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The check's in the post!

Blunders lives! Well, none of us can be perfect in an imperfect world... perhaps it's all part of the fun. But, that said, the staff of PCW actually does spend a great deal of time checking — even triple checking — contributions, be they letters, programs or features.

As the magazine grows in maturity — and complexity — so, inevitably, it's a system that occasionally fails. In order to minimise these failures, PCW now intends to establish a team of referees willing to validate contributions; a fee will be paid according to the amount of effort involved in checking each particular work.

If you feel you might be able to help in some way, drop us a line, marking the envelope "referee". And please don't automatically accept that "there must be others better than me". In this particular game, accuracy, consistency and reliability are just as important as depth of knowledge.

Should your interests lie in programs, we'll need details of your machine configuration and relevant software. If it's hardware that turns you on, then we'd be willing to validate contributions, a fee will be paid according to the amount of effort involved in checking each particular work.

Finally, before submitting an article, please check it through thoroughly for legibility and accuracy.

Guidelines for contributors
PCW welcomes articles of interest. Don't be put off if your style of writing is 'under developed'; true worth lies in the content, and shaping features comes naturally to most. Manuscripts should not exceed 3,000 words and authors are asked to use triple-spaced lists with a wide left-hand margin; diagrams, listings and/or photographs should be included wherever possible. Please enclose a stamped, self-addressed envelope if you would like your article returned.

Because of the foregoing, it is necessary to add that the views expressed in articles we publish are not necessarily those of Personal Computer World. Over all, however, the magazine will try to represent a balanced viewpoint.

Finally, before submitting an article, please check it through thoroughly for legibility and accuracy.

Subscription rates: Britain £8.00 for 12 issues, USA $20 for 12 issues (surface mail), Continent and elsewhere $9.80 for 12 issues. All prices include postage and packing. Supplies to specialist shops can be arranged by negotiation direct with the publishers.

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WHICH ONE? (ENTER 1-24)

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<td>£795.00</td>
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<td>3050 (dual drive) 400K storage</td>
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<td>3051 Think (dual drive) 800K storage</td>
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<td>Drive - 116K storage 1st drive</td>
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<td>Drive - 116K storage 2nd drive</td>
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<tr>
<td>IS Hard Disk (11m1)</td>
<td>£1350.00</td>
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<td>E</td>
<td>£150.00</td>
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<tr>
<td>Dual drive (630K storage)</td>
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<tr>
<td>IS Hard Disk (11m1)</td>
<td>£1350.00</td>
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**PRINTERS**

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<th>Item</th>
<th>Price</th>
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<tr>
<td>022 (80 col with PET graphics)</td>
<td>£525.00</td>
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<tr>
<td>0 Screen Printer</td>
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<td>Radio Shack Micro Printer</td>
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<tr>
<td>PAL</td>
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<td>pe 43 KSR Serial (pin or pinch) 132 cols</td>
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<td>pe 33 KSR Serial (110 Baud) conditioned</td>
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<th>Bank Select</th>
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<td>24K</td>
<td>£328</td>
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<tr>
<td>32K</td>
<td>£432</td>
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<th>Standard</th>
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<tr>
<td>64K</td>
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<td>48K</td>
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<td>32K</td>
<td>£346</td>
<td>£483</td>
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*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

Two unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter, and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:
- Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
- Unique syntax check: only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability—up to 26 string variables of any length. All strings can undergo all relational tests. (e.g. comparison). The ZX80 also has string input-to-request a line of text when necessary. Strings do not need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEER and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.

- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.
- ...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you—don't worry. They're all explained in the specially-written 128-page book free with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming—from first principles to complex programs. (Available separately—purchase price refunded if you buy a ZX80 later.)

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**NEWSPRINT**

Guy Keuney, with the news, rumours and gossip — plus, this month, he speculates on the great phone-tapping controversy.

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**Buzby's eavesdroppings**

Duncan Campbell originally revealed on February 1st in the New Statesman that computer technology was being used to trap KGB agents and IRA bombers... and a good thing too. Second, they will add that nothing as complicated and clever as has been mentioned in the National Press actually exists anyway.

On the second point, our micro man may be almost right. Duncan Campbell's original article in the New Statesman revealed the existence of an automatic speech transcriber. But other commentators (noting that the transcriber is said to be located in Victoria, at the same place as where a line monitor handles several thousand lines) made the (incorrect) creative deduction that the automatic transcriber could cope with telephone conversations simultaneously. It can't.

But Campbell says it does exist and what it does is produce a print-out of a telephone conversation. On the face of it, that may be a bit hard to swallow. After all, no less a sage than Professor Donald Michie, artificial intelligence guru, has decreed that the idea is "obviously bunk." I wish I had Michie's artificial intelligence. Even more, I wish I had the comfortable confidence in such "expert pronouncements" that some of my colleagues seem to have.

First, let us assume that a voice transcriber is something that cannot be done with equipment on the market today. I don't believe this assumption myself, but let's make it anyway. On the market, therefore, no can do. Well, what about off the market, then? Under the joint control of the Post Office and an intelligence electronics outfit, probably in Cheltenham, there is a speech research unit. Not surprisingly, it's called the Joint Speech Research Unit (JSRU) and it's been beavering away for 33 years.

The type of equipment it produces would be a useful start to anybody planning a computer transcriber. For example, the JSRU is known to make scramblers — voice scramblers. It won't surprise any readers to hear that I haven't seen a circuit diagram for the JSRU scramblers, and that I don't know whether they are digital or analogue, or a combination of the two. I don't think it matters. The point about a scrambler is that it splits up the voice into its component parts, at one end, and then puts everything back together at the other.

If the JSRU scramblers are as up to date as the vocoders used in the production of the Hitch Hiker's Guide to the Galaxy, they will be devices producing a digital output, neatly analysed into the sort of sound parameters that define what vowel or consonant you are pronouncing. My guess, however, is that they are a bit more sophisticated; they probably have some feature which produces a digital value from which the sound, at any moment in time, can be resynthesised later. If a speech research unit can't get to that point in 33 years, it's a waste of taxpayers' money.

The scrambling technology can probably be expected to do some clever analysis of voice pitch, too. This would give several likely clues to where words can be expected to start — an important requirement. Existing "on the market" speech recognition devices are not wonderful. They tend to mistake "five" for "nine", and if you say "five seven" without stopping for a second between the five and the seven, these machines recognise neither word, because they think you have just pronounced something new, "five seven". And if a new speaker takes up the microphone, the machine recognises rather little of what he/she says.

However there are two flaws in this "proof" that the auto transcriber will not work. First, speech recognisers that typically have a vocabulary of around 200 keywords are a tremendous overkill when it comes to the requirements of a transcriber. Japanese firms are known to have machines capable of printing somewhere over 90% of all Japanese words, from a syllabic vocabulary; apparently 68 syllables are all that you need to construct any word in that language. For various reasons, including inflexion problems, English is not as susceptible to analysis; however a machine that has to pick up syllables is not bothered by the fact that we speak sentences rather than words.

Second, a speech recognition machine has to take the right action when told something... it must not be vulnerable to ambiguity. It must open the door only on the phrase "Un petit d'un petit s'etonne aux Halles", and ignore all jokers who... think the password is "Humpty Dumpty sat on a wall!" — or vice versa.

A transcriber has no such ulcer-inducing worries; it will print out say: "un pretty dump ettisa tonn owl" in both cases. In other words, it doesn't have to produce a perfect match... all it has to do is correctly record the vowels and consonants spoken. If it has enough knowledge of likely words to produce the correct word, just one in ten, it will be possible — not easy, mind you, but definitely possible — to read its printout and understand the subject of conversation (for closer investigation, later, if necessary.)

My best guess is that a good microphone could enable a rather small computer (something the size of an Apple II) to search through the typical Englishman's sub-3000 word vocabulary and print out a recognisable version of 60%...
A truly touch sensitive keyboard from Star Devices. It offers full ASCII code output, and is the Mk II version of the board which also comes in a form with a key for every ASCII code. It gives me the excuse I need to apologise to Clive Sinclair for assuming that the ZX80 keyboard was touch sensitive — it isn’t. It’s flexible, and when pushed down, the top surface makes contact with the back. Star Devices is electronic, rather than mechanical in operation. Details on 0635 40405.

of what he said. The Post Office does not supply good microphones to its users — not even when it intends to bug their conversations. Nor does it supply telephone lines free from noise; only the effects. Nonetheless, electronics can come to its aid. Has anyone ever thought about an electronic sound that any tin-foil broadcast studios from somebody phoning in, appears rather better than one might reasonably expect. And it is. A device called a telephone balance unit is used; it compares the characteristics of the voice of the man in the street (who is talking into the telephone) with the characteristics of his voice as reflected back down the line. From this it deduces the flaws in the line. It then compensates for these flaws and balances the incoming call, to remove them.

My guess is that the Post Office doesn’t expect to get intelligence transcripts of nearly 40% of conversations monitored. The New Statesman found that something like 30% were “acceptable” to the authorities — line noise, funny accents or other problems taking care of the rest.

As to whether Irish and Russian agents are a sufficient threat to justify the use of this transcriber, I can only refer you to your own political views. Several of my readers will insist that a computer paper has no right to thoughts on the subject anyway — a view which I find as sensible as the idea that Jews should have views on anti-Semitism.

There will be many who will go along with Computer Weekly’s pontification, that the idea of a transcriber “will raise the eyebrows of anyone important is that it’s not in fact a brand new chip at all. It’s a copy of Intel’s 8085, plus a copy of Zilog’s Z80 — two of the most commonly used chips in the micro business. It will run any software written for those micros, without change. But it uses 4% of the power.

In the past, the only way to get a computer to do this work in its use of electricity, was to build it on a special chip with two layers of impurity — both P-channel and N-channel complementing each other on the silicon (hence its name, Complementary Metal Oxide Semiconductor, or CMOS). Normal fast micros are built in N-channel, or NMOS technology — and usually CMOS micros are a great deal slower in operation. National’s trick has taken place on two levels. First, it has found a way to speed up CMOS, and second, it has developed that faster CMOS so that the transistors are much smaller, and much closer together. In part, the first profit is the result of the second.

It works like this: the transistors on a silicon chip operate by pumping electrons into or out of one of the three elements of any transistor — collector, base and emitter. The exact details vary with the type of transistor you have built, but enough electrons in (or out, depending on type) can turn a piece of silicon from a good conductor into a rotten conductor of electricity; when the current flowing between the other two elements stops, the transistor has switched.

In an analogy as crude as last month’s financial modelling, one can say that the bigger the transistor, the longer it takes to pump enough electrons in, to switch it. If you pump harder — that is, increase the power — the thing gets hotter, but it does speed up.

Very, very crudely, the effect of shrinking the length of a chip by x per cent can improve the speed or power — whichever you design for — by a factor in proportion to x², that’s because it affects not just the area, but the volume, of the transistor.

Until now, the big problem of CMOS has been that although it overcomes the limitations of speed power on NMOS spreads itself over a lot more silicon. In so doing it causes more capacitance effects and increases the likelihood of a chip falling on a crystallizing discontinuity in the silicon wafer. The funny effects slow the chip down because capacitors take time to fill up with electricity; the flaws reduce the number of good chips on a wafer, and therefore increase the cost of building and testing.

A CMOS micro small enough to be economically viable was not much of a computer, as any user of an Intersil 6100 or an RCA Cosmac will have to admit. Since those devices were originally launched, however, the art of squeezing circuitry on to chips has improved. National’s latest improvement involves putting an extra layer of polysilicon on the chip — it calls the process double polysilicon or PCOMOS — and this allows it to build a very complex chip indeed. Like the Zilog Z80, it runs all the 8086 instructions and also unlike the Z80, it runs the 8089 instructions and interrupts.

It also contains quite a lot of extra circuitry for controlling memory, and input/output, which means that three of National’s chips will do quite a lot of computing — where the Z80 would need twice as many. Those three chips, unobtainable today, carry a $115 price tag. A 40% price cut next year and a 30% cut the year after will still make it more expensive than Z80 or 8080, but not killingly so. What makes it only a dream for the average home builder is the fact that, while the main chips will be available at £335 from Portable Microsystems, if you buy this Aimem.

Details on 0280 702017.

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Details on 0280 702017.
IBM2CPM

IBM does not use the universal micro operating system, CP/M. Load an IBM diskette on to your micro with CP/M and watch it crash, no matter how important it may be that you read the data.

That is why Precision Computer Systems of San Jose, California has written a bit of software, IBM2CPM, which will convert between the two. It allows the user to develop programs at work on his IBM, using cross assemblers or cross compilers to generate the code; and then load the resulting IBM diskette. It also allows the micro owner to enter a batch of data on his machine and take it to an IBM mainframe for further processing. Details (or $95 to PCS), 1737 First St, San Jose, Cal 95112.

Comart CAPs its success

When two people stick their necks out together, it does make the spectators wonder whether one is the solid citizen recommending that we trust the other, rather reckless innovator — or whether it's a case of the blind leading the blind.

On balance, Comart's decision to bring its chain of stores behind the Microcobol software produces developed by CAP is probably a feather in the software house's cap.

Both firms are being watched with awe at the moment. David Broad of Comart has had his hair cut, to suit the solemn image behind it, things may start to move a bit faster.

Colourful battle

The obvious machine to compare with the Apple II is the Compucolor, because both give colour video displays. This comparison has been highlighted by the latest aggressive marketing moves of both companies — Microsense for the Apple II, and Abacus who import the Compucolor.

Apparently in response to a press report on the Apple (a 16 Kbyte system with disc now costs £1040 plus VAT) Derek Rowe at Abacus issued the following statement that "there is nothing wrong with the Apple: it's just that Compucolor is a more advanced machine and about £500 cheaper and all in one box." Almost as he said it, the situation altered. Most of the change is his own doing; he has introduced engineering modifications to the Compucolor which will cure it of one or two vices.

The main reason behind the surgery was the fact that the disc drive was being twitched by the big magnetic
coils that drive the colour screen. Rowe has changed both hardware and software engineering. The software is designed to offer a quicker recovery from any errors caused by this interference; some 4 Kbytes of ROM chippery have been added and these will eventually be replaced by mask-programmed ROM.

To prevent the errors from arising in the first place, Rowe has put a four-phase stepper motor into the disc to drive the head, and has changed the power arrangements so that when the head is being moved, the screen coils are starved of current.

To pay for these changes and others, the price is going up to £1,600 from the £1,075 which applied when Rowe made his attack. However, some £200 worth of software for assemblers and “very good tutorials” will be supplied free at this price.

Incidentally, Compucolor has announced US prices for its machines. There are three models: the 8 Kbyte costing $1,495; the 16 Kbyte costing $1,695, and the 32 Kbyte at $1,895. Abacus parent company, Show Financial, is clearly after the 1980 Equipment Award for Middleman Margineering.

Abacus is on 01-580 8841. Microsense is on 0442 63561.

Off centre problems

Chips are very light in weight. This fact, and the consequences which arise, has evidently escaped the minds of the planners of a smart new “high technology” centre to be built in London’s dockland. The trouble with building a dockland centre, with research “campuses” and high technology displays, is far to the West. Docks are far to the East of display facilities, in Surrey uses” and high technology centre, with research “campus. The trouble with be built in London’s dockland. The trouble with economies..."

CRA warming-up

In organisation terms, the Computer Retailers Association has sorted out the problems it was having at the end of 1979 when its major preoccupation seemed to be finding an identity. It has appointed an independent secretariat, found a permanent address, and can now get down to recruiting members. Without members to pay for the things it has to do (ie. find out which dealers and which machines are not up to scratch) it cannot do them. It’s aims are important enough for the customers that any retailer who doesn’t join really owes us a good explanation. Alternatively, they can write to the new secretary, Mrs Helen Gibbons, at Owles Hall, Buntingford, Herts SG9 9PL or phone Royston (0763) 71209.

The name’s the same

Commodore has rather blundered with one of its latest bits of software. As far as I know, there’s nothing wrong with its Compay package... it’s not even overpriced. No, the problem lies in its name!

When we told the PET makers that Compay was a name that had been around a while, they smiled and shook their heads knowingly. Either they didn’t believe us, or, they’d done a deal with ICL, the big computer company, and were now letting Commodore use the name for something like 13 years. When we checked with ICL, it quickly became apparent that there was no deal. Accordingly, we hereby predict that the name of the PET program will change. It’s just innocent fun.

Algol for the kids

Schoolchildren in Inner London can all learn to program using Algol 60 — which should reduce the demand for Pascal as an alternative for BASIC. The new language is the result of a deal between the ILBA and its exclusive computer supplier, Research Machines. The RML version of Algol is derived from a portable compiler... one which will also run on Digital Equipment PDP 8 and PDP 11 minis... written by Dr Roger Abbott of RHA Minisystems.

The compiler takes up only 20 Kbytes of memory. Users of Algol tend to be contemptuous of those who praise Pascal, saying that it’s not even overpriced. No, the problem lies in its name!
The name on the video display is Burr-Brown — normally only seen on chips and boards. This is the company’s first system. It’s a data acquisition and control system. Details: 0923 33837.

something more like Algol — but not enough like Algol. These language battles are always fun, aren’t they? Research Machines can be contacted on 0865 49791, while Abbott is on 08677 3625.

Chris Evans tribute
Dr Christopher Evans, the author of the Mighty Micro — both book and TV series — died last year, leaving a bigger gap than ever between the computing experts and the average reader/viewer.

To commemorate Chris Evans’ life and work, John Stewart has decided to hold a free seminar in London in May. Speaking will be Tom Stonier, one of the many who will have to try and fill the Chris Evans gap; he will be “supported by” a member of the National Physics Laboratory staff where Dr Evans worked until his death.

Anybody wanting a ticket should contact John Stewart. He’s at the London Regional Management Centre which works with the five inner London polytechnics, address: 311 Regent Street, London W1R 8AL. The seminar will start at 2pm, at the building next door — the Fyvie Hall, 309 Regent Street. Phone 01-637 7583 for more details.

Petaid upgrade
As promised, Stage One Computers is busy expanding its software which will eventually turn the PCT into an intelligent filing cabinet.

It has launched version 2 of Petaid; this extends the abilities of Petaid version 1 to include random access files “thus allowing the user immediate retrieval of individual records.” Stage One has also launched new business packages — for estate agents, accountants, and print shop job control. Details on 0202 23570 in Bournemouth.

Angry of Finsbury Park
Personal Software, my favourite program writing outfit in the world, has just blown it — for ever!

It’s produced six programs to turn your nice microcomputer into a trashy TV programme. Just look at the titles: “Growing Up” — helps families cope with the teenage years; “Talking about Sex” — offers adults the proper information and appropriate attitude for a satisfying sex life. Aaaaaaargh!

Adda snakes ahead
The computer store which originally opened in the West of London — in Ealing — has opened new marketing offices in the capital’s centre. Adda Computers is the name of the store; the new offices are at Abbott House, 1-2 Hanover Street, London W1. Phone 01-104 1611. The company is a PPT dealer — more details from managing director David Whitehead, who is at Ealing, tel 01-579 9845.

Stronger 6809 support
Software for Motorola’s 6809 chip is still scarce, because the chip, an eight-bit data bus machine, has not been around long enough to have programs written taking advantage of its 16-bit internal arithmetic and logic unit. Fact: Technical Service Consultants (TSC) is by now accepted as one of the most reliable writers of software for the older 6800, usually as built into systems by SWTPC. Fact: SWTPC in this country will be importing the 6809-based SWTPC machine, not making it here.

All this is preparatory to saying that the TSC Basic for the SWTPC 6809 costs $75, and will run on the $500 computer; a statement which would otherwise not mean much. TSC also has written a version of the Flex operating system for $95, and a debug package for $75.

The software which turns this TEI based system into a word processor is called Magic Wand and costs £262 from Abacus. A complete system with NEC Spinwriter and diskettes costs £4900. The man with the light growing from his head is not an angry customer, but Derek Rowe himself. Details on 01-580 8841.

At £8500 with an enclosed (quieter) printer, two floppy discs and screen/keyboard, this Triumph Adler 1100C is a big change for the company. It was launched at the IMEC exhibition and the maker claims it is on one-week delivery from order.
Your Commodore PET System

The Commodore PET is Britain's best selling microcomputer and the most popular choice in every field:—

* In Education for teaching Computer Science and as a teaching aid for other subjects.
* In Science and Engineering for solving problems and for monitoring laboratory equipment.
* In Business the PET system can be put to a wide range of functions including Payroll, Accounting, Statistical Analysis, Stock Control and Word Processing.

Not least of its attractions is the price of a PET - from £550 for a self contained unit, to under £2,500 for the complete system including Floppy Disk Unit and high-speed Printer. Ask your nearest Commodore dealer below for details about Commodore hardware, software and training courses.

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Your six main computer centres, stocked up with new equipment for 1980. Complete systems carefully chosen for their reliability and availability. Plus the widest range of software for business, education and industry. For expert advice on which system suits you best call into one of the Big Six.
When the editor kindly invited me to make a regular contribution to Personal Computer World I hesitated to accept on three counts. The first was that a continuing and even passionate interest in a subject which stems from an awareness of its great importance, does not qualify one else to handle intelligent comment, let alone to pass judgement on issues of significance. The second was the degree, and to some extent, the unpredictability of pressure on a Member's time. I foresaw deadlines arriving when the only time left in the week had been preempted by a batch of Select or Standing committee documentation which had to be read before the morrow. The third was that I anticipated that there might be prolonged periods when Parliament, preoccupied with its conventional conflicts, would offer little of interest to those readers of this magazine who, I assume, want to know what is being proposed and discussed in the House of Commons which has some bearing on the world of "information technology", "telematique" or "communications" in broad terms. The disgraceful example of the jargon which the world of computers is inflicting on the English language.

The editor, however, persuaded me that my thoughts might occasionally be of some interest and has generously agreed that I will only put pen to paper when time, opportunity and suitable topics of interest coincide. As a result I am, for the first time, succumbing to the temptation to build a small bridge between the readers of this magazine and what I know many in the world of computing consider - quite rightly - to be the remote, indifferent and largely disinterested world of Westminster.

We have, it is true, made a tentative start to improve this reputation. In the last Parliament, a Joint Select Committee of both Houses under Lord Daring's Chairmanship, recommended in a report that they should look more closely at what computing could do for them. That report was read by an elderly body, the House of Lords, proved in fact to be far less reactionary and arthritic than the Commons in responding to this proposal and moved rapidly and effectively to equip itself with modern data-processing back-up for its European legislation Scrutiny Committee. The Commons permitted a series of equipment demonstrations and the libraries of both Houses made perceptible progress in appraisals, investigation and trials. The Select Committee which investigated the Steel Industry in 1976 took the bold step of insisting on modern information back-up for its deliberations and actually created and used models and databases - to some effect. But since then the House has fallen back, exhausted and disoriented by the experience. Our total expenditure on modern information technology cannot amount to more than 0.1 per cent of the total budget of Parliament. The exception to this rule of extreme caution is the recent introduction, as a service to Members, of the Treasury Economic Model. This has been used by a round dozen Members and by the staff of the Commons library, who act as advisers and intermediaries. For, after all, the average Member finds a computer terminal a most forbidding and nerve-racking object. My guess is that it will be fifteen years, at least, before this situation changes. I base that forecast on the assumption that it requires about a hundred like-minded characters in this place to achieve a change which not all may perceive to be necessary. And it will be fifteen years before there is a probability that a hundred Members of the Commons will have had a general education which was based on relatively modern concepts of information processing. They will then demand, and obtain direct, on-line, access to the world's integrated data-base system (as I suspect it will then be if we have not blown it ourselves and our data-bases to pieces).

In 1979 Parliament made progress in two other significant directions. We established, after some considerable difficulty, an All-Party Committee on Information Technology. This has set out, with some success, to beat the drum of the industry and the technology. Modern equipment has actually been seen operating within the precincts. Members scurrying from Committee corridor through the Upper Waiting Hall in December might, had they paused for a moment, have seen the Order Paper for the day on a television screen called up from the viewdata memory in which it had been placed. The Leader of the House, whom I pester every Thursday with demands for a two-day debate on microelectronics, assured me he had actually seen it. But I remain confident that it will be at least fifteen years before the Select committee terminals will be able to call up and read the business schedule in the Commons that day. It will continue to be printed by the technology of Gutenberg and delivered by another even more venerable - a man on foot.

The other direction in which we have made quite considerable progress is in our appreciation of the fact that the microprocessor is likely to be a device of some considerable social and political significance. In 1975 the worst was completely unknown. Today, even if we still await an opportunity to debate what every second conference in the country has been discussing, politicians are aware that they should heed the advice Lady Bracknell gave to her daughter in "The Importance of Being Earnest" about not being misunderstood on the platform. She was, of course, referring to Waterloo.

Parliament is beginning, then, to tinker with information technology, but the Chamber, our voting procedures, our Committees and our control of the legislative process still remain immune. This could change quite rapidly as we become more aware of invidious comparisons. The Japanese make those made between ourselves and the U.S. Congress. The Bundertag is also moving rapidly ahead. The Japanese have, with an Information Technology Committee since the late 60s and the concept of the "Information Society" originated in that country. Last week the parvenu institution, the European Parliament, introduced an electronic voting system designed by Olivetti. But my own judgement is that one day a Government will be floored, effectively and conspicuously by young backbenchers who has reinforced a natural capacity to ask the right questions with a highly skilled understanding of data-bases and systems analysis. On that day the House will rediscover the relationship between information and power and will appreciate that modern information technology alone will equip it to meet the Executive on equal terms.
Pretty pictures

I must say how much I enjoyed John Yale's 380Z picture program. Very interesting results and an even more interesting program. I have yet to discover how the inter-related macros in lines 1340 and 1450 are unravelled. Can anyone explain please?

Anyone using one of the early 380Zs with a different VDU mapping must substitute 3136 for 62656 in line 1360.

Due to typing errors (on my part) I spent some time debugging and trying to fathom the subroutine at line 1360—and, discovered a more visible and rather quick solution. Each character cell is divided into a 2 x 3 array of graphics blobs, with one data bit of 6 assigned to each blob. The decimal equivalent of each control bit can be stored in a small array and used as a look up table.

```
0 1 Y1=2 1 2
2 3 Y1=1 4 8
4 5 Y1=0 16 32
X1=0 X1=1
```

Stored in XY(X1,Y1)

I added the following lines

```
24 DIM XY(1,2)
25 XY(0,0)=16:XY(0,1)=4:XY(0,2)=1
26 XY(1,0)=3:XY(1,1)=8:XY(1,2)=2
```

I made these:

```
1380 X1^X2 INT(X/2)
1390 Y1=Y-3 INT(Y/3)
1400 P2=P2 AND XY(X1,Y1)
```

During the struggle with SUB 1360 I resorted to a bulldozer switch on wrap-around to prevent white screens. This effect is cancelled if $S$ is selected.

Add to lines 820 through 850 the statement: P5=1

Add 865 IF P6=1 THEN IF P1=0 THEN P1=2 ELSE P1=2

865 P5=0

This produces another pattern set, and some amusing effects. R.W. Stranks, Cheltenham.

Pascal 1

January's “Complete Pascal” contains a diagram (box 2) illustrating the IF THEN ELSE syntax. Surely this is incorrect. Shouldn't the ELSE branch occur if the first expression is false as in the following diagram?

R. J. Gerrard, High Wycombe

```
IF P1=0 THEN P1=2 ELSE
```

We see what you mean and your proposal would be quite reasonable if ELSE were mandatory. The syntax diagrams, however, always reflect the logic of the compiler which, in this case, always expects a THEN whereas the ELSE is optional.

Pascal 2

Your “guidelines for correct Pascal” seem to test them to check articles thoroughly for accuracy. It is a pity that the authors of your Pascal (not "PASCAL") series appear to ignore this advice. The following are by no means the only errors in Chapter 5, January 1980.

a) IF statements do not end with semicolons (and neither do CASE nor any other statements) — as in English, Pascal semicolons are separators, not terminators.

b) “i.e. ASCII” should be “e.g. ASCII” — this is not a quibble, for Pascal is machine-independent and thus it does not need any particular character code.

c) line 33 of SALESEXINFO should have parentheses around both comparators.

d) EOLN is not a reserved word.

e) there is no such operator as “NOT IN”.

The examples violate the spirit of Pascal as badly as the letter. They are badly laid out and make poor use of Pascal’s freedom in choosing identifiers. They are also badly structured and some are algorithmically incorrect.

William Findlay, Glasgow

Sue and Chris’ reply:

“a) In both our programs and our text we use semicolons as statement separators. A PASCAL-like statement in the text such as IF condition THEN statement ELSE statement; has a semicolon to point out where it is allowed—that is we were saying—no dashed semicolon before the ELSE.

b) Correct—we are so used to micro implementations that we tend to think of characters as ASCII codes. & d) Mea culpa! This was a real Monday morning program where more than the name came out backwards.

c) In our Look Up Table we use the term Reserved Word in the loose sense to mean a special PASCAL word that should not be used as an identifier.

D. Jones, Bath

The comment at the end of Newsprint was made by our technical editor, who still claims that Y and N are more user friendly than 0 and 1.

He even goes on to suggest a small routine along the lines of:

```
IF LEFTSAS1)="Y" THEN.
IF LEFTSAS1)="N" THEN.
```

The exact format would depend on the particular BASIC dialect in use — Ed.

Yesandno

When describing the recently published book called “Some Common Basic Programs” by George/McGraw Hill, some surprise was shown by Guy Kewney in respect of the use of 0 or 1 instead of YES or NO, for input statements.

As any PET user will have discovered, when using YES as a string constant for use in a YES/NO answer situation, it is possible to cause the same effect by typing the letter Y (or any other letter or number) instead of the whole word YES.

Unfortunately, if the single letter N is typed instead of the whole word NO the true meaning will not be interpreted. In fact, if any other single letter or combination, other than the actual word NO, is typed before return, a YES answer will be interpreted.

In short while Y implies YES, N does not imply NO. Inexperienced users could become confused by this, while a user in a hurry could type the wrong N in mistake for NO. Consequently for beginner programmers it may well be simpler to avoid the use of string constants and remove the above anomaly.

Finally, I would like to mention that the same comments apply when using the BASIC provided by our own mainframe computer at this University, the cost of which, unlike the few hundred pounds of the PET, runs into well over £1,000,000.

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Winning strategy-part 3

In his letter published on p11 of the January PCW, Alex G. Bell whines about the winning strategy for Othello for which he paid me £2.50. Of course I didn’t say that “both sides will win”!

Does he think that anyone will believe that? I revealed to him what Petsoft’s Super Othello’s Achilles’ Heel is and how to use it to win.

Why doesn’t he mention that? If my technique is a “good rule of thumb”, why isn’t it built into the 4 or 5 Othello programs he mentions? Yes, use my technique and avoid traps, and you will win! However, the offer is withdrawn, as I don’t have time to hold hands with every tyro who doesn’t know how to avoid traps! In conclusion, let me say that Alex G. Bell was the only respondent from whom I received any objections. Let him go back to inventing the telephone; he will never get any more help from me!

F. T. Chambers, Co Mayo, Ireland

Thank you Mr. Chambers, and goodnight. We feel that, both points of view having been aired, now is the time to come to a conclusion on the subject — Ed.

Genie vs Pet

I was annoyed to see that in your review of the Video Genie you referred to the PET numeric keypad as a “gimmick”.

The numeric keypad is in fact very useful as it enables you to type in numbers and arithmetical operations much faster than using an ordinary QWERTY keyboard.

Just as important is the fact that without the numerals on the top row of keys you can have the symbols there which you normally have to shift for without shifting — e.g. the |S# symbols, etc. These are used in BASIC programming a lot and having them available on the PET without having to shift saves a lot of time and effort; you can write a whole BASIC program without having to touch the shift key except when using the graphics.

So much for the “gimmick”!

Jonathan J Dick, Bristol

Point taken. Our comments came from a TRS-80 fanatic. Need we say more? — Ed.

Fictitious fax

Spurred by your letter, our technical editor spent hours checking the Rodney Zak’s book “Programming the 6502”. Not only did he unravel the answers to your questions but he also noticed a number of other mistakes in which either the bit patterns were correct but converted into hex incorrectly or vice versa. To answer your specific points: 20, 38, 78, F8, 4A and 5A were all correct in PCW. 41 and 7E are both ROR instructions being zero.

Unfortunately, we ran out of time on the current issue to check every single code so should we encounter any more discrepancies we shall publish them next month — Ed.

Discerning reader

Congratulations on saving me up to £1.60 every month. Why? There was a time when I felt compelled to buy one or more of your rival magazines. I don’t bother any more and the way PCW’s standard has been rising, I expect other readers are feeling likewise.

But just in case such praise goes to your head (and no letter is complete without a moan), in my February issue I counted no fewer than 7 pages devoted to In Store. I realise that PCW, unlike others, does actually update the list every month; even so, all those pages?

Mervyn Burridge, Nottingham

We beat you to it — our art-room whizzkids have now successfully compressed In Store down to half its previous size. And we’re keeping it; feedback tells us that it’s generally much appreciated — Ed.
Ohio Scientific has been around for a long time and markets a wide range of computers that starts with the Superboard and ends with the mighty Challenger 3. For some inexplicable reason, they never seem to have had much exposure over here and so it was with some interest that I undertook the review of this particular model. The Challenger 2 series is in the middle of the range and is claimed to be "professional", portable and highly expandable. It was with these claims in mind that I carried out the review.

Hardware
The C2 range itself comes in a variety of options. The version that I had was without floppy disc drive but with 8K of memory. It comes ready built in a typewriter style metal case with room for a TV or monitor to stand on top and 6 unlabelled phono sockets at the rear. The typical monitor size is 30 lines by 32 characters or 64x32 (software switchable). Good graphics, the VDU is rather clever as you can switch to 32x32 (actually it’s 30 lines by 32 characters) or 32x64 by poking to 56900 with 0 to 1 respectively; each character slot occupies an 8x8 matrix. Furthermore, the terminal width can be altered in size to suit either the printer or a poorly adjusted TV. Mutek (the dealers who supplied the Challenger for review) have modified the VDU to the British TV standard and the result is most satisfactory; each character slot occupies an 8x8 matrix. Furthermore, the terminal width can be altered in size to suit either the printer or a poorly adjusted TV. Mutek (the dealers who supplied the Challenger for review) have modified the VDU to the British TV standard and the result is most satisfactory; each character slot occupies an 8x8 matrix. Furthermore, the terminal width can be altered in size to suit

The Review

The VDU also features a total of 256 characters and includes numerous graphic and gaming characters like tanks, men and planes, and provides ample opportunity for extremely good graphics. The screen display is very fast and can be accessed by the computer directly. Mutek claim that the VDU board utilises special circuitry to minimise screen disturbance during video accessing. This may be so but on the review sample some disturbance was visible, though not particularly disturbing. Space is available on the VDU board for American (NTSC) type colour generation but, of course, it’s unusable over here and I don’t know whether or not anyone has plans for a colour add-on.

The VDU has three bonus features incorporated, namely an audio output, DAC and AC control! The audio control is a programmable divider whose division ratio (audio frequency) can be changed by POKING location 57089. This tone can be turned on or off by POKING 56832. The output of the divider is filtered and can be fed into an audio amplifier input. This divider is also used by the Digital to Analogue Converter which has an 8 bit logarithmic law. Machine code programs are given that show how to use this output. This time, the output of this divider is unfiltered and can again be fed into an amplifier.

The AC control, although needing a separate interface to operate external equipment, is nevertheless still a very useful facility. Little documentation (of which more later) is provided on this equipment, however, it can be understood from the circuit, the output appears to consist of a 40KHz square wave that is switched on and off by POKING a particular location. Altogether three very useful, hardly publicised facilities that extend the usefulness of this computer.

The VDU board comes with its own 2K of static RAM and resides from D000 to D7FF inclusive. The crystal controlled oscillator on this board is used as the 1MHz clock to the CPU card.

The CPC card contains up to 8K of static RAM, the 8K BASIC ROM and also a 1K monitor ROM (although only 768 bytes are used according to the blurb from Mutek).

**TECHNICAL SPECIFICATION**

<table>
<thead>
<tr>
<th>CPU 6502</th>
<th>1MHz (2MHz opt)</th>
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<tbody>
<tr>
<td>Memory:</td>
<td>8K static RAM (2114)</td>
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<tr>
<td>Keyboard:</td>
<td>see text</td>
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<tr>
<td>Screen:</td>
<td>30 x 32 or 64 x 32 (software switchable)</td>
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<tr>
<td>Cassette:</td>
<td>upper and lower case (with descenders)</td>
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<tr>
<td>Printer:</td>
<td>not tested</td>
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<tr>
<td>Bus:</td>
<td>OHIO 48 pin bus</td>
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<tr>
<td>Software:</td>
<td>Microsoft 8K BASIC</td>
</tr>
<tr>
<td>Floppy disc:</td>
<td>not tested</td>
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</table>
The CPU, the 6502, normally runs at 1MHz but can be easily modified to run at 2MHz. A Kansas City standard audio cassette interface is provided which runs at 300 baud (with an optional modification to 600 baud). It worked well with my own recorder once I had experimented a bit with the levels required. The overall impression is that it's reasonably fast and a 4K program will load in approximately 3mins. As the program is loaded from cassette, it's automatically listed on the screen, which I think is a great idea. A similar action takes place when saving, so at all times the user can see exactly what is going to and from the printer. Routines in the BASIC manual tell you how to store data and sequential files on tape.

The actual cassette loading routine seems also to be fairly robust and manages to sort itself out even if some random "garbage" is deliberately introduced on the tape. A syntax error message will result but the load will then carry on to the next good bit of data.

An RS232 interface is also provided (well, the PCB foils are there and Mutek can make the necessary modifications should you wish). Personally, I would have thought that for the handful of components required it would have been worth putting it in as a matter of course — you might like to suggest that they do that if you decide to buy one!

The two boards are connected together by a mother board and the OHIO 48 way bus. This uses Molex type sockets and is claimed "to look ahead to the next generation of 16 bit CPUs". This is a bit misleading as at present only 12 bidirectional data lines have been specified although up to 20 address lines can be used. Six control lines, two interrupts and three power lines complete the line up.

The Challenger 2P has a 5V only power supply and the consumption of the boards is about 3 Amps. This power supply has been modified by Mutek to 240V working by substituting the mains transformer; the primary is used as an autotransformer to feed the fan. It seems to me that the transformer is rather underrated in its specification as it does tend to run hot. Mutek say that a custom designed transformer is under development to eliminate this minor problem. There's room and a mounting bracket available for a second supply to drive any boards that are plugged into the remaining two spare holes on the mother board. The mounting of the boards inside is best described as "adequate".

### System Operation

At switch-on the user must hit the Break key (which functions as a Reset). The monitor is cleared and C/W/MP printed. Remembering to press Shift Lock (!) M will take you into the machine code monitor, W is a warm start and leaves the program intact and C is the cold start. This prompts with MEMORY SIZE? and the user can enter a limiting value, thereby reserving memory space for user routines. If a Return by itself is entered then the monitor will test the available memory and a 8K system should reply with 7423 bytes free. TERMINAL WIDTH can then be set if desired (it defaults to 72 for the printer) and then you are in BASIC — it's as simple as that.

The monitor is fairly elementary — nay, very elementary. You can load, examine and change memory, save and load a program on cassette and you can execute a program — and that's it. I was given a tape of OHIO's extended monitor and on it are such nice features as a disassembler and a memory relocato- tor. Unfortunately, the copy of the tape was so poor that it proved impossible to load satisfactorily... a shame as I would like to have put it through its paces. Certainly for £6 it seems very good value. One minor criticism is that nowhere in the documentation could I find where it lived in memory and thus hopefully remember not to overwrite it with any machine programs.

### System software

The BASIC comes from the same stable as Apple's and so has a good pedigree. It has been written by Microsoft and is claimed to outperform (in speed terms) most commonly available computers. I ran the standard Bench Mark programs and as you can see this claim is certainly upheld — the BASIC is very fast. Don't forget either that these were run on a clock rate of only 1MHz! The only sacrifice (if in fact it really is a sacrifice in practical terms) is that the precision of the arithmetic calculations is only 6½ digits. Should you wish for extra precision, then a 9½ digit BASIC is available but only on disc and it will run slower — swings and roundabouts. The available BASIC commands are listed elsewhere and as you can see most of

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### Comparison Check List

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the usual ones are present. I have, in fact, only two minor gripes. The first is that you can easily enter control codes as data entry (numeric or string variables) as the program aborts. There are ways round it, however, possibly via the user definable feature of the keyboard. The second is that there is no true backspace and therefore easy character deletion. True, you can remove the last character with Shift 0 but the cursor does not backspace nor even reprint the character so occurs on some systems that rely on TTYs for data entry. What does happen is that a hyphen is printed for each character deleted and you have to make a mental note when deleting more than one. However, as I say these are only minor gripes.

Mutek sent me a host of cassette tapes which included a Basic Line Editor by Sirrus Cybernetics. This did feature a true backspace and was quite a useful package. It ran a bit slow, however, and you could easily beat it from the keyboard. To be fair they do point out this is not the way to use the text in the user's manual suggesting that you operate at 2MHz or failing that, offer a fix to slightly speed things up — which is most probable. I had great fun playing Breakthr' and can thoroughly recommend it. Many of these programs are ridiculously low in price and anyone who pirates a copy is thoroughly recommended. What about one's Sampler Program cassette which proved indescribably, pathetically useless. Virtually every program had syntax errors and needed debugging before continuing. Mutek tell me that they use OHIO tapes for testing, bugging before continuing. Mutek tell me that they use OHIO tapes for testing, and they can't seem to make up their minds whether to call the machine the 2P or C2—4P! It's very difficult to be objective with the criticism, it's so bad. What's desperately needed is simple instruction on how to connect everything up, turn on and what to do next. They've tried, and failed miserably. One gets the overall impression that much of it was written by several people who were inadequately briefed on what they were supposed to cover; as a result there's a great deal of duplication in the text. Such documentation doesn't inspire confidence in the machine — which is a shame. Still 'nuff said — when in doubt read the manual. It's all there, just needs looking for... um, it's not all there — they don't supply a memory map!

Potential use

It's definitely for the person who wants a good ready-buil machine with plenty of expansion. There are a lot of facilities for the money and it's easily expandable to floppy disc — no false promises of "it will be ready in January... er, March... er, July?" Not only is it ready built but it's also tested so no head scratching. However, the dedica-

ed soldering iron basher should not dismiss it out of hand too hastily as everything's buffered properly on the bus and it's easy to plug in homebrew goodies to the spare sockets. Support at this level is also readily forthcoming with the advent of the OSI UK Users group — ask Mutek for details.

Conclusion

The Challenger 2P (sometimes called C2—4P) is a highly expandable ready-to-run computer that offers several extra facilities not normally provided. It has a clearly defined upward path that can be taken in easy steps. The documentation editor (is there one?) at OHIO should be buried in a deep pit and someone else (me?) hired to provide the good beginners guide that will do much to instil confidence in the machine. There are not many microcomputers that can offer 20K of RAM and a floppy disc for under £1000 (excl. VAT) OHIO claims the Chal-

lenger to be "professional, portable and expandable". The term professional is debatable but portable and usable, the Challenger 2P certainly is.

**BENCHMARKS (all timings in seconds)**

| Challenger | PET | Apple II+
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PCW 46
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***** excellent
**** v. good
*** good
** fair
* poor

### PRICES

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<td>C2-4P</td>
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<td>C2-4P MF</td>
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Part 1. Fact and Fantasy

With the possible exception of sex, viewdata appears to be the topic which has been the most spoken about but the least acted upon during the last decade.

To its proponents, viewdata is the means of bringing into every home remote access to a large information retrieval database with interactive facilities, by way of already existing equipment. To its critics, it's the merger of two pieces of equipment which are half a century and a century old respectively—the television and the telephone—to form a system the purpose of which is to increase Post Office revenue from its heavy capital investment in plant, at times when the system is lightly loaded.

As usual, the truth lies somewhere between these two extremes; it's clear that viewdata will not bear out its early promise, at least anywhere within the original timetable. My intention, therefore will be to give a fairly brief introduction to the concepts, history and uses of viewdata with particular emphasis on aspects of the system which are of (potential) interest to home-computer enthusiasts — an area which is starting to receive a significant amount of attention.

What is viewdata?

The entry in the Trade Marks Journal consists of 71 words and the information they convey is minimal; in fact, the registration appears under the name "Prestel" since, when the Post Office wanted to register the name "Viewdata", it was said that it was too descriptive and could only be applied as a generic term to the system. Thus Prestel is the British Post Office's viewdata (with a small "v") system.

Viewdata refers to the transmission of information from a remote information retrieval system, via a telephone line, to a receiver which consists of a modified television set. More recently, the term "videotex" has been used internationally to describe such a system.

There are other related services which, rather than being transmitted via a telephone line, are broadcast along with television pictures; these are normally known as "Teletext", although the term "broadcast videotex" is sometimes used. Teletext services are not interactive. The BBC's Teletext system is known as Ceefax ("see facts") and the IBA's version is called Oracle (a contrived acronym for "Optional reception of Announcements by Coded Line Electronics"). I shall be describing both viewdata and Teletext since there are many similarities.

The history of viewdata

The original idea of viewdata was suggested nearly ten years ago by Sam Fedida of the Post Office Research Centre. The P.O. decided to undertake a feasibility study between 1972 and 1974 to examine various aspects of a national viewdata set-up, including the telecommunication system required and the target market.

After this, a viewdata-type system was implemented on a Hewlett-Packard 2100 computer with about 300 pages of data. This differed very significantly from the current public system. In particular, it was monochrome and had relatively large, upper-case characters. It was completed in 1973 and there were various demonstrations during 1973/4.

At around the same time, the BBC and IBA were discussing the possibility of broadcast Teletext services, particularly for use in sub-titling programs for deaf viewers; it seemed sensible to discuss joint standards to make the broadcast and transmitted systems compatible. This was achieved fairly rapidly and a joint standard was published in January 1976 (followed by a revised version in September). This standard defined the system currently in use, including upper/lower case characters, colour, double-height letters and flashing. The size of the characters was reduced giving pages of 960 characters.

The first public demonstration of the system was given at EUROCOMP in 1975, and permission was gained for a pilot trial at the beginning of 1976. The trial was intended to help the various suppliers of hardware and information to gain experience of the system and it was followed by a large-scale market trial which officially started in September of 1978. The idea was to involve 1500 users (roughly half business and half residential) in three areas-London, Birmingham and Norfolk.

For various reasons, it ran into problems and there were difficulties in getting the 1500 users. However, although the market trial was expected to produce useful data, the whole basis of viewdata is widespread public usage and the Post Office decided to start the full public service as soon as possible. For this reason, the market trial was renamed the "Test Service" in 1978.

The public service proper was intended to start early in 1979, but, again, there were problems and a restricted "London Residential Service" was started in March 1979 with the full public service six months later.

The Post Office are still committed to a rapid expansion of the system and a large-scale publicity campaign is planned for this month. The latest projections from the Post Office still suggest a possible one million subscribers by the end of next year, accessing the system via twelve and a half thousand ports in 30 towns.

Viewdata and Teletext

While the Post Office was developing its viewdata system and making all the various trials, the television companies were getting on with the transmission of Teletext information.

Teletext is broadcast along with the ordinary television transmission in two of the unused lines (it can sometimes be seen on badly adjusted sets as flickering at the top of the screen). It's displayed on equipment very similar to that used for viewdata.

Each television channel transmits about 100 Teletext frames, simply because a single frame takes about a quarter of a second to transmit and so 100 frames give an average wait time of about twelve seconds. These frames can be changed easily and often and therefore perhaps one of the most important uses of Teletext is for transmitting transient information.

This is one of the major differences between viewdata and Teletext...a second lies in the difference in the amount of information; Teletext has its hundred or so frames, whereas the current Prestel databases consist of about a quarter of a million frames (a figure which will be
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<th>£1450</th>
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<td>48KB + Dual 5½ inch Floppies:</td>
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<td>48KB + Dual 8 inch Floppies:</td>
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"frame" — that's the amount of information that can be displayed on a television screen at any one time. If the amount of information needed in one logical unit is larger than this, a number of frames can be grouped together into pages, the frames being referenced by lower case letters. For example, a page (1234) might consist of three frames, 123a, 123b and 123c.

One frame consists of 960 character positions, arranged as 24 lines and each of 40 characters. The first and last rows are used by the system, leaving a total of 880 characters for user information. The characters which can be transmitted are the usual ASCII character set, together with "graphics" in which the character position is divided up into six squares, any combination of which may be sent. This gives rise to the possibility of sending diagrams although the resolution is low (effectively 80 by 72) and the technique is more accurately described by the term "alphamosaic".

Perhaps the most important aspect of viewdata is that all characters can be transmitted in any of seven colours: red, green, yellow, blue, cyan (light blue), magenta and white. Also, they may be made to flash — a useful facility to draw attention to parts of the screen if used carefully. Finally, there is a facility for double-height characters.

How is viewdata used?

A user who wishes to access viewdata dials up his local friendly viewdata computer (probably by means of an autodialler in the television — if this is not available, a short, three-digit, dialling code is used) and logs in (again, automatically in some sets). He is then presented with a "page" of information and can meander about the database at his leisure (and, obviously, cost).

In general, on each frame (a "routinet"), the user is presented with a choice of subsequent frames which are selected by a single digit on the keypadd. If a "continuation frame" is required (i.e. the next frame of a page), this is selected by pressing "8". Various other functions are made available by use of combinations of the basic twelve keys (on some keypads, special keys are available for these combinations), of which the two most important are "*" and "#" which takes the user back to the previous page seen, and "N" where "N" is a page number, taking the user directly to the specified page.

One item of interest to many users is the cost of the system. It's possible to spend a great deal of money in browsing around the viewdatabase and there are a number of charges which a user can incur. The first is the ordinary telephone charge; secondly, there is a time-based access charge to Prestel which is similar to the telephone charge. Finally, there is a charge for access to much of the data in the viewdatabase. The IP who supplies the data decides how much to charge for it and this charge can vary from nothing to 50p per frame. Frames which are essentially advertisements tend to be free whereas specialised information frames such as the "Financial Times" index are relatively expensive; very few frames cost more than 20p (per access)!. Of course, users are told of the cost of any frame before they access it.

viewdata systems abroad

The Post Office has marketed viewdata abroad and a number of countries have implemented the system and very closely on the UK's Prestel. These countries include Holland, West Germany, Switzerland and Hong Kong.

In addition, some countries are implementing their own videotex systems and it's worth mentioning two specifically. The first is Canada whose system, Telidon, is entirely different from Prestel. Telidon relies, not on the transmission of characters, but on compression of descriptions of characters (PDIs). Although each PDI requires a number of bytes, the number of PDIs needed to send a screenful of information can be very much lower than in Prestel, depending on the actual data. Also, it's possible to send high-resolution graphics (the co-ordinates being given to one part in 4096) with the additional advantage that lower resolution receivers may still receive the picture, although, of course, they can only display it at low resolution. Further enhancements to Telidon include transmitting modifications to pictures and not refreshing the picture each time, thus cutting down a great deal on transmitted data.

The second videotex system abroad which I'll describe is the French one — Antiope. Rather than the UK's eight-bit character set, Antiope uses a sixteen-bit character generated in the receiver from the transmitted eight-bit information. In the UK system, there are special characters meaning (for example, change colour) whereas in Antiope, each sixteen-bit character carries information with it (for instance, its colour). It's a more expensive system than Prestel to implement but it's more flexible and has the added advantage of probably being able to interwork with such other services as facsimile transmission.

Forthcoming attractions

In the second part of this article, I'll look at the uses of the system and particular aspects of interest in the field of personal computers — such as "telesoftware". Also, there's a chance to look at possible future implications of the system.
EASIER COMMUNICATION FOR THE DISABLED

A. R. Berry M.Sc describes the Electraid 5602, an adaptable communication aid for the disabled.

Basic system. Typewriter is an electric office machine fitted with a solenoid block. Input switches shown are only one of many types available — others include foot switches and ones operated by blowing/sucking.

The problem
Susan is studying "O" level Computer Science at a technical college. She is confined to a wheelchair, unable to write and has severe speech defects. These disabilities render her at a grave disadvantage compared to the rest of the class — yet Susan is intelligent and determined to succeed.

This article describes a system — the Electraid 5602 — which is designed to help the many hundreds of severely disabled people like Susan overcome their communication handicaps. Those who can write and speak normally may not realise the frustration of not being able to communicate, simply because the body refuses to do what the mind is telling it.

There are, of course, other systems like the 5602 (NPL's "MAVIS" is one of the best known). But what makes this system unique is that the team who developed it are themselves disabled. This gives them a better insight into the problems that the users may face both from personal experiences and from those of their many disabled friends. This article was produced using the system — without it, I don't think it would have been produced as quickly or as creatively.

Features of the 5602

The system is shown in Figure 1. In its simplest form, it is a typewriter which is operated not by the pressing of keys but rather by the giving of commands to an electronic controller. Optional equipment includes a large indicator and a VDU.

Why use a typewriter as an output device? There are many reasons, ranging from cheapness, through safety (certain printers fail to meet safety standards set by local authorities) to the ease with which a teacher can set up a sentence to be copied.

An important feature of the 5602 is its inherent flexibility. For example, there are ten ways of selecting letters and each of these can operate at one of six speeds. All (bar one) are based on the matrix shown in Figure 2.

Let's consider some of those available:

Q1: In this method, the system scans the entire matrix automatically, the user having merely to close a switch when the desired letter is reached.

T1: Here the cursor is stationary until the user presses a switch. It then scans down the first column until the switch is released. When the switch is pressed again, the cursor moves along the row; this continues until the switch is released again. The selected letter is then typed and the cursor returns to the start.

W2: This, and methods X4 and Y7, are extensions of T1. In W2, two switches are used. Switch "1" and "5"; switch "1" will cause the cursor to jump to row 1, while switch "5" causes a jump to row 5. We have used more switches to allow access to segments of the display and thus users can select letters more quickly.

If the methods described above seem a poor substitute for simply hitting the right key and getting the letter typed, try typing with the little finger of your left hand after drinking 8 pints and then imagine something about a hundred times more difficult. You will then begin to understand the sort of problems that the severely disabled face.

Some users of the 5602 will probably never use the system on a setting other than Q1 and at the slowest speed. In that case, a speed of one selection every 2 or 3 minutes would be very fast (and this doesn't make allowance for the many mistakes that these users will make because of gross involuntary movements).

Methods of selection like those used in the 5602 have the following advantages:

1. The number of "channels" required to achieve communication can be reduced from 56 to a number that the user can cope with.

2. The method of selection can be chosen to suit the user's particular disability. There are methods that are useful for users who can "relax to order" and others for users who can only "tense to order". Susan, for
This means that small children can use scanning used by the system. This can be replaced by the digital method of scanning used by the system. This can be of real benefit to users with gross movements, such as Athetoids.

3. The essentially analogue method of moving fingers around a keyboard is replaced by the digital method of scanning used by the system. This can be an advantage for users with gross movements, such as Athetoids.

In the scanning mode, if high speeds are to be attained, the user must possess a sense of rhythm and be able to anticipate the position of the cursor so as to activate his switch at the correct time.

For the less severely disabled, a selection method called "ELK" is available. In this mode, a keyboard is used, with a layout similar to a typewriter; it can be supplied very large (3' x 1') or very small (6" x 2"). In ELK mode, the controller checks that only one switch is depressed and the user can select a delay before inputs are accepted.

As well as all these methods of selection, the system also has a number of higher level features. The most basic of these is the "repeat mode". Once entered, all characters selected will be repeated at a fixed rate until another selection is begun. This is useful for users with severe fine movements and underline but can also prove great fun for small children who frequently find that repeating carriage return provides a big stimulus. Of course, the rate at which the character is repeated is determined by the scanning speed.

Then there is a "phrase store". At present, this is a fixed set of phrases (fixed, that is, when the system is built) one of which will be typed when a position in the first row of the matrix is selected. This may appear somewhat limited but, to give an example, if one arranges one phrase to be: "Hi, my name is...", then this may significantly improve the user's quality of life.

To be non-communicative and experience people losing interest during the introductions is very frustrating.

The 5602 may be used with a VDU in "store" mode. In this mode, text can be displayed on the VDU, changed using the backspace "key" and then dumped on the typewriter, a count of the number of spaces left on the line is displayed and, should this fall to zero, a carriage return is automatically inserted. Not only that, the system has
full buffering to allow fast users to continue inputting while the typewriter is printing — without keys clashing together.

A "self-test" routine is included which performs an internal check (RAM, I/O interfaces and interrupts) and tests the typewriter and the input switches.

### Hardware

The controller contains a purpose-built micro-computer and associated power supply. The computer is constructed on a single Double Euro-card size board 10" x 8". Fully populated, it is quite a powerful beastie, as it consists of:

1. 6802 micro-processor
2. sockets for 4 PROMs, either 2758 or 2716
3. 16 Kbytes of "invisible refresh" dynamic RAM
4. RS-232 port with software selectable baud-rate
5. 56 I/O lines, 24 of which can handle 2 amps at 24 volts
6. 4 16-bit timers
7. An interface to Micro Design's MAINLINE
8. A 1 watt audio amplifier

The RS-232 port is provided so that the 5602 can be used in place of a terminal by the disabled computer user. It is also very useful for production testing — something which is not considered in many systems available today.

Internally, the amplifier is connected to one of the timers so that it can generate tones. Some physically handicapped people have sight problems as well and the tones can help them to use the 5602 by providing information about their selections. For example, in the scanning modes, a different tone is generated when scanning vertically from when scanning horizontally. Fast users tend to rely more on the tones as well.

Figure 3 shows the optional Visual Display Unit which can be supplied with the system. This unit is a high-quality monitor with a micro-based control card which fits into the main controller box. For the user, the VDU can replace both the indicator and the typewriter although a typewriter will normally still be needed to provide hard-copy.

At first sight, it no doubt appears strange that the control card for the VDU uses another micro. The facilities offered by the VDC-09 are, however, very advanced and include: normal/inverse video, dual intensity, variable screen format and dynamically alterable character set. Most of these features are used with the 5602.

"Variable screen format" means that the VDC can display different sizes of characters in fact, the range of formals is from 3 lines of 4 characters up to 40 x 110. It allows partially sighted people to use the system and, perhaps more importantly, means that very small children can be taught to read and "write" with the system; they can use it through school and on into their employment.

The ability to change character sets — that is, to change what pattern is displayed in response to a selection from the 5602 — has not yet been fully explored. Possible applications include the display of foreign languages (not only those with accents, but also Russian, etc), special mathematical characters and "Bliss" symbols.

### Software

A substantial part of any micro-processor project is, of course, the software. This project is no exception, a full 5602 requires about 4 1/2 Kbytes and the VDC nearly 2 Kbytes. Most of this was written in 6800 Assembler (using "Tiny Assembler" modified to operate completely in memory) because of timing constraints. The software is modular and was designed using a meta-language called "KDL".

Basically, the software can be divided into 5 parts:

1. Typewriter and Display control
2. Control switch processing
3. Input switch processing
4. Text manipulation
5. Self-test routine

The hardware of the typewriter interface is completely dumb — the software is responsible for all timing and code conversion functions. So as to allow the user to carry on with the selection of the next letter while the present one is being typed, the typewriter driver is split into two parts: a foreground task and a background routine. The background routine queues characters to be output in an "O/P Character Queue" (OPCQ) and then checks whether the foreground task exists. If it doesn't, it creates it. The foreground task examines the OPCQ and, if there is a character waiting, begins the sequence of operations to output it. If there is no character waiting, the foreground task is killed. Once triggered, the foreground task is driven by interrupts from a timer and is completely separate from the background.

To reduce the cost of the hardware, the control switches ("CODE" & "SPEED") must be scanned by the software. Every time round the base

Cont. on P. 112
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Introducing the ZX80

Clive Sinclair has surprised the world with the launch of his attractive, hand-held personal computer. Costing less than a hundred pounds, and plugging into the domestic TV and cassette recorder, some now suggest the ZX80 to represent the thin edge of a mass consumer market wedge.

Hardware

I have to say that I think it very pretty (our art director would probably beg to differ) — the casing even has go-faster stripes, which look suspiciously like ventilation slots in black and white photographs (coincidence, I'm sure). I would, however, have been happier with something rather more sturdy; ABS plastic might have done the trick, although perhaps at the cost of attractiveness.

The keyboard is most interesting; it's one of those waterproof, chemical proof, completely sealed units and it's stuck on to the main PCB. Made of a special tough plastic, the under-surface is printed with the key symbols so as to eliminate any rubbering off. Between this keyplate and the PCB containing the metal contact strips (about five per key) is a piece of sticky plastic containing forty holes which line up with the "keys". This material is about .006" thick and is just sufficient to keep the metal underside of the keyplate away from the contacts, except when touched of course.

Typing gives a sensation of drumming your fingers rather than of doing anything useful. This is a totally mistaken impression because it really works rather well. For those who are interested, I found that a "wiping" action was more successful than the tapping movement usually associated with typing. Typists may be pleased to hear that the keys are in standard QWERTY layout although somewhat compressed compared to, say, the office IBM.

Looking inside the machine, I find that it's controlled by an NEC 780-1 processor chip. . . a copy of the well-known and very successful Z80A. This CPU, running at 3.29 MHz, does all the work for the ZX80, including driving the TV and the cassette recorder. You'll notice that if any work is taking place, be it calculation, accepting input from the keyboard or input from the cassette, then the TV picture disappears — only to return when the activity is complete. This can be irritating to observers (at a demonstration for an example) but I found it positively beneficial when keying in programs because it gave me positive feedback whenever a key made successful contact.

The BASIC interpreter, operating system, character set and editor are all held in a 4K Byte ROM. If you are feeling adventurous there's no reason why you shouldn't pop your own ROM (TMS 26532) in its place.

Memory in the basic system comprises 1K static RAM; you can add to it via the expansion port, giving a maximum of 64K. The memory expands with the aid of plug modules, each designed to carry up to 3K in 1K increments. Thus five modules would be required to give the 16K maximum. At switch-on the machine does a memory check which also tells the system how much memory is on-line. Should you reconfigure the memory, then the command NEW will execute the memory check cycle again.

Moving on to the "outside world" connections, there's a cassette interface, TV socket and a hefty edge connector. The cassette interface comprises two 3.5mm jack plug sockets, securely mounted on the main (and only) PCB. One connects to the "ear" socket on the cassette recorder and the other to the "mic" socket. There's no facility for remote control of the cassette motor. Anyone with DIN sockets will have to buy a jack plug to DIN connector lead.

Although I encountered one or two problems at first, once working, the cassette interface proved trouble free. My particular recorder had a nasty habit of recording noises when the CPU was "sending out" silence. This caused the system to get its knickers in a twist when reading from cassette because it expected silence just before the file header record. After a couple of hours (what a confession) the culprit was every time the processor would check to see if monitor while recording, was setting up some sort of oscillation. Answer — simple — disconnect the "ear" jack when recording. Another tip which enures trouble free is to move the tape into the silent section before issuing your LOAD instruction. Rumour has it that the cassette operates at around 250 baud. I believe it, although it doesn't seem terribly important when you're only loading the 1K that I was.

The television connector is simplicity itself; a long end of the ribbon cable (supplied) into the ZX80 and the other into the television aerial socket, tune to channel 36 and you're in business. The display is magic; rock steady and very clear although reversed characters (white on black) are not so good.

I have already mentioned the business of the display switching off every time the processor needs to do something else. If this drives you mad then you'll have to forfeit some of the undoubted pleasures that this machine has to offer. The screen is not mapped in memory; it being like a serial file — much faster. More about the reasons for this in the Software section, but anyone who is hooked on white characters on a black background can suitably modify the PCB, though why they should want to I'll never know. It's a matter of cutting one track and making a small bridge to another.

American television (525 line) users are catered for as well; all they need to do is solder in one diode and the system is converted from 50 to 60Hz standards. Do you take your computer camping with you? You'll be pleased to hear that it can run from a car battery, provided that the lead regulates the supply. I believe you can buy a cigarette lighter plug with a built in regulator . . . couple that with a portable TV and a battery powered cassette recorder and you'll be the envy of the campsite.

Now let's look at the hefty edge connector. This is where the memory expansion modules fit in, each one being "piggy backed" on the one previous. Thus there are always 44 contacts available for outside use.
There are 37 lines drawn from the CPU plus 3 power lines (at OV, 5V and 9V); the other lines comprise two earths, a "clock" signal and an "external memory in use" indicator.

All in all, the Sinclair ZX80 is a well designed, well produced personal computer. Memory addition comes a bit expensive at £300 for the full expansion but Clive Sinclair tells me bigger RAMs are on the way — that means cheaper expansion when they appear. If you like soldering and are good at it, it'll probably take you an evening to assemble the kit; if you're at all apprehensive than I suggest that you stump up the extra cost and save yourself twenty pounds worth of heartache by purchasing the ready built ZX80.

I'm sorry that there are no pictures of the machine's innards. The fact of the matter is that I was given one of the development machines which had a couple of "Veroboarded" EPROMs and a selector IC floating around on the ends of some pieces of wire which in turn were soldered into the "official" ROM socket. I thought it best to spare Mr Sinclair's blushes.

Software

The software of the ZX80 comprises the BASIC interpreter, the Editor and whatever it is that does the rest of the work (Operating System seems too grand a title). Rather than looking at each separately, I shall examine them in the order they might be encountered.

First of all the keying in of programs. For two reasons it's an absolute joy! First you don't have to type in many of the BASIC instruction codes, one key is sufficient; second you cannot enter anything that is syntactically incorrect. Some BASIC instructions have to be entered the long way (these are listed above the keyboard) but 29 of the instructions may be entered with a single keystroke, while only 8 need to be keyed in full.

As with many micros most of the instruction codes are stored in a single byte. Normal Z80 machine code can be entered using the POKE statement and executed with the USR instruction. This should keep the buffs happy after they have tired of BASIC. Syntax checking is superb — it's impossible to go wrong. Every character is checked on entry and, if the interpreter thinks that you are going to make a mistake, it signals with a reverse S (for Syntax) at the point it thinks you have gone wrong. If, later in the same line, you correct the error, then the marker disappears. What a grown up facility for such a small machine! Incidentally, the program lines are displayed very clearly with line numbers, instructions, operators and what have you being nicely spaced out.

Inside the memory, however, there's a completely different story. The lines
A Benchmark about to be executed: note and "grows" down; I put 327 entries on
screen buffer uses part of the 1K, as per instruction. I'll leave you to work
program (displaying the 1K memory) is
so
40 STOP
10 FOR A=16424 TO 17424
and far between. An example of the
operator needed one extra for some
instance the new line code is one byte,
very few extra bytes needed - for
The spaces are removed and there are
was most odd to watch.
Every time I keyed in a new one - it
crashed the system. It did notice
someone entering a string 868 bytes
nothing left on display. It was while
the
up into the screen buffer thus reducing
it before it stopped accepting them.
Another way of crashing the system,
with
error which is impossible to clear. For
you
excellent software
talk
after
neighbours(it's
class
integer expressions
like LET A=((K/K)*K)+K-K . . . if I
didn't, the expression would have exceeded
the ZX80's capacity. The machine can only operate on integers
and these must have values from
-32768 to 32767. I couldn't execute
Benchmark 8 because the machine has no logarithmic or trigonometrical
functions built in.
Finally, it's possible to save programs
and any variables associated with them.
If you want to make use of those same
variables when reloading the program,
use GOTO rather than RUN. Although it's possible to SAVE programs in this
way, no provision has been made to
save files - yet.
That's about it for the software; once
again, considering the size of machine
and price, I think that it's not at all bad.

Basic
The ZX80 BASIC has been well
thought-out and, while it lacks some
of the elegance and sophistication of the
bigger machines, it's a very usable version of the language.
The main limitations relate to file
handling and mathematical functions.
File handling facilities don't exist,
except by SAVEing the whole of
memory (which is probably not as daft
as it sounds). It does mean that you can
save a program with all its variables,
reload it the next day, remember to
kick off with a GOTO rather than RUN,
carry on from where you left off.
On the small memory machine it
doesn't seem that important, but on the
larger memory machines it means you
can hold some reasonable sized files
together with your program.
The mathematical limitations are
possibly more serious. The fact is the BASIC can only handle integers in the
range -32768 to 32767, no decimals,
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hence the programmer must write a little routine for each mathematical function that requires decimals to be used. This RND() pose few problems for those with the larger memory machines but it will undoubtedly occupy a fair chunk of the basic 1K system.

So much for bad news; now here are some of the good features of the language.

Taking numeric functions first, the BASIC offers up to 26 single dimension numeric arrays of any length. It also allows three Boolean operations — AND, OR and NOT.

The randomising functions are worth a mention. RND(n) gives a random number in the range 1 to n. PEEK and POKE are both available so it's possible to read or modify memory contents. Coupled with the USE function, this means that Z80 machine code routines can be executed.

Up to 26 FOR...NEXT loops can be nested and the number of nestable subroutines need to be dictated by the amount of memory available to the stack. On the 1K machine with a short (4 line) program, I was able to get 327 subroutine calls in before needing to RETURN.

String functions, while adequate, could definitely be improved. The absence of a DATA statement and the lack of string handling routines caused particular frustration. Although there are ways around these problems, they can be time consuming and messy.

The functions which are available, and which enable building blocks of string handling subroutines are STR$, TL$, CODE, CHR$ and INPUT.

STR$(n) returns a string of 1 to 6 characters representing the signed, decimal value of n. TL$ returns a string minus its first character, while CODE returns the code for the first character in a string. CHR$(n) represents the character whose value is n and INPUT allows the operator to input numeric or alphanumeric information. A nice touch is that if the destination of input is a string variable, then the BASIC kindly provides a pair of quotes which act not only as a prompt, they also save a little bit of keying.

There is one trap here for the unwary, and I fell into it. I had this nice little loop going and after a while I got fed up with it. Could I get out of the system — could I heck! I hit everything in sight but all I managed to do was crash the system (see earlier). The trick is that if you are in an input string loop, remove the quotes and then put in an arithmetic expression which will resolve outside the range 327 to 329.

So, that's the BASIC — I reckon that it's pretty good under the circumstances and in some respects I prefer it to the BASICS that do all your thinking for you.

Documentation

This comprises a programming cum operating manual. It's very well presented, being written by Hugo Davenport of Cambridge Consultants, with appendices by the mystery man from Cambridge who wrote the BASIC interpreter. (A fiver to the first reader to identify this elusive gent.) There are a few small mistakes in the manual — none of them terribly serious and all of them being dealt with before the next reprint. It's probably good enough to learn from the programming manual, and my only real criticisms lie in the area of what it does (or rather, doesn't do) for the raw beginner. I lent the machine to one such person for a few hours and here is his reply regarding the documentation:

"I read Chapter 2 (Getting Started) and got completely lost by the third page. One minute it's telling me how to wire everything up, the next there's something incomprehensible about storing programs on tape. I couldn't find the idiot's Guide to getting started anywhere."

Maybe the Operating Manual wasn't designed with such a person in mind — even so, novices like him must surely represent a good sized chunk of the ZX80's ownership potential."

Future plans

A new ROM is being developed which will overcome most of the shortcomings of the existing system. Being 8K instead of 4K means that file handling routines will enable the user to read and write tapes — even discs! This new ROM will also include the missing trigonometrical, logarithmic and floating point arithmetic functions.

Another area of development is on the memory front. A 16K plug board is likely to appear on the 1K machine to enable the user to expand his programs and subroutines. A printer is also likely to appear in due course.

Potential use

In its present form the ZX80 offers an ideal introduction to computing. It makes BASIC easy to learn, it's small enough for it not to be intimidating and it's cheap enough that, should you decide computing is not for you, you can give it away, sell it or whatever. Indeed it's probably cheaper to learn BASIC this way than to pay for many of the courses around.

Teachers might buy it for their students' use because at the price there is no need to go through a complicated rigmarole to get the money. The IK version can be used for fairly simple games and activities, although it's likely you will want to expand it before very long. Later, when the file handling facilities are introduced together with floating point arithmetic, I think the machine will become really useful, though still very much at the personal level. Home accounts and engineering calculations spring to mind immediately — don't ask me why! Suddenly the machine becomes something more than a teaching machine or toy: it starts to become a real computer.

Conclusion

Having just read Science of Cambridge's claims for the machine again, I have to say I agree with most of them. The only point I would question is that it offers high resolution graphics. OK, OK, so they are playing the same game as everyone else... all the same I feel that it should be explained. Just lately, people have taken to calling pixel high resolution graphics. Accordingly, what used to be called high resolution graphics now has to be called ultra high resolution graphics. To put it another way, the ZX80 offers a graphics resolution of one character of one character, plus you must write your own software to be able to use it. PET is in exactly the same boat, unless you want to buy the high resolution add-on at about £300.

The ZX80 appears to be a well thought out machine both in terms of hardware and software. It has an excellent editor and interpreter which both mean that it's very easy to help you avoid all sorts of nasty pitfalls. The BASIC instruction set lacks one or two fairly important facilities — namely file handling and floating point calculations. Despite this, it's still a fine machine on which to learn about computing. The new ROM expected later this year will overcome the prime limitations leaving me with only one or two niggles. Mr Sinclair and his merry men of Cambridge can cope with the expected flood of orders and, perhaps more importantly, the after sales service which is vital in this sort of operation.

Our thanks go to Clive Sinclair for lending us the machine, and to Jim Westwood (its designer) for patiently answering so many questions.

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<td>Built:</td>
<td>£99.95</td>
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<tr>
<td>Mains adaptor:</td>
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<td>Memory expansion board: £300</td>
<td>£12.00</td>
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<tr>
<td>each extra 1K:</td>
<td>£16.00</td>
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<tr>
<td>Manual: (free with machine)</td>
<td>£ 5.00</td>
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Benchmark timings (in seconds)

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<td>BM1</td>
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<td>BM2</td>
<td>4.69</td>
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<tr>
<td>BM7</td>
<td>39.2</td>
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<tr>
<td>BM8 not performed (see text)</td>
<td>68.8</td>
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AT A GLANCE

First Impressions

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<td>Looks</td>
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<td>Setting up</td>
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<td>Ease of use</td>
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<td>High Level Languages</td>
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<td>Value for money</td>
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Excellent: ****
Good: *****
Fair: *****
Poor: ****
Sci-fi sighs
There was a time when science fiction was clear cut. Bug-eyed bugs, Big Brother, brave new allegorical worlds and inter-galactic exploration and battles. Now, fact, fiction, fact and fantasy merge into one gel.

This mixture is vividly illustrated by looking round any specialist SF bookshop. Recently I visited one such — Dark They Were and Golden Eyed — nestling in the heart of London’s Sex Fantasy zone, Soho.

While there are, of course, rows and rows of traditional Science Fiction and Fantasy novels, there is also a wide assortment of magazines or “fanzines” as one of them calls itself. With names like Algol, New Worlds and Ad Astra, their general intergalactic, sciency flavour is clear but their content is often irritingly scrappy as they thrash around for some sort of identity.

One of the more intriguing is New Worlds (75p) which is co-edited by acknowledged science fantasy guru, Michael Moorcock. But issue 216 (no date) has an apologetic editorial which indicates the hit-and-miss (sometimes hit-and-run) aspect of these journals.

“Regular readers may have been bothered by a tendency of New Worlds to become significantly more obscure in recent issues,” begins the editorial, which then is at pains to point out that the last issue had been produced by staff who had no previous experience on the magazine. Issue 216, however, clearly identifies the nature of each section as News, Fiction, Poetry, etc. to avoid confusing the uninitiated.

Even so, it’s not clear what the magazine’s theme is supposed to be, except a search of “inner” space, with the New Worlds in the title seeming to refer to new perspectives on our current world rather than other planets. The stories and poems are interesting, if sometimes quirky, with more emphasis on reliving earth’s history and personal trauma than exploring other realms.

A note slipped in with the issue captures the “radical underground” flavour of some of the magazines. It points out that the New World printers, a “socialist collective”, had objected to the sexist nature of an extract from a Norman Spinrad book. The editors felt this objection was “unwarranted and absurd”. No compromise was reached — and the page remained blank.

The editors, however, are offering prizes to people sending in imaginary versions of the blank page and they promise to publish the full original text in the next issue which will be handled by a “less enlightened printer.”

Norman Spinrad is the “feature interview” in Ad Astra 7 (45p) and describes how he had the idea for a radical. The ridiculous spinrad if he views himself as a radical. The ridiculous absurd. No compromise was reached — and the page remained blank.

Although Spinrad is described as “one of the most significant writers of the 20th century”, the interview is so short, superficial and full of lazy writing as to be virtually meaningless. For example, the anonymous interviewer asks Spinrad if he views himself as a radical. The ridiculous response is “The answer is yes, but not as radical as whatever the word means.”

Ad Astra has an interesting article by Ian Ridpath on searching for life in space but other articles on Quatermass and The Black Hole add very little to the publicity which surrounded these ventures; also the few short stories are pretty mundane.

The main fault with Ad Astra, as with many of the others, is a lack of confidence and conviction. This is illustrated by an editorial which celebrates its first year of publication with a sigh of relief, saying that “after one year in existence ... is no mean achievement given the track record of magazines of similar ilk.” And there is a plaintive letter which begins “Every time I write to a magazine or comic it folds ...” Such poignancy is worthy of a Lennon-McCartney hit record.

Despite its name, Algol (£1.20) has nothing to do with programming languages. It’s very much for SF devotees and filled with interviews and reviews of science fictions writers and themes. However, the Summer-Fall issue 1977 (many of the magazines are of oldish or indeterminant age) contains an example of the type of approach which could attract the less dedicated SF freaks. Fred Saberhagen writes a brief introduction to how he started writing a series of stories about The Berserker, a war machine that roams the universe automatically killing things.

The Berserker actually appears in some computer space war games, although Saberhagen says that it’s still vastly outnumbered by the Klingon forces. Saberhagen describes how he had the idea one day in 1962 of a “functional, checker playing computer without any hardware more advanced than a game board, a few small boxes and a stock of various coloured beads.” Sitting in his Chicago apartment, stirred by this idea, the top of his “then-ungraved and crewcut head” he started writing. “The machine was a vast fortress, containing no life, set by its long-dead masters to destroy anything that lived...” And that was the start of a series of at least 20 stories about the Berserker, one of which is included in the same issue of Algol.

This approach provides interesting background to an outsider and a longish story for the enthusiast to get his teeth into. If only more magazines could grasp this formula and develop it with imagination and conviction, perhaps the survival rate of SF publications will grow higher.

Another approach, which seems more commercially successful than other formulae is illustrated by Future Life (95p). This concentrates more on actual technological developments, plus a heavy sprinkling of films and TV to attract the fans. Although it’s a bit late to bring out a February 1980 issue in the UK on Star Trek and The Black Hole, Future Life’s main feature on “forecasting the next decade” provides an intelligent and well presented view of information.
technology developments, a comparative guide to personal computers PE10, Apple, CompuColor, et al to micro games and Pestel information on science. Future Life does not attempt to provide fiction but its news snippets and interviews with authors like Theodore Sturgeon are vivid and of a depth unseen in some of the other more amateurish efforts. And it has a nice visual style which highlights the creators of our images of the future, and designers who provide the pictorial interpretations of writers' visions, such as Robert McCall who worked on the finale of the Star Trek film and Jon Lomberg who designed the TV series, Cosmos. The mass media seems to be shown in the US at least, later this year.

In the space of computing, communications technology and space travel have already turned sci-fi dreams into reality, there is clearly scope for a popular publication which explores the futuristic implications of technological developments. Using the imagination of fiction writers to do the inquiring, there is an hunger out scenes long after it was scrapped by the TV moguls. The mass media cosmos really moves in mysterious ways.

The sci-fi magazines were obtained from Dark They Were and Golden slim St Anne's Court, London W1 at the prices quoted.

TECHNICAL REVIEWS

by Michael James

Computer Programs That Work

J.D. Lee, G. Beech and T.D. Lee (Sigma Press, 99p, 24 programs, 6/" x 8/"., (£2.55)

This is a remarkable value. The programs are far from trivial and include some rare beasts among their number. Divided into three sections, we start with Maths programs: AREA (integration), CALENDAR, DAY OF THE WEEK, LEAST SQUARES straight line, PRIMES (sieve of Eratosthenes), ROOTS (complex quadratic equation), STANDARD DEVIATION; continues with the Science: LIFE (Conway's "game"), PREY (ecology), WASTE (pollution), TITRE (titration chemistry), ENDFIELD (potentiometric titration), ATOMIC ORBITALS (plots common orbits), WAVES (Fourier synthesis), BOMB (Monte Carlo simulation of nuclear fission), SATELLITE (Kepler's laws); and finishes with games: BATTLESHIPS, CARS, COMP, DRAG, FRUIT MACHINE, MASTERMIND, SPIES, TIMM (Nim).

The programs are well presented, starting with an introductory page, then a listing and a trial run. The discussions are well informed if somewhat brief. Of all the sections, the science one is most unusual, containing many programs that would be otherwise difficult to find.

The games have a distinctly educational flavour — it's not difficult to think of 6th form projects based on any of them. I am also glad to say that one or two of them are new to me!

Apart from the use of MAT statements, the BASIC used is easily within the scope of most microcomputers. Details of it are given in the preface. It still seems a pity (see other reviews) that we have to type these programs in and the promise of papertape copies, made on the back cover, offer little hope of obtaining a generally more readable form. Will we really have to perfect a computer reading peripheral before a standard interchange format is found?

An excellent book. Even if you only want one of the programs it will repay the investment many times.

Calculating with BASIC

R. Guido, 1979 (SCELBI Publications, 79 pp, 8/" x 11", £4.95)

This is an unusual book in that, rather than trying to teach the reader BASIC, it attempts to show how one can use BASIC in various fields of application.

My first complaint is that the cover lists "maths, finance and statistics," mechanical engineering and electronics; and the book only deals with maths at an A-level, finance and mechanics at about O-A level, simple electronics (the behaviour of resistors, capacitors, etc.) and something that isn't mentioned on the cover — games! Having made clear the topics covered, it must also be said that none of the programs listed would be of much use to an expert, or even to someone competent in the various fields. They are all fairly simple and wouldn't tax anyone's programming skills to write.

The value of this book would very likely be missed by anyone looking at it weekly in a shop. It's not a selection of programs to solve specific problems but rather a collection of simple problems and worked solutions in BASIC. Used in conjunction with a BASIC Manual, this would form a good basis for an applied course in BASIC at school or first-year university level. That's not to say that the book couldn't be used as a self-study text; the explanations are clear and each program is developed in reasonable chunks and is well commented. However, I feel that a computer student would be at hand in order to get the most from the book.

If you feel you're coping with BASIC but can't take how to use it in your own subject then Calculating with BASIC might convince you that it's all worth the effort.

6502 Applications Book

Rodnay Zaks, 1979 (SYBEX, 249pp., 5/" x 8/"., £7.95)

Any new book from Rodnay Zaks is important and anything called an Applications Book must be of interest to any computer owner? True — no, not necessarily. There is a distinct split between hardware and software experts. True, there is a small group who feel happily at home in both, but I've no evidence to say that this is because of their interest in microprocessors. The software experts seem to be interested in "soft" projects — games, business programs, etc. Any extra hardware is usually simple — a sound box for a PET or a joystick for an APPLE. Their creative effort goes into the program and the hardware is seen as something of a problem. The hardware people do not have quite such a cut off time of cut! Their main interest is in any creative effort goes into the hardware, but they cannot afford to ignore the software — they simply have to write a program to get their master-piece working.

The software/hardware division in the home computer world is as clear as when trying to write a book of applications. If you assume that the reader has only software knowledge, then quite a bit of time has to be spent teaching basic electronics. If you assume that the reader has only hardware knowledge then a course in computer science is what you finish with. If you assume a fully knowledgeable reader the book becomes redundant!

Taking all this into account one can only expect an applications book to be useful to a small group of people who happen to meet its hardware/software level. Rodnay Zaks has, however, solved the main problem by writing Programming the 6502 before the 6502 Applications Book. If you're a hardware expert then read the former; if you're a software (6502) expert interested in hardware applications of the 6502 then this book is for you.

Chapter 3 gives a description of the usual one-
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**BEEFING UP THE MK.14**

The alarming rate at which MK-14 microcomputers are appearing on the classified ads pages of the various computer magazines is a useful indicator of the shortcomings of this very popular device. Tim Hawkins feels the main problems centre around memory size and input/output limitations and in this article he describes a bus interface system which will allow the adding of suitable low cost options.

**A problem of size**

The Science of Cambridge (SOC) MK-14 is a very popular microcomputer training kit, representing for many people their first contact with the world of personal computing. Because of its very low initial cost it has become one of the mainstays of cheap, low budget computing used by amateurs, students, schoolchildren, and anyone wishing to gain a foothold in the world of data processing. Unfortunately as a user becomes more acquainted with his/her machine, and hopefully more ambitious, then the limitations of the device become increasingly apparent.

The first problem is that of memory size; the 600 or so bytes available on even a fully expanded board has a pronounced damping effect on the size and complexity of the programs that may be run on the machine. Secondly, I/O problems are pronounced by the Hex keyboard and 7 segment display are ideal for an educational trainer, but they hardly do justice to your latest version of "moonlander" or "shoot-out at the OK corral".

Is it little wonder that many people turn out their MK-14 in favour of something a little bigger and more flexible? On the other hand, as the MK-14 embodies most of the basic concepts of the larger machines, I see no reason why it should not form the nucleus of a more desirable system.

**A pack of cards**

Users of most other systems commonly have access to some form of expansion facility that allows the machine to be upgraded according to need . . . it's an extremely desirable feature, and the only other alternative is to change the computer every time you start to feel constricted. The normal approach to such computer expansion is the introduction of a system bus; mainly it takes the form of a mother board, often with buffered signal lines, into which memory and peripheral expansion cards can be slotted. Each card picks up the computer's address, data and control busses on its edge connector, communicating with the CPU via a bi-directional databus. The ideal expansion system for the MK-14 should:

a. have a low hardware cost, making small memory expansions economically feasible, and allowing those of us with hardware experience to construct "homebrew" hardware without having to resort to expensive prototyping systems (sometimes known as "kluge boards").

b. Extend the addressing range from the present maximum of 4K (of which not all is used) to a possible 64 Kbytes.

c. Leave the machine software and hardware compatible with the full range of SOC interfaces and software.

d. Have a wide range of options allowing the user to configure the machine to suit particular needs.

Careful choice of a card system is necessary in order to make the above objectives possible. In addition it's worth adding a few cost-related directives to aid the choice still further:

1. It must not use indirect edge connectors such as DIN 41612 as these items are generally very expensive.

2. It must be cheap, easily obtainable, and not likely to be discontinued in the near future.

3. It must not require a special mother board as these items are also very expensive.

Looking around the market turned up only one real possibility that fulfilled all 3 conditions — the Kemitron system. Others such as the Elektor bus and the Acorn bus were considered but they fell down on the overall hardware cost of each card. The Kemitron system uses a mother board constructed from a piece of Veroboard with 43-way edge connectors soldered across its width; no PCB — just Veroboard and connectors. Due to the use of direct connectors, pieces of Veroboard cut to a suitable size may also be plugged in to carry any user designed equipment. Kemitron make a wide range of boards ranging from RAM and EPROM cards to two different types of VDU and an EPROM programmer — about 20 options in all. Full details of the system can be obtained from Greenbank Electronics whose address is given at the end of this article.

Having decided on the card system to be used it remained for me to decide a method of interfacing it to the MK-14.

**A quick look at the MK-14**

The interface relies heavily on the fact that there are several holes in the MK-14's address map. If we send an address which lies inside one of these holes, then all of the on-board logic will be deselected and effectively disconnected from the databus. This feature allows us to switch between the MK-14 and any external memory on the expansion busses.

One of these holes lies immediately above the monitor program extending from Hex 200 to Hex 7FF. Unfortunately this is only true of the Mark 5 boards; if you have one of these (it's legended on the reverse side of the keyboard on the PCB) then all is well. If not then don't despair as the problem can be remedied. (If you are not sure about which model you have then check the locations in memory from Hex 200 comparing them with the corresponding locations from Hex 000 upwards. If they are the same then you have an early version of the board which has 4 copies of the monitor program in the first 2K. The required modifications are detailed in a later section of the article.)

The use of holes in the address map to provide deselection of onboard logic, whilst routing off-page addresses through the usual arrangement of
buffers on to the mother board, allows the MK-14 board to remain unmodified and hence compatible with SOC software and the full range of interfaces that SOC have released to date. Also, those of you who have fitted the extremely useful single-stepping facility should have no trouble at all operating it on programs developed in the expanded area of RAM. An option to implement single-step will be described in a later paragraph.

**Hardware**

The interface card connects to the machine via an interface cable which plugs into the CPU socket of the MK-14. The circuit works as follows. IC4 (74LS175) is used to capture the 4 most significant bits of the 16 bit addresses which are multiplexed on to the data bus whilst the NADS strobe is low. The other 4 bits of the databus carry status information during this time. The outputs of the latch are buffered via IC2 and fed to the system bus. This latch also provides a set of complementary outputs (IQ,4Q) which after being NANDED by N7 (74LS20) provides a signal which goes low if the CPU outputs a page zero address. This signal is used to control the address multiplexer IC5 (74LS157).

If the CPU selects any page other than page 0 then the output of N7 will go high, selecting the hardwired address up on S1-S4 and routing it to the most significant byte of the MK-14 address bus. This address is selected so that it points at an empty area of the MK-14 address map, and thus deselects the board. This select signal is inverted by N8 and is used to enable the data bus buffer IC1 and to allow the CPU to communicate with external hardware.

Address bus and control bus buffering is provided by IC2 and IC3 (2x811LS895) and N1-N6 (74LS04) respectively. The various I/O and interrupt pins of the SC/MP chip are shown as being wired to both connectors. In practice it is likely that a mix of signals will be needed on each connector, some not being used at all; it’s up to the user to decide which bus to use, depending on requirements.

**Options**

The basic system may be enhanced in several ways and the following are suggestions that have been tried and tested on the author’s prototype.

A. Single Step. This circuit is from the SOC Manual and generates an interrupt (sense A high) as control is passed from the program to the user routine. This causes the CPU to execute the first instruction of the routine and jump back to the monitor, displaying the address of the next instruction and its value. By pressing the “go” key the program will stop one instruction (not one byte) at a time, so that program flow can be checked. One must be careful, however, to ensure that there are no instructions that modify P(3) in the program or the single step will start doing some funny things.

The hardware to implement this is shown in fig. 2. Seven cycles before exiting the user program the MK-14 monitor executes a halt instruction which clears the single step counter. The 74LS93 counts NADS pulses which mark each cycle, so as the CPU reaches the first byte of the user program the QD output of the counter is incrementing to one, generating an interrupt on sense A. This causes the SC/MP to execute the current instruction and return to the monitor routine. The 3 position switch selects DEBUG (sense A low, normal monitor operation), system interrupts (sense A connected to system interrupt line) and single step (sense A to QD output of 74LS93). B Wait State Generator. If it is necessary to use a long interface cable (greater than half a metre) then this option will be necessary. Because of the longer length of cable there is a greater propagation delay through it, so the processor must be made to wait until the cable signals have stabilised. The circuit shown in fig.3 implements this. It effectively stretches the read/write cycle by the length of time needed for the signal levels in the cable to become valid.

**Construction**

The prototype was constructed on a piece of Veroboard with a goldplated 43-edge connector pad. There were no real problems encountered except
that supply decoupling proved to be critical. The problem was solved by liberally sprinkling 0.1\u2126F capacitors across the supply rails at various places. The interface cable can be constructed in many ways. I used a piece of 40-way ribbon cable with a 40 pin header on one end to mate into the SC/MP CPU socket. The other end was hardwired into the interface card. The Bus or Motherboard is relatively easy to construct and should present no problems... solder 0.1" pitch 43-way edge connectors across the width of a strip of Veroboard until you have as many slots as you need. I recommend that they should be spaced on 1" centres in order to make insertion of boards possible without the components touching.

Kemitron Electronics are currently working on PCBs to carry the components of the interface card, and these should be available from Greenbank shortly. (It should be pointed out that Kemitron may change some of the components in order to make the design more economical, so if you are considering waiting until this PCB is released, don't buy your chips yet!)

### Software considerations

The monitor program on the MK-14 is quite capable of handling the 64K memory map, so there are few differences between the expanded and the original system. The SC/MP's memory map is organised as 16 pages, each of 4K, each page being independent of the others. A program running over the edge of any of the page boundaries will "wrap around" to the start of the page it just tried to leave. Control transfer between pages is made possible by loading a pointer with the target address and then swapping the pointer with the program counter. In fact, it behaves like a much larger version of the original device.

The first programming exercise that the user should attempt is a better cassette interface program as the present SO1 routines are only capable of loading or storing a maximum of 256 bytes; loading a fairly large program requires that it be loaded or saved in a series of 256 byte blocks.

### Modifications for earlier models

As reported previously, the earlier models of the MK-14 cannot immediately be used under this system. This is because they have no unused portions of memory map that can be used to deselect the board, so we
have to create one. We can either remove the optional RAM or the INS 8154 RAM I/O and change the hard-wired address links on the B inputs of the interface's 74LS157 (IC5) from 01002 to 10112 (optional RAM) or 11102 (RAM I/O). Unfortunately this means that some of SOC's software cannot now be run on the system but this is a small price to pay for the increased flexibility available. The links are marked S1-S4 on the main logic diagram and are "made" for a logic 0.

**Conclusion**

This is probably the only project I have been involved in that has at its completion achieved no real visible increase in the machine's abilities — indeed, in some cases its capabilities have been reduced. But it must be remembered that a bus system is designed to allow additional hardware to be added easily to the computer. The decision on whether to build or buy is yours, and it depends on whether or not you have any experience with construction of memory and peripheral devices. I chose the Kemitron bus because of its low cost: each board, sold without components, costs between £5 and about £9 — and the user provides his own chips. This means, for instance, that buying an 8K RAM board lets you build up your memory in increments of, say, 1K until the 8K limit is reached, at which time another board becomes necessary.

If you decide to build your own gear then, as I've explained, a piece of Veroboard 43 strips wide with a key slot on strip 37 can be used to breadboard your own designs.

Further information on the Kemitron system can be obtained from Greenbank Electronics. Send a sae to the following address and ask for leaflet MP4. Greenbank Electronics, 92 New Chester Road, New Ferry, Wirral, Merseyside L62 5AG.

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**Personal Computer**

**World**

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Who needs the C.R.A?

You are choosing a micro system for your business. Each shop sells a different type of micro, alleged to be better than all the others. But they all agree on one thing: “Don’t go to a new, small, ‘unregistered’ or ‘unqualified’ firm”, whatever that may mean. Software is only a sideline for them, but they whisper meaningfully: “Beware the small man”.

On the subject of qualifications, all you need to get up a computer shop is a bank reference and some connection with the computer world. Many computer businesses started as a partnership between a salesman and a mainframe buff; all the “experience” came on the job. Now they have a couple of smart shop assistants, two lads at the back, thousands of pounds worth of computers on the shelves — and they talk patronisingly of inexperienced newcomers and cowboys. Unfortunately if you’re wanting some of their expertise they may be too busy to give you much of their time... you’ll have to see the new trainee programmer. No doubt they belong to a trade association, but so what? — they’re still too busy.

You may suppose that belonging to a trade association means that a firm is honest and reliable. You suppose wrong; all it means is that nothing has actually been proved against them. The snooty attitude of the established computer equipment business and the “trade association badge” retailer may be just another way of luring customers away from a rival concern. Many trade associations, despite the high ideals with which they are formed, soon become price rings or mutual admiration societies. Outsiders are discreetly damned with faint praise and hinted warnings of disappointing experiences. There’s nothing unusual about this; you just have to take it all with a pinch of salt.

Let’s consider some existing trade associations and your chances of getting a good deal from one of their members. Take solicitors and franchised garages. Lawyers have a very tight association, the Law Society, with compulsory exams, tribunals to investigate alleged misconduct and so on. And yet there is believed to be a larger proportion of crooks and incompetents in the law than in any other learned profession. Often, anyway, your work is quite likely to be handled by an unqualified clerk or trainee.

I wonder how many of you have entrusted your car to a franchised garage, expecting the highest standards? Independent research shows that you might well have been sadly disappointed. Suppose that by secretly marking parts of your car you discover they didn’t actually service it at all — a deliberate swindle, and you complain. “I’m very sorry sir, the new girl (or the floppy disc) put your job sheet in the ‘out’ tray by mistake. We’ll do it at once.” Will you complain to the trade association? Probably not. If another garage knows what goes on, are they likely to make trouble for themselves by sneaking? No. So another crook stays on the register.

The fact is that the big firm, being a system (in the Systemanics sense, see PCW book review Jan. 1980) has considerable opportunities for causing, excusing and glossing over all kinds of incompetence and even gross dishonesty. In a small business, at least you know where the buck stops. They are also probably more in need of your payment and your goodwill, and in the event of a serious dispute are more likely to settle quickly than to try to get you tied up with bureaucracy and other tricks.

So you need the services of a software consultant. What are these qualifications that are so essential? A university degree in computing? A chap who can write a program to sort a million files in 10 seconds may not be very practical in his suggestions on how to plan for future developments in your business. In any case, the best predictor of success as a programmer is apparently English “O” level. Also, if he’ll excuse me, mentioning it, what qualifications does he have to make him a business-man? The fact is, if you can deliver the goods you have enough, and if you can’t, they are irrelevant. It’s like defining a gentleman. Everyone does it so as to include himself but to exclude the chap he thinks is one rung down the ladder. Remember, the strongest conservationist is the man who has just built his bungalow.

Let’s get down to cost. A well-known, trade-registered all-singing-all-dancing consultant may well charge £19 per hour for programming. If you buy a complete turnkey system from a large firm they may subcontract the programming to the same chap and price it at £20 per hour. Compare this with what one man, working from home, might charge.

There is another disadvantage of the hardware only shop. Unless you get everything from the same firm — computer, printer, disc unit, interfaces, the lot — if something goes wrong it is difficult to prove that one particular supplier is responsible for the fault. I know a small man who leases only complete systems. He writes the programs and supplies the hardware too. If a hardware fault develops, he exchanges the faulty unit for one from his office while the repair is effected. I think he is giving as near a guarantee of satisfaction as you can find in this imperfect world. Perhaps this will catch on among the micro fraternity.

Incidentally, I have nothing against shops or trade associations. . . . my intention is simply to show the other
side of the coin. I don’t even think small is beautiful. I believe dishonesty and incompetence to be common in both large and small businesses... it all really depends on the people involved. As it says in the Bible, “every man proclaims his own honesty, but who can actually find an honest man?”

The new trade association may help, and I wish them well; but I can’t afford to join myself — yet.

Conscientious Cowboy

Schools—nice means, shame about the end

So, the Physics Department has got its hands on a micro, has it? Think of all the exciting binary and electronic lessons that can now follow. Hours... months of fascinating programming. Let the physics or maths teachers have their way and the next generation will be full of electronic whizz kids.

But who wants electronic whizz kids? A few will be needed for product and systems design, but with the advent of ever higher level languages and more and more packaged solutions, what is really required is a generation that can relate the capacities and scope of computing to the reality of the world around, with all its imperfections and compromises, rather than one which gets lost in the absolute logic of electronics and programming.

Think back twenty or thirty years. Computing started as a scientific activity and the academic world still rates computer science above computer applications. They have developed most elegant algorithms for most abstruse calculations, but we have all failed to construct computer based systems that work and are readily accepted in the outside world. Slowly these are emerging... but there are real dangers that our hard-won progress will be thrown away by the physics and maths teachers with their micros going back to the algorithms, registers recording 1790-1810, the critical period in the Industrial Revolution. From such analyses, the pupils can learn an immense amount about the social, cultural and economic trends of that period. Because they can explore the data themselves, they gain a new excitement in learning.

Secondly, computing can be used for simulation. Interactions which are on too large a scale (or, as in chemistry, are too dangerous) can be explored through simulation. Think of pupils in a geography class relating direction and temperature of sea currents to rainfall and climate on land, and then to agriculture, crops and national economies. How much more alive geography can become!

Thirdly, computers calculate... they compute. And how! The computers which are just emerging today can already perform ten million calculations in one second... ten million! There is indeed a challenge for the maths teachers. Not teaching binary or logic, but teaching the children how to use ten million calculations, and, having used them, how to look at the result and say “that looks about right!” Yes, we certainly need numeracy, but numeracy based on a technology which removes the chore of basic mathematics and opens up extraordinary horizons.

Finally, through communication links, computers open up a world of information. All known knowledge is available at the touch of a button. Lockheed - SDC - Euronet - Infoline - Videotex — these and others exist to make information available. But how do we select the information? How do we isolate the particular piece of information needed? That is what the teachers ought to be teaching!

The children at school today will be in the middle of their careers in twenty years time. A lot has happened over the past twenty years... much more will happen over the next. Many of the teachers of today received their training more than twenty years ago, and yet the schools have the unenviable task of preparing today’s children for their careers tomorrow.

So, teachers of mathematics and physics, put away your bits and bytes, your circuits and logic gates. Start applying computing and facing up to the opportunity and challenge computing presents. Measure your success not by the number of programs your pupils have written, but by the number of programs that are used in parts of the school curriculum other than your own.

David Firnberg
(Managing Director, Urwick NEXOS Limited)
If only buying a microcomputer was as simple as using one

With so many micros to choose from, how do you select the best to meet your needs?
Just look at the advertisements in this magazine. When can you find time to digest them all?
There are millions of chips, thousands of boards and hundreds of peripherals, software systems and application packages. How do you pick the right ones to meet your requirements?
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Company Profile
Digitus is building a centre of micro excellence with the best equipment, software and people we can find. Last year the company shipped 40 systems. This year we will ship over 100. Some will be standard commercial applications, accounting, wordprocessing, personnel and stock control; some will be management science applications, modelling, critical path, maths and stats; some will be new applications made possible by novel micro devices and by micro economics.

The company is continually evaluating new hardware and software, using available equipment and packages wherever possible, implementing new components when necessary, developing products to fill gaps in the market.

Personnel Profile
Microcomputing is not a career for everyone. Changes in technology are rapid; timescales to implementation short; variety of hardware and software endless. For these reasons we need high calibre people.

- Professional Designers/Programmers with three to seven years proven project experience.
- Senior Specialists with eight years plus experience in control, communications or commercial systems.

We provide almost infinite job variety, opportunity to keep pace with technology, good salaries, profit sharing, stimulating colleagues to learn from and nitty gritty technical work.

If you wish to develop your career in micros, forward a professional C.V. detailing your project experience and call for an appointment.

P.S. There are also a few openings for computer science/engineering graduates with up to two years' experience.
An improved version of Hex, the artificial intelligence game
By Tyrone Crudis

A previous article (PCW, October 1979) described ways of improving the graphics displays for HEX, the Artificial Intelligence Game and other board games, and promised that an improved version of HEX would follow; IMPHEX now arrives to fulfill that promise. If you pronounce it correctly, "IMP-HEX", you will be recognized as an aficionado and will become in every way more like those characters in the TV commercials who are richer, thinner, better dressed, and more attractive to the opposite sex after partaking of the sponsor's product. If you pronounce it incorrectly, "IM-PHEX", everyone else will know that you have not read this article and probably don't even read the right magazine. Be warned, however: in the process of studying what follows (and it will take some study!) you may learn things about games design in general, derive hints and kinks for use elsewhere, decide to buy a PET, gain insight into artificial intelligence, or be motivated to belabour the editor about his selection of writers and their ability or lack thereof.

Artificial intelligence

There is a natural human tendency to define intelligence as any ability with abstract processes that humans have but computers don't. To sustain this stance requires rapid footwork, however, as the list of machine abilities advances inexorably. One by one the sacred cows of yore have been led to the butcher: Memory, Logical Processes, Goal-Seeking Behaviour, The Ability to Prove Euclid's Theorems of Geometry, The Ability to Play Chess, The Ability to Play Chess Well, The Ability to Play Chess at Expert Level: all have at one time or another been advanced as defining the difference between humans and computers, and all have been inexorably converted to hamburger. The circular fallacy of defining intelligence as an ability possessed only by humans and recognizable by other humans, even if undefinable, is defeated by the famous program ELIZA which, when controlling a large-scale computer, is impossible to tell from a human psychologist communicating through a teletypewriter. Science fiction often predicts the replacement of doctors and lawyers by computers and it would seem from their over-reaction in real life to the threat of computerization that they subconsciously see and fear the possibility. The idea that there may be types of intelligence not yet known to humans is apparently sacrilegious or scatological; certainly it is never mentioned. But who has proved that inductive and deductive reasoning are the Only Ways, or that the scientific method is the most efficient? After a few drinks many scientists, engineers, and inventors will admit, if they think you are trustworthy, that their best ideas come to them in a flash and that they have subsequently to tortuously develop the necessary step-by-step rationalization and analysis. Intuition? The muses of antiquity? Revelation? Communication from alien beings on another plane of existence? I think we should keep an open mind about thought processes and be ready for the day when the first computer becomes aware of itself as an entity.

IMPHEX will not make any humans redundant. It will, however, demon-

Fig. 1: Block Diagram for IMPHEX
The problem

Whether called HEX, HEXPawn, or HEXPAWN, it's all the same game, and commercial programs are available. What's wrong with them, aside from uninspired graphics? There are three major criticisms: 1) You'd think that all cheating moves should be detected, but this is not the case; 2) The computer's series of responses is always the same; 3) The program informs the computer before the game of all possible board positions and all the legal moves from each position. Now you may have a version to which one of those criticisms does not apply, but I'll wager that no one has a version to which none apply. Therefore we will proceed to prevent all types of cheating, provide an option for random play (reproducible play is desirable initially, when studying how the computer goes about learning), and we will force the computer to learn without knowing any moves ahead of time.

The solution

Crudis’ Compendium of Games-Writing Standards consists of all the items in italics (unless the editor, who has a thing about italics, sneaks a few extra in), stand by for the first one: You've heard it before and I'll say it again: DRAW A BLOCK DIAGRAM. It should describe the sequence of required operations and be independent of the computer language used. It should use generally accepted symbols. It should be so simple that it can be contained on one page. Figure 1 is an example of what I mean. After the program is written, line numbers are added to the block diagram and will be of inestimable convenience to anyone studying the program in the future. Next, if not sooner, draw a screen layout showing the position of the various subroutines of the display. Figure 2 is of the kind of thing needed. For the case in hand it shows that there is a square 20 x 20 board display whose upper left corner (origin) is 18 cursor-right steps from home, a 7 x 14 scoreboard with origin at 3 cursor downs, and a 1 x 39 prompt message with origin at 22 cursor downs.

Thirdly, make up a preliminary list of variables. The names of all variables should be mnemonic; that is, they should give a clue to their usage. If your variable names, you have a right to feel cuckedoid. All manufacturers should provide for two-letter and letter-digit names. Having performed these three steps, you will undoubtedly find that your mind is cleared of cobwebs and that you realize that you don't understand the problem. This is normal. Do not understand circumstances start to write the program at this point. Instead, iterate the three steps until satisfaction sets in.

Some sensible standards for variable names:

- Reserve J, K, and L for counting variables in FOR-NEXT loops.
- Reserve X, Y, and Z for coordinates.
- Reserve D for delays, often useful in games to provide an impression of thoughtful response by the computer or just to give the human time to think.
- There's nothing magic about the following list of variable names specific to IMPHEX, but you will find that, like a pair of new shoes, they will become comfortable after a few wearings and will seem to have been always right.

**IMPHEX variables**

Y, X: board coordinates.
HI, HF: human initial and final position, numerical keypad coordinates.
FNC(X): converts keyboard to X, Y coordinates.
XI, XF, YI, YF: X, Y initial and final positions.
W: relative move in X.
XT, YT, WT: trial positions.
XD, YD: display update scan ordinates.
BD(4,3): board array; stores current position.
BM(3, 3, 15): bad move array; stores up to 15 "bad move" positions.
SI, SF: temporary store values of BD array.
XI=FNC(HI)-YI*10: YF=INT(FNC(X)<=6)*2: YI=FNC(HI): YF=FNC(HF)

**Keypad to X, Y conversion**

We are all agreed, aren't we, that it is desirable to use the familiar keypad format for inputting the human moves, but to convert each move to X, Y format to simplify computer analysis of their validity and legality and to make them compatible with the computer's moves and with storage in an X, Y array for analysis, yes? (If you are happy to input your moves at the keyboard in X, Y format at four digits each, initial X, initial Y, final X, final Y, then you can skip the following section.)

![Keypad Orientation X, Y Coordinates](image)

---

**Using an array to store the board**

An array is a set of numbers arranged by coordinates. A one-dimensional array is no more than a list. A two-dimensional array is like a checkerboard, and arrays of any number of dimensions are theoretically possible. Some dialects of BASIC are sadly lacking in the number of arrays which can be set up simultaneously, the number of dimensions possible, and the size of the number which can be stored at each set of co-
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**74 PCW**
Detecting invalid and illegal moves

As part of the process of accepting human moves the computer must check them to determine if they are valid (correspond to agreed-upon nomenclature) and are legal (correspond to agreed-upon nomenclature). This is because humans tend, unlike computers, to misunderstand instructions, make mistakes, make mischief, or try to cheat. Fig. 6 blocks out the requirements, all of which can be written in two lines, thanks to the use of X, Y coordinates.

Any confusion on board nomenclature can be detected and responded to by:

```
420 IF HI<1 OR HI>9 OR HF<1 OR HF>9 THEN PRINT "NOT IN THIS GAME!" followed by another move query or a kindly and sympathetic offer to show the instructions again.
```

If BD(XI, YI) is not equal to 1 (line 440) then the move is illegal because the initial cell is not occupied by a human piece (value +1). No human move can change the Y coordinate by other than +1, so if YF-YI is not equal to 1, (line 440) the move is illegal. A move can only be straight up or diagonal, so moves like 3, 4 are prohibited. These are tested for with IF ABS(XF-XI)>1 (line 440).

When the human move is on the diagonal, it should be because he is capturing a computer piece (value -1). Line 450 tests for this with IF ABS(XF-XI)+1 AND BD(XF,YF)<1 (line 440), that is a柳 moves to an empty cell with IF XI=XF AND BD(XF,YF)<0. No doubt we will always have with us the joker who tries all illegal moves, so we can opt to cater for him by counting the number of illegal moves attempted and having the computer print an apt remark when the number reaches, say, 4. This printout should be positioned so that it will not impede any other current display, so we will place it in the area reserved for the scoreboard, which is only seen at the end of each game (lines 510-540). Notice that reversed text should not be displayed nakedly, but needs a surrounding border. Later on I shall give you a "before and after" test to try out if you need any convincing on this point.

The computers move

Since we are not providing the computer with any strategy initially, its choice of piece to move can be made by one of two techniques, sequential or random. The sequential technique consists of looking at the board in an arbitrary fixed order, say, cells 7, 8, 9, 4, 5, 6. (No need to look at 1, 2, or 3 since the computer would have already won if it had occupied any of these cells.) The advantages of the sequential technique are that it is slightly easier to program for and that it makes it easier for the human who is studying the computer’s responses to follow its learning processes. The advantages of the random technique come into play when the human player, after many sets of games, has learned to eke out his winning streak as long as possible by taking advantage of the computer’s blind spots. Then converting from sequential to random selection makes for "a whole new ball game", as our American cousins say. I will append a discussion of random move generation as an option subsequently.

Having selected a trial piece, the computer must scan the possible moves for that piece until it finds one. This scan also can be implemented either sequentially or randomly. If the move so selected is not a "bad move", it can be carried out and announced. A "bad move" is one which led to a win for the human in a previous game. In the implementations of HEX which I have seen to date, this process of identifying a bad move took place as follows: one array stored all possible board patterns (there are 33 of them). This entire array was scanned, board by board, line by line, cell by cell, until the pattern corresponding to the current game condition was found. Another array stored all possible computer moves for each possible pattern. As the end of each lost game occurred, the
move leading to it was erased from the move array. If the computer determined that a board pattern it found itself in had no moves, it would resign, and that board pattern would be erased from the pattern array. Eventually only winning move series would exist in the two arrays. The best one can say of it is that this is a brute force technique!

The great improvement

To replace this technique, which on second thought I am willing to categorize as clumsy, inefficient, and lacking in charisma, I offer the following: The Bad Move array, which is tabula rasa or blank at the beginning of the game, will be used to record only the move reached in any game where the next move was a win for the human opponent. Then, before making any move, the computer will compare it with the Bad Move array and will reject it if it is found therein. In addition to the obvious appeal of its buildup from nothing, this technique is much more efficient in that it does not scan the whole Bad Move array but only the number of elements corresponding to the number of human wins to date. Also the scan of any board within the array can be cut off the moment the first cell being examined is found to be unique from the corresponding cell in the contemplated move. And clearly the total memory requirement is much less.

Concept of trial move

I trust that you are all referring to fig. 1 as you read and will have noted that the test for a human win is economically combined with the computer's search for a move. Having found a legal move, the computer generates the position which would result from the move. This position is called a trial move since the computer is prepared to retreat from it if it is found to be a Bad Move.

To make a trial move, the computer stores the current position of the piece to be moved and the current condition of the space to be occupied as SI and SF respectively. Then, if the move is determined to be a bad move, it reverts to that position. Notice that only one pair of binary numbers need be temporarily remembered, not the entire board. If the Snark is not a Boojum, which is to say if the trial move is not a bad move, it is retained and the display updated accordingly.

Acute trick

Now the strange thing happens which is labelled on the block diagram, "See text for explanation." The Acceptable Move is recorded in the Bad Move array!! This is so cute (in the sense of "clever, shrewd, ingenious") as to be unbelievable. Do you see the devilish beauty of it? If, on the next move, the human wins, it will have been the right thing to do. If, however, the human does not win, the computer will make another move and that move will be recycled in the same level of the array, overwriting the previous record. If the computer wins, the process continues to the next game and so on. The computer never scans this level of the array until after the human wins and the variable HW is incremented by one!

Nested loops

Figure 7, which is a diagram of the nested loops which carry out all these inter-related decision-making processes, shows the various ways of falling out of or being pushed out of the nest. Fortunately for PET owners, PET can leave a FOR-NEXT loop before it is finished, with no ill effects. This is not the case for some other computers which shall be nameless because the editor needs the advertising fees. One more thing to look for on Brand X when you go shopping! (Don't ask the salesman: test it yourself. He may not know or he may lie. Remember that he got where he is by being unsuit for other positions. The PET 2001-16 with proper keyboard and all has a machine-language monitor resident in ROM: did my salesman know that? No, he had a very nice cassette which he insisted on loading to demonstrate the monitor!)

Frills and furbelows

If you can remember the difference between stalactites and stalagmites, you will have no difficulty in keeping straight the difference between frills and furbelows: frills are the unessential but attractive arrangements along the top edge of a dress, while furbelows perform a similar function on the bottom edge. In this category I offer a number of suggestions. (One of Crudis' Compendium of Games-Writing Standards - PCW Oct '79 - you will recall, is that one might as well use the entire memory as

1. End of Game: As the whole point of IMPHEX is to see the computer demonstrating what it learned in the previous games, we must be prepared to cycle back to the all-games initialization point in the program on request (line 990). Likewise we can feel justified in allowing the computer a somewhat tart response if the human elects not to continue (line 995). Note that the first-game initialization point differs from the all-games initialization point in that the former defines functions, dimensions arrays, and sets win counts to zero. I recommend that all games, not just IMPHEX, should include an ANOTHER GAME/option. There is nothing more lachrymose than a program which retires into READY with a flash-
you may have to rewrite this as PRINT

only two tests determine if 15 is "Y",

instructions should always be included

4. Instructions:

selected
touched on previously, resulting from a

have the "HOW MANY TIMES DO I

THAT!" (line 975). Children and clergy-

ter wins its first one, we get "I NEEDED

thing, of course, but a little bit is like

input must be followed by RETURN;

5. Starting the Game after Reading the

Instructions: In line 1500 the command

WAIT 59410,4,4 waits for the space key

and no other to be depressed. This is the

only exception to the rule that each

input must be followed by RETURN;

but the uninitialized user, I have found,

sees the double-sized space key as a

special function key related to and alter-

dative to the double-sized return key,

and learns to expect its use as (and

restricted to) the start-of-game function.

Therefore I recommend the use of

WAIT 59410,4,4 to start games after

reading instructions or to turn pages of

the instructions. If you use it at all, you

should standardize on it throughout your

library.

6. The Scoreboard: A little attention to

details here (lines 935-950) pays off in

visual appeal. The use of black letters

on a white background sets off the

visual appeal. The use of black letters

throughout

that using

780: if this move is not legal, go to 850.

775: select a move randomly from the

760:

2 or 3:

750: zero

has been tried.

M(3). These will

P(3,3) and one for move selection DIM

sequence of the cell ordinates but allows
each position to be generated only once

and X= 3, 2, or 1 but it might generate

three times or indefinitely. What is needed is

an algorithm which sets up a random

sequence of the cell ordinates but allows
each position to be generated only once

and each position sets up a random

sequence of trail moves but allows each

trial move to be generated only once.

The problem is congruent to shuffling a

deck of cards, and the simplest imple-

mentation I have been able to generate

is as follows:

Set up an array for piece selection DIM

P(3,3) and one for move selection DIM

(3). These will be simply initialized to

record that each position and move has been tried.

760: zero the piece selection array.

755: select Y randomly from the values

2, 3, or 3: select X randomly from the

values 1, 2, or 3.

760: if this pair has been used before

on this turn, try again.

775: if there is no computer piece at

this point, go to 855.

770: if there is a computer piece at

this point, zero the move array.

750: select a move randomly from the

values 2, 3, or 3.

780: if this move has been used before,

try again.

785: if this move is not legal, go to 860.

850: put a 1 in the move array to show

that this move has been tried. Increment

the move count, N2. If all three moves

have not been generated, try again.

855: put a 1 in the piece array to show

that this cell has been tried: increment

the position count, N1. Try again until

Continued in Programs – P.113
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SPEEDING-UP THE SEARCH

In last month's article we introduced the extremely powerful Alpha-Beta algorithm for searching two-person game trees, and we saw how dramatic the effects of alpha-beta pruning can be when the branches of the tree are searched in their optimal order. Although optimal ordering is impossible to achieve (if we knew what the best move was, there would be no need to search the game tree to find it), there are a number of techniques which form the subject of this month's article.

Ordering by short look-ahead

Consider a program which searches a game tree to a depth of 10-ply. If the average branching factor is 36, as in chess, the tree will be enormous and any saving that can be achieved by optimizing the order of the search will be well worthwhile. One way in which this might be done is to carry out a much shorter look-ahead search, to a depth of 3-ply for example, and then order the moves on the basis of this shallower search. Once this has been done, the search routine moves down the tree and performs its full search of the tree, the first 3-ply of which have already been put into an approximate order. As a result of the approximate ordering, the full look-ahead search is conducted in a more efficient manner, with considerable savings in time. The following example should help the reader convince himself of the value of conducting a preliminary search.

Let us suppose that in a chess position there are 36 moves. On the basis of a shallow search it appears that move \( m_1 \) wins the opponent's queen, move \( m_2 \) wins only a pawn, and no other moves force the win of any material. At the other end of the scale, move \( m_{35} \) appears to lose a pawn while \( m_{36} \) looks as though it loses a bishop. The program now orders these 36 moves on the basis of its preliminary look-ahead, and it first carries out a full 10-ply search on the move that appears to win the queen, \( m_1 \). Unless there is some deep reason why this move does not win the queen, the program's alpha-beta search will return a score to the root of the tree that indicates its opinion that move \( m_1 \) wins a queen, and so the number of branches which are pruned off during the search process will be high. The same thing happens when the full search process examines \( m_3, m_4, \ldots m_{35}, m_{36}. \) The reason why we need to order all 36 moves is that our ordering will not be absolutely correct, but the effect of an error in one or more value judgements will be minimized if we make the preliminary ordering as accurate as possible. For example, if move \( m_{36} \) actually turned out to win a bishop instead of losing a bishop, the move would still be inferior to \( m_1 \) (winning a queen) so we would still wish to examine \( m_{36} \) after examining \( m_1 \).

Some interesting results on preliminary ordering were discovered by Richard Russell who wrote a Kalah program in 1964. Kalah (or Owari) is one of a family of games that go under the generic name Mancala. These games are played in Asia and Africa, and the rules vary slightly from one region to another. The game presents an ideal programming exercise because the rules are simple, the branching factor is typically no more than 6, and it is relatively simple to devise a satisfactory evaluation function.

Each player controls a number of pits or bowls (often pits in the sand) and one large pit or bowl called his Kalah. In the above diagram the pits labelled ‘a’ and Kalah labelled ‘A’ all belong to one player, pits ‘b’ and Kalah ‘b’ belong to his opponent. At the start of the game each pit contains an equal number of stones, say 5, and each Kalah is empty.

The players move alternately. To make a move a player picks up all the stones in one of his pits and, moving his hand in an anti-clockwise direction, drops one stone into each pit and into his own Kalah, but not into his opponent's Kalah. When his hand holds no more stones the player has had his turn, and it is then his opponent's turn to play. If the last stone is dropped in an empty pit on his own side, he captures all of the stones in the opposite pit and places them, together with the stone making the capture, in his own Kalah.

At the end of the game the player with the most stones in his Kalah is the winner.

Russell experimented with preliminary searches of various depths. With a full look-ahead of 5-ply he discovered that the program consumed the minimum CPU time when 90% of its total search time was spent in the short look-ahead of 5-ply. He then found a method for improving this that still further. Rather than begin a new 5-ply search at each ply, he used the fact that the short look-ahead searches overlapped - the summary search conducted at one position in the tree could be used as a 4-ply search of a position at the next level down in the tree. This means that a short look-ahead of 5-ply would have its own short look-ahead of 4-ply, and a depth of 4-ply the first move, 3-ply on the next move, 2-ply on the third move and 1-ply on the fourth. So when the program is executing the short look-ahead routine it can use one partial ordering within the short look-ahead, and the short look-ahead itself is speeded up. In the case of Russell's Kalah program this technique produced a reduction in total search time of approximately 65%.

One of the problems of implementing this short look-ahead method on a personal computer is the need to store the whole of the short look-ahead tree. For most games this will be impossible without a floppy disc system, and even then there will be games for which there is insufficient memory to cope with anything more than a 2-ply or 3-ply short look-ahead search. Nevertheless, the idea is worth remembering, either for games with relatively small branching factors, or for those where you upgrade your micro by adding a bubble memory. But with even the smallest memory configuration you can utilize this method to some extent, simply by restricting your short look-ahead to a 1-ply search! Let us see how this might work in practice, using noughts and crosses (tic-tac-toe) as our example.

The program generates the three, essentially different first moves: the central move (location 5), a corner move (location 1) and a move in the middle of an edge (location 2). Those of you who have followed my earlier
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The program evaluates the resulting positions, i.e. the positions it has found from a 1-ply search, and sorts them so that the best move is examined first. We shall assume that our evaluation function retains the order in which the moves were generated, in which case the program next produces the moves from position P1, the position arising after making the central move (location 5). In reply to this move there are two, essentially different moves, a corner (location 1) and the middle of an edge (location 2). We generate these moves in exactly that order, and then we evaluate the resulting positions (P1, and P12) using our evaluation function. Let us assume that the scores for P1 and P12 indicate that P1 is a better position than P12 from our opponent’s point of view. Then on the basis of the 1-ply search conducted from position P1 we can say that the next set of moves to be generated should be the successors of position P11. Here there are four, essentially different moves: a corner on the same edge as the X (location 3), the opposite corner (location 9), the middle of an edge adjacent to the X (location 2), and the middle of an empty edge (location 6). The program then evaluates all four of these positions, and on the basis of the 1-ply search conducted from P11 it orders them in such a way that the move most favourable from its own point of view is the one which will be expanded first. Thus the process continues. As each branch of a successor moves is generated, the resulting positions are evaluated and then sorted. Admittedly the sorting will be nowhere near 100% accurate, but it should certainly be sufficiently accurate to result in effective pruning when the program reaches the bottom of the tree and begins its alpha-beta search.

I touched briefly on this method in my previous article, but I felt it worthwhile re-iterating my point by means of this example, because the notion of an ordered search is so very fundamental to efficient tree-searching, and this method is relatively painless to program.

The killer heuristic

Imagine that you are playing a game, thinking about which move you should make next. You come up with the idea of making move m1, but then you notice that if you do play this move your opponent has the very strong reply ZAP at his disposal, completely wrecking your position. You therefore stop thinking about m1 and start to think about another move, m2, but now you have been forewarned because you have already spent some of your thinking time on the discovery of the refutation move ZAP. You therefore look to see whether m2 could be met by ZAP, and if so, with what result.

The logic behind this approach is not difficult to understand. If ZAP kills your prospects of victory after you make the move m1, it is quite possible, even likely, that ZAP will ruin you after you make the move m2. In chess and many other games there is the concept of the threat, and ZAP moves often fall into this category. If your queen is threatened and you play a random move, the chances are that your opponent will be able to capture your queen on his next turn. Each time you think of a move you should first look to see if it loses your queen in the same way, and if it does then you will have pruned off large chunks of the game tree simply by finding the refutation move (sometimes called the "killer" move) early in the search.

The implementation of the killer heuristic is not difficult, but it does require the use of extra RAM. At each level in the tree, keep a note of which move produced the last cutoff (this is the killer move) and try that move first when examining the next group of positions at the same level. This method becomes clearer from an examination of the following example.

The program has already looked at the first move from the root of the tree, and returned a score to the root position. It now examines move m2, leading to position P2, and soon discovers that in reply to m2 if its opponent chooses m2 then the opponent will have improved on his score which is currently at the root of the tree. In other words, move m2 refutes move m1, and the program need not look at m21, m22, ... etc.

Next the program examines move m3. It knows that m3 refuted m2 so it first looks at its list of legal moves from position P3 to see if the same move as m3 can be found in this list - if so it examines that move first, in the hope of finding that here too the same move provides a refutation, thereby terminating the search from m3 after examining the minimum number of branches. If it turns out that m3 is refuted by a different move, then this new killer move replaces the original one and it is this new killer which is looked for first when examining the successors to m3.

There are various ways in which this heuristic may be refined and expanded, but each of them requires still more RAM. Instead of storing just one killer move at each level, the program could store (say) the first five killer moves that it encountered at each level and keep a note of how often each killer was as a refutation move at that level. Each time the count for one of the killers was updated, all five killers could be ordered so that the next time the program reached this level of look-ahead it examined the most frequently used killer first, then the second most frequently used, and so on.

Another idea is to store killer moves linked to the moves that they refute, and use this information at different depths of search. For example, if it was discovered that in a chess position the move e2-e4 by White was refuted by the reply c7-c5, then wherever the move e2-e4 was found in the tree,
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whether it be at 3-ply, 5-ply, 7-ply or deeper, the first move to be examined for Black would be c7-c5. Again the logic behind this use of the heuristic is easy to understand — a decision which is bad today will probably be bad in a similar situation tomorrow.

The principal continuation

When a program has finished its search of the game tree, and has decided on its move, it will have in its memory the path through the tree which it considers to represent the best play by both sides. Its own best move will be at the top of the tree, the move which it expects its opponent to make in reply, then the move which it thinks is the most likely reply to its opponent’s expected move, and so on. It seems a pity to waste this information when so much effort has been put into its acquisition, and no more memory is required to take advantage of the information than one needs for the killer heuristic. Simply use the 3rd ply move from the current search as the first move to be examined when the program next begins to compute a move. The 4th ply move in the current search can serve as the “killer” at ply-2 in the next search; the 5th ply move now can be the first killer at ply-3 next time, and so on. Very little computation time will be taken up with this method, and it is as well to start your search looking at vaguely sensible moves.

The Alpha-Beta window

This is another trick, inexpensive in terms of code, which will often speed up the search process. Under certain circumstances it may actually slow down the speed of search but if the parameters are carefully chosen the overall effect will be beneficial.

In most games it is true to say that in general it will not be possible to force a substantial gain within the next ply, nor will it be likely that the player whose turn it is to move must concede a substantial loss. In view of this it seems unreasonable to set the values of alpha and beta to —∞ and +∞ respectively at the start of the search. Let us take chess as our example. We can start our search by assuming that White (whose turn it is to move) cannot force the win of more than two pawns, and that White is not faced with the inevitable loss of more than two pawns. We can therefore set the “window” to be four pawns wide, by assigning to alpha and beta the values of minus two pawns and plus two pawns respectively. This means that when searching for a move for White the program will only examine moves which, at worst, lose two pawns for White, and when looking for Black moves the program will ignore all moves which permit White to win more than two pawns. This process will speed up the tree search provided that the true value of the root position does lie within the window. Occasionally though, it will be possible for White to win more than two pawns, and for the program to conclude at level 1, then think again, widening its window.

The flowchart

The flowchart that follows illustrates how the alpha-beta algorithm works when backing-up in the tree search. This diagram is an abbreviated form of figure 4 from Whaland’s excellent article (see bibliography).

(If you have finished last month’s task you will find this one much shorter.) Write a program to play noughts and crosses, taking advantage of symmetry and employing the alpha-beta algorithm. Search the whole of the game tree using the primitive evaluation function: program win = +1, opponent win = —1, draw = 0. Generate moves in the order: centre, corners, middle of edges. (Thus far as in last month’s task.)

Add, in turn, routines to use the killer heuristic in its simplest form, and a modification to set the alpha-beta window to —0.9 and +0.9. Note the effect that each of these changes has on the time taken to search the whole of the game tree from the initial position. Add a routine to make use of the principal continuation, and test this by timing the program’s computation, with and without this routine, after one move has been made by each side (remember to use symmetry here also).

These results should bear out the assertions contained in this article.

Bibliography

### SDOS
- Text Editor
- Basic Compiler
- Conditional Assembler
- Basic Interpreter
- Sort/Merge
- User Manuals +
- Source Code for most system Utilities
- Optional Compiler
- Translator Programme

### FLEX
- TSC Text Editor
- Basic Interpreter
- Text Processor
- Sort/Merge
- + Flex System Utilities
- User Manuals +
- Source Code for most system Utilities
- TSC Business Basic
- Precompiler for above 6800/6809 Cross Assembler

### MSI DOS
- Text Editor
- Basic Compiler
- Conditional Assembler
- Basic Interpreter
- Sort/Merge
- User Manuals +
- Source Code for most system Utilities

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SDOS & FLEX will support the HD8R 10 Megabyte Fixed / Removable hard disc
Objectives
The objectives of a word processing system are to enable the acceptance, storage, amendment and manipulation of textual style information, allowing for its printing out to a predetermined format and including (if necessary) variable normal data.

Who would be likely to use a word processing system? Well almost anyone who uses writing to communicate, qualifies: obviously that includes anyone whose writing is published — such as authors, reporters and contributors to magazines such as myself. But publication is not the sole preserve of the writer, what about anyone who submits written reports? Almost any manager would qualify on that basis.

In fact if you consider most products or services offered by businesses, the process through which they go almost demands written communication in order that they succeed. Potential customers have to be informed about the products or services they are interested in, preferably in a written proposal. Having decided to “buy” he will need to know how to use the product or service.

Where will he get this information? Probably from user guides, manuals, operating instructions or system descriptions — all written in normal fashion. And he’ll almost certainly need to know exactly what he’s getting for his money — and this is usually contained in a written contract.

In fact, once having attracted a customer the whole process starts again since he is likely to be a good potential client for other products and services. So a word processing system can help us to get customers, to hold them interest and to expand the revenue we get from them.

Functional requirements
Once he has decided that a word processing system might be of use to his business, the potential user will need to know exactly what he can expect from it.

There are two divisions of the functional requirements, Editing and Printing, and these can be sub-divided into essential and preferable features.

Editing
1. It is essential to be able to enter text and have it displayed on a screen. Then we must be able to find any part of that text by scrolling the screen up or down to the correct line or passage.
2. We must be able to insert to and delete from any part of the text by referring to a character, word, line or paragraph. We must also be able to move any part of the text around. To do this we must be able to mark the part to be changed.
3. We will expect no less of our word processor than of our typewriter and so will wish to be able to set and clear tabs to allow for indented or columnar format.
4. We will want to be able to change a word or string of words throughout the text without having to search through manually.

Other useful functions that we would like are:
1. Word-wrap . . . the ability to carry on entering text without regard to line length; a word which is too long will automatically be transferred to the next line.
2. If we have many letters to send with the same content we will wish to be able to take names and addresses automatically from another file.
3. A repeat function and automatic centring are useful for text design, particularly if our output is to be used for advertising or sales work.
4. Another very useful feature is on-screen text formatting which enables us to see the “look” of our text without printing hard copy.

Printing
1. We must be able to set both vertical and horizontal margins.
2. We will require a variation of line spacing — just as we have on our typewriter.
3. We will also want to be able to set our page length so that on long documents we can continue on to the next page automatically.
4. We should have the ability to set for right hand justification so as to be able to produce “blocked” printed matter.

Other useful functions include:
1. The ability to underline any part of the text.
2. The ability to double strike or boldface any part of text for added impact.
3. The ability to number or title pages.
4. The ability to include both upper and lower case.

The full system contains a TRS 80 Level II microcomputer with a 16K memory, keyboard, cassette recorder and a daisywheel printer. The system is supplied with an excellent, easily understandable operators manual and I'm sure any experienced typist could familiarise themselves with the system in a very short time.

London Computer Store will supply full hardware maintenance for 12% of the cost and will replace any tape which corrupts.

**WORDCRAFT**

This product is available from two major distributors, Dataview Ltd, of Colchester (0206 78811) and Hipposoft of Derby (0332 366803) and is available countrywide from Commodore and Petsoft dealers. The cost of the package is £325.

There are two versions of this software and both are on disc. The first is designed to run on a 32K Commodore PET, with a 3040 Dual Diskette drive and a choice of output printers (available from Commodore dealers) and the other on Computhink Disc Drives, designed to run on both the PET and ACT series of computers (available from Petact dealers).

The minimum hardware is estimated to cost from £2900.

There are about fifty users of the Commodore version and twelve users of the Computhink disc version. Dataview offers an "open line" for dealers and customers alike to answer any queries about using the program. The manuals come with the package. Full technical documentation is supplied in the first and the second is an excellent step by step instruction book designed specifically with the novice in mind.

**XTAL TEXT PROCESSOR VERSION 1.1**

This is available from Crystal Electronics, Torquay (0803 22699) and is supplied on tape or disc, price £140 plus V.A.T., which includes a hardware lower-case generator.

The minimum hardware required to run the system is a 32K disc-based Apple system which, with Applesoft and a printer (Anadex), costs approximately £1800. Tape users can run on a 16K system with printer at an approximate cost of £1425.

Crystal Electronics give a 12 month guarantee for any defects or major updates which should have been included in the first instance. The package is supplied with limited instructions in hard copy and step by step instructions are held within the program.

**TEMPLEMAN SOFTWARE WORD PROCESSING PACKAGE**

This package is available from Templeman Software Services, Stratford on Avon (0789 66237) or from ITT distributors. It contains two programs which are linked automatically and comes supplied with operating instructions. The program is written in Petsoft BASIC and is supplied on disc.

The minimum hardware required to run the system is a 48K processor, 1 disc drive and a screen which Templeman estimate to cost around £1400 — to which must be added the cost of a printer. The hardware can be expanded with the addition of more discs for extra on-line storage at the approximate cost of £425 each. The software alone is sold for £500.

On site installation service with full telephone backup is available plus ½ day training at no charge. Longer training courses can be arranged if required. If a user corrupts the supplied program a new disc is supplied and bugs are immediately rectified. Templeman do not feel personalisation is required for a word processing package but will customise a package if required.

**HARTFORD SOFTWARE TEXT AND ADDRESS PROCESSOR**

At present Hartford Software, Hartford (0606 76265) are the sole distributors of this package. It’s supplied on cassette at a cost of £25 but a disc based version is planned in June. The software is supplied with full and concise documentation and it’s claimed that formal training is unnecessary. The system is very simple and I believe the documentation does meet Hartford’s claim.

The minimum hardware required to run the system is an 8K PET although two cassettes are needed to be able to use all the facilities. The minimum configuration would cost from £1200 depending on the type of printer used. A second cassette tape unit would cost £55. The later, disc based, version will require a further outlay of £300 for a disc drive unit. No installation service is available.
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Continued from page 61

board 6502 systems KIM, SYM and AIM 65. The rest of the book makes reference to the SYM system in nearly all its programs but this need not worry any AIM, KIM or even PET owner because the software changes required to use alternative 6502 systems are slight (only I/O port addresses).

Chapter 4 is where it all starts and where I become slightly uneasy. The applications are developed using two “applications boards” with relays, speakers, LEDs, etc. In the first list of parts is “120 V AC plugs”, indicating on which side of the Atlantic this book is more at home. Extreme care should be exercised when connecting any 240 V device to a relay for computer control - PCW would hate to lose any of its readers!

After dealing with the use of relays and loudspeakers, we have our first application - a Morse code generator, quickly followed by a time-of-day clock, a home control program (based on the time-of-day clock) and a telephone dialler (not for the UK). The second part of the chapter gives examples of useful techniques - a siren, sensing an input, pulse measurement and a simple music program. All very interesting and very basic.

Chapter 5 “Industrial and Home Applications” is a collection of fairly major projects - a traffic light controller, a 5 x 7 dot matrix LED, a music program, a burglar alarm, a motor controller and a heat sensor. All are well described and interesting. The book ends with a pleasant surprise — a 6502 Assembler written in BASIC — the bad news is that it is Hewlett-Packard BASIC which is as unlike most micro BASICS as is possible. However, it would not take long to convert it and it’s an additional reason to buy the book!

All the control programs are written in 6502 assembler. It may seem almost unnecessary to make this point because high level languages are well known to be of little use in control tasks, but it should be noticed that there are BASIC extensions specially for control applications - XYBASIC, LAB BASIC - that would minimise the software problems. I hope that one day someone will write a book on general control applications without making reference to a particular micro, by using a high level language.

In conclusion - the 6502 Applications Book is well written, interesting, stimulating and an excellent companion for Programming the 6502, but we still have a long way to go before microprocessor control is an easy subject.

All three books in this section are available from LP Enterprises.
American purchases

I'm going to New York shortly and am considering the purchase of a PET or an Apple whilst there. Will you please advise me about such things as modifications required and the availability of parts if I require to operate it in the UK. Also, what is the position regarding customs VAT?

AGA Macareanzas, Wembley

Personally, I'm all in favour of this type of purchase although it does have a few disadvantages. However, first the choice of computer and the question of what modification are required. Both machines will be 110V and the simplest solution is to purchase an auto-transformer. The capacity required is not large (150VA is adequate although 250VA will give the extra margin). Suitable sources are Computer Components or Barrie Electronics Ltd., The Minories, London, EC3 (01-488 5318). Alternatively, you could modify the internal power supplies. The Apple, however, has a switch in the power unit and is not easily modified - you would be better off buying a new 240V supply from ITT (approx. £110) and keeping the 110V supply for spares. The PET uses a normal supply and you could replace the transformer with a 240V primary (33k); (by the way, don't bother asking Commodore for one - they don't like people bypassing their dealers). However, some dealers may be prepared to supply you with a transformer on the "QT". Also, some reader out there may have done the same modification but using a different transformer - I'd like to hear from you.

Apart from the mains voltage, the PET needs no further modifications. The Apple will come without a UHF modulator board so for a better display you ought to consider buying a small monitor (£30) - or, alternatively, take a good look at the article in March's PCW for converting a TV set to a monitor. You won't be able to use the Apple colour facility because you won't have the PAL box, nor will you be able to buy it over the counter in NY. Eurocolour boards are advertised in this country but as far as I know they aren't available and therefore the quality is unknown.

In my opinion, the Apple is still the better machine to buy but only get a 32K memory and then buy the extra 32K of RAM for £130 (total) from the States (try ringing California Digital on 213-679 9001 while you are over there and use Access or Barclaycard). Don't get confused by the big memory PET. It might seem reasonable to upgrade the 16K version to 32K by only buying an extra 16K of RAM - WRONG! You have to throw away the "funny" memory already fitted and buy a complete set of 32K chips - which, I personally, think is a case of a nerve and NOT VERY WELL PUBLICISED.

I was surprised to find hardly any computer shops in New York. The only one that I used was The Computer Factory, 485 Lexington Avenue (0101-212 687 5001) but even they were out of stock of the items I wanted. Therefore, ring them before you go to check on the availability of your items (and, if possible, reserve it). Agree too on the method of payment and be prepared for quite a heavy sales pitch. Resist the temptation to buy any software as most of it is unadulterated rubbish.

Both computers come adequately boxed and can be shipped as excess baggage but check with the airline that they can take it when you are confirming your return flight reservation in NY. Don't come back on the TWA 1700hrs flight as it's very, very popular. The Apple is in a conveniently sized box that can just about be carried under one arm. The PET box is huge and you need both arms and large biceps to carry it. Don't forget too that the PET has a fragile cathode ray tube that could get broken if handled roughly in transit by the baggage people at either end. The Apple is therefore infinitely more robust in this respect. Beware also of irate American ladies who berate you for taking your own aerial from an aeroplane without putting airholes in the box for it to breathe - a true story.

When you enter England, declare your computer and produce your receipt. With only one, you may be lucky and just have to pay to the desk the duty officer. More likely you will have to find your way to the office of clearance (?) and go through the rigmarole of the (large) VAT machine. But do not despair, there are people to help you for a (small, reasonable fee) called Custom Clearance Agents. I used Greyhound Courier Service (01-570 1018 0975) for a flat fee of £15 and the £35 cleared me through the paper-jungle. Again, give them a ring beforehand and confirm meeting arrangements method of payment etc for import duty and VAT.

As the only disadvantage now is if your computer goes wrong. You obviously have no claim anywhere in this country. If it's an Apple that you have bought then I for one, would recommend that you have instead opted to choose a PET then I suggest that you try Petallect in Woking as my dealings with them have always left a very favourable impression. Hopefully, this and previous replies have answered all the queries regarding the purchase of components and computers from America. We, in this column, feel that perhaps it is now time to call a halt on this topic - at least for a while.

M. Dennis

Sporting times

In order to record the finish times of a large number of orienteering (a form of cross-country running) competitors, our club would like to purchase a digital clock with a print-out and storage facility. On the print-out we need a reference number and the competitor's time (to the nearest second). Storage is needed to cope with the situation of competitors finishing close together then the printer is able to keep up with.

R. Matthews, Lichfield, Staffs

I am delighted to see that you feel micro-electronics may have a way of helping such a rapidly growing sport as orienteering. I am not immediately aware of the commercial approach you are taking, but the equipment you have in mind, but the same results can certainly be obtained, and in a variety of ways. As usual, the more refined the method, the greater the cost. At the one extreme you could build a domestic battery digital clock and a "Polaroid" camera. At the other end of the spectrum you could buy a "PET" computer with a built in timing function, a printer, and give you mains power from a car battery. The latter highlights one of the main problems with most of the sophisticated approaches - the need to provide 240 volts A.C. in the middle of a field!

In between these extremes one real contender is the Rockwell "AB/65" (approx. £110) which in turn would run off two car batteries and has a "Polaroid" camera. At the other end of the spectrum the equipment is uncased. For about another £100 you could buy a "Polaroid" camera and case for the "AIM 65", ideal for transportation to events. At about £650 there is a version complete with case, mains power pack unit, and an acoustic coupler for connection to microcomputers via a telephone line. but that's going way beyond your presently envisaged needs.

The only snag with this system may lie with the timing device itself - a need for some assembly language programming. Hopefully, this and previous replies have answered this for you.

Alternatively one of your members may already have the necessary skills. Then again you could approach your nearest computer club. By keeping the 5-volt power on the whole time you could record start times as well as finish times (in each case the operator would just have to enter the competitor's number on your card); the time taken by each competitor could then be automatically printed out. Of course, this depends on there being enough time to move the unit from the start to the finish point - in between the last competitor setting out and the earliest one getting home. This depends on the course and the number of competitors (or how much knowledge of orienteering suggests).

If you could interest the right people in the suggestion of establishing a demand for a reasonable number of
timers of the sort you describe, then it might be possible to persuade a manufacturer to produce something that exactly meets orienteering needs at perhaps a lower cost. I know of at least one company that might take up the idea.

P. McIlmoyle

Micros in school

Our school has firmly decided to buy a computer, but is still undecided as to whether to buy a PET, Tandy, NASCOM or whatever. I would be obliged for your views on this matter.

P. Messer,

Croydon.

Having decided that you are going to buy a computer means you have overcome the first hurdle. However, any views on the particular machine will depend a great deal on where you intend going from there. Will you use the computer to teach computer science or data processing? What level should these courses be? Will the computer be used in other subjects as well? Is it only you who want the computer to stimulate interest — perhaps you'd form a hobby club around it. There are other questions. Have you the teacher resource to make good and effective use of it? Do you require the computer to handle BASIC only or will you need to program in assembly/Fortran/Algol/Pascal/Forth etc? Are you thinking of expanding the system at a later date by adding a printer, disc, a plotter, more memory etc?

I am sorry to have posed so many questions, but there are so many machines around that I must know more about your requirements. Here are my views on choosing a computer system for a school:

1. It must be as cheap as possible.
2. It should utilise any existing equipment available at the school — e.g. teleprinter, TV, cassette tape reader.
3. It should provide both assembly language and high-level language capabilities.
4. It must allow gradual expansion as and when funds allow.
5. It must be robust and electrically safe; therefore it should be encased in a strong case.
6. It should be reliable and easy to repair.
7. There should be good hardware and software manuals.
8. It must be able to support several users.
9. Software exchange is very important — is there a user group, or somewhere to exchange ideas?

Perhaps item 9 is the most important as few schools have experienced programmers as teachers; even if they do they will rarely have any spare time in which to develop good applications packages. Just because most microcomputers are BASIC does not mean that software is exchangeable — far from it. There are dozens of BASIC dialects, and several different cassette formats.

Don't just take my advice, ask around in your area. There should be someone co-ordinating computer education and who has already been a policy about hardware. Only by cooperation can you achieve the most for the least effort. For example in Hertfordshire all computer education is coordinated by Hatfield Polytechnic's "Advisory Unit for Computer Based Education". They make recommendations and policy statements to all schools in the area — you are not forced to abide by their views, but if you do, you will be greatly helped. There should be a similar group in your area.

For most of the reasons stated above a great many authorities have decided to standardize on the Research Machines 380Z. The 380Z satisfies all requirements except for price (which is a bit high) and the quality of the manuals. Both these faults could be rectified easily. For out-and-out value for money the PET/Tandy/etc are hard to beat and if you find them unable to satisfy your requirements, at least you can easily sell them through PCW's Transaction File at very reasonable prices.

Please keep an open mind about computers because they are many that I haven't mentioned, and each will have its good points. S.W.

Peeks and pokes

I am writing to you in the hope that the functions PEEK and POKE can be explained more fully. Also I would like advice on a home system similar to the PET that I can assemble myself.

M. Settle,

Wendover, Bucks.

PEEK and POKE statements allow a BASIC program to directly access locations in memory. POKE 22768,255 will store FFh in location 8000h. The statement X=PEEK(2768) will read whatever byte of data is stored on location 8001h and store its value in the variable X. PRINT X will display that value as a decimal number. Neither instruction is particularly convenient to use, most programs written in machine code use hexadecimal whereas BASIC programs refer to everything in decimal. You have to convert everything as you go along.

Care must be taken when
using PEEK and POKE because if you get the value wrong and POKE a wrong location you could quite easily corrupt your program, or even the BASIC interpreter itself. In the majority of cases, PEEK does not suffer from this problem; however some circuits may detect a specific address and reset a latch (or some other similar function) when they see this address. You should therefore use as much care with PEEKing as you use with POKEing. Don’t forget that you cannot POKE a memory location that doesn’t exist (i.e. there’s no RAM or ROM there). Perhaps therefore you can see why mainframe computers do not allow you to use PEEK and POKE.

I am afraid that your computer requirements are rather vague. If by a PET you mean the BASIC interpreter location you could quite easily expand to a disc based NASCOM 2. Compukit UK101 and the existing TV set then three kits spring to mind. They are the OHIO superboard, the quick Microfiche and the TV screen. This would call well supported by the manufacturers — joud promises for good ones seems to be the order of the day and I have to say that I find this situation appalling. Out of the three kits, the NASCOM 2 offers more bytes per buck than the other two, but don’t forget that the disc drives have been promised for a long, long time. And, by the way, since they are all in popular demand, don’t part with your money unless you have been guaranteed that they are in stock. M. Dennis.

**Facts on FORTH**

I should be most obliged if you could tell me about FORTH, including references to books, articles etc. I should also be interested to know whether it has been implemented for CP/M. Incidentally, I have no reason to believe there is a suitable compiler for the TRS80. H. Martin, York.

FORTH is an interactive language. It’s ideally suited to microcomputers as it only requires 5-6K bytes for a complete system consisting of the interactive FORTH compiler running stand-alone as its own operating system, assembler written in FORTH and a text editor.

About 2K bytes written in assembly language form a kernel of some 40 FORTH words, sufficient to define the rest of the language. Other "words" are then defined in terms of these or using the FORTH assembler. These definitions are stored in a "dictionary" which is a list of addresses of the words making up a definition.

Typing a FORTH word on the keyboard causes the dictionary to be searched for that word, and if found it is executed. Certain words allow the definition of new words or even new data types. Parameters are passed between words using a reverse-Polish stack familiar to users of the Hewlett Packard calculators. Global variables and constants may also be used if required. Normally a disc is used for program storage; it’s also used as "virtual memory" organised as any number of 1K byte blocks. Only two blocks can be in memory at any one time. If access is requested to a block not currently in memory, the FORTH will first free a buffer by writing its contents back to disc if it had been changed, and then reading the requested block from disc. Thus "virtual memory" for program or data storage is only limited by the disc space available.

FORTH was developed by C. H. Moore around 1970 and he now markets the language through FORTH INC. He’s represented in the UK by D. E. Butler, 239 Kin condol Road, Bedford. FORTH products are also available from COMSOL Computer Solutions Ltd, 87 Brier Road, Shepperton, Middlesex. Two FORTH Inc books are available from COMSOL, The Microfiche Primer and Using FORTH and they come out around £8 and £13 respectively, post paid.

A CP/M version called STOIC is available on Vol. 23 of the CP/M users group manual. FORTH for the PET using cassette is available from Petsoft as a version called FIFTH, which is said to combine the advantages of FORTH and PASCAL. The following references may be of interest:

2. "FORTH for Microcomputers" Dr. Dobbs Journal No. 24 pp. 21-27.

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**Pyral**

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1. INTRODUCTION

The question is often posed as to which language is "the best". As with so many things, there is no hard and fast answer since the appropriate language usually depends somewhat on the application for which the programs are being written. In this series, BASIC has frequently come in for a (perhaps unwarranted) drubbing, largely because some familiar basis was required with which to compare PASCAL. Having now covered the major features of the language, the time has come to slot PASCAL into its rightful place — suitable for medium to large applications with complex logic where the advantages of structure can make themselves felt and where speed is still called for but not so much that the programs cannot be run sufficiently frequently (i.e. not "one-off") to make the bother of compilation and linking worthwhile.

If, in the course of the discussion which follows in Section 5, you should ever feel overwhelmed by the complexities of interpreting formatting commands or shuffling segments of text backwards and forwards, you should consider the days of implementing the same problem in, say, FORTRAN where text-handling can be a nightmare, or the much abused BASIC whose strings are easy to manipulate as a whole but difficult to fragment. Above all compare the readability of the PASCAL code with that of its would-be rivals. All the formatting can be elegantly contained in a single data structure and all the conditional constructs can be employed named Boolean variables rather than numerical flags.

2. TEXTFILES

Before embarking on a specification for a text formatting program and discussing the programming strategies associated with a top-down implementation it will be necessary to consider the provision PASCAL makes for the control and manipulation of textual data. During execution, the program may need access to a variety of external media. On discs or magnetic tapes the program will access a file. As described in Chapter 6, the key features of a file are that it is external to the program; and its components are all of the same, predefined data type; and that the program communicates with the file by means of a buffer variable and the reserved words GET and PUT. By contrast, when the program communicates with a terminal or line printer, the reserved words READLN and WRITELN are used to manage input or output in lines.

Clearly the disc (or tape) file is a merely a form of storage for the program (perhaps an inconveniently slow but permanent form of memory), while the terminal is the primary means of communication with the human user. The textfile exists as a compromise between these two "media". It is stored on and accessed from a disc, yet it is set up for output on a VDU or lineprinter. It can contain all the printable characters recognised by the terminal together with a manipulable "control" character, used to separate one line of text from another, and called the line separator. In ASCII, the line separator is actually a pair of control characters — carriage return and line feed.

A declaration of the form

VAR ROUGHCOPY : TEXT

has the effect of declaring ROUGHCOPY as a textfile via the standard type TEXT defined as a FILE OF CHAR. Since this will be a file of characters, the buffer variable (ROUGHCOPY) will be of type CHAR and access may occur by means of GET and PUT operations. However, in a textfile there are likely to be a large number of characters to manipulate so that Wirth provides, as a shorthand, the standard procedures:

READ (FILEID, CHARBUF), which has the effect of CHARBUF := FILEID;
GET (FILEID);
WRITE (FILEID, CHARBUF), which has the effect of FILEID := CHARBUF;
PUT (FILEID) where FILEID is a declared file identifier and CHARBUF stands for "character buffer".

Note that this still only deals with one character at a time, and only with textfiles. Note also that in the case of READ, the FILEID buffer contains the next character to be read (as a result of the GET operation) while CHARBUF contains the character of immediate interest. When the GET operation encounters the line separator character, FILEID becomes blank and the Boolean EOLN (FILEID) is set to TRUE. This is in order to help the programmer to deal with the line-nature of the textfile. A following READ would just transfer the blank in FILEID to CHARBUF before advancing the file pointer to allow the program to continue to read (WRITELN) the next line of input.

The principles involved in top-down design are of universal application — regardless of language; use of this clear and logical method will invariably result in quicker and more successful writing of programs.

In this chapter of The Complete Pascal we shall tackle a large-scale text formatting program from scratch, showing how it can be constructed from the top down. We have chosen this particular program because it offers readers something very much worth implementing, whatever their particular interest in personal computing.
Note that RESET (INPUT) and REWRITE (OUTPUT) are assumed to be implicitly called and must never explicitly appear in a program. Readers will notice that data-base oriented systems are more fortunate in that access is interactive so that the "file" INPUT refers directly to the terminal keyboard while OUTPUT refers to the VT100 terminal or teletype roll. This brings the formal definitions of PASCAL input/output procedures into line with the syntax which will have been familiar to anyone who has been following this series.

UCSD PASCAL makes a few changes to the Wirth definitions to take into account the interactive nature of their systems. These changes are summarized in the Look-Up Table at the end of the Chapter. In our text formatting program we felt the need of a buffer big enough to take a whole line of characters at a time (i.e. a string) and of procedures to move the line to and from a textfile in one operation. Accordingly we have developed our own input/output procedures for this purpose. These appear in Box 1. The call FREADLN (INFILE, BUFFER) will read the next line of text from the textfile INFILE into the STRING (: ARRAY [1..MAX-LINE] OF CHAR) called BUFFER. In line 5 a check is made to see if this line is the first of the program. If it is, a blank line is disposed of. The buffer is then filled, a character at a time, until the line separator is detected (EOLN (INFILE) is TRUE, lines 9 to 11). At this point a check is made that the line was not a blank line. If it was, it is ignored and the next line is read; if not, the remainder of BUFFER is filled with space characters (this is important since the spaces will overwrite any characters left over in BUFFER from a (longer) previously read line. FWRITELN (lines 15 to 20) merely outputs the printable characters from BUFFER onto the indicator. To complete the buffer, we append a line separator.

3. THE TEXT FORMATTER

The idea of a text formatting program is to exploit the text handling capabilities of the computer (together with its control of the line printer) to produce correctly formatted textual output. First the required text is entered into a file using the system editor and without much attention being paid to the layout of the text. If this file were to be offered as input to a text formatting program, the program would accept one line at a time and "pack" an output buffer, producing an output file each line of which is constructed according to some standard format; for example, each output line would be formed with the maximum number of white words possible. Invariably, however, a simple line-width specification will not be adequate for most text formatting tasks and the user will want to impose other conditions on the text output. The lines of text may perhaps be divided into pages, consisting of a fixed number of lines, which may or may not be numbered and which may be single, double or triple spaced. Furthermore, the text may need to be subdivided into paragraphs, each line could be right-justified, spaced out evenly between the left and right margins. Sometimes the formatting scheme may need to be temporarily suspended in order to deal with a title or heading or a table of specially "hand"-formatted material. All this information has to be passed to the formatting program and this can most easily be done by embedding formatting commands in the input text. While the program is processing the input line text it can transform input text with a "text" command and dynamically alter the formatting specification to meet the requirements dictated by the new information. Before taking a look at some of the functions which could be implemented under such a scheme. Note particularly the syntax of the formatting commands. Each command will appear on a line of its own, and each line begins with a "text" which is a very unlikely character for a line of text to start with! In this way the program can recognize which lines of the input file are formatting commands and which are just plain text.

Most of the formatting commands relate to the text which follows the command, although some commands (e.g. Break) relate to the text immediately before it. For this reason a great deal of care must be taken, during programming, to keep the input and output file buffers independent, and to "look ahead" at the input while formatting the output. It is also important to distinguish between those commands which are effective for one line only (like .B) and those which alter the output format for the ensuing text until new commands are issued (like .M).

Due to space considerations we had the choice of either using one large program input file or a number of boxes or presenting the complete listing. Although the former choice would have simplified the discussion, it would have made the actual output tabulates of the ensuing text until new commands are issued (like .M).}

At this point it is necessary to test the code currently written. No matter how trivial this may seem, it's specially important at the initialization stage of the design since a logical error at this level of the program could have devastating results on the outcomes at lower levels. To test, dummy procedures or stubs must be written for STANFORMAT and TEXTFORMAT, e.g. PROCEDURE TEXTFORMAT;

WRITELN(('THIS IS TEXTFORMAT') END;

Then use the main program calls TEXTFORMAT some sort of action occurs, enough to test the continuity of the main program. For procedures
which return values, the stub has to be more sophisticated and actually fake the return values to enable testing of the logic of the module under scrutiny. In this way the program can be built up as a collection of tested procedures and stubs which combine to form a test harness for the procedure currently under consideration.

The next step is to implement the procedures STANFORMAT and TEXTFORMAT. STANFORMAT assigns the default values to the fields of the record FORM (lines 101 to 109). Another run through this part of the program will test STANFORMAT in its test harness. TEXTFORMAT however, is more complex. Local data structures include (i) USERFARM for the current formatting environment record — since TEXTFORMAT has to process an entire file, (ii) the two strings INBUFFER and OUTBUFFER which act as windows on the files INFILE and OUTFILE (iii) the Boolean flags EMPTYINBUFFER and EMPTYOUTBUFFER to keep an eye on the status of the INBUFFER and OUTBUFFER. Our processing algorithm will depend on the state of these two flags. Only when EMPTYINBUFFER is TRUE can another line of input text be read in, while a TRUE EMPTYOUTBUFFER signals that OUTFILE has already been written to.

Unfortunately, some of the formatting commands make the solution more complicated than this. In particular, those that apply to foregoing text (i.e. that which is in OUTBUFFER before the command is encountered) require that the text be retained in OUTBUFFER while the next input line is checked to see if it affects the format (“look-ahead”). Also there is no reason to suppose that just because INBUFFER is empty OUTBUFFER is completely filled. The differences between FILL and UNFILL, together with the conditions imposed by BREAK, PARAGRAPH and EOF(INFILE) will all have an effect on the state of READYTOOUTPUT. The conditional (line 483) reflects the complexities of the conditions on which READYTOOUTPUT would depend. Testing at this level requires stubs for OBEY, FILLOUT, ADJUST and CLEAR. OBEY should display the command passed (to test whether the interface between the procedures is correct), FILLOUT could simply transfer INBUFFER to OUTBUFFER and CLEAR could write this to a disc file. If all is well at this stage, OUTFILE should contain the text of INFILE without the embedded formatting commands. The logical paths dictated by both states of fill should be tested in turn (i.e. change the default value to false in STANFORMAT).

OBEY is clearly a straightforward application of the CASE statement and as such does not warrant particular scrutiny here. FILLOUT, on the other hand (line 303 onwards) offers more interesting possibilities, since for the first time the details of handling a line of text must be considered. Does one deal with words or characters, for instance? In our program we opted for a character subdivision. The available space in OUTBUFFER is calculated by taking into account the margin and indent format specifications and any possible OUTBUFFER contents from a previous INBUFFER (PROCEDURE STARTINGPOINT lines 309 to 323). We then count down from the right hand side of INBUFFER until a space is found (i.e. there are a whole number of words to the left) such that the left-hand substring would fit into OUTBUFFER (c.f. FINDSTRING lines 325 to 337). The actual transfer is handled by PROCEDURE MOVESTRING (lines 340 to 345).
Look up table

<table>
<thead>
<tr>
<th><strong>Computer Jargon</strong></th>
<th><strong>Pascal Jargon</strong></th>
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<td>Buffer</td>
<td>DEFAULT</td>
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<td>Default</td>
<td>TEST harness</td>
</tr>
<tr>
<td>Look-ahead</td>
<td>Program Stub</td>
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<tr>
<td>Program</td>
<td>Task harness</td>
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</tbody>
</table>

**Pascal words**

**TEXT**

**READ, READLN**

**WRITE, WRITELN**

**INPUT, OUTPUT**

**UCSD Exceptions**

Standard data type INTERACTIVE identical to TEXT except that READ (INFILE, CH) expands to GET(INFILE). CH: INFILE? rather than the other way about.

Exercises

Implement the following enhancements to the text formatting program.

(i) .T. — skips to top of new page

(ii) .Z. return to predefined standard format (Zero)

(iii). N n p — where "p" is a flag which directs the page number to the left hand, centre or right hand side of the page.

(iv) .H. — checks if there is enough space below heading for first line of text and if not skips to a new page.

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In its basic configuration the HP-41C is a conventional looking (but beautifully made) hand held calculator, with 441 bytes of user memory. This may be expanded by plugging in further 448 byte modules up to a total of 2233. The memory is organised into 7-byte registers and the number of registers reserved for data storage is chosen by the user, as on the Texas TI-59.

The display, an advanced liquid crystal one, uses a “starburst” grid for character formation; this allows the production of an upper and lower case alphabet and symbols, in addition to numbers. The lower display also has a variety of keyword “annunciators” to indicate calculator status conditions e.g. low battery, angular mode etc. As with the new Casios, the low current requirement allows continuous memory (ie protected) on all registers - even the stack and display - whilst giving up to 1 year battery life.

The display can hold up to ten digits, though like the Texas (but unlike the Casio) only 8 digit mantissas may be shown in scientific notation. Internal operations retain a 10 digit mantissa plus 2 digit exponent, so in maximum Fixed Point configuration the tenth digit may be unreliable (Texas uses 13 digits internally, Casio 12 for full 10 digit accuracy). As one would expect from H-P the logic is Reverse Polish; I marginally prefer the True Algebraic but wouldn’t make a big fuss about it.

### Built-in functions and alpha mode

The real sophistication of the 41C becomes clear when one discovers how use has been made of the alphanumeric capability.

Alpha characters are not merely an appendage, as on the TI-59, for labelling results and programs; instead they are the main means of communicating with the calculator.

The 41C has four modes of operation, Normal, User, Program and Alpha. The Alpha Mode treats its characters rather like quoted strings in BASIC; they cannot be mixed with numeric data. If numerals are required a special set of “alpha” numerals are available which cannot be the subject of arithmetical operations. Alpha strings are chained together and stored in a separate register which holds 24 characters and scrolls when containing more than a display-full. Alpha characters may also be stored and recalled in data registers using ASTO and ARCL, but give rise to DATA ERROR if accessed by arithmetical operations.

The reason I have taken up so much space describing this system is that here lies the essence of the 41C’s originality. From now on your programs (and even subroutines) will have names and not numbers. Once you have mastered naming and assigning functions, writing programs becomes utter simplicity, since subroutines may be treated almost like Procedures in Pascal... i.e. self contained programs which can be called by name.

### Programmed operation

Although in hardware terms program memory is a single block of registers in RAM, to the user it behaves more like the modular system of the Casio-fx502. Memory management is fully automatic. A program file is opened and line numbers beginning at 1 are automatically provided. The first step is always the Alpha name of the program. There are of course no key codes; the function names appear directly in the pro-
program. All instructions are merged so that one instruction occupies only one
program line (though not necessarily only one byte). Once END is written
the file closes, memory is packed and
the number of free registers is displayed.
The next program now begins with a
new name, and line numbers starting
again at 1.

Any number of programs may be
stored within the limits of available
RAM. Once the file is closed a program
may only be entered by GTO (program
name) which sets the pointer to step 1,
by XEQ (program name) which runs the
program or by assigning to a key. Once
in a program the editing functions are
excellent and logical. The current step
is always displayed and insertion rather
than overwriting is automatic. Forward
and back single stepping are provided
(but backstep is rather annoyingly the
shift of forward step, rather than a
separate key) while GTO’n takes you
and back single stepping are provided
x# y? will accept Alpha data and can be
used for string comparisons.
v) TONEn. This sounds one of ten
audible tones via a built
in acoustic
diode. Since it’s indirectly addressable
the 41C can compose simple tunes.
vi) 30 user flags, 11 of which are in
Continuous Memory are provided plus
six flag set, clear and test functions;
25 system flags are also accessible by
the user.

The 41C operating system makes
most of the built in functions may be
used in programs. Special points worthy
of mention are:-
1) INDIRECT addressing is available on
memory, branching, flag and Alpha
storage operations and the stack regis-
ters may hold indirect addresses.
ii) The loop control functions ISG and
DSE are more general than the usual
loopers. Both may start and finish
at any specified numbers and increment/ decrement specified. If not
specified they step 1 step 1 and skip on zero.
iii) PROMPT. This commands halts a
program and displays an Alpha message
(e.g. a request for input) which is con-
tained in the previous line.
iv) Ten conditional tests are available
including praise the Lord, x<y? as well
as x= y? Two of the tests x=y? and
x # y? will accept Alpha data and can be
used for string comparisons.
v) TONEn. This sounds one of ten
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vi) 30 user flags, 11 of which are in
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six flag set, clear and test functions;
25 system flags are also accessible by
the user.

The 41C operating system makes
extensive use of Alpha error messages
and prompts, some of which like TRY
AGAIN and NONEXISTENT can
provide mirth or fury the first time you
encounter them.

Peripherals
The 41C has four I/O ports which will
accept RAM expansion modules, ROM
Application Packs, a printer or a card
reader (if either is in use only 3 RAM/
ROM modules can be present). The
temperature printer is small, quiet and
highly portable, being rechargeable
battery operated. It can LIST, TRACE
and produce user defined symbols in
addition to full alphanumerics.

The card reader stores 32 registers
per magnetic card i.e. 2 cards per
module.

Conclusion
It’s not possible to more than skim
the HP-41C’s capabilities in this review. I
hope I’ve given a feel of how different
and exciting a calculator it is.

My only serious gripe is that the
Alpha keyboard is awkward to use (the
characters are printed under the keys
in alphabetical order) compared to a
qwerty set-up, and that processing,
while faster than the TI-59 is still not
up to the speed of the Casio.

The Alpha facility has been seriously
used to make what is after all a formid-
ably powerful calculator, more friendly
and less intimidating to the first time
user; for the experienced user the result
is a super CALCULATOR.

The next program now begins with a
new name, and line numbers starting
again at 1.
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The Alpha facility has been seriously
used to make what is after all a formid-
ably powerful calculator, more friendly
and less intimidating to the first time
user; for the experienced user the result
is a superb pocket calculator.
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PAST FEATURES: PART TWO

On P.77 of February PCW we provided a sectionised breakdown of the contents of earlier editions of the magazine, up to and including Volume 2 number 4. This month, in Part 2, we extend the list to include all the remaining editions in Volume 2. From our next issue on we shall be publishing a list, cumulative by issue by issue, for our current 3rd Volume.

Hardware Interfacing
Analogue to digital converter
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Say that again? - (documentation standards)
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Not let the right hand ... (VAT moans)
Future - what future?
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<td>Compelec: 01-636 1392: (N/A)</td>
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<td>Equinox 200 (£7,500)</td>
<td>Equinox 01-739 2387 (N/A)</td>
<td>64-256K RAM: Z80: 10MB H/D: 1/S/P: 1 P/F</td>
<td>CP/M: CBASIC: Fortran:</td>
<td>(£500 (£)</td>
</tr>
</tbody>
</table>

### List of Abbreviations

| A | Assembler |
| B | BASIC |
| C | Cassette |
| D | Disc |
| E | Extensive |

| F/D | Floppy disc |
| G/C | Graphics card |
| H | Hardware |
| I | Interface |
| M/A | Macro assembler |
| N/P | Numeric pad |
| O/S | Operating system |
| P/P | Parallel port |
| S | Software |

Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.
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 August edition. In the meantime we shall of course continue to publish User Group Index update information - as and when it reaches us.

NATIONAL

11a Users Group. A sort of help service only. No meetings no newsletter. Contact: Pete Harris, 44 Arthurs Bridge, Malvern, Worcs.

150 Petes Users Group. No meetings. Contact: Moe Brown, 150 Bedcot Rd., London W6 9LU.

77/80 Users Group. The 6502 Users Club. Hoping newly formed and a division of Tewkesbury, Glos.

Contact: Chris Cadogan, 21 Thistle Downs, Northway Farm, Tewkesbury, Glos.

List of Abbreviations

- A: Assembler
- B: BASIC
- C: Interface
- D: Extensive
- E: Enthusiast
- F: Floppy disc
- G: Graphics card
- H: Hardware
- I: Headset
- P: Parallel port
- S: Software
- T: Text editor
- U: Utility

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

USER GROUPS INDEX

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List of Abbreviations

- F/D: Floppy disc
- G/C: Graphics card
- H: Hardware
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- P/P: Parallel port
- S: Software
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USER GROUPS INDEX

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

British TI Users' Club. A loose association of owners and users of the TI family of programmable calculators, the club exists for the purpose of providing a regular meeting program and exchange (and is in no way connected to the TI Company). The club's activity is a production of a (roughly) 250 members and membership costs £5.50. Details from Gordon Coulson, Clayton, Newcastle-under-Lyme, Staffs ST5 4BW.

SOUTH

Independent PET Users Group - South. For full details of the meetings the first Wednesday of every month - please contact F. James, 59 Red House Park Road, Manchester, M21 1JX. Tel: 061 881 1933.

TRS 80 - North West Group. Subscription £5, Newsletter (for 6 issues). Meetings last Wednesday of each month - at the Stag Hotel, Carswood, Nr. Wilmslow, Cheshire. Contact: Mr. W. Franklin, 40 Cowlees, Wilmslow. Tel: 0942 812843.

IRELAND

Computer Education Society of Ireland. A voluntary organisation that consists of a national body and an expanding number of local branches. This is to monitor computer education in Ireland. Contact: Joel Darmidh McCarthy, 57, St. Kevin's Park, Leevale, Co. Cork. Tel: 021-577328.

WALES

Gwent Amateur Computer Club. Covering most of the counties of Wales, the club has its own computer room at the technical library. Meetings are held once a week at 10 Park Place, Newport. Contact Ian Hall on 0632 277711 (office hours).

SCOTLAND

The Grampian Amateur Computer Society. Meetings are held on the first Monday of the month at the Hotel Marischal, Aberdeen and there's a monthly newsletter. Contact: M. Baul, Old Town, Aberdeen. Tel: 0224 911167.

The Scottish Amateur Computer Society. Meetings are on the 1st Wednesday of each month in each of the respective towns of Scotland. Contact: M. Baul, Old Town, Aberdeen. Tel: 0224 911167.

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The remarkable Sharp MZ280, representing a new concept in data processing, puts real computing power at your fingertips, for less than the price of a programmable calculator. It brings large capacity in a small package to Engineers, Research Scientists, Mathematicians and technical people — people who require on the spot processing power.

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- **Built-in clock.**
- **Editing using a cursor control.**
- **Internal memory expansion up to 48 K bytes of RAM.**
- **50-pin universal bus connector for system expansion — printers, floppy discs etc.**

The MZ280 opens the world of programming to your own fresh ideas for less than the price of a programmable calculator.

---

**New Apple, North Star Horizon & S100 products.**

**APPLE**

**IEEE 488 Interface**

This is a general purpose Listener/Talker/Controller type implementation for operation within the IEEE-488-1976 GPUS Standard. A really superb or product imported directly from the manufacturer by Keen Computers Limited.

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- Allows DMA Daisy Chain (pass through).

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This has got to be the most exciting interface for the Apple to date. This powerful hardware floating point unit will significantly improve the execution speed of your Applesoft II programs. Decrease execution time by an order of magnitude!

To help achieve true power these additional functions have been added and are available through the USB function:
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Gaining this speed has a trade in reduction of round off errors, to seven but just look at the gains.

Using CCSOFF each floating point function was timed over 5000 repetitions. The following was achieved:

<table>
<thead>
<tr>
<th>Function</th>
<th>Overhead</th>
<th>CCSOFF</th>
<th>AS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDW</td>
<td>14.0 sec</td>
<td>17.6 sec</td>
<td>27.3 sec</td>
</tr>
<tr>
<td>TAN</td>
<td>13.8 sec</td>
<td>17.7 sec</td>
<td>24.8 sec</td>
</tr>
<tr>
<td>ACOS</td>
<td>13.8 sec</td>
<td>28.7 sec</td>
<td>244.8</td>
</tr>
</tbody>
</table>

If you went increased speed then this is for you boil your Apple to the bench — it is that bad! Try it — you'll like it.

**Order Number:** K00623A \£420.00.

**PIA Interface**

This interface opens up your Apple to a variety of peripherals such as printers, paper tape equipment or another computer. It is a parallel input/output card. Apple has output parallel interfaces but there are not that many parallel input cards around. We think this is a good one. It has two 8- bit bi-directional parallel ports and four handshake lines. TTL compatible 5v and B with a 180V Drive capability on Side A. All external lines via a DB15, Type Connectors in our option a good solid interface.

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- 4. Edit the disk Catalog
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- 7. Change Tokens in Basic Programs

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- **Learn Siegler ADM 3A**, Order Number: K01201T
- **Learn Siegler ADM 42**, Order Number: K01202T
- **TVI 912**, Order Number: K11502T
- **TVI 920**, Order Number: K11502T

**To find out more... phone or write to:**

Keen Computers
5b The Poultry, Nottingham NG1 2HW.
Tel: 0602 583254, telex: 37297 (keenco)
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Powertran Comp-80 ... 5K RAM BASIC, full graphics and printer. TV Monitor; cassette recorder; metal case. Offer around £250. Tim Brown on Stafford 850244.

New professional ASCII keyboard ... 13 Alma Vale Rd, Clifton, Bristol, BS8 2HL. Tel: 0272 312850.

London, England

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Brighton, England

Computer Aided Design Conference & Exhibition. Illiffe Promotions Ltd., Dorset House, Stamford Street. London SE1 9LU. Tel: 01-266 8718

Harrogate, England

Mini/ Micro Computers, Word Processors and Business Machines Exhibition. BIZTRONIC. Ground Floor Exhibition Co., 7 Market Street, Altrincham, Cheshire WA14 1QW. Tel: 0161-420 0406

Plymouth, England

S.W. Business Efficiency and Office Equipment Exhibition, Gwen Shillaber Design, 13 Alma Vale Road, Clifton, Bristol, BS8 2HL. Tel: 0272 312850

London, England

Peripherals '80 Exhibition. Illiffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-266 8718

London, England

All Electronic Show. All Electronic Show, 34-38 High Street, Saffron Walden, Essex. Tel: 0799 226212

Liverpool, England

Mersey Micro Show. Online Conferences Ltd., Cleveland Road, Uxbridge, UB2 2DD. Tel: 0895 39262

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Business Efficiency & Office Equipment Exhibition, Gwen Shillaber Design, 81 Whiteladies Rd., Clifton, Bristol BS8 2NT.

Anahiem, USA

National Computer Conference and Exhibition (NCC). 210 S Main Ave, Montvale, NJ 07645

Dallas, USA

Int. Telecommunications Exbn — INTELCOM. Horizon House — Microsol Inc., 25 Victoria Street, London SW1H OEX. Tel: 01-222 0466

London, England


Dublin, Ireland

International Computing Exhibition — COMPUTEX. SDL Exhibitions Ltd., 88 Fitzwilliam Square, Dublin 2, Ireland. Tel: Dublin 763871

Geneva, Switzerland

International Microcomputers, Minicomputers, Microprocessors & Data-communications Exhibition — IMM/DATACOMM. Kiver Communications International Microcomputers, Minicomputers, Microprocessors & Data-communications Exhibition — IMM/DATACOMM. Kiver Communications S.A., 171/185 Ewell Road, Surbiton, Surrey. Tel: 01-390 0281

Newcastle-Upon-Tyne, England

Mini/Micro Computers, Word Processors and Business Machines Exhibition — BIZTRONIC. Ground Floor Exhibition Co., 7 Market Street, Altrincham, Cheshire WA14 1QW. Tel: 061-928 0406

TRANSFILE FILE

PCW Vol 1 numbers 9 and 10... phone Greg McNelly after 5pm. Taunton 88844.

Kim owner, living near Dewsbury, West Yorkshire. Purpose: to assist me with the cheap video cookbook. D Goodall Dewsbury 450185.
loop, the last value accepted is loaded into PROM with the rest of the software. Figure 4 shows a code diagram and the ELIC code produced. It was quite simple to implement; it was a minute part of the total design effort.

To define a code, one draws a diagram like a flowchart, showing what sequence of actions must be followed; this diagram is then translated into a language called ELIC. The source code is then processed by a program to produce a binary version which is loaded into PROM with the rest of the 5602's software. When the input switches are pressed, the pattern which operates on words, sentences and paragraphs, but whether it will be easy to use is, as yet, unknown.

Given the ELIC approach, the processing of the input switches becomes merely one of interpreting the ELIC code - just as a "BASIC" interpreter does with BASIC. In fact, it takes less than 600 bytes of code.

The text manipulation part of the software is at a fairly primitive level because we are still investigating certain aspects of user's requirements. When the "phrase store" feature was being specified, for example, we initially thought of having about 200 phrases. However, after discussions with teachers, we realised that this would be useless since the average teenager's vocabulary is nearer 4,000 words and to remember 200 codes is an almost impossible task. There is also the problem of displaying the available phrases when a large number of alternatives exist in the store.

A similar situation arises when considering an editor package. It is impossible to have a line-oriented one, because of the different lengths of lines (typewriter and VDU) that will be in use - indeed, in "store" mode there won't be any lines until the text is dumped. A screen-orientated editor presupposes a VDU which, in these days of "shared logic" systems, in which one 5602 would be shared by a whole class of disabled children - each having his own input switches and VDU. It may also be possible to develop a portable version with speech synthesis.

Why haven't we waited for the day when speech recognition becomes commonplace? Two simple reasons; first, disabled people need help now, and second, some of the users of this system are totally without speech.

Future developments

Micro Design and Electraid are planning to evolve the 5602 along a wide front. In the short term, a printer is under development which will eventually replace the typewriter as the hard-copy device. Called "MDE-132", this will be able to print text at any size between 1/16" and 2" and will be, like the VDC, particularly valuable for children or the partially sighted. It will use the RS-232 standard and will be available with proportional spacing and graphics capability at a later date.

In the longer term, it's planned to implement a BASIC interpreter on the 5602 and provide a mass-storage system, probably using floppy-discs. When these are available, the 5602 system will span a huge spectrum of needs; from simple to very sophisticated. In addition, thought is being given to "shared logic" systems, in which one 5602 would be shared by a whole class of disabled children - each having his own input switches and VDU. It may also be possible to develop a portable version with speech synthesis.
The program listing

If you like everything that has been offered, you are at liberty to transcribe the solution more efficiently. The program can be programmed to select my moves in a random or a sequential manner. If you don't like it, feel free to chop and change as you see fit. The program can be offered, you are at liberty to transcribe commercial use. If you don't like it, feel off. If your like everything that has been implemented the solution more efficiently.

Cont. from page 77

[1] any text in brackets is to be interpreted as instructions to print cursor, clear, home, space, or reverse symbols.

CU: cursor up
CD: cursor down
CL: cursor left
CR: cursor right
CS: clear screen
HO: home
RO: reverse
SH: shift (hold shift down for next symbol outside of brackets)
SL: shift lock (hold shift down for all symbols outside of brackets unless advised otherwise or end of line)
SR: shift release (cancels SL)
SP: space

Example: "([5CU 3CR])": print cursor up symbols followed by 3 cursor right symbols. Note that it is not necessary to specify that these require the use of the shift key.

Software for 8/16/32K PETs

TEXT AND ADDRESS PROCESSOR (TAP)

Allows creation and editing of TEXT and SECONDARY files to operate in three modes:

-WORD PROCESSOR (Text file)
-WORD PROCESSOR with inserts from secondary file (letters etc)
-REPORT GENERATOR (Sec. file) using text file to format prints.

User sets secondary file content:
Stock Lists
Inventories
Pupil Records
Personnel
Exam Questions
Pupil Records and, of course, name and address.
Features conditional selection of secondary file entries!

Business: 2040 disc-based £40
Personnel: tape-based £20
Documentation only £6
Configuration details please.

HARTFORD SOFTWARE
9 Massey Avenue, Hartford, Cheshire CW8 1RF.
BUSINESS PROGRAMS TO ORDER - PET AND TRS80 cassettes are £4.50 for ten.

ATOMIC brings colour to your screen at £3.00 includes a free overlay which is available from us, and as for games, AIR 1016 TASK capability STANDARD to 32 MEGABYTES DISK STORAGE.

Many of our 17 utility programs are only £2.00 (TRS80). SUPERSOFT 28 Burwood Avenue, Pinner, Middx, phone 01 847 7777. Deluxe ASCII Touch screen editor is £96.00. DSG-2 Monitor allows you to create and edit programs for BASIC.

TASA ASCII Touch keyboard unit is £32.00. Attention, Microcap Mod II owners. Phone for details of Users Club.

Phone 0670 822790/733125.

PET EDITOR

Provides full creation and editing of symbolic text or data files, etc. using powerful commands including CREATE, EDIT, FIND, REPLACE, INSERT, MOVE, TAB, etc. (SAE for full software list.)

On cassette

CIRCLE £20.00 SOFTWARE + VAT (Some old/new ROM + size)

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Our new FREE catalogue lists 38 PET programs from £1 to £12. Many of our utility programs are only available from us, and as for games, AX6 ATTACK at £3 includes a free overlay which brings colour to your screen! Blank MAGL cassettes are £4.50 for ten.

SUPERSOFT 28 Burwood Avenue, Pinner, Middlesex.

**************************************** STOP PRESS ****************************************

BUSINESS PROGRAMS TO ORDER - PET AND TRS80

****************************************

Pascal. cont. from p. 96

WHEN PRINTED

DIM STR(100), NAT(100), C(100)

VAR

I,IND,NUM

BEGIN

FOR I:=1 TO 10 DO

FOR IND:=1 TO 10 DO

FOR NUM:=1 TO 10 DO

WRITEIND,NUM

FOR I:=1 TO 10 DO

FOR IND:=1 TO 10 DO

FOR NUM:=1 TO 10 DO

WRITEIND,NUM

END

END

END

END

END

END

END

MODATA will meet SABRE in pursuit of UK and IRELAND.

114 PCW
SOFTWARE FOR THE NEW ROM PETS

COMMAND KEY
A 300 byte machine code routine that inserts the shift key into a command key when used outside quotes. Single key entry of BASIC commands possible. A logical layout with template provided. Also gives optional repeating
and a one key monitor call.
£35.00

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subsequent programs. Command key to insert of any length can be added at any time. Not a tutorial - ready to run.
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Four fast machine code subroutines in one program to fit in the second
cassette buffer. Set to clear a quarter screen. Request screen reverse.
Stock transfers in one key word.
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Micromart
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A realistic instructional business simulation including auctions, realistic
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property. Thousands of different items
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deal with. One to four players.

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Systems, cont. from p. 86

provided as Hartford Software don't feel the package is complex enough to warrant it.

Should user corruption of a tape occur, Hartford Software will provide a replacement at nominal charge. Bugs will be fixed on a priority basis and users who have paid a user registration fee of £4 will be given preference and advised of any fault. Should a user corrupt his files, assistance will be given, although without any guarantees; also a fee would be charged.

CONNECTICUT MICROCOMPUTER WORD PROCESSOR PROGRAM

Petsoft (0635 201131) market this program designed for an 8K PET. The package costs £25 and is available both on disc and tape. The cost for the minimum hardware consisting of 8K PET disc drive/cassette and printer is £1250 for cassette based and £1990 for disc based.

A very basic manual is included in the price which would appear to be adequate for this simple system. Petsoft will correct any bugs free of charge.

MAGIX Wand

This package is also supplied by London Computer Store (01-388 5721) as part of a complete system. It consists of a 64K Superbrain computer, dual floppy disc drives, daisywheel printer and Magic Wand software for the price of £4300.

The system is supplied with an owner's manual which covers the use of the package in great detail. It has step by step instructions which are very clear and although the tasks covered by the software are quite complex, with the use of the graduated lessons contained in the manual, they shouldn't take too long to learn.

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Our thanks to all the readers who responded to our recent plea for programs. It seems that, after PET, the next most popular machine is Comp Shop’s UK101 — we’ve been inundated with programs for this. Keep sending them in, especially if you want to prove that your machine is in fact the most popular.

---

**Addition of sine waves on the MZ80K**

by A. Tiplady

At school I was taught that all complex waves can be built up by the addition of simple sine waves. It takes quite an act of faith for a schoolboy to believe that a square wave is built up of multiple sine waves. My scepticism was rewarded with a homework of constructing a sine wave and adding odd numbered harmonics to show it is squared off.

I recently bought a Sharp MZ-80K and started to learn BASIC programming. Surprise, surprise — the first program I have written from scratch is to illustrate the effect of addition of sine waves.

Up to six frequencies F1 to F6 can be input. Their sines are generated in lines 80, 90 and 100. Line 110 combines these values at amplitudes decreasing in a harmonic series. The added constant shifts the curve to fit on the screen with the odd 0.5 to ensure that the INT function inherent in the SET statement does not offset the harmonics by one unit.

A fundamental frequency of 5 shows just over one complete wave across the screen. Unwanted harmonics can be discarded by input 0.

5,0,0,0,0,0, produces a simple sine wave. 5,0,15,0,25,0 shows the odd harmonics starting to square off the wave.

5,15,25,35,45,55 produces a credible, if slightly “noisy” square wave as the higher frequencies are added.

In, 10,10,10,10,10, shows the cross over distortion dreaded by all hi-fi amplifier designers.

---

**FUN & GAMES**

**Dodgems for UK101**

by N. E. Berry

This is a micro version of the pub game, and is ridiculously simple to play (but very difficult to win). For those who’ve never played it before, the idea is that you drive your little man around the course, mowing down dots and jumping from one lane to the other at the gaps in the walls, dodging the robot car driving the other way. You gain ten points for each pair of dots you obliterate and 200 points for each beacon (these appear randomly around the board). You need 3000 points to win and there is a time limit after which the robot gets you and the game ends.

The controls are key 1 to move the
car down or to the left and key 2 to bar to double your speed.
move up or to the right. Use the space

1 REM ********************
2 REM *** DODGEMS 2.4 ******/
3 REM ********************
5 REM ********************
5 BC:50:SA=1:FOR ALL=1:TOI0:PRINT:NEXT
1 INPUT 'S K I L L  L E V E L 1  ( F A S V) OR 2 (N O T  E A S Y) ':11:U=U-1
10 FORI=1:TO2:READI
20 V=1:L=1:M=1:I=E:POKE5101
99 REM BOARD SHAPE
100 DATA000000000000000000000000
105 DATA002222222222222222222222
110 DATA002200000000000000000003
115 DATA002200222222222222222222
120 DATA002200220000000000003
125 DATA0022002200000000000000
130 DATA0022332233220033333333
135 DATA0022332233220033333333
179 REM POKE BOARD
180 IFSA=1THENFORL=53248TO54283:POKEL.1
185 SA=0
299 D=C
300 FORA=1TO8:READA$
310 FORB=1TO24:IFMIDS(A$.8.1)="1-"THENPOKEB.187
312 IFMIDS(A$.8.1)="-2"THENPOKEB.213
313 IFMIDS(A$.8.1)="3"THENPOKEB.96
315 D=D+1:NEXT:FORB=24TO1STEP-1
316 IFMIDS(A$.8.1)="1-"THENPOKEB.187
317 IFMIDS(A$.8.1)="2"THENPOKEB.213
318 IFMIDS(A$.8.1)="3"THENPOKEB.96
320 D=D+1:NEXT:D=D+16:NEXT:RESTORE
330 D=C+107
340 FORA=1TO8:READA$
350 FORB=1TO24:IFMIDS(A$.8.1)="1-"THENPOKEB.187
360 IFMIDS(A$.8.1)="-2"THENPOKEB.213
361 IFMIDS(A$.8.1)="3"THENPOKEB.96
370 D=D+1:NEXT:FORB=24TO1STEP-1
371 IFMIDS(A$.8.1)="1-"THENPOKEB.187
372 IFMIDS(A$.8.1)="2"THENPOKEB.213
373 IFMIDS(A$.8.1)="3"THENPOKEB.96
380 D=D+1:NEXT:D=D+16:NEXT:RESTORE
380 D=C+107
390 FORB=1TO24:IFMIDS(A$.8.1)="1-"THENPOKEB.187
391 IFMIDS(A$.8.1)="2"THENPOKEB.213
392 IFMIDS(A$.8.1)="3"THENPOKEB.96
399 D=D+1:NEXT:D=D+16:NEXT:RESTORE
450 S=53241POKE3:POKE4,199
460 D=C+1
490 REM REACT SUB ROUTINE
500 I=INT(RND(8)*512+.5)*2+53248
510 IFPEEK(Z)=32THENPOKEZ.9:POKEZ+1.9
520 GOTO1005
599 REM JUMP ROUTINE --HORIZONTAL
799 IFUANDRND(8)).1THENYY=1:GOTO930
800 IFY=1THENI=53752
805 IFY=2THENI=53748
810 IFY=3THENI=53744
815 I=I+1:GOTO1095
820 GOTO1095
830 I=5370THEN860
840 IFY=1THENI=53752
850 IFY=2THENI=53748
860 IFY=3THENI=53744
870 I=I+1:GOTO1095
875 IFY=1THENI=53774
880 IFY=2THENI=53778
885 IFY=3THENI=53782
890 IFY=1THENI=53782
895 I=I+1:GOTO1095
899 REM JUMP ROUTINE --VERTICAL
900 IFUANDRND(8)).1THENHY=1:GOTO930
905 K=EXTK=INT(RND(8)*2+.5)-1+128
910 IFK(5378ANDK)53730ANDK53754ANDK53744THENK=GOTO1095
920 GOTO1095
930 I=5378THEN980
940 IFY=1THENI=53548
950 IFY=2THENI=53476
960 IFY=3THENI=53604
970 I=I+1:GOTO1095
980 IFY=1THENI=54180
985 IFY=2THENI=54052
990 IFY=3THENI=53924
995 E=I+1:GOTO1095
999 REM MOVE ROBOT
1005 H=K
1006 AF=AF+1:IFAF=5THENGOUB029:AF=0
1020 IFL=IANDPEEK(E-2))187THENE=E-2:GOTO1090
1030 IFL=2ANDPEEK(E-4))187THENE=E-4:GOTO1090
1040 IFL=3ANDPEEK(E-6))187THENE=E-6:GOTO1090
1050 IFL=4ANDPEEK(E-8))187THENE=E-8:GOTO1090
1060 L=L+1:IFL=5THENL=1

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Fox and Hounds for TRS80
L. J. Aston

This program generates a very nice draught board, upon which are placed four hounds and one fox. The object is to corner the fox. Full instructions are contained in the listing. It is fairly easy to corner the fox with four hounds, difficult with three and, I think, impossible with two. The program requires 4K of memory and runs on a TRS80 level II.
130 L(5,C)=1:L(5,C+1)=4
140 L(6,C)=4:L(6,C+1)=1
150 L(7,C)=177..:1
160 L(9,C)=4:DI 8, C f 1 ')=1 : IEE4TC
170 L(9,5)=3:X=8:Y=5:A=X:B=Y
180 GOSUB 820
190 PRINT5114,"COLUMN 1
200 PRINT"
210 PRINT"+STRING$(15,176)
220 FOR L=1TO8:PRINT"R"L;+CHR$(170);
230 FOR C=1TO8
240 IFL(L,C)=1PRINTCHR$(191)+CHR$(191);
250 IFL(L,C)=2PRINT"H ";
260 IFL(L,C)=3PRINT"F ";
270 IFL(L,C)=4PRINT".
280 NEXT C
290 PRINTCHR$(149)+" R";L:NEXT L
300 PRINT"+
310 PRINT"12345678"
320 IF X=1 THEN 790
330 IF Z=1 THEN 770
340 PRINTG832," YOUR MOUE - RON? COLUMN?
350 GOSUB 1110 :FOR I=1TO300:NEXT
360 PRINT"- TO ?":50SUP 1150 :FOR I=1TO
370 IF T<>FPRINT"YOU CANNOT WOW
380 IF T<>F GOTO 340
390 IF T<>F<>1GOTO 420
400 IFL(F,M.-.:200TO 420
410 IFL(T,T1)=4ANDL(F,F1)=2GOTO 440
420 PRINT"INVALID MOVE"÷CHR$(31);
430 GOTO 340
440 L(T,T1)=2:L(F,F1)=4:0=0
450 K=INT(RND(0)*12)
460 IF K>2 THEN 450
470 IF K=1 THEN 490
490 IF K=0 THEN 550
490 0=0+1:X=A-1:Y=B-1
500 IFL(X,Y)=4TI-FN' (I, Y')=7
510 IFL(X,Y)<:..3AND0<>2THEN 550
520 IFL(X,Y),.:7ANDO=2CUTO 510
530 IFL(X,Y)=7THENL(X+1,Y+1)=4
540 IFL(X,Y)=7THEN 180
550 X=A-1:Y=8+1:0=0+1
560 IFL(X,Y)=4THENL(X,Y)=3
570 IFL(X,Y)<3ASCK4THEN 700
580 IFL(X,Y)=7THENL(X-1,Y+1)=4
590 IFL(X,Y)=7THEN 180
600 Y=B-1:X=A1-1:0=0I-1
610 IFL(X,Y)=4THENLX,Y)=7
620 IFL(X,Y),:7ANDO.4TWPN 530
630 GOTO 100
640 IFL(X,Y)=7THENL(X-1,Y-1)=4
650 IFL(X,Y)=7THEN 180
660 IFL(X,Y)<>7THEN2=1
670 GOTO 100
680 PRINT"YOU WIN - LIKE ANOTHER GAME (Y.)
690 GOTO 700
700 PRINT"YOU HAve - LIKE TO TRY AGAIN (N)
710 GOTO 800
720 IF (M)="N":IFRA="THEN 000 ELSEIFRA="N":THEN 00
730 END
740 IFX=1 THEN 770
750 IFX=1 THEN 770
760 IFX=1 THEN 770
770 PRINT"YOU WERE - LIKE ANOTHER GAME (Y.
780 GOTO 700
790 PRINT"YOU NOE - LIKE TO TRY AGAIN (N)
800 GOTO 800
810 IF (M)="N":IFRA="THEN 000 ELSEIFRA="N":THEN 00
820 END
830 IF2=IF3=PRINT"MIRROR(23):PRINT" I
840 IF2=IF3=PRINT"MIRROR(23):PRINT" I
can't move
850 IF2=IF3=PRINT"MIRROR(23):PRINT" I
860 IF2=IF3=PRINT"MIRROR(23):PRINT" I
870 RETURN
880 IF (M)="N":FOR=1TO300:NEXT
890 IF (M)="N":FOR=1TO300:NEXT
900 PRINT"YOU HAVE FOUR PLAYERS (Y)
910 PRINT"YOU HAVE ONLY FOUR PLAYERS (Y)
920 PRINT"PRINT THE COMPUTER IS THE FOX
930 PRINT"PRINT YOU ARE THE HOUND
940 PRINT"PRINT IF THE FOX GETS TO ROW 1
950 PRINT"PRINT THE COMPUTER MINS";PRINT
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THE PROBLEM SET IN FEBRUARY

LEISURE LINES

With J. J. Clessa

The problem set in February Leisure Lines was to find the smallest square and that is also the average of two other perfect squares. Despite being rather easy, more than 20 of the 70-odd entries received turned out to be incorrect. Clearly there is an infinite number of squares which satisfy the conditions, but the smallest of these is 25, which is the average of 1 and 49. So, this month’s prize of a folding umbrella goes to the first correct entry selected — which was from Mr Phil Ogden of Halifax, Yorks. Congratulations Mr Ogden, although in such a sunny part of the country, you’ll probably never have need for it; still, you can always use it as a parasol.

Many thanks, by the way, to those of you who have sent in ideas for future puzzles. They’re always welcome and I’ll undoubtedly be using some of them in future issues.

QUICKIE

This one shouldn’t cause too many brain ruptures! As usual, no prizes and no answers.

A girl has as many sisters as she has brothers. But each brother has twice as many sisters as brothers. How many brothers and sisters in the family?

PRIZE PUZZLE

A nice variation on the “truth/lie situation”

There is a famous island in the Pacific (whose name I forget) on which there live three tribes:

- the Whites, who always tell the truth
- the Blacks, who always tell lies
- the Greys, who lie and tell the truth alternately.

(although their first answer may be either truth or lie).

These natives always gather in groups of three, with one representative from each tribe in the group. A visitor to the island approached such a group of three natives and had the following conversation with the first native:

“Are you the White, the Black, or the Grey?”

“I am the Grey.”

“And what about your first friend here?”

“He is a Black.”

“So your other friend is the White?”

“Of course.”

Was the “other friend” a White — and if not, what was he?

Answers please on a postcard to PRIZE PUZZLE, Personal Computer World, 14 Rathbone Place, London W1P 1DE.

PRIZE OF THE MONTH

For connoisseur drunks only, this month I’m giving away a bottle of Remy Martin champagne cognac (which I may be bringing around to deliver personally). As usual, good luck (hic!).

A bumper crop this month — see editorial.

January 1980. Correct the Z80 Homebrew circuit diagram as follows:

- IC13 = IC20: "pin 11" should read "pin 12" and vice versa.
- IC11: Labels AO - A7 should read Y0 - Y7 and vice versa.
- March 1980. Correct Macronoa as follows:
  - Equations box
  - Line 6: change one of the "+.35"s.
  - Line 3: replace (E(t)/2 with (E(t-1))/2.
  - Line 13: replace the first 1 with a 1.
  - Last line: replace 1460 with 7740 and add xP1(t) at the end.

Program listing

Line 420: change the GOTO to 400.
Line 430: number as 435.
Line 465: number 430.
Line 860: add :K8=Y(J).
Line 900 & 910: transpose them.
Line 1270: remove the second equation.
Line 1680: remove the /100 at the end.
Line 1810: remove.
Line 1895: Replace with INPUT "TYPE Y OR N" AS$
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