn up. Furthermore, should the program continue its analysis it will discover that its opponent's queen and rook are simultaneously attacked, so if the White queen moves, Black will play 26 . . . Bc1—d2, capturing the rook, while if the rook moves from d2, Black will capture the White queen. Thus the program can come to the conclusion that this variation wins material for Black, overlooking the small technical detail of the illegality of Black's 24th move.

The moral of this story is that your program must always have some means of detecting checkmate. One way is to terminate a search with any move that captures a king, and then look to see if the king capture was inevitable in the previous position. An alternative method is to test every move in the tree to see whether it attacks the enemy king, in which case the program knows that it should only consider moves which are captures of the checking piece, king moves or interposing moves.

The endgame

It has long been recognized that the endgame is the phase which sorts out the Grandmasters from the patzers (the men from the boys). In the science of computer chess programming, too, the endgame has always been the one area where very little progress has been made towards an intelligent player. There have been programs written to play certain basic endings perfectly, including king and queen v king and rook, and queen, king and g-pawn (or b-pawn) v king and queen. But very little has been accomplished in the way of general principles for programming endgames, with the result that programs frequently miss good moves that can be spotted by human players whose overall ability at the game is far from astounding.



Modular Game System 2.5 v Mike III

Mike III had played very well to reach an ending in which a win is very easy for Black to force. Black's advantage may be illustrated by the simple variation 76 . . .Qd6—c7 77 Kb7—c7 g4—g3 followed by . . .g3—g2 and . . .g2—g1, promoting to a new queen. Black then has king and queen v king, for a simple win.

The game continued:

76 . . . Qd6—b4+
77 Kb7—c6 Qb4—c4+
78 Kc6—d7 Qc4—d5+
79 Kd7—e7 Qd5—e5+
80 Ke7—d7 Qe5—d4+
81 Kd7—c6 Qd4—c4+
82 Kc6—d7 Qc4—d5+
83 Kd7—e7

The second time that this position has been reached. Black has a quick win with 83 . . . Qd5—f7+ 84 Ke7—d8 (if 84 Ke7—d6 Qf7—e8, then 85 . . .Qe8—c8 and White can never advance the pawn) 84 . . .Kg6—f6 85 Kd8—c8 (or 85 c7—c8 when Black mates by 85 . . .Qf7—e7) 85 . . .g4—g3, etc.

83 . . . Qd5—e5+
84 Ke7—d7 Qe5—d4+
85 Kd7—c6 Qd4—c4+

This last move produces a position which has now occurred three times. Under the rules of chess the game is drawn under such circumstances.

Drawing by threefold repetition in this way is a frequently overlooked problem in microcomputer chess programs. In order to detect a repetition it is necessary for the program to store the move sequence going back as far as the last pawn move or the last capture, and so a 50 move, or 100 ply sequence must be allowed for. (Another rule is that a game is drawn if 50 moves are played by each side without a pawn being moved or a piece being captured.) The program may then compare the move selected by the tree search (or any move within the tree search) to see if it produces a position that has already occurred. If so, the value of this move is set to a draw, and the move is only made if there is no alternative move which keeps the advantage. Here the program would reject the draw because it would eventually give up its queen for the White pawn, leaving itself with an extra pawn.

Another method for avoiding this problem in the game given above is to have a simple routine which measures whether or not a passed pawn can be caught by the enemy king, before it reaches the promotion square. If it can not be caught, and if there is nothing else on the board except the kings, the program can set the value of this pawn to the value of a queen. In the final position Black has the advantage of queen and pawn v pawn, or ten pawns to one (for a difference of nine), but if Black gives up its queen for the c-pawn it will be left with an effective advantage of a queen for nothing — still a nine-pawn difference but 9-0 is better than 10-1. Simple ideas like this can often make the difference between a win and a draw.

Mobility

As every chess programmer knows, mobility is the second most important feature in the game, after material. Thus all programs try to maximise the mobility of their pieces. Unfortunately this heuristic can lead to problems if measures are not taken to prevent the queen from being developed too early in the game. The following miniature is a suitable illustration.

WHITE: PRINCHESS
BLACK: K CHESS IV

1 e2—e4 c7—c6
2 d2—d4 e7—e6
3 Nb1—c3 Qd8—h4

Black makes the move that maximizes the mobility of his pieces. From h4 his queen attacks most squares in the enemy half of the board. But it is also vulnerable to attack.

4 Ng1—f3 Qh4—h5

Maintaining a mobile stance.

5 Bc1—g5 d7—d5
6 Bf1—d3 e6—e5
7 d4—e5 d5—d4
8 Nc3—e2 c6—c5

Up to now Black has moved nothing but his queen and some pawns, and although his queen at first looked mobile, it is suddenly left without a safe move.

9 Ne2—f4 Qh5—g5

This move might look like an elementary blunder, but in fact the Black queen is lost. If 9 . . .Qh5—g4, White takes away the flight square d7 by 10 e5—e6, and then wins the queen with 11 h2—h3.

10 Nf3—g5 and White soon won.

The moral here is, "Do not bring out your queen too early in the game, unless there is a very good reason for doing so." I would advise a penalty of at least half a pawn for exposing the queen to attack before castling.

The state of the art

How strong or weak are microprocessor chess programs at the present time? This question may best be answered by taking a look at a game played between the programs that finished first and second in the World Championship. The following game was not actually played as part of the tournament, but took place on the final day of the main event as part of a match being played for a stake of £2,500 per side. The reader should be aware that Chess Challenger, which won the tournament, is not commercially available at the current time — it is a development program. For a fuller explanation please read Kevin O'Connell's report on the tournament in 'Micro Chess' this month.

WHITE: Chess Challenger
BLACK: Boris Experimental

French Defence

1 e2—e4 e7—e6
2 d2—d4 d7—d5
3 Nb1—c3 Bf8—b4
4 e4—e5

This move came out of White's opening book but Black's book appeared to end here. How many moves one stores in one's openings library is obviously a matter of availability of memory. In a dedicated unit intended for consumers, memory prices play an important part in such decisions, but when writing a chess program for your own machine you will usually have more memory and consequently you can store more moves. Some people prefer to store openings by keeping a number of variations and branching out at random. Others store the actual board positions, so that their program can transpose into or back to any variation in the book. Which you do is largely a matter of taste — the trade off between more moves (when storing moves rather than positions) and the ability to transpose (when storing positions) is not crucial.

4 . . . Nb8—c6

The normal move is 4 . . .c7—c5, to attack White's pawn centre.

5 Qd1—g4 g7—g6
6 Ng1—f3 f7—f5

Although this move looks unnatural, it is quite good in this type of position which often arises in the French Defence.

7 Qg4—g5 Bb4—c3+

I have noticed that micro programs have a greater tendency to exchange pieces than humans, or even stronger

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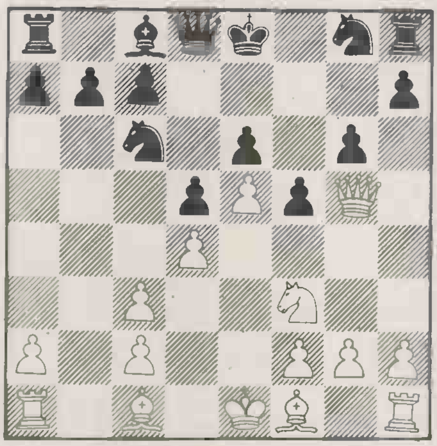
mainframe computer programs. The reasons may vary, but a common one is that the program calculates strategic scores only at the first ply. This leads it to believe that any capture is strategically strong because it deprives the captured piece of its strategic value. At the second ply, when the capturing piece is recaptured (ie 8 b2—c3) the program knows that it has lost back an equal amount of material but it does not know that it has also lost some strategic value. It only updates the change in material.

I doubt that this is the reason for the unnecessary exchange of Black's bishop for White's knight in this instance, but it is something to bear in mind when writing a technology type program.

8 b2—c3



8 . . . Ng8—e7
9 Qg5—h6!

A strong move, preventing Black from castling, but I would have been tempted to play a quiet, developing move such as 9 Bf1—d3, and wait for the reply 9 . . .Ke8—g8 which loses at once to 10 Qg5—h6 followed by 11 Nf3—g5. Black must then give up material to avoid being mated.

9 . . . Ke8—f7!

Black realises that it is in a bind and that it must do something about the threat of 10 Qh6—g7 followed by 11 Nf3—g5, attacking the pawn at h7 and simultaneously threatening to fork Black's rook and queen with 12 Ng5—f7.

10 Bc1—g5!

An aggressive move, threatening 11 Bg5—f6, attacking the rook, and if 11 . . .Rh8—g8 12 Qh6—h7+, winning at least a pawn.

10 . . . Qd8—f8!

Again Black spots the threat. Now White must retreat or exchange his queen.

11 Qh6—f8+ Rh8—f8
12 Bf1—d3 Bc8—d7
13 Ke1—g1

Everyone knows that it is important to castle in chess, so as to unite the rooks and get the king into safety, but in some positions it is much better not to castle, so that the king will be nearer the centre of the board in readiness for the endgame. This is often true when queens have already been exchanged, as in the present position, but few (if any) chess programs utilize this heuristic.

13 . . . Ra8—d8
14 Ra1—b1 Bd7—c8
15 Bg5—h6 Rf8—e8
16 Rf1—e1 Ne7—g8

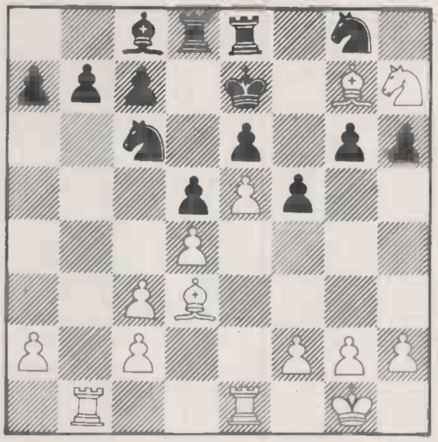
A passive and unnecessary move, even though it drives away the bishop (which was no longer doing anything useful on h6). I noticed more than once at the World Championships that when programs get into a passive position they do not understand how to play to improve the freedom of their pieces. Here, for example, Black should try for counterplay on the queen side by means of . . .Nc6—a5, . . .b7—b6 and . . .c7—c5.

17 Nf3—g5+ Kf7—e7
18 Bh6—g7

Threatening the pawn on h7.

18 . . . h7—h6
19 Ng5—h7?!

A highly dubious plan which deserves to lose material. If Black played carefully it could probably trap one of the White pieces (the knight at h7 or the bishop at g7).



19 . . . Ke7—f7!

A good move, but Black misses the main point of the idea.

20 Bg7—f6 Ng8—f6??

A blunder. After 20 . . .Rd8—d7, White would have to go through great contortions even to try to save his knight from permanent incarceration. The immediate threat would be 21 . . .g6—g5, followed by 22 . . .Kf7—g6. If White played 20 h2—h4, to prevent the advance of the Black g-pawn, Black could respond 20 . . .b7—b6, followed by . . .Bc8—b7, . . .Re8—c8 and . . . Kf7—e8, leaving the knight with no place to go. Such plans are not difficult for human players, who realize that entombed pieces are liable to be trapped, but planning is one of the most difficult aspects of computer chess.

21 Nh7—f6 Re8—e7
22 h2—h4 b7—b6
23 h4—h5 g6—g5
24 g2—g3 a7—a6

Although White's knight still cannot get out of the Black camp, it will never be in any danger so long as White can maintain a pawn on e5. For this reason, among others, Black should still be striving to play . . .c7—c5, with the idea of undermining White's pawn structure. But again this plan is far too long term for an innocent computer program.

25 f2—f3 Nc6—a5!

At last. Black begins to do something positive.

26 g3—g4!

But it is too late. White crashes in on the king side. If now 26 . . .f5—f4, 27 Bd3—g6+ Kf7—g7, and White will soon extricate its knight via e8, once Black moves one of his rooks away from its defence of that square.

26 . . . b6—b5
27 Kg1—g2 Na5—c4?

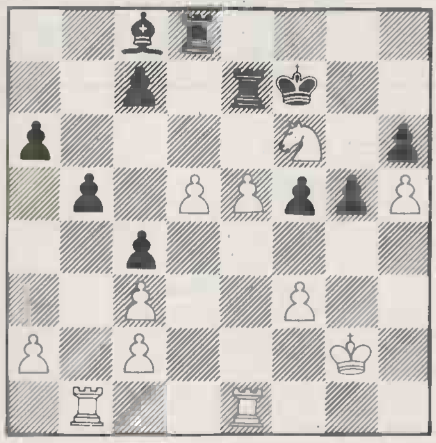
Not understanding the position, Black makes an obvious looking move which is strategically wrong. In positions of this type . . .c7—c5 is just about the only way to create satisfactory counterplay.

28 Bd3—c4 d5—c4

28 . . .b5—c4 was best, hoping to keep the position closed.

29 g4—f5 e6—f5
30 d4—d5!

Natural and strong. White dominates the centre.



30 . . . Bc8—b7!

The best way to achieve counterplay. Black attacks the centre.

31 Rb1—d1 Bb7—c8?

After its previous fine move, this is inexplicable. More logical would have been 31 . . .Kf7—g7, defending the h-pawn, so that Black could continue with 32 . . .g5—g4, opening up the king side in the hope of creating counterplay. If White's knight moves off f6 the pawn on d5 can be captured.

32 Kg2—f2 a6—a5
33 Rd1—b1

With the Black bishop on b7 this would not have been possible because 33 . . . b5—b4 34 c3—b4 a5—b4 35 Rb1—b4 Bb7—d5 is probably satisfactory for Black.

33 . . . c7—c6!
34 d5—c6 Rd8—d2+
35 Kf2—g1 Bc8—a6

Black's 33rd move might also be justified by 35 . . .Rd2—c2 36 Rb1—b5 Rc2—c3, when Black has a passed pawn.

36 Nf6—d7 Rd2—c2
37 e5—e6+! Kf7—e8

Not 37 . . .Re7—e6 38 Re1—e6 Kf7—e6 39 Nd7—c5+ winning the bishop on a6 (another good reason for preferring 35 . . .Rd2—c2).

38 Nd7—f6+ Ke8—f8
39 Nf6—d5

Now Black is helpless.

39 . . . Re7—a7
40 e6—e7+ Kf8—e8
41 Nd5—f6+ Ke8—f7
42 e7—e8(Q)+ Kf7—g7

42 . . .Kf7—f6 is answered by 43 Qe8—g6 mate.

43 Qe8—g6+ Kg7—f8
44 Re1—e8 mate

This game gives a good idea of the standard of play that your programs will need to reach if they are to have any chance in next year's tournament. I would be happy to hear from any reader who has his own microcomputer chess program, if the program contains any original ideas or if it plays particularly well.

Readers should write directly to David Levy, 104 Hamilton Terrace, London NW8 9UP, England, and not to PCW.

PCW SUB SET

Continuing PCW's unique series of useful subroutines for the serious assembler language programmer, Alan Tootill describes more examples sent in by readers. If you have a subroutine for Sub Set, send it to: Alan Tootill, PCW, 14 Rathbone Place, London W1P 1DE

You might have noticed that I tend to write as 'we' in this feature; this is not the royal plural. Since my letter proposing the feature was printed in May, I have been corresponding with a few readers in this country who first responded and offered to help. They are Roger Hargrave of Crawley, Jim Chance of Birmingham University and David Yeomans of Halifax.

Roger and Jim you already met in the September feature; David is busily churning out machine code for the microcomputer he hadn't finished building when last I heard. All I can say is, watch out when he has a machine.

How small?

Are very small routines worth making into Datasheets? Yes, if you are going to call them often enough. With only four bytes of working code in a routine plus three bytes to store and restore a register and return and three more bytes for the call, you have broken even when you have called it seven times. With eight bytes of working code and the same overheads you are wining on the third call.

In this month's BFSN and ASCNO, I have lumped in BFSN2, BFSN3, NUMCH and CMPL simply to save space. You, I hope, like me, will eventually file them or their equivalents as separate datasheets.

Zero suppress

To be recognised as such, a good program idea must have visually attractive output. The mania to save the odd byte or two has spoilt the look of many a good result by a mess of leading zeros on the screen. So keep zero suppression in mind as an output feature, as we do in our first Datasheet this month. In September we asked for a converse routine to SBNF in the fewest possible bytes. Here is a hybrid effort, part from one reader and part from another, in 43 bytes.

Negative overflow

Many binary conversion and calculation routines have been published and it is amazing how many do not cater for negative numbers and overflow. Can you imagine life where nobody goes into the red? Jim Chance gives the conversion routine, ASCNO, in our second datasheet, that caters for both. With 16-bit registers, 16-bit conversions, even good ones, are not too difficult. We would like to see some 32-bit conversions on the same lines.

Documentation

Instead of SUBr DEPENDENCIES, Jim Chance used SUBr DEPENDENCE. It sounds better and makes more sense, so it will be SUBr DEPENDENCE from now on.

I am getting a bit tired of writing "8080 COMPATIBLE: No", so from now on it will be "PROCESSOR:", which can be Z80 or 8080, or Z80 *and* 8080, or 6502, or 6800 or. . . whatever you send in that we can check out.

Wanted

The shortest solution to: HL = HL/2, where HL contains four BCD digits.

If you are following this series, there are two things you can do to push it along so that it will still be there for you to follow in the months ahead. You can try out, understand and improve the routines printed *and send your improvements in*. Improvements can be to the code or to the way it is documented and explained. It is just as important for the routines to be clearly visible as it is for them to be good. You can also contribute your own useful routines for others to have a go at.

This is our series; PCW has given us the space, its skills in presentation (you should see the difference between these pages and the sheets I send in) and the circulation, so let's make the most of it.

Datasheet

```
;= BFSN  — Packed BCD/ASCII
;/ "BFSN"  — level 0, class 2
;/         — level 1, class 1 if BFSN1 & BFSN2 are separate routines
;/                   in the library
;/ TIME CRITICAL?: No
;/ Converts packed BCD to ASCII, with leading zeros, but not the
;/ least significant of an all zero field, suppressed.
;/ ACTION:              high nibble A←—3H
;/                      A[ ][ ]   [ ][ ](HL)
;/                         when A = zero
;/                         return with space in A,
;/                         if byte below that pointed
;/                         to by DE holds a space
;/                      (DE) ←— A
;/                      DE←—DE + 1                    twice
;/                      A[ ][ ]   [ ][ ](HL)
;/                      HL←—HL + 1
;/                      B ←—B  — 1
;/                      repeated from start until B = 0
;/                         when last ASCII = space
;/                         make it zero
;/ INPUT: DE holds address of most significant byte of destination
;/           (DE—1) must be space
;/           HL holds address of most significant BCD byte
;/           B holds number of BCD bytes
;/ OUTPUT:The destination holds ASCII code representing the
;/           BCD bytes
;/ REGs USED: A, B, DE & HL
;/ STACK USE: 4
;/ LENGTH:    43 (22, 12 & 9)
;/ SUBr DEPENDENCIES: None or
;/                    BFSN1 & BFSN2 when they are separate
;/                                routines in the library
;/ INTERFACES: None
;/ 8080 COMPATIBLE: No
BFSN:   LD    A,30H    ; initialise A              3E  30
BFSN1:  CALL  BFSN2    ; process 1st digit of byte CD  YY  YY
        CALL  BFSN2    ; process 2nd digit         CD  YY  YY
        RLD            ; restore (HL)              ED  6F
        INC   HL       ; point next BCD byte       23
        DJNZ  BFSN1    ; decrement counter &       10  F5
                       ; loop until finished
        DEC   DE       ; point to last destination 1B
        LD    A,(DE)   ; get character             1A
        CP    20H      ; if not space              FE  20
        RET   NZ       ; return                    C0
        LD    A.30H    ; else make last            3E  30
```

GOTO page 125

MICROCHESS

Kevin O'Connell describes the battle for the big title.

The first World Microcomputer Championship was treated with the full respect it deserved, being held under the auspices not only of the ICCA (International Computer Chess Association) but also under those of FIDE (Federation Internationale des Echecs) — the World Chess Federation. Held in London, as part of the Personal Computer World Show (4-6 September), it was certainly a prestigious event, which the commercial entries, seeking publicity from the World Champion title for their program, proved by sending top executives to oversee the operation of their machines.

There were 14 competitors — there could have been more but quite a few enquiries arrived too late: a very strong American program arrived two days after the tournament ended! Originally sent in June with a 15 cent stamp, it had been returned to sender because of insufficient postage, was put back in the mail bearing a second 15 cent stamp (just one cent short of the airmail tariff) and so travelled by sea, no doubt leaving the programmer feeling rather sick.

Once all the entries were in and the Championship ready to start, David Levy and myself handed over responsibility for the event to Michael Clarke and Peter Morrish who were, respectively, Tournament Arbiter and Tournament Director.

The first round results would have completely justified the seeding had not Sargon 2.0 lost on time when it was more than a queen ahead on material. K. Chess IV also had an unfortunate experience — the draw gave it the white pieces but it could only play with black! K. Chess IV lost that game by default, but some hurried modifications enabled it to complete the course.

Round two put a check to the aspirations of Mike Johnson, winner of the 1978 PCW tournament, and David Broughton, winner of last year's non-commercial prize. David Broughton's Vega went down to Sargon 2.0 while Mike 3.0, the only program running on special chess hardware, drew by repetition against the Modular Game System 2.5 despite being a queen up.

The two programs that had now emerged as favourites met in the third round. You will find this game, between Chess Challenger and Boris Experimental, later in my article. The destiny of the non-commercial first prize seemed almost sure to go to Mike Johnson and Dave Wilson when Mike 3.0 won while Vega lost again.

In round five, Chess Challenger played its most convincing game of the Championship, beating the Modular Game System 2.5. Since Challenger's other nearest rival at the start of this round, Mike 3.0, also lost, Challenger's lead, with just one round to go, extended to a full point.

In the last round attention was focused on the games Sargon 2.0 v Chess Challenger and Rook 4.0 v Mike 3.0, with a weather eye cast on developments in Boris Experimental's game. If Sargon 2.0 could beat Challenger and Boris Experimental could defeat its opponent (which it did), there would be a tie for first place and the excitement of a play-off match. As you will see from the position below, Sargon 2.0 had its chance but missed it and was then relentlessly ground down, so Challenger finished with a clean score. The game between Rook and Mike would determine the winner for the top non-commercial prize. In the event these two programs drew and there could have been a tie for all three non-commercial prizes had Vega been able to win, but it was having an uphill struggle to draw with the Auto Response Board 2.5.

Mike 3.0 and Rook 4.0 shared £750 for the top two non-commercial entries, the other prize of £100 going to Vega 1.7. Chess Challenger took the handsome trophy and the glory of being the first program to bear the illustrious title of World Microcomputer Chess Champion.

Table of results

PROGRAM (* commercial entry)	R1	R2	R3	R4	R5	Tot.	S/ded
1 CHESS CHALLENGER * (USA) (Dan & Kathe Spracklen, Ron Nelson, Frank Duason & Ed English) (6502 - Assembler) 20 k	W12	W10	W2	W7	W5	5	5
2 BORIS EXPERIMENTAL* (USA) (programmers not named but based on Boris 2.5 by Dan & Kathe Spracklen) (6502 - Assembler) 8 k	W14	W8	L1	W3	W7	4	6
3 MIKE 3.0 (UK) Mike Johnson & Dave Wilson (6502 & chess hardware - Assembler) 48 k	W10	D7	W11	L2	D4	3	3
4 ROOK 4.0 (Sweden) Lars Kalsson (Z8000 - Assembler) 16 k	L9	D12	W10	W6	D3	3	9
5 SARGON 2.0* (USA) Dan & Kathe Spracklen (6502 - Machine Language) 24 k	L11	W9	W13	W12	L1	3	7
6 GAMBIET* (Netherlands) Wim Rens (Z80 - Assembler) 10k	L7	W11	W8	L4	W12	3	11
7 MODULAR GAME SYSTEM 2.5* (USA) Dan & Kathe Spracklen (6502 - Assembler) 8 k	W6	D3	W9	L1	L2	2½	4
8 AUTO RESPONSE BOARD 2.5* (USA) Dan & Kathe Spracklen (6502 - Machine Language) 8 k	W13	L2	L6	W11	D9	2½	1
9 VEGA 1.7 (UK) David Broughton (Z80 - Assembler) 12 k	W4	L5	L7	W13	D8	2½	2
10 VIKTOR (Switzerland) Herbert Bruderer (8085 - Assembler) 8 k	L3	L1	L4	W14	W13	2	10
11 ALBATROSS (UK) Michael Parker (Z80 - Assembler) 18 k	W5	L6	L3	L8	W14	2	14
12 FAFNER 2 (UK) Guy Burkill & Alex Kidson (6502 - Pascal & Assembler) 16 k	L1	D4	W14	D5	D6	1½	12
13 PRINCHESS 1.0 (Sweden) Ulf Rathsman (6502 - Assembler) 12 k	L8	W14	L5	L9	L10	1	8
14 K. CHESS IV (UK) Andrew Thomason (Z80 - Machine Language) 2.2 k	L2	L13	L12	L10	L11	0	13

Looking through the final score-table it seems almost to be a match tournament Dan and Kathe Spracklen against the rest of the world, an event they lost by the narrowest of margins; the five programs written by them (entirely or in large part) scored 17 out of the total available 35 points.

Fidelity Electronics' representatives were rather coy about the Spracklens' involvement with the Chess Challenger program. However, there were three major give-aways: Fidelity's entry for the World Computer Championship in Linz listed the five programmers who I have listed in brackets on the results table, the program's playing style bore an uncanny resemblance to Sargon 3.0 which, in the Auto Response Board, won last year's PCW tournament, and the third point seems a clincher. All previous Challenger programs, including the brand new Sensory Voice, have used a Z80 or Z80A processor while the Championship winning program, although playing in a Sensory Voice housing used a 6502 processor, just like all the Spracklen's other recent chess programs.

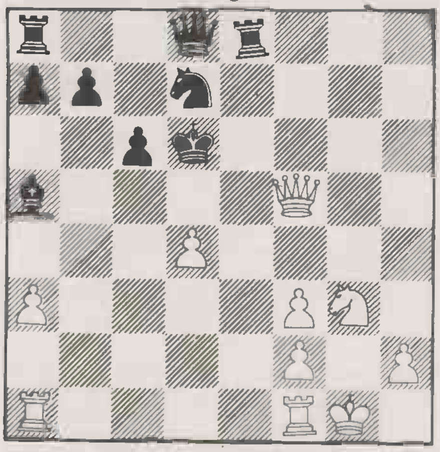
By all means rush out to your nearest store and buy a Sensory Voice Challenger, but don't expect it to play anything like as well as the program that won the Championship. No doubt, though, the Champion program will be marketed sometime next year.

The games and positions that follow were the most interesting played in the Championship. Readers wishing to obtain a copy of the tournament bulletin, containing the moves of all the games played, should send a large stamped addressed envelope and £1.50 to PCW (Chess Games), 14 Rathbone Place, London W1P 1DE.

The Games

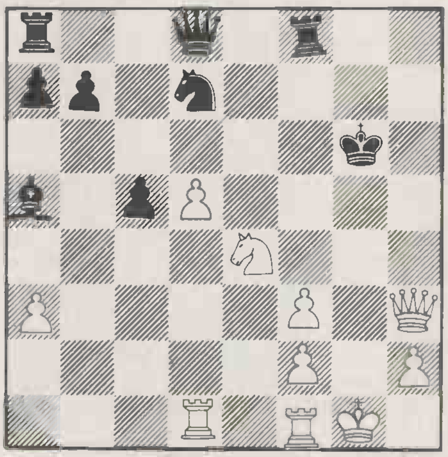
En route to victory, Chess Challenger had quite a lot of good fortune, being hopelessly lost in no less than three games. Before looking in detail at the important game against the Boris Experimental, here is an episode from Challenger's second round game.

White: Viktor
Black: Chess Challenger



26 Qf5-f4+, which gets at least a draw, would have been interesting, eg, 26 . . . Kd6-d5 27 Qf4-f5+ Kd5xd4 28 Rf1-d1+ Kd4-c4 29 Ral-c1+ Kc4-b3 30 Qf5-d3+ with a quick mate, or 26 . . . Kf6-e7 27 Rf1-e1+ Ba5xe1 28 Ra1xe1+ Nd7-e5 29 Ng3-h5! with a tremendous attack.

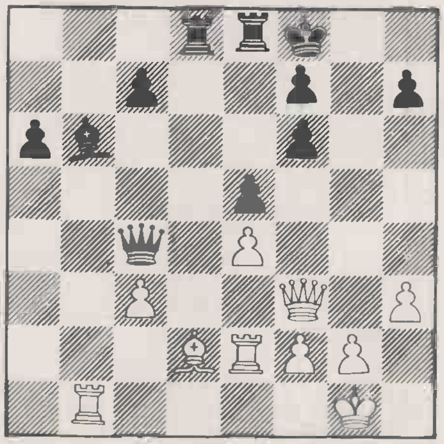
Instead Viktor played 26 Ra1-d1 and the game continued 26 . . . Re8-f8 27 Ng3-e4+ Kd6-e7 28 Qf5-g3+ Ke7-f7 29 Qg5-f5+ Kf7-g7 30 Qf5-g4+ Kg7-h6 31 Qh4-h3+ Kh6-g6. Now Viktor's power supply became disconnected. The game got under way again with 32 d4-d5! c6-c5, reaching the position of the next diagram.



Now, instead of 33 Rd1-c1 as played, White could have won with 33 Kg1-h1! for then there is nothing Black can do about the threat of Rf1-g1+, for example:
(A) 33. . .Kg6-f7 34 Qh3-e6+ Kf7-g7 35 Rf1-g1+ Kg7-h7 (35. . .Kg7-h8 36 Qe6-h6 mate) 36 Qe6-g6+ and mate next move.
(B) 33. . .Nd7-f6 34 Rf1-g1+ Kg6-f7 35 Qh3-e6 mate.

Then, in the final round, Challenger needed only a draw to be assured of outright victory in the Championship. However, a loss would give Boris Experimental a chance to tie and force a play-off match.

White: Sargon 2.0
Black: Chess Challenger.



Sargon 2.0 now played 24 Bd2-h6+?? Any strong human (or program for that matter, for it is not a terribly deep combination) would have played instantly 24 Qf3xf6! If 24. . . Qc4xe2 then 25 Bd2-h6+ Kf8-g8 26 Qf6-g7 mate. Other defensive tries also fail: 24 . . . Re8-e7 allows 25 Qf6-h8 mate while 24 . . .Re8-e6 simply permits 25 Qf6xd8+ and White wins a whole rook.

However, Challenger got away with everything and made a clean score, but there is so much that a simple table of results does not reveal. Let us now look in detail at the crucial third round meeting between the two programs that were to finish first and second.

White: Chess Challenger
Black: Boris Experimental

1	e2-e4	e7-e5
2	Ng1-f3	Nb8-c6
3	Bf1-b5	a7-a6
4	Bb5-a4	b7-b5
5	Ba4-b3	Bf8-c5
6	c2-c3	Ng8-f6
7	d2-d4	e5xd4
8	e4-e5	Qd8-e7
9	c3xd4	Bc5-b4+
10	Ke1-f1?	

A very bad move, losing the right to castle. 10 Nb1-c3 was best - if 10 . . . d7-d6 then 11 0-0 Ke1-g1 when a capture search reveals that White loses the pawn on e5 (11 . . .d6xe5 12 d4xe5 Nc6xe5 13 Nf3xe5 Qe7xe5) but fails to produce the killer move 14 Rf1-e1.

10	. . .	Nf6-g8
11	Bc1-f4	Nc6-a5?

Obviously Boris has a strong preference for bishops over knights, otherwise it would get on with the main task in hand – developing some pieces and getting the king safely castled.

12	a2-a3	Na5xb3
13	Qd1xb3	Bb4-a5
14	Nb1-c3	Bc8-b7
15	d4-d5	

An interesting move. This reduces White's mobility in the crudest sense but is good by human standards because it frees the d4 square for use by the knight on f3 and there are possibilities of a later d5-d6.

15	. . .	0-0-0?

Horrible. Castling (0-0-0 = Ke8-c8) into the path of the attack - White can pile up pressure along the c-file (the white bishop is also trained on c7) and there are too many weaknesses in front of the black king.

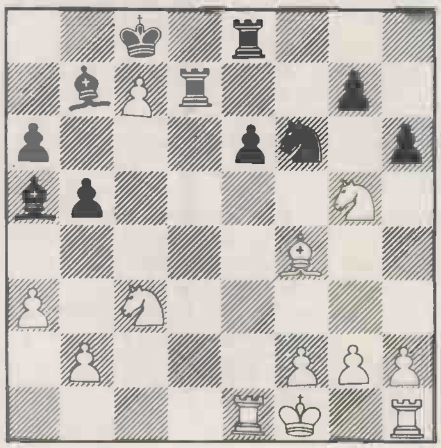
16	Ra1-c1!	f7-f6
17	e5xf6	Ng8xf6
18	d5-d6!	

If 18. . .c7xd6 then 19 Nc3-d5+ (discovered check from the rook on c1) wins the black queen.

18	. . .	Qe7-e6
19	Qb3xe6	d7xe6
20	d6xc7	Rd8-d7

If 20 . . . Ba5xc7 then 21 Nc3xb5 a6xb5 22 Rc1xc7+ Kc8-b8 23 Rc7xg7+ Kb8-a8 24 Kf1-e2 leaves White comfortably two pawns ahead.

21	Nf3-g5	Rh8-e8
22	Rc1-e1	h7=h6



23 Ng5xe6?
It is obvious (to a human) that this loses material. It might also have been obvious to Challenger but for the availability of b2-b4, attacking a piece and pushing the loss of the knight on e6 over the horizon.

23 ... Rd7-e7
24 b2-b4 Ba5-b6
25 a3-a4 Re7xe6

Did Boris know that White was not threatening to capture twice on b5 or did it know that the knight on e6 is going nowhere?!

26 Re1xe6 Re8xe6
27 a4xb5 a6xb5
28 Bf4-e3
Certainly not 28 Nc3xb5 because of 28 . . .Bb7-a6.
28 ... Bb6xc7

Black now has a substantial material advantage (knight for pawn) and should win easily, but the story has only just begun.

29 Be3-d4 Bb7-c6
30 f2-f3 Bc7-d6
31 Nc3-a2 Bc6-d5
32 Na2-c3 Bd5-c4+
33 Kf1-f2 Bd6xb4
34 Rh1-b1

So far so good (for Black). Having increased its material advantage, Boris could now have exchanged on c3, but programs do not seem to realise that when ahead you should exchange pieces not pawns.
34 ... Bb4-d6?
Black is still winning but the easiest route to victory (pushing the b-pawn to the queening square) now disappears. With all the pawns on one side of the board (and only two of them) the danger of a draw increases greatly.

35 Nc3xb5 Bd6xh2
36 Nb5-c3
Of course Challenger spots the threat of 36 . . . Re6-e2+ 37 Kf2-f1 Re2-b2+ end of game.
36 ... Bh2-d6
37 g2-g3 Kc8-d7
38 f3-f4 g7-g6
39 Kf2-f3 Nf6-d5
40 Nc3-e4 Bd6-e7

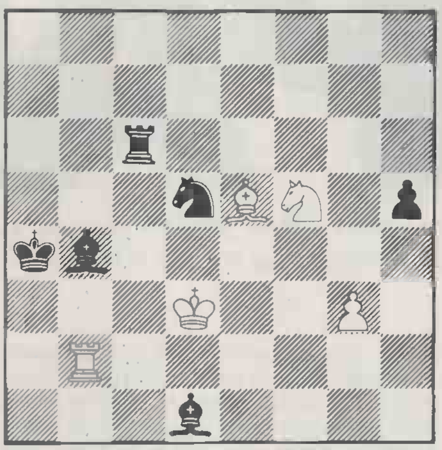
Either 40 . . .Bc4-d3 or 40. . .Bd4-e2+ (41 Kf3xe2 Re6xe4+) would exchange off some pieces.

41 Rb1-b7+ Kd7-c6
42 Rb7-b2 h6-h5

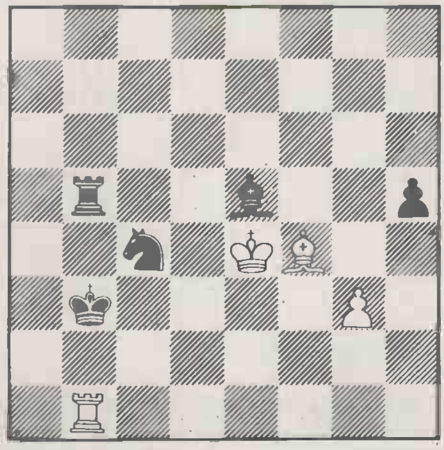
Now 42. . .Nd5-f6, exchanging off some pieces, or 42. . .Nd5-b4, in each case hoping to follow up with Bc4-d5, would be better, but of course Black is still winning.

43 Rb2-c2 Kc6-b5
44 Rc2-b2+ Be7-b4
45 Bd4-e5 Bc4-d3
46 Ne4-d6+ Kb5-c5
47 Rb2-b3 Bd3-c2
48 Nd6-b7+ Kc5-b6
49 Rb3-b2 Re6-c6

It would be so much simpler to exchange some pieces with 49 . . .Kb6xb7. Now life starts to get rather complicated.
50 Nb7-d6 Bc2-d1+
51 Kf3-e4 Kb6-c5
52 f4-f5 f4-f5 Nd5-c3+
53 Ke4-d3 g6xf5
Only one pawn left now.
54 Nd6xf5 Nc3-d5
55 Be5-d4+ Kc5-b5
56 Bd4-e5 Kb5-c5
57 Be5-d4+ Kc5-b5
58 Bd4-e5 Kb5-a4
Boris knows it's winning and so avoids the draw by repetition.



59 Rb2-a2+ Bb4-a3
60 Kd3-d4
Avoiding the knight fork on b4.
60 ... Nd5-c3
61 Ra2-a1 Nc3-b5+
62 Kd4-e3 Bd1-c2
63 Ke3-f4 Rc6-c4+
64 Kf4-g5 Rc4-g4+
65 Kg5-f6 Rg4-c4
66 Kf6-g5 Rc4-g4+
67 Kg5-f6 Ka4-b3
68 Ra1-h1
If White wins Black's last pawn the game is likely to be drawn, but . . .
68 ... Bc2xf5
69 Kf6xf5 Nb5-d6+
70 Kf5-e6 Rg4-g6+
71 Ke6-d5 Nd6-c4
72 Be5-f4
White also seems to think that bishops are more valuable than knights and so declines to go in for the variation 72 Rh1xh5 Nc4xe5 73 Rh5xe5 Rg6xg3 although that would be an almost certain draw.
72 ... Rg6-b6
73 Kd5-e4
Now if 73 Rh1xh5 Rb6-b5+ wins the rook.
73 ... Rb6-b5
74 Rh1-d1 Ba3-b2
75 Rd1-e1 Bb2-e5
76 Re1-b1+ Be5-b2
77 Rb1-e1 Bb2-e5
78 Re1-b1+



78 ... Kb3-a4?
The time to avoid the draw by repetition was last move by playing something other than Bb2-e5. But Boris still knows it is winning, so it avoids the repetition at the last possible moment, playing a move which will draw, at best, and which also gives Black excellent losing chances!
79 Rb1xb5 Be5xf4
80 Rb5-c5 Ka4-b4
80. . . Bf4xg3 would draw very comfortably, but that would mean giving up material, so . . .
81 Rc5xc4+ Kb4xc4
82 Ke4xf4 Kc4-d5
83 Kf4-g5 Kd5-e4
84 Kg5xh5 Ke4-f5
85 g3-g4+ Kf5-e4

Oh dear, those central square weightings again! The best move here is 85 . . . Kf5-f6. That certainly would have provided a test of Challenger's endgame ability (86 Kh5-h6 would win, other moves would only draw - against best play that is!).
86 g4-g5 Ke4-f5
87 g5-g6 Kf5-e6
88 Kh5-h6
Assuming there will be no problems in winning the queen ending, then this was the last hurdle. 88 g6-g7 would only draw (88. . .Ke6-f7 89 Kh5-h6 Kf7-g8 90 Kh6-g6 is stalemate).
88 ... Ke6-f6
89 g6-g7 Kf6-f7
90 Kh6-h7 Kf7-e6
91 g7-g8Q+ Ke6-e5
92 Kh7-g6 Ke5-e4
93 Qg8-c4+ Ke4-e5
94 Kg6-g5 Ke5-d6
95 Kg5-f6 Kd6-d7
96 Qc4-c5 Kd7-d8
97 Kf6-e6 Kd8-e8
98 Qc4-e7 Checkmate

A mammoth tussle!

After the World Championship was over a challenge match was held between the new champion, Challenger, and the runner-up, Boris Experimental. Terry Knight of Competence, the UK distributors of Boris units, staked £2500 on the Boris Experimental winning a best of three game match. Chess Challenger had a great advantage because it was decided to count the Championship game, which Challenger had won, as the first game of the match. The second game of the match was most exciting:

White: Boris Experimental
Black: Chess Challenger
1 d2-d4 d7-d5 2 c2-c4 e7-e6 3 Nb1-c3 Ng8-f6 4 Ng1-f3 Bf8-e7 5 Bc1-g5 0-0 (Ke8-g8) 6 e2-e3 Nb8-d7 7 Bf1-e2 Nd7-b6 8 c4-c5 Nb6-c4 9 Be2xc4 d5xc4 10 Qd1-a4 Bc8-d7 11 Qa4xc4 Bd7-c6 12 0-0-0- (Ke1-c1) Bc6xf3 13 g2xf3 h7-h6 14 Bg5-f4 Nf6-d5 15 Nc3xd5 e6xd5 16 Qc4-b4 b7-b6 17 Rh1-g1 g7-g5 18 Qb4-c3 Kg8-h8 19 Bf4-g3 c7-c6 20 c5xb6 Qd8xb6 21 Bg3-e5+ f7-f6 22 Be5-g3 Ra8-c8 23 Kc1-b1 Rf8-d8 24 e3-e4 Be7-b4 25 Qc3-e3 c6-c5 26 d4xc5 Bb4xc5 27 Qe3-e2 d5-d4 28 f3-f4 Bc5-d6 29 e4-e5 g5xf4 30 Bg3xf4 f6xe5 31 Bf4xe5+ Bd6xe5 32 Qe2xe5+ Qb6-f6 33 Qe5xf6+ Kh8-h7 34 Qf6-g7 checkmate.

Challenger won the third game to take the match 2-1.

MAKING AN IMPACT

The Nascom IMP is one of the cheapest matrix printers around. As such it's ideal for the hobbyist and Ian Sinclair found a neat way to interface it to his TRS-80.

The IMP is a very compact little printer which looks mechanically sound, is well constructed, and which works very well indeed. It has the usual full range of ASCII characters, upper and lower case, but with the English pound (£) sign replacing the hash-mark (#). This is very convenient for accounts work but I would have preferred the £ to replace the dollar so that I could make use of the TRS—80's PRINT USING command. It's a fine argument, though, and dollars are useful to have.

The machine was exceptionally well packed and came (in my case) with a mains plug and a 25-pin Cannon connector.

The input to the printer is RS232 serial, with a wide selection of baud rates from 75 to 12,000 available by changing the wiring of an internal DIL plug. Another internal DIL plug allows you to select options such as line feed after carriage return or not, 7- or 8-bit words, one or two stop bits, etc. As it comes, the printer is set for 300 baud, no line feed after carriage return, 8-bit word and two stop bits.

After the unpacking and gloating stage was over, I had to get down to the job of interfacing. Eventually, I intend to expand my TRS—80 to its full 48k Level II by using a $79 PCB available in the USA, so I didn't want to build a full high speed interface because the expansion board (not a Radio Shack product) comes with a serial interface. I knew of the Small Systems Hardware interface in the USA and had seen a simple circuit published by the TRS—80 users' group which looked similar. These circuits make use of the cassette output port, using a short machine-language program to convert data into serial form at the correct rate and feed it out. This also raises the possibility of recording these signals instead of printing them, so that the printer can be operated directly from cassette later, but some signal processing would probably be needed.

The simple circuit didn't work, mainly because the signal was inverted and should not have been, so I redesigned it. The problem is that the signal out from the cassette port of the TRS—80 has a DC bias on it and this meant that DC amplification was needed. It's not difficult to get this without phase reversal using a 741 but the problem was keeping the bias right. I had printed several sheets of gibberish and was about to give up, when I got a complete error-free listing with no trace of a red light (the IMP has an error-sensing circuit which displays a red warning light after an error, and the error is marked on the paper by a black square; until then the printouts had been mainly black squares......).

This looked encouraging but proved to be luck; the bias setting was simply too touchy to be useful. A lot of time was wasted on it with no fruitful results and in frustration I ordered a commercial interface which I had seen working between a TRS—80 and a Teletype, reckoning that another £40 might be well spent if I could just get going. This commecial interface is probably similar to the Small System Hardware type. The cassette jack of the TRS—80 is plugged into the interface and the power DIN plug from the TRS—80 transformer supply also plugs into it, with an extension then going to the power input of the TRS—80. The main snag with this is that you have to remember to swop the jack plug between interface and cassette recorder if you are alternately listing and recording or using data tapes. There was another snag on mine — it didn't work! Every now and then it would print a good listing but mostly it either did nothing or printed gibberish. Something obviously had to be done.

The next obvious step was to find out just how much the voltage swing at the cassette port of my TRS-80 was. According to the circuit diagram in the technical manual, I should have had a voltage of 0.85 V on standby, changing to 0.0 when the logic voltage changed. Mine actually showed the voltage swing-

```
10 OUT 255, 0: FOR N=1 to 1500: NEXT N: OUT 255, 1: FOR N=1 TO
   1500: NEXT N: GOTO 10
```

Fig 1 Basic program for determining the size of the signal at the cassette output port; a voltmeter is placed across the output pins and this program RUN.

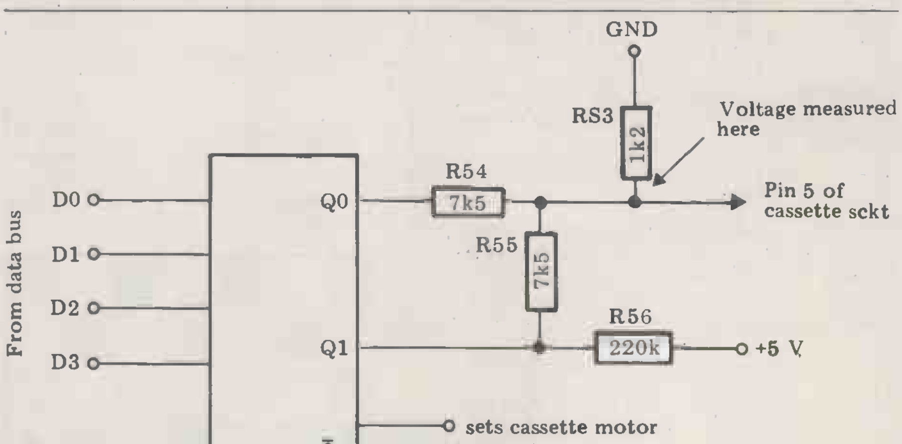


Fig 2 The circuit of the unmodified TRS-80 cassette output latch. The cassette signal is synthesised by mixing the outputs from two sections of the latch.

ing between 0.46 V and 0.48 V when the short program of Figure 1 is used. This explained all the problems — to make the interface work I would need to bias to 0.47 V, and a charge of as little as 0.01V would upset the interface action completely. I thought at first that this was a TRS-80 fault but then dimly remembered a reason. I didn't buy my '80 as a complete keyboard-monitor-casette-player unit but as a keyboard alone from Comp Shop of Barnet. What suddenly filtered back in my memory was a remark they made about having modified the cassette output resistors so I could use any cassette recorder with less risk of distortion due to overloading. Since my TRS—80 has no cassette-loading problems and operates perfectly with a wide range of recorders, I'm not inclined to change the circuit. The alternative, which became apparent after studying the circuit for a while, was to change the software and this should interest those who have had similar problems.

The normal software action is to write 1 and 0 alternately to the cassette port, which is at address 255 decimal. The circuit (courtesy of Tandy Ltd) is shown in Figure 2. It comprises a four-bit latch of which two bits affect the cassette output signal, When a cassette dump takes place, signals appear on both the D0 and D1 lines, so that the output voltage swings from 0.46 to 0.86 and down to zero, giving a waveform balanced about 0.46 V, which is easier to record than a simple set of pulses. The manual describes the arrangement as a sine-wave synthesiser.

Now the software for using a cassette-port interface used the D0 line only, and in this state, with line D1 at 0, the output $\overline{Q1}$ will be set high. This was part of my problem — the logic 1 voltage at $\overline{Q1}$ caused the output at the cassette DIN socket to stay at around 0.47 V whether Q0 was high or low. If the circuit in the technical manual is correct, I should get a full 0.86 V when Q0 goes high, but I didn't. The immediate solution was to make $\overline{Q1}$ go low when Q0 went low, which means making Q1 go *high* when Q0 goes low.

The Basic command which corresponds to the output is OUT 255,1 to make Q0 go high, and OUT 255,0 to make it go low. To control Q1, we need to use the next bit along, so if we use the command OUT, 255,2 instead of OUT 255,0 then Q1 will go high (so $\overline{Q1}$ goes low) when Q0 goes low (Figure 3).

I tried the modified program, using first of all the Basic program of Figure 3 having the 0 changed to 2. It produced a voltage swing of nearly 0.5 V, a great improvement. Changing the 0 to 2 in the printer software had the effect of making the commercial interface work. What's better, my own interface worked and since it was so much simpler and convenient to use, I have settled on it, having suitably changed my own software.

The circuit of my interface is shown in Figure 4. It was the usual 741, with power supplies derived from the low voltage AC inputs to the TRS—80. The in-phase input on pin 2 is from the cassette port, with a current-limiting resistor, and the inverting input is used for bias and feedback.

The bias is obtained from the voltage across a silicon diode, so giving some stabilisation against voltage surges in the supply. The feedback resistor, Rf is chosen so that the gain is high enough to send the ouput swinging approximately between the +9 V and −9 V limits when the printer waveform is output from the cassette port. The output at pin 6 of the 741 is taken to the printer through ordinary two core cable. I haven't used a Cannon plug — it's expensive and unnecessary for a two wire signal.

```
10 OUT 255, 2: FOR N=1 TO 1500: NEXT N: OUT 255, 1: FOR N=1 TO
   1500: NEXT N: GOTO 10
```

Fig 3 The Basic program of Fig 1 modified so as to provide a larger output.

The mechanical construction is more important. The unit was built in a BIM box measuring about 70mm x 110mm x 30mm. Two DIN sockets were mounted on one long side, and 5-core cables connected through the box to corresponding pairs of DIN plugs. This arrangement allows the interface to be connected between the TRS—80 keyboard and its power supply and cassette cables. Two of the DIN plugs which normally go into the TRS—80 are plugged instead into the interface and the plugs on the interface are then connected to the TRS—80, so that no connections need to be changed when the printer is used.

The power supply for the interface is taken by feeding the rectified bridge from two of the AC input lines, pins 1 and 3 on the power DIN plug. This is about as much extra load as the transformer could cope with; don't attempt to run any more elaborate circuitry in this way. The other DIN socket supplies the signal which is delivered from the cassette output port. Keep the cassette leads screened as far as possible to avoid hum pickup. The output for the printer can be taken through ordinary twin cable, with the brown lead connected to the output from the 741 and the blue lead to earth. At the printer end, earth is pin 7 of the 25-way plug and the

GOTO page 123

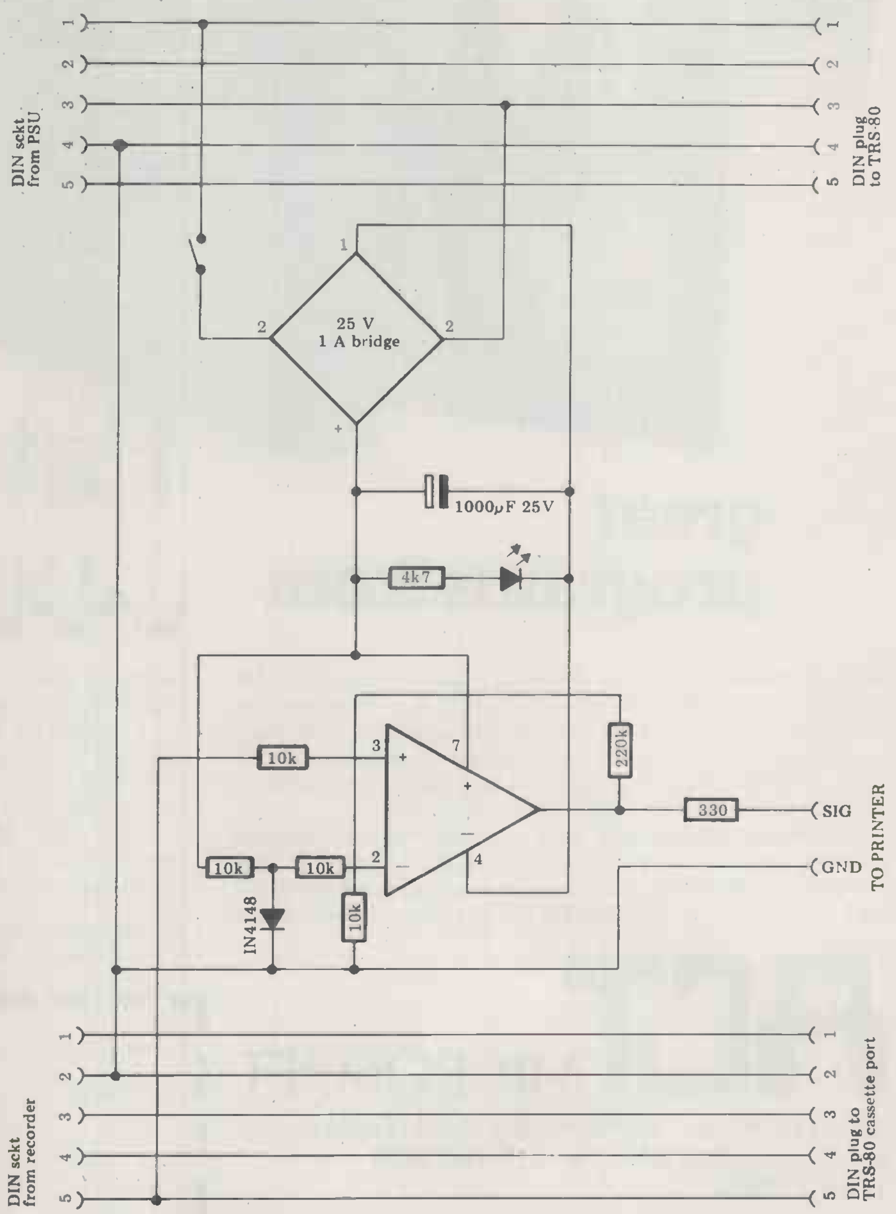
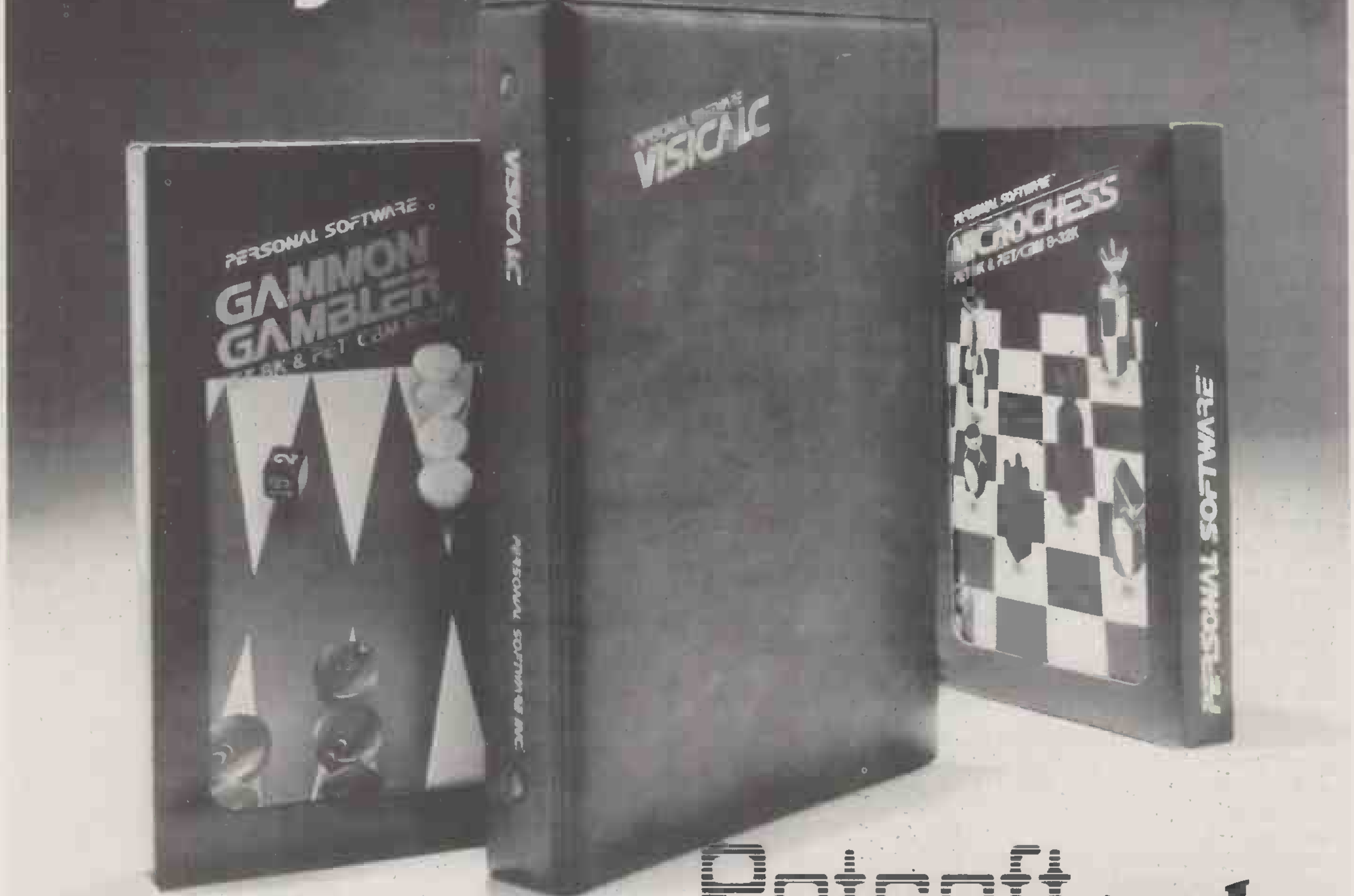


Fig 4 The TRS-80 to serial-printer interface. The cassette recorder can be operated with this interface in place and the current drain on the TRS-80 PSU is negligible. Provided the baud rate does not exceed 300, this simple scheme works with complete reliability.

Why not the best?



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CASIO QUIRK

Our resident expert Dick Pountain brings you more calculator thoughts and programs.

One disappointing feature of the otherwise excellent Casio Fx-502p has been that, unlike the TI and HP machines, it appeared to have no chinks in its armour; that's to say that there are no firmware glitches which allow the meddling user to see into its inner workings — as the TI pseudo-operations do, for instance.

In fact, of course, this is a testament to the thoroughness of Casio's design engineers, but it is frustrating for the curious, destructive and malevolent user such as myself who likes to beat the system.

Now, I am happy to report, this pristine purity is besmirched. Over the past few months my own researches and several readers' letters have confirmed that havoc may indeed be wrought and a certain limited peep into the operating system may be gained.

The way in is to place in a memory register the address of a non-existent memory register (eg 23), clear the display, and then to indirectly recall it, ie 23 Min 1 AC INV IND MR1.

This will give an unusual display: -0^{00}. But performing various arithmetic operations on this number is where the fun starts. A large variety of curious quantities containing mixed numeric and alpha characters together with non-allowed exponents in excess of 99 may be produced. For example, taking the reciprocal of -0^{00} gives $1\ -3P\ -3P\ -3P^{118}$. One can play for many hours once this basic trick is discovered, without unfortunately gleaning much systematic idea of what is going on. Obviously some forbidden region of memory containing, among other things, the alpha characters is being accessed. The only discovery of significance that I have made is that this region is used by the random number generator. If you generate a random number and then perform the 'garbage routine' thus:

INV RAN INV IND MR1

a 10-digit fraction is displayed, the last three digits of which are invariably those of the previously displayed random number.

If any readers can find any *useful* applications by exploring this route, or deduce anything of significance about the internal architecture, then I shall be interested to hear it.

Right — now I'm going to hand over to reader N Horwood who has sent in a useful routine for squeezing more memory space into the TI59. (He's the chap who wrote about accountancy in our May 'Calculator Corner'.)

More miles per Texan stetson

For most arithmetic or scientific applications the memory capacity of the Texas TI 59 is quite adequate. However, when the printer is used to any extent, especially in a commercial or industrial context where prompts and annotation are the order of the day, the memory is soon used up with print codes, and any means of increasing the effectiveness of the limited memory capacity must be explored.

One of the characteristics of the TI 59 is the provision of so called 'guard' digits located on the end of each group of the displayed value. There are three of these, and their normal function is to ensure the accuracy of the displayed value to the tenth decimal or significant place. They do not appear when a register is full with ten data digits on the command RCL or when a listing is called up, and they are completely rejected by the Op 1 to Op 4 print register loading operations which effectively INT any value presented for print formatting. However, the guard digits are saved when data is recorded onto the magnetic cards, and can therefore be relied upon to be available for repeat usage once recorded. They may therefore be used to augment the numerical data stored so that, under certain circumstances, not only may a numerical value of some magnitude — up to seven digits — be stored in a data register, but also, in the same register, the coding for up to three alpha characters — six numerical digits. For example, if it is anticipated that the result of some computation will not exceed 9999.999999999 and an answer correct to the second place of decimals is sufficient, then the data register can be split into two sectors. The first sector containing the numerical result in seven digits, and the second sector of six digits containing the alpha code for three letters which can be used as descriptive annotation for the value in the first sector. There is nothing to prevent these three characters being used for any other purpose, leaving the numerical value intact in the first sector to be accessed as required.

The example illustrated shows the result of inputting the values 9999.995; 9999.99 ; 0.005 ; and 0.004. At the end of each run the visible contents of the data memory are shown, and it can be seen that the alpha data in no way reacts with the numerical results. Taking the program listing, the first seven steps is a subroutine to save space when multiplying or dividing by 1000. Label A starts the run having entered a number in the acceptable range via the keyboard or from some computation within the previous program. Steps ten and 28 are making use of the HIR

GOTO page 126

000	76	LBL
001	19	D'
002	01	1
003	00	0
004	00	0
005	00	0
006	54	)
007	92	RTN
008	76	LBL
009	11	A
010	82	HIR
011	04	04
012	73	RC*
013	00	00
014	22	INV
015	59	INT
016	65	X
017	19	D'
018	22	INV
019	59	INT
020	65	X
021	19	D'
022	65	OP
023	19	D'
024	69	OP
025	04	04
026	58	FIX
027	02	02
028	82	HIR
029	14	14
030	69	OP
031	06	06
032	22	INV
033	58	FIX
034	65	X
035	19	D'
036	59	INT
037	55	÷
038	19	D'
039	85	+
040	53	(
041	53	(
042	73	RC*
043	00	00
044	65	X
045	19	D'
046	22	INV
047	59	INT
048	55	÷
049	19	D'
050	54	)
051	54	)
052	72	ST*
053	00	00
054	73	RC*
055	00	00
056	99	PRT
057	91	R/S

```
      9999.995
      10000.00   /FT
   9999.995632

       9999.99
       9999.99   /FT
   9999.990632

         0.005
          0.01   /FT
   0.005632137

         0.004
          0.00
   0.004632137
```

NEWCOMERS-START HERE

This is our unique quick-reference guide, reprinted every month to help our new readers pick their way through the most important pieces of (necessary) jargon found in PCW. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say "numbering system with a radix of sixteen in which the letters A to F represent the values 10 to 15" when instead we can simply say "hex". No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, PCW will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, processing it, storing the results or sending them somewhere else. All this information is called data and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in 'human' form, inside it's a different story — they must be held in the form of an electronic code. This code is called binary — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or bits as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being ASCII (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a byte and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called hex. The hex equivalent of a byte is obtained by giving each half a single character code (0—9,A—F): 0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101 ...... E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in memory as bytes. The rules are called programs and while they can be input in binary or hex (machine code programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the programming language is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is Basic. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To run such a program the computer uses an interpreter which picks up each English-type instruction, translates it into machine code and then feeds it into the processor for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are PEEK and POKE. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to hardware, this means the physical components of a computer system as opposed to software — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (CPU), a single microprocessor chip with supporting devices such as buffers, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board (PCB) or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a bus system is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the S100.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, RAM (Random Access Memory) and ROM (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — static and dynamic; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuity to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called PROMs (Programmable ROMs) and EPROMs (Eraseable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, cassettes and floppy disks are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a read/write head across the disk's surface. The disk is divided into concentric rings called tracks, each of which is in turn subdivided into sectors. Using a program called a disk operating system, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: soft sectoring where special signals are recorded on the surface and hard sectoring where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the stringy floppy — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. Hard disk systems are also available for microcomputers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit (VDU), which looks like a TV screen with a typewriter-style keyboard; sometimes these are built into the system, sometimes they're separate. If you want a written record (hard copy) of the computer's output, you'll need a printer.

The computer can send out and receive information in two forms — parallel and serial. Parallel input/output (I/O) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the baud rate and, very roughly, the baud rate divided by 10 equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is RS232 (or V24) while, for parallel interfaces to printers, the Centronics standard is popular.

Finally, a modem connects a computer, via a serial interface, to the telephone system allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's permission; instead you could use an acoustic coupler, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — British Telecom isn't so uppity about the use of these.


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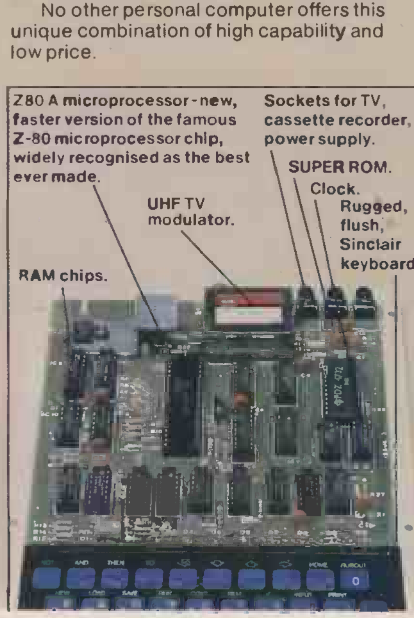

plete

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FUTURE PERFECT?

We'd all like to know what the future holds, wouldn't we. Unfortunately there's no way you can interface a crystal ball to your micro, but Alan Green describes how you can forecast future trends with a little maths and some quick programming.

Forecasting future events requires a blend of the statistical analysis of historical data and an intuitive feel for what might happen. Any formalised system of prediction must allow for both these elements if worthwhile and realistic predictions are to be made. But, because the intuitive element is essentially subjective, little can be computerised other than perhaps a few decision rules and logic statements which are appropriate to the particular problem in hand. The statistical analysis of historical data *can* be computerised but it is open to many approaches and contains many problems. This is what we look at in this article.

Problems of analysis

The problems involved in statistical analysis include the following:

— Using historical information obviously involves the storage of past data and the longer the time scale, the more data to be stored. The more data stored, the bigger computer memory you need.

— A forecasting system must be a combination of sensitivity and stability. Sensitive in the sense that it will respond to movements in the data, yet stable in the sense that it will not react wildly to 'hiccups'. It is fairly obvious that these two qualities are contradictory — the ideal forecasting system allows for the correct blend of sensitivity and stability.

— Using only recent data will yield a very sensitive forecast, yet any method based on taking averages of past results will give equal weight to all those past figures. Thus, it seems only sensible to give more weight to what has happened in the recent past than to the remote past.

— Any system using past data must inevitably lag behind what is actually happening. The further back in time one looks, the greater the time lag in the forecast. The best systems are those which minimise this time lag. To eliminate it completely is impossible unless one has access to a reliable crystal ball.

Many forecasting systems exist which, in various ways, overcome some of these problems to some degree but few actually help in solving all the problems. What follows is an explanation of what is probably the most adaptive, easy to use, individually tailored and economical way of forecasting any continuous process such as sales demand or football results. It goes under the delightful name of *exponential smoothing*. Although what follows may appear complicated, it is in fact fairly simple to understand and certainly very simple to operate.

Theory of exponential smoothing

F_0 = forecast to be made for the next period

F_1 = forecast made for the period just finished

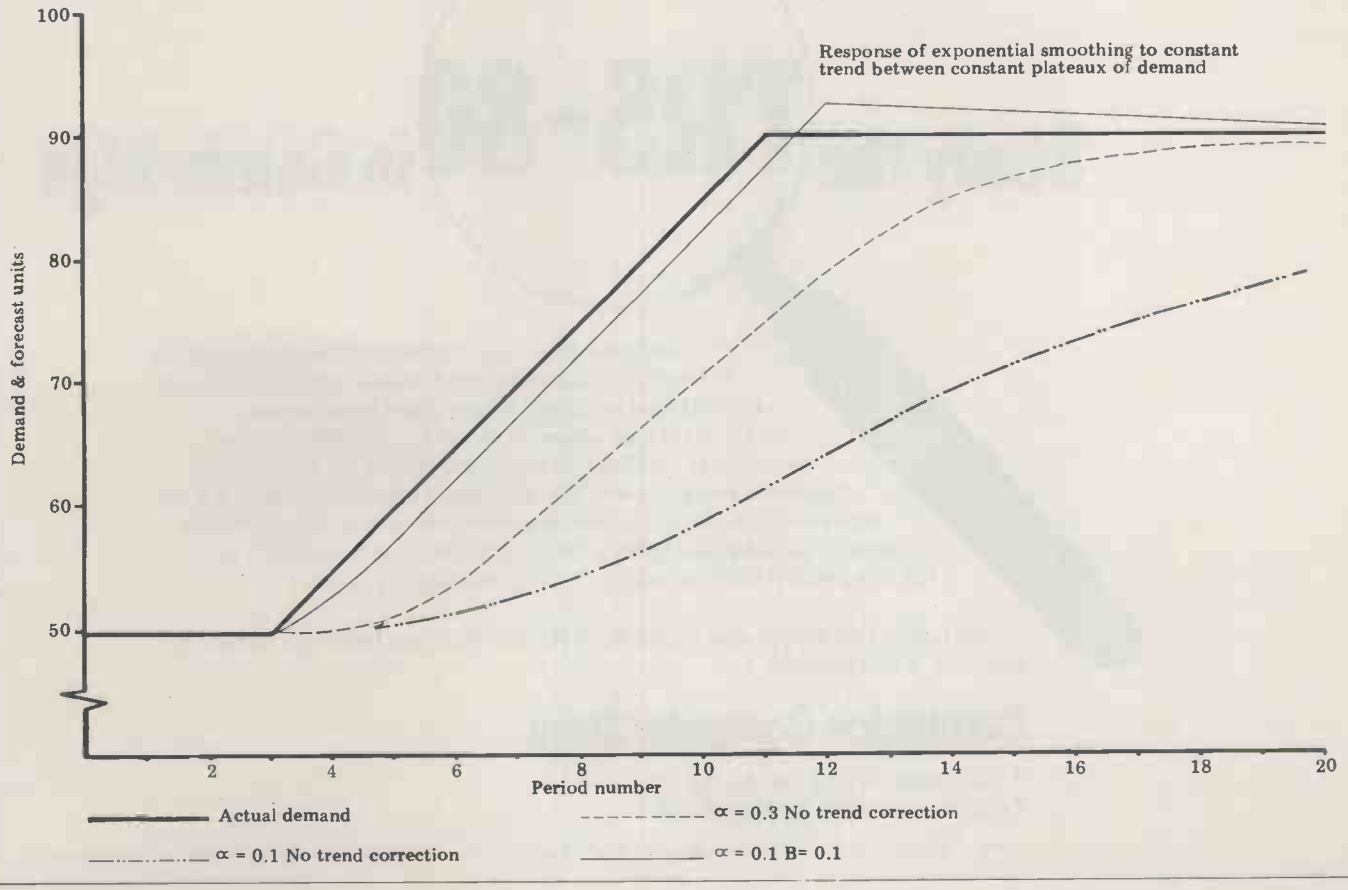
F_2 = forecast made for two periods ago .....etc

R_1 = result of period just finished

R_2 = result of two periods ago... etc.

We could use the most recent result (R_1) as our forecast for next time, ie $F_0 = R_1$, but if used continually this would yield a very sensitive and wildly fluctuating forecast. We could alternatively use the forecast for the period just finished (F_1) as our forecast for next time, ie $F_0 = F_1$. Clearly this would lead to our continually repeating the same forecast. Stable but useless.

A compromise would be to take the recent forecast plus some of the difference between forecast and result,



obviously adding none of the difference would amount to using only the last forecast, whereas using all the difference would amount to using the last result. Thus $F_0 = F_1 + \propto(R_1 - F_1)$, where $\propto$ is between 0 and 1; if $\propto = 0$ then $F_0 = F_1$; if $\propto = 1$ then $F_0 = R_1$

Re-arranging this formula yields:

$F_0 = \propto R_1 + (1-\propto)F_1$ . . . .(1)

However, the F_1 in formula (1) was arrived at by the same approach but using the data from two periods ago, ie:

$F_1 = \propto R_2 + (1-\propto)F_2$ . . . .(2)

If formula (2) is substituted for F_1 in formula (1) the result is:

$F_0 = \propto R_1 + (1-\propto)(\propto R_2 + (1-\propto)F_2)$

and this expands to:

$F_0 = \propto R_1 + \propto(1-\propto)R_2 + (1-\propto)^2 F_2$.(3)

By similar logic,

$F_2 = \propto R_3 + (1-\propto)F_3$

and by adding this to (3) and expanding, the result is

$F_0 = \propto R_1 + \propto(1-\propto)R_2 + \propto(1-\propto)^2 R_3 + (1-\propto)^3 F_3$ . . . . (4)

Clearly this procedure could be continued to no advantage ad nauseum.

What we have demonstrated is that, by using only the result and the forecast for the period just finished (R_1 and F_1), we have in fact incorporated into the forecast all previous results (R_1, R_2, R_3, . . .). We have then a forecast for next period based on *all* past results. However, a look at the coefficients in front of the results in formula (4) yields an interesting fact. Remember that $\propto$ is some value between 0 and 1. If we assume that $\propto$ is 0.2 then the coefficients are as follows:

$\propto R_1 = 0.2R_1$

$\propto(1-\propto)R_2 = 0.16R_2$

$\propto$	0.1	0.2	0.3	0.4
$\propto R_1$	0.100	0.200	0.300	0.400
$\propto(1-\propto)R_2$	0.090	0.160	0.210	0.240
$\propto(1-\propto)^2 R_3$	0.081	0.128	0.147	0.144
$\propto(1-\propto)^3 R_4$	0.073	0.102	0.103	0.086
$\propto(1-\propto)^4 R_5$	0.066	0.082	0.072	0.052
etc				

Table 1

$\propto(1-\propto)^2 R_3 = 0.128R_3$

$\propto(1-\propto)^3 R_4 = 0.102R_4$, etc.

The coefficients, then, are the weightings given to previous results and it can be seen that more weight is given to the most recent result with progressively less weighting to earlier results. In fact the weights reduce exponentially, hence the technique's name. The weights for other values of $\propto$ are given in Table 1.

So far we have overcome the first three problems mentioned earlier. We need only store the results and forecast for the previous period. We can balance sensitivity and stability by our choice of the value for $\propto$, the lower the value the higher the stability. It has been found by experience that $\propto$ values in excess of 0.3 usually result in a forecasting system which is too sensitive. Finally we have achieved a weighting system which gives greatest emphasis to most recent events.

To give a concrete example, let's imagine we are forecasting rainfall. Our forecast for October's rainfall was 3.2 inches. In fact the October rainfall was 3.5 inches.

Choosing an $\propto$ of 0.1 and inserting these figures into formula (1) we have:

$F_0 = 0.1 \times 3.5 + 0.9 \times 3.2 = 3.23$

So our prediciton for November's rainfall will be 3.23 inches. And so on.

If results are not fluctuating too wildly, or if no definite trends are evident, then the system can be used as detailed above. However, if trends exist or are likely — say, sales may rise or fall or a football team may hit a winning or losing sequence — then the fourth problem of time lag becomes one of major importance. To deal with this it is necessary to use double exponential smoothing.

Double exponential smoothing

When a trend occurs in a set of figures it does, by definition, continue for a number of periods. If it did not, it would not be a trend but merely a random movement. The problem created by such a trend is that because of the time lag in the forecasting system, the trend in results will have operated over a number of periods before the forecast responds. Consequently the forecast will seriously over- or under-estimate. In order to compensate for this problem, two additional pieces of information need to be computed — the system's time lag and the nature of the trend. With this additional information, an allowance can be made for the rising or falling figures.

The time lag of the system is a function of the chosen value of α as follows:

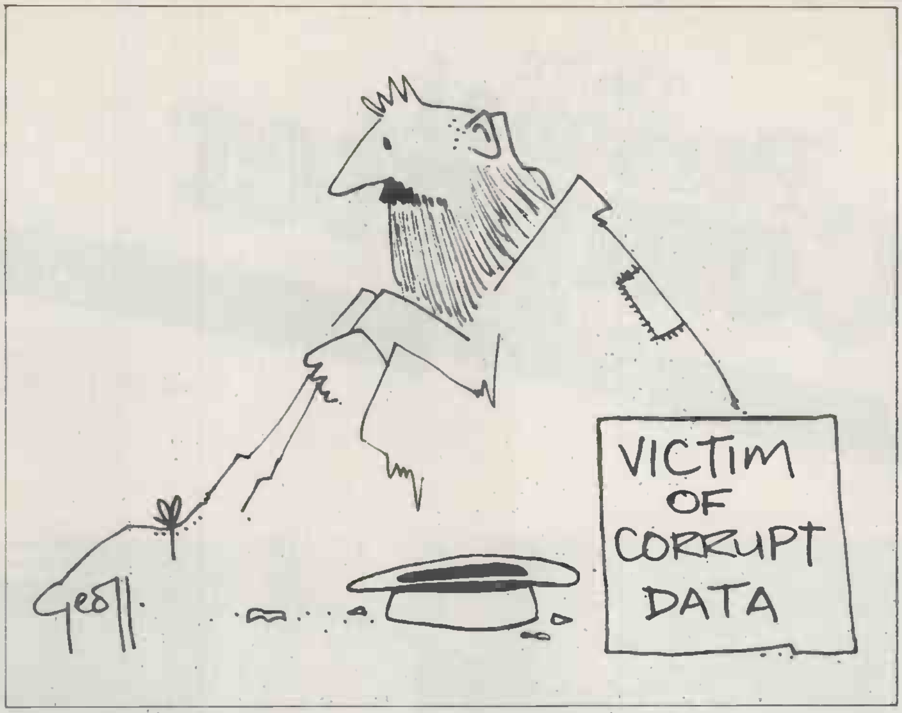
$$\text{Time lag} = \frac{(\frac{2}{\alpha} - 1)}{2} + 1$$

This if $\alpha = 0.1$, the time lag is 10.5 periods; with α of 0.2 or 0.3 the lag is 5.5 or 3.8 periods respectively.

When considering the trend, the same approach should be adopted as was used when handling the original result figures. That is, the most recent trend is more significant than earlier trends. It is therefore logical to exponentially smooth the trend as well as the basic result figures. However, it has been empirically found that α values are usually too large and therefore a factor β with a value of between 0 and 0.1 should be used. As before, a forecast trend for the previous period is used in conjunction with the actual trend exhibited, the actual trend being taken as the absolute difference between the two most recently available results. Therefore the forecast trend is:

Forecast trend $= \beta(\text{Actual trend}) + (1 - \beta)$ Previous trend forecast)
$= \beta(R_1 - R_2) + (1 - \beta)$ (previous trend forecast)

As before, this will contain exponentially weighted trends from all earlier periods. This forecast is of the latest trend per period but as the system has a time lag of x periods then the forecast trend must be multiplied by x and then added to the basic result forecast to form the revised and final forecast for the next period. Normally such a system is only used for predicting one period ahead but, should longer term forecasts be required, then it is simply a matter of adding additional units of the forecast trend.



The program

The listing is for a demonstration program forecasting sales demand; the section performing the calculations is from line 100 to line 180. REMark lines have been included for ease of understanding. As listed, the program performs double exponential smoothing but if single only is required, the trend analysis can be by-passed by adding:

115 GOTO 170

For demonstration purposes the program forecasts demand for the following six periods; if the forecast is only required for one period ahead then the loop in lines 220 and 230 can be removed.

A program for practical use would obviously need the addition of a small routine to file and recall the three variables:

F0 Latest Forecast
D Latest Result(Demand)
T1 Latest Trend Forecast

The theory and program detailed above are immediately usable for forecasting sales demand, stock usage, etc, but if it is intended to use the system for forecasting football results, for example, where the result can only be win, draw or lose and the points scored per match can only be 0, 1 or 2, then certain precautions must be taken. Details of its use for this purpose are contained in next month's article on football result forecasting.

```
10 PRINT"      DOUBLE EXPONENTIAL SMOOTHING"
40 INPUT"       VALUE OF ALPHA (0=<A=<1)   ";A
45 IFA<0ORA>1THENPRINT"":GOTO40
50 INPUT"     VALUE OF BETA (0=<B=<1)    ";B
55 IFB<0ORB>1THENPRINT"":GOTO50
60 INPUT"       PERIOD 1 FORECAST    ";F0
70 INPUT"     PERIOD 1 DEMAND      ";D0
80 N=1:NQ=(2/A)-1:TL=((NQ-1)/2)+1:D=D0:F1=F0:GOSUB2000
100 REM  BASIC FORECAST
110 F1=(A*D0)+(1-A)*F0
120 REM  TREND ALLOWANCE
130 T1=B*(D0-D)+(1-B)*T1
140 REM  TOTAL TREND CORRECTION
150 TR=TL*T1
160 REM REVISED FORECAST
170 F=F1+TR
180 F0=F1:F1=F:D=D0
190 PRINTTAB(3);N+1;
200 PRINTTAB(13);INT(F*100+.5)/100
220 FORJ=1TO5:PRINTTAB(3);N+1+J;
230 PRINTTAB(13);INT((F+(T1*J))*100+.5)/100:NEXTJ
250 INPUT"";D0:N=N+1
280 FORJ=1TO5:PRINTTAB(10);"                    ":NEXTJ:PRINT"":GOTO100
2000 PRINT"ALPHA=";A;"   BETA=";B;"   TIME LAG=";
2015 PRINTINT(TL*100+.5)/100
2030 PRINT"PERIOD         FORECAST         DEMAND"
2040 PRINT"                                      "
2055 PRINTTAB(3);N;TAB(13);F0;TAB(28);D0:RETURN
```

The 3rd Personal Computer World Show

This year's show proved an unqualified success for visitors and exhibitors alike. Here's just a brief selection of photos taken during a hectic three days.

Clockwise (from top left): totally absorbed on the Houghton County Primary stand; "Where's all this data they keep talking about?"; a tense moment during the World Microcomputer Chess Championship; a busy day on the Tandy stand.

THANKS FOR COMING SEE YOU NEXT YEAR!

OUR DAY AT THE PCW SHOW

By twins Joanne and Sarah Walton (aged 10)

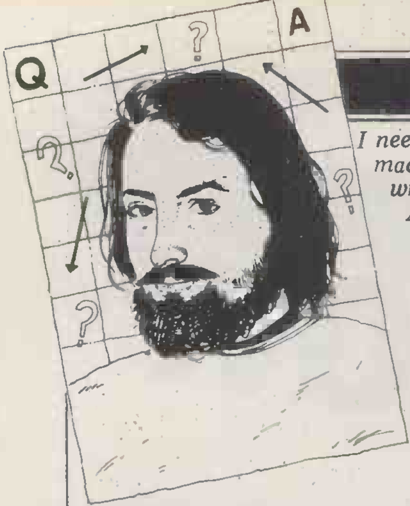
We arrived in London on 4 September to go to the Personal Computer World Show at the Cunard International Hotel. We were going to help on our school's computer stand. We had planned to arrive there at 8.00 am but arrived at 9.45 am. We met Derek, David, Timothy and Oriel. Timothy was running around looking harassed with a cigarette in his hand. There was a man with a very posh suit on and there was a carpenter having trouble with some very large signs. It was held in a very large room and it got very hot at times. A man from London Radio kept saying Personal Computer Show instead of Personal Computer World Show, so when he started again he emphasised the word 'World' with his mouth stuck out.

A foreign interviewer came just as my Dad was eating a boiled sweet and he found difficulty in understanding him. Dad dangled Richard Baldry's boiled sweet in front of him so he could understand why he wasn't speaking properly. Hint: boiled sweets are not advisable in this kind of event.

We liked the badge 'I'm a computer kid'. There were lots of great games. I liked 'Haunt'. You had to travel around a house moving North, South, East or West. It tells you where you are and it also tells if there is a coffin, tins or cupboards you can open. It might then say (if you have opened the box) "there is a large key in there, do you want it?" Then you either say "yes" or "no". But it might say instead you need a hat-pin to get in, in which case you cannot get in the box. In the end the computer adds up your score and you get some money. Once I opened the coffin and got eaten by a skull.

On the Intex Datalog Stand their games programs were great fun. I liked Breakout and Acrobat best. Acrobat was very good. First of all a man on a see-saw came up on the screen and so did two boards (lines) on the side. Some circles (balloons) came up on the top of the screen and then the game began. The object of the game was to burst as many balloons as possible in five goes. If you do not catch the little man he dies. Then the computer plays a death march and an ambulance comes to take him away. The empty circles score 3 and the full circles score 5.

At the end of the show we all agreed it had been *fab!*



COMPUTER ANSWERS

I need consultants to answer question on the TRS-80 and Compucolor, with thorough experience of machine code programming, the disk operating systems and the hardware of these machines. Please write to me, Sheridan Williams, at 35 St. Julian's Road, St. Albans, Herts, stating your experience. A reminder to readers that personal replies can only be given to Computer Answers if an SAE is enclosed. Send your questions to me at the above address.

Which single?

I would be grateful if you could tell me which single board computers are most suitable for scientific and mathematical calculations.
R J Hercock, Brentwood, Essex

When computers were first designed during the second world war, they performed scientific calculations such as code-breaking and plotting missile trajectories. Since then the emphasis has shifted so that the majority of computers now perform data processing. But that said, I doubt very much if any of the single board computers are used for data processing; most must be used for game playing, learning about computers, and scientific and control uses. The answer to your question depends upon the systems software available. For example there's the question of whether they support a floating point Basic — if the answer is yes, then they are okay for scientific purposes. It's also worthwhile checking that they have a cassette filing system, to enable the storing of numerical data on file. With the information given there are far too many systems to recommend one in particular, but if you can produce a more detailed list of requirements, then I'll try.
SW

Present or future?

I'm thinking about getting a computer, but don't know whether to spend all my money on one like the PET, Apple, TRS-80, etc, or get a smaller model like the UK101, Nascom 2, etc. I would use the computer mainly for games and later for business.

I would be grateful for your advice on this decision, or perhaps you think it might be better to wait a year or two for the arrival of one of the super computers that we are all hearing about. I'd also like to know if Apples work from cassettes and, if so, how much this would cost.
D N Hardwick, Stourbridge.

It's important, when deciding on a computer, to keep clearly in mind the purpose for which it is needed: . . different machines are designed for different uses. They tend to fall into fairly broad classes, such as: instructional/hobbyist; personal/games; educational; business; scientific; word processing.

So the first thing is for you to decide whether you are able to see clearly your long-term needs — and therefore can go for a computer that will cover all these — or whether it makes better sense to aim for something simpler for the present, with the thought that you could always sell it in due course, as and when needs change. I say this because, if you want a computer for serious business use, then I think that at the very least, you need one 5¼-inch floppy disk drive — preferably two. Even better, of course, would be two 8-inch drives. This would, in itself, rule out some of the machines you mention.

So if your real use is for business and you're not ready for it yet — then, as you say, it could be well worthwhile waiting until you are, as new machines are appearing all the time. In fact, there are so many appearing at the moment that it's difficult to advise about choice, especially as it's not yet possible to try out some of the more interesting machines that have been announced.

If your main use is really for games, or if you want to learn about computing and programming this way (and it's a good way to learn), then by all means take the plunge now. The computers that will be appearing in the next two years or so will probably be aimed mostly at the business, educational, and scientific end of the market. If, as seems likely, second-hand prices continue to hold up well, you could always change.

For games you'll want a machine with either a video screen or at least the ability to work through your TV and preferably with at least a rudimentary high level language, such as 'Tiny Basic'; a larger Basic, especially one with graphics facilities, would be even better. As always, the more you want, the more it's likely to cost, so while colour, for example, has many advantages for games, the extra cost must be borne in mind. Any of the machines you mention should be suitable for games. and as they all use either the Z80, or 6502 microprocessors — and popular versions of Basic — there should also be a wide range of published games programs needing little, if any, alteration for you to use.

If you don't mind writing your own programs, altering published ones (or waiting for appropriate ones to be published) then you could also think about the new Sinclair ZX80, which at about £109 ready assembled (and including mains adaptor) would be appreciably cheaper than the £270—£350 that most single board computers cost on the same basis — VAT included.

Alternatively, if you're sure about the eventual business use, and want to get going now, without having to change your computer later, you could think about buying a Level 1, 4k Tandy TRS-80, or a 8k PET, and upgrading these in due course. Starting prices would be about £500 for the PET, and £420 for the Tandy. Extra memory, and even disks, could be added to both in due course. Another approach would be to purchase a 16k Level II TRS-80 without screen or cassette unit for some £460. This would cover the simpler business applications on its own.

Yet another machine which you could think about is the Video Genie. At £425 (all the prices I'm giving here include VAT) this offers compatibility with TRS-80 programs, 16k of memory, built in TV interface, and cassette unit; it's also claimed that it loads from cassette rather more reliably.

As regards the Apple, this is another expandable machine which can take disks and be used for business programs; in its basic form it uses cassettes. The snags are that data files cannot be used without disks, and the minimum price is £800.

To sum up, for business use you should aim to have disk capability while for games you need only a simple Basic computer and a TV screen, the addition of graphics being highly desirable. If you can only afford, say, about £300 now, then you can either wait a year or so, or get a computer suitable for games, with a view to selling it in due course in order to get a bigger one. If you can manage £450 now, you can get a machine which will do games very well, and can later be expanded for business use.
P McIlmoyle

Professional problems

I am a professional programmer and wish to buy a personal computer for home use. I have access to some good HP desk-top computers and so know the importance of good systems features. The PET with Toolkit has good features but limited graphics, and can only be extended to 32k; the Apple is more expensive than a PET, needs a separate monitor and lacks the cassette operating system of the PET (I won't be able to expand to disks for quite a while). Would you answer the following questions:
1. Can ROMs similar to the PET's Toolkit be added to the Apple and if so, for how much?
2. Is there any facility under Applesoft Basic for formatting numeric output?
3. I've heard that the Z80 CPU is superior to the 6502 CPU. What's your opinion of the Exidy Sorcerer and TRS-80 (which both use the Z80), and *is* the Z80 superior?
4. Is the Apple worth the extra cost over the PET, and if so, why?
Edward Bradford, London

1. The only ROM I know of is the 'Programmers Aid' but as far as I can remember the only program manipulation feature is renumber, and that in Integer Basic. Since it takes up one of the spare ROM spaces it can't be used with Applesoft in ROM. There are several programs both in Basic and in machine code that offer extra features although I find that with on-screen editing, cursor and repeat keys I can do without them.
2. I think you are referring to a PRINT USING or similar command, and the answer is no. This can be got round by a subroutine. The direct cursor commands and protected fields capability more than make up for this lack. In fact, some of the PRINT USING commands are tedious to use.
3. If the Z80 is superior to the 6502 then why do PET, Apple, Ohio Superboard, etc use the 6502? In my opinion the Z80 is easier than the 6502 to learn machine code programming on because it has more registers and although the Z80 has fewer indexed modes of addressing than the 6502 it's easier and simpler to use and understand. As it appears that Exidy has pulled out of the

market, I'm not sure if it would make a practical proposition — although the Exidy does have some nice features such as programmable graphics. Exidy and PET machine code monitors are extremely poor; the Apple is far better in this respect though some of the page zero locations are shared by too many routines to make single-stepping always viable. What about the Nascom 2 — that has Basic and a very good machine code monitor?

4. Yes certainly!!! How about 48k of RAM and seven expansion slots to begin with. The people at Apple certainly got the whole design concept right the first time round and although they left out a few things — such as renumbering — it's still amazing how many good points they got in (and all this quite some time ago). The Apple really is quite a potent machine.

I don't like the attitude of Commodore to its customers. Right back to when the PET was launched it's been "pay us your money first, and when PET comes we'll let you have it." When it finally did come it had several bad design features, some of which were put right on later models. Commodore's attitude still seems wrong — for example using two rows of 'funny' 8k dynamics in their 16k machines so that you have to buy a complete set of 32k RAM when you want to upgrade, the others being useless. Commodore is now apparently drilling out the spare holes in the 16k machines as, I guess, it ran out of 'funny' 8k RAMs. Commodore is also unhappy with other manufacturers supplying add-ons — such as the Computhink disk drives — and is trying to take steps to make this sort of thing as difficult as possible. Frequently these add-ons are better than Commodore's own. If you are still in doubt, then I suggest you hire a PET and Apple for a few days.
Mike Dennis

Although I agree totally with the remarks on Commodore's attitude, I disagree slightly on some other points — for instance, I feel that the absence of a PRINT USING is an oversight. I feel you should also look for 80-column screens and in this instance both PET and Apple have these available. The lack of cassette files on the Apple hasn't been mentioned, and in this area the PET certainly wins. Finally I would say that I need to know more about Mr Bradford's requirements before recommending any machine; plenty more systems could be mentioned — for example, what about lease-purchase of a North Star Horizon, or the new Tandy? The list goes on and on. . .
SW

ZX80 part 1

I am considering buying a Sinclair ZX80. Can you play good chess on the 1k machine? Are continuous graphics possible? How can the I/O bus be extended to run lights and heating? How can I modify the system with a quartz timer? Should I buy a ZX80 or an Acorn Atom?
Ian Maw, Southsea

Until someone writes a chess program for the ZX80, you won't be able to play chess with it at all and there's little chance that a good chess program will fit within 1k. It's hard enough to fit a decent 'Noughts and Crosses' into 1k. The PET 'Microchess' program needs 8k, so if and when a chess program is written for the ZX80, you'll probably need at least that much memory.

It's impossible to have true moving graphics, because the screen is not memory-mapped. You can POKE directly onto the screen, but no matter what you do, it's inevitable the screen display will flash off while the processor is working.

You need a hardware modification to run things like lights and heating, and such a device is sold by Timedata Ltd, 57 Swallowdale, Basildon, Essex. Although I know the ceramic filter timer has been criticised, you would gain nothing — even if it could be done easily — by modifying a limited capability computer such as the ZX80.

It's impossible to answer a question like "Should I buy a Whizbang Fortran or a Force-fed Slowbed IV?" without knowing things like the following: (a) How much money you are prepared to spend; (b) How much experience you have with computers; (c) Whether you want to write your own programs, or buy off-the-shelf software; (d) What you want to do with the computer; and (e) What sort of peripherals you would like to add on.

However, as a general guide, the ZX80 is an ideal 'first system'. The Basic is easy to learn and manipulate and the screen display, although limited, is adequate for most purposes. The memory, once you expand above the 1k supplied with the machine, is surprisingly efficient. Against this, the Acorn Atom has moving graphics and, if you're willing to forgo 6k RAM, can produce high-resolution, colour (after a fashion) graphics. The Acorn Atom also has a built-in sound box and goodies like a floating-point ROM and a Viewdata interface are available — or will be shortly. The big drawback of the Acorn Atom is, in my opinion, the convoluted, unnecessarily non-standard Basic. If you're just starting out, get a ZX80 and then decide in a year or so where you wish to go from there.
Tim Hartnell, National ZX80 Users' Club

ZX80 part 2

The ZX80 screen is not memory-mapped. Does this mean you cannot POKE onto it? Is it true the screen blanks out whenever executing a FOR. . . NEXT loop? Can you print cursor up, down, left and right as on the PET? When will the new ROM be out?
(Name and address supplied)

A big problem with POKEing directly onto the ZX80 screen is that the part of the memory that holds the display 'floats' on top of the program, so changing one byte of the program in turn changes every POKE address. However, it is possible to do it with a fairly modest subroutine.

The screen *does* blank out when executing a FOR. . . NEXT loop and when doing anything else at all. Sinclair has kept the price of the ZX80 down by using the processor to drive the display, and it cannot do two things at once. Either the machine is 'thinking' and the screen is blank, or the display is there. You cannot get the ZX80 to do anything while there is a display visible, except time the duration of the screen display.

It's always difficult to get difficult to get precise dates from Science of Cambridge but at the PCW Show Uncle Clive was heard to promise deliveries of two new optional items — a plug in ROM and a 16k memory expansion — in mid to late October.

You don't have cursor movement on the ZX80 as you do on the PET.

Tim Hartnell, National ZX80 Users' Club

High res for PET

Having just read your review of the Research Machines 380Z high resolution graphics board, I wondered if there was anything similar available for the Commodore PET?
I Ballarini, London

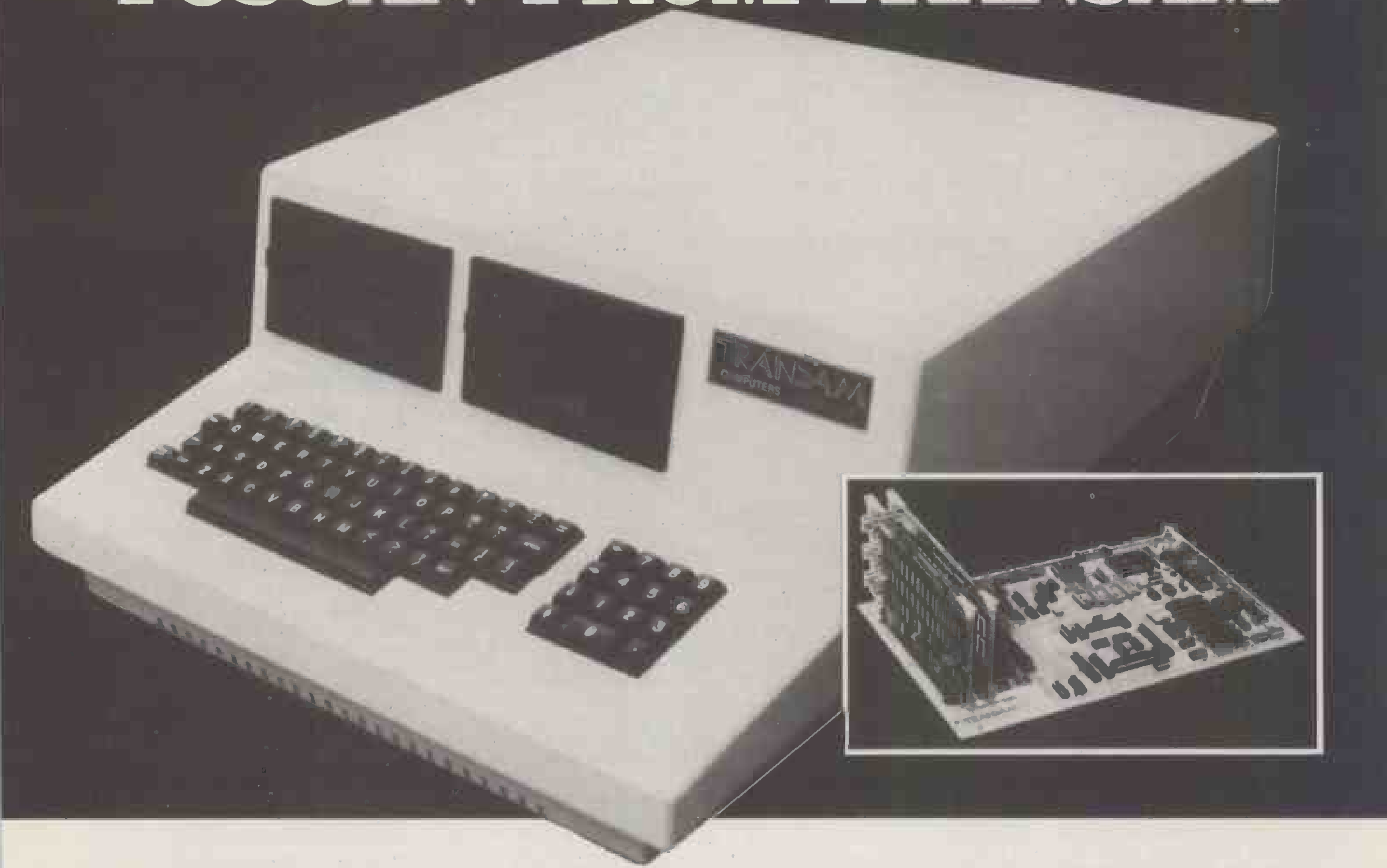
Yes, there is a very similar system for the PET, and for around the same price. It's available from I J J Design, London Road, Marlborough, Wiltshire (0672 53153) and the price is about £320. This includes all the necessary systems software for adding six keywords to Basic — including SET, SETLINE, DOTLINE and TEXT — making graphics plotting very easy. The resolution is 320 x 200 points and the screen acts like a flattened sphere because points plotted off any edge of the screen appear on the opposite side.

The high resolution graphics board occupies 8k and resides from 40k - 48k. It can be bought as either an internal or external fitting — I strongly recommend that you buy the former as the external fitting is far from portable and is very difficult to transfer between machines.

I believe that Computerama of Bath also has an HRG board for the PET, but I'm afraid I know nothing about it.
SW

"He creates them in his own image"

'TUSCAN' FROM TRANSAM



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SECRETS OF SYSTEMS ANALYSIS

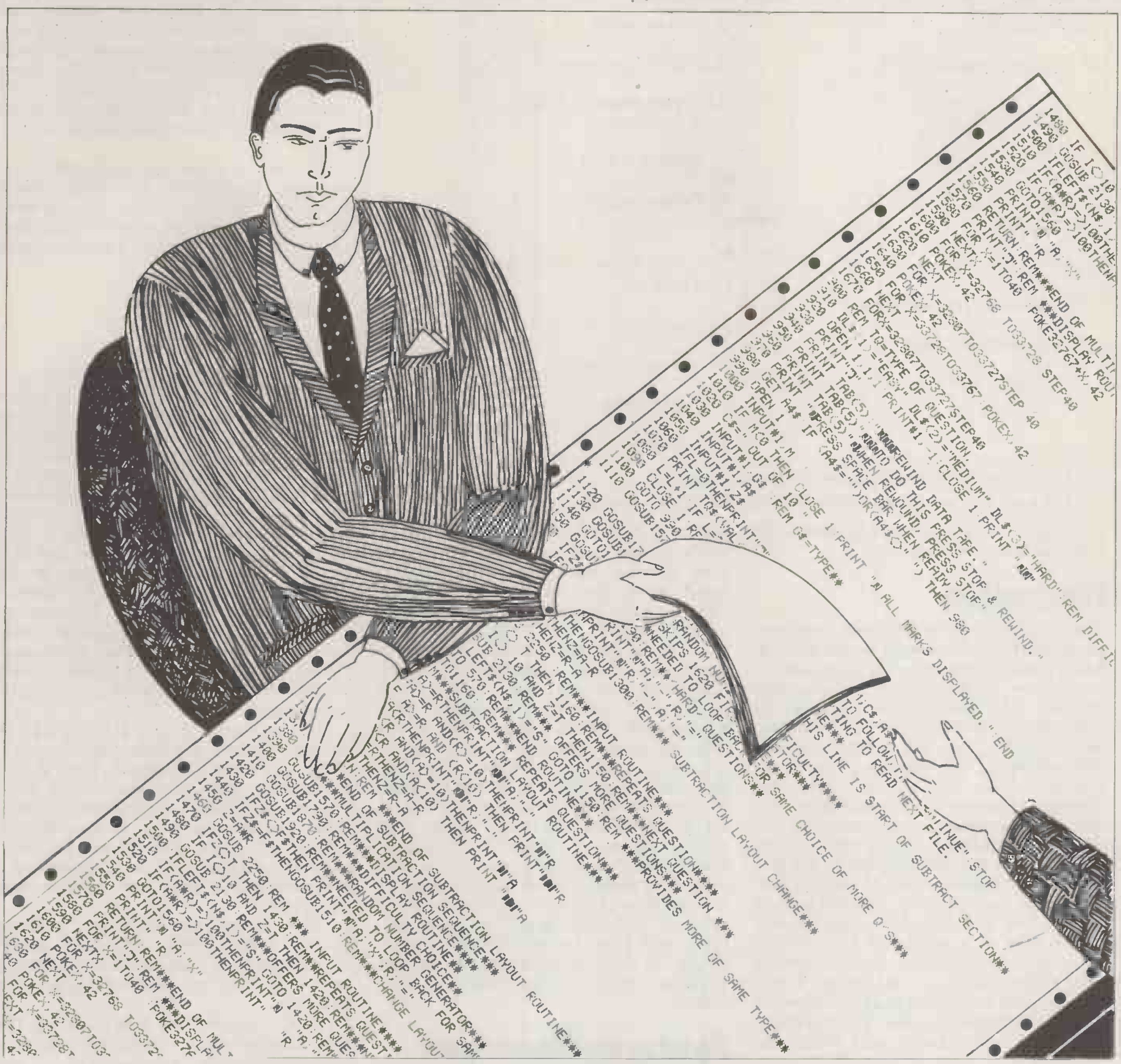

Illustration by Valerie Wickers

Lynn Antill continues her series aimed at bridging the gulf between the would-be micro user and the microcomputer specialist.

PART 3: Why be formal?

Last month I suggested ways in which a potential user can go about the business of deciding what he wants his system to do. This is a very individual job. No-one can tell you how to have good ideas, but there are fairly well defined ways of communicating these ideas to a computer professional. The NCC has devised a whole series of forms which demand answers to all the questions that need to be asked about a computer system. Many of these are for specifying the detailed requirements for a computer program, and I will be looking at some of these in Parts seven and eight. Others relate to the design of the system. Although intended for mainframes, and thus smacking somewhat of the 'sledgehammer and nut' syndrome, some of these forms are still very useful to the micro user.

I know everyone groans at the word 'forms', but they do have their advantages. . . supposing of course that you've understood the questions! A well designed form asks every question that needs to be answered; anything left out of the specification will therefore show up as a gap on the form. Also a form should be clearer to understand and less ambiguous than narrative.

The micro user is fortunate as compared with his mainframe equivalent in that the line of communication between user and machine is very short, with only a salesman (and perhaps a programmer) coming in between: therefore there's less opportunity for a customer's requirements to be misunderstood along the way. Even so, communication is not so straightforward that it can be done well without at least some formality. I've made the mistake in the past of programming to a verbal specification. Because of all the changes I had to make to get it to do what the user *actually* wanted, rather than what I had thought he wanted, the program took twice as long to get working as it should have done, and had much messier code. This can be a particularly tricky problem where the programmer is being paid by the day, or where a customer is buying a program without having the chance of trying it out first. With no proof of the original brief there's little comeback if the result turns out not to be what was expected.

There isn't room here for a crash course on the whole NCC manual, so I'll have to restrict myself to suggesting a few simple ways in which you can make your requirements clear — without

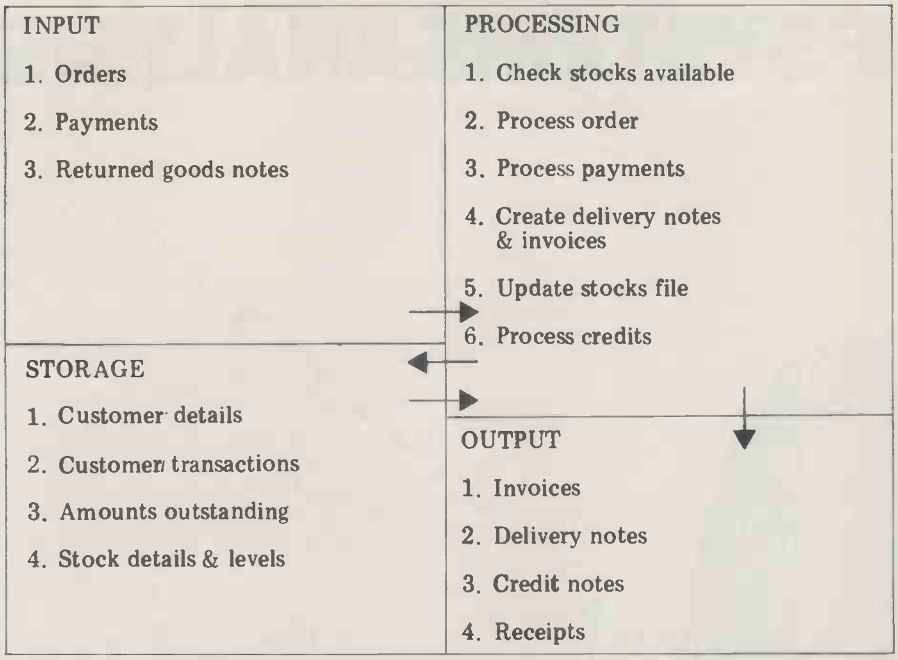

Fig 1 Systems Outline Chart for 'Customer Orders'.
For this system we will need another chart for 'Stock Control'.

jumping to any conclusions about the actual solution to adopt.

Narrative

Even if you try to write down what you want, a written explanation can have its limitations; it can be misunderstood, or it may be incomplete or not logically ordered. A specification should be *accurate*, *unambiguous*, *well-ordered* and *complete*. As an example of the disadvantages of narrative, look no further than the article you are reading! I believe that everything I've written is accurate, and I certainly do my best to make the meaning unambiguous. However, the hardest to achieve is a logical presentation of the subject. *I* can see the logic of the series as it unfolds but, more importantly, can *you?* In the case of a magazine series this is only important insofar as it influences your willingness to go on reading. You'll make your own decisions about whether or not the series is logical. The programmer, on the other hand, must follow the user's logic.

The final thing about a specification is its completeness and this is something to which I can make no pretence (although in the final article I shall be giving a list of references for further reading). All this series can do is to give a feeling for systems analysis, and explain some of the techniques involved. For this task it's clear that narrative is well suited. A specification, however, cannot leave questions unanswered.

The place of narrative in a specification is to serve as an introduction — and to provide additional explanations — so that the programmer gains a real feeling for the job in hand.

IPSO Systems outline chart

I've already talked about Input, Processing, Storage and Output. The NCC has produced what is definitely my favourite form on which to specify these. It's called a Systems Outline Chart, which is rather unfortunate because it tends to get confused with an outline flow chart — which in turn gets confused with the NCC Systems Flow Chart, which is a different thing again.

The Systems Outline Chart consists of four boxes into which you write down the major categories of input, processing, storage and output. The NCC talks about files rather than storage but this is jumping the gun a little because you may not want to use what, in computer jargon, is strictly described as a file. The chart is extremely easy to use as it enables you just to jot down items as they cross your mind. Figure 1 gives an example. There's only room for broad categories — eg 'Payments' rather than details of all the various fields which go to make up the different types of payment; these will have to be looked up elsewhere. It really is important to get the 'Outline' right before filling in the details.

Systems flowchart

It's very important to realise that a systems flowchart won't look anything like a programming flowchart — for the very good reason that it shows the flow of a piece of information from one process (or person) to another, rather than the flow of control between the program instructions. The different departments/people/processes through which the information passes are represented by vertical columns. The information and its direction of travel are shown by boxes and arrows respectively.

Figure 2 gives an example of a Systems Flowchart. It's only worth using one of these on a large system (by micro standards) where information really does have to travel around outside the computer.

Samples and examples

You can save yourself a lot of time — and give the programmer a much better idea of the requirements — by showing samples of all the forms and documents that you use for input, or produce as output. Make sure they display realistic detail so as to convey in the clearest possible way the information that is *really* needed. *(You* may know that certain boxes are never filled in and that extra information often has to be written across the top, but that doesn't show up on a blank form). Pick out all the forms, even the ones that are only used at Christmas; it's often the exceptional things that are the determining factor in choosing between possible solutions.

If you decide you want displays or printouts which are different from anything you have at present, then sketch them out. But only do this if their content or format is genuinely important, because as soon as you specify details you limit your choice of package, or commit your programmer to a solution which may not be the best one overall.

The major use of these samples is to show what individual pieces of information are collected/required and how they are grouped together in practice.

Also included in this part of the specification are examples of any calculations that are required — the way you work out your VAT returns, discounts, trends, etc. Even where the

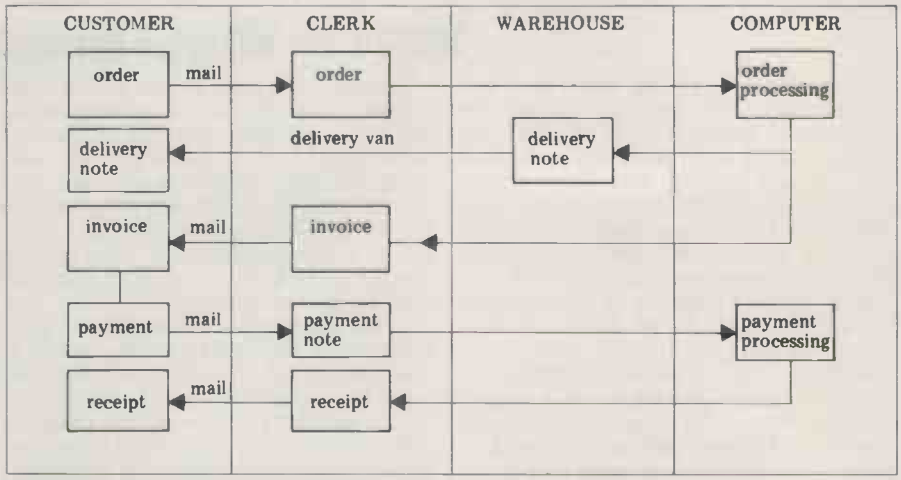

Fig 2 Systems flowchart for 'Customer Orders'.
This is just the flow of information. . . we don't follow the progress of the goods or money.

calculation is a prescribed one, such as VAT, it's surprising the number of different ways there are of coming to the same answer from the same raw data. It's also surprising how many people there are who don't know how to do the calculations that you take for granted. Where the calculation is for your own benefit, your method of performing it is probably unique. Be prepared to go through it step by step, explaining where all the figures come from, and what you're going to do with the answers.

By the time you've collected all these samples and examples, you've probably created an untidy looking heap, so fasten them all together with something like a treasury tag, give each one a unique reference number or name, and refer explicity to them whenever they are quoted in other parts of the specification.

File specs

Files are undoubtedly the most difficult part of a computer system specification for the non-programmer to come to terms with. Indeed, it's perfectly feasible to leave the design of files entirely to the discretion of the programmer. If all the inputs to and outputs from the system have been properly defined, then the programmer should be able to design files to handle all the storage. In this case you are asking the programmer to do some of the analysis as well, and many of the people working with micros quite rightly describe themselves as 'analyst/programmers'.

Most users, though, will either want or need to have some say in the way in which files are organised. Although I shall be discussing this in more detail in Part 7 (as part of a program specification) it would be worth having a look at the sort of things which need to be considered, and also introducing any of you who are not familiar with it to the jargon.

A FIELD is any single item — eg a name, a date, an amount, a description.

A RECORD is a number of fields grouped naturally together — eg for one customer you may have Account number, Name, Address, Credit Rating, etc.

A FILE is a group of related records — eg the records of all the customers. Usually there is a KEY field in each record which uniquely identifies that record within the file. Account numbers and the like make very good keys because the machine can easily recognise them. Names don't because there's no easy way that a computer can tell that SMITH W F is the same as WALLY SMITH. You could make a double key out of the surname and the initials, treating them as separate fields, but it's rather an irritating constraint on your operators to have to stick to just one of the several acceptable formats for names. People are in the habit of being much more precise about account numbers and it helps to build your system on that. So the questions you must answer are:

1. What fields appear in input and output, and how are they naturally grouped together? This should show up in the samples and examples.
2. What different types of records are there to constitute the different files?
3. How are the records normally accessed? Is there a key field? Are records called up at random, or can you sort the input before you start processing it, and take the records in key order?
4. What cross-referencing is there between records from different files?

Checks and safeguards

What sort of mistakes or failures would really put you up a gum tree? The new system is unlikely to work in detail in the same way as the old, so don't write down a whole collection of detailed checking requirements. Concentrate instead on listing those items which must be right, those where errors are most likely to be introduced from outside, and those where computer records are to be checked against reality (eg at stock taking).

If you are keeping accounts of money (other than your own) you must include in your specification anything that your auditor needs to know, and any checks he wants made.

Volumes

Not only is 'what is to be stored and processed' to be specified. . . it's also important to record just how much of it there is. Two people may be doing what is functionally the same job. One, however, may be handling ten times the volume of the other; he will need a bigger, faster machine, and may also need a more complicated system just to keep track of where records are stored. With small volumes, you can often take advantage of short cuts (eg storing several files on one floppy disk) which are ruled out when the files reach a critical size. (You may have to do some fiddly arithmetic to find out whether your files will actually reach that critical size for a given package, but more of that anon.)

There are two aspects to the volume question — how much information must you store, and how much do you process on any given day? You may need to ask this question about several different types of record; for instance, you may keep information about customers and about stock.

Also there's the possibility that volumes will expand. Any figure for this likely rate of increase may well be based on hope rather than fact, but it's still worth making some sort of estimate.

Constraints

You will already have thought about some of the constraints that are going to be imposed on the system — financial, physical and operational. These should be listed, and some sort of priority put on them. It's a good idea, too, to give a description of the underlying problem that is imposing the constraint, as there may be another way round it.

Some of the constraints may be legally imposed — company law, trades descriptions, Customs & Excise, Inland Revenue and so on. If a package has been produced by a young computer science graduate with no business experience, or if it has been imported from the States where regulations are different, there's a distinct chance that it won't match up to UK requirements. So, for example, if you know that you have to present certain figures to the Inland Revenue, don't forget to include that in your specification. If you are in doubt, it's worth paying your accountant for his opinion, rather than buy something which will not serve your purposes.

The complete specification

This will consist of:

1. An introduction: a page or so of narrative giving the background to the system — the sort of thing that you would say to the computer salesman if he was listening attentively enough.
2. Samples and examples of all your input, output and processing.
3. Systems outline chart — one for each major function you want performed (many micro applications will only have the one).
4. Systems flowchart — but only for the largest applications; usually it will not be required.
5. Explanations — of anything which may be difficult or unusual.
6. Constraints — a straightforward (and preferably short) list.
7. Ideas about files; don't impose them — rather they should be used as a basis for considering the programs you are offered.
8. The index: perhaps I should have put this in large letters at the beginning and called it a table of contents — then there's no excuse for anyone not to have read all of it.

Next month

'Towards a Computerised Solution.' How to work out exactly one's needs. . . type and size of computer, what peripherals and programs and what extras.

CUSTOMER DATA

FIELDS	Name Address Telephone no Account no Credit rating Amount outstanding Date of last payment History of orders and payments
VOLUME	500 regular customers 25—60 orders in any one day 0—200 payments received in any one day (mostly at month end).
EXPECTED GROWTH	Possibly up to 750 regular customers and 100 orders per day.
ACCESS	Usually by name or account number. Occasional reports by credit rating or amount outstanding.

Data Collected from new customer details, and orders and payments.

Data used for orders, invoices, mail shots, debtors, reports.

Fig 3 Broad requirements for a file for 'Customer Orders'.

DIRECT ACCESS

PACKAGES

Mary Knight of Mike Rose Micros presents our guide to widely-available software packages. This appears bimonthly alternating with our In Store hardware guide.

	ARDEN DATA PROCESSING 0533 22255		B+B COMPUTERS LTD 0204 26644		BEAM BUSINESS CENTRE 01-636 1392			BENCHMARK COMPUTER SYSTEMS 0726 61000
	PET	**Apple**	**PET/CBM**	**Altos (CP/M MP /M)**	**PCC 2000 Simpelec Triton 3**	**PET**	**Apple**	**North Star Horizon**
Stock Control/Recording	15	P.O.R.	300	300	350			450
Sales Ledger		300			350			250
Purchase Ledger		300			350			250
General Ledger/NL		300			350			250
Integrated Accts			300	300				950
Word Processing		75						
Mailing List		300	75	75				
Invoicing			25-50					100
Database Management/ Information Retrieval		150	75					250
Payroll		P.O.R.						350
Incomplete Records								
Personnel Records								
Estate Agent		850			350			
Time/Cost Recording			300		350			250
Job Costing								
Mail Shot					450			
Credit Control								
Cash Flow								
Production Analysis			300					
			Disk Operating System 150			Standard PET + Apple Packages		

	BENCHMARK COMPUTER SYSTEMS 0726 61000	BRISTOL SOFTWARE FACTORY 0272 23430	CAP-CPP MICRO PROD-UCTS LTD 01-404 0911	COMMODORE 01-388 5702		COMP-SOFT 0483 39665	COMPUTASTORE LTD 061-832 4761	
	Cromemco	**PET**		**PET/CBM**	**8000 Series**	**PET**	**Vector**	**PET**
Stock Control/Recording	450	300		150				
Sales Ledger	250	300	800	200	250		400	
Purchase Ledger	250	300	1000	200	250		400	
General Ledger/NL	250			200			400	
Integrated Accts	950			(50)	P.O.R.		1000	
Word Processing				75/150	250		400	325
Mailing List								
Invoicing	100		400					
Database Management/ Information Retrieval	250		P.O.R.	50/150	P.O.R.	170		
Payroll	350		P.O.R.	150	250			200/350
Incomplete Records								
Personnel Records								
Estate Agent								
Time/Cost Recording	250							
Job Costing								
Mail Shot								
Credit Control		650						
Cash Flow								
Production Analysis								
	Revolving Credit 400+; Hire Purchase 400+; Leasing 400+			Assembler Dev 50; LISP 75; Pascal 120				

	COMPUTECH 01-794 0202		DATA BANK 0509 217671			GRAFFCOM SYSTEMS LTD 01-734 8862
	Apple II	ITT 2020	PET	ITT 2020	Apple II	CP/M
Stock Control/Recording			10	10	10	350
Sales Ledger	295	295				450
Purchase Ledger	295	295				450
General Ledger/NL	295	295				400
Integrated Accts						1100
Word Processing			40	40	40	400
Mailing List			50	50	50	250
Invoicing						
Database Management/ Information Retrieval						
Payroll	375	375	10	10	10	500
Incomplete Records						
Personnel Records						
Estate Agent						
Time/Cost Recording						400
Job Costing						
Mail Shot						
Credit Control						
Cash Flow						
Production Analysis						
	Utilities 20	Utilities 20	Bank Account 10 Salesman 10 Cash Register 10	Bank Account 10 Salesman 10 Cash Register 10	Bank Account 10 Salesman 10 Cash Register 10	Equipment Lease/Rent/HP 400 Financial Modelling 400 Order entry/ invoicing 350

N.B. Discounts on multiple sales

	GRAMA (WINTER) LTD 01-636 8210	GREAT NORTHERN 0532 450667		A J HARDING 0424 220391	HARTFORD SOFTWARE 0606 76265	H.B COMPUTERS 0536 83922
	PET/CBM	8080/Z-80	Apple	TRS 80	PET	CBM
Stock Control/Recording	150	275	150	200		35/25
Sales Ledger		275		225		350
Purchase Ledger		275		225		350
General Ledger/NL		275		225		200
Integrated Accts	650	995				
Word Processing	75/150			15	85/65/40/20	35
Mailing List				25/38/55	45	35
Invoicing				25		
Database Management/ Information Retrieval	150			32.50		
Payroll	150	275		200		10
Incomplete Records				40		
Personnel Records					85	
Estate Agent						30
Time/Cost Recording						
Job Costing						
Mail Shot						
Credit Control						
Cash Flow						
Production Analysis						
		Job Order Control 275 Prof Appts. groups 275 Prof Appts individ. 220 Prof Client. Billing 330	Video message 200 Statistics 150	VAT Register 15	Lotteries 45 Membership Accting 85 T.A.P. Business System 125	Utility set 78 VAT Master 25 Bureau de Change 8 Price Lister 12

PACKAGES

	HIPPOSOFT 0332 23127		INTEREUROPE SOFTWARE DESIGN 0734-786644	INTEX DATALOG LTD 0642 781193	T V JOHNSON 0276 62506			KATANNA MANAGEMENT SERVICES 0245 76127
	PET	ACT 800	MCZ Zilog	PET	PET/CBM	TRS 80	Apple II	TRS 80I
Stock Control/Recording				195	150	115		200
Sales Ledger					P.O.R.			225
Purchase Ledger					P.O.R.			225
General Ledger/NL								325
Integrated Accts					650	75		
Word Processing	375	375	500+		75/150	45/95	75	70
Mailing List								
Invoicing					P.O.R.			75
Database Management/ Information Retrieval	225	225			150	150		
Payroll				50/195	150			218
Incomplete Records								
Personnel Records			500+					
Estate Agent								
Time/Cost Recording								
Job Costing								
Mail Shot			200					
Credit Control								
Cash Flow								
Production Analysis								
			Screen Generator 75+; Conference Organiser 500+; Budgeting Package 500+		Petsoft programs 160			Individual designed programs 100 up

	KATANNA (cont'd)	KEEN COMPUTERS 0602 583254	LIFEBOAT ASSOCIATES 01-836 4663		LIVEPORT (EXIDY SORCERER FIRMWARE) 0736 798157	MICRO COMPUTER APPLICATIONS LTD 0734 470425		PADMEDE COMPUTER SERVICES 025671 2434	
	CP/M	Apple	CP/M	8080/Z80	Sorcerer	Tandy Model I	Tandy Model II	Apple II	ITT 2020
Stock Control/Recording	500	P.O.R.	325	325		30-50	300	300	300
Sales Ledger	500	300	425	425		90	90	300	300
Purchase Ledger	500	300	425	425		90	90	300	300
General Ledger/NL	500	300	375	375		90	90		
Integrated Accts			950	950		350*	350*	450	450
Word Processing	500	75				50/75	175-240		
Mailing List		300				40	75		
Invoicing	500		325	325		90	90	300	300
Database Management/ Information Retrieval		150				25-80			
Payroll	500	P.O.R.	475	475	250	249			
Incomplete Records		P.O.R.				40			
Personnel Records									
Estate Agent		850							
Time/Cost Recording						P.O.R.	P.O.R.	300	300
Job Costing						P.O.R.	P.O.R.	300	300
Mail Shot							75		
Credit Control									
Cash Flow									
Production Analysis									
			Order processing 550		+ range of Lifeboat progs.		CP/M & utilities 150; CBasic 70		

* includes invoicing

PACKAGES

DIRECT ACCESS

	PERSONAL COMPUTERS LTD 01-626 8121		ACT/PETSOFT 021-454 5348	SMG MICRO COMPUTERS 0474 55813	THE SOFTWAREHOUSE 01-637 2108		STAGE ONE SOFTWARE 0202-23570
	Apple II	**MZ-80K**	**PET**	**PET*/8032**	**Apple**	**TRS-80**	**Commodore/ Computhink**
Stock Control/Recording	35/98	150	12/25/350	395	80	48	100/250
Sales Ledger	295		95/350	395			P.O.R.
Purchase Ledger	295		95/120/350	395			P.O.R.
General Ledger/NL	295						P.O.R.
Integrated Accts	340	150					P.O.R.
Word Processing	150-300		25/325		60	30/60/90	120
Mailing List	40		15	75/150	50-150	50-150	100
Invoicing	125		350	in stock control	295		P.O.R.
Database Management/ Information Retrieval	98		325		60-140	60	45-250
Payroll	200		50/25/195		200		
Incomplete Records	125				250		750
Personnel Records	98						
Estate Agent	175		25				250
Time/Cost Recording	125				450		P.O.R.
Job Costing	125						
Mail Shot	225				14		125
Credit Control	98						
Cash Flow	75		8				
Production Analysis	75						
	Pad to plotter system 250; Statistics 100-195; Programming Aids 40		VAT 17.50	Vet Package P.O.R.; Solicitor's package 750; Planning/ maintenance 595; Warehousing P.O.R.; *Computhink Disks	Solicitor's complete record accounting 3000; Postal Advertising Response Package 350	Statistics 45; Investment Portfolio 20	Petaid report generator 125; PR/Advertising Package 1000; Bonds/Pension Quotations 100; Printers Job Control 250; Bank Accounts 100; Appointment Planner 100

	SYSTEMATICS INTER-NATIONAL 0268 284601	SUMLOCK BONDAIN 01-250 0505	TRIDATA MICROS LTD 021-622 1754		VLASAK ELECTRONICS LTD 062-84 74789
	Apple II/ ITT 2020	**Apple**	**TRS 80I**	**TRS 80II**	**Apple II**
Stock Control/Recording	500	P.O.R.	200	375	285
Sales Ledger	250P	300	225	375	315
Purchase Ledger	250P	300	225	375	315
General Ledger/NL	250P	300	225/325	425	225
Integrated Accts					855
Word Processing	180/95	75			120
Mailing List	100	300			
Invoicing			75	125	140
Database Management/ Information Retrieval	100	150			
Payroll	250P	P.O.R.	218	375	375
Incomplete Records					
Personnel Records					
Estate Agent	750	850			
Time/Cost Recording					
Job Costing					
Mail Shot					
Credit Control					
Cash Flow					80
Production Analysis					
	Text File Librarian 125; Financial Planning 250; Office Admin 100				Letter writer 80

Key: POR Price on request
(   ) Program used to link accounts packages.
P = program written in Pascal

DIRECT ACCESS

TRANSACTION FILE

For sale

T159. . . PC100C, ML10 (Math/utilities) & all supporting doc, offers around £220 or will split. D Stringer, 16 Hall Drive, Cropwell Bishop, Notts. Tel: 0602 892191.

T159. . . with PC100B printer plus structural engineering & maths/utilities modules, cost over £400, accept £230. Tel D Nunn, 01-878 3457 day, 01-870 6017 eves.

UK101. . . 8k RAM, new monitor, cased with several games cassettes inc Master Pack, £260 (£250 if you collect). Casio FX502P with FA1 cassette int & Master Pack program cassette, £55. Tel: V Day, Malvern, 06845 2733 day, 06845 4930 eves.

PET 8k. . . small keyboard plus sound box, books, mags, games progs inc Invaders, Startrek, Microchess & Life, £400. Tel: 01-534 1114.

Nascom 2. . . 32k, Naspen, PSU, graphics ROM, cased, full doc, hardly used. Unfortunate disagreement with solicitor forces sale, may deliver if local. Tel: Erith 32835.

PDP8-L. . . 4k minicomputer with TTY int and full diagnostics software, £200 ono. Tel: 0705 385589.

T159/PC100C. . . with stats & maths/utilities modules, software, blank mag cards, printer paper, full doc, all in perfect cond, bargain at £250. Stock, Hodge Howe Lane, Windemere, Tel: Windemere 2044.

MK14. . . new monitor, RAM, I/O, sockets on all but 1 chip, original doc, buyer collects, £20. Tel Sedgley 76319 eves.

S100. . . static RAM boards, 16k, £165, 8k, £150; SSM VBI VDU card, £85. Tel: Ware (0920) 67519 after 5.

TRS-80 L2. . . 16k, little used, with cassette recorder, manuals, some games, exc cond, £350. Tel: St Albans 54042 eves.

Nanocomputer. . . with PSU, unused, £240 ono. Tel: John Reid, Aylesbury 86500 day.

SWTP SS50 Bus. . . system update forces sale, all items with doc: RO33 Teletype, PSU, £100; 8-hole optical paper tape reader, £25; 8k RAM boards, £95; I/O port cards, £10; 6800 CPU board, £25; motherboard, £10; Smokesignal BFD-68 dual disk system, controller card, software, £450; 12k random Basic, £25. Tel: 0937 72855 eves.

6809 SBC. . . S100 processor with 1k RAM, 1k ROM, space for 10k, 2400 baud cassette int, keyboard port, with full doc & 12k Basic on cassette, £175. Or complete system with 24k RAM, VDU board, 11-slot motherboard, keyboard, in Vector case + extras, £800. Tel: Aaron, 01-959 4851.

8k Nascom Basic. . . ROM, £20, PSU (+5, –5, +12, — 12 10 amp), £30. Tel: Kings Lynn (0553) 672825.

Nascom 2. . . fully assembled & tested by Comp, 16k RAM, PSU, cased in a Microcase, full doc & some games cassettes, £320 ono or swap for PET, TRS-80 etc. Tel: 031-331 3651.

Sinclair Microvision. . . as new, with earphone, viewing hood, carrying case, mains adaptor, car batt connector. still under guarantee, £45. Tel: Earleswood 2143 after 6.

PET 2001. . . 8k, old ROMs, calc keyboard, full working order with new cassette head, £375. Tel: 01-582 7766.

ZX80. . . beat the waiting list, ready assembled, PSU, inc all lead leads, tape with many useful progs, manual + extra notes from Science of Cambridge, £90. Tel: Chichester 527461.

Eight MK4108. . . DRAM chips, used in PET for a year then removed as it was expanded, chips were in sockets & therefore unsoldered. £10. Tel: Bristol (0272) 684688.

Triton L5.1. . . full 4k on-board RAM, tiny Basic, 8080 monitor & listings, documentation, games cassettes, £200. Tel: 0502 2166.

ZX80. . . adaptor & leads, £70. 3k extra RAM, £35. Both for £100. Tel: Potters Bar 50369 eves or w/ends.

PET 8k. . . old ROM, exc. cond, manuals, documentation, much software on cassette (Microchess, etc), £400 ono. P Irwin, 1 Gillebank Close, Stockwood, Bristol BS14 8HT, tel: Bristol 835139.

Superboard. . . extensions, almost new, prof. built, 16k RAM & ROM, £135 ono; I/O board, 2 PIAs, one configured for LED/relay, switch, DAC with motor/lamp control & sound, room for extension, other PIA unconfigured, £35. B Mistry, 75 St Margarets Road, Bradford BD7 2BY.

TRS-80. . . software & hardware inc RS232 printer int, sound box, editor/assembler, m/1 monitor, many tapes, cost over £350, accept £150. Tel: Asthall Leigh (099387) 241.

PET 2001. . . 8k, green screen, old keyboard, hardly used, good cond, £400 ono. Tel: Doncaster 851269.

Phillips. . . 67000 videopac games computer & 17 cartridges, £190 or swap for UK101. Tel: 01-593 4287.

Nascom 1. . . B Bug extended monitor, 1k user RAM, full doc, some games, cased, prof built with 10 amp PSU, good cond, can be seen working, £200 ono. Tel: Bob, 01-778 8798 working hours.

PET. . . 8k, small keyboard, £400. 24k extra memory, £200. Tel: 0304 617209 eves.

HP9100B. . . prog calculator (desktop), exc cond, cost £3500 in 1972, will sell for £500 with prog library, manual, 21 mag cards, 49 used cards, info & peripherals inc. Tel: Medway 403530 eves.

Memory chips. . . 34 Fujitsu 200 ns 16k x 1 dynamic RAMs, type MB8116/E, new & unused, sell at £3.70 each, £27.50 for 8. Also 2 brand new TMS1600 16-bit microprocessor chips (3 MHz clock) at £25 each. Alastair Knights, 28 Cotswold Road, Westcliffe-on-Sea, Essex. Tel: Southend (0702) 41658.

Fast printer. . . 170 1pm, 80 col, V24 int, suits listing & word proc, 3 line/second throughput, £300 inc paper stock. Tel: Tring 4797 or St Albans 64077 anytime.

TRS-80/PET etc. . . Centronics printer 101A, 165 cps, 132 col, working order, needs to be wired up, suit electronics hobbyist with above computers, £450. Tel: Mr Lewis on 01-229 8749 or 01-727 5722.

UK101. . . built & cased, 6k RAM, separate PSU, inc unfinished EPROM programmer & some 6502 books + some tapes, £235 ono. Tel: Bourne End (06285) 23454.

Teletype. . . 33 with paper tape punch/reader, working with slightly soiled case, £60 ono. Tel: Esher 66453 or write J Rudge, Brendon Cottage, Riverside Drive, Esher, Surrey,

Wanted

Keen novice. . . Nascom 2 owner seeks fellow Nascom owner around London N13 area to answer odd questions & help lift the haze. Tel: 01-882 5727.

Large keyboard. . . 8k PET with cass deck, reasonable cond please. Tel: (0705) 596318.

Teenagers. . . are there any teenagers interested in writing & exchanging listings with another young computer freak? Machine irrelevant (ours is a Sharp). Write Phil, 25 Broadclyst Gdns, Thorpe Bay, Essex SS1 3QP. All letters answered.

PCW. . . Vol 1 Nos 6 & 7 wanted to complete a set. Tel: 01-670 0547.

Triton owner. . . with L5.1 monitor would like to contact anyone with the L7.1 or L7.2 system. Tel: Ross-on-Wye (0989) 2715.

Nascom 1. . . buffer board & mini ROM graphics board (good cond). Contact Robin, Coventry (0203) 411628 eves.

Bridge and chess. . . progs for Nascom 1. Alternatively, would consider 2nd hand games machines. Details to Crawford, 13 Church St., Broadway, Worcs.

Anyone got. . . a spare Apple/ITT floppy drive & controller? Somebody with a Corvus mini-winnie must have one to spare. Ring Pete, Hornchurch 42291 (will collect).

DIRECT ACCESS

USER GROUPS INDEX

As promised, here is a complete printout of our User Group Index. If we have failed to include YOUR group, then please address the relevant information to PCW (User Group Index), 14 Rathbone Place, London W1P 1DE. Notification of changes will also be appreciated. The next full listing will appear in PCW's February edition. In the meantime we shall of course continue to publish User Group Index update information — as and when it reaches us.

INTERNATIONAL

Tangerine Users Group (International). Recently formed for users of the Microtan 65, the TUG will act as a central information clearing house, including exchange of programs etc. Annual membership is £5.00. Details from TUG at 3/22 Donoughmore Road, Boscombe, Bournemouth, Dorset, UK.

USCD System User Society. Set up in San Diego in June for users of USCD Pascal, the society aims to establish a software library, promote regional and special interest group activities and liase with USCD system distributer Softech on future development plans. Existing special interest groups include industrial application, word processing, real time, business applications and forward planning. UK contact: John Ash, Dicoll Data Systems Ltd., Bond Close, Kingsland Estate, Basingstoke, Hants RG24 0QB.

Microcomputer Users Club: recently established for program writing and exchange, emphasis on 6502/Z80 users. Contact c/o Synthetronics Microcomputers P.O. Box 151, 1322 Hoevik, Norway.

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

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

Amateur Computer Club — 2650 Library. No meetings, no newsletters, the library serves to act as a help point for disseminating 2650 related data on demand. Contact: Roger A. Munt, 51 Beechwood Drive, Feniscowles, Blackburn, Lancs BB2 5AT (0254 22341).

Minicomputer Users in Secondary Education (MUSE). MUSE is the national organisation for coordinating activity in schools, teacher training institutions, colleges of technology and so on. Meetings are held on both a regional and national basis. For full details on MUSE's range of activities, contact the Treasurer, R. Trigger, 48 Chadcote Way, Catshill, Bromsgrove, Worcestershire.

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

Ithaca Audio S100 bus UK User Group. Contact: Dave Weater, 16 Etive Place, Cumbernauld, Glasgow 067 4JE. Phone 02867 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.

UK Apple Users Group. Contact: (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 Service (£10 Europe, £20 overseas) provides 10 free programs p.a. Contact: Mrs Judith Brown, The Polytechnic, Wilfruma St., Wolverhampton, WV1 1LY.

Cosmac Users Coub (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 (enclosed sae, please).

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

ZX80 Users Club. The group's aim is to create and share software which will fit within the machine's 1K RAM. Membership is free and first move will be to distribute a newsletter. Address to write is: c/o Tim Hartnell, 93 Coningham Road, London W12.

USER GROUPS INDEX

DIRECT ACCESS

Ohio Scientific UK User Group. Independent of OSI, an important role will be the disentangling of poor documentation. There will be regular newsletters and membership is at present £5 per year. The group will initially be concerned with the practical aspects and applications of OSI systems — rather than with games. Contact Tom Graves at: 19a West End, Somerset, BA16 0LQ.

Medical Micro Users Group. Set up to enable medical micro users to locate programs already written in their field by other medics. Newsletters and meeting in the pipeline — contact P.J.V. Dixon, c/o MEDICOM, 1-2 Hanover Street, London W1.

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

British TI Users' Club. A loose association of owners and users of Texas Instruments programmable calcs, the club exists for the purposes of information and program exchange (and is in no way sponsored by TI). The main activity is production of a (roughly) monthly newsletter and membership costs £5.50. Details from 2 Woodside Crescent, Clayton, Newcastle-under-Lyme, Staffs ST5 4BW.

ZX80 Users Club. Bi-monthly newsletter. Low cost software. Technical support. Subscription £6 (UK), £10 (overseas). Contact: D. Blagden, PO Box 159, Kingston upon Thames, Surrey, KT2 5UQ. (s.a.e. for further information).

COMP 80 Users Group. Monthly newsletter. Annual subscription £5. Contact: Philip L. Probetts, 50, Cromwell Road, Wimbledon, London, SW19 8LZ.

National Personal Computer Users Association. Full membership now costs £8.00, but you'll receive a free datasheet of special routines for the UK101/Superboard on enrolment (routines include a fast Basic line renumberer only four lines long). For detail details send an SAE to: The Secretary, NPCUA, 11 Spratling Street, Manston, Ramsgate, Kent.

Powertran Users Club. Annual subscription £5.00, which includes a monthly newsletter. Contact Mr P L Probetts, 50 Cromwell Road, Wimbledon, London SW19 8LZ.

Acorn Atom User Group. Set up for interchange of software & hardware tips. Membership costs £4 pa inc. access to program library & free newsletter. Group supported by but independent of Acorn Computers. Contact: T G Meredith, "Sheerwater", Yealm View Rd, Newton Ferrers, S. Devon.

National T158/59 Club: bi-monthly newsletter, program exchange etc. Annual sub £5.50 or, if you include a program with your cheque then it's £3.50. Contact: R M Murphy, Dept. of Electronic Engineering, University College Swansea, S. Wales.

Sharp User Group: Sub £3. p.a., inc newsletter and free Space Invaders cassette for MZ-80K. Contact: Knights TV & Computers, 108 Rosemount Place, Aberdeen. Tel 0224 630526.

Sorcerer Program Exchange Club; Contact Colin Morle, 32 Watchyard Lane, Formby, Nr. Liverpool L37 3JU, Tel 070 48 72137.

SOUTH

Southern Users of PETs Association. Free membership, meet first Wed. each month. £1.50 for monthly newsletter. Contact: 42 Compton Road, Brighton BN1 5AN.

NORTHWEST

Amateur Computer Club — North west group. Meetings 1st and 3rd Thursdays monthly at St. Peter's Chaplaincy, 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, Carswood, Nr. Wigan. Contact: Melvyn D. Franklin, 40 Cowlees, Westhoughton, Bolton, BL5 3EG. Tel: 0942 812843.

Northwest Computer Club. Fortnightly meetings. 25p attendance fee. No subscriptions. Contact: John Lightfoot, 135, Ashton Drive, Frodsham, Warrington, Cheshire, WA6 7PU. Tel: 0928-31519.

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.) — Dairmuid 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 are held once a week on Wednesdays at 10 Park Place, Newport. Contact Ian Hazell on 0633 277711 (office hours).

SCOTLAND

The Grampian Amateur Computer Society. They meet every 2nd Monday of the month at the Holiday Inn, Bucksburn, Aberdeen and there's a monthly newsletter. For more details, contact M. Basil, Orton Cottage, Burnside, Lumphanan, Kincardineshire, Grampian Region (033 983 284).

Scottish Amateur Computer Society. Meets first Wed. each month in the Claremont Hotel, Claremont Crescent, Edinburgh, at about 7.30 pm. Contact: Alastair MacPherson (Secretary), 6 Curriehill Castle Drive, Balerno, Edinburgh 14.

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).

Compukit User Club. Details, contact P. Crabb Esq., 21 Jones Close, Yatton, Avon (0934 834808).

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).

BUCKS

Would anyone interested in setting up an Apple Users Group in the Bucks/Berks area contact: Steve Proffitt, Tel: 01-759 5511 ext 7298 (day), or Marlow 73074 eves or w/ends.

CLEVELAND

Cleveland Micro Computer Users Group. Adult Meetings 3rd Tuesday monthly, under 18s — 2nd Tuesday. Yearly subscription £2 (18), £3 (18-21), £5 (21+). Journal. Contact: J. Telford, 13, Weston Crescent, Norton, Cleveland.

CORNWALL

Anyone interested in forming a computer club in Cornwall, catering mainly for PET, ZX80 and UK 101 computers should contact: M F Grove, 35 Causeway Head, Penzance, Cornwall.

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. They meet the 2nd Monday of each month for software tuition and the 3rd Monday for hardware tuition (both in addition to normal activities). They start at 7.00pm and meet in the PET Lab, Newcastle Polytechnic, Ellison Building, Newcastle upon Tyne.

EAST ANGLIA

Anglia Computer User Group. Contact Jan Rejzl, 128 Templemere, Sprowston Road, Norwich NR3 4EQ.

EAST MIDLANDS

East Midlands TRS-80 Independent User Group. Free newsletter from Mike Costello, 17 Langbank Avenue, Rise Park, Nottingham NG5 5BU.

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 — 7.30 pm start. Membership is open to all, on payments of £5 annual sub (£1 for full-time students). Contact: the Information Centre at the University on the evening of the meeting.

Compukit User Club. Details, contact Adrian Waters, 117 Haynes Road, Hornchurch, Essex RM11 2HX (Hornchurch 40490).

Springfield Computer Club. Special interest in Sorcerer but beginners and others welcome. Meetings 1st Friday monthly. Contact: Stephen Cousins, 1, Aldeburgh Way, Springfield, Chelmsford, Essex CM1 5PB. Tel: 0245 50155.

South East Essex Computer Society. Meets monthly at the Southend-on-Sea College of Technology, has access to the college's micros, and is open to anyone over 14. Contact: R Knight, 128 Lt. Wakering Road, Lt. Wakering, Southend-on-Sea, Essex. Tel: Southend 218456.

GLOUCESTERSHIRE

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

HAMPSHIRE

Southampton Amateur Computer Club. Meets 8 pm 2nd Wed each month (not July — Sept) at Medical Science Building, Bassett Cres. East, Southampton. £3 pa, OAP, & students £2. Newsletter & special int. groups; 2 yrs old, 80 members soon setting up another club in Portsmouth area. Contact: P G Dorey, Dept Physiology, The University, Southampton SO9 3TU or Andy Low, Tel: (0703) 555 605 ext 34.

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).

ISLE OF WIGHT

IoW TRS-80 Users Club: Meets each Friday at 8 pm at 72 Union Street, Ryde. Contact: Mr M R Collins, 3 Altofts Gardens, Ventnor, IoW.

KENT

MACRO (Medway Amateur Computer & Robotics Organisation). Meets monthly, sub £3. Contact: Mrs Christine Webster, 13 Ladywood Road, Cuxton, Rochester, Kent Tel: 0634 78517

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 including: 380Z User's Group (Alan Pope on 051-924 2470); Computer Education Society (Mr M. Trotter on 051-652 1596); SC/MP Special Interest Group (Bob Perrigo on 051-677 6716); PET Special Interest Group; 6800 and 77/68 Special Interest Group; Apple Special Interest Group. The Secretary is John Stout of the Dept. of Architecture, Liverpool Polytechnic, 53 Victoria Street, Liverpool L1 6EY (051-236 0598).

North Lancs User Group. Contact John Robinson, 12 Harold Ave., Blackpool, Lancashire.

USER GROUPS INDEX

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

West London Personal Computer Club. Meets first Tues. each month at Willesden Technical College. Also visits, special int. groups, demos, problem surgeries. Contact: Graham Brain, 81 Rydal Cres, Perivale Middx, Tel: 01-997 8986

Southgate Computer Club. The club recently held its AGM and adopted a formal constitution. Annual subscription will be £2.50 from January 1981, including a club newsletter; full-time students under 18 pay half-cost. The club now has 83 members. Contact: Panos Koumi, Southgate Computer Club, 33 Chandos Avenue, London N14.

East London Amateur Computer Club. Meetings 3rd Tuesday monthly. £2.50 p.a. (½ price to school students). Contact: Dr. Graham Crisp, 45 Leadale Ave, Chingford, London E4 8AX. Tel: 01-520 6010.

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).

SELMIC (South East London Microcomputer Club). £5 subscription. Meetings fortnightly at Thames Polytechnic. Contact: John Williamson, 129 Greenvale Rd., Eltham Park, London SE9 1PG Tel: 01-850 4195

Croydon micro/small computer group. Contact Vernon Gifford, 111 Selhurst Road, London SE25 6LH.

LONDON & SOUTH EAST

Sharp MZ-80K User Group. Contact: Joe L.P. Seet, 16, Elmhurst Drive, Hornchurch, Essex, RM11 1PE. Tel: 04024 42905.

MIDDLESEX

Sunbury Amateur Computer Club. Membership free. Contact Mr S N Taylor, 8 Priory Close, Sunbury on Thames, Middlesex. TW16 5AB. Tel: Sunbury 86649.

Harrow Computing Group. Meetings on alternate Wednesdays at 7pm in room G43 of Harrow College of Higher Education. They welcome anyone with an interest in computers — with or without a machine. Membership is free. For further information contact Bazyle Butcher, 16 St. Peter's Close, Bushey Heath, Herts WD2 3LG (01-950 7068).

IPUG setting up in Teddington. Interested? Contact: G. Squibb, 108, Teddington Park Road, Teddington, Middlesex.

NORTHANTS

Anybody interested in forming a microcomputer users club in the Towcester (S. Northants) area, please contact R J Wellsted, 20 Hampton Court Close, Abbey Chase, Towcester, Tel: Towcester 51354 eves.

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

SUSSEX

A Crawley computer club has recently been formed, open to anyone interested in personal computing, with or without computing facilities. The intention is to hold meetings weekly, and publish a monthly or bi-monthly newsletter. Details, contact either Mr J. Fieldhouse, 18 Seaford Road, Broadfield, Crawley, West Sussex (Crawley 542509) — or — Mr J. M. Clarke, 31 Hyde Heath Court, Pound Hill, Crawley, West Sussex (Crawley 884207)

TYNE AND WEAR

Newcastle-upon-Tyne Personal Computer Society: meets first Tues each month in Room D103, Newcastle Polytechnic. Over 60 members sub £5.00. Several sub-groups inc. PET, TRS-80 and S100 (last one meets weekly). Contact Pete 0632 573905 or John on 0632 579887.

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. Meets the 2nd & 4th Tuesday of each month, usually at Elmfield School, Love Lane, Stourbridge, West Midlands. Annual sub is £3 (£2 if full time student). . . visitors welcomed without obligation. For more information contact John Tracey of 100 Booth Close, Kingswinford, West Mids (0384 70097).

Compukit User Club. Details, contact S.H. Grisvenor Esq., 11 Bernard Road, Oldbury, Warley, West Midlands (021-422 3298).

YORKSHIRE

Shipley College Computer Group (Sorcerer/6800). They meet Tuesdays (software) and Wednesdays (hardware/advanced) between 7.00 & 9.00 pm. Contact Paul Channell on Shipley 595731.

West Yorkshire Microcomputer Group. Formed following an inaugural meeting on October 23rd, a varied diary of events has been drawn up. For details contact the Chairman, Phillip Clark, Care Computer Services, 15 Wellington Street, Leeds LS1 4DL (0532 450667) OR the Secretary, Keith Knaggs, Price Waterhouse & Co., Leeds (0532 448741).

South Yorkshire Personal Computing Group. Meetings are on the second Wednesday of each month in Room F135, St. Georges Building, Sheffield University. Experts and beginners welcomed alike, contact Paul Sanderson (Secretary), 8 Vernon Road, Totley, Sheffield S17 3QE (0742) 351895.

Penine & District Computer Club. Open at both 26 and 51 Mill Hey, Haworth, W. Yorks. each Sat & Sun 10am to 10pm. Systems, books, magazines, members' shop. Contact: club at w/ends on Haworth 43007 or chairman, Douglas Bryant, on Bradford 569660.

DIARY DATA

Bradford, England	(Norfolk Gardens Hotel) Business Efficiency Exhibition. Contact Gwen Shillaber Design, 0272 312850	Oct 21 — Oct 23
Riyadh, Saudi Arabia	Int Exhib. of Consumer Electronic Apparatus Contact: Interfama, 177 Brighton Rd, S. Croydon CR2 5EG	Oct 21 — Oct 25
Manchester, England	(Forum) BIZTRONIC. Mini/Micro Computers, Word Processors and Business Machines Exhibition. Contact Groundrule Exhibition Co., 061-928 0406	Oct 21 — Oct 26
Essen, W. Germany	Int Computer — aided Production Exhib. Contact: TMA Technische Messen & Ausstellungen AG, Delsbergerallee 38, CH-4018 Basle, Switzerland.	Oct 28 — Nov 1
London, England	(West Centre Hotel) Professional Viewdata Exhibition. Contact IPC Exhibitions Ltd., 01-837 3636	Oct 29 — Oct 31
London, England	(Olympia) COMPEC. Computer Peripheral & Small Computer Systems Exhibition and Conference. Contact IPC Exhibitions Ltd., 01-837 3636.	Nov 4 — Nov 6
Cardiff, England	(Sophia Gardens) BEX. Business Equipment Exhibition. Contact Douglas Temple Studios Ltd., 0202 20533	Nov 5 — Nov 6
London, England	(Wembley Conf. Centre) Video Tradex Int. Exhib Contact: Link House Magazines, Link House, Dingwall Ave, Croydon	Nov 18 — Nov 21
Birmingham, England	(NEC) Which Computer? Show. Contact Clapp & Poliak Europe Ltd., 01-995 4806	Nov 25 — Nov 28
Brighton, England	(Metropole Exhib. Hall) Semiconductor Int. Exhib Contact: Kiver Communications SA, 171/185 Ewell Rd, Surbiton, Surrey KT6 6AX	Nov 25 — Nov 27
London, England	(Royal Hort. Hall) Breadboard Contact: Modmags Ltd, 145 Charing Cross Road, London WC2H OEE	Nov 26 — Nov 31

MAKING AN IMPACT

Continued from page 97

signal connection is to pin 3.

This arrangement is satisfactory at baud rates up to 300, because 300 baud is not a particularly high frequency signal. For higher speeds quite different arrangements are needed because the simple interface makes no provision for 'handshake' signals. The printer uses a buffer into which signals are fed from the computer and from which the printer takes bytes in sequence until the buffer is empty. At 300 baud you'll never overload the buffer but at higher speeds there's a risk of pushing data in faster than it can be taken out. A signal from the printer (buffer full) can be used to halt the computer temporarily until there is buffer space; this needs an extra lead. As it happens, this would not be difficult to implement on the TRS—80, since the control signals are available at the expansion interface output but I haven't tried this...yet. The main difficulty is the silly one of trying to get hold of a suitable edge connector, since I have a horror of wires held on by paper-clips and Blutak! Local Tandy stores never seem to have any connectors to fit!

A short program for operating the printer at 300 baud is shown in Figure 5. This is a strictly utilitarian program with no provision for trimmings like dumping whatever appears on the screen to the printer. Since I much prefer to use one cassette load per program, I always transform machine-code programs into Basic ones, using a little program (available from AJ Harding, Molimerx) which converts the machine code bytes into a Basic DATA line. The POKE instructions then place the bytes into the correct part of memory, and place this address into the section of RAM which is used to contain the addresses of the printer, screen and keyboard routines. The Basic routine can be made to delete itself after poking the machine-code in place and can be incorporated into any other program, provided that the appropriate lines are left for it. An alternative, which does not require MEMORY SIZE to be set, is shown in the latest editions of the TRS—80 Level II manuals.

The TRS—80 and the IMP are now doing what they ought to, apart from the curious appearance of a 'line-shift'. The IMP prints bi-directionally except when the lines are very long. On a long print session, such as when I disassembled the ROM, the lines which were printed right-to-left started to slip leftwards. After 200 lines, the slip was one-character, but when the slip got to five characters, I turned it off because addresses were disappearing off the edge of the paper. As the printer never does this until it has been running for some time, it looks very much like an over-heating problem somewhere rather than any constructional or electronic fault; a few air vents over the two 10 W resistors might help.

```
                           ORG   7F64H
                 LPRT:     EQU   7F7AH
7F64 E5                    PUSH  HL
7F65 217A7F                LD    HL,LPRT
7F68 222640                LD    (4026H),HL
7F6B 21F37F                LD    HL,7FF3H
7F6E 221640                LD    (4016H),HL
7F71 212940                LD    HL,4029H
7F74 3648                  LD    (HL),48H
7F76 E1                    POP   HL
7F77 C37200                JP    0072H
                           ORG   7F7AH
7F7A F3                    DI
7F7B 79                    LD    A,C
7F7C FE0D        ENDLN:    CP    0DH
7F7E 2805                  JR    Z,RELOAD
7F80 FE20                  CP    20H
7F82 D8                    RET   C
7F83 1807                  JR    START
7F85 E5          RELOAD:   PUSH  HL
7F86 212940                LD    HL,4029H
7F89 3648                  LD    (HL),48H
7F8B E1                    POP   HL
7F8C F5          START:    PUSH  AF
7F8D E5                    PUSH  HL
7F8E C5                    PUSH  BC
7F8F 0609        AGAIN:    LD    B,09H
7F91 37                    SCF
7F92 F5                    PUSH  AF
7F93 F5                    PUSH  AF
7F94 2101FC                LD    HL,0FC01H
7F97 CD2102                CALL  0221H
```

```
7F9A 21DE00          LD   HL,00DEH
7F9D 2B      DLY1:   DEC  HL
7F9E 7C              LD   A,H
7F9F B5              OR   L
7FA0 20FB            JR   NZ,DLY1
7FA2 F1      ROUND:  POP  AF
7FA3 1F              RRA
7FA4 F5              PUSH AF
7FA5 300F            JR   NC,OUT1
7FA7 2102FC          LD   HL,0FC02H
7FAA 180F            JR   OUT2
7FAC 0E03    LNFD:   LD   C,03H
7FAE AF      CRTN:   XOR  A
7FAF 0D              DEC  C
7FB0 2802            JR   Z,ZERO
7FB2 18DB            JR   AGAIN
7FB4 182D    ZERO:   JR   OUT4
7FB6 C600    OUT1:   ADD  A,00H
7FB8 2101FC          LD   HL,0FC01H
7FBB CD2102  OUT2:   CALL 0221H
7FBE 21DE00          LD   HL,00DEH
7FC1 2B      DLY2:   DEC  HL
7FC2 7C              LD   A,H
7FC3 B5              OR   L
7FC4 20FB            JR   NZ,DLY2
7FC6 10DA            DJNZ ROUND
7FC8 11DE00          LD   DE,00DEH
7FCB CB4A            BIT  1,D
7FCD 280B            JR   Z,OUT3
7FCF 2102FC          LD   HL,0FC02H
7FD2 CD2102          CALL 0221H
7FD5 1B      DLY3:   DEC  DE
7FD6 7A              LD   A,D
7FD7 B3              OR   E
7FD8 20FB            JR   NZ,DLY3
7FDA F1      OUT3:   POP  AF
7FDB F1              POP  AF
7FDC FE0D            CP   0DH
7FDE 28CC            JR   Z,LNFD
7FE0 B7              OR   A
7FE1 28CB            JR   Z,CRTN
7FE3 C1      OUT4:   POP  BC
7FE4 212940          LD   HL,4029H
7FE7 35              DEC  (HL)
7FE8 2006            JR   NZ, OUT5
7FEA E1              POP  HL
7FEB F1              POP  AF
7FEC 3E0D            LD   A,0DH
7FEE 1895            JR   RELOAD
7FF0 E1      OUT5:   POP  HL
7FF1 F1              POP  AF
7FF2 C9              RET
                     ORG  7FF3H
7FF3 CDE303          CALL 03E3H
7FF6 67              LD   H,A
7FF7 015000          LD   BC,0050H
7FFA CD6000          CALL 0060H
7FFD 7C              LD   A,H
7FFE C9              RET
                     END
```

Fig 5 Assembler listing of the print driver software. The section from 7F64H to 7F79H initialises the driver addresses (a keyboard delay is incorporated in the program). The print routine is from 7F7AH to 7FF2H and the section from 7FF3H onwards is the keyboard delay for key debouncing and slowing down the scrolling speed.

```
2 FOR I=32634 TO 32766:READ J:POKE I,J:NEXT:POKE 16422,122:POKE 16423,1
27:FOR N=16480 TO 16488:READJ:POKEN,J:NEXT:POKE 16526,96:POKE16527,64:P
RINT USR(0)
3 CLS:PRINT@335,"PLEASE ENTER CHARACTERS/LINE (UP TO 80)";:INPUT C:POKE
 32629,C:POKE 32650,C:PRINTTAB(15)"PLEASE ENTER DELAY (0 TO 255)";:INPU
T C:POKE 32761,C
5 REM NEW PROGRAM STARTS HERE
5000 DATA243,121,254,13,40,5,254,32,216,24,7,229,33,41,64,54,72,225,245
,229,197,6,9,55,245,245,33,1,252,205,33,2,33,222,0,43,124,181,32,251,24
1,31,245,48,15,33,2,252,24,15,14,3,175,13,40,2,24,219,24,45,198,0,33,1,
252,205,33,2,33,222,0,43,124
5001 DATA181,32,251,16,218,17,222,0,203,74,40,11,33,2,252,205,33,2,27,1
22,179,32,251,241,241,254,13,40,204,183,40,203,193,33,41,64,53,32,6,225
,241,62,13,24,149,225,241,201,205,227,3,103,1,80,0,205,96,0,124,201,229
,33,243,127,34,22,64,225,201
```

Fig 6 The serial printer and delay routine in Basic. The conversion from machine code to the DATA lines was done using a short program from A J Harding.

PCW SubSet, continued from page 91

```
        LD    (DE),A   ; character zero            12
        RET            ; and return                C9
BFSN2:  RLD            ; get high nibble (HL) in A ED 6F
        CP    30H      ; check if zero             FE 30
        CALL  Z,BFSN3  ; if so check last ASCII    CC YY YY
        LD    (DE),A   ; store ASCII               12
        INC   DE       ; point to next destination 13
        SET   4,A      ; restore high nibble of A  CB E7
        RET            ; and return                C9
BFSN3:  DEC   DE       ; point to previous ASCII   1B
        LD    A,(DE)   ; get it in A               1A
        CP    20H      ; check if space            FE20
        INC   DE       ; point to current destination 13
        RET   Z        ; return if space           C8
        LD    A,30H    ; else put zero in A        3E 30
        RET            ; and return
```

Datasheet

```
;= ASCN0 — ASCII to 16-bit binary conversion
;/ "ASCN0"  — level 0, class 2
;/          — level 1, class 1 if NUMCH and CMPL are separate
;/                     routines in the library
;/ TIME CRITICAL?: No
;/ Converts a string of ASCII characters, in the range +32767
;/ to —32767, into a 2s complement binary number. The string
;/ may be preceded by a + or — sign and is terminated by any
;/ character outside the range 30H to 39H. If there is no sign,
;/ a positive number is assumed.
;/ ACTION:     HL    zero
;/             A     (DE)          repeated
;/             HL    10*HL +A      until A
;/             DE    DE + 1        non-numeric
;/ INPUT: DE points to the first character of an ASCII string
;/ OUTPUT: If the ASCII string is valid, the 2s complement
;/         equivalent is in HL and the carry is set.
;/         If the first character of the ASCII string (after
;/         any sign) is not numeric HL = 1 and the carry is set.
;/         If overflow occurs, there is a jump to an error
;/         routine (not provided).
;/ REGs USED: AF, DE, BC and HL
;/ STACK USE: 4
;/ LENGTH:    61
;/ SUBr DEPENDENCE: None or
;/                  NUMCH, CMPL and ERR1 when they are separate
;/                  routines in the library
;/ INTERFACES: None
;/ 8080 COMPATIBLE? No
ASCN0:  LD    A,(DE)    ; get first character   1A
        CP    "+                                 FE 2B
        JR    Z,AN1                              28 08
        CP    "—                                 FE 2D
        JR    NZ,AN2                             20 05
        LD    HL,CMPL   ; if —ve no.             21 YY YY
        PUSH  HL        ; return through CMPL    E5
AN1:    INC   DE                                 13
AN2:    LD    HL,1      ; default = 1            21 01 00
        CALL  NUMCH                              CD YY YY
        RET   C         ; if not number          D8
        LD    L,H       ; HL = 0                 6C
AN3:    CALL  NUMCH                              CD YY YY
        RET   C                                  D8
```

```
            INC     DE                                13
            ADD     HL,HL                             29
            ADD     A,L                               85
            LD      C,A                               4F
            LD      A,H                               7C
            ADC     A,0                               CE  00
            LD      B,A      ; BC = 2*HL + number     47
            ADD     HL,HL                             29
            OR      H                                 B4
            ADD     HL,HL    ; 8*HL                   29
            OR      H                                 B4
            ADD     HL,BC    ; 10*HL + number         09
            OR      H        ; bit 7, A=1=overflow    B4
            JP      M,ERR1                            FA  YY  YY
            JR      AN3                               18  E9
;NUMCH      CHAR    IN   (DE) TO NUM IN A,CY=NONE
NUMCH:      LD      A,(DE)                            1A
            SUB     30H      ; <'0'?                  D6  30
            RET     C        ; if yes                 D8
            CP      0AH      ; >'9'?                  FE  0A
            CCF              ; set CY if not numeric  3F
            RET                                       C9
;CMPL       2s COMPLEMENTS HL
CMPL:       LD      A,L                               7D
            CPL                                       2F
            LD      L,A                               6F
            LD      A,H                               7C
            CPL                                       2F
            LD      H,A                               67
            INC     HL                                23
            RET                                       C9
;ERR1       YOUR OWN OVERFLOW ROUTINE, eg:
ERR1:       RST     28H      ; to Nascom monitor to   EF
            DEFM    /Overflow/ ; output message       4F  76  65  72
                                                      66  6C  6F  77
            DEFB    00H                               00
            RET              ; and return
```

Calculator Corner-continued from page 99.

pseudo Op code in order to save memory usage, as these instructions (entered in Learn mode only by – RCL 82; RCL 04 (or 14) then deleting both the RCL Ops) put the value in the display register into, or extract it from, one or other of the eight pending operation stack registers, first ensuring that some other arithmetic function is not already there! The number entered is therefore stored temporarily in stack register No 4. Before starting, of course, the data register to be used in this sequence must have been loaded into data register No 00, and the three letter sequence, in this case /FT with code 632137 , and this is entered beforehand as .000632137 and stored in the Data register whose number has been placed in register No 00.

Program steps 012 to 023 pull out the contents of this register and split off the alpha coding making it an integral value using the subroutine D'. Steps 024 to 031 use the machine's facility to annotate a printed result with up to four alpha characters following the printed value. In this case I have chosen to print the value to the second place of decimals, and this restricts the annotation to three letters. For convenience I have included the INV FIX instruction to return the calculator to standard mode. The next series of steps reforms the numerical value to three places of decimals and combines it with the print code before replacing the whole bag of tricks back in the selected data register. I have also printed out the final contents of the data register and it can be seen that, depending on the number of digits in the numerical part, all or some of the alpha coding is visible. At any time the coding may be made visible by using the INV Int instruction.

Where memory capacity is under pressure the small additional program overhead of some 40 steps can be beneficial.

PROGRAMS

PET SKI

by Jeff Aughton

We suggest that some PETs will need a change in line 155. Change the value of K to 151.

```
100 REM SKI - BY J.AUGHTON
105 REM
110 REM IN THE PRINT STATEMENT IN LINE
115 REM 330 THE 3RD,4TH,9TH,10TH
```

```
120 REM CHARACTERS MUST BE SHIFTED
125 REM SPACES
130 REM
135 REM FOR A SLIGHTLY HARDER COURSE:
140 REM IN=.05:C2=6.2:C3=4.4:C4=5.8
145 REM REST STAY THE SAME
150 REM
155 GN=17:R=15:IN=.09:K=515:CR=88
160 INPUT"WANT THE RULES";A$
170 IFLEFT$(A$,1)="Y"THENGOSUB640
180 PRINT"RATE YOURSELF AS A SKIER"
190 PRINT"0=DUMMY....10=KLAMMER"
200 INPUT"YOUR RATING";SK
210 IFSK<0THENSK=0
220 IFSK>10THENSK=10
230 SK=(SK+1)/20
240 C1=14.5:C2=6.3:C3=5.1:C4=1.9
250 NG=GN+1:SP=40:X=0:P=32788
260 H=0:G=0:Z=0
270 PRINT"ON YOUR MARKS";
280 TS=TI+1030-320*SK
290 T=TI
300 Y=INT(C1+C2*SIN(X)+C3*SIN(C4*X))
310 Z=Z+1:IFZ<RTHEN340
320 Z=0:NG=NG-1:IFNG=0THEN500
330 PRINTTAB(Y)"..  ⊦  ⊣  ..":GOTO350
340 PRINTTAB(Y)"..          .."
350 IFPEEK(P)>50THENG=G+1
360 IFPEEK(P)=46THEN450
370 POKEP,8:SP=SP-SK
380 IFPEEK(K)=42THEND=-1:GOTO420
390 IFPEEK(K)=41THEND=1:GOTO420
400 IFTI-T<SPTHEN380
410 X=X+IN:GOTO290
420 POKEP,32:P=P+D
430 IFPEEK(P)=46THEN450
440 POKEP,8:GOTO400
450 POKEP,42:H=H+1:SP=40
460 GOSUB950
470 D=-5:IFPEEK(P+10)=46THEND=5
480 IFNGTHEN420
490 GOTO610
500 PRINTTAB(Y)"   FINISH   ";
510 T=TI:POKEP,32:P=P+40
520 IFPEEK(P)=46THEN450
530 IFPEEK(P)>120THEN960
540 IFPEEK(P)>50THENG=G+1
550 POKEP,8:SP=SP-SK
560 PRINT"  ";.1*INT((TI-TS)/6)
570 IFPEEK(K)=42THEND=-1:GOTO610
580 IFPEEK(K)=41THEND=+1:GOTO610
590 IFTI-T<SPTHEN560
600 GOTO510
610 POKEP,32:P=P+D
620 IFPEEK(P)=46THEN450
630 POKEP,8:GOTO590
640 PRINT""TAB(13)"OLYMPIC SKI RUN"
650 PRINT"YOU ARE THE H AT THE ";
660 PRINT"TOP OF THE SCREEN."
670 PRINT"YOU SKI DOWN THE COURSE ";
680 PRINT"USING THE KEYS:-"
690 PRINT"  4  TO MOVE LEFT"
700 PRINT"  6  TO MOVE RIGHT"
710 PRINT"HOLD THE KEY DOWN FOR";
720 PRINT" GREATER MOVEMENT."
730 PRINT"OTHER KEYS HAVE NO EFFECT
740 GOSUB920
750 PRINT"THERE ARE";GN;"GATES ALO";
760 PRINT"NG THE COURSE AND YOU MU";
770 PRINT"ST PASS BETWEEN THE FLAGS";
780 PRINT" WITHOUT TOUCHING THEM."
790 PRINT"MISSING A GATE OR HITTING";
800 PRINT" A FLAG INCURS A 5-SECON";
810 PRINT"D PENALTY WHICH IS ADDED";
820 PRINT" TO     YOUR FINAL TIME."
830 GOSUB920
840 PRINT"AS YOU MOVE DOWN THE COU";
850 PRINT"RSE YOU WILL     ACCELERA";
860 PRINT"TE . HOWEVER,IF YOU CRASH";
870 PRINT" YOU    INCUR A SMALL TIM";
880 PRINT"E PENALTY  AND  YOU     ";
890 PRINT"RESTART FROM THE MIDDLE ";
900 PRINT"OF THE COURSE AT A SLOWER";
910 PRINT" SPEED.":RETURN
920 PRINT"PRESS SPACE TO CONTINUE
930 GETA$:IFA$<>" "THEN930
940 RETURN
950 FORJ=0TO1500:NEXT:RETURN
960 T=.1*INT((TI-TS)/6)+5*G
970 GOSUB950:PRINT"COURSE COMPLETE"
980 PRINT"YOU CRASHED";H;"TIME/S"
990 PRINT"YOU MISSED ";G;"GATE/S"
1000 PRINT"YOUR FINAL TIME WAS";T
```

```
1010 POKE525,0:IFT>CRTHEN1040
1020 PRINT"▒A NEW COURSE RECORD!!!
1030 CR=T:GOTO1050
1040 PRINT"▒COURSE RECORD STILL";CR
1050 INPUT"▒▒AGAIN▒▒▒▒▒▒▒";A$
1060 IFLEFT$(A$,1)="Y"THEN180
1070 PRINT"▒BYE-EE"
```

MZ-80K Bouncing ball

by Norman Webster

This is an infuritating program which involves catching balls as they are fired from a series of holes at the bottom of the screen. Each hole has a number corresponding to the key to be pressed in order to catch the ball.

```
10 REM Bouncig Ball Game
20 PRINT"▒▒▒▒▒▒"
30 PRINTTAB(10);"**********************"
40 PRINTTAB(10);"*                    *"
50 PRINTTAB(10);"*  Bouncing Ball     *"
60 PRINTTAB(10);"*                    *"
70 PRINTTAB(10);"**********************"
80 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒HI SCORE  ";T
85 FOR I=1TO2500:NEXT
90 GOSUB 3000
100 PRINT"▒▒▒When ready to start press"
110 PRINTTAB(12);"▒the S key"
150 GET A$:IF A$="" THEN 150
160 IF A$="S" THEN USR(62):GOTO 200
170 GOTO 150
200 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
220 PRINTTAB( 5);"└─┴─┴─┴─┴─┴─┴─┴─┴─┴─┘"
230 PRINTTAB(5);"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
240 PRINT TAB(5);"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒"
250 PRINT TAB(5);" 1  2  3  4  5  6  7  8  9  0"
900 T=0
1000 FOR L=1 TO 20
1010 PRINT"▒▒▒▒▒▒▒SCORE ";T,"HI SCORE ";TH
1020 I=INT(RND(1)*100/10)
1030 ON I GOTO 1040,1045,1050,1055,1060,1065,1070,1075,1080
1035 C=33:GOTO 1130
1040 C=6:GOTO 1130
1045 C=9:GOTO 1130
1050 C=12:GOTO 1130
1055 C=15:GOTO 1130
1060 C=18:GOTO 1130
1065 C=21:GOTO 1130
1070 C=24:GOTO 1130
1075 C=27:GOTO 1130
1080 C=30:GOTO 1130
1095 C=21:GOTO 1130
1130 D$=STR$(I)
1200 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒";TAB(C);"*";
1210 FOR K=4 TO 1 STEP-1
1220 FOR J=S TO 1 STEP-1
1230 GET C$
1240 IF C$=D$ THEN T=T+K*J:USR(62):GOTO1280
1250 NEXT J
1260 IF K<3 THEN PRINT"▒ ▒▒*";:GOTO 1270
1261 PRINT"▒ ▒▒*";
1270 NEXT K
1280 PRINT"▒ "
1290 NEXT L
1300 IF TH<T THEN TH=T
1400 PRINT"▒▒▒▒▒▒▒▒▒▒▒";TAB(13);"GAME OVER"
1500 PRINT"▒▒▒▒";TAB(5);"SCORE ";T,"HI SCORE ";TH
1600 PRINT"▒▒▒▒▒▒▒▒▒Do you want another game ?"
1700 PRINT"▒▒▒▒▒▒▒▒Key Y for YES , N for NO";
1800 GET E$:IF E$="" THEN 1800
1900 IF E$="Y" THEN GOTO 20
1950 IF E$="N" THEN GOTO 2000
1955 GOTO 1800
2000 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒GOODBYE    "
2020 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒"
2030 STOP:END
3000 PRINT"▒▒▒▒          Degree of Difficulty"
3001 PRINT"          ____________________"
3002 PRINT"▒▒▒▒▒The object of the game is to"
3003 PRINT"▒▒▒▒catch the ball whilst itis still"
3004 PRINT"▒▒▒▒in the air."
3005 PRINT"▒▒▒▒There are three levels of difficulty"
3006 PRINT"▒▒▒▒▒▒▒▒▒▒▒1. Most difficult
3007 PRINT"▒▒▒▒▒▒▒▒▒▒▒2. Average"
3008 PRINT"▒▒▒▒▒▒▒▒▒▒▒3. Easiest"
3009 PRINT"▒▒▒▒▒Enter your selection now"
3010 GET S$:IF S$="" THEN 3010
3015 ON VAL(S$) GOTO 3020,3030,3040
```

```
3020 S=VAL(S$)*5   :GOTO 3050
3030 S=VAL(S$)*5   :GOTO 3050
3040 S=VAL(S$)*5   :GOTO 3050
3050 PRINT"▒                                        "
3060 RETURN
```

Superboard/UK101 Bug bypass

by Roger Derry

Officially, to associate a character string with a number, it is necessary to set up a string array and fill it via the usual READ and DATA statements. The disadvantages of this approach are twofold: first, the text appears twice in memory, and second, there is a bug in the garbage collection routine which causes these machines to hang up very easily when string arrays are used.

This program demonstrates a way of accessing the individual DATA statements without using string arrays. The secret lies in the fact that locations 143 and 144 contain the address of the next DATA statement. It becomes a simple matter to READ through the DATA list loading some or all of the DATA addresses into numeric variables. If these are subscripted then the addresses may be manipulated just like string variables but slower and using less memory. By POKEing 143 and 144 with the appropriate values DATA can be READ in any sequence, even backwards.

```
100 REM PROGRAMMABLE RESTORE DEMO.PROGRAM
110 REM ROGER DERRY
120 REM JULY 1980
125 :
126 :
127 REM INITIALIZE NUMERIC ARRAYS
128 :
130 DIM D(7,1),M(12,1)
136 :
137 REM D= DAYS OF WEEK  M= MONTHS OF YEAR
138 :
140 FOR X=1 TO 7
150 D(X,0)=PEEK(143):D(X,1)=PEEK(144)
160 READ A$
170 NEXT
175 :
180 FOR X=1 TO 12
190 M(X,0)=PEEK(143):M(X,1)=PEEK(144)
200 READ A$:NEXT
201 :
205 PRINT"ENTER 0 TO PRINT MONTHS BACKWARDS OR
210 INPUT "ENTER DAY (1-7) ";D
215 IF D=0 THEN 2000
220 IF D<1 OR D>7 THEN 210
222 :
225 INPUT "ENTER MONTH (1-12)";M
230 IF M<1 OR M>12 THEN 225
235 :
240 POKE 143,D(D,0):POKE 144,D(D,1)
250 READ D$
255 :
260 POKE 143,M(M,0):POKE 144,M(M,1)
270 READ M$
275 :
280 PRINT:PRINT:PRINTD$,M$
290 PRINT:PRINT:GOTO 210
300 :
301 :
1000 DATA SUNDAY,MONDAY,TUESDAY,WEDNESDAY,THURDAY,FRIDAY,SATURDAY
1010 DATA JANUARY,FEBRUARY,MARCH,APRIL,MAY,JUNE
1020 DATAJULY,AUGUST,SEPTEMBER,OCTOBER,NOVEMBER,DECEMBER
1500 :
1501 :
2000 PRINT:PRINT:REM  PRINT MONTHS BACKWARDS!
2005 POKE 16,30:REM SET WIDTH FOR COMMA SPACING
2010 FOR X=12 TO 1 STEP -1
2020 POKE 143,M(X,0):POKE 144,M(X,1)
2030 READ M$:PRINTM$,
2040 NEXT
2050 PRINT:PRINT:PRINT
2060 GOTO 210
```

PET Replace

by Trevor Lusty

Do you like those multiplication puzzles in which each digit is replaced by a letter of the alphabet? If you do you'll love this program — it generates such puzzles till the cows come home.

```
1000 REM"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒
1020 REM"▒                           ▒
1040 REM"▒ "REPLACE"                 ▒
1060 REM"▒                           ▒
1080 REM"▒ TREVOR LUSTY    25/6/1980 ▒
1100 REM"▒                           ▒
1120 REM"▒    A MULTIPLICATION GAME  ▒
1140 REM"▒ WHERE ALL THE DIGITS ARE  ▒
```

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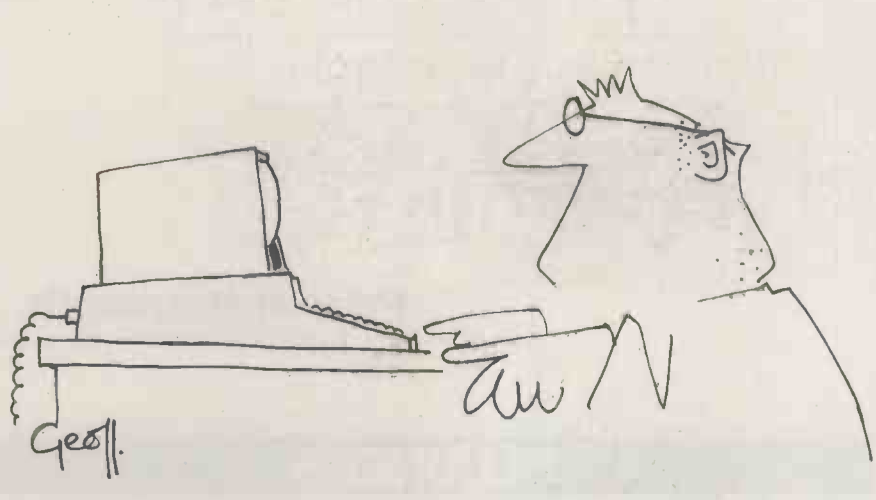
```
1160 REM"* REPLACED BY LETTERS.      *
1180 REM"*                            *
1200 REM"
1220 GOSUB 2540:GOSUB 2700
1240 U=0:T1=0:POKE 59468,12
1260 PRINT "□ HOLD IT! --- PROBLEM SETTING."
1280 FOR I=0 TO 10:E$(I)="":K$(I)="":Q$(I)="":K(I)=-1:K1(I)=-1:NEXT I
1300 GZ=0:W=0:F$=" ":C$="ABCDEFGHIJ":FQ$=" 1234567890"
1320 R=INT(LEN(C$)*RND(1)+1):N$=MID$(C$,R,1):F$=F$+N$:T$=""
1340 IF R>1 THEN T$=LEFT$(C$,R-1):GOTO 1360
1360 C$=T$+MID$(C$,R+1):IF LEN(C$)>0 THEN 1320
1380 REM *** WORK OUT THE SUM ***
1400 N(0)=100+INT(900*RND(1))
1420 IF N(0)/10=INT(N(0)/10) THEN 1400
1440 N(1)=10+INT(90*RND(1))
1460 IF N(1)/10=INT(N(1)/10) THEN 1440
1480 N(2)=N(0)*(N(1)-10*INT(N(1)/10))
1500 N(3)=N(0)*INT(N(1)/10)
1520 N(4)=N(0)*N(1)
1540 REM *** REPLACE WITH LETTERS ***
1560 FOR X=0 TO 4:B=0:EQ$(X)="":E$(X)="":FOR Y=1 TO 5
1580 A=INT(N(X)/INT(10↑(5-Y)+.5)):C=A-10*B:B=A
1600 E$(X)=E$(X)+MID$(F$,C+1,1)
1620 EQ$(X)=EQ$(X)+MID$(FQ$,C+1,1)
1640 NEXT Y:NEXT X:E$(3)=RIGHT$(E$(3),4)+" "
1660 EQ$(3)=RIGHT$(EQ$(3),4)+" "
1680 REM *** SORT OUT THE ZERO'S ***
1700 FOR X=0 TO 4:FL=0
1720 FOR Y=1 TO LEN(E$(X))
1740 IF MID$(E$(X),Y,1)<>" " THEN FL=1
1760 IF FL=0 OR MID$(E$(X),Y,1)<>" " THEN 1820
1780 E$(X)=LEFT$(E$(X),Y-1)+RIGHT$(F$,1)+RIGHT$(E$(X),5-Y)
1800 EQ$(X)=LEFT$(EQ$(X),Y-1)+RIGHT$(FQ$,1)+RIGHT$(EQ$(X),5-Y)
1820 NEXT Y:NEXT X
1840 REM *** PRINT THE PROBLEM AND ***
1860 REM *** INPUT THE NEXT GUESS. ***
1880 GOSUB 3880
1900 GOSUB 3300:IF F THEN PRINT:PRINT "□QUIT■              ":GOSUB 4000:END
1920 GZ=GZ+1:IF GZ>31 THEN GZ=0
1940 Z=ASC(Z$)-64:IF N<>K1(Z) THEN 1980
1960 M$="YOU ALREADY KNOW THAT":GOSUB 3760:GOTO 1900
1980 IF N<>K(N) THEN 2020
2000 M$=MID$(F$,N+1,1)+" = "+RIGHT$(STR$(N),1)+", TWERP■":GOSUB 3760:GOTO 1900
2020 IF Z$<>K$(Z) THEN 2060
2040 M$=Z$+" = "+RIGHT$(STR$(K1(Z)),1)+", TWERP■":GOSUB 3760:GOTO 1900
2060 IF Z$=Q$(N) THEN M$="YOU GUESSED THAT BEFORE":GOSUB 3760:GOTO 1900
2080 IF Z$=MID$(F$,N+1,1) THEN 2180
2100 W=W+1:M$="QQQ WRONG QQQ  THAT'S"+STR$(W)+" MISSES":GOSUB 3760:GOSUB 3880
2120 Q$(N)=Z$:GOTO 1900
2140 REM *** INSERT DIGIT AND ***
2160 REM *** CHECK FOR END.   ***
2180 N1=50:FOR X=0 TO 4:FOR Y=1 TO 5
2200 T$=MID$(E$(X),Y,1):M=ASC(T$):M1=M-64
2220 IF T$=" " THEN 2320
2240 IF T$<>Z$ THEN 2300
2260 E$(X)=LEFT$(E$(X),Y-1)+RIGHT$(STR$(N),1)+RIGHT$(E$(X),5-Y)
2280 K(N)=N:K$(M1)=Z$:K1(M1)=N:M=0
2300 IF M>N1 THEN N1=M
2320 NEXT Y:NEXT X
2340 IF N1<61 THEN 2380
2360 PRINT:GOTO 1880
2380 GOSUB 3880:PRINT "WELL DONE --- YOU GOT IT"
2400 PRINT "    MISSES =";W
2420 T1=T1+W:U=U+1
2440 PRINT "     AVERAGE=";T1/U
2460 PRINT "    ANOTHER GAME ? ";:GOSUB 3120
2480 IF A$="Y" THEN 1260
2500 PRINT:PRINT "BYE-BYE   HOPE YOU ENJOYED IT■         "
2520 PRINT "                                          ":END
2540 REM *** TITLE PAGE ***
2560 POKE 59468,14:PRINT "□"
2580 PRINT TAB(12);"          ■"
2600 PRINT TAB(12);" REPLACE ■"
2620 PRINT TAB(12);"          ■"
2640 PRINT "";TAB(16);"BY"
2660 PRINT "";TAB(11);"TREVOR LUSTY"
2680 RETURN
2700 REM *** INSTRUCTIONS ***
2720 PRINT "     DO YOU WANT INSTRUCTIONS■ ? ";
2740 GOSUB 3120:IF A$<>"Y" THEN RETURN
2760 PRINT "□ REPLACE WILL PRESENT YOU WITH A"
2780 PRINT "MULTIPLICATION PROBLEM WHICH HAS DIGITS"
2800 PRINT "REPLACED BY LETTERS."
2820 PRINT "   FOR EXAMPLE :-"
2840 PRINT "       D F B            4 6 2"
2860 PRINT "     X G I            X  7 9"
2880 PRINT "     _______          _______"
2900 PRINT "     D A E H          4 1 5 8"
```

```
2920 PRINT "     C B C D J          3 2 3 4 0"
2940 PRINT "     _________          _________"
2960 PRINT "     C F D I H          3 6 4 9 8"
2980 PRINT "     _________          _________"
3000 PRINT "▣   HERE THE LETTER A IS 1, B IS 2 ETC."
3020 PRINT "▣▣   TO ENTER A GUESS JUST TYPE A LETTER"
3040 PRINT "NUMBER PAIR IN ANY COMBINATION, IE. C3"
3060 PRINT "AND 3C WILL BOTH WORK.  ENTER 'Q' TO"
3080 PRINT "QUIT, AND THE SOLUTION WILL APPEAR."
3100 GOSUB 3260:POKE 59468,12:RETURN
3120 REM *** GET A CHARACTER ***
3140 PRINT "▣ ▮";:FOR I=1 TO 200:NEXT I
3160 PRINT "■ ▮";:FOR I=1 TO 200:NEXT I
3180 GET A$:IF A$="" OR A$=CHR$(13) THEN 3140
3200 IF A$="⌉" OR A$="▣" THEN 3140
3220 IF A$="⌉" OR A$="▣" THEN 3140
3240 RETURN
3260 PRINT "▣▣   ▣PRESS A KEY TO CONTINUE■";
3280 GOSUB 3120:RETURN
3300 REM *** ACCEPT GUESS ***
3320 REM *** 2 CHARACTERS ***
3340 F=0:Z$="@":N=-1
3360 PRINT "YOUR GUESS:     ▮▮▮▮";
3380 FOR K=1 TO 2
3400 GOSUB 3120:PRINT A$;
3420 IF A$="Q" THEN F=1:RETURN
3440 REM *** SORT Z$ AND N ***
3460 IF A$>"@" THEN Z$=A$:GOTO 3500
3480 N=ASC(A$)-48
3500 NEXT K
3520 REM *** CHECK VALIDITY ***
3540 IF N<0 OR N>9 THEN 3680
3560 IF N=0 THEN N=10
3580 IF Z$<"A" OR Z$>"J" THEN 3680
3600 PRINT:PRINT LEFT$("▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣",7+INT(GZ/8))
3620 NZ=N:IF NZ=10 THEN NZ=0
3640 PRINT TAB(INT(32*(GZ/8-INT(GZ/8))+1.5));NZ;"      ▮▮▮▮▮▮▮▮▮▮";Z$;
3660 PRINT LEFT$("TTTTTTTTTTTTTT",9+INT(GZ/8)):RETURN
3680 PRINT:PRINT "⌉ BAD LETTER OR NUMBER"
3700 FOR J=1 TO 500:NEXT J
3720 PRINT "⌉                              "
3740 PRINT "⌉";:GOTO 3340
3760 REM *** MESSAGE DISPLAY ROUTINE ***
3780 PRINT "▣▣";M$
3800 FOR J=1 TO 2000:NEXT J
3820 PRINT "⌉                                        "
3840 PRINT "TTTTT":RETURN
3860 REM *** DISPLAY PROBLEM ***
3880 PRINT "▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣ YOUR PREVIOUS GUESSES ARE GIVEN BELOW"
3900 PRINT "▣▣ REPLACE ■     MISSES =           ▮▮▮▮▮▮▮▮▮▮▮▮";W;"▣▣"
3920 FOR X=0 TO 4:FOR Y=1 TO 5
3940 PRINT MID$(E$(X),Y,1);" ";:NEXT Y:PRINT
3960 IF X=1 OR X=3 OR X=4 THEN PRINT "_________"
3980 NEXT X:PRINT:RETURN
4000 REM *** DISPLAY SOLUTION ***
4020 PRINT "▣▣ REPLACE ■                    ▣▣"
4040 FOR X=0 TO 4:PRINT TAB(20);:FOR Y=1 TO 5
4060 PRINT MID$(EQ$(X),Y,1);" ";:NEXT Y:PRINT
4080 IF X=1 OR X=3 OR X=4 THEN PRINT TAB(20);"_________"
4100 NEXT X:PRINT:RETURN
```



'Honestly it's different with you Norman, I've had other programmers who'd feed me anything just to get the right answer"

LEISURE LINES

by J J Clessa

Thanks possibly to the extended deadline, over 100 entries were received for Puzzle 12 and, embarrassingly, it seems there is more than one solution to the problem, as we hadn't considered using the ½p coin. So, here are the three solutions:
1. £1.20, £1.25, £1.50, £3.16
2. £1.12½, £1.28, £1.58, £3.12½
3. £1.18½, £1.20, £1.60, £3.12½

The winner, chosen by Tebbutt random methods, was Mr G Erskine of Perth (the Scottish one), with solution 3. Those binders will be with you soon, Mr Erskine.

Quickie

Some ducks are marching across a path. There's a duck in front of two ducks, a duck behind two ducks, and a duck in the middle of two ducks. What's the minimum number of ducks which could have been involved? As usual, no answers required and no prizes.

Prize puzzle

This one will get your micros ticking. Starting at the square marked 'Start' (logically), and moving either east, northeast or southeast each move (assume north is to the top of the grid), make 12 moves and reach the square marked 'Finish'.

Add up the numbers in the 11 squares traversed to give a total, A. Then repeat the performance, without entering any square used in the first move (except Start and Finish, of course), and add up the squares again to give total B.

The object is to find two routes which give the greatest difference in values between A and B. I want details of the two routes (eg Start-2-14-3-18 . . . etc), the two totals A and B and their overall difference, on a postcard (no letters, please) to: Puzzle 15, PCW, 14 Rathbone Place, London W1P 1DE, no later than 30 November.

						10						
					14	5	3					
				18	15	3	9	5				
			1	13	19	7	2	18	9			
		18	9	15	13	11	5	2	11	1		
	8	2	3	3	7	18	12	16	1	17	8	
START	2	14	3	18	7	5	14	6	4	9	17	FINISH
	2	9	8	2	19	14	18	2	18	15	1	
		18	18	5	7	9	19	16	10	8		
			1	14	2	2	16	2	5			
				2	13	17	13	13				
					6	2	9					
						13						

Prize of the month

Still boring, I'm afraid — it's a book token.

BLUDNERS

Only a couple this month, as far as we're aware. In the Computer Answer headed 'Routine Suggestion' in September, the first '±' in both lines 30 and 40 should have read '∓'. And the Microtype model 3 case pictured in that month's 'Newsprint' is for the Nascom 2, not 1.

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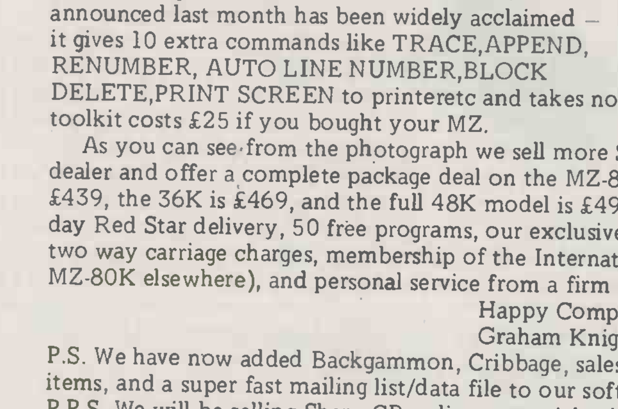

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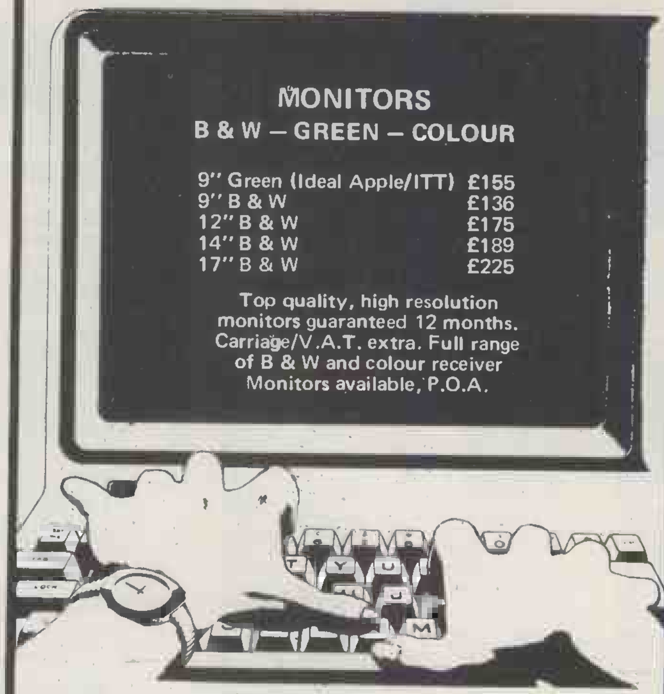

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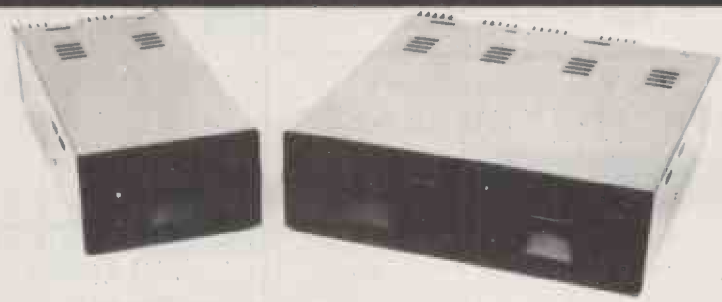

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BARCLAYCARD

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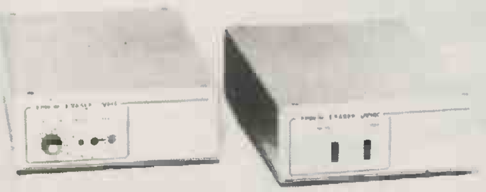
UV 140, UV 141



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Also available without timer as

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(Dimensions — 325 × 64 × 38mm)

EPROMPT ERASER: Price £33.56

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4006	95p	4045	£2.63	4098	£1.92	4415V	£5.24	4536	£3.69
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4013	50p	4052	80p	40105	£1.85	4462	£4.41	4552	£14.85
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4015	84p	4054	£2.18	40107	£1.28	4490VP	£3.14	4554	£1.38
4016	45p	4055	£2.55	40108	£7.54	4500	£6.95	4555	78p
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4020	99p	4062T	£10.00	40160	£1.54	4505	£5.71	4559	£4.38
4021	£1.10	4063	£1.90	40161	£1.54	4506	50p	4560	£2.50
4022	£1.00	4066	55p	40162	£1.54	4507	55p	4561	81p
4023	27p	4067	£7.21	40163	£1.54	4508	£2.90	4562	£5.60
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4025	27p	4069	27p	40181	£5.03	4511	£1.50	4568	£2.38
4026	£3.25	4070	30p	40182	£1.90	4512	80p	4569	£2.50
4027	50p	4071	25p	40192	£2.41	4514	£2.65	4572	40p
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4031	£4.31	4076	£1.07	40257	£2.31	4518	£1.00	4583	90p
4032	£1.31	4077	29p	4160	98p	4519	80p	4584	90p
4033	£2.63	4078	29p	4161	98p	4520	£1.00	4585	£1.27
4034	£2.00	4081	27p	4162	98p	4521	£2.50	4597	£2.44
4035	£1.10	4082	27p	4163	98p	4522	£1.11	4598	£2.98
4037	£1.99	4085	£1.35	4174	90p	4526	£1.08	4599	£6.95
4038	£1.20	4086	£1.35	4175	£1.15	4527	£1.50	4700	£1.75
4039	£2.78	4089	£2.91	4194	£1.16	4528	£1.20		
4040	£1.00	4093	80p	4408	£9.37	4529	£1.30		
4041	£1.59	4094	£2.50	4409	£9.37	4530	70p		

74C

74C00	28p	74C76	57p	74C163	£1.15	74C903	57p	74C925	£5.01
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74C08	28p	74C86	67p	74C173	93p	74C906	57p	74C928	£5.01
74C10	28p	74C89	£4.62	74C174	93p	74C907	57p	74C929	£17.90
74C14	90p	74C90	89p	74C175	93p	74C908	£1.00	74C930	£17.90
74C20	28p	74C93	89p	74C192	£1.15	74C909	£1.69		
74C30	28p	74C95	£1.08	74C193	£1.15	74C910	£7.45	80C95	85p
74C32	28p	74C107	£1.27	74C195	£1.08	74C911	£7.39	80C96	92p
74C42	95p	74C150	£3.81	74C200	£7.46	74C912	£7.39	80C97	85p
74C48	£1.43	74C151	£2.55	74C221	£1.41	74C914	£1.46	80C98	92p
74C73	57p	74C154	£3.81	74C245	£2.98	74C915	£1.15	82C19	£6.20
74C74	59p	74C157	£2.29	74C373	£1.79	74C918	£1.10	88C29	£2.90
		74C160	£1.49	74C374	£1.79	74C921	£17.07	88C30	£2.90
		74C161	£1.15	74C901	57p	74C922	£3.78		
		74C162	£1.15	74C902	79p	74C923	£3.86		

MODULATORS

UM1111 E36 UHF Ch.36 Vision Modulator	£2.50
UM1231 UHF Ch 36 Vision Modulator wide bandwidth (for computers etc)	£4.70
UM1263 FM Sound Sub carrier Modulator	£2.50

SWITCH MODE PSUs

AC 5221S 5V/10A	£69.90
AC 9221S 5V/5A, 12V/1A, −12V/1A, −5V/0.1A	£86.80
AC 5421S 5V/20A	£99.20
AC 9421S 5V/10A 12V/2A, −12V/2A, −5V 0.1A	£126.50

MICROPROCESSORS

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114 × 203 mm fibreglass, gold plated edge connector.

Buffered SC/MP CPU	£9.40
SC/MP Protoboard	£9.40
Z80 CPU card	£9.40
VDU "A" } set	£8.90
VDU "B" } of	£8.90
VDU "C" } three	£9.40
EPROM Programmer (2708s)	£9.40
4k PROM board (5204s)	£9.40
8k PROM board (2708s)	£9.40
2k RAM board (2102s) 1k-2k	£9.40
8k RAM board (2114s) 1k-8k	£9.40
Tape interface	£8.90
Keyboard interface	£8.90
PSU 5v, +12v, −12v board	£8.90
PSU 5v, −12v board	£5.50
ISBUS 11 13 slot backboard	£11.50

13" × 14½" approx. Epoxy Glass, tinned

Further details on request

Z80

Z80 CPU (2 MHz)	£9.90
Z80 CTC (2 MHz)	£5.95
Z80-PIO (2 MHz)	£6.60

(Add £1 for the 4MHz version of any of the above 3 chips)

SC/MP II RAM I/O

SC/MP II (4MHz)	£10
INS 8154 RAM I/O	£9.40

6800

6800 MPU	£6.55
6802 MPU	£9.95
6810 (128 × 8 RAM)	£3.25
68A10 (128 × 8 RAM)	£3.75
6820, 6821 PIA	£3.96
6850 ACIA	£4.85
MC6880	£2.64

6502

6502	£7.95
6520 PIA	£6.22
6522	£7.95

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COSMAC CDP 1802CE	£6.50
COSMAC CDP 1802E	£10.85
CDP 1864	£7.25

STATICS (Mostly 450nS)

2101—256 × 4	£2.25
2102—1K × 1	£1.20
2111—256 × 4	£1.95
2112—256 × 4	£2.25
2114 4045—1K × 4	£4.39
8 × 2114	£28.00
2114L—1K × 4	£5.50
4118—1K × 8	£15.50

DYNAMICS

MK 4116 16K 250nS	£4.95
MK 4816 2K × 8	£30.52

UV ERASABLES

5204 (512 × 8)	£11.50
2708 1K × 8	£6.75
2716/2516 2K × 8 single 5v	£17.95
2532 4K × 8 (5v)	£47.00
PROMWASHING each Prom	50p (+30p + VAT)

UV PROM ERASER

UV140	£61.20
UV141	£77.70

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81LS95/6/7/8	£1.40
75491 LED driver	50p
75492	89p
7N425	£3.95
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IL74	48p

CRT Controller; Uarts

Thompson CSF SF 96364E	£11.50
AY-5-1013 UART TR 1602	£4.00
AY-5-1013A	£4.70
AY-3-1014A	£5.60
AY-3-1015	£5.60

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MCM 66760	£9.75
MK 2302	£15.29
RO-3-2513 (5v Uppercase)	£6.00
DM 8678 CAB/BWF	£14.27
AY-5-2376	£9.75

FIRMWARE

ZMON for Z80 (1 × 2708)	£14.95
2K Tiny BASIC for Z80 (2 × 2708)	£19.95
4K NIBL for SC/MP (4 × 2708)	£49.95
4K NIBL ROM for SC/MP (4 × 2708)	£49.95
1K Various for SC/MP (1 × 2708)	£14.95

(Descriptive leaflet available on above, Ref SW4, 5)

1K Elektor Junior 1x2708	£19.95
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ETIBUG 1 (1 × 5204)	£14.95
ETIBUG 2 (1 × 5204)	£14.95
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1.8 MHz	£4.29
1.8432 MHz	£3.62
2.000 MHz	£3.62
2.097152 MHz	£3.23
2.4576 MHz	£3.62
2.500 MHz	£3.92
2.56250 MHz	£3.62
3.000 MHz	£3.62
3.2768 MHz	£3.62
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5.185 MHz	£3.23
6.000 MHz	£3.23
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6.400 MHz	£3.23
6.55360 MHz	£3.23
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10.000 MHz	£3.23
10.245 MHz	£3.23
10.700 MHz	£3.23
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11.000 MHz	£3.92
12.000 MHz	£3.92
14.0 MHz	£3.92
14.31818 MHz	£3.23
16.000 MHz	£3.23
18.000 MHz	£3.23
18.432 MHz	£3.23
20.000 MHz	£3.62
20.1134 MHz	£3.23
26.690 MHz	£2.10
27.0 MHz	£3.92
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NE555 556   29p/49p

OP-AMPS

(All Mini dips)

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CA 3140E	35p
UA 741 (Texas)	22p

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Multiplexed, common cathode prime quality.

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LED DISPLAYS

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DL-727E/728E	£2.00
DL-747E/750E	£1.80
FND 500/560	£1.20

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CLOCK CHIPS

AY-5-1224A	£2.60
MK 50253	£5.50
MK 50366	£6.50

SIX DECADE COUNTERS

MK 50395/6/7	£9.90
MK 50398/9	£7.50

DATA

Note: in this section all data books are subject to 0% VAT. For postage see 'Terms' at top of page.

113 page Electronic Projects Index 72-77 (North Tyneside Libraries)	£1.50
c650 page COSMOS Databook (RCA)	£4.95
c31 page 'A Guide to SC/MP Programming' by Dr. Drury (Kemitron)	£3.75
c20 page 'A Guide to Kitbug' (Kemitron)	75p
c24 page NIBL Reference Guide (National)	£3.45
Data for 4116 (Mostek)	50p
c6 page data for MK 4118	25p
16-page data for INS 8154 (ISP 8A 650) (National)	50p
20-page data for SC/MP II (National)	50p
c100 page CDP 1802 MPU User Manual (RCA)	£4.50
c45 page Fixed Point Binary Arithmetic Routines for COSMAC	£4.50
c31 page Floating Point Arithmetic Routines for COSMAC (listings excluded)	£4.50
c43 page COSMAC MPU Product Guide (RCA)	75p
c15 page CDP 1802 Instruction Summary	25p
c70 page Understanding CMOS (RCA)	£1.50
1 page COSMOS Pocket Selection Guide (RCA)	25p
c21 page COSMOS Digital Integrated Circuits (RCA)	75p

Z80 DATA PACK £14.95

This contains all the data we can obtain on the Z80 CPU and related chips, and the Z80 Programming Manual. Depending on our own supplier the data is either loose sheets photocopies or bound volumes or a combination of both. The weight of the set of data is about 1½ kilos, and some information on other processors, memories, and systems is often included

c50 page Finite State Fantasies (Cartoons putting programming on human level) (Matrix Press)	£2.00
c175 page Home Computers: Beginners Glossary and Guide by Miller and Sippl (Dilithium)	£4.95

74LS

		74LS27	28p	74LS76	40p	74LS125	60p	74LS163	£1.18	74LS240	£2.36	74LS283	£1.92	74LS375	£1.60
		74LS28	48p	74LS78	40p	74LS126	60p	74LS164	£1.14	74LS241	£2.32	74LS290	£1.28	74LS377	£2.12
74LS00	14p	74LS30	22p	74LS83	£1.15	74LS132	95p	74LS165	75p	74LS242	£2.32	74LS293	£1.28	74LS378	£1.84
74LS01	14p	74LS32	27p	74LS85	£1.18	74LS136	55p	74LS166	£2.26	74LS243	£2.32	74LS295	£1.85	74LS379	£2.15
74LS02	16p	74LS33	39p	74LS86	43p	74LS138	85p	74LS170	£2.88	74LS244	£1.70	74LS298	£1.68	74LS384	86p
74LS03	16p	74LS37	39p	74LS90	60p	74LS139	85p	74LS173	£1.05	74LS245	£3.50	74LS324	£2.40	74LS386	86p
74LS04	16p	74LS38	39p	74LS91	£1.04	74LS145	£1.08	74LS174	£1.06	74LS247	£1.90	74LS325	£2.90	74LS390	£2.30
74LS05	20p	74LS40	28p	74LS92	89p	74LS147	£1.70	74LS175	£1.10	74LS248	£1.90	74LS326	£2.94	74LS393	£2.30
74LS08	22p	74LS42	98p	74LS93	89p	74LS148	£1.73	74LS181	£3.98	74LS249	£1.90	74LS327	£2.86	74LS395	£2.18
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74LS13	38p	74LS54	28p	74LS112	55p	74LS156	96p	74LS193	£1.30	74LS259	£1.60	74LS365	65p	74LS447	£1.44
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74LS15	30p	74LS63	£1.50	74LS114	50p	74LS158	96p	74LS195	£1.36	74LS266	52p	74LS367	65p	74LS668	£1.82
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74LS21	22p	74LS74	41p	74LS123	70p	74LS161	98p	74LS197	£1.40	74LS275	£2.50	74LS373	£1.80	74LS670	£2.48
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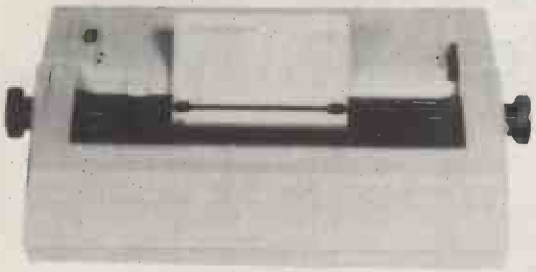
PRINTER SUPERMARKET

COMPLETE SYSTEMS



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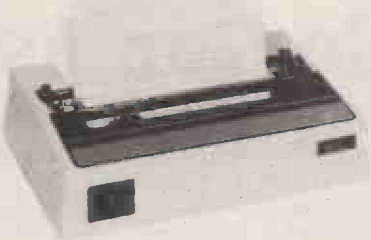

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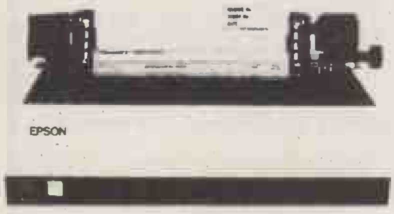

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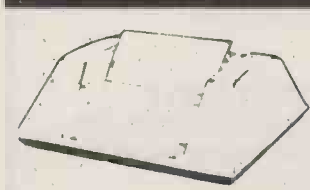

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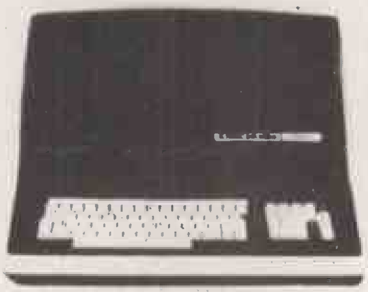

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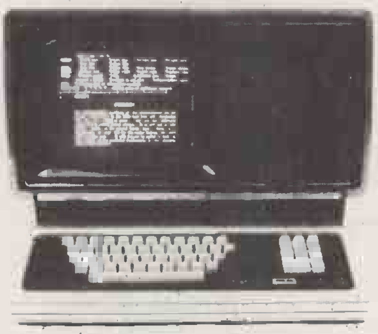

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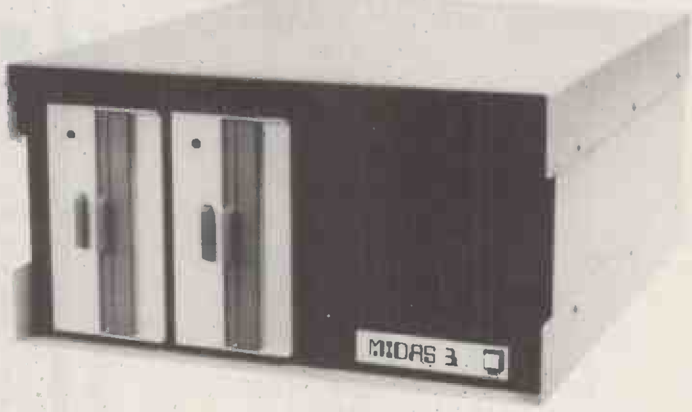

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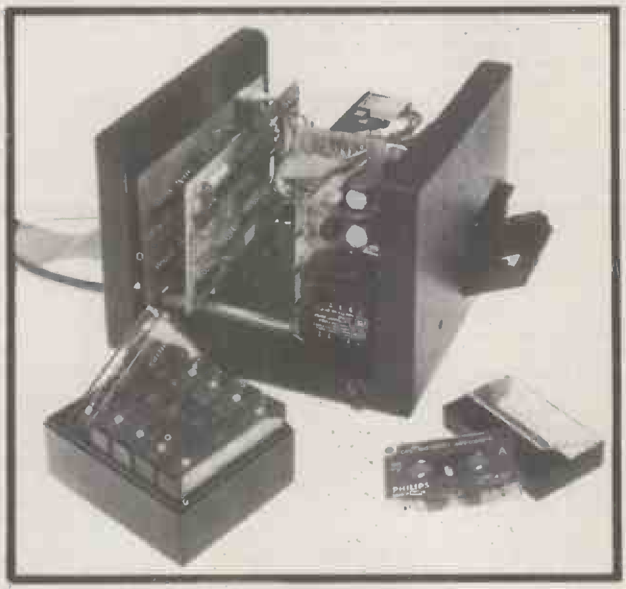

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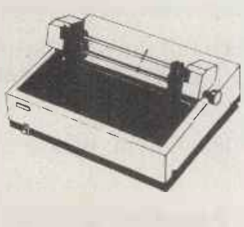

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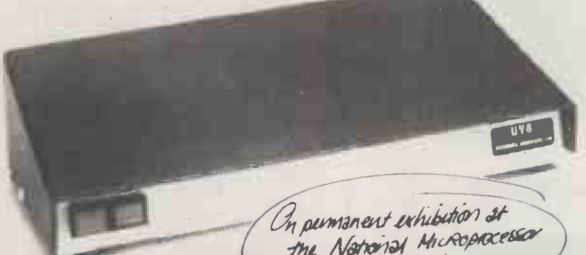

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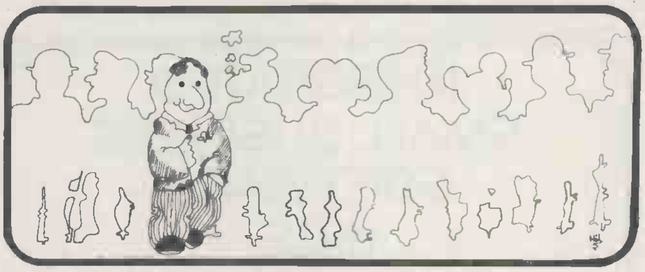

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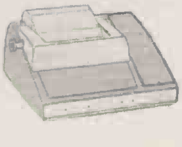

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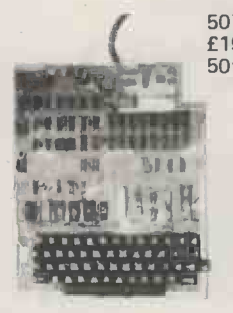

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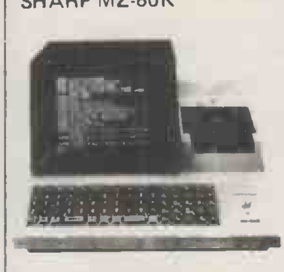

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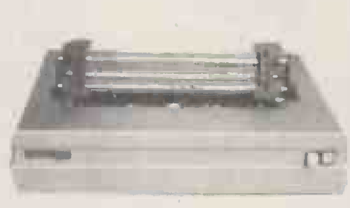

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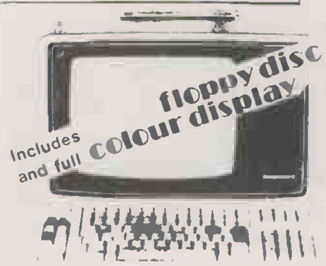

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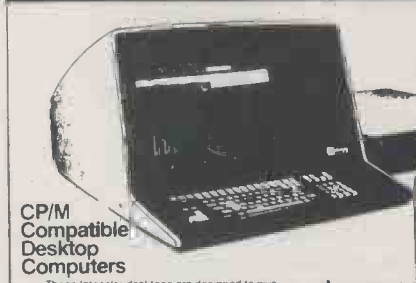

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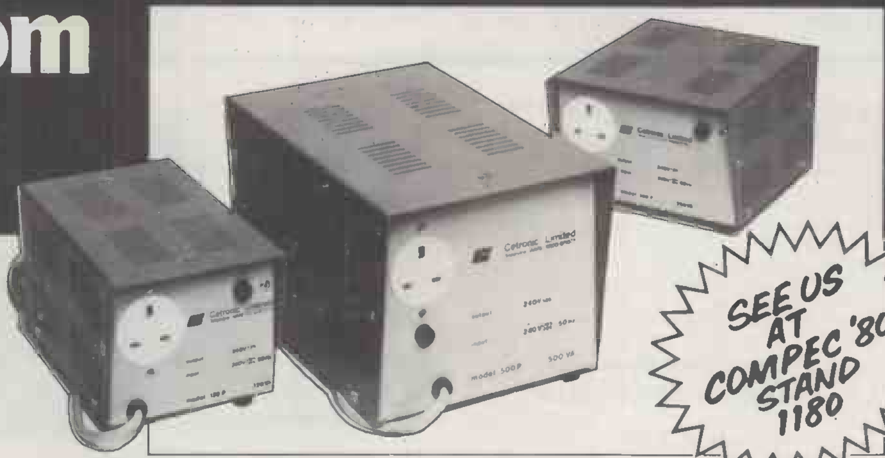

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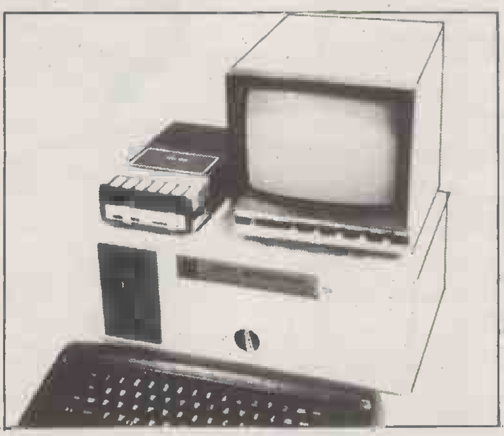

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In particular, thank you:–

– The gentleman who said "I had to come back to have another look at your boards, I couldn't believe that they were as good as I remembered them to be, but they areare!",

– The man from Newcastle who was kicking himself for having just sent £800 to America,

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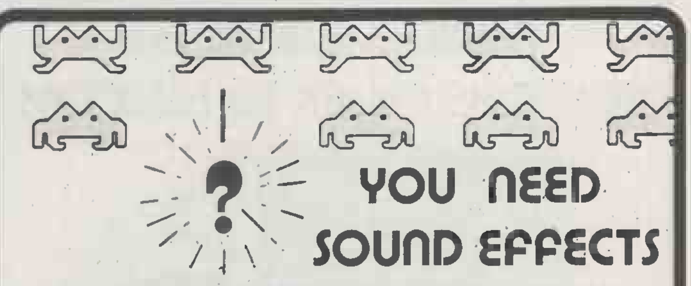

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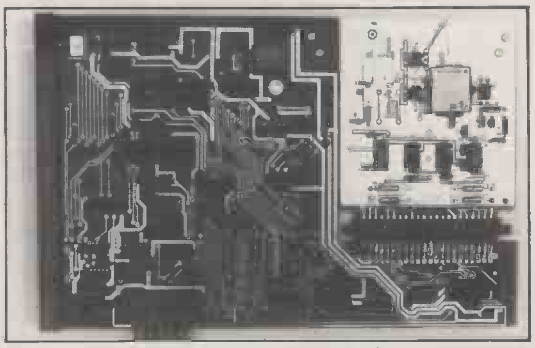

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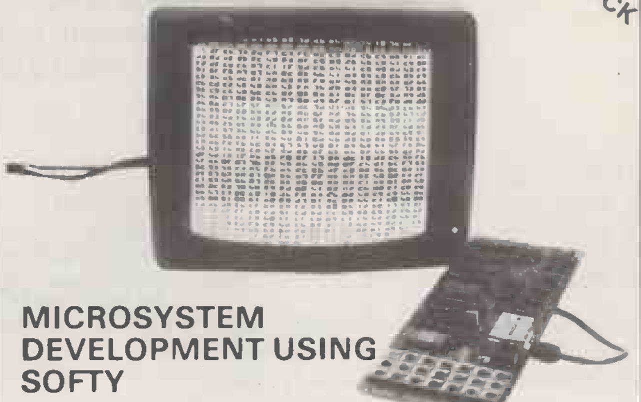

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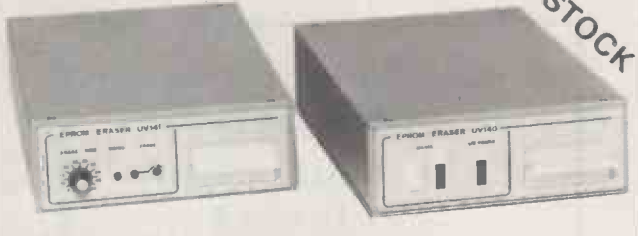

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ADVERTISERS INDEX

CHIP CHAT

Well, we had a great time at the PCW Show — and in fact everyone else seemed to enjoy it too. Comp Shop got off to a good start by secretly putting an advertising brochure into every single copy of PCW on our stand while our backs were turned. Unfortunately the brochures were slightly oversize and we noticed them sticking out. . . 'Bumper' Harris disgraced himself by spending all three days in the bar; he was last seen dancing on Hammersmith flyover with 'Legless' . . . Graham Clifton of Transam brightened his stand by wearing eccentric blue spectacles and promptly earned himself the nickname 'Elton'. . . But it was Comp Shop (again) who provided the last straw. With the show over and the hall cleared, organiser Tim Collins of Montbuild was relaxing in the bar when in rushed a distraught hotel manager, who dragged 'Timbo' back to the hall. In the centre of the hall, neatly parked on the carpet, was Comp Shop's van — our thanks to Angie for failing to deny this story. . . Coming soon, a micro system from Philips, to be marketed through its video division. . . Weekly rag *Datalink* has decided that PCW staff aren't involved in the computer industry and has purged us from its circulation list. Could this have anything to do with the recent appointment of 'Wise Guy' Kewney to *Datalink's* editorial chair? He seems very reluctant to put us back on the mailing list. . . 'Squire' Allason has recently lived up to his rural image by having his phone ploughed up. The 'Squire' was so upset at not being able to talk to anyone that he flew off to the States in a huff (or was it a 747?). . . Overheard recently in a Tandy shop, an enthusiastic salesmen trying to convince a punter that the RS in RS232 stands for 'Radio Shack'. . . Derek Hacker of Cream complains that we haven't mentioned him. Well there you are, Derek — you've been mentioned. Happy now? (Actually it was Derek who mended the CBM 8032 which we recently Benchtested, after it arrived dead). . . Would Derek Chown please write to us and let us know where we can contact him — he'll learn something to his advantage. . . Our thanks to Rodnay Zaks for reducing our workload — instead of sending us a copy of his recent tome on Z8000 programming he's sent us a review; surprisingly, it's quite favourable. . . Thanks also to the lovely but unpronouncable Ilona Uhl, Commodore's PR person, for her recent letter offering us a SuperPET to Benchtest. Commodore, meanwhile, persists in invoicing us for the SuperPET we had two months ago for this purpose, and which we returned within a fortnight . . . Margaret McLean of Computer Bookshop came to us with a great story for 'Chip Chat' but unfortunately she referred to this column as 'Tits and Bits'; the story was lost in gales of hysterical laughter from the Editor. . . We recently met Prestel's Richard Hooper, who immediately wanted to know why all personal computerists weren't using Prestel. We explained that British Telecom is scarcely helpful to those wishing to connect up their micros to the system; his instant reply was that anybody who runs into red tape problems should ring him personally. So get dialling. . .Finally, our congratulations to Editor Tebbutt and his wife Sylvie on the recent birth of their son Daniel John, their third child. David had time to notice that pre-delivery monitoring was done by an HP8030A with thermal printer and digital readouts. The young Daniel's Benchtest of the machine will appear next month.

Sharp has recently announced a new range of 'soft' peripherals for the MZ-80K. Pictured here is one Daniel Streeter demonstrating the twin teddies and RS232 fluffy duck interface.

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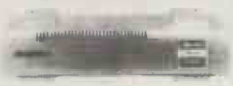

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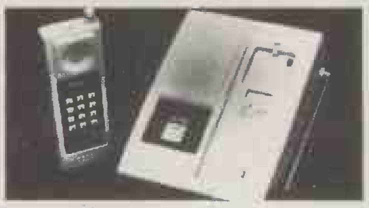

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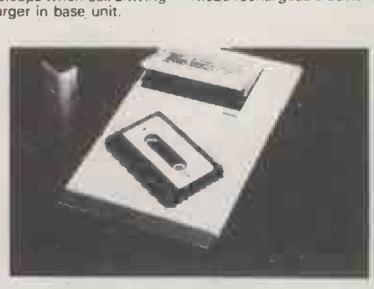

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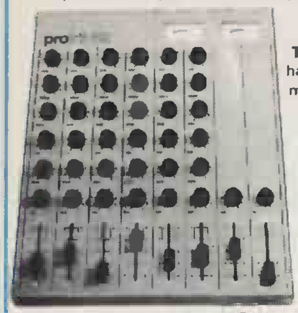

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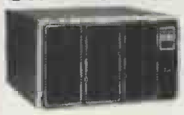

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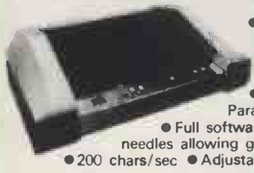

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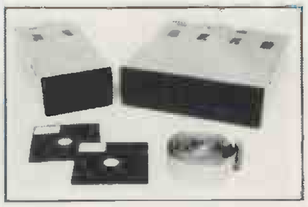

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