Personal Computer World

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ADD MUSCLE TO YOUR MK-14

EUROPE'S LEADING MICRO MAGAZINE

ZX80 DOUBLE FIRST

Sinclair makes it, PCW tests it

The computer with growth potential

Single-user System Three, with 64K memory, 2 discs, terminal and printer. Ideal for small businesses.

The System Three is Cromemco's best selling small business computer. It's easy to see why.

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You can start small. A 64K computer with a megabyte of floppy disc storage costs under £4,000.*

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Volume 3 No 4. April 1980

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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 us! Manuscripts should not exceed 3,000 words and authors as asked to use triple-spaced lines 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. Overall, 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.

TEST SUITE
Personal Computer World thanks Sharp UK Ltd., for their kind donation of a model MZ-80K.

EDITORIAL

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 welcome word on your areas of interest and experience.

All of us here feel that, once implemented, a referee system will greatly assist the continued evolvement of Personal Computer World as Europe's premier journal of microcomputing. Volunteers. . . one step forward please!

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PCW1

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We will soon be able to choose which phone we want to plug in. And that creates competition, and competition usually results in lower prices, innovative products and better service.

We do now have lower prices and a very exciting new product which we have selected as the best example of the new telephone ownership decision. The big break for you is neither of these things, but something far more reaching, but more of that later.

THE NEW PHONE

It's called the Rovafone Mobile Telephone System. And its manufacturer is a supplier of phones to other large telephone companies.

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Why?
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What other features?
Takes up to 16 digit telephone numbers, has last number radial, push buttons, pager and intercom, security coded, reachargeable cells, charger, carrying case, belt clip and only weighs 28 ounces.

THE 'DIAL FREE' KEYBOARD

The push buttons save time and money and temper. Simply key in the number as fast as you like. It goes straight into memory and is automatically dialled for you. Number engaged! Simply press Redial button and number will be recalled again automatically. Number remains in memory until updated with new number.

Push-button dialling, works anywhere in the world, you are not charged by the telephone company for this extra service. Assuming that you have rotary dial service at present, you are actually able to Push-Button Dial for FREE!

Base Station only item to connect. Simply attach two wires to your telephone line, and you don't have to disconnect present phone (still operational). You're on the Air within seconds ready to go. And since Rovafone operates like a phone it's very easy to use.

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Plug it in. See how nice it looks, see how easy it is to dial numbers by pressing buttons and how little space it takes up, and how convenient and efficient it is.

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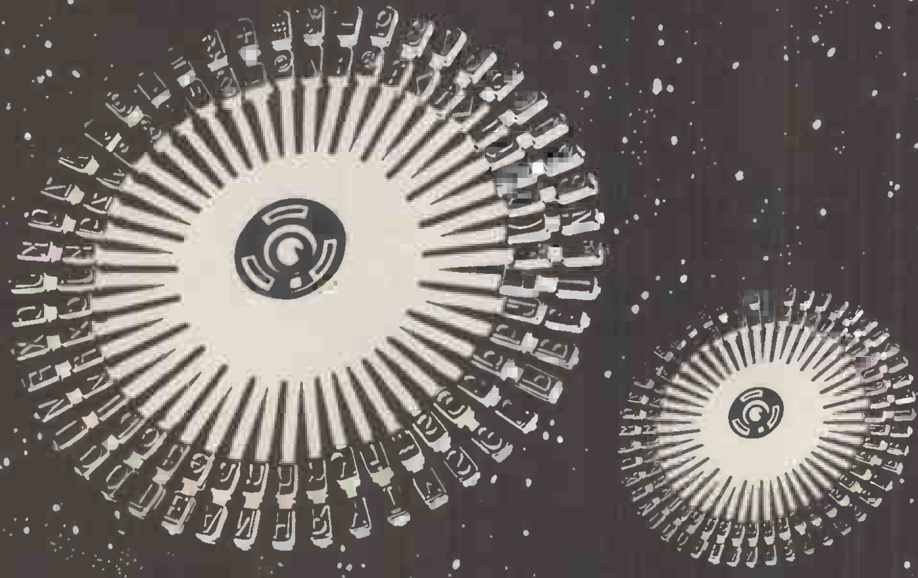

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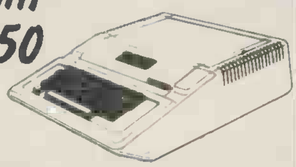

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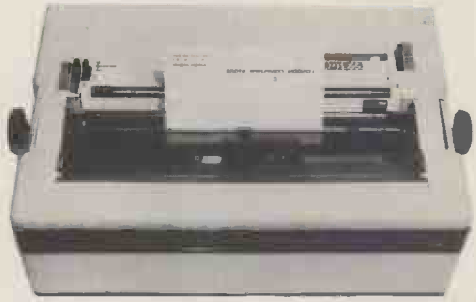

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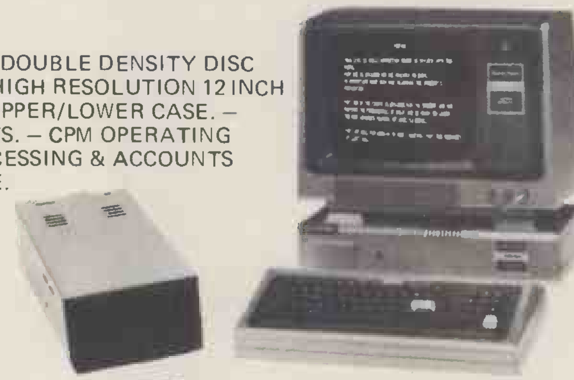

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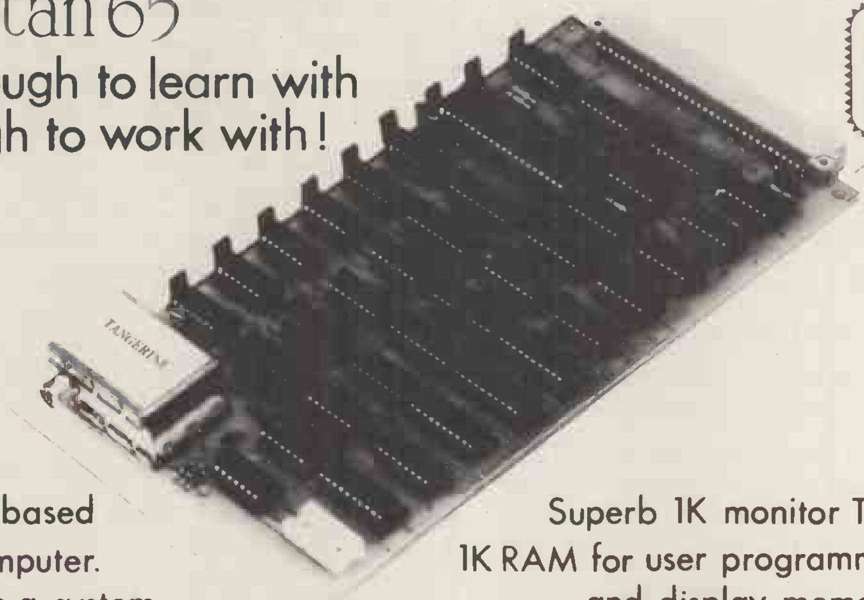

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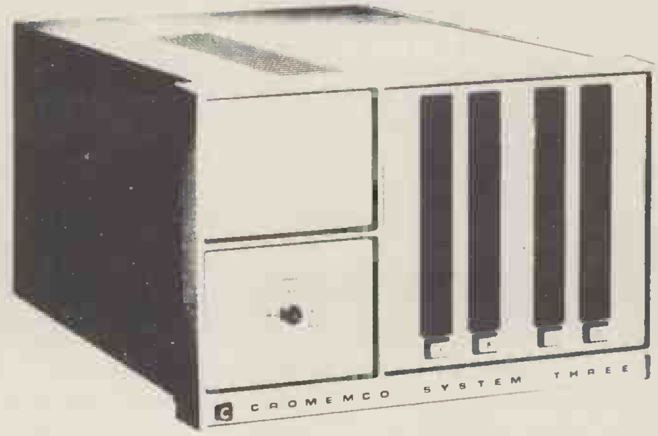

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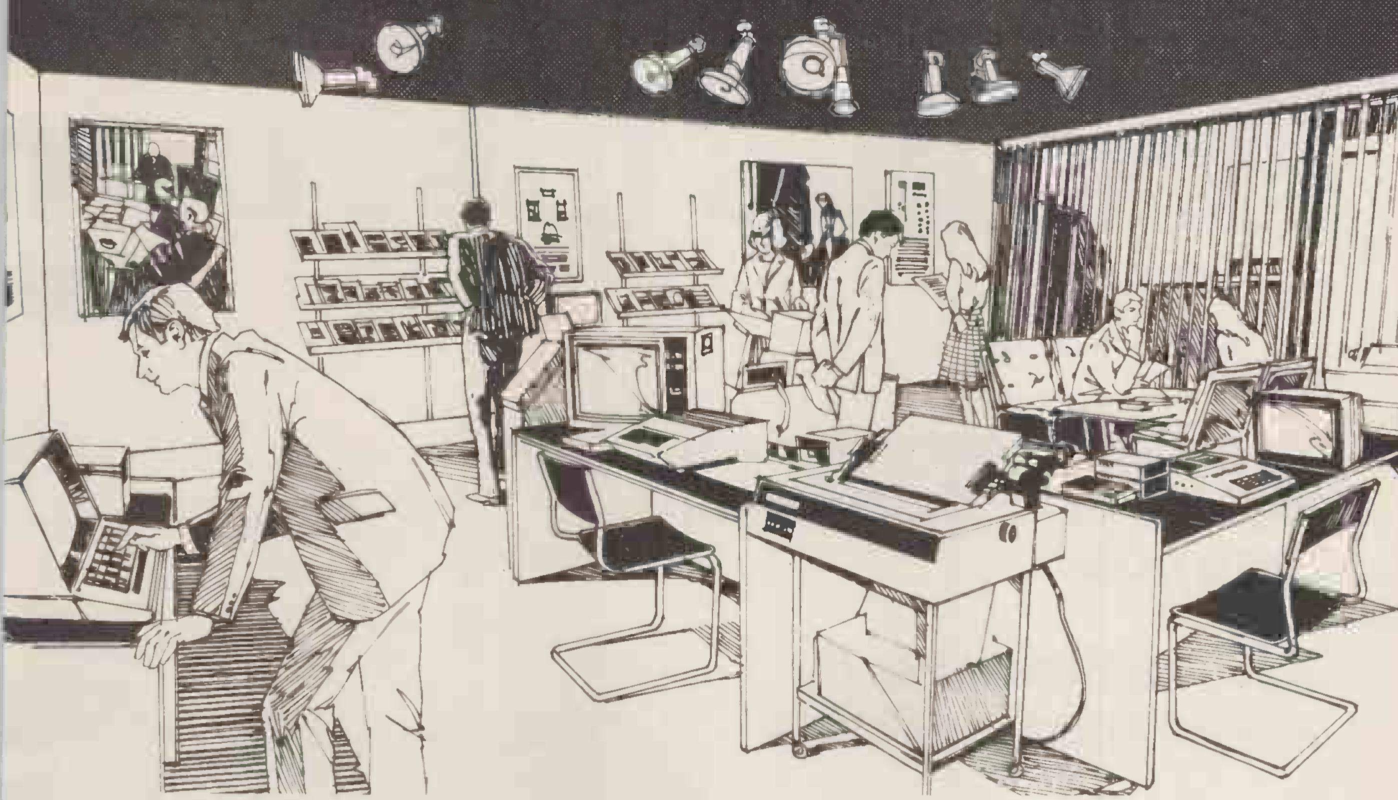

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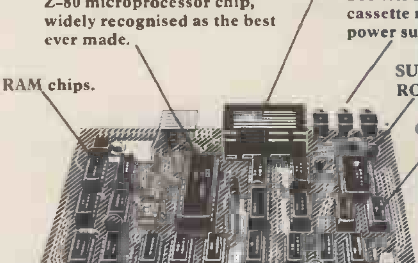

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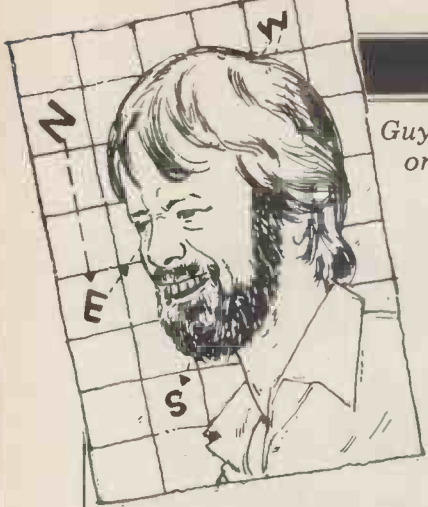


NEWSPRINT

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

Buzby's eavesdroppings

Duncan Campbell originally revealed on February 1st in the New Statesman that computer technology was being used to monitor phone calls made by ordinary citizens — without the knowledge of Parliament.

Most owners of microcomputers will think only two, quickly passing, thoughts about telephone bugging. First, they will say, such bugs would only be 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 a thousand 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, "fiveseven". 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: "um 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%

Magnetic tapes, magnetic diskettes, and magnetic cards, all made by Verbatim and displayed by BFI Electronics at Computermarket. The range includes an extra-length cartridge which has 450 feet, rather than 300, of quarter-inch tape . . . providing 4.3 Mbytes.

A truly touch sensitive keyboard from Star Devices. It offers full ASC11 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 nasty distorting effects. Nonetheless, electronics can come to its aid. Have you listened to any radio phone-in programmes lately? If your mind is not totally numbed by the inanity of the typical dialogue, it will probably have been alert enough to notice that the quality of sound that any tin-pot studio broadcasts 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 studio (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 could reasonably 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 no 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 with a reasonable knowledge of computing" (Feb 7). The implication of that statement is that Duncan Campbell, writing for an arty-lefty paper like the New Statesman, must be an innocent fool who would fall for any agitator's plausible story of Big Brother Computer.

He is in point of fact an electronics systems expert, and a very experienced, sceptical writer. I know virtually nothing about this matter beyond what he has published; but I do know that his expertise in encryption, electronics (analogue and digital) and military intelligence, is greater than anything all of us this end can muster in total. The fact that "experts" say it's impossible of course impresses me. After all there's no need for alarmist talk about what are just words from the pens of sci-fi writers. Take radar for instance. . .

National power down

The American chip maker National Semiconductor has been tackling one of the most irritating problems of microcomputers — the fact that they burn up a lot of power.

A six transistor radio can run for days off a small nine-volt battery. A 7000 transistor Motorola 6800 doesn't use proportionally more, but a system using it plus a manageable amount of memory, plus a useful amount of amplifying circuitry (to make sure that the words it wants to print will reach the printer) will kill that battery in an hour.

National Semiconductor reckons that the people who have tackled this problem in the past have got it all wrong; instead it has produced the new NSC 800 micro. Not just a new computer, but a brand new chip.

What makes the NSC 800 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 be this miserly 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 point 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 x^3; that's because it affects not just the area, but the volume, of the transistor.

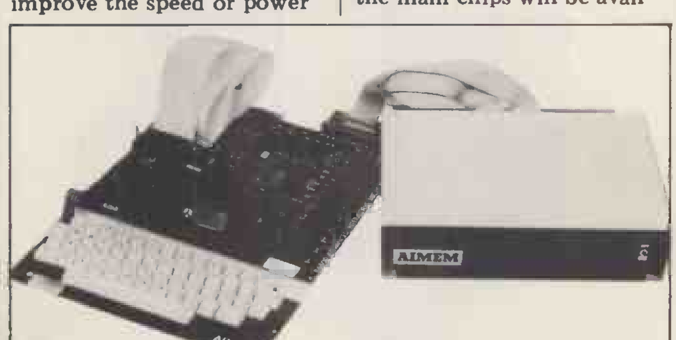
Until now, the big problem of CMOS has been that although it overcomes the limitations of speed power on NMOS, it spreads itself over a lot more silicon. In so doing it causes more capacitance effects and increases the likelihood of a chip falling on a crystalling discontinuity in the silicon wafer. The capacitance effects slow the chip down because capacitors take time to fill up with electrons; 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 P^2CMOS — and this allows it to build a very complex chip indeed. Like the Zilog Z80, it runs all the 8080 instructions and also unlike the Z80, it runs the 8085 instructions and interrupts. A small difference, but quite crucial to somebody with an 8085 program that goes beyond what the 8085 can do.

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 useful 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 8085, 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 avail-



Attaching 32 Kbytes to the £250 Aim computer will cost £335 from Portable Microsystems, if you buy this Aimem. It does cost more than 32 Kbytes worth of memory chippery — but it does include its own power supply, and it will work with other 6502 micro products. Details on 0280 702017.

able by the end of this year, there are many support chips that will only be available in standard CMOS (rather slower) or perhaps, even only NMOS. One such chip is the EPROM, the ultra-violet eraseable, reprogrammable permanent memory. You can mix them, certainly, but one EPROM will chew up ten times the power you just saved by switching to P²CMOS.

Believe it or not dept.

The first microprocessor, Intel's 4004, was a very simple device by any of today's standards; indeed, only by courtesy was it a processor at all. Most of the essential functions of a processor chip were on secondary, support chips. Even up to the point of the 8080, this was still true.

Now that a chip is capacious enough to carry things as powerful as Motorola's 68000, Data General has gone back to the 8080 approach — in order to squeeze its enormous Eclipse "mini" on to a single chip. The only acceptable reason for calling the Eclipse a mini is that Data General is a minicomputer company. IBM makes several smaller machines and calls them "mainframes".

The single chip that is the central processor of the Eclipse does not have room for all the instructions that can normally be added by microcode. Nonetheless, the DG microEclipse is an awesome bit of silicon, driving two megabytes of memory. I mention this machine in a "personal computer" publication just to put a little perspective on the future.

The Japanese have all announced 256 Kbit RAM chips now, and in two years, these will be available. A useable system with the microEclipse and 2 Megabytes of store will occupy 20 pieces of silicon . . . the size of Clive Sinclair's ZX80. Scared?

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 its a case of the blind leading the blind.

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

Both firms are being watched with awe at the moment. David Broad of Comart has had his hair cut, to suit the solemn image required of the chairman of a group that now includes Byte Shop. He is also the recipient of a Charterhouse loan of £200,000, and is regarded as A Success . . . . nearly.

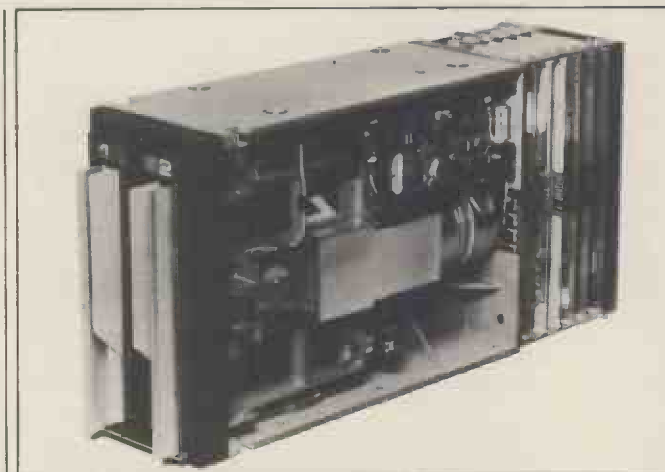
CAP has had Microcobol up on stage for two years, and has been through a rough financial time. Many believe that this rough time has been due to the slowness of the computer industry to have faith in Microcobol. The fact that David Broad has picked it up can be taken as a milestone, if for no better reason than that it indicates that the pricing on Microcobol has become reasonable, and the product retailable.

Comart is not a company to compete with Sinclair's sub-£100 system. It sells to buyers who can sign company cheques, but who don't want to do enough work to justify a Systime, a Data General, or a Honeywell £30,000 machine — it doesn't sell to home buyers. Nonetheless, Comart is a retail business; when Microcobol was launched, it would have cost more to buy the support software needed to run a program written in Microcobol, than it would have cost to buy the machine needed to run it.

That is no longer true; and Microcobol does offer one thing which the very well-known CP/M operating system claims to offer, but does not . . . compatibility. On CP/M, a program written in BASIC may be transferable from a machine using an 8080 to a machine using a Z80 or 8085 — ostensibly three chips all using the same 8080 machine instructions, ostensibly all running a standard high level language which is processor independent. More likely than not, however, there will be differences that prevent the transfer.

With Microcobol, a program written in the language will run on any machine that has the the Business Operating System (BOS) sold by CAP. It really won't matter a bag of dingo's kidneys whether the micro chip is a Z80, a Motorola 6809, or a Texas Instruments 9900.

CP/M still offers more likelihood of finding a program written for exactly your micro, simply because there are so many CP/M users writing programs for your micro — because there are so many users of your micro. With BOS and Microcobol, the total number of machines still won't exceed the smallest single number of users of any one CP/M-based machine. But with Comart moving behind it, things may start to move a bit faster.



Readers will remember that PCW has long predicted very high density diskette drives once the "voice coil" actuator arrives, allowing much more precise head positioning through the ability to follow any irregularities in the recorded track. This is it: a Burroughs dual drive offering 6 Mbytes. If you have to ask what it costs, you can't afford it. But it's made in Scotland. Details from the OEM division on Rickmansworth 70545.

The latest discs, offering 10 Mbytes in the space of a diskette, are Winchester technology — that means permanently attached. Saving the data is the job of a tape drive like this one from Sintrom, using the 450 ft cartridge drive. Sintrom is on 0734 85464.

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 price cut on the Apple (a 16 Kbyte system with disc now costs £1040 plus VAT) Derek Rowe at Abacus issued the fighting 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.

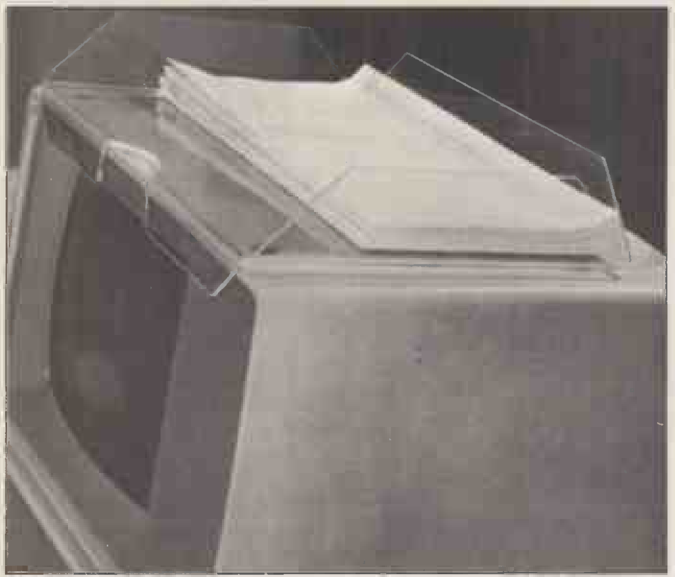
The main reason behind the surgery was the fact that the disc drive was being twitched by the big magnetic coils that drive the colour screen. Rowe has changed both hardware and software engineering. The software is designed to offer a quicker recovery from any errors caused by this interference; some 4 Kbytes of EPROM chippery have been added an 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 £1400 from the £1078 which applied when Rowe made his attack. However, some £200 worth of software — editors, 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 $1495; the 16 Kbyte costing $1695, and the 32 Kbyte at $1995. Abacus' parent company, Show Financial, is clearly after the 1980 Eurapple Award for Middleman Margineering.

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



Don't look at the video: look at the plastic tray. It costs £11.92, has four rubber feet, a thumb notch in the front to let you pick up paper easily, and is supplied by Data Efficiency, whose subsidiary Microsense is the Apple II importer. It may even keep spilled coffee from spoiling the electronics. Details 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 development centre, with research "campuses" and high technology display facilities, in Surrey Docks, is the fact that Surrey Docks are far to the East of London. Heathrow Airport is far to the West.

More than in any other industry, chip-based businesses are to be found in geographical areas centred on airports. The reason is simple: chips are light enough to be cheap cargo when sent via air freight. There is no point in sending them surface mail. Chip companies like others, are moving away from the old water port, to the new airports. The fact that the centre of gravity of London has shifted is disguised by the fact that the City of London, where the wealthy congregate, is to the East of most of the metropolis. Fashionable people therefore try to live in the newly "gentrified" areas of Islington.

Nonetheless, the semiconductor firms who have offices in the South (the majority in the UK have quick access to Glasgow's airports) are in the High Wycombe, Reading, Bracknell, and Swindon areas.

The Surrey Docks project is being promoted by property people Knight, Frank and Rutley. Publicity man Michael Barton at KFR is hoping that plans to put City of London Poly there, together with Cranfield Institute of Technology, will attract established and new forms in the science and technology areas. Barton is obviously fighting a tough battle: contact him on 01-629 8171 if you think you want to help.

Double talk

Chip-maker Zilog has come to the aid of the computer builders who use the Z80 processor, by introducing two ready-built computers, both capable of talking to more than one user at the same time.

First to announce a commercial system based on these multi-terminal machines is the Basingstoke firm, Micropower.

Multi-terminal systems are not, one would obviously think, designed for the single user. This means they can stretch the budget a bit. All they have to do is be cheaper than a Data General three-terminal CS/50 at £25,000, and the people in this market will feel some inclination to see what they offer.

Micropower's systems are not bargain basement. At the upper end of the micro market, however, they will be seen as good value for money; the software offered is the sales key. The Micropower Production Control System has been launched to run on the new Zilog systems. It is described as a "wholly integrated suite of programs written especially for the manufacturing environment, to enable accurate forecasting and costing of all stock requirements." It is possible to buy it as part of the Complete Business System software launched a year ago. Details: 0256 54121.

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!

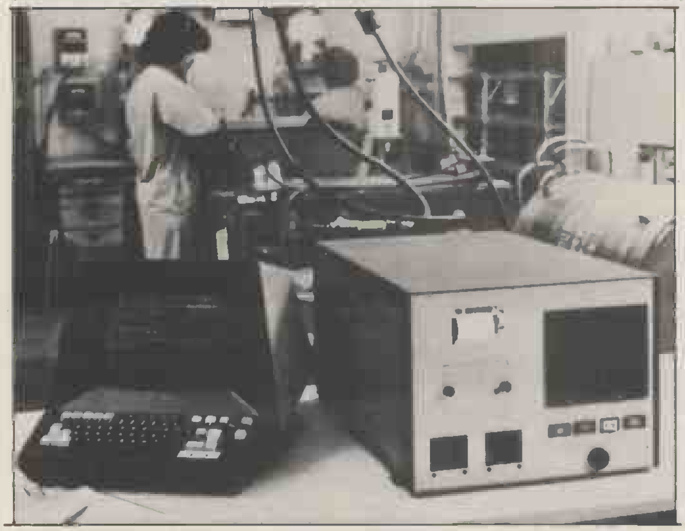
When we told the PET makers that Compay was a name that had been around a while, they smiled and shook their heads knowingly. Either they didn't believe us, or, they'd done a deal with ICL, the big computer company that has sold Compay for something like 13 years. When we checked with ICL, it quickly 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 ILEA 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 Pascal is a nice attempt to wean BASIC users on to

Another word processor package for Apple is the one supplied by the importer Microsense for £42. It's called Apple Writer. Phone 0442 63561.



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 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 PET 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 01-408 1611. The company is a PET dealer — more details from managing director David Whitehead, who is at Ealing, tel 01-579 5845.

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:–

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TINKERING WITH TECHNOLOGY

From the House of Commons, Ian Lloyd MP presents the first of his occasional reports on matters associated with the "micro revolution".

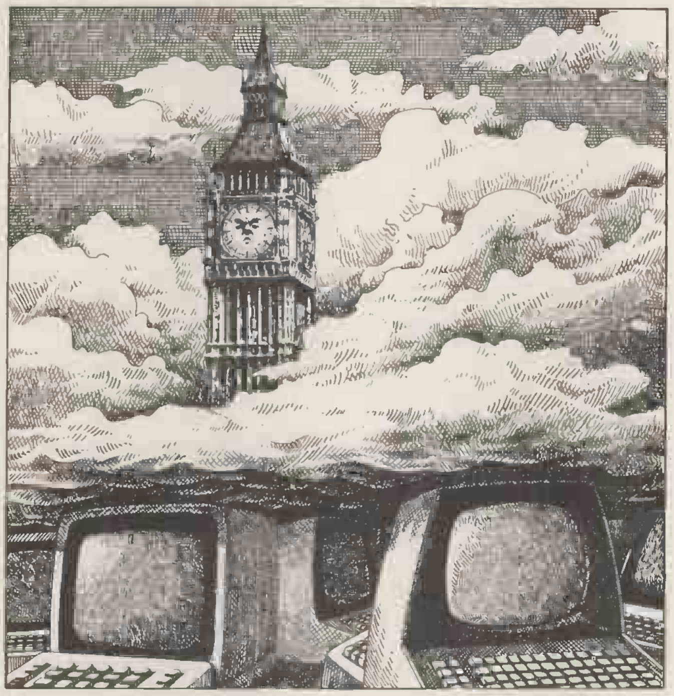


Illustration by Ingram Pinn

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 to make 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 very 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 "compunications" — a bizarre, gaunt and disgraceful example of the jargon which the world of computers is inflicting on the English Language.

Your editor has, 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 Darling's Chairmanship, recommended in a report that they should look more closely at what computing could do for them. That reactionary and 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 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 the 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 those with viewdata terminals will be able to call up and read the business scheduled in the Commons that day. Until then 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 word 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 comparison. The most invidious are those made between ourselves and the U.S. Congress. The Bundertag is also moving rapidly ahead. The Japanese Diet has had 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 a young backbencher 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.

COMMUNICATION

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

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 1440 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 quicker 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)=32:XY(1,1)=8:XY(1,2)=2
```

and changed these to:

```
1380 X1=X—2*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 855 IF P5=1 THEN IF P1=0 THEN P1=2 ELSE P1=0

856 P5=0

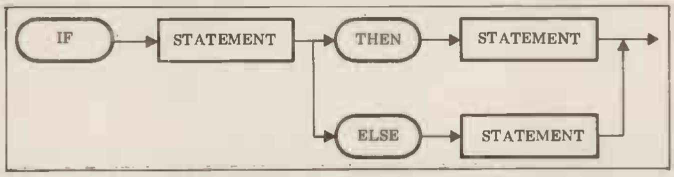
This produces another pattern set, and some amusing effects.

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



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 — Ed.

Burning Chips

The January PCW under the "Newsprint" flag had a short article called "Spiking the System" suggesting the worst thing you can do to your computer is to turn it off.

I appreciate that the main point of the article concerned itself with mains spikes but surely the first statement cannot be allowed to go unchallenged.

I had always thought that thermal ageing led to the eventual death of most electronic components and I note that my EPROMS run quite hot whilst neither the memory chips nor the CPU are quite cold.

I feel sure myself that leaving them running is likely to cause quicker demise than turning off when finished quite apart from the fact that a computer usually has a cathode ray tube which will certainly wear out whilst some even have fans, those horribly noisy mechanical devices with near plastic bearings grinding themselves to bits in abrasive dust.

How about seeking some definitive statement from a chip manufacturer — myths grow too easily.

B. R. Smith, Herne Bay

Definitive statement courtesy of Zilog coming up. Power surge and temperature fluctuation are more likely to cause problems than heat alone. In fact, even in a properly designed system, EPROMs do tend to run rather warm. So, Mr Smith, the verdict is that switching on will introduce the dreaded power surge, while switching on and off will cause temperature fluctuations. However, you are absolutely right when it comes to electromechanical parts — these will definitely suffer from continuous use. — Ed.

Yes and no

When describing the recently published book called "Some Common Basic Programs" by Osborne/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 easily type 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.

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 LEFT$(A$,1)="Y" THEN.
IF LEFT$(A$,1)="N" THEN.
GOTO . . . . (a retry routine)
.
.
```

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

Pascal 2

Your "guidelines for contributors" request 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 assume any particular character code;

c) line 33 of SALES-LEGDER (enough said!) must have parentheses around both comparisons;

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 — never put a semicolon before the ELSE.

b) Correct — we are so used to micro implementations that we tend to think of characters as ASCII codes.

c & d) Mea culpa! This was a real Monday morning program where more than the name came out backwards.

e) 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.

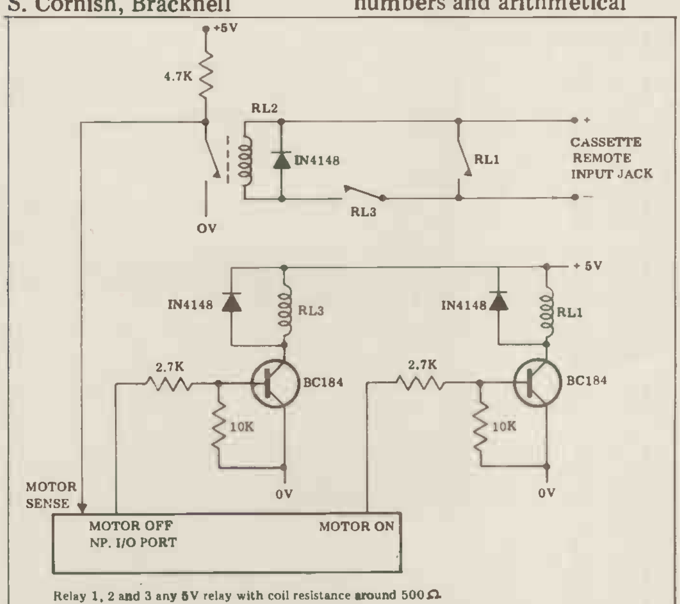
Turning to the more general points — we use PASCAL to distinguish the language from the man (Pascal) and the unit of pressure (pascal).

We produce examples from a range of applications which are programmed in an informal style on a variety of different systems. At the same time we follow, fairly strictly, a reasonable set of layout and structuring rules. Other sets of rules exist but these are surely questions of taste and don't warrant such vehemence."

Cassette control

This circuit provides remote sense and control of an audio cassette recorder in use with home computer systems. An I/O port provides the necessary interface to the microprocessor and a 2.5mm jack plug, via the remote input, to the audio cassette recorder. If no remote input is available then a normally closed jack socket can be inserted into the motor supply lead. Relay 2 provides a positive output when the cassette motor is activated by the cassette control keys, provided relay 3 contacts are closed. In some cases the relay 2 coil is enough to prevent the cassette motor from running. In this case relay 3 can be omitted. Relay 2 will however prevent the motor from running properly. Relay 1 is used to bypass the relay 2 coil and so provide full power to the motor.

Relays 1 and 3 are provided with transistor drivers to provide the necessary low current interface to the microprocessor I/O port.
S. Cornish, Bracknell



Winning strategy~part 3

In his letter published on p. 41 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 close correspondence 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 operators 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 – eg the " ()$# 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.

"Francis has his own language translator – strictly for the birds!"

Fictitious fax

Getting involved in industrial control applications we purchased an Acorn to learn about microprocessors. The user's manual left a lot to be desired due to numerous printing errors and bad grammar. Nevertheless we have persevered and are beginning to make some sense out of it. We were pleased to see in your February issue the 6502 mnemonics, but to our dismay found further discrepencies upon which we would appreciate your comments.

Acorn manual omissions are 20, 38, 78, F8 and confusion at 4A and 5A. PCW omissions according to Acorn are at 76, 89 and 7E. A copy is enclosed for your reference. We do not wish to cause any embarrassment but trust you appreciate our efforts which may help some other poor struggler.
D. Goodall, Dewsbury.

Spurred by your letter, our technical editor spent hours checking the Rodnay Zaks 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. 76 and 7E are both ROR instructions being zero page, X and absolute, X respectively.

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.

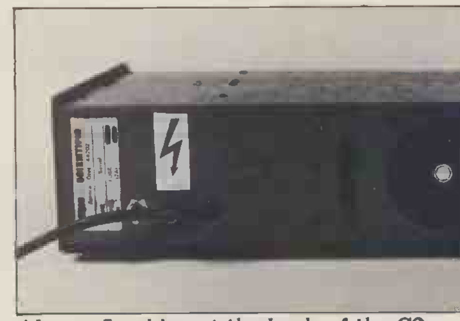
But just in case such praise goes to your head (and no letter is complete without a moan), in my February issue I counted no fewer than 7 pages devoted to In Store. I realise that PCW, unlike others, does actually update the list every month; even so, all those pages?
Mervyn Burridge, Nottingham

We beat you to it — our artroom 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.

BENCH TEST

CHALLENGER C2-4P

by Mike Dennis



Above: Looking at the back of the C2-4P note the "busy little finger" holes. Right: A general view.

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. It's quite a robust case and the system, weighing, about 12lbs, is easily carried.

The keyboard has 53 keys with the added facility that the values of the keys can be user defined. All the keys feature auto-repeat and there is a peculiar inter-relationship between the Shift Lock, Left Shift and Right Shift keys. Normal entry is with the Shift Lock down at which time upper case letters are produced and the shift keys work normally to produce punctuation marks or numerals. When Shift Lock is released, all hell breaks loose! No seriously, it's not as bad as all that even though at times I began to wish that I had a couple of extra fingers growing out of the bottom of my wrists!

With no shift key pressed, letter keys produce lower case letters (with a little descender where necessary). To produce upper case letters then press Left Shift and the letter. To get numerals and those punctuation marks that live on the bottom half of keys, press Left Shift and the required key together (notice it's the opposite way logically thinking to the letter keys). To get the upper punctuation marks then press Right Shift and the required key together. Pressing Right Shift and a letter key produces unexpected results. Incidentally, you have to hit Return and Left Shift to terminate the line when Shift Lock is released. This quirk of the keyboard is only of real consequence if you intend to do any word processing and normal operation with Shift lock in the down position yielded no problems at all.

A fan is fitted as standard to keep the "works" cool and on the review sample, it was noisy (I seem to be plagued with noisy fans). On a more serious note it needs a better guard to stop little fingers from coming to a premature end - OHIO PLEASE TAKE NOTE. Inside, the "works" are assembled on two high quality pcbs that contain the VDU and the CPU section.

The VDU is rather clever as you can either 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; one really needs a good monitor to do justice to the 32x64 format.

An RF modulator is also fitted to which, normally, the video output socket is connected. On the review sample, the signal from this was so bad that I temporarily bypassed the modulator and fed the video signal directly into my rather ancient monitor and had no more problems. Mutek say that usually the modulators give no problem and I am prepared to take them at their word.

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 the 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 but 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 CPU 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

CPU 6502:	1MHz (2MHz opt)
Memory:	8K static RAM (2114)
Keyboard:	see text
Screen:	30 x 32 or 64 x 32 (software switchable). Good graphics,
Cassette interface:	upper and lower case (with descenders)
	Kansas City 300 baud (600 baud opt)
Printer:	not tested
Bus:	OHIO 48 pin bus
Software:	Microsoft 8K BASIC
	Basic Editor (tape)
Floppy disc:	not tested

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 tape. 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 leaving the user to rewind past the bad bit for another attempt at loading.

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 CPU's". 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 screen is cleared and C/W/M? 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 relocator. 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 £8 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 out perform (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

BASIC COMMANDS

CONT LIST NEW NULL RUN

Statements

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

Expressions

Usual arithmetic and logical functions. Range $^{-32}$ to 10^{32}.

Functions

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

String Functions

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

the usual ones are present. I have, in fact, only two minor gripes. The first is that you can't 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 — as 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 Sirius 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 fact in the user text, suggesting that you operate at 2MHz or failing that, offer a fix to slightly speed things up — which is most commendable. I had great fun playing Breakthru' and can thoroughly recommend it. Many of these programs are ridiculously low in price and anyone who pirates a copy is just plain mean.

Ohio supply a 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 purposes only and heartily agreed with the quality of the programs on this tape — lousy!

Expandability

The Mutek price list features many expansion units for this system. They range from extra memory, through real time clocks, to a Centronics printer interface. To upgrade to a floppy disc is relatively painless and fairly cheap — it largely depends on what Mutek have in stock as there are several ways of achieving floppy status. If you are going to expand considerably then you ought to consider a slightly bigger version (the C2—8P) which has 6 slots on the mother board. Whichever way you go, I understand from Mutek that they offer generous trade-ins as you upgrade. Don't forget the extra facilities that are already provided — viz. audio, DAC and AC control.

Business & education potential

Serious business use will require at least one floppy disc drive and ideally two. Since the floppy disc controller indeed supports two then the hardware capability is there. There is no reason why much of the business software written for other Microsoft machines should not run on the Challenger with a little bit of modification. If you want to teach machine code programming then this machine is not for you. Admittedly, you can use the Extended monitor but since it's in RAM it's not robust enough for education. . . it crashes too easily. Quite frankly, I don't think that this machine was every really aimed at the educational market so my comments are largely irrelevant.

Documentation

Oh boy, oh boy, oh boy — so you thought Commodore's PET documentation was bad? When OHIO documentation is good, it's very good but for the most part it's bad — very bad. There's no clear concise expalanation of anything — even connecting up to the TV takes several sides of confusing options, 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 — it 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-built machine with plenty of expansion. There are a lot of facilities for the money and it's immediately 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 dedicated 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 micro-computers that can offer 20K of RAM and a floppy disc for under £1000 (excl. VAT)! OHIO claims the Challenger to be "professional, portable and expandable" The term professional is debatable but portable and expandable, the Challenger 2P certainly is.

BENCHMARKS (all timings in seconds)

	Challenger	PET	Applesoft
BM1	1.4	1.7	1.3
BM2	7.8	9.9	8.5
BM3	15.0	18.4	16.0
BM4	16.5	20.4	17.8
BM5	17.8	21.7	19.1
BM6	27.0	32.5	28.6
BM7	39.5	50.9	44.8
BM8	7.5	12.3	10.7

At a glance

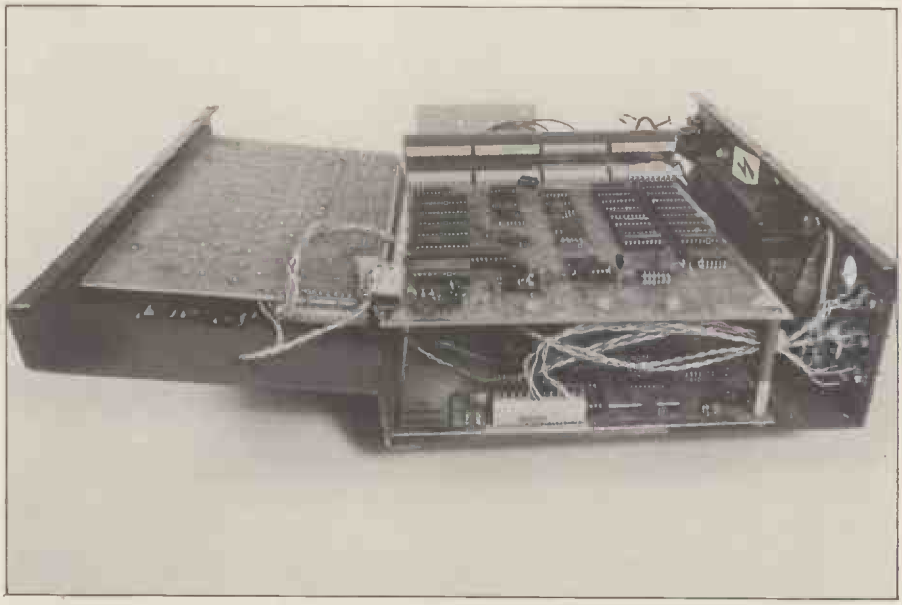
First Impression	
Looks	****
Setting up	**
Ease of use	***
High Level Language	
BASIC	****
COBOL	N/A
FORTRAN	N/A
PASCAL	N/A
OTHER	N/A
System Software	***
Packages	
Business	N/A
Education	N/A
Home	N/A
Games	****
Performance	
Processor	*****
Cassette interface	****
Disc	not tested
Peripherals	***
Expandability	
Memory	****
Cassettes	not tested
Discs	not tested
Bus	****
Compatibility	
Hardware	***
Software	****
Documentation	*
Value for Money	*****

*****	excellent
****	v. good
***	good
**	fair
*	poor

PRICES

C2-4P	£349 (includes 4K RAM)
C2-4P MF floppy	£909 (includes 20K RAM)
C2-8P	£475 (has 6 slots on mother board)
4K RAM	£ 32
Memory expansion	£125 (includes 8K RAM but caters for 24K)
Floppy drive	£250

These prices (exclusive of VAT) were supplied by Mutek, Quarry Hill, Box, Wilts.



The C2-4P turned turtle, showing the underside of the keyboard on the left with the two main boards coupled via the motherboard at the rear.

VIEWDATA
AND THE INFORMATION AGE

Despite various half-hearted press campaigns, many people remain muddled over aspects of the viewdata concept. Dr Adrian Stokes, author of a recent book on the subject, presents his own two-part guide.

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 though 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

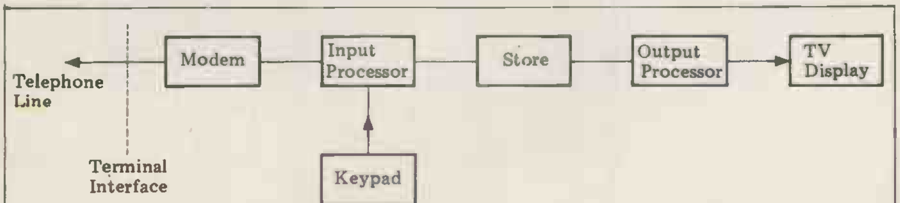


Figure 1: Viewdata Adaptor Schematic

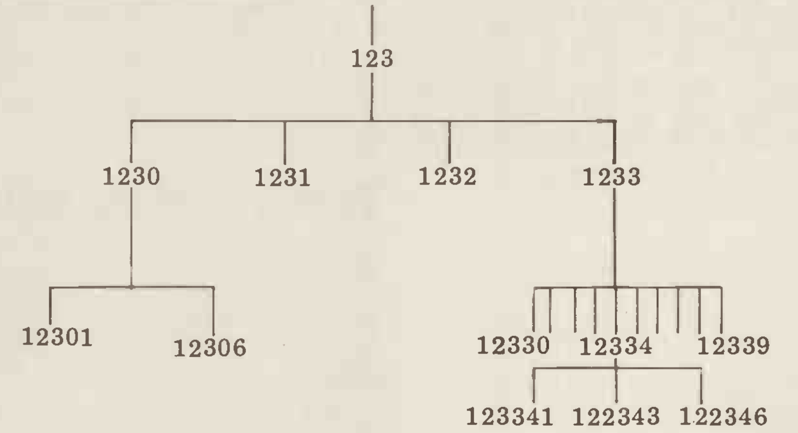


Figure 1: Schematic of Viewdatabase

doubling in the near future). The third major difference is that Teletext is not interactive whereas viewdata is.

The user's equipment

The equipment needed to access a viewdata system consists of a modified television set and a telephone. The television is modified by the provision of an adaptor. Usually, this adaptor is internal to the set but it is possible to buy external adaptors for use on existing sets. This adaptor (the block schematic is shown in Figure 1) consists of the following parts:

1. Isolation circuits to prevent the television interfering with the telephone system. The Post Office insist on some form of isolation when any electrical equipment is connected to a telephone line (as readers of David Hebditch's recent articles will know only too well!) but it is particularly important in this case because of the very high voltages involved.

2. A modem which converts the digital signals in the adaptor to analogue signals so that they can be transmitted over telephone lines, and vice versa.

3. Memory to store the information received.

4. Input and memory control which accept the signals and store them in the memory.

5. A character generator which takes the data from the memory and changes it into the format needed by the raster-scan display of the television — together with control to generate the appropriate synchronisation and control signals for the set.

In addition, a "keypad" is needed. This is a small box, usually a larger version of the remote control box supplied with many televisions, which allows the user to select normal TV pictures, viewdata or Teletext and has twelve buttons labelled 0 to 9, * and #. One of the major design criteria of viewdata was that its use should be as simple as possible; the entire system can be controlled and used by means of these twelve characters.

The viewdatabase

At the viewdata computer, the data which is supplied by various organisations, known as Information Providers (IPs) is stored in the "viewdatabase".

The structure of the viewdatabase is based on a tree (see Figure 2) with the data contained in numbered pages. More strictly, the unit of information is a "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, 1234a, 1234b and 1234c.

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, of course, cost).

In general, on each frame (a "routing frame"), the user is presented with a choice of subsequent frames which are selected by a single digit on the keypad. If a "continuation frame" is required (i.e. the next frame of a page), this is selected by pressing "#". 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 "*#" 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 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 systems based 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 picture description instructions (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 Teledon 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 be 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.

Fig. 1

Basic 5602 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, called "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 then 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

0	1	2	3	4	5	6	7
1	SP.	t	r	o	l	p	C.R.
2	e	i	a	c	m	x	> +
3	n	s	h	y	k	B.S.	@ 4
4	d	f	g	q	" 2	£ 5	! 1
5	u	w	j	/ 3	− 6	) 0	* -
6	v	b	z	& 7	: ;	< =	% ÷
7	SH.	REP.	' 8	(9	' ,	· .	ON OFF

Fig. 2
Electraid selection matrix. The positions of the letters were determined by their frequencies — the ones which occur most often are nearest to the start position of the "cursor" (0,0). Thus, in scanning modes, the quickest letters to select are the most frequent.

example, will use two large foot switches in W2.

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 of real benefit to users with gross movements, such as Athetiods.

4. In the 5602, the methods have been carefully chosen so as to form a sequence of graded steps from slow (but simple) to quick (but fairly complex). This means that small children can use the system and as their control improves, gradually use the faster methods — indeed, most children find that the stimulus of using the system improves their ability to control their movements. It is also of benefit in progressive conditions, such as Multiple Sclerosis.

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.

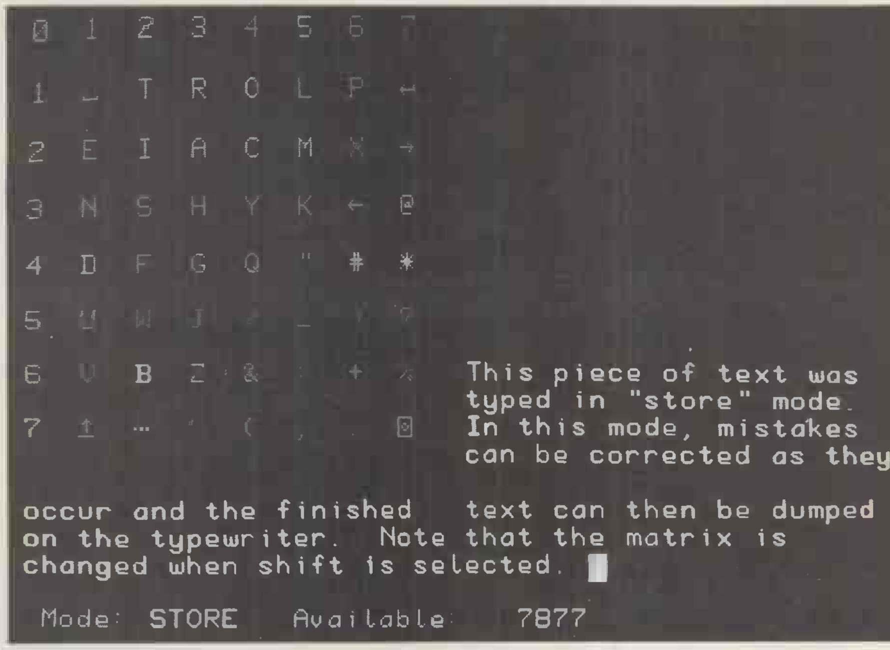
For the less severely disabled, a selection method called "ELK" is available. In this mode, a keyboard is used, with a layout similar to a typewriter; it can be supplied very large (3′ x 1′) or very small (6″ x 2″). In ELK mode, the controller checks that only one switch is depressed and the user can 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 characters such as backspace 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.

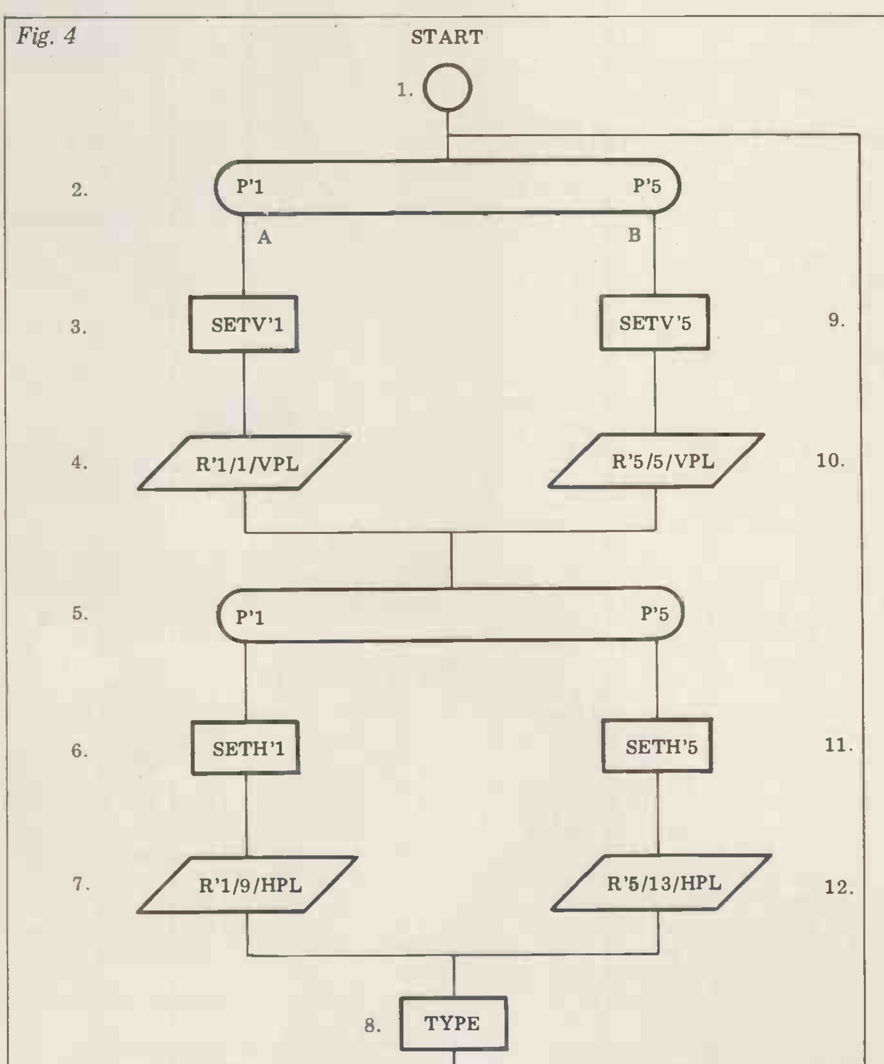
Then there is a "phrase store". At present, this is a fixed set of phrases (fixed, that is, when the system is built) one of which will be typed when a position in the first row of the matrix is selected. This may appear somewhat limited but, to give an example, if one arranges one phrase to be: "Hi,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



VDU for 5602. Display format is 50 by 23 — line 23 gives status information such as mode. The selection matrix is in half brightness, the "cursor" being indicated in full brightness. Note how the matrix displays upper-case characters when shift is selected.



Code-diagram and ELIC code. The shape of the box indicates its function. Box 1 means "start", box 2 means "until", box 3 is an operation and box 4 is a "do-while"-type loop. Inside each box are conditionals (P'1 means test input switch 1) and operators (SETV'1 means set cursor to row 5). Once the code-diagram has been drawn, it is translated into ELIC.

full buffering to allow fast users to continue inputting while the typewriter is printing — without keys clashing together.

Finally, 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 Eurocard 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 MAIN-bus
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 formats 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.

```
W2  05                 defines code "05" as "W2"
1   C                  the start of the code
2   U    A—P'1,B—P'5   wait until either switch "1" or "5" is pressed
3   0    SETV'1        sets cursor at row 1
4   D'1  VPL,R'1       wait until switch 1 is released, move cursor down
5   U    A—P'1,B—P'5   as node 2, horizontal movement
6   0    SETH'1        set cursor in column 1
7   D'9  HPL,R'1       note that different tone is generated "D'x"
8   0    TYPE          type out letter
9   0    SETV'5        as switch "5" pressed, go to row 5
10  D'5  VPL,R'5       as node 4
11  0    SETH'5
12  D'13 HPL,R'5       as node 7
.EN                    end of node definitions
1   —2                 a flow-path from 1 to 2
2A  —3                 since node has two exits, specify which
3   —4
4   —5
5A  —6
6   —7
7   —8
2B  —9                 go back to define other exit
9   —10
10  —5
5B  —11
11  —12
12  —8
8   —2                 round again. . .
.EC                    end of definition
```

Fig. 5

Fig. 6

Top: The ELIC coding of figure 4. Above: A close look at the 5602 controller.

Software

A substantial part of any microprocessor project is, of course, the software. This project is no exception, a full 5602 requires about 4½ Kbytes and the VDC nearly 2 Kybtes. 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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seed

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BENCH TEST

SINCLAIR ZX80

by David Tebbutt

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.

Introduction

Sinclair Research set out to build a simple to use personal computer, running BASIC and capable of breaking the psychological price barrier of £100. Well, they succeeded with their ZX80. Why ZX80? No reason really except that it's based on an NEC copy of the Z80 processor chip . . . and it sounds nice.

The machine is available through mail order either ready made or in kit form; there are no firm plans to sell it through the shops — yet. A kit will cost you £79.95 while its ready built twin will come out at £99.95. In addition to this you'll need a mains adaptor ("600ma at 9V DC nominal unregulated") . . . if you buy Sinclair's it will cost you an extra £8.95. Deliveries of the kit were expected to start in February, the ready-made in March.

The ZX80 is amazingly light, twelve ounces in fact, and easily held in one hand. The low weight is achieved through use of a moulded plastic casing just 1mm thick.

It connects quite happily to the television set and the cassette recorder, although it might take a few minutes to find the optimal settings. Once attached to the TV, it gives a rock steady display (more on that later).

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 rubbing 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 Z80. This CPU, running at 3.25MHz, 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 driving 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 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 2532) in its place.

Memory in the basic system comprises 1K static RAM; you can add to it via the expansion port, giving a maximum potential of 16K. The memory expands with the aid of plug in 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 online. 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 is 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 found — the "ear" lead, which acts as a monitor while recording, was setting up some sort of oscillation. Answer — simple — disconnect the "ear" jack when recording. Another tip which ensures trouble free loading 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. Plug one end of the 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 memory mapped; it's treated like a serial file — like a printer in fact — which means that fast moving graphics are out of the question. No doubt some clever Dick out there will take up the challenge and fudge the system, just to prove me wrong. 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 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

TECHNICAL SPECIFICATION

CPU:	NEC 780C-1 (copy of Z80) 3.25 MHz
Memory:	1K static RAM, expandable to 16K
Keyboard:	Keyplate, under-surface printed
Screen:	Use own television. Pixel graphics 24 lines x 32 chars.
Cassette:	Use domestic audio cassette recorder.
Bus:	Edge connector with 44 lines — 37 from CPU, 0V, 5V, 9V, Clock, External memory indicator and two earths.
Software:	4K ROM containing BASIC, Editor and Operating System

A Benchmark about to be executed: note the clear display and, while you're at it, compare the size of the ZX80 with the cassette recorder.

of code are held as compactly as possible with most of the commands and operators occupying one byte each. The spaces are removed and there are very few extra bytes needed — for instance the new line code is one byte, although I did notice that the "=" operator needed one extra for some reason. I'm sure there are others, but I'm equally sure they are very few and far between. An example of the storage requirement is as follows:

10 FOR A=16424 TO 17424	18 Bytes
20 PRINT PEEK(A);	12 Bytes
30 NEXT A	5 Bytes
40 STOP	4 Bytes

So you see, the storage for that program (displaying the 1K memory) is 39 bytes long — an average of 10 bytes per instruction. I'll leave you to work out what sort of program you can get in 1K. Perhaps I should mention that the screen buffer uses part of the 1K, as does the stack and system control area. The stack is held at the top of memory and "grows" down; I put 327 entries on it before it stopped accepting them.

The program and variables "grow" up into the screen buffer thus reducing the amount of data on display. Eventually it's possible for the program or variables to grow so large that there's nothing left on display. It was while experimenting with this interesting feature that I crashed the system. It seems the software couldn't cope with someone entering a string 868 bytes long! After about 424 bytes of input the screen removed another character every time I keyed in a new one — it was most odd to watch.

Another way of crashing the system, in fact the only other way I could find, is to hit the EDIT key while in the middle of an INPUT loop. This returns the current program line with a syntax error which is impossible to clear. For those who are feeling unhappy about all this talk of crashing systems, don't worry, it's not as bad as it sounds. In the first place you have to enter forty characters after the screen has gone blank, and in the second place you can only hit EDIT when you are also holding the SHIFT key down.

Now it may be that, having loaded your program, you wish to edit it. Well once again there is some rather excellent software to help you. The Editor enables you to move a "current line marker" up and down the program text. Wherever it is you will always be able to see the marked line and at least some of its neighbours (it's called getting it in context). Pressing the HOME key causes the marker to disappear — it has in fact gone to an imaginary position, one above the first program line. Having reached the line to be edited press the EDIT key and the line will be presented at the bottom of the screen ready for you to do your worst. From now on it is as if you are entering the line for the first time.

The benchmark timings show the ZX-80 to be very fast, even though I had to introduce some extra code to make some of the instructions work. Specifically I had to bracket expressions like LET A=((K/K)*K)+K—K . . . if I hadn'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, and 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,

BASIC

String Expressions			
CHR$(n)	TL$(s)	STR$(n)	
Integer Expressions			
PEEK(n)	CODE(s)	RND(n)	USR(n)
ABS(n)			
Statements			
NEW	LOAD	SAVE	RUN n
RUN	CONTINUE	REM	IF n THEN stmnt
INPUT dest	PRINT	LIST n	LIST
STOP	DIMα(n)	FORα=n TO n	GOTO n
POKEn,n	RANDOMISE n	RANDOMISE	CLEAR
CLS	GOSUB n	RETURN	NEXT α
Operations			
n**n	— n	n*n	n/n
n+n	n — n	n = n	n > n
n<n	s = s	s > s	s < s
NOT n	n AND n	n OR n	

n = number
s = string
** = to the power of

hence the programmer must write a little routine for each mathematical function that requires decimals to be used. This should 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. RANDOMISE n sets a seed value, while 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 USR 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 subroutine calls seems 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 arrays caused particular frustration. Although there are ways around these problems, they can be time consuming and messy.

The functions which are available, and which form the 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 − 32768 to 32767.

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 to program from it 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 an '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 us 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 in dynamic RAM is a distinct possibility; this will be considerably cheaper than taking the present £300 expansion route. 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 graphics, 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 quarter 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 between them 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 very little to say except that I hope 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.

Prices	
Kit:	£79.95
Built:	£99.95
Mains adaptor:	£ 8.95
Memory expansion board: (takes up to 3K)	£12.00
each extra 1K:	£16.00
Manual: (free with machine)	£ 5.00

Benchmark timings (in seconds)	
BM1	1.46
BM2	4.69
BM3	9.18
BM4	8.95
BM5	12.7
BM6	25.9
BM7	39.2
BM8 not performed (see text)	

AT A GLANCE	
First Impressions	
Looks	*****
Setting up	***
Ease of use	****
High Level Languages	
BASIC	***
Performance	
Processor	****
Cassette	***
Expandibility	
Memory	***
Bus	**
Compatibility	
Hardware	*
Software	*
Documentation	***
Value for money	*****

*****	excellent
****	v. good
***	good
**	fair
*	poor

BOOKFARE

Malcolm Peltu threads his way among the plethora of sci-fi "fanzines" while, back once again, we welcome Michael James to a regular new Bookfare spot entitled Technical Reviews.

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, faction 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 irritatingly 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.

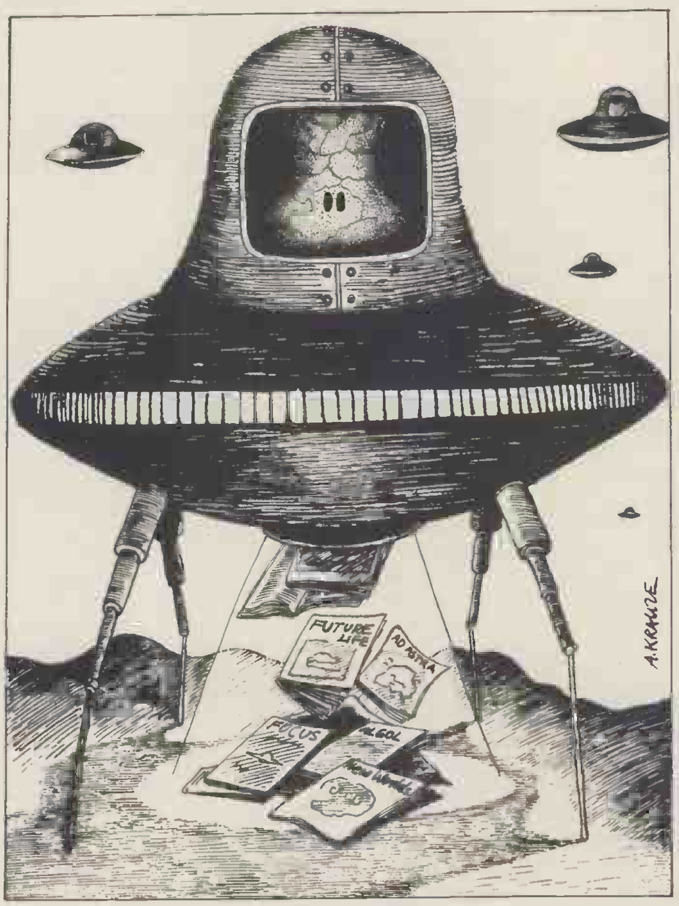
The editors, however, are offering prizes to people sending in imaginary versions of the blank page and they promise to publish the full original text in the next issue which will be handled by a "less enlightened printer."

Norman Spinrad is the "feature interview" in *Ad Astra Issue 7*, (45p) a particularly disappointing magazine because it promises more than it delivers. It has an attractive full colour cover and describes itself as "Britain's premier science fact/science fiction magazine", adopting a similar formula to the glossy Penthouse-backed *Omni*, an even more over-inflated tease (Bookfare, January 1980).

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 "a whole 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 hard-ware 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, off the top of his "then-ungrayed 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 plus 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, from a comparative guide to personal computers PET Apple, Compucolor et al to micro games and Prestel information services.

Future Life does not attempt to provide fiction but its news snippets and interviews with authors like Theodore Sturgeon are serious and of a depth unseen in some of the other more amateurish efforts. And it also has a nice visual style which highlights the real creators of our images of the future — artists 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 (featuring scientist and Pulitzer Prize Winner Carl Sagan and due to be shown in the US at least, later this year).

Now that 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 offer insights into the likely direction and impact of the technology. The lavishly-financed *Omni* has so far failed to do this in a forceful and coherent way, while others, such as those reviewed here, still see themselves too much as preaching to the converted fan rather than opening out to a wider audience.

In the meantime, for those who want to actively participate in creating, rather than consuming, dreams of the future, *Focus* (75p) published by the British Science Fiction Association (contact Alan Dorey, 20 Hermitage Woods Crescent, St Johns, Woking, Surrey GU21 1UE) contains useful, practical hints for budding sci-fi writers. Articles in the Autumn 1979 issue with titles like Who needs an agent? and Writing SF for Children indicate the style of the publication. There is also advice on the need to do research to flesh out imaginative ideas in a way that captures the right sense of "reality" — even if in a fantasy situation. And there are some worthwhile guidelines on how to approach publishers.

For passive consumers of sci-fi, however, *Future Life* promises that the 1980's will be vintage American TV years for futurism, with the small screen following trails blazed by block-buster movies like Star Trek. This of course was the most successful TV flop of all time, with the SS Enterprise haunting out screens long after it was scrapped by the TV moguls. The mass media cosmos really moves in mysterious ways.

All the sci-fi magazines were obtained from *Dark They Were and Golden Eyed, 9-12 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 8¼", (£2.55)

This book is 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 (quadratic equations), STANDARD DEVIATION; continues with the Science section: LIFE (Conway's "game"), PREY (ecology), WASTE (pollution), TITRE (titration chemistry), END-POINT (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, CHOMP, 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, offers little hope of obtaining a generally machine-readable form. Will we really have to perfect a computer reading peripheral before a standard interchange form 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 about 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 quickly 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 should be at hand in order to get the most from the book.

If you feel you're coping with BASIC but can't see 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., 5½" x 8½", £7.95)

Any new book from Rodnay Zaks is important and anything called an Applications Book must be of interest to a home 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 people 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 someone else's problem. The hardware people do not have quite such a clear cut time of it! Their main interest and hence creative effort goes into the hardware, but they cannot afford to ignore the software — they simply *have* to write a program to get their masterpiece working.

The software/hardware division in the home computer world is a problem 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 experience then a course in computer science is what you finish with. If you assume a fully knowledgeable reader the book becomes redundant!

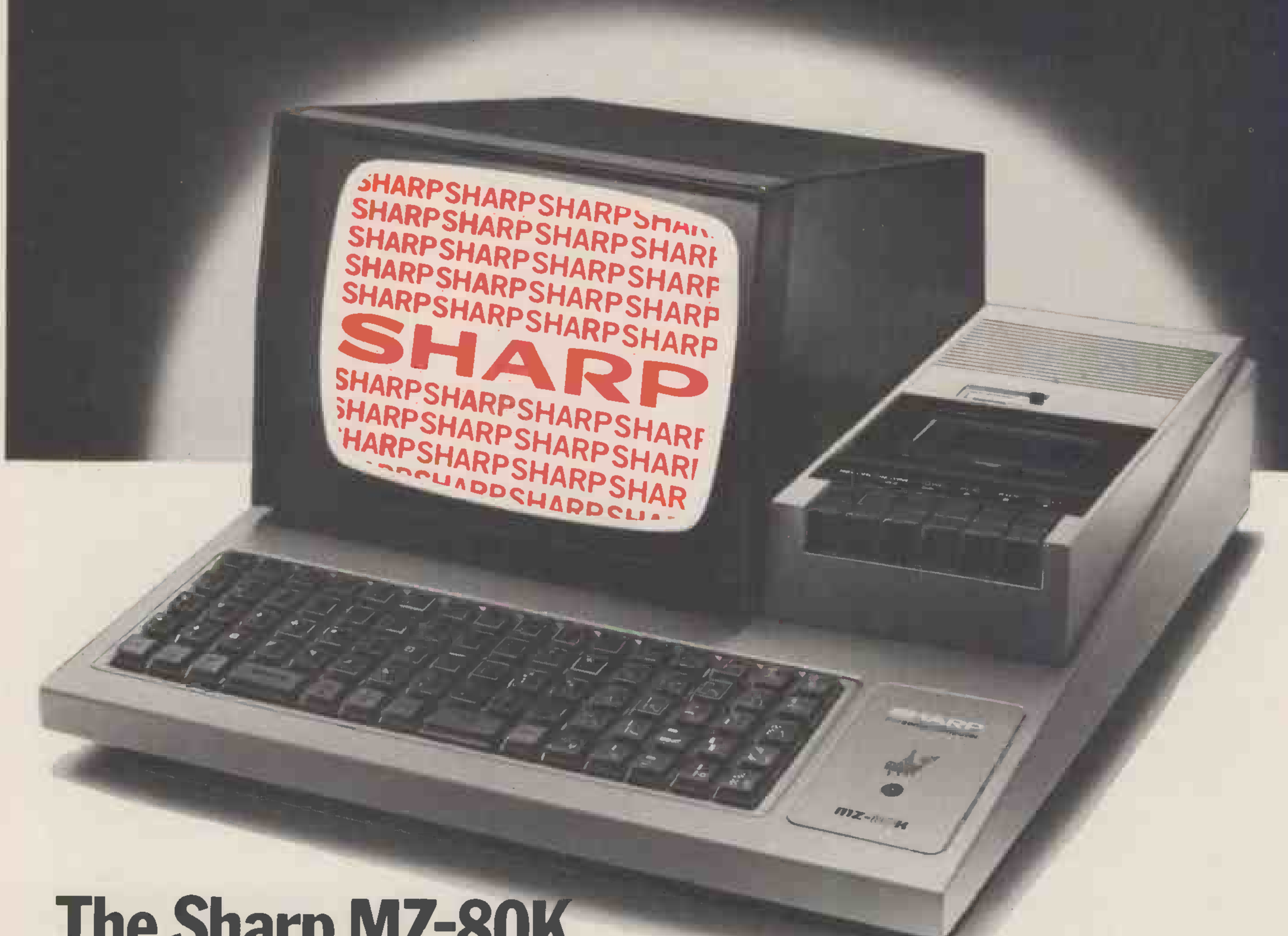
Taking all this into account one can only expect an applications book to be useful to a small group of people who happen to meet its hardware/software level. Rodnay Zaks has, however, solved the main problem by writing *Programming the 6502* before the *6502 Applications Book*. If you're a hardware expert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

It starts with a discussion of the standard interface chips — the 6520, 6522, 6530 and 6532. This is tough going if you try to take it all in at once. Don't! Read it briefly and then as required to understand the later applications.

Chapter 3 gives a description of the usual one-

Cont. on p89

The multi-minded micro



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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; 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.

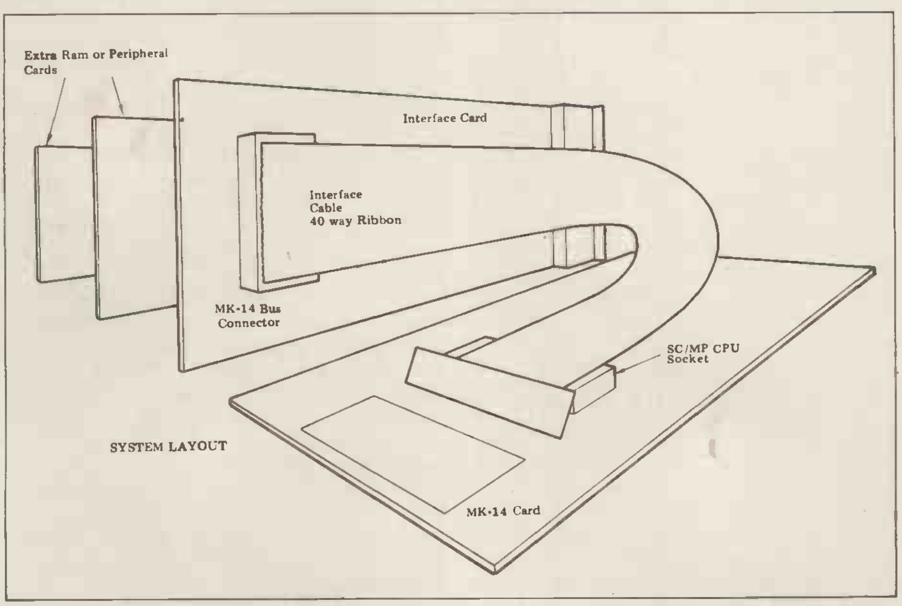
Having decided on the card system to be used it remained for me to decide a method of interfacing it to the MK-14.

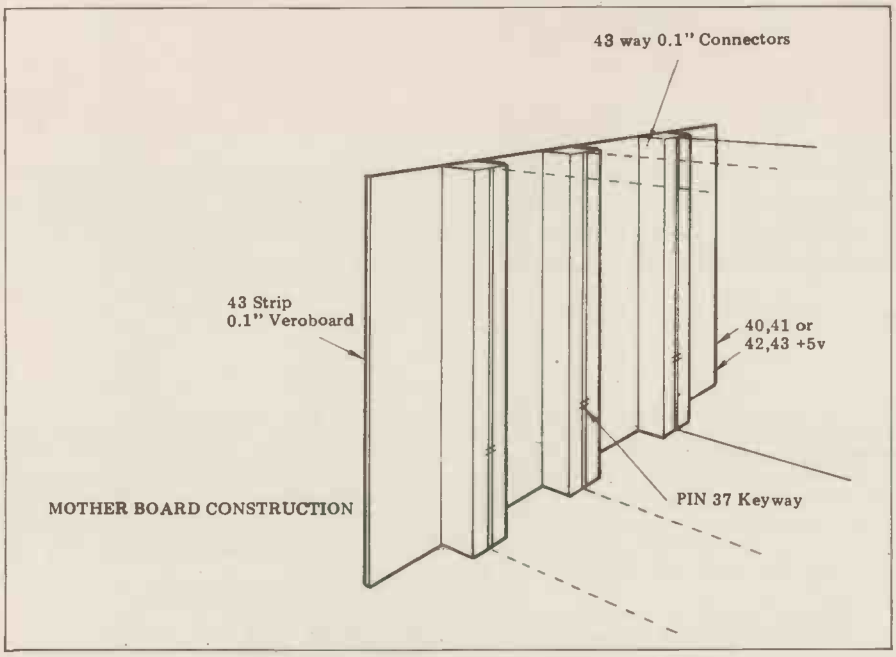
A quick look at the MK·14

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 onboard 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 (2x81LS95) 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).

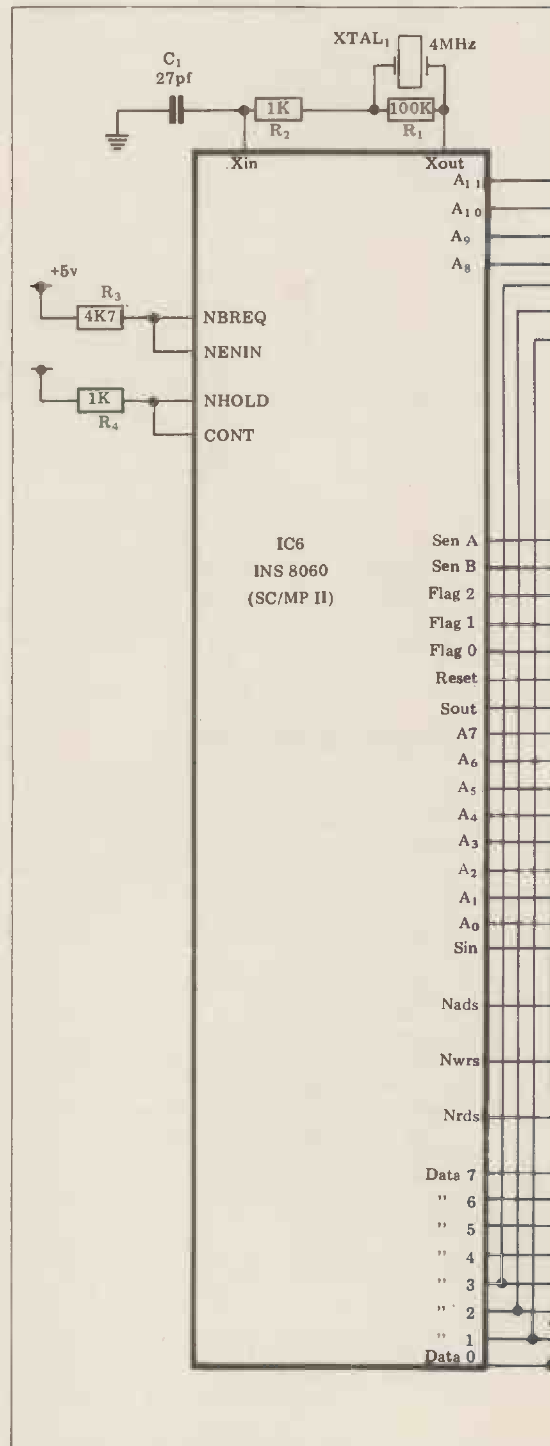
B Wait State Generator. If it is necessary to use a long interface cable (greater than half a metre) then this option will be necessary. Because of the longer length of cable there is a greater propagation delay through it, so the processor must be made to mark time until the cable signals have stabilised. 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.

IC1 is a 74LS122 which is triggered from the falling edge of either NRDS or NWRS; this results in the $\overline{Q}$ output going low and freezing the processor for the duration of the time period of the monostable. The clear input is connected to the output of the address decoder gate N7 (in the main logic diagram) which ensures that this freezing action only occurs on page 0.

The other method of slowing the processor down is to lower the frequency of the CPU crystal. Unfortunately this has the effect of upsetting any timing dependent (real time) programs such as the onboard tape I/O routines (SCIOS monitor only).

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 0.1µF 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, then don't buy your chips yet!)

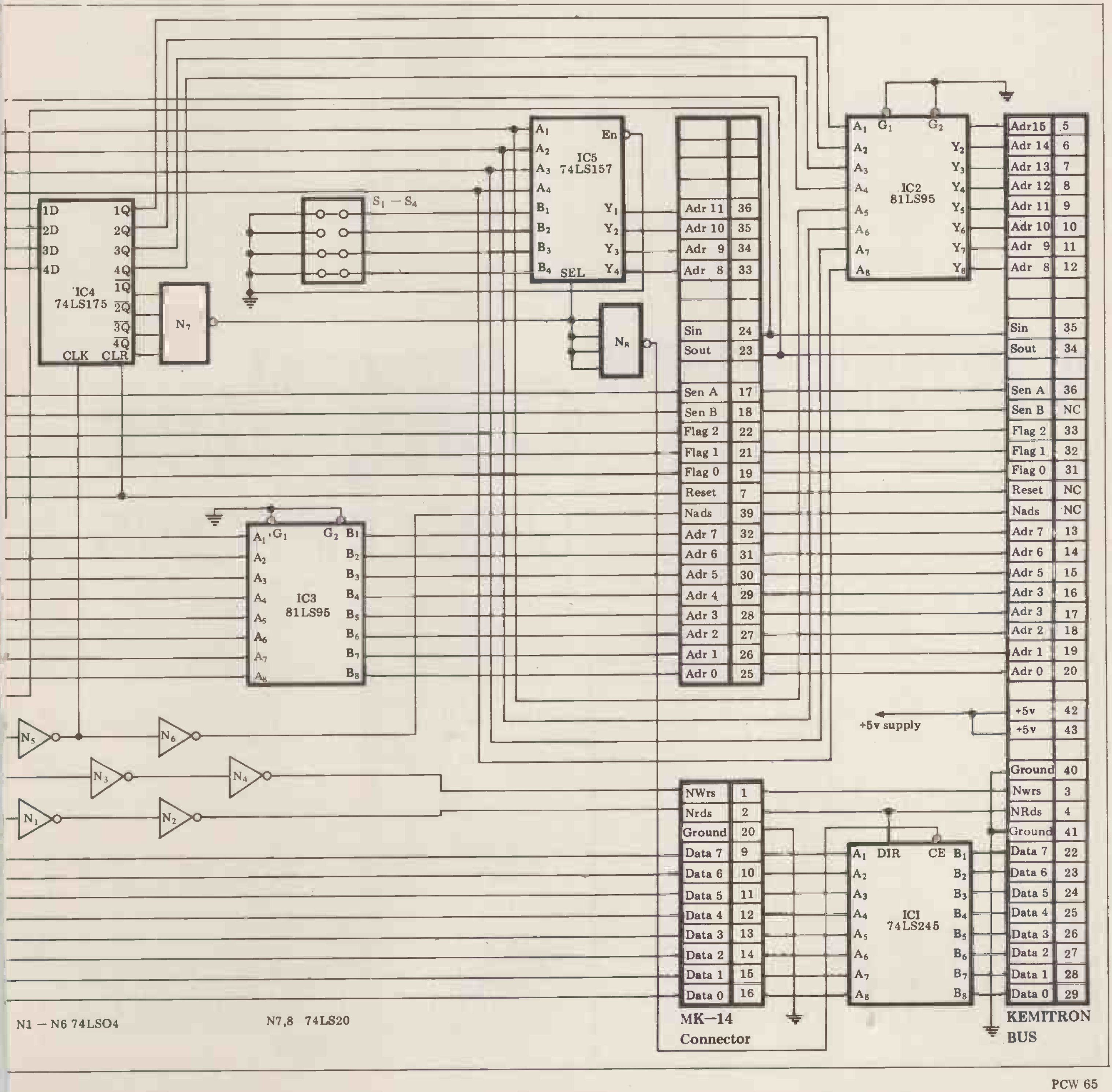
Software considerations

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 SOC 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.

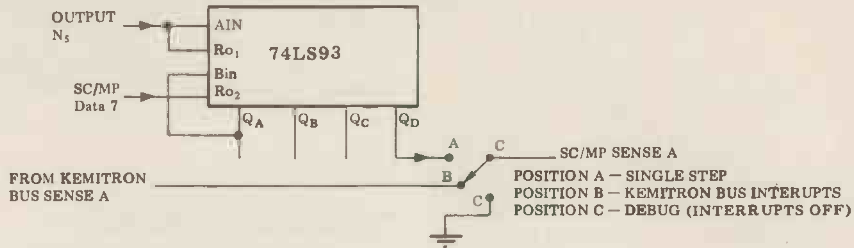
Modifications for earlier models

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 0100_2 to 1011_2 (optional RAM) or 1110_2 (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 S_1-S_4 on the main logic diagram and are "made" for a logic 0.

Fig. 2 SINGLE STEP INTERRUPT GENERATOR



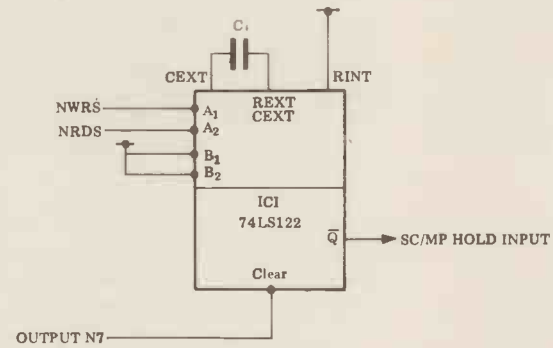


Fig. 3 WAIT STATE GENERATOR

COMPONENTS
ICI 74LS245
IC2,3 81LS95
IC4 74LS175
IC5 74LS157
N1-N6 74LS04
N6,7 74LS20
IC8 SC/MP II (FROM MK-14)

R_1 100K
$R_{2,3}$ 1K
R_4 4K7
C_1 27pf
XTAL1 4MHZ (FROM MK-14)

SINGLE STEP
ICI 74LS93
S_1 SPTT

WAIT STATE GEN
ICI 74LS122
C_1 SELECT ON TEST (DEPENDS ON CABLE LENGTH)

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 bread-board 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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16	12p	39p
18	16p	46p
20	17p	58p
22	19p	61p
24	21p	63p
28	27p	70p
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This month "Conscientious Cowboy" questions the raison d'etre *of the Computer Retailers' Association and David Firnberg debates the uses to which computers are being put in schools today.*

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 partronisingly 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 you 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 Systemantics 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.

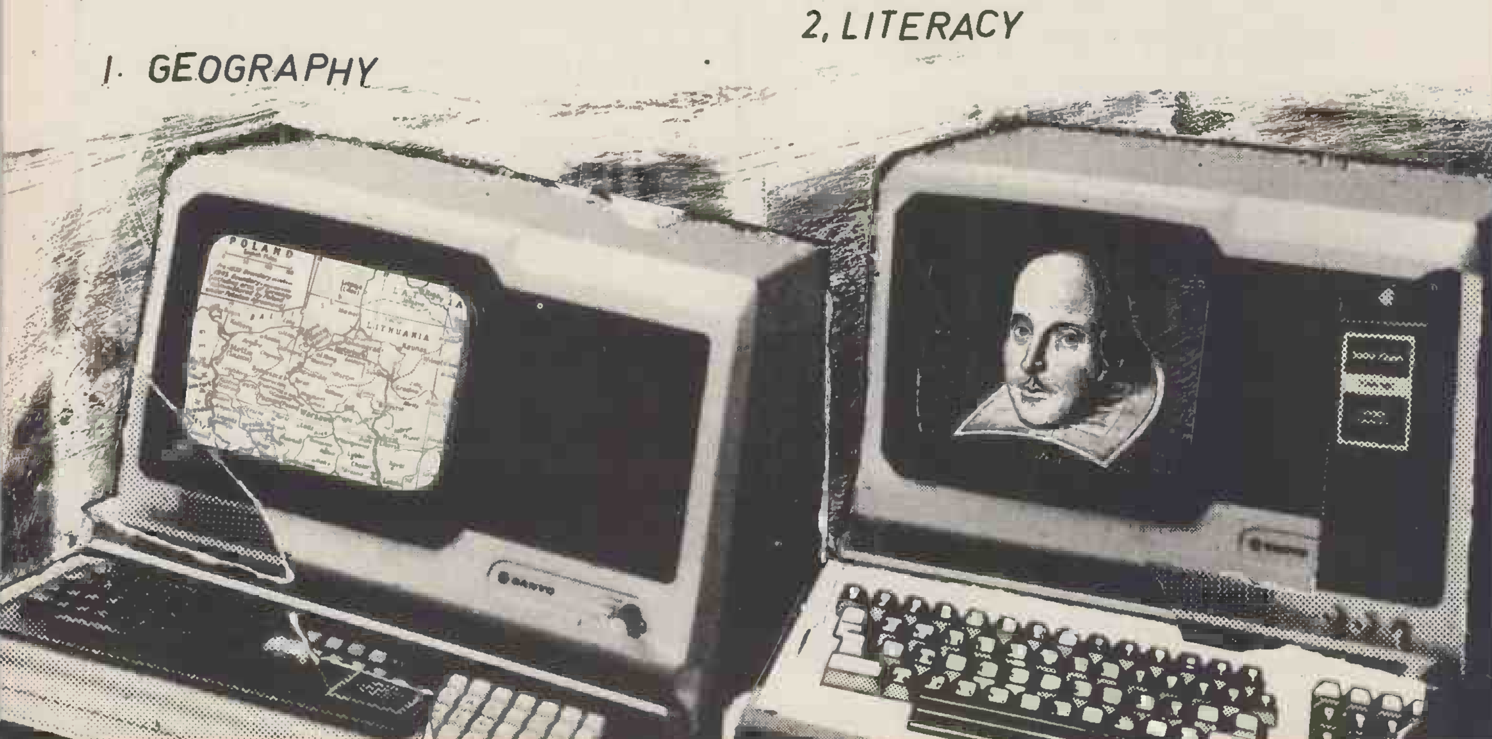
So you need the services of a software consultant. What are these qualifications that are so essential? A university degree in computing? A chap who can write a program to sort a million files in 10 seconds may not be very practical in his suggestions on how to plan for future developments in your business. In any case, the best predictor of success as a programmer is apparently English "O" level. Also, if he'll excuse my mentioning it, what qualifications does he have to make him a businessman? 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 £13 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 in 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. . . periods. . . 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.

Very few of the children at school today will design computer based systems tomorrow, but they will all live in an age in which they will be surrounded by computing and communications technologies. The task for the schools is to ensure that the children are at ease with these technologies, not alienated by them, and can apply them to the reality not the abstraction.

Computing, as we so often glibly say, is a tool. It is a tool which can, and should, be used to support every curricula subject. Computing can be used to help teachers teach and pupils to learn.

Computing adds four facilities to tackling a problem or undertaking a task:

Firstly, it can be used as a device on which data can be stored, retrieved and analysed. There are history classes in which pupils can access details from the parish 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 economics. 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
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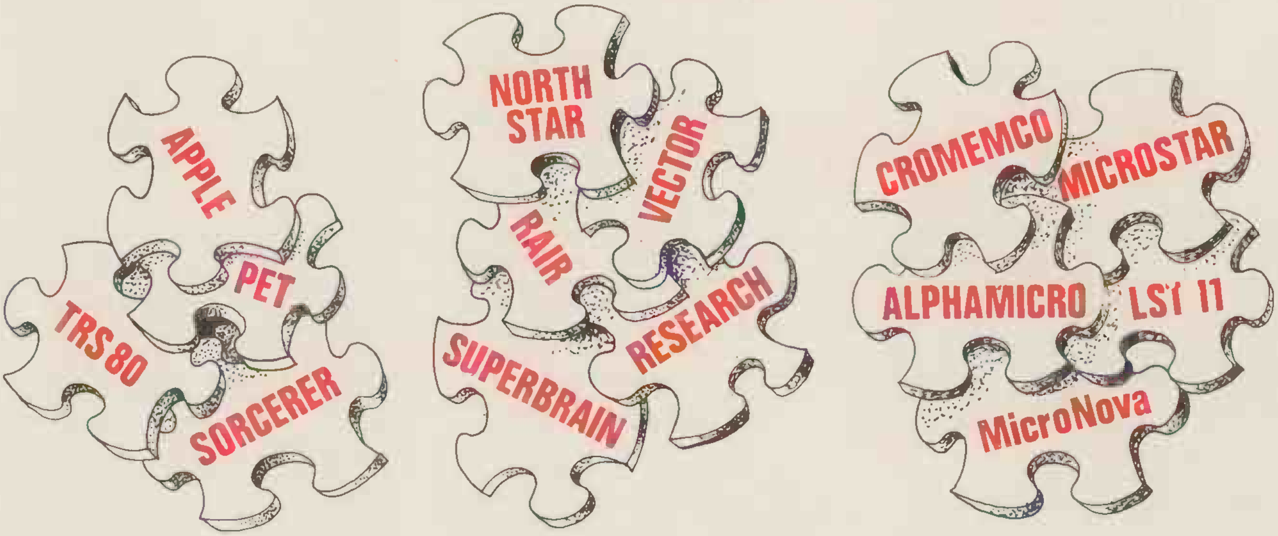

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IMPHEX=HEX+AI²

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 computers and humans, and all have been inexorably converted to hamburger. The circular fallacy of defining intelligence as an ability posessed 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-

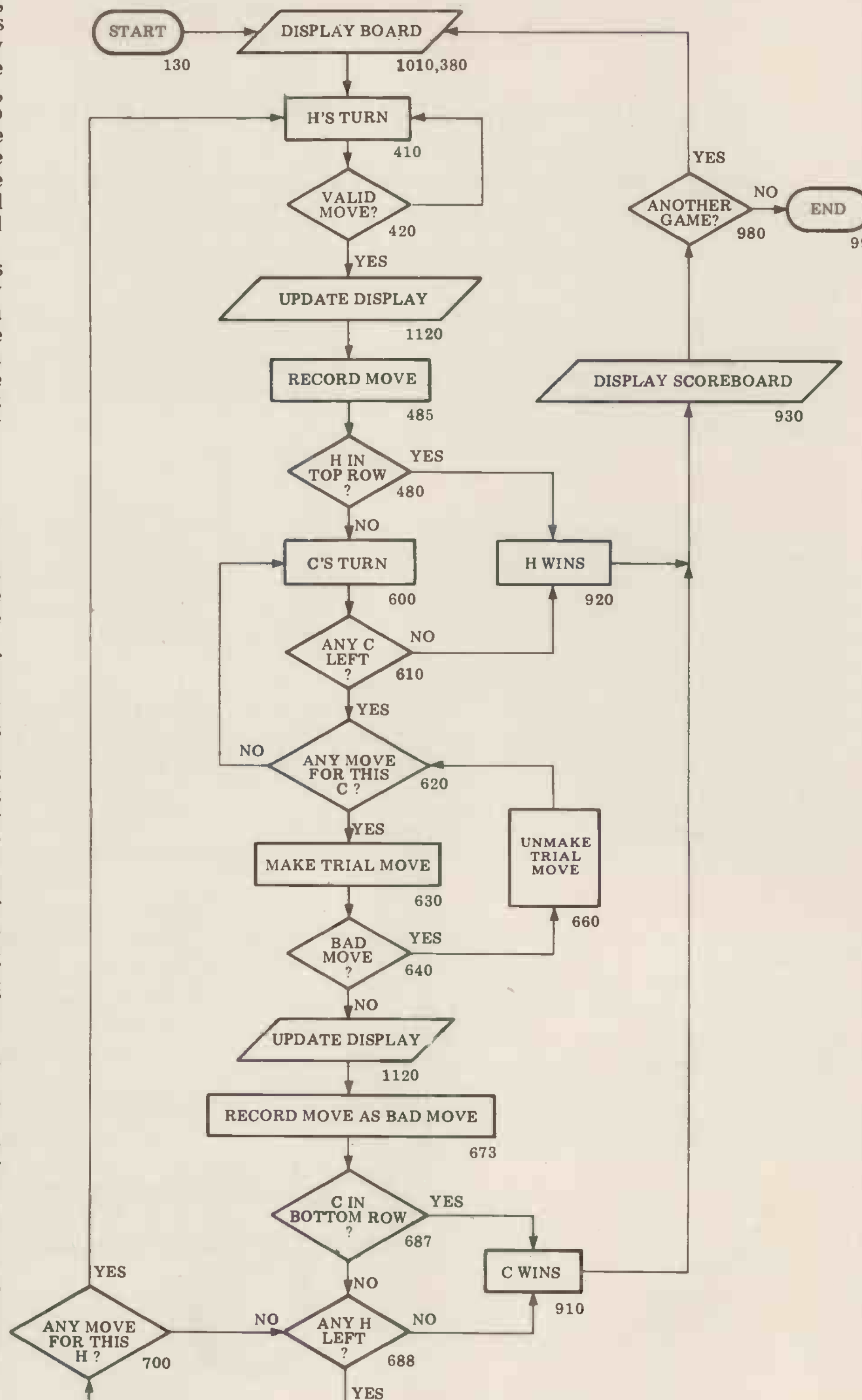


Fig. 1: Block Diagram for IMPHEX

strate one type of behaviour that we can all agree partakes of intelligence: it learns from its mistakes. So well does it do this that you can sit down at the keyboard and win a few games to demonstrate the rules to a visitor, turn the keyboard over to the visitor, and be sure that he will be beaten soundly in spite of his best efforts. Sound intriguing?

The problem

Whether called HEX, HEXPAWN, or HEXAPAWN, 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 these 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 (reproduceable 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 subsections of the display. Figure 2 is 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 cuckolded. 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 under any circumstances start to write the program at this point. Instead, iterate the three steps until satisfaction sets in.

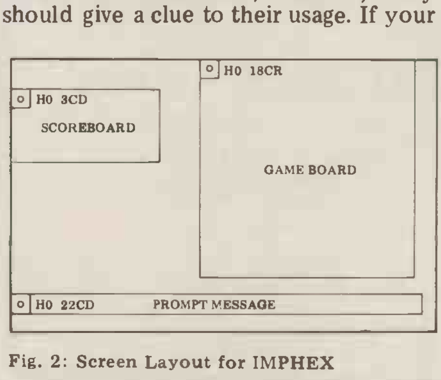


Fig. 2: Screen Layout for IMPHEX

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 ordinates.
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 during trial moves, initial and final; used to rewrite BD array if trial move not accepted.
P(3,3), M(3): position array and move array used to check that all positions and moves have been tried when in random scan mode.
N1, N2: position and move count when in random scan mode.
C: computer's turn
H: human's turn
TU: turn
CW: number of computer wins
HW: number of human wins
F1: illegal move count
F2: has "I needed that" been used?
F3: who won last game?
D$: down string; positions cursor on prompt line.
E$: erase string; erases prompt line.
BP$: board position string; positions cursor to write first piece on board.
BD$: board down string; moves cursor down on board row.
BL$: board left string; moves cursor left three board columns.
C$: computer piece
H$: human piece
BE$: board erase string; erases one piece
BU$: board up string; moves cursor up one board row.

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.)

Fig. 3a

7	8	9
4	5	6
1	2	3

Keypad Orientation

Fig. 3b

31	32	33
21	22	23
11	12	13

X, Y Coordinates

Fig. 3: Naming the Cells of the IMPHEX Board

What is wanted is an algorithm to convert fig. 3A to fig. 3B. I'll give two examples, the second of which is a bit shorter. If anyone can come up with an even more compact solution, I'll be glad to have it. For those who may not be familiar with "DEF FNA(V)", this BASIC statement allows the user to define his own function which can subsequently be called up just as is any built-in function such as SIN, SQR, etc. V is a dummy variable. The function name is FN followed by any legal variable name.

The first time I saw a line like (X > 6)*(6–X) I was, to say the least, bemused, and attributed the ">" to the misprint gremlin who lives in all typewriters, linotypes, and similar inventions of the devil. However, as most of you no doubt know, (X > 6) has the value 0 if false and –1 if true, and (X > 6)*(6–X) is therefore a very convenient way of implementing IF X > 6 THEN FNA(X)=X–6 and compacting it within a more complex expression. Work out for yourself how line 10 below utilizes this technique.

Solution No. 1

```
10 DEF FNA(X)=(X > 6)*(6–X)+
(X<=6)*(3–X)–(X<=3)*3:XI=FNA
(HI):XF=FNA(HF)
20 DEF FNB(Y)=(Y<=3)–(Y>6)*3–
(Y<=6)*2:YI=FNB(HI):YF=FNB(HF)
```

Solution No. 2

```
30 DEF FNC(X)=X+10–(X>3)*7–
(X>6)*7:YI=INT(FNC(HI)/10)
40 XI=FNC(HI)–YI*10:YF=INT(FNC
HF)/10):XF=FNC(HF)–YF*10
```

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-

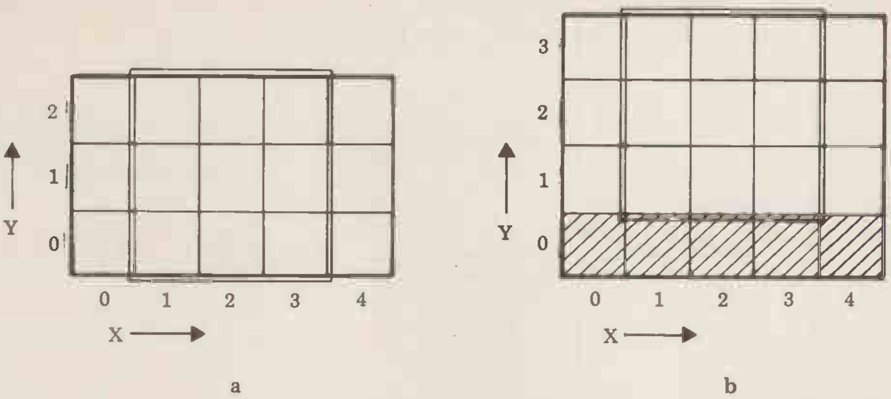


Fig. 4: The Board Array

ordinates. In PET's BASIC the number of arrays is limited only by the number of possible names, the number of dimensions is limited to about 34, and the number of elements to 255. Even this limitation is to be overcome in future ROMs. (Commodore's early literature refers to their arrays as matrices: I object to this usage as it implies that matrix arithmetic is provided, which it is not). To set up an array we program a line such as 50 DIM F(4,5) which defines an array F having two dimensions and coordinates 0 to 4 by 0 to 5. The contents of each coordinate point are automatically initialized at zero. Note that in PET the coordinate names start with 0: in some dialects they will start with 1. The array which we will implement to store the board position for IMPHEX is shown in fig. 4. The two extra columns shown at 4a simplify the computer's move-selection algorithm, as will be shown subsequently. We could define array BD by DIM BD(2,4), but then the rows would be numbered 0 to 2 instead of 1 to 3, so to avoid confusion we can throw away a bit of storage facility and define it as DIM BD(3,4) as shown at 4b which has the desired coordinates for the 3 x 3 board. The bottom row will not be used at all.

Similarly we are going to want another array to store bad moves, defined as the board pattern just before the human made his winning move. Pragmatic tests indicate that storage for 15 such patterns is more than enough, so this array can be defined as DIM BM(3,3,15). Here we don't need the extra columns, but have retained and wasted the zero X, Y, and Z ordinates so as to keep the numbering system straightforward. Array BM can be visualized as looking like fig. 5.

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 the agreed-upon rules). 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 and similarly line 445 tests for the vertical move to an empty cell with IF XI=XF AND BD(XF,YF)< >0. No doubt we will always have with us the jokester 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 where 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 a legal 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

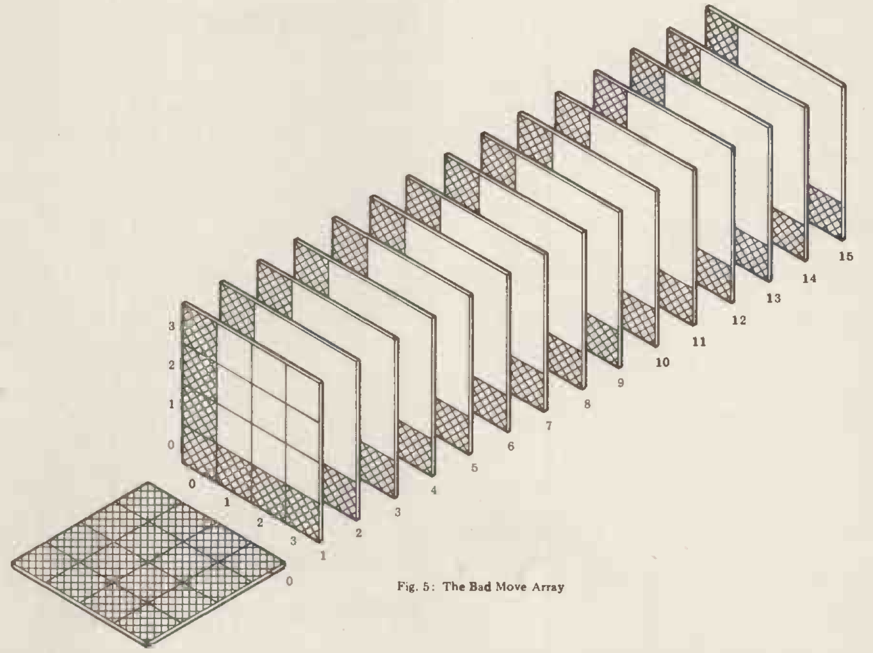


Fig. 5: The Bad Move Array

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 pattern 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 build-up 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 different 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.

A cute 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 recorded 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

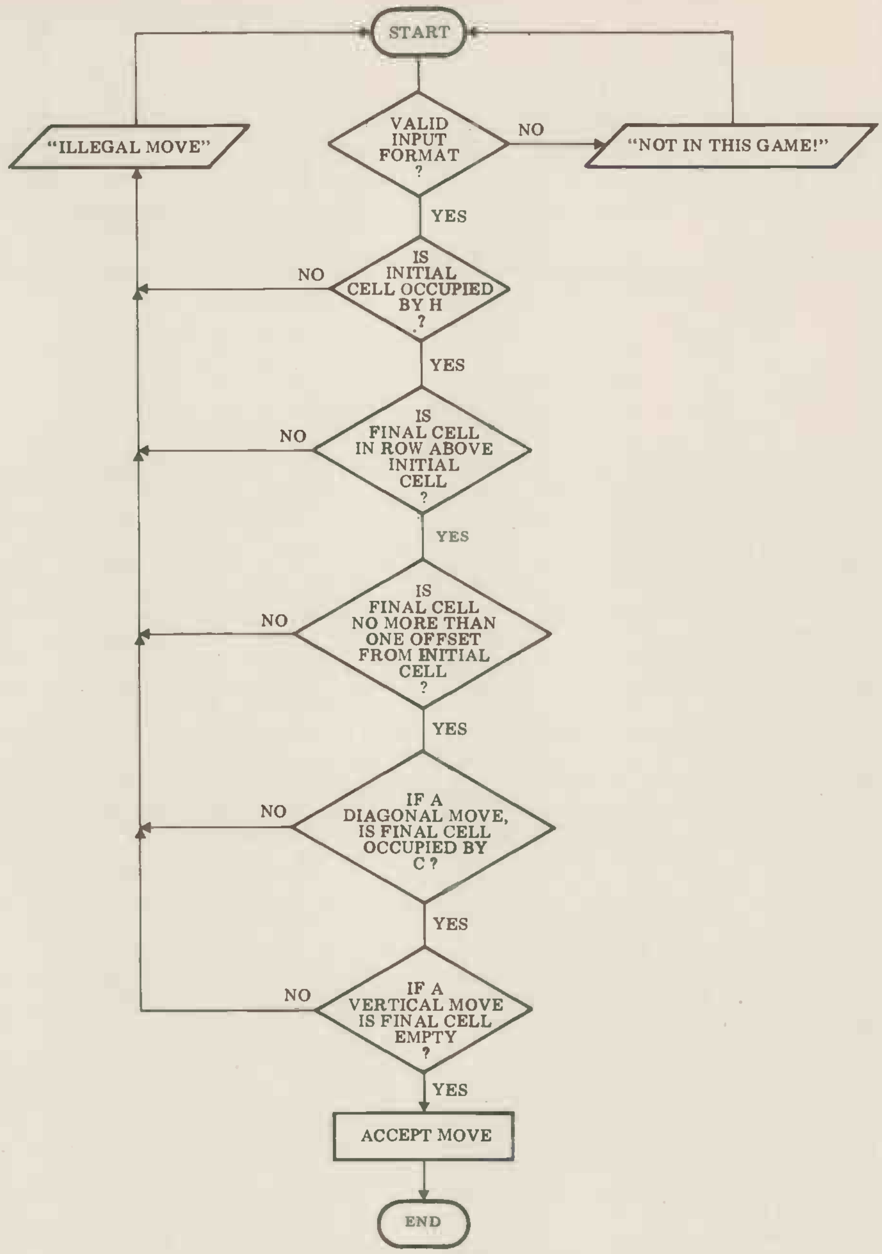


Fig. 6: Block Diagram for Checking Human's Moves in IMPHEX

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 unsuited 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 not).

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 980). 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 lacklustre than a program which retires into READY with a flash-

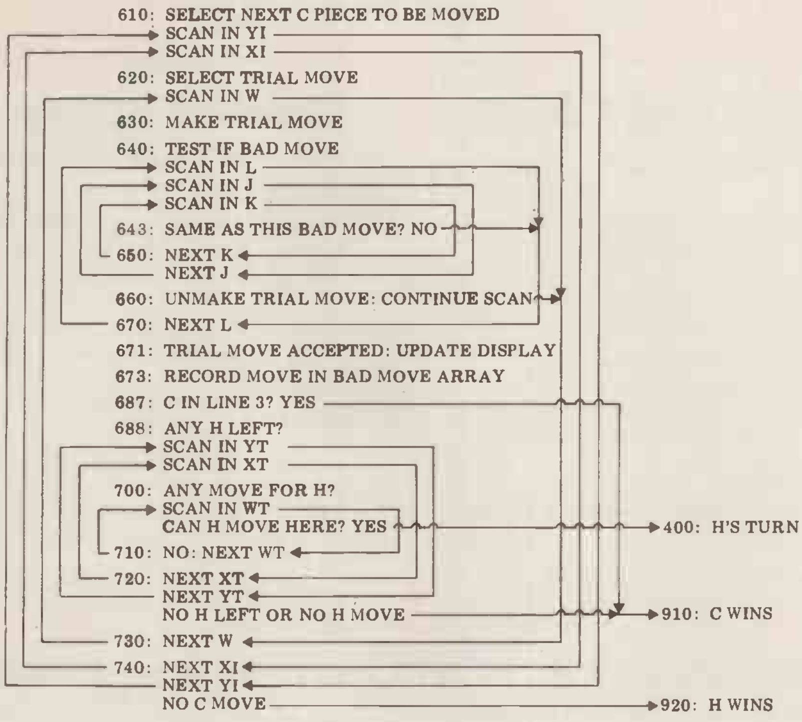


Fig. 7: Nested Loops in IMPHEX

ing cursor as soon as it has completed one tour of duty. Incidentally, note the positioning of "READY" in line 2 when the game sequence is finally ended. This avoids either an unattractive scroll-up with loss of part of the board display or two lines of readout with no space between them, the sign of a rank amateur (unless I do it for some special reason). See for yourself why the semicolon is required in line 995.

2. *Invalid and Illegal Move Response:* As it is easy to *differentiate invalid from illegal moves,* we can provide two different responses: "NOT IN THIS GAME!" for the former; "ILLEGAL MOVE" for the latter with, in both cases, erasure of the previous human input and a flicker to indicate a new message.

3. *Unsolicited Computer Responses:* One can go too far with this kind of thing, of course, but a little bit is like the right amount of salt in the soup. After each lost game, the "I HAVE LEARNED. . ." response (lines 1080-1095) is presented in varying form. If 6 games have passed before the computer wins its first one, we get "I NEEDED THAT!" (line 975). Children and clergymen are especially responsive to this sort of touch. In this category we also have the "HOW MANY TIMES DO I HAVE TO TELL YOU?" response, touched on previously, resulting from a selected number of illegal moves.

4. *Instructions:* Complete, concise *instructions should always be included* in the program, but *display should be optional* (lines 130, 140). Note that only two tests determine if I$ is "Y", "N", or neither one. *Don't mix GET and INPUT in the same program;* it invariably leads to the user bombing out by pressing READY at the wrong time. Note that PET permits a printout combined with an INPUT command as in INPUT "INSTRUCTIONS ('Y' OR 'N')"; I$. For some other computers you may have to rewrite this as PRINT "INSTRUCTIONS ('Y' OR 'N')";: INPUT I$. Always show the acceptable responses unless they are self-evident, and don't require the user to spell out "YES" and "NO". If you want to guard against someone writing "YES" when only "Y" is required, you can write IF LEFT$(I$,1)="Y" instead of IF I$="Y"

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 uninitiated user, I have found, sees the double-sized space key as a special function key related to and alternative 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 scoreboard and isolates it from other elements of the display. You will see that there is a little trick in line 950 which permits us to write the values of a variable in reverse mode without worrying about how many digits long it is or generating unwanted black spaces. Don't be so lazy as to write an isolated line of reverse characters. Since the characters all touch the top but not the bottom of the 8 x 8-dot pixel, such a technique gives a raw, unbalanced look. Instead, surround the reversed characters with a bit of a border. To see what I mean, compare these two printouts:

```
10 PRINT "[CS 2CD 16CR RE] BEFORE"
20 PRINT SPC(15)"[5CD RE SL]88888888"
30 PRINT SPC(15)"[RE SP]AFTER![SP]"
40 PRINT SPC(15)"[RE SL]""""""""[SR]"
```

Note the minor subtlety that using reverse shifted "8" instead of shifted quotes gives the same number of scan lines above as below, making the lettering appear accurately centered.

7. *Ensuring that the Display is Up-to-Date:* Another sign of sloth, inebriety, or slovenliness is to leave no-longer-current displays on the screen. *Don't leave no-longer-current displays on the screen!* Go to a little trouble to generate suitable erasure strings such as E$, and use them to sweep off the offending prompt or no-longer-valid remark, just as you use similar strings such as EB$ to erase portions of the board.

Board graphics

Methods of designing and implementing graphics for board games were treated in a previous article, with HEX as an example. For any reader who doesn't have this issue available, I will explain that lines 1120-1260, which update the display, go to some trouble to erase a piece and then write it in the new position in rapid sequence so that the piece appears to move from one spot to the other, due to the persistence of human vision.

Choosing the next move randomly

As previously explained, the options open to the computer are to look for its next move along a programmed scan sequence or to choose randomly which piece shall be moved next. Both approaches have advantages and it is instructive to see both in operation. For my own use I have incorporated both methods into the program and you may choose to do the same.

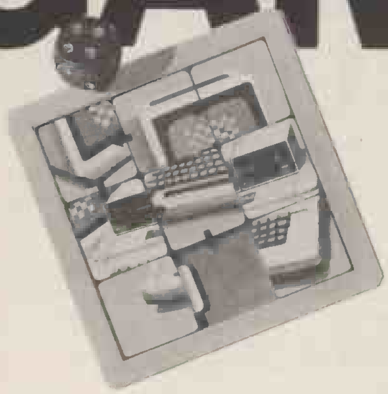
It is not enough to call for Y=INT (2*RND(1)+2):X=INT(3*RND(1)+1). That would indeed generate Y= 3 or 2 and X= 3, 2, or 1 but it might generate the same set of ordinates twice or three times or indefinitely. What is needed is an algorithm which sets up a random sequence of the cell ordinates but allows each position to be generated only once and for each position sets up a random sequence of trial moves but allows each trial move to be generated only once. The problem is congruent to shuffling a deck of cards, and the simplest implementation 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 M(3). These will be used simply to record that each position and move has been tried.

750: zero the piece selection array.
755: select Y randomly from the values 2 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.
765: 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.
775: select a move randomly from the values 1, 2, or 3.
780: if this move has been used before, try again.
785: if this move is not legal, go to 850.
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

COMPUTER GAMES



SPEEDING-UP THE SEARCH

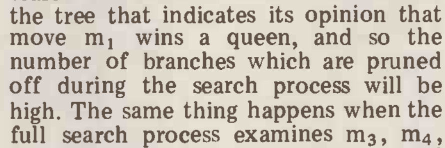
In last month's article we introduced the extremely powerful Alpha-Beta algorithm for searching two-person game trees, and we saw how dramatic the effects of alpha-beta pruning can be when the branches of the tree are searched in their optimal order. Although optimal ordering is impossible to achieve (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, . . . 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 biship, 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; but if the last stone lands in a player's Kalah he has another turn, so it is advantageous to plan the game so that you will have two or more turns in succession. The other important rule is that if a player's last stone lands 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 10-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 the search speed still further. Rather than begin a new 5-ply search at each ply, he used the fact that the short look-ahead searches overlap — the 5-ply 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 ordered: to 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 take advantage of this 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 the day when 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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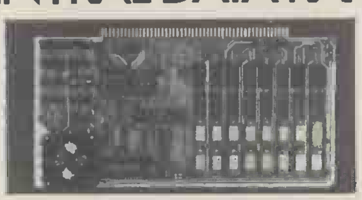

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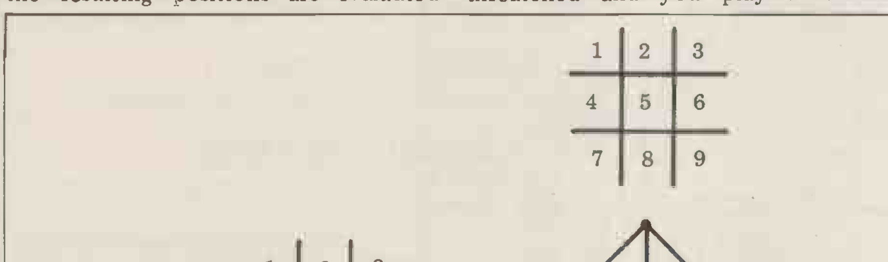
articles will know that the moves may actually be generated in that order by the application of an elementary understanding of the game.

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 P_1, 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 (P_{11} and P_{12}) using our evaluation function. Let us assume that the scores for P_{11} and P_{12} indicate that P_{11} is a better position than P_{12} from our opponent's point of view. Then on the basis of the 1-ply search conducted from position P_1 we can say that the next set of moves to be generated should be the successors of position P_{11}. 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 P_{11} 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 bunch of 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.



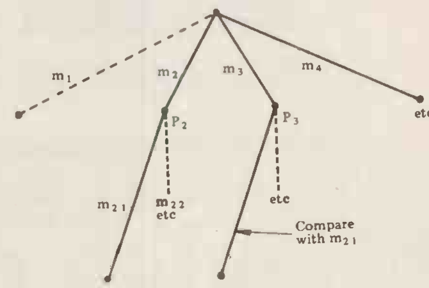
Short look-ahead for noughts and crosses.

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 m_1, 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 m_1 and start to think about another move, m_2, 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 m_2 can 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 m_1, it is quite possible, even likely, that ZAP will ruin you after you make the move m_2. 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 so 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 m_2, leading to position P_2, and soon discovers that in reply to m_2 if its opponent chooses m_{21} then the opponent will have improved on his score which is currently at the root of the tree. In other words, move m_{21} refutes move m_2, and the program need not look at m_{22}, m_{23}, . . . , etc.

Next the program examines move m_3. It knows that m_{21} refuted m_2 so it first looks at its list of legal moves from position P_3 to see if the same move as m_{21} 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 m_3 after examining the minimum number of branches. If it turns out that m_3 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 m_4.

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 used 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 then 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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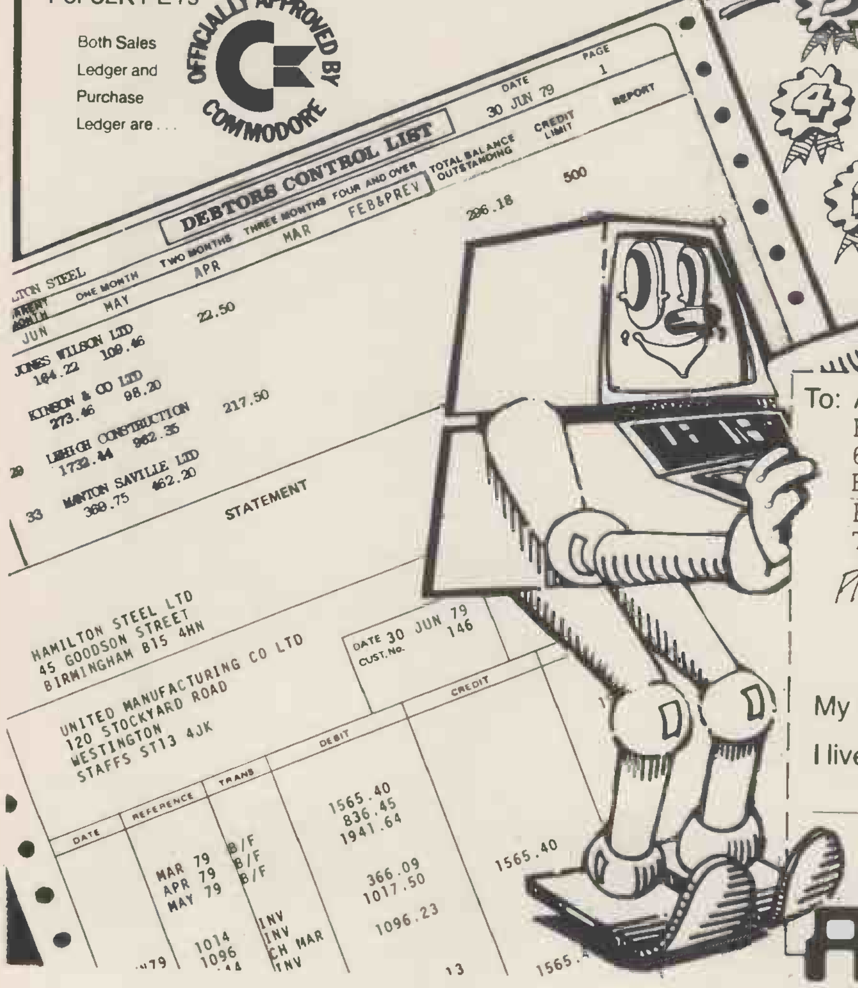

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whether it be at 3-ply, 5-ply, 7-ply or deeper, the first move to be examined for Black would be c7—c5. Again the logic behind this use of the heuristic is easy to understand — a decision which is bad today will probably be bad in a similar situation 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, then 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 $-\infty$ and $+\infty$ 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 or impossible for White to avoid conceding more than two pawns. Under these circumstances the search will terminate without the values of alpha and beta undergoing any change, and the program must then think again, widening its window.

The flow chart

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).

(i) is the ply number currently under investigation.

L(i) is a pointer to the list of moves possible at level i (all sharing the same parent move at level i—1).

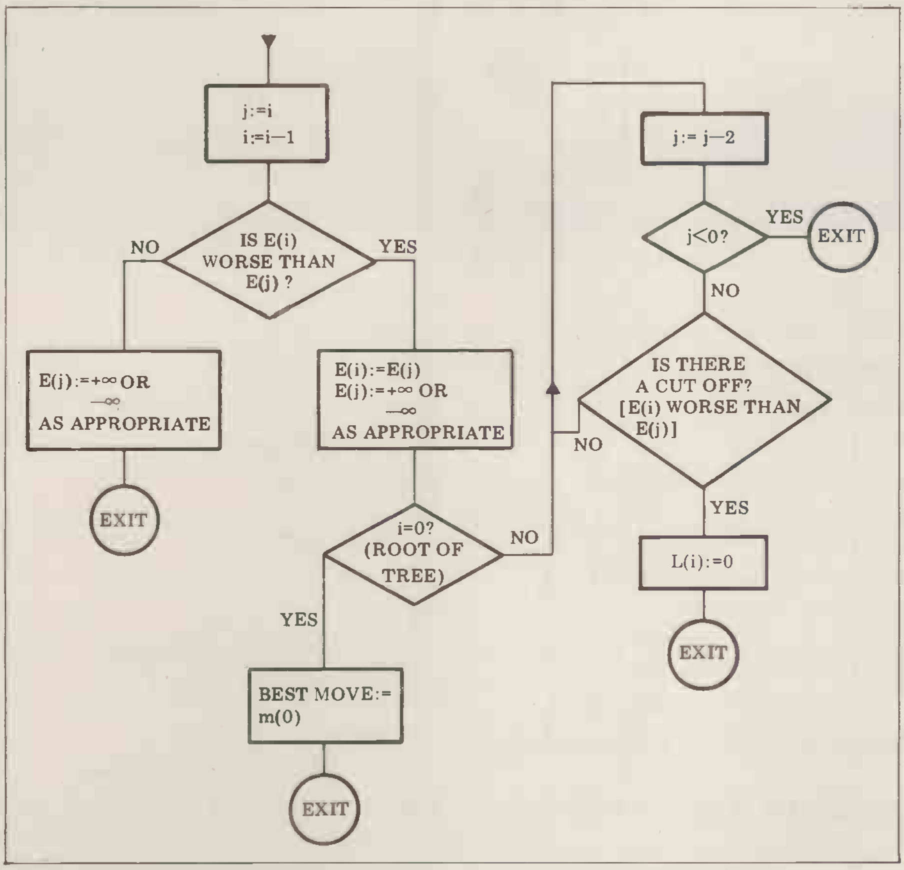
m(i) is the move, at level i, currently being processed.

E(i) is the evaluation of this move.

The left hand part of the tree assigns values to the nodes as the search proceeds. A value of $+\infty$ is assigned as initial values to nodes at odd depths, and $-\infty$ as initial values to nodes at even depths. These are the values which are to be bettered if a candidate node is to be acceptable. The program compares the value of E(i) with E(i—1) and replaces E(i—1) with E(i) if E(i—1) is "worse than" E(i). To be worse than E(i), it is necessary for either: E(i—1) to be greater than E(i) and i to be even; or E(i—1) to be less than E(i) and i to be odd.

When there are no more moves to consider from a particular node, the value of E(i—1) is compared with E(i—2), and so on, back up through the tree, until E(1) replaces E(0) whereupon the move leading to the evaluation E(1) is the best move found so far from the root of the tree. Once all moves from the root have been examined (or search time is exhausted), this move is played.

The right hand side of the flow chart performs the pruning made possible by the alpha-beta algorithm. When a new value of E(i) is found, the alpha-beta routine compares it with the evaluation at ply i—1. If a cutoff is found the pointer L(i) is set to zero to terminate the search of nodes at level i.



Task for the month

(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).

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

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WORD PROCESSING

Compiled and edited by Mike Knight of Mike Rose Micros

We've all read about the micro revolution in the office. Visions are created of rooms filled with robots communicating with humans via television-type screens or in squeaky dehumanised voices and speaking to each other by means of an all powerful computerised master controller. The reality is somewhat different. The major office revolution is in fact occuring in word processors, and it's to that area that we are turning our attentions this month.

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 external 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 media industry . . . 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, whether by direct media advertising, sales brochure or mail shot. Our "prospect", once attracted, will probably need to be told in detail exactly how he will benefit, once again probably 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 their 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.
5. The ability to create in-text diagrams, using normal keyboard (eg. graphs).

In the next two sections I look to see how eight of these packages meet these requirements.

Evaluations

WORDSTAR

This package is supplied on disc at an average cost of £250. It's available from many outlets throughout the country. . . here's a short list:

Compelec Business Systems, London (01-636 1392) who market the system under the name Simpelec Word Processing System, Byte Shop/Computerland group who are based in London but have countrywide outlets (01-554 2177), Metrotech, Uxbridge (Uxbridge 57780), London Computer Store, London (01-388 5721), Telesystems Ltd, Gt. Missenden (02406 5314) and Lifeboat Associates, London (01-379 7931).

The package comes supplied with an extensive user's manual covering every aspect of use, starting with an overview of the system and going through each function in turn. There are also sections on System Requirements, Installation and Modification. For the technically minded amongst us this manual gives all necessary information but for those not fully acquainted with computer jargon, I feel a training course would be advisable.

MicroPro International Corporation, the authors of the software, recommend an 8080/8085/Z80 Microcomputer with a minimum of 44K RAM, a screen, CP/M or a similar operating system, two floppy disc drives and a printer. Although they state that the system will run perfectly well on this minimum hardware they do recommend that more RAM is added for systems which will be used intensively in word processing applications involving documents more than a few pages long.

The cost of this minimum hardware varies from around £3400 (London Computer Store) to £6300 (Simpelec System 1). Most of these outlets offer installation services and software maintenance, including replacement of corrupted discs or bug fixing — often at a small cost. Training however is not always provided — so check before you buy.

THE ELECTRIC PENCIL

This product is supplied as part of a complete hardware/software package selling under the trade name of

TASKS	Wordstar	Electric Pencil	Wordcraft	XTAL	Templeman	T.A.P.	C.M.C.	Magic Wand
EDIT								
Video editing	*	*	*	*	*	*	*	*
Scrolling	*	*	*	*	*	*	*	*
Insert/delete	*	*	*	*	*	*	*	*
Move	*	*	*	*	*	*	*	*
Cursor motion	*	*	*	*	*	*	*	*
Set/clear tabs	*	*	*	*	*	*		*
String search/replace	*	*	*	*	*			*
Word wrap	*	*	*					
Read to/write from additional files	*	*	*	*	*	*		*
Repeat	*	*	*			*		*
Automatic center	*	*	*		*	*		*
On-screen text formatting	*	*	*					
PRINT								
Vertical/horizontal margins	*	*	*	*	*	*	*	*
Vary line spacing	*	*	*	*	*	*	*	*
Vary page length	*	*	*	*	*	*		*
Right justify	*	*	*	*	*			*
Underline	*	*	*	*		*		*
Double strike/ boldface	*		*					*
Number/title pages	*	*	*	*	*	*		*
Upper/lower case	*	*	*	*	*	*		*
Text diagrams	*		*	*				
COSTS								
Software	£ 250		£ 325	£ 140	£ 500	£ 25	£ 25	
Hardware (minimum)	£3400 -£6300		£2900	£1425tape £1800disc	£1400+ printer	£1200	£1250tape £1990disc	
Both	£3400 -£6550	£1950	£3225	£1825tape £2200disc	£1900+ printer	£1225	£1275tape £2015disc	£4300

Wordstation. It's supplied by London Computer Store, London (01-388 5721) for the inclusive price of £1950.

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 fity 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 Palsoft 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 £900 for a disc drive unit. No installation service is

Cont. on Page 116

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!

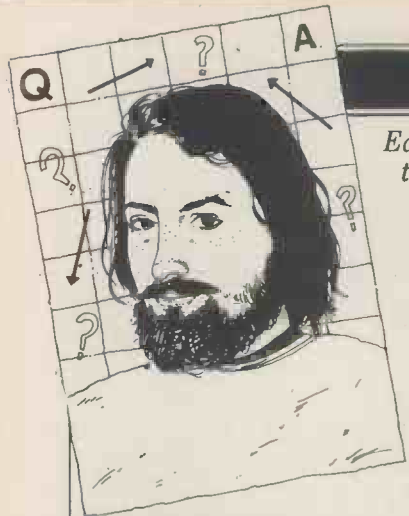
After dealing with the use of relays and loudspeakers, we have our first application — a Morse code generator, quickly followed by a time-of-day clock, a home control program (based on the time-of-day clock) and a telephone dialler (not for the UK). The second part of the chapter gives examples of useful 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.



COMPUTER ANSWERS

Each month Sheridan Williams and his panel of consultants answer readers questions. Topics may be hardware — from kits to mainframes, or software — from differential equations and statistics to file handling or sorting; the choice is yours. Send your questions direct to Sheridan Williams at 35 St Julians Road, St. Albans Herts.

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 Mascarenhas,
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 RS Components or Barrie Electronics Ltd., The Minories, London, EC3 (01-488 3316). Alternatively, you could modify the internal power supplies. The Apple, however, has a switched-mode supply 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 (£35): (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 (£90) — or, alternatively, take a good look at the article in March's PCW on cheaply 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 board — 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 16K version 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 conned 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 bit 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 Apple (!) 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 luggage 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 pet on 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 at the desk to the duty officer. More likely you will have to find your way to the clearance (?) office and go through the rigmarole of incomprehensible forms. But do not despair, there are people to help you (for a small, reasonable fee) called Customs Clearance Agents. I used Greyhound Courier Service (01-570 1018 0975) who for a flat fee of £15 eased me through the paper jungle. Again, give them a ring beforehand and confirm meeting arrangements, method of payment etc for import duty and VAT.

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 repair those, but if you have instead opted to choose a PET then I suggest that you try Petalect 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 closer together than 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 availability of precisely 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 do the job with a domestic battery digital clock and a "Polaroid" camera. At the other, £1500 should buy you a "PET" computer with a built in timing function, a printer, and a converter to 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 "AIM 65". £370 will buy you the machine complete with 20 column printer, a BASIC interpreter and, I suspect, enough memory for your purposes. It only needs 6 volts DC, apart from the printer which takes 24 volts (and which would run off two car batteries in series). At that price the equipment is uncased. For about another £100 you could get a specially fitted 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 other computers 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 — there could be a need for some assembly language programming. Hopefully the supplier would be able to do 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 the keyboard); 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 — which in turn depends on the course and the number of competitors (or so my limited knowledge of orienteering suggests).

If you could interest the British Orienteering Federation in 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, my 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 would these courses be? Will the computer be used in other subject areas? Maybe you just want the computer to stimulate interest — perhaps you'd form a hobby club around it. There are other questions. Have you the teacher resources to make good and effective use of it? Will you require the computer to handle BASIC only or will you need to program in assembler/Fortran/Algol/Pascal/Forth etc? Are you thinking of expanding the system at a later date by adding a printer, discs, 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 enclosed 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 coordinating computer education and who already has 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 reasonable prices.

Please keep an open mind about computers because there 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 32768,255 will store FF_H in location 8000_H. The statement X=PEEK(32769) will read whatever byte of data is stored on location 8001_H and store it 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 a kit complete with metalwork, TV screen, computer etc. then I'm afraid there are none that I know of on the market. If, however, you mean that you want to start programming in BASIC as quickly as possible using an existing TV set then three kits spring to mind. They are the OHIO superboard, the Compukit UK101 and the NASCOM 2.

If you want immediate expansion to a disc based system then only the OHIO currently offers this (though I personally haven't seen one). None of the three is what I would call well supported by the manufacturers — loud promises for no goodies 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 a Sorcerer and 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 Kimbolton Road, Bedford. FORTH products are also available from COMSOL Computer Solutions Ltd, 87 Briar Road, Shepperton, Middx. Two FORTH Inc books are available from COMSOL, *The Microforth 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 is a version called FIFTH, which is said to combine the advantages of FORTH and PASCAL. The following references may be of interest:

1. "FORTH a new way to program a minicomputer" 1974 Astron. Astrophys. Suppl. 15 pp. 479-511.
2. "FORTH for Microcomputers" Dr. Dobbs Journal No.25 pp.21-27.
3. "FORTH dump programs" Dr. Dobbs Journal No.28 pp.26-28
4. "FORTH's forte is tighter programming" Electronics March 15 1979.

John Yale.

10 PART PASCAL SERIES

THE COMPLETE PASCAL

BY SUE EISENBACH AND CHRIS SADLER

CHAPTER 8 TOP-DOWN DESIGN

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.

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 most 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 which are going to 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 3, you should ever feel overwhelmed by the complexities of interpreting formatting commands or shuttling segments of text backwards and forwards, you should consider the joys 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 conditionals can employ 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 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 non-printable "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 window but this is undesirable and liable to lead to errors. As a consequence, a second standard procedure, READLN (FILEID), exists whose function is to move the pointer beyond the line separator and clear EOLN (i.e. make it FALSE again) without placing the (spurious) blank in CHARBUF. After a READLN, FILEID↑ will contain the first character of the *next* line and the program is thus ready for succeeding READs. If the READLN is called before all the characters on the line have been read, the pointer will skip to the beginning of the next line anyway. In a similar fashion, WRITE (FILEID, CHARBUF) transfers a character to an output file and WRITELN (FILEID) will append a line separator.

This scheme is sufficiently useful in general programming that a non-standard extension, sanctioned by Wirth in his "Report", has been developed to allow more generalized READ and WRITE procedures. The first enhancement concerns the *type* of the variable permitted in a READ or WRITE call. In general, any variable of type INTEGER or REAL may be specified. The interesting point here is that the file type must still be a *textfile* so that some sort of conversion must be done (implicitly) between the character string in the textfile and the number in the program. Incidentally, variables of type Boolean may also appear in WRITE or WRITELN statements in which case TRUE or FALSE will appear in the output file — although you are unlikely to find this feature implemented on a micro system yet. The second extension allows more than one variable to appear in a READ or WRITE statement. Thus

READLN (FID,VAR1, VAR2, VAR3)

is equivalent to
READ (FID, VAR1); READ (FID, VAR2); READ (FID, VAR3); READLN (FID)
which represents a considerable compression.

On large main-frame implementations of PASCAL, the mode of operation is usually non-interactive and communication with a program would be through two standard textfiles called INPUT and OUTPUT which are regarded as *defaults* so that their identifiers need not be specified. Thus

WRITELN	refers to	WRITELN (OUTPUT)
READLN	" "	READLN (INPUT)
EOLN	" "	EOLN (INPUT)
EOF	" "	EOF (INPUT)
READ (VAR)	" "	READ (INPUT, VAR)
WRITE (VAR)	" "	WRITE (OUTPUT, VAR)

Note that RESET (INPUT) and REWRITE (OUTPUT) are assumed to be implicitly called and must *never* explicitly appear in a program. Readers with access to micro-based PASCAL 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 VDU screen 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 system. 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 to access textfiles in lines. 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. .MAXLINE] OF CHAR) called BUFFER. In line 6, the line separator from the previous 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 8 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 spaces (line 13). 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 in the buffer onto the indicated OUTFILE and appends 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 capacity to control 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 filled with the maximum number of whole 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 the lines 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 text, it can *trap* each formatting command and dynamically alter the formatting specification to meet the requirements dictated by the new information. Box 2 tabulates 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 command begins with a "." 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 the command. 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 incoming line of text before writing out the latest line of ouput text. 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 all the ensuing text until new commands are issued (like .M).

Due to space considerations we had the choice of breaking the program into a number of boxes or presenting the complete listing. Although the former choice would have simplified the discussion, it would have made the actual program difficult to read or use, so, with some reservations, we chose the latter course. The problem specification for PROGRAM PROFF is as follows:

Write a program that allows a user to produce formatted textfiles from named unformatted textfiles in which are embedded the set of commands listed in Box 2.

Assuming the string handling procedures described in Chapter 7 and the file accessing procedures from Box 1, the first step is to consider the main data structures needed for the problem. Both the input and output files are textfiles and can be referenced by the file identifiers INFILE and OUTFILE provided these are declared as such (line 19). Likewise INFILENAME and OUTFILENAME are strings which will contain the external file names, as specified by the user. Finally, a look at Box 2 will show what a complex formatting "environment" the program must maintain, utilize and occasionally amend. Clearly, the record structure lends itself to the easy association of data types suggested by the fields of FORMAT lines 5 to 15). While manipulating the text, the program will format according to the specifications held in a FORMAT record, and when obeying a formatting command, the program will alter a field in a FORMAT record.

Having chosen the data structures, the next step is to design and test the main program (lines 497 to 514). This should begin by calling STANFORMAT to initialize the FORMAT fields with the predefined default values (see box 2). This technique minimizes the number of commands used since only requirements at variance with the defaults need to be explicitly mentioned. In order to enable a series of files to be formatted successively, the remainder of the main program is placed in a loop (lines 499 to 513). Within this the user is asked for the input file name (and can exit with "E") and an output file name. The files are initialized for reading and writing respectively, and the text is formatted (line 509). This is the major ploy of top down design — once the current details (like filenames) have been dealt with, the "buck" is passed to another procedure down the line — in this case TEXTFORMAT. Finally, the files are closed — our program shows the UCSD instruction to close an external file (lines 510 and 511). Other micro PASCAL systems are likely to adopt a similar approach although Wirth PASCAL stipulates that external files must be explicitly passed to the program in the program heading (e.g. PROGRAM PROFF (ROUGH.TEXT, FINAL.TEXT)).

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 initial stages 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;
BEGIN
WRITELN('THIS IS TEXTFORMAT')
END;

Thus when the main program calls TEXTFORMAT some sort of action occurs, enough to test the continuity of the main program. For procedures

(1)

```
 1:    PROCEDURE FREADLN (VAR INFILE:TEXT ; VAR BUFFER:STRING) ;
 2:
 3:    VAR I, J : INTEGER ;
 4:    BEGIN
 5:        REPEAT  (*BLANK LINES*)
 6:            READLN (INFILE) ;
 7:            I := 1 ;
 8:            REPEAT
 9:                READ (INFILE, BUFFER[I]) ;
10:                I := I + 1
11:            UNTIL EOLN(INFILE)
12:        UNTIL EOF(INFILE) OR (LENGTH(BUFFER) > 0) ;
13:        FOR J := I TO MAXLINE DO BUFFER[I] := ' '
14:    END ; (*FREADLN*)

15:    PROCEDURE FWRITELN (VAR OUTFILE:TEXT ; BUFFER:STRING) ;
16:    VAR I, J : 1..MAXLINE ;
17:    BEGIN
18:        FOR I := 1 TO LENGTH(BUFFER) DO WRITE (OUTFILE,BUFFER[I])
19:        WRITELN (OUTFILE)
20:    END ; (*FWRITELN*)
```

Box 2

FORMATTING FUNCTION	OVERRIDING COMMAND	RESULT OF COMMAND	DEFAULT
PAGE CONTROLS:			
+LENGTH — NUMBER OF LINES TO THE PAGE.	.L n	SETS NUMBER OF LINES PER PAGE TO "n".	n=58
+NUMBER — SUCCESSIVELY NUMBER EACH NEW PAGE.	.N n	STARTS NUMBERING AT "n".	TRUE n=2
	.O	SUPPRESSES PAGE NUMBERING.	FALSE
+SPACING — INTERSPERSE BLANK LINES BETWEEN TEXT LINES.	.S n	INTERSPERSES "n —1" BLANK LINES BETWEEN TEXT LINES.	FALSE n=1
LINE CONTROLS:			
+MARGINS — INSERTS SPACES TO LEFT AND RIGHT OF TEXT ON EACH LINE.	.M l r	FIRST CHARACTER OF TEXT AT POSITION "l" AND LAST AT "r".	l=0 r=60
+FILL — PACK AS MANY WHOLE WORDS AS POSSIBLE INTO EACH LINE.	.F	INVOKES FILLING	TRUE
	.U (UNFILL)	SUPPRESSES FILLING	FALSE
+JUSTIFY — REARRANGE WORDS IN LINE SO LAST WORD ENDS ON LAST CHARACTER POSITION.	.J	INVOKES JUSTIFICATION	TRUE
	.R (RAGGED)	SUPPRESS JUSTIFICATION	FALSE
ONE-OFF COMMANDS: (APPLY ONLY TO IMMEDIATE TEXT AFTER WHICH PREVIOUS FORMATTING RESUMED.)			
+INDENT — INSERT SPACES AT BEGINNING OF NEXT LINE.	.I n	INDENTS "n" SPACES	
+BREAK — TERMINATE LATEST LINE WITHOUT JUSTIFYING OR FILLING.	.B n	TERMINATES LINE AND INSERTS "n" BLANK LINES.	
+PARAGRAPH — TERMINATE CURRENT LINE AND INDENT FOLLOWING LINE.	.P i n	EQUIVALENT TO .B n FOLLOWED BY .I i	i=5 n=1
+CENTRE — POSITION NEXT LINE OF TEXT IN CENTRE OF OUTPUT LINE. (FOR HEADINGS)	.C		FALSE

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 the program will test STANFORMAT in its test harness. TEXTFORMAT however, is more complex. Local data structures include (i)USERFORMAT — 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.

The while loop (lines 472 to 491) will ensure that the entire input file is processed, reading one line at a time into INBUFFER (line 474). The contents of INBUFFER must either be a command (which must be OBEYed — line 477) or text. The text must be transferred to OUTBUFFER, with reference to the conditions imposed by the formatting record USERFORMAT. An initial stab at this algorithm could be:

```
WHILE NOT EMPTYINBUFFER DO
BEGIN
    FILLOUT; (*transfer max. number of whole words
               to OUTBUFFER observing MARGINS*)
IF READYTOOUTPUT
THEN
BEGIN
    IF JUSTIFY THEN ADJUST; (*Right justify the line*)
    CLEAR(OUTBUFFER) (*write it to OUTFILE*)
  END
```

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 competely 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 346).

PROCEDURE ADJUST (lines 362 to 424) distributes the spare spaces, left over at the end of the text line, between the words on the line. This is known as "right justification". The technique is to advance down the textfile from right to left searching for spaces. When a space is found, another space from the pool of surplus spaces (GAP) is added in. Care must be taken that two adjacent spaces are not doubly added to, and also that, when the left margin is reached, the process can be "turned around" and used in the opposite direction.

The lower level procedures are fairly easy to understand and do not contribute to the overall strategy of the solution. There are a variety of other commands which could have been implemented (some are suggested in the exercises in the Look-Up Table) and obviously there are different tactics for tackling problems like ADJUST and FILLOUT. Nevertheless, we hope that this program may serve as an illustration of the close parallel between an algorithm, as it is thought out, and its expression in PASCAL code.

PCW thanks Equinox Computers Ltd., for making their North Star Horizon available to us.

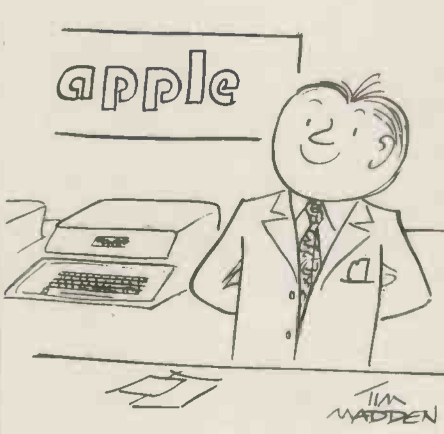
Look up table

Computer Jargon
Buffer
Default
Look-ahead
Program Stub
Test harness

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 enhacements 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.




```
PROGRAM PROFF;

CONST MAXLINE=80;

TYPE  FORMAT=RECORD
                NUMBER : BOOLEAN ;
                FILL : BOOLEAN ;
                JUSTIFY : BOOLEAN ;
                PAGENUMBER : INTEGER ;
                INDENT : 0 .. MAXLINE ;
                LEFTMARGIN : 0 ..MAXLINE ;
                RIGHTMARGIN : 0 .. MAXLINE ;
                LINES : INTEGER ;
                SPACING : 1 ..10
              END ;
      STRING = ARRAY[1..MAXLINE] OF CHAR ;

VAR INFILENAME,OUTFILENAME : STRING ;
    INFILE,OUTFILE : TEXT ;
    STANDARD : FORMAT ;

FUNCTION LENGTH(S:STRING) : INTEGER ;
VAR TEMP : 0..MAXLINE ;
    FOUND : BOOLEAN ;
BEGIN
    TEMP := MAXLINE ;
    FOUND := FALSE ;
    WHILE (TEMP>0) AND NOT FOUND DO
       IF S[TEMP] = ' '
       THEN TEMP := TEMP - 1
       ELSE FOUND :=TRUE ;
    LENGTH :=TEMP
END ;(*LENGTH*)


PROCEDURE STREADLN (VAR S:STRING) ;
VAR I, J: 1..MAXLINE ;
BEGIN
    I := 1 ;
    READLN ;
    REPEAT
       READ(S[I]) ;
       I := I + 1
    UNTIL EOLN ;
    FOR J := 1 TO MAXLINE DO S[J] := ' '
END ; (*STREADLN*)

PROCEDURE STWRITE (S:STRING) ;
VAR I,J : 1 .. MAXLINE ;
BEGIN
    IF LENGTH(S)>0
    THEN    FOR I := 1 TO LENGTH(S) DO
                WRITE(S[I])
END ; (*STWRITE*)

PROCEDURE COPY(SOURCE:STRING;VAR DESTINATION:STRING;INDEX,SIZE:INTEGER);
VAR I, J: 1 .. MAXLINE ;
BEGIN
    FOR I := 1 TO SIZE DO
    BEGIN
        J := INDEX + I -1 ;
        DESTINATION[I] := SOURCE[J]
    END ;
    FOR I := SIZE + 1 TO MAXLINE DO
        DESTINATION[I] := ' '
END ; (*COPY*)

PROCEDURE DELETE (VAR DESTINATION:STRING ; INDEX,SIZE:INTEGER) ;
VAR I : 0 .. MAXLINE ;
BEGIN
    FOR I := INDEX + SIZE TO MAXLINE DO
    BEGIN
        DESTINATION[I-SIZE] := DESTINATION[I] ;
        DESTINATION[I] := ' '
    END ;
    FOR I := 0 TO SIZE-1 DO
        DESTINATION[MAXLINE-I] := ' '
END ; (*DELETE*)


PROCEDURE INSERT (SOURCE:STRING ; VAR DESTINATION:STRING ; INDEX:INTEGER);
VAR I, SIZE : 1 .. MAXLINE ;
BEGIN
    SIZE := LENGTH(SOURCE) ;
    IF SIZE + LENGTH(DESTINATION) > MAXLINE
    THEN WRITELN ('STRING OVERFLOW -- INSERTION NOT MADE')
    ELSE
    BEGIN
       IF LENGTH(DESTINATION)>=INDEX
       THEN FOR I := LENGTH(DESTINATION) DOWNTO INDEX DO
                DESTINATION[I+SIZE] := DESTINATION[I] ;
        FOR I := 1 TO SIZE DO
          DESTINATION[INDEX + (I-1)] := SOURCE[I]
     END
END ; (*INSERT*)

PROCEDURE STANFORMAT ( VAR FORM : FORMAT) ;
BEGIN
    WITH FORM DO
    BEGIN
        NUMBER := TRUE ;
        FILL := TRUE ;
        JUSTIFY := TRUE ;
        PAGENUMBER := 2 ;
        INDENT := 0 ;
        LEFTMARGIN := 0;
        RIGHTMARGIN := 60 ;
        LINES := 58 ;
        SPACING := 1
    END ;
END;

PROCEDURE TEXTFORMAT ;
(* READS FROM INFILE, FORMATS AND WRITES FORMATTED TEXT TO OUTFILE *)

VAR USERFORMAT : FORMAT ;
    INBUFFER, OUTBUFFER : STRING ;
    EMPTYINBUFFER, EMPTYOUTBUFFER : BOOLEAN ;
    CURRENTLINE: INTEGER ;

PROCEDURE FREADLN (VAR INFILE : TEXT ; VAR BUFFER : STRING) ;
(*READLN INTO BUFFER FROM INFILE*)
VAR I,J : INTEGER ;
BEGIN
```

Cont on p114

Dick Pountain takes PCW's second look at the Hewlett Packard HP-41C with an eye to how it actually operates, rather than to add to the "is it a computer or a calculator?" debate.

HP-41C

Alpha and omega of programmables?

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 plus 130 built in functions. The 34 key keyboard (plus shift) allows 68 functions to be executed from it in Normal mode. So how do you get at the rest? Well, each function has a mnemonic or symbolic name, (e.g. clear storage registers is CLRG) and it may be executed by pressing the XEQ key followed by spelling its name in Alpha Mode — i.e. XEQ CLRG. Since this involves 5 key strokes it's tedious if repeated frequently, hence the User Mode. In this mode any function may be assigned to any key where it remains active until reassigned. So a whole alternative keyboard may be set up to the user's fancy.

Not only built-in functions but also user's programs may be assigned in this way, and also Special Application Functions from the many ROM packs which are available. Two means are at hand to keep track of what is available. Firstly each key, when depressed for less than half a second, displays its function name before executing. If held for longer, the function is cancelled and NULL appears without execution. Secondly the CATALOG function displays a scrolled menu of what is in the calculator; CATALOG3 is built in functions, 1 is user's programs, 2 is ROM pack functions (if present).

Functions such as STO and RCL, which require a register address, prompt you by displaying a dash for each digit required e.g. STO— —.

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 arithmetic 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 arithmetic 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 program. All instructions are merged so that one instruction occupies 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 straight to line n. DEL nnn deletes nnn lines starting from the current one.

All branching is to labels (no absolute addresses) and subroutines may be either XEQ-ted by name if outside the main program, or by numeric label if inside. There is no GOSUB as such; routines are called like any other function. A compiling feature allows control to "remember" the location of all numeric labels in a program after the first search — which speeds execution (whereas outside Alpha labels require a search of the whole of program memory).

Most of the built in functions may be used in programs. Special points worthy of mention are:-

i) INDirect addressing is available on memory, branching, flag and Alpha storage operations and the stack registers may hold indirect addresses.
ii) The loop control functions ISG and DSE are more general than the usual ISZ and DSZ. Both may start and finish at any specified numbers and increment/decrement by specified steps. If not specified they 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 contained 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 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 Continous 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 extensive use of Alpha error messages and prompts, some of which like TRY AGAIN and NONEXISTENT can provoke 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 thermal 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 gripes are 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 formidably powerful calculator, more friendly and less intimidating to the first time user; for the experienced user the result is readable programs and flexible, modular program design. If it isn't yet the pocket micro, it's certainly a superb pocket calculator.

What will you do with a 12-year old programmer when he reaches 16?

Any microcomputer is a major investment for an educational establishment. Many potential users feel that a BASIC only computer is ample for their needs. That may be fine today, but with computer education starting so early you may in a surprisingly short time find you want more than current implementations of BASIC.

The 380Z is a computer that can grow to match your needs.

In the design of the 380Z our target user is the graduate research scientist. This ensures that the expandability and versatility needed tomorrow has been provided for in the computer you buy now.

Might you want to add disc storage in the next few years?

If you do:

Given good hardware, software availability completely determines the flexibility and usefulness of your system. There is absolutely no question that a Z80 based micro-computer which uses the industry-standard CP/M* disk operating system has several times more software on the market available to it than non CP/M computers.

Today you can purchase a mature CP/M BASIC, FORTRAN, COBOL or Text Processor for the 380Z. Soon there will be CP/M Pascal and Database Management systems.

CP/M software is several years ahead of software available for non CP/M family machines.

If you don't:

Remember that professionals writing packages for your cassette system will themselves often use a disk 380Z, and the power of their tools will influence what they produce.

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

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

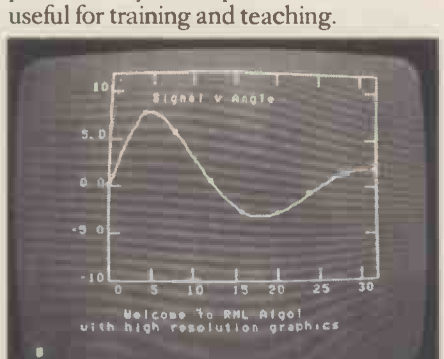
On the 380Z the memory used by a BASIC interpreter can also be used for other software.

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

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

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

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



It is worth remembering too that neither our low resolution graphics nor our optional scientific (high resolution) graphics has any limiting effect on your memory usage, and in both you can

freely mix upper and lower case text and diagrams.

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

Don't buy a 380Z on patriotic grounds.

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

Prices range from a 16K cassette 380Z @£897 to a 56K Dual Full Floppy Disk 380Z @£3322.

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Personal Computer World

PAST FEATURES: PART TWO

On P. 77 of February PCW we provided a sectionalised 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 issue by issue, for our current 3rd Volume.

PLEASE NOTE THAT THE FOLLOWING ISSUES ARE SOLD OUT

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Super software from the world's leading microsoftware supplier.

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DIGITAL RESEARCH

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☐ CP/M version 2 (not all formats available immediately) NEW .... £95/£15

☐ MP/M .... £195/£25

☐ MAC — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) .... £55/£10

☐ SID — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values .... £45/£10

☐ ZSID Includes Z80 mnem NEW quires Z80 CPU .... £50/£10

☐ TEX — Text formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer .... £45/£10

☐ DESPOOL — Program to permit simultaneous printing of data from disk while user executes another program from the console .... £30/£1

MICROSOFT

☐ Ⓛ Ⓜ BASIC-80 — Disk Extended BASIC Interpreter Version 5, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records .... £155/£15

☐ Ⓛ Ⓜ BASIC Compiler — Language compatible with Version 5 Microsoft interpreter and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes Macro-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... £195/£15

☐ Ⓛ Ⓜ FORTRAN-80 — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object complier, linking loader, library with manager. Also includes MACRO-80 (see below) .... £205/£15

☐ Ⓛ Ⓜ COBOL-80 — ANSI '74 Relocatable object output. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM, Interactive ACCEPT DISPLAY, COPY, EXTEND .... £325/£15

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☐ Ⓛ KISS — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80 etc .... £190/£15

Ⓛ KBASIC — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS REL as described above, and a sample mail list program. .... £295/£25
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☐ Ⓛ Super-Sort I — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! .... £125/£15

☐ Ⓛ Super-Sort II — Above available as absolute program only .... £105/£15

☐ Ⓛ Super-Sort III — As II without SELECT/EXCLUDE .... £75/£15

☐ Ⓛ Word-Master Text Editor — In one mode has super-set of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video-mode, provides full screen editor for users with serial addressable-cursor terminal .... £75/£15

☐ Ⓛ Word-Star — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center, underscore and PRINT. Edit facilities include global search and replace, read/write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning .... £255/£15

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Ⓛ PAYROLL — Designed in conjunction with the spec for PAYE routines by HMI Taxes. Processes up to 250 employees on weekly or monthly basis. Can handle cash, cheque or bank transfer payments plus total tracking of all year to date figures. Prints emp master, payroll log, payslips and bank giros. Requires CBASIC-2 .... £475/£15

☐ Ⓛ COMPANY SALES — Performs sales accounting function. Controls payments of invoices and prints sales ledger and aged debtors report. Suitable for any accounting period. Comprehensive VAT control and analysis of all sales invoices. Requires CBASIC-2 .... £425/£15

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☐ Ⓛ STOCK CONTROL — Maintains stock records, monitors stock levels to ensure optimum stock holding. Details include stock desc., product code, unit, unit price, quantity on hand on order/minimum. Stock analysis reports NEW be weekly, monthly, quarterly etc. Interfaces with Order Entry & Invoicing system. Requires CBASIC-2 .... £325/£15

☐ Ⓛ ORDER ENTRY & INVOICING — Performs order entry and invoicing function. Handles invoices for services and consumable items, part orders and part quantities. Sales Analysis report shows sales movemets and trends for user-defined period Interfaces with Stock Control, NAD and Company Sales systems. Requires CBASIC-2 .... £325/£15

☐ Ⓛ NAD — Complete control of all your names & addresses including suppliers, clients, enquiries etc. Assign your own coding system and select all output via the report generator. Will print anything from mailing labels to directories. Requires CBASIC-2 .... £225/£12

☐ Ⓛ COMPLETE ACCOUNTING PACKAGE — Combined Company Sales, Company Purchases, General Accounting, and NAD systems NEW .... £950/£45

☐ Ⓛ SALES ORDER PROCESSING PACKAGE — Combined Stock Control, Order Entry and Invoicing and NAD systems NEW .£550/£30

STRUCTURED SYSTEMS GROUP

ANALYST — Customised data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval and update facility makes information management easy. Sophisticated report generator provides customised reports using selected records with multiple level breakpoints for summarisation. Requires CBASIC-2, 24 x 80 CRT, printer and 48K system NEW .... £125/£10

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

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☐ Ⓛ Ⓜ APARTMENT MANAGEMENT SYSTEM — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC-2. Supplied in source code. .... £300/£25

☐ Ⓛ Ⓜ INVENTORY SYSTEM — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC-2. Supplied in source code .... £300/£25

☐ Ⓛ Ⓜ CASH REGISTER — Maintains files on daily sales. Files data by sales person and item. Tracks sales, Overrings, refunds, payouts and total net deposits. Requires CBASIC. Supplied in source code .... £300/£25

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Ⓛ STANDARD CIS COBOL — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... £400/£25

☐ Ⓛ FORMS 2 — CRT screen editor. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. Output is COBOL data descriptions for copying into CIS COBOL programs. No programming experience needed. Output program directly compiled by CIS COBOL (standard) .... £100/£12

OTHER

☐ PASCAL/Z — Z80 native code PASCAL compiler. Produces optimised portable reentrant code. All interfacing to CP/M is through the support library. The package includes compiler companion macro assembler and source for the library. Requires 56K and Z80 CPU. Version 2 includes all of Jensen/Wirth except variant records NEW .... £155/£15

☐ Version 3 Upgrade with variant records and strings expected 2/80 .... £205/£15

☐ Ⓜ PASCAL/MT — Subset of standard PASCAL. Generates portable 8080 machine code. Symbolic debugger included. Supports interrupt procedures and BCD arithmetic for real variables. CP/M file NEW and assembly language interface supported. Lacks sets. Enumeration and Record data types. Manual explains BASIC to PASCAL conversion Requires 32K .... £65/£17

☐ Source for PASCAL/MT run time package. Requires MAC (See under Digital Research) £30

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

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

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

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

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

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

☐ Ⓜ ZDT — Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Facilities similar to DDT £20 when ordered with Z80. Development Package .... £30/£7

☐ DISTEL — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL Xitan pseudo ops optional. Runs on 8080. .... £35/£7

☐ Ⓜ DISILOG — As Distel to Zilog Mostek mnemonic files. Runs on Z80 only .... £35/£7

☐ Ⓜ TEXTWRITER III — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertion. Ideal for contracts manuals. etc. .... £75/£3

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

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

☐ XYBASIC Interative Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in integer, Extended and ROMable versions.
Integer Disk or Integer ROMable .... £165/£15
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☐ SMAL/80 Structured Macro Assembley Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... £40/£10

☐ Ⓜ SELECTOR III-C2 — Data Base Processor to create and maintain multi Key data bases. Prints formatted, sorted reports with numerical summaries or mailing labels. Comes with sample applications including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC Version 2. Supplied in source code. .... £185/£12

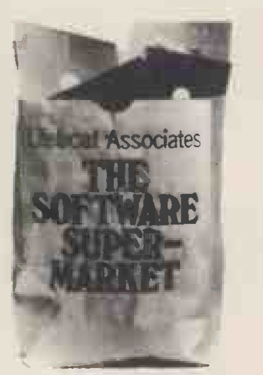
☐ CPM/374X Utility Package — has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... £125/£7

☐ Ⓜ BASIC UTILITY DISK — Consists of (1) CRUNCH-14 Compacting utility to reduce the size and increase the speed of programs in Microsoft Basic and TRS-80 Basic. (2) DPFUN — Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation .... £30/£10

☐ Ⓜ THE STRING BIT — Fortran character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source .... £30/£10

☐ Ⓜ BSTAM — Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansions to send *.COM, etc. 9600 baud with wire, 300 baud with phone connection. Both ends need one. Standard and M versions can talk to one another .... £75/£5

☐ Flippy Disk Kit — Template and instructions to modify single sided 5¼" diskettes for use of second side in singled sided drives £6



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EFFECTIVE JANUARY 1980

DIRECT ACCESS

IN STORE

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

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
ABC 80 (£790)	CCS Microsales: 01-444 7739 (TBA)	16-40K RAM: Z80A: C: 12", 16x40 b&w VDU: 4680 bus: IEEE 488: RS232 port: option — dual 5¼" F/D (160K, own DOS), £895	DOS: BASIC:	Graphics loudspeaker with 128 effects: Viewdata compatible: (S)
Act System 800 (£3950)	ACT: 021-455 3585: (50)	48K RAM: 6502: dual 5¼" F/D (800K): 12", 30x64 VDU: 1 S/P: 1 P/P	MDOS: BASIC: A: PL/M: Fifth	Fully IBM compatible K/B: high resolution graphics: available with dual 8" F/D (2.4MB), £4950: (E)
Alpha Micro (£8,200)	Alpha Micro (UK) Ltd 01-250 1616 (TBA)	64K-16M RAM: 16 bit: dual 8" F/D (2.4MB): 6 S/P: modular	multi-user O/S: BASIC: M/A: Pascal: U	Expands to 1200 MB, 32 terminal system: (E)
Altos ACS 8000 (£3,398)	Logitek: 02572 66803 (TBA)	64K RAM: Z80: 1K ROM: dual 8" F/D (1MB): 2 RS232: 1 P/P	CP/M: *BASIC: Fortran: Cobol: Pascal: M/A*	(S&H)
Apple II (£810)	Microsense: 0442 63561 (80+)	16-48K RAM: 6502: 8 I/O slots: option — single 5¼" F/D (116K), £425	O/S: BASIC: *Pascal: games:*	280x192 high res graphics: integer BASIC in 6K ROM (S)
Athena 8285 (£7955)	Butel-Comco Ltd: 0703 39890 (TBA)	64K RAM: 8085A: dual 5¼" F/D (644K): 12", 25x80 VDU: 150 cps printer: RS232C port: options — dual 8" F/D (2MB)	AMOS: T/E: BASIC: *Cobol: Fortran: Pascal: APL: M/A*	Extended ASCII K/B with numeric pad: graphics: many fully integral configurations possible: (S)
Attache (£7,000)	R.H.Thorpe Ltd: 0276 29492. R.J.Spiers Ltd: 0603 416573 (TBA)	48K RAM: 8080: dual 8" F/D (616K): 9", 16x64 b&w VDU: 180 cps printer	ExBASIC: *Fortran*	(S)
Billings BC-12FD (£4,295)	Mitech: 04862 23131 (TBA)	64K RAM: Z80A: dual 5" F/D (640K): 12", 24x80 b&w VDU	DOS: BASIC: *Fortran: Cobol: A*	8" F/D (2MB) to replace 5", £6,000: additional dual 8" F/D, £2,750 (S)
Canon BX-1 (£3,850)	Canon Business Machines (UK) Ltd: 01-680 7700	64K RAM: 6800: Single 5¼" F/D (65K): 12", 25x80 VDU: 5xV24 ports: options — single 5¼" F/D (65K), £1,500	DOS: ExBASIC: *A*:	Also supplied with integral thermal printer instead of VDU: (S&H)
CBS Mk 1, 2&3 (Mk1, £5,413; Mk2, £5,900; Mk3,£8,648)	Compelec: 01-636 1392 (N/A)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU; 132 col, 30 cps printer: 2 S/P: 1 P/P	CP/M: BASIC	Mk. 2 with 2MB F/D, £5,900. Can upgrade to Mk.3 — £8,150 (11MB H/D and 4 more S/Ps): Desk mounted: Up to 44MB H/D possible, £4,529 extra: multi user system with 208K RAM, £10,648: (S&H)
Challenger 1P & C2 (1P, £238; C2, £404)	CTS: 0706 79332: MBM: 01-980 3993. Mutek: 0225 743289. Millbank Computing: 01-549 7262. U-Microcomputers: 0606 853390. Byte Shop: 01-518 1414	4-32K RAM: 6502: C int: RS232 port:	O/S: BASIC: A: *ExBASIC*	D/A conv: col capability: 8K microsoft BASIC in ROM: option — dual 5¼" F/D (160K), £550: for C2, dual 8" F/D (1.15MB) and 20MB H/D: runs OSI business software on 8" F/D. (S)
Challenger C3 (£2,334)	As above	32-56K RAM: 6502, 6800, Z80: dual 8" F/D (1.15MB): 2-16 S/P	OS65U: BASIC: *CP/M: Fortran: Cobol*	Also C3B & C3P H/D modules: 74MB for about £10,000: (S&H)
Comma VO3 (£4,200)	Comma: 0277 811131: (N/A)	32K RAM: LSI 11: dual 8" F/D (512K): 4 serial DLU11S ports: modular	*RT11 O/S (£750): BASIC: Cobol: Fortran*	Many configurations possible: (H)
Compelec Series (£2,400)	Compelec: 01-636 1392: (N/A)	32K RAM: Z80: dual 8" F/D (512K): 2 RS232 ports: 1 P/P	CP/M: A: CBASIC: cobol: Fortran: Pascal	Also with double density F/D (1MB), £2,900: 1K EPROM: (S)
Compucolor II (£998)	Abacus: 01-580 8841: (6)	8-32K RAM: 8086: 13", 32x64 8-colour VDU: single 5¼" F/D (51K): RS232 port	ExBASIC (ROM): A	16K module, £1,078: 34K, £1,209: maintenance and programming manual available: (I)
Compucorp 625 (£6,000)	Compucorp: 01-952 7860: (17)	60K RAM: Z80: dual 5¼" F/D (700K): 9", 16x80 b&w VDU: 40 cps printer: 1 RS232 port	A: BASIC: U	Also 655 model with 320K F/D capability and 12", 20x80 VDU — £4,345 (B)
Comp Workshop System 1 (£1,600)	Comp Workshop: 01-491 7507 (N/A)	32K RAM: dual 5¼" F/D (170K): 9", 16x64 b&W VDU: modular	A: BASIC: Fortran: Flex: Pascal: Pilot	This is an example configuration from a fully compatible modular range: (E)
Cromemco System 2, System Z2H, System 3 (£1,995/£4,998/ £3,293)	Comart: 0480 215005; Datron: 0742 585490; Microcentre: 031 225 2022 (20)	64K RAM: Z80: dual 5¼" F/D (346K) Sys 2 and Z2H... dual 8" F/D (1.24MB) Sys. 3: S/P: P/P	CDOS: *BASIC: Cobol: Fortran; Multi-user BASIC: A:*	All systems expandable to multi-user (2—7 users), £3,455 £6,400: 11 and 22MB options: also dual 8" F/D (996K) on Sys. 2 and 3: (E)
DAI (£998 48K version)	Data Applications (UK): 0285 2588 (TBA)	12-48K RAM: 8080: C int: 24x60 VDU int: RS232 port: Over 20 industrial ints: 2 C ints	BASIC (ROM): U (ROM)	Up to 255x335 resolution graphics: 3 notes and noise generator: PAL output to TV: games paddle
Digital Microsystem DSC-2 (£5,395)	Modata: 0892 39591 (TBA)	64K RAM: Z80: dual 8" F/D (2.28MB): 4 RS232 ports: EIA port	CP/M: BASIC-E: *CBASIC: Cobol Fortran: Pascal*	Up to 6 additional F/D units possible: (H)
Durango F-85 (£8,250)	Comp Ancillaries: 07843 6455 (12)	64K RAM: 8085: dual 5¼ F/D (1MB): 9", 16x64 green VDU: 132 col 165 cps printer: N/P	O/S: *DBASIC*	Takes up to 5 work stations: fully integrated system: options — additional dual 5¼" F/D (1MB) and 12 MB H/D: (S)
Dynabyte DB8/1 (£1,500)	Dynabyte UK/Europe Ltd: 0723 65559 (6)	32-64K RAM: Z80: S100 bus: 2 RS232 ports: 1 P/P	CP/M: BASIC: Cobol: *Pascal*	Expands to multi-user system: option — dual 8" F/D (1MB), £2,000: also DB8/2 with dual 5¼" F/D (400K), £3,000 (E)
Equinox 200 (£7,500)	Equinox: 01-739 2387 (N/A)	64-256K RAM: Z80: 10MB H/D: 1 S/P: 1 P/P	CP/M: CBASIC: *cobol: Fortran:*	Multi-user MVT/FAMOS available in place of CP/M: (S/H)

List of Abbreviations

A	Assembler	F/D	Floppy disc	M/A	Macro assembler	S/P	Serial port
B	BASIC	G/C	Graphics card	N/A	Not available	T/E	Text editor
C	Cassette	H	Hardware	N/P	Numeric pad	TBA	To be announced
E	Extensive	H/D	Hard disc	O/S	Operating system	U	Utility
		I	Introductory	P/P	Parallel port		
		Int	Interface	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.

IN STORE

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Euroc (£7,995)	Eurocalc Ltd: 01-405 3113 (TBA)	64K RAM: 8080A: dual 8" F/D (1MB): 15", 25x80 b&w VDU: 132 col 140cps printer	CP/M: CBASIC: A: U:	A year's maintenance and stationery supply inc: (S)
Executive Minicomputer	Binatone 01-903 5211	See Video Genie		
Exidy Sorcerer (£650)	Liveport Data Products 0736 798157 (27)	8-32K RAM: Z80: RS232: 1 P/P: S100 connector: 30 x 64 VDU I/O	O/S: ExBASIC (ROM): *Editor: A: CP/M: Algol: Fortran*	High res graphics capability: 16K version, £760: 32K £859: 48K, £960: option — dual 5¼" F/D (630K), £1,200: User programmable character set: (I)
HP 85 (£2,240)	Hewlett Packard Ltd: 0734 784774 (16)	16-32K RAM: C.P.U.: 5" 16x32 b&w VDU: C (200K): 64 cps printer: RS232 port: 4 P/P	BASIC:	Full dot matrix graphics: N/P: compact portable unit: (S)
IMS 5000 (£1,935)	Equinox: 01-739 2387 (20)	32-64K RAM: Z80: dual 5¼" F/D (320K)	CP/M: CBASIC: *Cobol: Fortran:*	3 drives option: (S&H)
IMS 8000 (£3,515)	As above	64-256K RAM: Z80: dual 8" F/D (1MB)	CP/M: CBASIC: *Cobol: Fortran: MicroCOBOL*	Multi-user MVT/FAMOS available in place of CP/M: (S&H)
IMSAI VDP 42 (£3,900)	Computermarket: 0603 615089 (TBA)	32-64K RAM: 8085: dual 5¼" F/D (400K): 9", 24x80 b&w VDU: 1 S/P: 1 P/P	IMDOS (CP/M comp): A: ExBASIC: U: *CBASIC: Cobol: Fortran*	Supports 8 additional F/D drives: also available, VDP 44 with F/D (780K), £4,400: (H)
IMSAI VDP 80 (£6,200)	As above	32-64K RAM: 8085: dual 8" F/D (1.2MB): 12", 24x80 b&w VDU: 1 S/P: 1 P/P	IMDOS: A: ExBASIC: U: *CBASIC: Cobol: Fortran*	(H)
ITT 2020 (£867)	ITT: 0268 3040 (15)	16-48K RAM: 6502	Monitor: A: ExBASIC: Dis A:	360x192 high res graphics: ExBASIC in 6K ROM: options — single 5¼" F/D (116K), £425; 16K RAM, £110; RS232 port, £96: 32K system, £931: 48K system, £995: (B)
LX-500 (£3,500)	Logabax Ltd: 01 965 0061 (13)	32K RAM: Z80: dual 5¼" F/D (180K): 12" 25x80 b&w VDU: 100cps printer	DOS: BASIC: A	Other printers available: (S)
Megamicro (£6,080)	Bytronics: 0252 726814 (5)	256K: 8080A: dual 8" F/D (1MB): 12", 20x80 b&w VDU: 120cps printer: 2 S/P: 2 P/P	CP/M: U	(H&B)
Microstar 45 Plus (£4,950)	Microsense: 0442 41191 (20+)	64K RAM: 8085: dual 8" F/D (1.2MB): 3 S/P: RS232 port	STARDOS: CP/M: BASIC: Cobol: Fortran	(E)
MSI 6800 (£1,203)	Strumech: 05433 4321 (5)	16K RAM: 6800: C: 9", 16x64 b&w VDU: 1 S/P	BASIC: Mini A: U	Up to 8 serial or parallel ints possible: (S&H)
MSI 6800 System 1 (£2,175)	As above	32K RAM: 6800: dual 5¼" F/D (160K): 9" 16x24 b&w VDU: 1 RS232 port	DOS: BASIC: U: *A: Fortran*	As above: option — dual 8" F/D (624K), £1,640: (S&H)
MSI 6800 System 2 (£7,500)	As above	56K RAM: 6800: single 8" F/D (312K): 10MB H/D: RS232 port: 9", 16x64 b&w VDU	DOS: BASIC: Multi-user BASIC: A	Rack mounted: options — dual 8" F/D (624K), £1,640; 10MB H/D, £4,250: (S&H)
MSI System 7 (£5,200)	As above	56K RAM: 6800: dual 5¼" F/D (640K): 9", 16x24 VDU: 1 P/P	DOS: BASIC: A	Choice of FDOS, SDOS or Flex: also option — 10MB H/D: (H&S)
Nanocomputer (£420)	Midwich: Waltham Cross 29310 (TBA)	4K RAM: 2K ROM: Z80: C int: 8 digit LED: K/B: RS232 port: 4 P/P	Machine language: *BASIC: A: T/E:*	Designed for hardware education: expandable to 64K RAM system with F/D: (E)
North Star Horizon (48K, £4,650)	Comart: 0480 215005; Comma: 0277 811131; Equinox: 01-739 2387 (20)	24-56K RAM: Z80A: dual 5¼" F/D (360K): 15", 24x80 b&w VDU: 150 cps printer: 2 1 P/P	DOS: BASIC: *CP/M Cobol: Fortran: Pascal*	(E)
Oxford Minicomputer	Binatone 01-903 5211	See Video Genie		
Pascal Microengine (£2,080)	Pronto: 01-599 3041 (TBA)	64K RAM: MCP 1600: 2 RS232 ports: 2P/P: options — dual 5¼" F/D (1MB), £1550: dual 8" F/D (2MB), £1950	BASIC: Pascal	CPU has user written word set:
PET 8K,16K & 32K (£550, £675 & £795)	Commodore: 01-388 5702 (150)	8-32K RAM: 6502: C: 9" 25x40 VDU: IEEE488 port	O/S: BASIC: A: *Forth Pilot:*	BASIC in 8K ROM: options — dual 5¼" F/D (353K), £795; same, but (800K), £995, plus, with the 2001-8, £30 for the disc operating ROM: (I)
Powerhouse 2 (£1,175)	Powerhouse Micros: 0422 48422 (TBA)	32-64K RAM: Z80A: 5", 27x96 b&w VDU: 1 P/P: RS232 port	FDOS: BOS: BASIC: *ExBASIC: (14K EPROM), £260*	Graphics card available, £190: option — dual 5¼" F/D (700K): (I)
Rair Black Box (£2,300)	Rair: 01-836 4663 (N/A)	32-64K RAM: 8085: dual 5¼" F/D (160K): 2 RS232 ports	CP/M: BASIC: Cobol: Fortran: M/A	16K RAM expansion, £250; dual 5¼" F/D (520K)' £1,000: (H)
Research Machines 380-Z (£1,048)	Research Machines: 0865 49791 (N/A)	16-56K RAM: Z80A: C: RS232 port:	Tiny BASIC: graphics: *A: ExBASIC: CBASIC: Cobol: Fortran: Algol: CP/M: U:*	Designed for education: high res graphics being developed: options — dual 5¼" F/D (168K), £895 and dual 8" F/D (1MB), £1,695: 56K version, £1,654: (S)
SDS 100 (£4,290)	Airamco: 0294 57755 (11)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: S100 bus: RS232 port: N/P: 1 P/P	CP/M: A: ExBASIC: *Cobol: Fortran*	Facility for 8K PROM: (E)
S.E.E.D. System One (£2,175)	Strumecn: 05433 4321 (4)	32-56K RAM: 6800: dual 5¼" F/D (160K): 9", 16x24 b&w VDU: RS232 port	DOS: BASIC: U: *Fortran: Cobol: M/A*	Up to 8 I/O ports: max of 4 F/D drives: option — dual 8" F/D (624K): (E)
Semel 1 (£2,900)	Strutt Electrical: 0822 5439 (N/A)	16-64K RAM: Z80: single 8" F/D (250K): 12", 24x80 b&w VDU: RS232 port	BASIC: *Cobol: Fortran*	Supports up to 8 drives option — single 8" F/D (250K), £500: (I)
Sharp MZ-80K (£520)	Sharp Electronics (UK) Ltd: 061 205 7321 (22)	6-34K RAM: Z80: C: 10", 24x40 b&w VDU	BASIC: A:	Graphics: loudspeaker: BASIC in 14K RAM: 34K machine, £740: (B)
Simpelec Mk 1 (£7,421)	Compelec: 01-636 1392 (N/A)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 2 S/P: 1 P/P	CP/M: BASIC	Also Mark II with 2MB F/D, £7,900; will upgrade further: (S&H)
Sinclair ZX80 (£100)	Science of Cambridge: 0223 311488 (N/A)	1-16K RAM: 780-1: C int: T.V. int: full K/B: 44 pin expansion port	4K BASIC in ROM	CPU is NEC 3.25 MHz version of Z80A: available as kit, £80: mains adaptor £9:(S)

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IN STORE

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Sirocco (£3,900)	Elvingate Computers: 069 245189 (TBA)	64K RAM: Z80: dual 5¼" F/D (940K): 12", 24x80 VDU: RS232 port	CP/M: CBASIC: *Cobol: MBASIC: Fortran*	Direct memory addressing: memory mapped VDU: free standing keyboard: option — 10MB H/D
Smoke Signal Chieftain 1 (£3,050)	Windrush Micro Designs 069 245189 (TBA)	32-64K RAM: 6800: dual 5¼" F/D (160K): 12", 24x80 VDU: 112 cps printer: RS232C port	DOS: BASIC: *DBASIC: RBASIC: A: Fortran: U*	Also Chieftain 3 with dual 8" F/D (1MB), £3,950 (E)
Solitaire WP & BS200 (£6,750& £7,950)	Solitaire KPG: 01-995 3573 (TBA)	64K RAM: 8085: 14" VDU (with own CPU): 45 cps printer: CPU port: dual 5¼" F/D (700K) with "WP", and dual 8" F/D (960K) with "BS200"	DOS: BASIC (optional on the "WP")	All Solitaire systems are compatible: graphics on 11x13 dot matrix: (S)
Solitaire/HBS100 (£9,500)	As above	64K RAM: 8085: 10MB H/D: 14" VDU (with own CPU): 200 cps printer: CPU port	DOS: BASIC	Up to 8 interface terminals can be used: also HBS200 with 20-80 MB of H/D: HBS100 limit is 40MB: (S)
Sord M100 ACE (£2,650)	Midas Computer Services Ltd: 0903 814523	48K RAM: Z80: single 5¼" F/D (143K): 12" 24x64 col VDU RS232 port	O/S: BASIC	With colour graphics: 8K ROM: option — single 5¼" F/D, £300: (I)
Sord M223 (£3,500)	As above	64K RAM: Z80: single 5¼" F/D (350K): 12", 24x80 b&w VDU: S100 bus: RS232 port	O/S: BASIC	Other configs possible: extra F/D, £450: (I)
Superbrain (£1,995)	Icarus: 0632 29593 (TBA)	64K RAM: 2xZ80: dual 5¼" F/D (320K): 12", 25x80 b&w VDU: S100 bus: RS232: TRS80 port	CP/M: A: *BASIC: Cobol: Fortran: APL Pascal*	Limited graphics: mainframe int available: options — dual 5¼" F/D (320K): dual 8" F/D (2.4MB): 8-120 MB H/D: (S&H)
Tandberg EC10 (£5,000)	Tandberg: 0532 35111: (N/A)	50K RAM: 8080A; single 8" F/D (250K): 12", 25x80 b&w VDU: RS232 port	ExBASIC (24K): Multi-user BASIC: A: U: *Cobol*	(S&H)
Tandy TRS 80 Level 1 (£380)	Tandy: 021 556 6101 (200)	4-16K RAM: Z80: C: 12", 16x64 b&w VDU	BASIC: A:	BASIC in 4K ROM: upgradable to level 2: (I)
Tandy TRS 80 Level II (£515)	As above	4-48K RAM: Z80: C: 12", 16x64 b&w VDU: RS232 int: 1 P/P	BASIC: *M/A: Fortran*	16K machine includes N/P: 4-16K upgrade, £120 (£85 without pad): max config, £1,005: option — single 5¼" F/D (78K), £478 (max of 4): (I)
TECS (£1,600)	Technalogics: 051 724 2695 (TBA)	16-56K RAM: 6800: 8K PROM: RS232 port: C int	BASIC: *T.DOS: Prestel: Monitor:*	256 ch graphics: Prestel compatible: plugs into standard TV: option — dual 5¼" F/D (320K), £800: (S&H)
TEI 208 (£3,841)	Abacus: 01-580 8811 (5)	32-60K RAM: 8080/8085: dual 5¼" F/D (320K): 9", 24x80 green VDU: 3 S/P: 3 P/P	CP/M: *BASIC: Cobol: Fortran: Pascal: Algol*	(S&H)
TEI 212 (£4,886)	As above	32-60K RAM: 8080/8085: dual 8" F/D (1MB): 15", 24x80 green VDU: 3 S/P: 3 P/P	CP/M: *BASIC: Cobol: Fortran: Pascal: Algol*	(S&H)
Terodec DPS 64/1-4 (£3,014)	Terodec (Micro-systems) Ltd: 0344 51160: (TBA)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 b&w VDU: 2 S/P: 3 P/P	CP/M: *BASIC: Cobol: CBASIC: Fortran: Algol: Pascal*	TMZ 80, enhanced model in integral work station, £5,495 (with 4MB F/D): DPS 64 with 2MB F/D is £3,319: options — dual 8" F/D (1MB), £1,150: dual 8" F/D (2MB), £1,455: (S&H)
Vector Graphics MZ (£2,595)	Almarc: 0602 625035: Sintrom Microshop: 0734 85464: Metrotech 0895 57780: (5)	56K RAM: Z80: dual 5¼" F/D (630K): 3 S/P: 2 P/P	DOS: BASIC: A: *CP/M2: Algol: CBASIC: Cobol: Fortran: Pascal*	Includes PROM burner: also System B with graphics and N/P, £3,195: (E)
Video Genie EG 3003 (£378)	Lowe Electronics: 0629 2817: Binatone: 01-903 5211 (N/A)	16K RAM: Z80: 500 bps C: 32x64 TV int: extra C int: 1 P/P	BASIC: *M/A: Fortran*	BASIC in 12K ROM: graphics available: F/D under development: Binatone call *their* 16K model "Executive Minicomputer" and a 4K version, "Oxford Minicomputer" — prices TBA: (I)
Zenith WH-11A (£4,359)	Heath Ltd 0452 29451 and 01-636 7349 (N/A)	LSI 11: 16-32K RAM: 25x80 VDU: S/P: P/P	*O/S: BASIC: Fortran:* A: U:	PDP 11 compatible: option — dual 8" F/D (512K): (S&H)
Zenith Z89 (£1,490)	As above	16-48K RAM: Z80: single 5¼" F/D (102K): 12", 25x80 b&g VDU: RS232	*BASIC: A: H.DOS: CP/M: MBASIC: CBASIC: Fortran*	3 drives option: (I)
Zentec (£5,700)	Zigal Dynamics Ltd: 02405 75681 (1)	32-64K RAM: 2x8080: dual 5¼" F/D (512K): 15", 25x80 b&w VDU: RS232 port	O/S: A: U: *BASIC: Micro Cobol*	User programmable character set: option — dual 8" F/D (1MB): (S)
Zilog MCZ 1/05 (£4,200 — portable)	Micropower: 0256 54121: Memec: 084421 5471 (N/A)	64K RAM: Z80: dual 8" F/D (600K): RS232 port	RIO O/S: M/A: U: *BASIC: Cobol: Fortran: Pascal*	Debug in 3K PROM: also available as desk top unit or R/M model, both £4,800: (S&H)
Z Plus (£4,000)	Rostronics: 01-874 3665 (TBA)	32-64K RAM: Z80: dual 8" F/D (1MB): 2 S/P: 2 P/P	CP/M: A: U: *BASIC: Cobol: Fortran: Pascal*	(S&H)

SINGLE BOARDS

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Acorn (£65)	Acorn: 0223 312772 (N/A)	1.1/8K RAM: 6502: EPROM socket: Hex K/B: C int: 8 digit LED display: up to 16 ports: options — Eurocard 64 way connector: VDU card: Full K/B card	½K monitor: *BASIC*	Kit: programmable address linking; on board 5V regulator: available assembled, £79 (S&H)
Aim 65C (£265)	Pelco: 0273 722155 (4)	1-4K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: Cx2: RS232 port.	A: Dis A: T/E: 8K monitor in ROM	Available as S100 system with A or BASIC in ROM (£480) from Portable Micros (0280 702017): they also have briefcase version (£750) (E)
Cromemco SC (£260)	Comart: 0480 215005 (17)	1K RAM: Z80A: 8K EPROM sockets: RS232 port: 3 P/P: option — S100 bus.	*Monitor and control BASIC in EPROM*	5 program interval timers: can put own BASIC programs in EPROM (E)
ELF II (£114)	Newtronics: 01-348 3325	1/4K RAM: RCA 1802: Hex K/B: 2 digit LED: TV int: C int: RS232 port: options — 4K RAM, £69; full K/B; VDU card	1K monitor: A: Dis A: T/E: *BASIC:* 244	TTY, n-line decoders: low resolution graphics (high resolution available) kit (H)

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Explorer (£295)	Newtronics: 01-739 1582 (15)	4K RAM: 8085: Hex K/B: RS232 port: S100 bus: C int: options — 6 slot S100 £32; 8K EPROM sockets £50.	2K monitor: *CP/M: BASIC*	Programmable 14 bit counter: kit (S&H)
H8 (£262)	Heath: 0452 29451 (TBA)	4K RAM: 8080A: Octal K/B: 6 digit LED: speaker: options — single 5¼" F/D (102K), £399; 16K RAM, £314; C int, £72	1K monitor: *BASIC in RAM: FORTRAN: T/E: A: U:*	Kit (S&H)
Hewart 6800S (£299)	Hewart: 0625 22030 (N/A)	16K RAM: 6800: full K/B: VDU int: 2xC int; 1 S/P: 2 P/P: option — 16K RAM, £90	1K monitor: A: T/E	Can be upgraded with 6809 (H)
Hewart 6800 MkIII (£152)	As above	1K RAM: 6800: VDU board: options — single 5¼" F/D (75K), £350; PROM programmer, £32: calculator board, £32	1K monitor	(H)
Mk 14 (£39.95)	Science of Cambridge: 0223 311488 (N/A)	8060: 1/4-2K RAM: Hex K/B: 7 char LED: options — VDU int (32x16 with graphics), £29; C int, £6; PROM prog, £10, 2K memory expansion, £15	Machine code	Designed for control applications rather than high level computing expansion (H)
Microtan 65 (£69)	Tangerine: 0353 3633	1K RAM: 6502: 16x32 T.V. int: options — TANEX board, 7K RAM, 6K ROM, 8K BASIC; 3S/P	1K TANBUG monitor: *BASIC*	Optional 64x64 pixel graphics:(E)
Nascom 1 (£165)	Nascom: 02405 75155 (20)	4K RAM: Z80: full K/B: TV int: 2 P/P: 1 S/P	2K monitor: *BBASIC: tiny BASIC: A: T/E: U*	Now available as Nascom 2 with 8K RAM and 8K microsoft BASIC in ROM, £295
77/68 (£90)	Newbear: 0635 30505 (N/A)	4K RAM: 6800: LED: C int: VDU int.	1K Monitor: *BASIC:*	Expandable to racked Nascom compatible system: (B)
SBC 100 (£135)	Airamco: 0294 57755 (11)	1K RAM: Z80: 8K ROM: S100 1 S/P: 1 P/P: option — voltage regulator	*1K monitor: DOS in ROM*	Kit: available assembled, £196 (E)
Superboard (£188)	MBM: 01-981 3993 (N/A)	4-8K RAM: 6502: 10K ROM: full K/B: VDU int: C int: options — RS232; single 5¼" F/D (100K), £316; 8K RAM, £188	BASIC in 8K ROM:	Available with 32K RAM and single 5¼" F/D, £867 (S&H)
SYM-1 (£160)	Newbear: 0635 30505 (N/A)	1-4K RAM: 6502: bps C int: VDU int: 2x6522 ports: option — TV int.	4K monitor: *BASIC: A*	Can be expanded to 64K RAM (S&H)
Triton 4.1 (£286)	Transam: 01-402 8137 (N/A)	2K RAM: 8080: 3K ROM: full K/B: 16x64 VDU or TV int: C 1 S/P: option — 2K RAM, £30	1K monitor: 2K BASIC: U	64 character graphics: 8 levels interrupt: kit (S&H)
Triton 5.1 (£294)	As above	2K RAM: 1K VDU RAM: 8080: C int: T.V. int	1½K monitor: 2½K BASIC: *A: Dis A: 8K BASIC: Pascal*	Graphics facility: disc interface running CP/M, about £200: (S&H)
Tuscan (£170)	As above	8K RAM: 8K ROM: Z80: 6xS100 slots: RS232 int: T.V. int: C int	8K monitor: or 8K BASIC	DD disc controller, £195: graphics: (S&H)
UK 101 (£219)	Computer Shop: 01-440 7033	4K RAM: 6502: full K/B: 16x48 VDU or TV int: C int: RS232 port: option — 4K RAM, £49	1K monitor: 8K BASIC: *Dis A: U*	Graphics: will run Superboard software (S&H)

List of Abbreviations

A Assembler	F/D Floppy disc	M/A Macro assembler	S/P Serial port
B BASIC	G/C Graphics card	N/A Not available	T/E Text editor
C Cassette	H Hardware	N/P Numeric pad	TBA To be announced
E Extensive	H/D Hard disc	O/S Operating system	U Utility
	I Introductory	P/P Parallel port	
	Int Interface	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.

DIRECT ACCESS

USER GROUPS INDEX

As promised, here is a complete printout of our User Group Index. If we have failed to include YOUR group, then please address the relevant information to PCW (User Group Index), 14 Rathbone Place, London W1P 1DE. Notification of changes will also be appreciated.
The next full listing will appear in PCW's August edition. In the meantime we shall of course continue to publish User Group Index update information — as and when it reaches us.

NATIONAL

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

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

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

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

Amateur Computer Club — 2650 Library. No meetings, no newsletters, the library serves to act as a help point for disseminating 2650 related data on demand. Contact: Roger A. Munt, 51 Beechwood Drive, Feniscowles, Blackburn, Lancs BB2 5AT (0254 22341).

Minicomputer Users in Secondary Education (MUSE). MUSE is the national organisation for coordinating activity in schools, teacher training institutions, colleges of technology and so on. Meetings are held on both a regional and national basis. For full details on MUSE's range of activities, contact the Treasurer, R. Trigger, 48 Chadcote Way, Catshill, Bromsgrove, Worcestershire.

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

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

Ithaca Audio S100 bus UK User Group. Contact: Dave Weater, 16 Etive Place, Cumbernauld, Glasgow O67 4JE. Phone 02867 36570.

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

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

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

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

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

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

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

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

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The microcomputer for perfectionists, patriots, penny-pinchers and potential agents everywhere.

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RECT CESS

USER GROUPS INDEX

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

British TI Users' Club. A loose association of owners and users of Texas Instruments programmable calcs, the club exists for the purposes of information and program exchange (and is in no way sponsored by TI). The main activity is production of a (roughly) monthly newsletter and membership costs £5.50. Details from 2 Woodside Crescent, Clayton, Newcastle-under-Lyme, Staffs ST5 4BW.

SOUTH

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

NORTHWEST

Amateur Computer Club — North west group. Meetings 1st and 3rd Thursdays monthly at St. Peter's Chaplaincy, Precinct Centre, Oxford Rd., Manchester. Contact: Jane Lomas, 9 Crescent Court, Alderfield Rd., Chorlton, Manchester, M21 1JX. Tel: 061 881 1933.

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

IRELAND

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

WALES

Gwent Amateur Computer Club. Covering the Gwent and Cardiff areas, the club has its own computer room and technical library. Meetings are held once a week on Wednesdays at 10 Park Place, Newport. Contact Ian Hazell on 0633 277711 (office hours).

SCOTLAND

The Grampian Amateur Computer Society. They meet every 2nd Monday of the month at the Holiday Inn, Bucksburn, Aberdeen and there's a monthly newsletter. For more details, contact M. Basil, Orton Cottage, Burnside, Lumphanan, Kincardineshire, Grampian Region (033 983 284).

The Scottish Amateur Computer Society. Meetings are on the 1st Wednesday of each month in the Lothian Room of the Grosvenor Hotel, Edinburgh — also in Fife on the 4th Wednesday of each month. . . locations variable. Details from Secretary, Alistair MacPherson, 6 Curriehill Castle Drive, Balerno, Edinburgh 14.

AVON

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

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

Compukit User Club. Details, contact P. Crabb Esq., 21 Jones Close, Yatton, Avon (0934 834808).

BERKSHIRE

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

CLEVELAND

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

DEVONSHIRE

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

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

COUNTY DURHAM

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

Northeast PETS. Contact: Jim Cocallis, 20 Worcester Road, Newton Hall Estate, Durham. They meet the 2nd Monday of each month for software tuition and the 3rd Monday for hardware tuition (both in addition to normal activities). They start at 7.00pm and meet in the PET Lab, Newcastle Polytechnic, Ellison Building, Newcastle upon Tyne.

EAST ANGLIA

Anglia Computer User Group. Contact Jan Rejzl, 128 Templemere, Sprowston Road, Norwich NR3 4EQ.

ESSEX

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

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

Compukit User Club. Details, contact Adrian Waters, 117 Haynes Road, Hornchurch, Essex RM11 2HX (Hornchurch 40490).

GLOUCESTERSHIRE

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

HAMPSHIRE

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

HERTFORDSHIRE

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

KENT

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

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

LANCASHIRE

Merseyside Microcomputer Group. Several sub-groups including: 380Z User's Group (Alan Pope on 051-548 500 Ext 189); Computer Education Society (Mr M. Trotter on 051-652 1596); SC/MP Special Interest Group (Bob Perrigo on 051-677 6716); PET Special Interest Group; 6800 and 77/68 Special Interest Group; Apple Special Interest Group. The Secretary is John Stout of the Dept. of Architecture, Liverpool Polytechnic, 53 Victoria Street, Liverpool L1 6EY (051-236 0598).

North Lancs User Group. Contact John Robinson, 12 Harold Ave., Blackpool, Lancashire.

LEICESTERSHIRE

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

LINCOLNSHIRE

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

LONDON

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

East London Amateur Computer Club. Meetings 3rd Tuesday monthly. £2.50 p.a. (½ price to school students). Contact: Dr. Graham Crisp, 45 Leadale Ave., Chingford, London E4 8AX. Tel: 01-520 6010.

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

SELMIC (South East London Microcomputer Club). £5 subscription. Meetings at Woolwich Polytechnic. Contact: John Williamson, 129 Greenvale Rd., Eltham Park, London SE9 1PG. Tel: 01-850 4195.

MIDDLESEX

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

Sunbury Amateur Computer Club. Membership free. Contact Mr S N Taylor, 8 Priory Close, Sunbury on Thames, Middlesex. TW16 5AB. Tel: Sunbury 86649.

OXFORDSHIRE

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

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

SURREY

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

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

WARWICKSHIRE

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

WEST MIDLANDS

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

West Midlands Amateur Computer Club. Meets the 2nd & 4th Tuesday of each month, usually at Elmfield School, Love Lane, Stourbridge, West Midlands. Annual sub is £3 (£2 if full time student). . . visitors welcomed without obligation. For more information contact John Tracey of 100 Booth Close, Kingswinford, West Mids (0384 70097).

Compukit User Club. Details, contact S.H. Grisvenor Esq., 11 Bernard Road, Oldbury, Warley, West Midlands (021-422 3298).

YORKSHIRE

South Yorkshire Personal Computing Group. For details of the SYPCG, contact Tony Rycroft, 88 Spinneyfield, Moorgate, Rotherham, 8. Yorks. (Tel: Rotherham 74889, eve).

Shipley College Computer Group (Sorcerer/6800). They meet Tuesdays (software) and Wednesdays (hardware/advanced) between 7.00 & 9.00 pm. Contact Paul Channell on Shipley 595731.

West Yorkshire Microcomputer Group. Formed following an inaugural meeting on October 23rd, a varied diary of events has been drawn up. For details contact the Chairman, Phillip Clark, Care Computer Services, 15 Wellington Street, Leeds LS1 4DL (0532 450667) OR the Secretary, Keith Knaggs, Price Waterhouse & Co., Leeds (0532 448741).

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APPLE

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Supports Daisy Chain Interrupts with on board arbitration logic. Allows DMA Daisy Chain (pass through).
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The converter is designed to measure an input potential between 0 and +3.999 volts and convert it to four Binary Coded Decimal numbers that your Apple II can understand.
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Arithmetic Processor

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 USR() function:
ASIN (X). ACOS (X). COGIO (X). SINH (X). COSH (X). TANH (X). INVERSE (X). PI and several others.

All existing Applesoft II arithmetic options are still available but are now performed by the processor unit where a speed advantages is needed.

Gaining this speed has a trade in reduction of nine sig. figs. to seven but just look at the gains.

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

Function	Overhead	CCSOFT	AS II
FDIV	11.4 sec	17.6 sec	27.3 sec
SQR	13.8	17.1	248.9
TAN	13.8	28.7	244.8
ACOS	13.8	30.6	554.8

If you want increased speed then this is for you (bolt your Apple to the bench – it is that fast!) Try it – you'll like it.
Order Number: K00623A £240.00.

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 Side A and B with a CMOS Drive capability on Side A. All external lines via a DB-125 Type Connector. In our opinion a good solid interface.
Order Number: K00624A £180.00.

Synchronous RS232C Interface

What more need be said! Synchronous Serial interfacing has been a problem in the past. Now we have the answer. If any extra protocol is required this can easily be catered for.

DATA Transfer mode:
7 or 8 data Bits. OPP, EVEN or NO parity. 1 or 2 stop bits. Synchronous Serial by word. Serial by bit.

DATA Transfer Rates:
50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, BAUD. EXTERNAL.

PROGRAM Memory.
ROM (Mask)
or PROM (Fuse Link)
or RAM (Static 2112's)
NOTE: ROM/PROM Auto power down.
Order Number: K00625A £180.00.

Light Pen

The Symtec Light Pen is now imported by ourselves directly and is in our opinion the best light pen for the Apple. Complete with software you can now read a coordinate on the hires, page or text page. Ideal for Computer aided graphics or simple data entry. Try one.
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Use the light pen in turtlegraphics with K.C.L's advanced library software.
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K00680A (Supercolour interface) £90.00.
K11502A T.V. (Supercolour KVI400) £345.000.

Micromikes Time Sharing Software

Specially designed for North Star Horizons. Five share and Four share allow you to link up to 5 or 4 terminals to your Horizon system.
Special introductory offer of £35.00.
You need some more terminals then?
We hold the following range:
Cifer 2960, Order Number: K11910T.
TVI 912, Order Number: K11800T.
TVI 920, Order Number: K11801T.
Lear Siegler ADM 31, Order Number: K11703T.
Lear Siegler ADM 3A, Order Number: K11704T.
Lear Siegler ADM 42, Order Number: K11705T.

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DIARY DATA

DIRECT ACCESS

Glasgow, Scotland	Computermarket '80. Couchmead Ltd., 42 Great Windmill Street, London W1V 7PA. Telephone: 01-437 4187	Mar 18 - Mar 20
London, England	The Home Video Show. "The Home Video Show", Link House Magazines (Croydon) Ltd, Pembroke House, Wellesley Rd., Croydon CR9 2TA. Tel: 01-686 7181	March 21 — March 25
London, England	Computermarket '80. Couchmead Ltd., 42 Great Windmill Street, London W1V 7PA. Telephone: 01-437 4187	Mar 25 - Mar 27
London, England	Viewdata '80 Exhibition. Online Conferences Ltd., Cleveland Road, Uxbridge, UB8 2DD. Tel: 0895 39262	Mar 26 - Mar 28
Brighton, England	Computer Aided Design Conference & Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street. London SE1 9LU. Tel: 01-261 8000	Mar 31 - Apr 2
Harrogate, England	Mini/Micro Computers, Word Processors and Business Machines Exhibition — BIZTRONIC. Groundrule Exhibition Co., 7 Market Street, Altrincham, Cheshire, WA14 1QW. Tel: 061-928 0406	April 15 — April 16
Plymouth, England	S.W. Business Efficiency and Office Equipment Exhibition, Gwen Shillaber Design, 13 Alma Vale Road, Clifton, Bristol, BS8 2HL. Tel: 0272 312850	April 15 — April 17
London, England	Peripherals '80 Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-261 8000.	Apr 16 - Apr 17
London, England	All Electronic Show. All Electronic Show, 34-36 High Street, Saffron Walden, Essex. Tel: 0799 22612	Apr 29 - May 1
Liverpool, England	Mersey Micro Show. Online Conferences Ltd., Cleveland Road, Uxbridge UB8 2DD. Tel: 0895 39262	April 30 - May 2
Brussels, Belgium	Compec Europe Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-261 8000.	May 6 - May 8
Manchester,England	Business Efficiency & Office Equipment Exhibition, Gwen Shillaber Design, 81 Whiteladies Rd., Clifton, Bristol BS8 2NT. Tel: 0272 312850	May 13 - May 15
Anaheim, USA	National Computer Conference and Exhibition (NCC). 210 Summit Ave., Montvale, NJ 07645	May 19 - May 22
Dallas, USA	Int. Telecommunications Exbn — INTELCOM. Horizon House — Microsol Inc., 25 Victoria Street, London SW1H OEX. Tel: 01-222 0466	May 19 - May 23
London, England	International Word Processing Exhibition and Conference. Business Equipment Trade Association, 109 Kingsway, London WC2B 6PU. Tel: 01-405 6233	May 20 - May 23
Dublin, Ireland	International Computing Exhibition — COMPUTEX. SDL Exhibitions Ltd., 68 Fitzwilliam Square, Dublin 2, Ireland. Tel: Dublin 763871	June 17 — June 19
Geneva, Switzerland	International Microcomputers, Minicomputers, Microprocessors & Data-communications Exhibition — IMMM/DATACOMM. Kiver Communications S.A., 171/185 Ewell Road, Surbiton, Surrey. Tel: 01-390 0281	June 17 — June 19
Newcastle-Upon-Tyne, England	Mini/Micro Computers, Word Processors and Business Machines Exhibition — BIZTRONIC. Groundrule Exhibition Co., 7 Market Street, Altrincham, Cheshire, WA14 1QW. Tel: 061-928 0406	July 3 — July 4

TRANSACTION FILE

For sale

Powertran Comp-80 . . . 5K RAM BASIC, full graphics and plotting. TV Monitor; cassette recorder; metal case. Offers around £250. Tim Brown on Stafford 850244.

New professional ASCII keyboard . . . KB756. £40 or best offer. Andy Robson, 40 Loveridge Ave, Chanterland, Hull. 0482 443316 (after 4pm).

Shugart SA400 . . . pair, £295. 020-881 3649 after 6pm

Teletype ASR33-20ma current loop . . . Auto stop/start reader, punch. Good cond., all manuals & logics, pedestal. £375 ono. 01-543 2430 (evenings)

Superboard II . . . PSU, modulator, case, 7K user RAM, extended monitor, cursor control utilities & other software (games etc.) Modified cassette interface, switchable baud rate — 300/600. £230 ono. 051-487 9586.

Sinclair Enterprise programmable . . . 79 steps, 7 memories, trigs, logs etc. Full program library, mains adaptor & instruction manual. £10 ono — first over £12 takes the lot (£11 if you'll collect). H L Thomas, Plasparciav, St Clears, Carmarthen, Dyfed SA33 4DW.

Teleprinter, Creed 75 . . . with tape punch, teletype tape reader and rolls of paper. £40 or will exchange for good ASCII keyboard, video board or WHY 0274 47235.

MK-14 . . . with extra RAM, manual & Science of Cambridge mains adaptor, £45 ono. D J Nutley, 13 Sycamore Rd, Bishop's Waltham, Hants.

ITT 2020 . . . 16K, Palsoft, colour modulator, 4 months old, perfect. Includes tapes and Microchess. £720. 051-334 2405 (evenings).

Compukit UK101 . . . 7K RAM, cased. £320 ono. Hemel Hempstead 3040 (evenings).

MK-14 . . . complete & socketed with new VDU & character generator, edge connector, graphics, modulator etc. New RAM I/O, Univac 45 keypad plus original keyboard, £65. 0282 67677.

MK-14 . . . PSU, 640 Bytes, I/O chip, single stepping, cassette interface, £50 ono. Buyer collects. Ilminster 3301.

TRS80 . . . 16K, Level II, Video, Cassette, Manual & 3 programs, £570 ono. Medway 31757 after 7.30 pm.

Cipher Cub VDU . . . nearly new, £250. Upper/lower case, RS232/V24, switchable baud rate etc. Leatherhead 74674.

TRS-80 Level I . . . 4K RAM, VDU, cassette etc. Boxed, as new £300 ono. 0438 52901 (after 6pm).

SWTPC 6800 . . . 24K RAM, triple floppy, IBM Selectric printer, FLEX & INDEX DOS, lots of tape & disc software, extras. Will deliver, £1500 the lot or will split — offers? 097-081 267.

PET 2001-8 . . . Fitted upgrade ROM, manuals, many programs (utilities and games), £475. 0253 869108 (evenings/weekends).

Nascom 1 . . . cassette, case, PSU, B-Bug, BASIC, approximately 60 taped programs, £375. Buckfastleigh 2383.

NASCOM 1 . . . PSU, documentation, software, spares, cased, £200. P Watson. Oakley 2867.

Heathkit 5" oscilloscope (IO18U) . . . Will swap for a well-constructed or unopened Nascom 1 kit. Keith on 0635 63074.

Compukit UK101 . . . 8K memory, 8K Microsoft BASIC, full documentation, games tape, built, Kansas City interface, £300. 0274 27635 or 29 Wingfield Mount, Bradford, West Yorkshire.

TRS 80 Level II . . . (new Oct), 16K, numeric pad, VDU, cassette, tapes/books, £495. 01-989 0430.

MK-14 . . . improved keyboard, power supply, cassette interface, programs & manuals, £65. 02357 4753 (weekends or after 5pm).

Aim 65 . . . 3K RAM, PSU, edge connectors, thermal paper, some software — Pilot, Chess & Utilities. Offers around board only price. Chelmsford 351704 (evenings).

Nascom I . . . PSU, monitor. Any reasonable offer. Electronic organ, switch selectable string, brass or wind, £220 ono. 061-225 9951 after 6pm.

Exidy Sorcerer. . . 32K, S100 expansion box, reverse video, colour graphics & full manuals. Most currently available software. £850. Pete Scargill, Newcastle upon Tyne 573905 after 6pm.

PSU bits, 5V 5A . . . 100VA transformer, 12A bridge, 15000 microfarad 16V electrolytic, 78H5 5A regulator. All used but in good nick — £12 ono. 6800 CPU chip, £5 ono. 9112 (same as 2112) 256x4 RAMS (suit 77-68) — £1.25 each. Phone Weymouth 73426 (office hours) or call in at 44 Leamington Road, Weymouth (evenings & weekends). Ask for Mr. K Morris.

2102 RAMS . . . tested and unused, 50p each. Phone E. Badcock on 0793 721627.

ICL high speed tape punch . . . 110cps, very compact, vgc — £40 ono. Also electronic tape feeder, prevents jamming, use with punch and readers, vgc, £20 ono. Ring 061-761 4566 after 6.

Casio FX502P . . . Casio FA-1 cassette interface, Masterpac user manual & program library, cassette recorder, all as new £100. Greenwood, Skipton 60811

Programming the 6502 by Rodnay Zaks. Will swap for a good BASIC manual. B Shuttleworth 061-643 3196.

Wanted

NCR 500 program display panel . . . phone 01-866 1179 (evenings/weekends).

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.

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loop, the last value accepted is loaded into the scanner and the output is checked to see whether the switch is still in the same position. Only if it isn't does the system make a complete scan.

Since flexibility had to be the keynote of the 5602's design, it was recognised very early that some means of allowing changes to the selection methods needed to be found which was both quick and easy. The solution adopted, while appearing very complex, 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. Figure 4 shows a code diagram and the ELIC code produced. It is hoped that the design of ELIC will allow the more intelligent users to design their own methods of selection to optimise their rate of input.

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 intitally 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 obviously can't be 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 Government cutbacks, is far from certain to be available to all users. We are considering a context editor which operates on words, sentences and paragraphs, but whether it will be easy to use is, as yet, unknown.

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 typwriter 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.

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.

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all six positions have been tested.

I would be indebted to any reader who, understanding the problem, can implement the solution more efficiently.

abbreviations used in text.

- [ ]: 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.
- RE: reverse.
- RO: reverse off.
- SH: shift (hold shift down for next symbol outside of brackets.
- SL: shift lock (hold shift down for all symbols outside of brackets until advised otherwise or end of line.
- SR: shift release (cancels SL).
- SP: space.

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

The program listing

If you like everything that has been offered, you are at liberty to transcribe the program exactly as follows, for non-commercial use. If you don't like it, feel free to chop and change as you see fit. Lines 750-860 contain the random scan option and there is some duplication with lines 610-740, which contain the sequential scan. They could have been interwoven but I have kept them separate to make the program easier to read and to delete the random scan if desired. If transcribing all that data is too much trouble, you can always wait until it comes on the market.

```
100 PRINT"J"SPC(16)"IMPHEX ":PRINTSPC(15)"
105 PRINTSPC(8)"A NEW VERSION OF HEXAPAWN"
110 REM:BY T.CRUDIS 5/79.
130 INPUT"INSTRUCTIONS ('Y' OR 'N')";I$:IF I$="Y" GOTO 1310
140 IF I$<>"N" GOTO 120
145 PRINT"
150 PRINT"I CAN BE PROGRAMMED TO SELECT MY MOVES
155 PRINT"IN A RANDOM OR A SEQUENTIAL MANNER. IF
160 PRINT"YOU CHOOSE 'SEQUENTIAL' MY RESPONSE TO A
165 PRINT"GIVEN SITUATION WILL ALWAYS BE THE SAME.
170 PRINT"WHICH DO YOU WISH TO HAVE ME USE:
175 INPUT"('R' OR 'S')";M$:IF M$<>"R" AND M$<>"S" GOTO 175
210 C=-1:H=1:CW=0:HW=0:DIMBD(4,3),BM(3,3,15),P(3,3)
220 D$="":E$="                                        "
230 BP$="":BD$="":BL$="
240 C$="":H$=""+C$+"
330 :FOR Y=1 TO 3:FOR X=1 TO 3:BD(X,1)=H:BD(X,2)=0:BD(X,3)=C:NEXTX,Y
335 TU=H:F1=0:F2=0
340 GOSUB 1010
330 PRINT BP$C$C$C$BD$BD$BL$H$H$H$
400 PRINTD$E$D$;
410 PRINT"YOUR MOVE";:INPUT HI,HF
420 IF HI<1 OR HI>9 OR HF<1 OR HF>9 THENPRINTD$"NOT IN THIS GAME!   ";:GOTO 410
425 DEF FNC(X)=X+10-(X>3)*7-(X>6)*7
430 YI=INT(FNC(HI)/10):XI=FNC(HI)-YI*10:YF=INT(FNC(HF)/10):XF=FNC(HF)-YF*10
440 IF BD(XI,YI)<>1 OR ABS(XF-XI)>1 OR YF-YI<>1 GOTO 500
450 IF (XI=XF AND BD(XF,YF)<>0) OR (ABS(XF-XI)=1 AND BD(XF,YF)<>-1) GOTO 500
455 PRINT"":FOR J=0 TO 7:PRINT"                         ":NEXT J
470 GOSUB 1120.
480 IF YF=3 GOTO 920
485 BD(XI,YI)=0:BD(XF,YF)=1
490 GOTO 600
500 PRINT D$E$D$"ILLEGAL MOVE!   ";:F1=F1+1:IF F1<>4 THEN 410
510 PRINT"HOW MANY TIMES":PRINT"DO I HAVE TO ":PRINT"TELL YOU?
515 PRINT"                ":PRINT" ILLEGAL MOVE! "
520 PRINT"                ":GOTO 400
600 PRINT D$E$:TU=C:FOR D=1 TO 530:NEXT D
605 IF M$="R" GOTO 750
510 :FOR YI=3 TO 2 STEP-1:FOR XI=1 TO 3:IF BD(XI,YI)<>-1 THEN 740
520 :::FOR W=1 TO 3:IF BD(XI+2-W,YI-1)<>ABS(2-W) THEN 730
530 :::SI=BD(XI,YI):SF=BD(XI+2-W,YI-1):BD(XI,YI)=0:BD(XI+2-W,YI-1)=-1
540 ::::FOR L=0 TO HW:FOR J=1 TO 3:FOR K=1 TO 3
643 ::::::IF BD(J,K)<>BM(J,K,L) THEN 670
650 ::::::NEXT K,J
660 ::::BD(XI,YI)=SI:BD(XI+2-W,YI-1)=SF:GOTO 730
670 ::::NEXT L
671 :::GOSUB 1120
673 ::::FOR Y=1 TO 3:FOR X=1 TO 3:BM(X,Y,HW)=BD(X,Y):NEXT X,Y
687 :::IF YI=2 THEN 910
688 ::::FOR YT=1 TO 3:FOR XT=1 TO 3:IF BD(XT,YT)<>1 THEN 720
700 ::::::FOR WT=-1 TO 1:IF BD(XT+WT,YT+1)=-ABS(WT) THEN TU=H:GOTO 400
710 :::::::  NEXT WT
720 :::::NEXT XT,YT:GOTO910
730 :::NEXT W
740 ::NEXT XI,YI:GOTO 920
745 END
750 FOR Y=2 TO 3:FOR X=1 TO 3:P(X,Y)=0:NEXT X,Y:N1=0
755 N2=0:YI=INT(2*RND(1)+2):XI=INT(3*RND(1)+1)
760 IF P(XI,YI)=1 GOTO 755
765 IF BD(XI,YI)<>-1 GOTO 855
770 FOR W=1 TO 3:M(W)=0:NEXT W
775 W=INT(3*RND(1)+1)
780 IF M(W)=1 GOTO 775
785 IF BD(XI+2-W,YI-1)<>ABS(2-W) GOTO 850
790 SI=BD(XI,YI):SF=BD(XI+2-W,YI-1):BD(XI,YI)=0:BD(XI+2-W,YI-1)=-1
795 :FOR L=0 TO HW:FOR J=1 TO 3:FOR K=1 TO 3
800 :::IF BD(J,K)<>BM(J,K,L) THEN 815
305 ::NEXT K,J
310 :BD(XI,YI)=SI:BD(XI+2-W,YI-1)=SF:GOTO 850
815 :NEXT L:GOSUB 1120
820 FOR Y=1 TO 3:FOR X=1 TO 3:BM(X,Y,HW)=BD(X,Y):NEXT X,Y
825 IF YI=2 THEN 910
830 :FOR YT=1 TO 3:FOR XT=1 TO 3:IF BD(XT,YT)<>1 THEN 840
835 :::FOR WT=-1 TO 1:IF BD(XT+WT,YT+1)=-ABS(WT) THEN TU=H:GOTO 400
836 :::  NEXT WT
840 ::NEXT XT,YT:GOTO 910
850 M(W)=1:N2=N2+1:IF N2<3 GOTO 775
355 P(XI,YI)=1:N1=N1+1:IF N1<6 GOTO755
860 GOTO 920
910 PRINTD$"I WIN!          ":CW=CW+1:F3=1:GOTO 930
920 PRINT D$+"YOU WIN!         ":HW=HW+1:F3=0
930 FOR D=1 TO 1000:NEXT
935 PRINT"                ":PRINT"    SCORE      ":PRINT"
940 PRINT" COMPUTER:      ":PRINT"               ":PRINT"    HUMAN:     "
950 PRINT"                ":PRINT""CW:PRINT""HW
```

```
970 IF CW>HW THEN F2=1
975 IFF2=0AND CW=1 AND HW>5 THEN FOR D=1TO500 NEXT PRINT"I NEEDED THAT!" F2=1
980 PRINT D$"ANOTHER GAME ('Y' OR 'N')"; INPUT G$ IF G$="Y"GOTO 240
990 IF G$<>"N"GOTO 980
995 PRINT D$E$D$"SOUR GRAPES!   SO TURN ME OFF!"; END
1010 PRINT"J"SPC(17)"
1020 FOR J=1 TO 3 PRINT SPC(17)"
1030 FOR K=1 TO 4 PRINT SPC(17)" |    ||    ||    |" NEXT K
1040 PRINT SPC(17)"" NEXT J
1050 PRINT SPC(17)"
1080 IF F3=1 GOTO 1095
1090 IF HW>0 THEN PRINT"I HAVE LEARNED
1091 IF HW=1 THEN PRINT"A BAD MOVE.
1092 IF HW=2 THEN PRINT "ANOTHER ONE!
1093 IF HW>2 THEN PRINT""HW"BAD MOVES.
1094 IF HW>5 THEN PRINT"THE HARD WAY!
1095 RETURN
1120 BE$="
1130 BU$="TTTTT" H$=""+C$+"
1140 IF TU=H THEN W=XI-XF+2
1150 IF TU=C THEN BU$=BD$ H$=C$
1160 PRINT BP$; FOR YD=3 TO 1 STEP-1 FOR XD=1 TO 3
1165   IF XD<>XI OR YD<>YI THEN PRINT""; GOTO 1250
1170   PRINT BE$BU$MID$(BL$,W,W↑2+W)H$ GOTO 1260
1250   NEXT XD PRINTBD$BL$; NEXTYD
1260 RETURN
1310 PRINT"HEXAPAWN IS PLAYED WITH CHESS PAWNS ON
1320 PRINT"A 3 X 3 BOARD. YOUR PAWNS ARE WHITE.
1330 PRINT"TO ENTER A MOVE, TYPE THE NUMBER OF THE
1340 PRINT"SQUARE YOU WISH TO MOVE FROM, A COMMA,
1350 PRINT"AND THE NUMBER OF THE SQUARE YOU WISH TO
1360 PRINT"MOVE TO, FOR EXAMPLE '2,5'. THE SQUARES
1370 PRINT"ARE NUMBERED LIKE THE KEYBOARD:" PRINTSPC(16)"      "
1375 PRINTSPC(16)" 7 8 9" PRINTSPC(16)"
1380 PRINTSPC(16)" 4 5 6" PRINTSPC(16)"
1385 PRINTSPC(16)" 1 2 3" PRINTSPC(16)"
1390 PRINTSPC(7)"PRESS 'SPACE' TO TURN PAGE." WAIT 59410,4,4
1400 PRINT"TO WIN, MOVE ONE OF YOUR PIECES TO THE
1410 PRINT"OPPONENT'S SIDE OF THE BOARD FIRST,
1420 PRINT"CAPTURE ALL OF THE OPPONENT'S PIECES, OR
1430 PRINT"BLOCK HIM FROM MAKING ANY MOVE.
1440 PRINT"THE COMPUTER STARTS A SERIES OF GAMES
1450 PRINT"KNOWING ONLY HOW TO MOVE AND HOW TO
1460 PRINT"RECOGNIZE A WIN. IT HAS NO INITIAL
1470 PRINT"STRATEGY, BUT IT KEEPS A RECORD OF ALL
1480 PRINT"BAD MOVES AND IMPROVES ITS STRATEGY
1490 PRINT"UNTIL IT BECOMES INVINCIBLE.
1500 PRINTSPC(7)"PRESS SPACE TO START GAME." WAIT59410,4,4 PRINT"J" GOTO150
```

Pascal, *cont. from p. 96*

```
    REPEAT
        READLN(INFILE) ;
        I := 1 ;
        REPEAT
            READ(INFILE, BUFFER[I]) ;
            I := I + 1
        UNTIL EOLN(INFILE)
    UNTIL EOF(INFILE) OR (LENGTH(BUFFER)>0) ;
    FOR J := I TO MAXLINE DO BUFFER[J] := ' '
END ; (*FREADLN*)

PROCEDURE FWRITELN(VAR OUTFILE : TEXT ; BUFFER : STRING) ;
(*WRITELN BUFFER TO OUTFILE*)
VAR I,J : 1..MAXLINE ;
BEGIN
    FOR I := 1 TO LENGTH(BUFFER) DO WRITE(OUTFILE,BUFFER[I]) ;
    WRITELN(OUTFILE)
END ; (*FWRITELN *)

PROCEDURE FLUSH (VAR BUFFER : STRING) ;
(*OUTPUTS SPACING BLANK LINES, FLUSHES BUFFER AND THEN FILLS WITH SPACES*)
VAR I : INTEGER ;
PROCEDURE LINESPACING ;
VAR I : 2 .. 10 ;
BEGIN
    IF USERFORMAT.SPACING>1
    THEN
        FOR I := 2 TO USERFORMAT.SPACING DO
        BEGIN
            WRITELN (OUTFILE) ;
            CURRENTLINE := CURRENTLINE + 1
        END
END ; (*LINESPACING*)
BEGIN
    IF NOT EMPTYOUTBUFFER
    THEN
    BEGIN
        FWRITELN (OUTFILE,BUFFER) ;
        CURRENTLINE := CURRENTLINE + 1 ;
        LINESPACING
    END ;
    FOR I := 1 TO MAXLINE DO BUFFER [I] := ' ' ;
    EMPTYOUTBUFFER := TRUE
END ; (* FLUSH*)

FUNCTION COMMAND : BOOLEAN ;
(* TRUE IF IN BUFFER IS A COMMAND AND FALSE OTHERWISE *)
BEGIN
    COMMAND := INBUFFER[1] = '.'
END ; (* COMMAND *)

PROCEDURE OBEY (VAR INBUFFER,OUTBUFFER : STRING ; VAR EMPTYINBUFFER,
                     EMPTYOUTBUFFER : BOOLEAN ; VAR FORM : FORMAT ) ;
(* CARRIES OUT FORMATTING COMMANDS  *)

VAR VALID : SET OF CHAR ;
    . : INTEGER ;

FUNCTION PARAMETERS (BUFFER : STRING ) : BOOLEAN ;
BEGIN
    PARAMETERS := LENGTH(BUFFER) > 2
END ; (* PARAMETERS *)

FUNCTION NEXTPARAMETER (START : INTEGER) : INTEGER ;
VAR I,NUM : INTEGER ;
BEGIN
    I := START ;
    WHILE INBUFFER[I] = ' ' DO I := I+1 ;
```

```
     NUM := 0 ;
     WHILE INBUFFER[I] <> ' ' DO
     BEGIN
          NUM := 10 * NUM + (ORD(INBUFFER[I]) - ORD('0')) ;
          I := I+1
     END ;
     NEXTPARAMETER := NUM
END; (* NEXTPARAMETER *)

PROCEDURE BLANK (VAR EMPTYOUTBUFFER : BOOLEAN ) ;
VAR I : INTEGER ;
BEGIN
     FLUSH (OUTBUFFER) ;
     IF PARAMETERS (INBUFFER)
     THEN
     FOR I := 1 TO NEXTPARAMETER(3) DO
     BEGIN
          WRITELN (OUTFILE) ;
          CURRENTLINE := CURRENTLINE + 1
     END
END ; (* BLANK *)

PROCEDURE CENTERED (VAR EMPTYOUTBUFFER : BOOLEAN ) ;
VAR I,START,CENTRE : INTEGER ;
BEGIN
     FLUSH (OUTBUFFER) ;
     FREADLN (INFILE,INBUFFER) ;
     CENTRE := (USERFORMAT.RIGHTMARGIN - USERFORMAT.LEFTMARGIN) DIV 2 ;
     IF LENGTH(INBUFFER) >= CENTRE*2
     THEN START :=USERFORMAT.LEFTMARGIN
     ELSE START := CENTRE - (LENGTH(INBUFFER) DIV 2) ;
     FOR I := 1 TO LENGTH(INBUFFER) DO
          OUTBUFFER[START+ I] := INBUFFER[I] ;
     EMPTYOUTBUFFER := FALSE ;
     FLUSH(OUTBUFFER)
END ; (* CENTERED *)
PROCEDURE NUM ;
BEGIN
     USERFORMAT.NUMBER := TRUE ;
     IF PARAMETERS(INBUFFER) THEN USERFORMAT.PAGENUMBER := NEXTPARAMETER(3)
END ; (*NUM*)

PROCEDURE MARGIN ;
BEGIN
     FLUSH (OUTBUFFER) ;
     WITH USERFORMAT DO
     BEGIN
          LEFTMARGIN := NEXTPARAMETER(3) ;
          RIGHTMARGIN := NEXTPARAMETER(6) ;
          IF LEFTMARGIN + 20 >= RIGHTMARGIN THEN RIGHTMARGIN := LEFTMARGIN
            + 20
     END
END ; (* MARGIN *)

PROCEDURE PARAGRAPH (VAR EMPTYOUTBUFFER : BOOLEAN ) ;
VAR I,SKIPLINES : INTEGER ;
BEGIN
     FLUSH (OUTBUFFER) ;
     IF PARAMETERS(INBUFFER)
     THEN
     BEGIN
          USERFORMAT.INDENT := NEXTPARAMETER(3) ;
          SKIPLINES := NEXTPARAMETER(6) ;
          FOR I := 1 TO SKIPLINES DO WRITELN (OUTFILE)
     END
     ELSE
     BEGIN
          USERFORMAT.INDENT := 5 ;
          WRITELN (OUTFILE)
     END
END ; (* PARAGRAPH *)

PROCEDURE JUST ;
BEGIN
     USERFORMAT.JUSTIFY := TRUE ;
     USERFORMAT.FILL := TRUE
END ; (*JUST*)
PROCEDURE UNFILL ;
BEGIN
     USERFORMAT.FILL := FALSE ;
     USERFORMAT.JUSTIFY := FALSE
END ; (*UNFILL*)

BEGIN     (* OBEY *)
     VALID := ['B','C','F','I','J','L','M','N','O','P','R','S','U'] ;
     IF INBUFFER[2] IN VALID
     THEN
        WITH USERFORMAT DO
          CASE INBUFFER[2] OF
               'B' : BLANK(EMPTYOUTBUFFER) ;
               'C' : CENTERED(EMPTYOUTBUFFER) ;
               'F' : FILL := TRUE ;
               'I' : INDENT := NEXTPARAMETER(3) ;
               'J' : JUST ;
               'L' : LINES := NEXTPARAMETER(3) ;
               'M' : MARGIN ;
               'N' : NUM ;
               'O' : NUMBER := FALSE ;
               'P' : PARAGRAPH (EMPTYOUTBUFFER) ;
               'R' : JUSTIFY := FALSE ;
               'S' : SPACING := NEXTPARAMETER(3) ;
               'U' : UNFILL
          END  (* CASE*)
      ELSE
      BEGIN
      STWRITE(INBUFFER) ; WRITELN(' NOT RECOGNIZED')
      END ;
      FOR I := 1 TO MAXLINE DO INBUFFER[I] := ' ' ;
      EMPTYINBUFFER := TRUE
END ; (* OBEY *)

PROCEDURE FILLOUT (VAR INBUFFER, OUTBUFFER : STRING ; VAR EMPTYINBUFFER,
                       EMPTYOUTBUFFER : BOOLEAN) ;
(*TRANSFERS WORDS FROM INBUFFER TO OUTBUFFER UNTIL OUTBUFFER IS FULL*)
VAR POINTER : INTEGER ;
    START : 0..MAXLINE ;

PROCEDURE STARTINGPOINT ;
VAR I : INTEGER ;
BEGIN
    IF EMPTYOUTBUFFER
    THEN
```

```
    BEGIN
        WITH  USERFORMAT DO
        BEGIN
           FOR I := 1 TO MAXLINE DO OUTBUFFER[I] := ' ' ;
           START := LEFTMARGIN + INDENT + 1 ;
           INDENT := 0
        END (*WITH*)
    END
    ELSE START := LENGTH(OUTBUFFER)  + 2
END ; (*STARTINGPOINT*)
PROCEDURE FINDSTRING ;
VAR FREELENGTH : INTEGER ;
    SHORTENOUGH, ENDOFLINE, WHOLEWORD : BOOLEAN ;
BEGIN
    FREELENGTH := USERFORMAT.RIGHTMARGIN - START + 1 ;
    POINTER := LENGTH (INBUFFER) ;
    REPEAT
        POINTER := POINTER - 1 ;
        SHORTENOUGH := POINTER < FREELENGTH ;
        ENDOFLINE := LENGTH(INBUFFER) = POINTER + 1 ;
        WHOLEWORD := INBUFFER[POINTER +1] = ' '
    UNTIL (SHORTENOUGH AND (ENDOFLINE OR WHOLEWORD)) OR (POINTER = 0)
END; (*FINDSTRING*)
PROCEDURE MOVESTRING ;
VAR TEMPBUFFER :STRING ;
BEGIN
    COPY(INBUFFER, TEMPBUFFER, 1, POINTER + 1) ;
    DELETE (INBUFFER, 1, POINTER +1);
    INSERT(TEMPBUFFER, OUTBUFFER, START)
END ; (*MOVESTRING*)
PROCEDURE SETFLAGS ;
BEGIN
    EMPTYINBUFFER:=(LENGTH(INBUFFER)=0) OR (EOF(INFILE) AND
                                          (LENGTH(INBUFFER) = 1)) ;
    EMPTYOUTBUFFER := LENGTH(OUTBUFFER) = 0
END ; (*SETFLAGS*)
BEGIN (*FILLOUT*)
    STARTINGPOINT ;
    FINDSTRING ;
    IF POINTER > 0 THEN MOVESTRING ;
    SETFLAGS
END ; (*FILLOUT*)
PROCEDURE ADJUST (VAR BUFFER : STRING) ;
VAR POINTER, NEWPOINTER, GAP, START : 0  .. MAXLINE ;
    DIRECTION : -1 .. 1 ;
FUNCTION INRANGE : BOOLEAN ;
BEGIN
    INRANGE := (POINTER>START) AND (POINTER<USERFORMAT.RIGHTMARGIN)
               AND (NEWPOINTER>=START) AND
                   (NEWPOINTER<=USERFORMAT.RIGHTMARGIN)
END ;(* INRANGE *)
PROCEDURE SETUP ;
VAR ONEWORD : BOOLEAN ;
    I : 0 .. MAXLINE ;
BEGIN
    GAP := USERFORMAT.RIGHTMARGIN - LENGTH(BUFFER) ;
    POINTER := LENGTH (BUFFER) ;
    DIRECTION := 1 ;
    NEWPOINTER := POINTER + DIRECTION*GAP ;
    START := 0 ;
    REPEAT
       START := START + 1
    UNTIL BUFFER[START]<>' ' ;
    ONEWORD := TRUE ;
    FOR I := START TO LENGTH(BUFFER) DO
        IF BUFFER[I] = ' '
        THEN ONEWORD := FALSE ;
    IF ONEWORD THEN GAP := 0
END; (*SETUP*)
PROCEDURE MOVECHARACTER ;
BEGIN
    BUFFER[NEWPOINTER] := BUFFER[POINTER] ;
    BUFFER[POINTER] := ' '
END ; (*MOVECHARACTER*)
PROCEDURE PADIFSPACE ;
BEGIN
    IF INRANGE AND (BUFFER[NEWPOINTER] = ' ')
    THEN IF BUFFER[NEWPOINTER+DIRECTION] <>' '
         THEN
         BEGIN
            BUFFER[NEWPOINTER-DIRECTION] := ' ' ;
            GAP := GAP - 1
         END
END ; (*PADIFSPACE*)
PROCEDURE MOVEPOINTERS ;
BEGIN
    IF INRANGE
    THEN POINTER := POINTER - DIRECTION
    ELSE
    BEGIN
       POINTER := NEWPOINTER ;
       DIRECTION := -1*DIRECTION
    END ;
    NEWPOINTER := POINTER + DIRECTION*GAP
END ; (*MOVEPOINTERS*)
BEGIN (*ADJUST*)
    SETUP ;
    WHILE GAP>0 DO
    BEGIN
        MOVECHARACTER ;
        PADIFSPACE ;
        MOVEPOINTERS
    END
END ; (*ADJUST*)
PROCEDURE CLEAR (VAR OUTFILE : TEXT ; VAR OUTBUFFER : STRING ;
                 VAR EMPTYOUTBUFFER : BOOLEAN ) ;
VAR I, LINESLEFT : INTEGER ;
PROCEDURE NEWPAGE (VAR CURRENTLINE : INTEGER ) ;
VAR I : INTEGER ;
BEGIN
```

```
      WITH USERFORMAT DO
      BEGIN
         FOR I := 1 TO 3 DO
            WRITELN (OUTFILE) ;
         IF NUMBER
         THEN
         BEGIN
             FOR I := 1 TO RIGHTMARGIN - 7 DO
               WRITE (OUTFILE,' ') ;
             WRITELN (OUTFILE, 'PAGE ',PAGENUMBER) ;
             PAGENUMBER := PAGENUMBER + 1
         END
         ELSE WRITELN (OUTFILE) ;
         WRITELN (OUTFILE) ; WRITELN (OUTFILE) ;
         CURRENTLINE := 3
    END (* WITH*)
END ; (* NEWPAGE *)
BEGIN (* CLEAR *)
      WITH USERFORMAT DO
      BEGIN
          IF (CURRENTLINE + SPACING) >= (LINES - 2)
          THEN
          BEGIN
               LINESLEFT := LINES - CURRENTLINE ;
               FOR I := 1 TO LINESLEFT DO WRITELN (OUTFILE) ;
               NEWPAGE (CURRENTLINE)
          END ;
          FLUSH (OUTBUFFER)
      END (*WITH*)
END ; (* CLEAR *)

BEGIN (* TEXTFORMAT *)

      USERFORMAT := STANDARD ;
      WITH USERFORMAT DO
      BEGIN
          CURRENTLINE := 1 ;
          EMPTYINBUFFER := TRUE ;
          EMPTYOUTBUFFER := TRUE ;
          WHILE NOT EOF (INFILE) DO
          BEGIN
              FREADLN (INFILE, INBUFFER) ;
              EMPTYINBUFFER := LENGTH(INBUFFER)=0 ;
              IF COMMAND
              THEN OBEY (INBUFFER, OUTBUFFER, EMPTYINBUFFER, EMPTYOUTBUFFER,
                         USERFORMAT) ;
              WHILE NOT EMPTYINBUFFER DO
              BEGIN
                   IF FILL OR EMPTYOUTBUFFER
                   THEN FILLOUT(INBUFFER, OUTBUFFER,EMPTYINBUFFER,
                             EMPTYOUTBUFFER) ;
                       IF NOT EMPTYOUTBUFFER AND ((NOT EMPTYINBUFFER)
                                               OR EOF(INFILE) OR NOT FILL)
                   THEN
                   BEGIN
                       IF EOF(INFILE) AND EMPTYINBUFFER THEN JUSTIFY:=FALSE;
                       IF JUSTIFY THEN ADJUST (OUTBUFFER) ;
                       CLEAR (OUTFILE, OUTBUFFER, EMPTYOUTBUFFER)
                   END
              END
          END ;
          WRITELN ('FORMATTING COMPLETED')
      END (* WITH *)
END ; (* TEXTFORMAT *)


BEGIN   (* MAIN PROGRAM *)
      STANFORMAT (STANDARD) ;
      REPEAT
           WRITE ('FILENAME OR E TO EXIT -> ') ;
           READLN (INFILENAME) ;
           IF INFILENAME <> 'E'
           THEN
           BEGIN
               RESET (INFILE, INFILENAME) ;
               WRITE ('NEW FILE NAME -> ') ;
               READLN (OUTFILENAME) ;
               REWRITE (OUTFILE, OUTFILENAME) ;
               TEXTFORMAT ;
               CLOSE (INFILE, LOCK) ;     (* UCSD  ONLY *)
               CLOSE (OUTFILE, LOCK) ;     (* UCSD ONLY *)
           END
        UNTIL INFILENAME = 'E'
END.
```

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.

MAGIC 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.

London Computer Store offer a

hardware maintenance contract at 12% of the initial outlay and will replace any disc which corrupts.

Other systems known but not evaluated:

Memec Systems Ltd.	084 421 5471
Intereurope Software Design Ltd	0734 786644
Commodore	01-388 5702
Databank Software Services	0509 217671
A. J. Harding	0424 220391
T. & V. Johnson Microcomputers	0276 62506
Optronics	01-892 8455
Stage One Computers	0202 23570
H. B. Computers Ltd.	0536 83922
Algobel Computers Ltd.	021 233 2407
Interface Software Ltd.	0276 25247
Micromedia (Systems) Ltd.	0633 63310
Katanna Management Services Ltd.	0245 76127
Sail	01-359 2818
Liveport (Exidy Sorcerer Firmware)	0736 798157

PROGRAMS

Submitting programs to PCW

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 how 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.
5,10,10,10,10,10 shows the cross over distortion dreaded by all hi-fi amplifier designers.

```
5 REM ** Sine Waves - By A.Tiplady **
10 PRINT"■";
20 PRINT"F1,F2,F3,F4,F5,F6"
30 INPUT F1,F2,F3,F4,F5,F6
40 FOR Y=0 TO 20:PRINT"| ":NEXT
50 PRINT"■"
60 PRINT"↓↓↓↓↓↓↓↓↓↓↓↓————————————————————————————————"
70 FOR J=0 TO 79
80 A=SIN(J*F1*π/180):B=SIN(J*F2*π/180)
90 C=SIN(J*F3*π/180):D=SIN(J*F4*π/180)
100 E=SIN(J*F5*π/180):B=SIN(J*F6*π/180)
110 SET J,10*(A+B/3+C/5+D/7+E/9+F/11)+22.5
120 NEXT J
130 PRINT"↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓"
140 A$="":GET A$:IF A$="" GOTO140
150 GOTO 10
```

Listing courtesy of Sharp Electronics (UK) Ltd

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 move up or to the right. Use the space bar to double your speed.

```
1 REM  ******************************
2 REM  ****     DODGEMS    2.4     ****
3 REM  **** NICK BERRY 1979/80    ****
4 REM  ******************************
5 SC=50:SA=1:FORLL=1TO16:PRINT:NEXT
9 INPUT"SKILL LEVEL 1 (EASY) OR 2 (NOT EASY)";U:U=U-1
10 F=1:Y=1:E=54180:C=53260
20 V=1:L=1:M=1:I=E:POKE530,1
99 REM BOARD SHAPE
100 DATA000000000000000000000000
105 DATA002222222222222222222222
110 DATA002200000000000000000003
115 DATA002200222222222222222222
120 DATA0022002200000000000Q0003
125 DATA002200220022222222222222
130 DATA002200220022000000000000
135 DATA002233223322003333333333
179 REM POKE BOARD
180 IFSATHENFORLL=53248TO54283:POKELL,187:NEXT
185 SA=0
299 D=C
300 FORA=1TO8:READA$
310 FORB=1TO24:IFMID$(A$,B,1)="1"THENPOKED,187
312 IFMID$(A$,B,1)="2"THENPOKED,213
313 IFMID$(A$,B,1)="3"THENPOKED,96
315 D=D+1:NEXT:FORB=24TO1STEP-1
316 IFMID$(A$,B,1)="1"THENPOKED,187
317 IFMID$(A$,B,1)="2"THENPOKED,213
318 IFMID$(A$,B,1)="3"THENPOKED,96
320 D=D+1:NEXT:D=D+16:NEXT:RESTORE
330 D=C+1007
340 FORA=1TO8:READA$
350 FORB=1TO24:IFMID$(A$,B,1)="1"THENPOKED,187
360 IFMID$(A$,B,1)="2"THENPOKED,213
361 IFMID$(A$,B,1)="3"THENPOKED,96
370 D=D-1:NEXT:FORB=24TO1STEP-1
380 IFMID$(A$,B,1)="1"THENPOKED,187
390 IFMID$(A$,B,1)="2"THENPOKED,213
391 IFMID$(A$,B,1)="3"THENPOKED,96
400 D=D-1:NEXT:D=D-16:NEXT:RESTORE
450 S=53724:POKES,83:POKES+1,99:POKES+2,111
460 POKES+3,114:POKES+4,101
499 REM BEACON SUB-ROUTINE
500 Z=INT(RND(8)*512+.5)*2+53248
510 IFPEEK(Z)=32THENPOKEZ,9:POKEZ+1,9
520 GOTO1005
799 REM JUMP ROUTINE--HORIZONTAL
800 IFUANDRND(8)>.1THENYY=I:GOTO830
805 K=E:K=K+INT(RND(7)*4+.5)*4-8
810 IFK<53783ANDK>53773ORK<53754ANDK>53744THENE=K:GOTO1095
820 GOTO1095
830 IFE>53760THEN880
840 IFY=1THENI=53752
850 IFY=2THENI=53748
860 IFY=3THENI=53744
870 E=I:I=YY:GOTO1095
880 IFY=1THENI=53774
885 IFY=2THENI=53778
890 IFY=3THENI=53782
895 E=I:I=YY:GOTO1095
899 REM JUMP ROUTINE--VERTICAL
900 IFUANDRND(8)>.1THENYY=I:GOTO930
905 K=E:K=K+(INT(RND(8)*2+.5)-1)*128
910 IFK<54181ANDK>53923ORK<53605ANDK>53347THENE=K:GOTO1095
920 GOTO1095
930 IFE>53780THEN980
940 IFY=1THENI=53348
950 IFY=2THENI=53476
960 IFY=3THENI=53604
970 E=I:I=YY:GOTO1095
980 IFY=1THENI=54180
985 IFY=2THENI=54052
990 IFY=3THENI=53924
995 E=I:I=YY:GOTO1095
999 REM MOVE ROBOT
1005 H=E
1006 AF=AF+1:IFAF=5THENGOSUB2029:AF=0
1020 IFL=1ANDPEEK(E-2)<>187THENE=E-2:GOTO1090
1030 IFL=2ANDPEEK(E-64)<>187THENE=E-64:GOTO1090
1040 IFL=3ANDPEEK(E+2)<>187THENE=E+2:GOTO1090
1050 IFL=4ANDPEEK(E+64)<>187THENE=E+64:GOTO1090
1060 L=L+1:IFL=5THENL=1
```

```
1065 NN=NN+1:IFNN=20THENV=0
1070 GOTO1005
1090 IFE=53774ORE=53778ORE=53782THEN800
1091 IFE=53752ORE=53748ORE=53744THEN800
1092 IFE=53924ORE=54052ORE=54180THEN900
1093 IFE=53348ORE=53476ORE=53604THEN900
1095 O1=PEEK(E):POKEH,O:POKEH+1,O:POKEE,4:POKEE+1,4
1096 O=O1
1100 POKE57088,253:IFPEEK(57088)()239ANDNTHENN=0:GOTO1005
1110 N=1:J=I
1120 IFM=1ANDPEEK(I+2)()187THENI=I+2:GOTO1150
1130 IFM=2ANDPEEK(I-64)()187THENI=I-64:GOTO1150
1140 IFM=3ANDPEEK(I-2)()187THENI=I-2:GOTO1150
1145 IFM=4ANDPEEK(I+64)()187THENI=I+64:GOTO1150
1146 M=M+1:IFM=5THENM=1:SC=SC+10
1147 GOTO1110
1150 IFPEEK(I-1)=4ORPEEK(I)=4ORPEEK(I+3)=4THEN2000
1151 IFPEEK(I+64)=4ORPEEK(I-64)=4THEN2000
1152 POKE57088,127:IFPEEK(57088)=127THEN3000
1153 IFPEEK(57088)=191THEN3500
1154 IFPEEK(I)=213THENSC=SC+10
1155 IFPEEK(I)=9THENSC=SC+200:FORLL=1TO2000:NEXT
1156 POKEJ,32:POKEJ+1,32:POKEI,3:POKEI+1,3
1160 IFRND(8)).95THEN500
1170 GOTO1005
1999 REM POKE SCORE ETC.
2000 POKEI,42:POKEI+1,42
2005 SC=SC-100
2025 GOTO2060
2029 S=53732
2030 SC$=RIGHT$(STR$(SC),LEN(STR$(SC))-1)
2040 FORA=1TOLEN(SC$):POKES+A,ASC(MID$(SC$,A,1))
2050 NEXT:S=53788
2055 RETURN
2060 IFVTHEN10
2065 S=53788
2070 IFSC)3000THEN2200
2080 POKES,71:POKES+1,65:POKES+2,77:POKES+3,69
2090 POKES+5,76:POKES+6,79:POKES+7,83:POKES+8,84
2099 REM IF LOSE,END.IF NOT OFFER ANOTHER GO
2100 FORLL=1TO10000:NEXT:FORLL=1TO16:PRINT:NEXT:END
2200 POKES,89:POKES+1,79:POKES+2,85:POKES+4,87
2210 POKES+5,73:POKES+6,78
2220 FORLL=1TO10000:NEXT:INPUT"ANOTHER GO ";A$
2230 IFLEFT$(A$,1)="Y"THENRUN
2240 POKE530,0:END
2999 REM ROUTINE TO DETERMINE WHICH TRACK YOU'RE ON
3000 IFI=53348ORI=53476ORI=53924ORI=54052THENI=I+128
3010 IFI=53778ORI=53782ORI=53752ORI=53748THENI=I-4
3020 IFI=53774ORI=54180THENY=1
3030 IFI=53778ORI=54052ORI=53748ORI=53476THENY=2
3040 IFI=53604ORI=53744THENY=3
3050 GOTO1155
3500 IFI=53476ORI=53604ORI=54052ORI=54180THENI=I-128
3510 IFI=53774ORI=53778ORI=53744ORI=53748THENI=I+4
3520 IFI=53348ORI=53752THENY=1
3530 IFI=53778ORI=54052ORI=53748ORI=53476THENY=2
3540 IFI=53782ORI=53924THENY=3
3550 GOTO1155
```

Listing courtesy of Comp Shop.

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 6K of memory and runs on a TRS80 level II.

```
10 CLS:PRINT:PRINT:PRINT:PRINTCHR$(23)
20 PRINT"        FOX AND HOUNDS
30 PRINT:PRINT"   LIKE INSTRUCTIONS (Y/N
)":GOTO 40
40 A$=INKEY$:IFA$=""THEN 40 ELSEIFA$="Y"
GOSUB 880
50 DIML(9,9)
60 Z=0:CLS:PRINTCHR$(23)
70 FORC=1TO8STEP2
80 L(1,C)=1:L(1,C+1)=2:NEXTC
90 FORC=1TO8STEP2
100 L(2,C)=4:L(2,C+1)=1
110 L(3,C+1)=4:L(3,C)=1
120 L(4,C)=4:L(4,C+1)=1
```

```
130 L(5,C)=1:L(5,C+1)=4
140 L(6,C)=4:L(6,C+1)=1
150 L(7,C)=1:L(7,C+1)=4
160 L(8,C)=4:L(8,C+1)=1:NEXTC
170 L(8,5)=3:X=8:Y=5:A=X:B=Y
180 GOSUB 820
190 PRINT@14,"C O L U M N
200 PRINT"      1 2 3 4 5 6 7 8"
210 PRINT"      "+STRING$(16,176)
220 FORL=1TO8:PRINT"R"L;+CHR$(170);
230 FORC=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 NEXTC
290 PRINTCHR$(149)+" R";L:NEXTL
300 PRINT"      "+STRING$(16,131)
310 PRINT"      1 2 3 4 5 6 7 8
320 IFX=1THEN 790
330 IFZ=1THEN 770
340 PRINT@832," YOUR MOVE - ROW? COLUMN?
";
350 GOSUB 1110 :FORI=1TO300:NEXT
360 PRINT"  - TO ?";:GOSUB 1150 :FORI=1T
O300:NEXT
370 IFT<FPRINT"YOU CANNOT MOVE    BACKWA
RD";
380 IFT<FGOTO 340
390 IFT-F<>1GOTO 420
400 IFL(F,F1)<>2GOTO 420
410 IFL(T,T1)=4ANDL(F,F1)=2GOTO 440
420 PRINT"INVALID MOVE"+CHR$(31);
430 GOTO 340
440 L(T,T1)=2:L(F,F1)=4:Q=0
450 K=INT(RND(0)*2)
460 IFK>2THEN 450
470 IFK=1THEN 490
480 IFK=0THEN 550
490 Q=Q+1:X=A-1:Y=B-1
500 IFL(X,Y)=4THENL(X,Y)=3
510 IFL(X,Y)<>3ANDQ<>2THEN 550
520 IFL(X,Y)<>3ANDQ=2GOTO 610
530 IFL(X,Y)=3THENL(X+1,Y+1)=4
540 IFL(X,Y)=3THEN 180
550 X=A-1:Y=B+1:Q=Q+1
560 IFL(X,Y)=4THENL(X,Y)=3
570 IFL(X,Y)<>3ANDQ<2THEN 490
580 IFL(X,Y)<>3ANDQ=2THEN 610
590 IFL(X,Y)=3THENL(X+1,Y-1)=4
600 IFL(X,Y)=3THEN 180
610 IFK=0THEN 630
620 IFK=1THEN 700
630 Q=Q+1:X=A+1:Y=B+1
640 IFL(X,Y)=4THENL(X,Y)-3
650 IFL(X,Y)<>3ANDQ<4THEN 700
660 IFL(X,Y)=3THENL(X-1,Y-1)=4
670 IFL(X,Y)=3THEN 180
680 IFL(X,Y)<>3THENZ=1
690 GOTO 180
700 Y=B-1:X=A+1:Q=Q+1
710 IFL(X,Y)=4THENL(X,Y)=3
720 IFL(X,Y)<>3ANDQ<4THEN 630
730 IFL(X,Y)=3THENL(X-1,Y+1)=4
740 IFL(X,Y)=3THEN 180
750 IFL(X,Y)<>3THENZ=1
760 GOTO 180
770 PRINT"YOU WIN -LIKE ANOTHER GAME (Y/
N)";
780 GOTO 800
790 PRINT"I WIN - LIKE TO TRY AGAIN (Y/N
)":GOTO 800
800 A$=INKEY$:IFA$=""THEN 800 ELSEIFA$="
Y"THEN 60
810 END
820 IFA=XTHEN 870
830 IFZ=1CLS:PRINTCHR$(23):PRINT"      I
 CAN'T MOVE
840 IFZ=1THEN 870
850 CLS:PRINTCHR$(23):PRINT@060,"I MOVED
 FROM ";A;"";B;"TO ";X;"";Y;
860 A=X:B=Y:FORI=1TO900:NEXT
870 RETURN
880 CLS:PRINTCHR$(23):PRINT:PRINT"YOU AR
E THE HOUNDS
890 PRINT"YOU HAVE FOUR PLAYERS (H)
900 PRINT"YOU MAY ONLY MOVE FORWARD.
910 PRINT:PRINT"THE COMPUTER IS THE FOX
(F)
920 PRINT"AND MOVES FORWARD OR BACKWARD.
930 PRINT:PRINT"IF YOU TRAP THE FOX. YOU
 WIN
940 PRINT"IF THE FOX GETS TO ROW 1,
950 PRINT"THE COMPUTER WINS":PRINT
```

PROGRAMS

```
960 INPUT"PRESS ENTER TO CONTINUE";A$
970 CLS:PRINTCHR$(23)
980 PRINT"WHEN IT IS YOUR TURN,
990 PRINT"TYPE IN THE ROW NUMBER
1000 PRINT"AND COLUMN NUMBER OF
1010 PRINT"THE MAN TO BE MOVED
1020 PRINT:PRINT"THEN WHEN ASKED - TO ?
1030 PRINT"TYPE IN ROW NUMBER AND
1040 PRINT"COLUMN NUMBER TO WHICH
1050 PRINT"YOU ARE MOVING.
1060 PRINT"ONLY THE BLACK SQUARES
1070 PRINT"MAY BE USED.
1080 PRINT"   GOOD LUCK !!!
1090 PRINT:INPUT"PRESS ENTER TO CONTINUE
";A$
1100 CLS:PRINTCHR$(23):RETURN
1110 A$=INKEY$:IFA$=""THEN 1110
1120 F=VAL(A$):PRINTF;",";
1130 B$=INKEY$:IFB$=""THEN 1130
1140 F1=VAL(B$):PRINTF1;:RETURN
1150 A$=INKEY$:IFA$=""THEN 1150
1160 T=VAL(A$):PRINTT;",";
1170 B$=INKEY$:IFB$=""THEN 1170
1180 T1=VAL(B$):PRINTT1;:RETURN
```

LEISURE LINES

With J. J. Clessa

The problem set in February Leisure Lines was to find the smallest square 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 Puzzle No. 8, Personal Computer World, 14 Rathbone, Place, London W1P 1DE. All solutions must arrive by April 14th latest.

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!).

BLUDNERS

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. IC 11: Labels A0 - A7 should read Y0 - Y7 and vice versa.

March 1980. Correct Macronoia as follows:
Equations box
Line 6: remove one of the "+.35"s.
Line 3: replace (E(t)/2 with (E(t−1)/2.
Line 13: replace the first / with a —.
Last line: replace 1460 with 7740 and add xP1(t) at the end.

Program listing
Line 420: change the GOTO to 400.
Line 430: renumber as 435.
Line 465: renumber to 430.
Line 860: add :K8=Y(J).
Lines 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";A$

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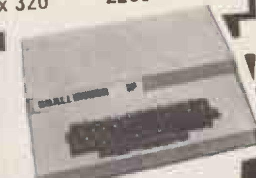

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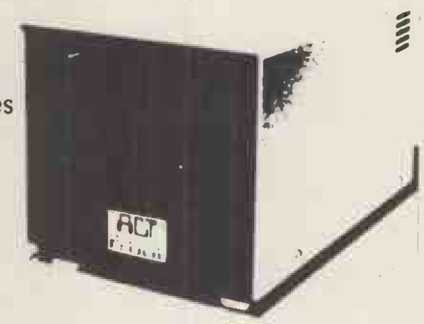

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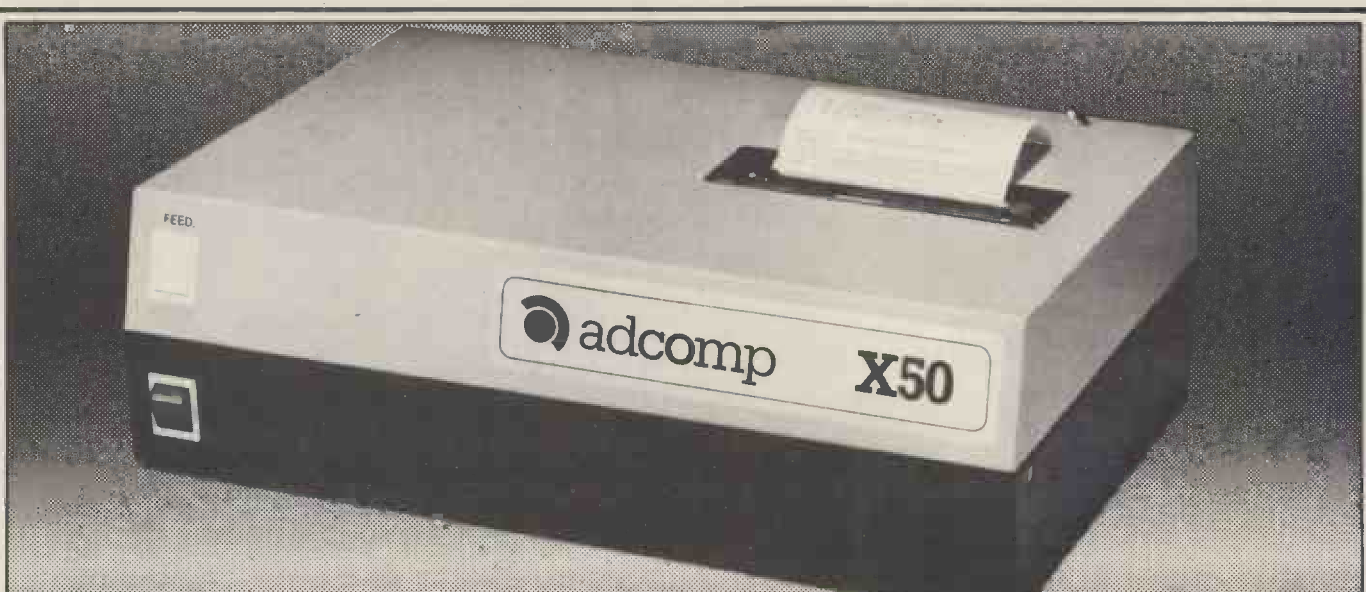

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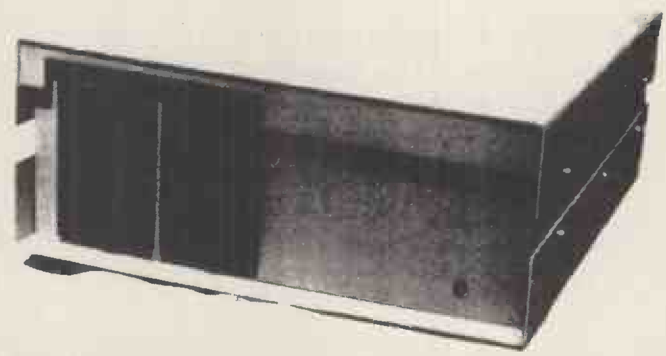

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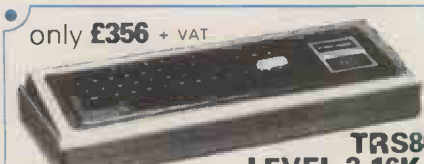

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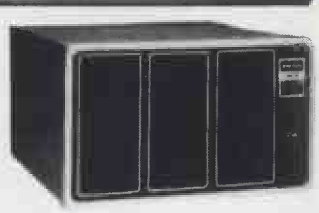

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