GATEWAYS TO LOGIC
Britain's first step-by-step guide to teaching microcomputing
The best computers PLUS the best service

At MicroCentre, we're concentrating our resources on what we genuinely believe are the very best computers available today. ... Cromemco computers, naturally. This way we can offer you the best deal possible.

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What we don't do is spread our expertise thinly amongst umpteen different systems, or try to stock every S100 product on the market. We don't claim to offer "impartial" advice on the best buy. And we don't sell from price lists or catalogues.

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Some micro-computer suppliers work like that, but we don't. Because we realise that when you're buying a computer you want more than the "brochures and boxes" approach. You want to see computers running, to try them out with different software products; to study the documentation; above all, you want expert answers to your most searching questions.

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That's why we've specialised in Cromemco systems. Not simply because we think Cromemco systems are the best serious computers available at the price. But because by doing so we can dedicate our time, energy and resources to giving you the highest standard of Cromemco support possible.

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Tel. 031-556 7354

MicroCentre

Complete Micro Systems Ltd., 30 Dundas Street, Edinburgh EH3 6JN
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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 are 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 present a balanced viewpoint.

Finally, before submitting an article, please check it through thoroughly for legibility and accuracy.
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PCW 2
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CP/M version 2 (not all formats available immediately)

MIP 

PC/M - $150

MAC - (88x) Macro Assembler. Full Intel macro definition. Programs include DITF, IRP, REPT, TITLE, PAGE, and MACLIB. 2.80 library included. Produced Intel absolute hex. Symbols are for use by SBD test below. $55.00

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PCW 6
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<td>Sumlock Electronic Services Ltd., Manchester</td>
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* BASIC execution speeds for 2MHz conversion, derived from comparisons of the Challenger series BASIC with other systems in PCW's Benchmarks. UK101, Pet, Apple and TRS80 are all registered trademarks, of CompShop, Commodore Business Machines, Apple Corporation and Tandy Corporation respectively.

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At last a printer that matches the unique flexibility of Ohio Scientific's small computers. The Base-2 800 MST is compact but amazingly versatile and at an almost incredible price:

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<td>4K on-board RAM expansion</td>
<td>£255</td>
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<tr>
<td>2MHz, 32x48 display</td>
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<tr>
<td>Standard C1 4K RAM, 1MHz, 25x25 display</td>
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Every function in the Base-2 is software controlled and available to the user within programs. The only switches on the front and back panels are manual over-riders or start-up conditions — after start-up, everything can be controlled from your program. Everything is programmable — even the character set!

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<td>First Book of OSI</td>
<td>£6.50</td>
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<tr>
<td>C1 Technical Guide</td>
<td>£4.95</td>
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- Four flat adjustments for taxable lump-sum payments that vary from week to week or from month to month.

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memory chips – special purpose chips – bit slicing - new systems architecture – Motorola 6809 – Intel 8086 – Zilog Z8000 – 16 bit micros

Storage Systems
diskettes – single/double density – single/double sided – hard disks – 8" Winchester technology – fixed/changeable – costs and reliability

Communications
modem technology – PO facilities – data link controls – high level protocols – local area networks – Prestel – personal computer networks

Systems Review
survey of micro systems – Texas Instruments TI 99/4 – Apple III – Triumph Adler Alphatronic Sinclair ZX80 – other new releases

Technology Stream II

Monitors and Operating Systems
CP/M– MP/M– low level monitors – multi-testing – multi-user operating systems – utility programs

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Thunder clouds

"This proposed rip-off of my ZX80... Uncle Clive began pre-emptively, "...if it is based on my software, I will sue with the full force of the law."

Somebody with £100 to spend could not have bought a usable computer six months ago. In six months time, she or he will be able to choose from two or three; extend that price range to £150 and the number to select from will possibly double.

We owe it all to Uncle Clive Sinclair... and now people are imitating him. The first hint I had of the imitations, I dismissed as bravado from Kerr Borland, unreliable, I mean that he was behind the well-known 'nearly copy' of the Ohio Superboard, the UK 101, and anyway he is the only known operator with the chutzpah to try to undercut Sinclair on the ZX80 price. Against that, he says it ain't him, Guy, and Kerr Borland (of Product Launch) says it's "some people in Cambridge."

Chris Cary also adds the unreliable suggestion that a second imitation of the ZX80 is being planned. By unreliable, I mean it's being considered, he doesn't know if the idea will be followed through. "But somebody has approached me for prices on a list of components which would fit exactly into an imitation ZX80, and there aren't many other things you can build with those chips, in that volume," he pointed out. Sit back and enjoy the fun, folks.

Pascalising PET

The fact that PCW is not written in French doesn't mean that French isn't quite a nice language (in its way). Rather, it reflects the fact that most of the Frenchmen in England who want to read about computers can manage in English.

The fact that there is going to be a version of the programming language Pascal for the PET microcomputers does not prove that Pascal is much more than quite a nice language; instead, it indicates that there are a lot of people who have learned Pascal, and find that the PET's memory limit of 32 kbytes prevents them from using their skill.

Getting a Pascal compiler into PET isn't just a question of writing a program which will run on the Pet and translate Pascal instructions into strings of 6502 code. There's also the small problem of getting the program to fit inside 32 kbytes, leaving enough room for it to write the 6502 code it generates.
Push out the boat

The Software Supermarket, as program distributor Lifeboat calls one of its manifestations, has followed the good practice of other super-markets, and is selling magazines at the checkout. Like the magazines that you will find at the Safeway checkout, this one, called Lifelines, is not unconnected with the business: "Each month," says Lifeboat very candidly, "there will be a table listing the array of serious CP/M compatible software products distributed by Lifeboat Associates." It's a catalogue, in fact. This publication - costs £1.80 for twelve issues in North America, £4.00 elsewhere, and £2.50 for a single copy.

There's nothing wrong in selling one's catalogue, or in making it look as interesting as possible. Call it a newsletter when it's a catalogue, however, is pushing credibility a bit harder than the buffers will stand. Calling this the 'official organ of the CP/M users group' doesn't excuse it. The only real useful information is contained in a section called BUGS - errors and fixes in Lifeboat supplied software. In my version of business ethics, you notify your customers of faults in your products at your own expense, by making them pay for your advertising. The faults, after all, shouldn't be there in the first place.

Enter superPET

Here - at last - is the new 80-column PET. Despite Commodore UK's secretive attitude (the machine was launched and unreleased by the British press was banned from even seeing it until the official launch on 14 June) we managed to prise the following details from their reluctant grasp: the green screen is a bit narrower, 15 inches instead of nine and the keyboard has been lowered to keep the overall height increase down to one inch. As you can see from looking at the keyboard, the machine is very business-oriented: new features include repeat, tab and ESC keys with auto-repeat on the cursor controls. The 25 x 80 screen can be scrolled up or down and there are facilities for inserting and deleting lines and for defining 'windows' on the screen. The machine, officially known as the 8032, has an 18k Basic in ROM which includes disk operators.

Retail price for the SuperPET (as we'll call it) is £895 excluding V.A.T. Look out for a full Benchtest in PCW soon.

Counting on apple

Putting a Basic interpreter program into a computer effectively turns that computer into a calculator — provided you don't mind hunting around a typewriter keyboard for the signs for +, -, *, and /, not to mention the numbers, all along the top line, and the decimal point somewhere else.

On the Apple, Personal Computers has thoughtfully provided a Multi Function Numeric Keypad, which has the ten numeric keys, plus eight of the necessary function keys. Somewhat puzzlingly though, the pad includes two cursor control keys instead of a multiply and decimal point. The keypad plugs into any available expansion slot in the Apple II, and the subroutines that control it are contained in read-only memory on the module itself.

It costs £125 - not cheap for a calculator, but then neither is an Apple II cheap for a calculator, and you pay for convenience, not economy. Details: 01-626 8121.

Success

There are something like 15,000 floppy disk drives used for storing UK computer data, supplied exclusively by one firm, CPU Computers. The manufacturer of these drives, Shugart, has decided that this represents success, and that the 60% of the UK market which it represents in this was justifies a renewal of the CPU agreement with Shugart, until 1982.

Improved filing

Compro reports that its £170 video package, DMS1, which is used to store and retrieve information on the PET, has now sold 100 copies. This success has encouraged the company to write a second, more advanced program called (creatively) DMS2. This DMS2 provides numerical processing, and allows users to play games that were not possible on version 1. . .compressing and extending or merging files.

A PET with 32k and disks is needed. Details on Guildford (0483) 39666.

Easy conversion

Buying a program to run on a Commodore PET with diskettes is a simple process, complicated by the need to know whether the program runs on Commodore's own diskettes, or on those made by Computhink and supplied by ACT.

A program which can convert from one to the other is BBDOs, from B & B computers; details: 0204 26644.

Alien fortune

Space Invaders is a game - perhaps I should say concept - which has sold more micro-processors than anything apart from the pocket calculator. It's now selling Atari video computer systems - via a £29 cassette that offers 112 ways of battling against sneaky, evil arm-waving multi-coloured speeding up banks of invaders: it's been on the market a fortnight, and by order, planned to last six weeks, is sold out. The message for private punters is clear, don't write a Space Invaders program, because it's been very much done.

Safety first

An encouraging sign when looking at someone else's software salesroom, is the recognition that he who did not do it will instantly try to do the one thing that really must not be done. Protection against operator error is more important than ease of operation, and both are more important than sophistication of function: by which you should understand that a program which pays tax and calculates redundancy is of less value than a simple tax payer which makes sure that you aren't accidentally pressing the comma instead of the full stop, or the full stop instead of the comma.

Programs supplied include the unusual idea of a vehicle profitability package for car fleets or companies, and one for vehicle hire bookings. There is also a payroll (natural) calculator that is designed for use on a micro with big diskettes and plenty of internal storage.

Down and down

One of the more fairy-tale aspects of this business is the way in which price tumble. Latest price cuts come from Sharp and Commodore. Sharp have officially announced a new pricing structure for the MZ-80K series, while trade sources confidently expect Commodore to follow suit. Sharp have supplied their new price list while my confident trade source has leaked Commodore's. First of all, Sharp's are £480 for the 20k model, £529 for the 32k, £549 for the 36k and £599 for the 48k. You must, of course, deduct 14k if you want to use Basic because it's resident in ROM. Other interesting news from Sharp is that they're about to announce an expansion interface which will allow the addition of printers, disk drives, plotters and the like. TI's expansion box costs £70, a matching twin disk drive costs £790 and a suitable printer, £517.

Privat programmers is sold out. The message for private programmers is clear, don't write a Space Invaders program, because it's been very much done.
Cabinet costs $250, and must be hierarchical. It must be amended and updated. The good news from Indiana, the data structure is becoming available, though the question that then arises is: how can one be sure that it works?

With a program like Star Trek, testing the software is merely a case of spending two or three days familiarising oneself at the terminal, trying to decide if the mistakes that are being made are yours or the computer's. With an IBM database, as with any sort of database organising software, things aren't so simple.

In the words of Alan Wood of Digitus, "Any fool can demo- trundle from one side of the cavern to the other, and as times as many pantomime actors. The phenomenon of virtual storage is one of many reasons why Zilog has decided to launch its Z8001 on a board with parity checks for the 32 kbytes of memory. To prove it, count the memory chips in the top right corner of the board. Nine, not eight. The extra one is a check bit for the eight bits in the standard byte.

Further details of this official Zilog product from 0628 3861. However if you just want a Z8001 micro on a board remember that Ithaca Intersystems has announced one using the S100 bus, which will fit into many standard personal machines. The Zilog one won't, because it's on a 'standard' double Eurocard.

Commodore cull
Possibly the most useful bit of green paper to be published recently is Commodore's list of prices — because it includes a comprehensive list of its dealers. This list may be shortened. When you get your list, make a note of the ones which don't have a star beside their name. The dealers, not the prices. As usual, Commodore itself is tactful to the point of obtrusiveness when asked for details: but it seems likely that the rumours of impeding axe-wielding on dealers are soundly based.

The stars are the dealers who can supply Commodore Business Software to do which, they must measure up to certain standards. They must be able to demonstrate, fix, and provide support for the software. Kit Spencer says that he would like all dealers to be approved to this standard.

Since some of them clearly won't make it, and since many were ad-hoc groupings of people who just wanted a cheap PET each, I'm putting my money on a PET Dealer Purging operation next year. And I think it will do more good than harm, if you want my opinion. No?

Newbear news
For people who have a Sharp MZ-80K, knowing how its internal Business Software actually work can be invaluable. Fortunately, although Sharp does not provide this information, Newbear Computing Store does.

According to someone who has seen the Newbear dissection of this software, the reason for the secrecy is probably coyness: "The code is written for an Intel 8080 in a high level language, and it's pretty robust, and it has been slightly modified to run on the faster 8086, but it certainly isn't elegant."

Newbear has also written, or re-written — the ZEN assembler and assembler package for the MZ-80K. It has been approved by Nascom and TRS-80 users in the past; it costs £19.50 plus tax, and details are on 0635 30505.

Cosmic invasion
Cosmic Raiders landed on the editorial desk this week, so to speak. Yet another version of this invasion this one should please any PET-owning addicts. It runs on any model PET and very good it is too. Unlike Apple's, for example, this one offers ten levels of skill and has a nasty 'second phase' in which individual raiders split randomly in two. Sound effects are said to be excellent.

Congratulations to D Hipkin, who wrote it and to Petafo who market it at £10.00.

PETstore addition
Commodore approved software is now available mail order, through a new PET dealer, Audiogenic.

The company has now started selling hardware, too: it's announced a £15 switch which allows the user to survive a 'crash' infinitely preferable to switching off and starting again.
Audiogenic claims to be 'always in stock' because it's a tape duplicating service - it can supply a program as quickly as it can run off a copy on the duplicator. It also publishes PET information on Oracle. Details from 0734 595269.

**Newsprint**

**Zilog GT**

Zilog has announced 6 MHz versions of its Z80 and Z8000 processor chips for use in applications demanding extra speed.

The 'go-faster' Z80 is known as the Z80B to distinguish it from the Z80A (4 MHz) while the faster versions of the Z8000 will be known as the Z8001A for the 48-pin, segmented version and the Z8002A for the 40-pin, non-segmented version.

However, before you rush out to buy one to upgrade your existing system in the quest for Ultimate Speed, be warned that you'll probably have to rebuild your system's memory as well. The new processors will require high speed memory chips having an access time of 150 ns, and although these are available you'll need to take more than a little care when using them.

**Priorities**

At the time when publishing company IPC had fired all its journalists for wanting more than 17% pay rises when inflation was 22%, it sent us a press release showing that its computers get, not only air conditioned rooms to work in, but also anti-static carpets. This, says Illingworth & Company of Halifax, carpet supplier, "eliminates static charges which would otherwise interfere with the information fed into the units." Moral: be a computer, not a journalist. Details about anti-static carpet tiles on 0274 676721.

**Why disks?**

Chris Cary (again of Comp Shop fame) is incensed that people are saying that floppy disks can't be attached to his UK101 kit. They can, he says, with just a few changes, mainly to the operating software: "but the reward is out of proportion to the price: who wants to put expensive floppies on our cheap computer?" Comp has decided that diskettes are a good idea on Nascom 2: a drive with a removable drive as well, 2 dollars gets you a copy of the comprehensive catalogue I've ever seen. Advanced Computer Products Inc are responsible and inside Advanced Consumer Products catalogue I've ever seen. Engsoft catalogue I've ever seen.

**Bipolar PROM programmer**

The micro produced the EPROM. The requirement of programmers is to turn original PROMs, into 'read-only memory chip. The fact that programs always have errors led to the need for a rechargeable chip — like the soda syphon, it may be more expensive, but if you use concrete that will not shatter if the axle-loadings are put up by Government statistic. These are the questions that users of engineering software tend to ask before they will call him a man.

An exhibition of such software will be held next year in March, at Imperial College in London. It's the Second International Conference and Exhibition on Engineering Software, and if stand space is required, contact Engsoft on Southampton (0705) 21937.

**Truth will out**

In a foolish attempt to gain publicity for his journal, Richard Pavan has printed (in GREEN ink) the astonishing suggestion that people call me the Pink Panther in this business. I wish they did — it would make a pleasant change from some of the unkind names I've been given by people who believed their own publicity material more implicitly than I could. I can inform Printout readers of one interesting fact: I am speaking in the third person as the man who writes Inside Trader. Now, there's a thing.

**Good cat**

Two dollars gives you a copy of the most comprehensive catalogue I've ever seen. Advanced Computer Products Inc are responsible and inside you'll find listed (and sometimes described) components, games, single boards, personal computers, test equipment and lots more besides. Send your S2 to: Advanced Consumer Products Inc, 1310, E Edinger, Santa Ana, CA 92705, USA.

**Debating disks**

By storing data on a hard, rigid magnetic disk cartridge, designers can put a lot more data in, and do it much faster.

But normally, hard disks take up more space than floppy disks and the world is moving to mini-hard disks called mini Winchester. Enlarged, suppliers of the older cartridge disks are writing to me, insisting that their machines, like the Equinox KB10 offering 5 Mbytes of fixed disk and another 5 Mbytes of removable disk cartridge, are 'more flexible' than new unremovable Winchesters.

The argument is that since the new Winchester disks are sealed permanently into their drives, if one has an internal malfunction, all the data will be lost. If there is a removable drive as well, several copies of important data files can be made easily. This may be true. At the same time, I feel I ought to point

---

**Apollogies to Bob Dylan**

How many roads can a man walk down, before he has exhausted the capacity of Highway 1, the software program that computes the width of drainage, where to put telegraph poles if the corner is tight, and the angle the slip-road must join at, every five yards? And can he display the depth of

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

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

Commodore Courses

Commodore offer a range of residential training courses and one day seminars. An excellent start. And when you have installed your system the PET User's Club Newsletter can keep you informed of new ideas and later developments.
out that no mini-Winchester system I've ever seen lacks ordinary floppy disks. There are those who say 'You can't back up hard disks with floppy.' They may be right; if they are, IBM has sold many hundreds of System/32 and System/34 minis on false pretences, because that is exactly how those machines back up their fixed disks — on floppy. Equinox is on 01-739 2387.

Six of one
All books on microcomputers are agreed on one thing: that all other books on microcomputing are hard to read. Sharing this comfortable viewpoint is Peto's 'Understanding which Julian Allason (or Daddy, as he is known in the trade) says will be 'readily comprehensible by newcomers to computing,' and adds: 'Unlike most current micro books.' Ah well. £15 plus 75p postage; or ask a PCW dealer if you can see his copy.

Well I never
Pretend that Fortran is actually part of the language Pascal. You are writing Pascal (which you also need to write bits of assembler, too) and suddenly you realise that the next section is something you can do (if that is what you want to do). Contact Microsense or Your PET/PC/C/CLear. Microsense is on Hemel Hempstead (0442) 63561.

Eh?
Complaints that the contents of an industry magazine are uninteresting rantle with me. When it comes to digital-to-analogue, however, I confess: it is unintelligible.

Specialist company Burr-Brown, that can do D/A and A/D with its eyes closed, has published a four page brochure on a recently announced CS450 programmable data acquisition system which, it says, provides a comprehensive yet easily understood explanation of the operation and configuration of the CS450. Read it. If you still don't understand, that proves it's the subject, not me.

Slow but sure
Chip-making giant Texas Instruments is now selling a range of computer boards which have what is a large memory, but here the data in the memory doesn't get scrambled if the power fails.

The drawback is that the memory is about 20 times slower than normal semiconductor chips, because it is made of magnetic 'bubble'

NEWSPRINT

The new TM990/210 bubble memory board (see 'Slow but Sure', below).

circuits — which produce the data they ask for within an average of four milliseconds.

Since bubbles are still costly compared with diskettes, however Texas says it is 'confident that the new board series will have attractions for the designer in industrial control.' Details on 0234 67446.

Start nibbling
NIBBLE is published by Micro-SPARC of Massachusetts and now you can get it here as well. F.R. Business Systems has arranged to take on UK distribution. The magazine is not only useful and fairly chunky with games, etc, it's professional and makes pleasant read. Eight issues will cost you £17.50 - Tor are at 114 Tooley Street, London SE1 1TH, phone 01-403 3211/2.

Follow that
Microprocessor design courses started at Henley Technical College on September 16 with a 500 course in System Design with Micros, lasting two weeks with one day's tuition each week from 9.30 to 5.00. There's an evening version of this course; a follow-up applications course, and a What he had in mind was a method of getting into semi-

Conductor component distribution. Normally, this lucrative business costs a fortune to break into. To distribute Motorola integrated circuits, you have to carry sufficient large volumes of a wide range of different circuits to be able to meet unexpected orders of medium volume. Initially, before the first flow of orders comes in, this means something like £200,000 worth of goods on the shelves, generating small income with tiny or non-existent margins.

It was cheaper,' Marshall recalls, 'to design a single-board computer which might sell between 500 and 500 models, than to try and market the required components directly.' When orders flow in by thousands, Marshall went to his bankers and told them how much money it would take to fulfill the orders.

Anybody who has watched their bank manager panic, at the sight of an unexplained £20 overdraft will quite readily understand that such explanations don't have the mentality to cope with companies selling 10,000 systems this year when they sold 2,000 last year. Head Office doesn't like it if you don't fill in the 'Last Year's Turnover' and 'Previous Five Years Turnover' boxes on the form.

Learning to keep up with anxious customers and dilatory suppliers without proper finance has made Nascom a lot of enemies, because many people simply slipped between the cracks.

Without finance, the research effort needed to follow up the unexpected success of Nascom 1 has fallen down. And even with the Government backed NRDC able and willing to put up £500,000 or so to support new projects, it's been safer to put money into houses than into industry.

When Nascom hit the world shortage of TTL components — the basic building blocks needed to switch memory address signals and control input and output — it found itself slipping behind its already precarious position. It needed cash to flow in, just to finance the staff it had recruited to cope with the administration problems, never mind to expand and develop; and it couldn't ship computers because it didn't have enough components.

Grovewood seem embarrassed by the about-face. When it set up the £1,000,000 deal in the first place, it wasn't keen on publicity, but it did talk about it when asked. Now the subsidiary of Eagle Star is keeping quiet — which is a real shame. If there were more lessons to be learned, then the industry needs to know what they are. Other incredulities of such soundly based British micro firms such as Rain, Acon, Research Machines and so on, becomes precarious. At the rate these companies have to grow, hiccup cannot be tolerated.

Meanwhile in the Cabinet, Ministers continue to set a good example at example employers by trying to pull out of the project to set up Inmos as a general purpose memory and micro chip builder.

Adding to the fun, Plessey imports a Norwegian bitslice microchip design, as its contribution to British excellence: GEC has the second-source option on that invention, the Intel 8080 (but has yet to build any) and Ferranti is doing a clone and fails to convince the Navy that its F100L micro is even as useable as the 8080.

If there are important lessons to be learned, then the industry is more than willing to put up £500,000 or so to support new projects, it's been safer to put money into houses than into industry.

If there are important lessons to be learned, then the industry is more than willing to put up £500,000 or so to support new projects, it's been safer to put money into houses than into industry...
If only buying a microcomputer was as simple as using one

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Alan C. Wood Digitus Limited 9 Macklin Street Covent Garden London WC2 Tel: 01-405 6761
Newbury Labs
New Brain

Production is not expected to start until August or September, but pre-production prototypes were available for inspection at the official launch at the end of April. While these were not 'together' enough to warrant a full bench test, PCW still managed to sneak one away for closer inspection.

Hardware

Made in ABS plastic, the first impression is one of ruggedness — it feels like a serious piece of equipment despite being no larger than a normal hard-back book. The keyboard uses quirky layout at standard typewriter pitch, although the keys themselves are slightly smaller than usual. Two versions of the New Brain boast an on-board display of 16 x 14 segment characters produced by vacuum fluorescent elements under green/blue perspex. This display, coupled with the fact that the machine contains rechargeable batteries, indicates easy portability... it can be used on the train, in the restaurant, in the garden, or wherever.

Model MB is designed as a mains-powered device which may be disconnected temporarily, while model MBS allows prolonged use away from the mains. The third model in the range, the M, is a mains-only machine without the on-board display.

Internal memory comprises 16k to 24k ROM and either 2k 4k static RAM or 16k dynamic. External memory may be attached via an expansion box and this will be able to take up to 3 MBytes of system ROM, up to 3 MBytes of application ROM and up to 4 M4 bytes of RAM. At the moment the Basic can only address a maximum of 40k.

Up to two cassettes drives may be attached and Newbury claims that it hasn’t yet found one that doesn’t work on this system. Full motor control is provided and the tapes whizz along at 1200 baud — albeit to Newbury’s own protocol, once again ensuring minimum compatibility with other machines. Two video interfaces are provided — one for a monitor, the other for the attachment of a UHF modulator and, through that, a domestic television. Newbury describes the modulator as “a bump in the cable.” The screens are laid out in a viewdata compatible 24 lines of 40 characters. In fact, there’s even a key marked ‘Viewdata’ so this looks extremely promising although no agreement has yet been reached with British Telecom.

Other interfaces provided are V24, analogue input and output, 8-bit latched output, 8-bit sample input, a 3-pin DIN printer socket derived from the V24 and, finally, an edge connector allowing attachment of the expansion boxes. Parallel ports, mains socket relay drivers, extra memory, IEEE devices and so on may in turn be connected through the expansion boxes. Newbury’s next main hardware project will be to develop an economic disk system and with a firm like DRI backing them I’d say they stand a better chance than most in this area.

I flicked through the manual, the rest all seemed pretty straightforward.

The machine that I managed to borrow only had the on-board display, the keyboard and the maths functions working; the rest of the systems software was still under development, putting any thorough investigation of the software right out of the question.

Potential

The New Brain is undoubtedly ideal for the classroom, both for use as a tool and for teaching the rudiments of computing. The analogue input and output facility ensures its use in the laboratory while the promised Pascal and Cobol will secure it a place in computer science courses. I’ve no doubt either that such professional people as surveyors and engineers will find themselves much attracted by its portability. At £155 I suspect that more than a few will be bought for home use, especially with the promise of interesting attachments via the expansion box. At the moment it couldn’t be described as a business machine although, who knows, with disks and suitable ROM-based application packages the New Brain may even come into its own in this area as well.

Documentation

The documentation, like so many aspects of the machine at present, is not complete. All I can say is that the preliminary draft of the Basic manual looks pretty promising - I hope they try it out on a few beginners before committing themselves to a large print run.

Conclusion

When this machine hits the market there’s every chance it will offer good value for money. Obviously so much depends on costs and performance that final judgements may have to wait until the Benchtest is carried out on the commercially available machine. All I will say for now is that it looks promising — very promising.

David Tebbutt

The one we’ve been waiting for — the new Apple III. See Yankee Doodles (opposite) for details.
Myopia may not be an incurable condition, but it sometimes seems to require radical therapy. I give you the example of Radio Shack and other manufacturers who are convinced that they have achieved the greatest hardware design. The fact that this design is different than anything else in existence is claimed to be one of the product's greatest assets, and well it may be from the standpoint of pure technological excellence. But when it comes to selling other companies and users of products that are both useful and valuable, user considerations, considerations that require a little 'letting go' on the part of manufacturers.

It is a truism that the $100 bus is the best and most refined design for micros. It's also true that, since $100 is not the proprietary design of a single company, there is more hardware and software available for it than for any other micro bus. This is not meant as a promotion for $100, but as an example of a philosophy on competition. That seems to be going on before everyone's eyes, and was misperceived by many to their detriment.

The example is that a major product which has been the result of much investment and design work can positively benefit from a cottage industry. This cannot be done for ROM-based applications, because each author would have to develop a system for the computer in question, and that costs around $25,000. Texas Instruments and Heathkit were hedging a bit on this because they originally planned to have most applications programs on ROM. They've since come out with tape and diskette systems, but the ROMs. They seem unsure of their identity and have not attracted independent software vendors, and may be in trouble. The Texas Instruments machine is definitely in trouble and TI engineers who worked on the 99/4 project have to develop their own computer because of their new computer's base.

Apple III is a CPU that's built around the 6502A with several other chips such that it executes a subset of the 6502 instructions. It also features relocatable page register, relocatable stack, an 125 kbyte address space. The basic machine comes with 196k of RAM and is expandable to 128k.

Apple III is supplied with a built-in 5 1/4-inch disk drive, and 12-inch black- and-white monitor. Apple will be offering it as a complete 'problem solving' system. The first two such configurations are expected to be offered will be a word processor and an 'information analyst'. The word processor will include a second disk drive, a printer (there are several options), and word processing software. The information analyst will come with the single drive and Visi-File III, as well as a mail list manager and Apple Business Basic.

The most impressive thing about the Apple III is its software orientation of its design. The display, which is 80 characters by 24 rows, can be selected for any of 16 combinations of foreground and background colours. The character generator is in RAM, and is loaded when the operating system starts. This means that the entire set of 128 characters and symbols can be configured in software. A lookup table defines which letter, number, or symbol will be specified as each character code in the keyboard code comes in. Thus any character set -Arabic, Greek, Japanese, Cyrillic, etc. - can be defined in software. The software definable character set is also very useful in word processing software. I saw some of the WP software under development and various type fonts were being displayed on the screen - medium, italic, boldface, etc. These, along with proportional spacing, corresponded exactly to what would appear on the printed page.

I/O is likewise very software oriented. Apple has written a large number of device drivers for most popular peripherals. When the system is configured, the user simply assigns a peripheral to a certain slot, and assigns a program to write data to it. Thus, whenever that device is called, the operating system takes care of slot and driver, the user simply says what peripheral to use.

Apple is also building in a battery-powered clock/calender that it says will run continuously for 50 years. It's said to be accurate to one millisecond, and will keep track of year, day, month and day.

One other nemesis of Apple users has been cured: the reset button has been placed on the rear edge of the keyboard, and the control key must be pressed simultaneously to reset the machine. In addition, Apple has provided an Apple II emulation software package, which when loaded into the Apple III makes it look exactly like an Apple II in terms of software and I/O. Thus, all the existing Apple II software can now be run on the Apple III.

Delivery of Apple III is scheduled to begin in late July or early August with the Information Analyst priced at about $4,400. The next will be the word processor around September, which will be priced at $5,400 to $7,800 depending on the type of printer chosen.

Technical specifications

CPU: 2 MHz 6502-based with extended addressing
Memory: 128 kbytes dynamic RAM, 4k ROM
Disks: 1 - 4 minis, 143 kbytes/disk
Screen: 40x24 b/w, 80x25 with extended addressing
Audio: Integral 2 inch speakers, one-bit square wave, 'beep'
I/O: RS232, two joy-sticks, printer output
A number of readers have commented on the delivery times for the Sinclair ZX80, which is now at a standstill due to stock shortages. We should add that since the ZX80 was first announced, the company has been unable to keep up with demand. In the early advertisements, Sinclair promised delivery within 28 days, but this has been extended to 46 days. We welcome correspondence from our readers, but please be as brief and concise as possible and include your postal address.

Address letters to: "Communications", Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Sinclair ZX80

A number of readers have contacted PCW regarding the delivery times for the Sinclair ZX80, which is certainly longer than the 28 days promised in the early advertisements. To clear the air we wrote an open letter to Clive Sinclair, which we reproduce below, with his reply. We should add that he has now been dropped from the list of Sinclair Research Ltd.

An open letter to Sinclair Research Ltd.

"We are currently receiving several enquiries per week about the delivery delays on the ZX80. As a newcomer to home computing, I have been reading PCW for some months to pick up some background information. I was pleased to read your Benchtest of the ZX80 which will be a good first computer for me but: (a) If I buy now will I be able to replace the ROM with the new 8k ROM when it becomes available? (b) Will the present keyboard be suitable? (c) If I expand the memory with 3k static RAM could this be used later with the dynamic RAM when introduced?"

C H Underhill, Kenilworth, Warks.

Sinclair Research tells us that (a) the intention is to make a new ROM a direct replacement for the old, (b) the keyboard will probably have a SIR (or similar) connection and (c) the dynamic RAM will replace the static RAM.

Q&A

I have just read my second copy of PCW and hope that you can answer a few questions:

1. Could you print listings of your Benchmark programs, as without these the timings are somewhat meaningless?
   2. I am buying a UK101 soon; could you recommend a good primer on 6502 machine code programming and a supplier for this book?
   3. PCW is obviously the best computing magazine on the market, why isn't it only one?
   4. What nationality is the operator in normal use.

O C R, etc. were mentioned and its cost was under $200. I decided to build this myself, as my first shock: nowhere could I find a 32 x 32 (or similar) solid state imaging device for less than 10% of the range of less than a few hundred pounds, I don't need a complete camera and interface! Does anyone know of a supplier of a suitable chip (I tried Fairchild, Rockwell and IP) at a 'hooby-bit' price, or does anyone import the US device at a decent price?

Sinclair ZX80

We know of no UK company which imports these devices and they are only available to them if we'd like to hear from them. The alternatives would be to import one yourself from the States — Ed.

No hazard

I was very pleased to read the independent assessment of the model UV8 high speed EPROM eraser and would appreciate the opportunity to correct the impression about a potential electrical hazard.

The area your reviewer reported as an exposed live line is in fact the solder tag of the 20mm fuseholder and is completely inaccessible to the operator in normal use. However, I do take the point that the clearance could be improved and the orientation of the fuseholder has now been modified to provide a SIR clearance.

B. Lamb, Managing Director, Microdata Computers Ltd, Hayes.

Bearing fruit

I would like to make the following comments with regard to the Computer Answers in the April issue of American Purchase of Apple II:

1. Apple say that one needs to change more than just the power supply. They say that the crystal needs to be changed plus also resoldering the "user jumpers" on the keyboard board.
2. Eurocolour cards are available in the UK.
3. Neither US nor UK Apples come with a modulator; it is a separate item. One bought in the UK will be OK.

Incidentally a modulator is not required with the current colour card.

4. If you really want to be clever try ordering an Apple with a dual-voltage power supply (it will still not have the other mods). This requires at least two months advanced preparation.
5. Negotiate your price, especially in New York.

If you have paid £110 for an ITT power supply it's better not to bother — buy your Apple here. Don't forget that there is a sales tax in New York to be added to the quoted price.

K Leach, Twickenham, Middlesex.

Mike Dennis replies:

1. I agree with Mr Leach. However, there is so much range on the line and field hold controls of some TV sets that these mods are not always necessary.
2. There have been different 'Eurocolour' cards around but I have yet to see one where the setup is as complete as with the ATX-08.
3. I agree with Mr Leach as far as vision is concerned a US modulator will work fine with an Apple in this country. I am not sure what you mean by “not required with the current colour card”.

There must be a modulator somewhere. I assume that you mean on the colour card itself in which case, I agree that you don't need another modulator. However, the only decent colour that I have seen with the Apple is with a direct RGB feed to a colour monitor.

4. No comment!
5. Agreed.
6. You can get ITT power supplies for less than £110 now. I do believe that if you cut the red tape, then it is possible to get a refund of the Sales Tax from Customs when you leave the country.

 However, I believe that there is some form that you have to get from the shop where you bought it — I suggest that you ask the US Embassy.

Primary probe

We are starting work on a project designed to evaluate the use of microcomputers and the current software in primary schools in the area around this college.

The project has been funded in part by the Department of Industry, and to
May the Forth be with you

On the ever intriguing subject of computer languages I was delighted to see references to Forth being made by John Yale and Sheridan Williams. Your readers may be interested in the Forth Interest Group (fig), a worldwide organisation of Forth fanciers, which has produced implementations of Forth for many MPUs. These implementations have been designed at two levels. Experienced Forth system programmers have produced a model glossary of terms, which serves as an outline implementation guide for any micro. Programmers familiar with specific MPUs have then coded implementations of the figForth Model in the assembler language of their respective machines. A general information handout on Forth, details of fig activities in the UK, and figForth implementor listings for the 6802 and 6800 are available from Bill Powell, 16 Van- tors Road, Sawbridgeworth, Herts.

I have been using a circuit published in Backgammon Beef below, in which using and implementing Forth will be major topics. Bill Stoddart, Department of Science, Willeton College of Technology, London.

Backgammon beef

With reference to my Backgammon program (May PCW), the weights (lines 80-100) can be adjusted to give different game. At the moment PET plays in my own rather reckless manner (I usually lose!) and changing the weights will cause it to play in a different style.

Each move is evaluated by subroutine 3000 and the 'best' chosen — the weights place different emphasis on the various aspects of each move as shown in the list below: Increasing W(7) will cause PET to move its back pieces earlier and adopt 'running' tactics. Increasing W(8) will make it more aggressive and look for hits. Making W(1) more negative will make PET less keen on leaving blanks (even on the first of its two moves — not advisable) and so on.

The present weights suit the way I play and are almost certainly not the optimal ones for this program. Jeff Aughton, Birkdale, Cheshire.

PET

Not being a PET owner, I find it difficult to either interpret or implement some of the programs written for the PET, and other machines with a non-ASCII character subset, which you publish. Since I do not know the meaning or function of the specific graphic characters and reverse characters which are reproduced in the listings, it makes understanding how the screen displays work rather a hit and miss affair. I have not seen an explanatory table for these non-standard characters anywhere. — can you help?

G. Holman, Linton, W. Yorks.

We'd be glad to Mr Holman, here's the key — Ed.

[Diagram of PET graphics discussion]

Safe circuit

Several people have commented on the unusual protection circuit that I use in my computer, especially when I try out home-built boards. The same idea can be used with any power supply. It is faster than a fuse, does not form an electronic circuit breaker. Here it is for your guys.

The 5-volt rectified source is opened before it hits the regulator, and a photo-transistor (any type that can handle the current) is inserted in series. At the output of the regulator, there is a LED with a current-limiting resistance. This LED is placed alongside the phototransistor and a light-tight enclosure (black electricians tape in my case) surrounds the pair. As long as the LED glows which means that power is being applied to the circuit — the transistor conducts and all is well. However, if I make an accidental short circuit — which is common when playing around with a board — the voltage drops, the LED goes dark, and the transistor unsaturates, thus opening the circuit. The instant that the short is removed, the LED glows, and power is restored.

If your current demands exceed the phototransistor limits, then use the same circuit, except use the photo-transistor to drive a high-power transistor connected in series with the dc line.

I have been using a circuit like this for a few years now, and find that it has been a great help — especially at the cost of regulators these days. Keep in mind that some of the 5-volt regulators do have built-in short-circuit protection. I happen to use discrete regulation.

Les Solomon, New York
The last year has spawned an ever-growing number of single board computers that offer, in assorted shapes and sizes, the ability to program relatively easily in a high level language and at a reasonable price. The Acorn Atom is part of this group and its recent launch has been accompanied by some very attractive advertisements. In this first-ever Bench Test, Mike Dennis reveals all there is to see of the Atom's totally British design.

Introduction
It only seems yesterday that the original Acorn was launched and since that date many units based on Eurocard size boards have been announced by Acorn to augment the range. The Atom, however, is a departure from this philosophy in so far as it's a self-contained computer in its own right with its own expansion 'sub-set'. This ranges from the basic kit at £120 to a fully expanded Atom for £250; in other words it's designed to appeal to both wide tastes and, perhaps, not so wide pockets.

Hardware
The Atom is packed in a small poly-styrene box of quite small dimensions - 15" x 10" x 3". The keyboard is integrally mounted on a sloping front panel and sports a full complement of 60 keys; at about 7lbs the whole issue is surprisingly compact and light in weight. It's in fact quite similar to the TRS-80 in dimensions and suffers from the same drawback of needing an external power supply - something extra to cart around when you have to clear the kitchen table! The overall impression left me cold and disappointed and having seen the superlative photographs in the glossy adverts it merely confirms my opinion that photogenic really means 'looks better on film than in real life'.

The minimum connections required to the outside world are a DC supply of capacity dependent on the system configuration and, for once, a decent professional BNC video socket instead of those abhorrent phono plugs. Hopefully, the production models of the Atom will mount this socket rather more substantially than on the prototype. Program storage is on cassette and a seven-pin DIN plug is provided for that. Further expansion is facilitated by bringing out various bus lines and other signals to a 64-pin Eurocard type connector (one that's a standard feature of all Acorn products). However, before you can use this facility you have to install some additional buffer components inside (the sockets are already there) - but that's not mentioned in the sales blurb. The DC input plug is of a relatively obscure design and hopefully Acorn will supply suitable leads both for this and for the video.

The Atom is available in either a kit or an assembled version; the model I had for review was a production prototype and therefore already assembled. I can't foresee any difficulty in construction as the component density is not particularly high. Unfortunately, the assembly instructions weren't available at the time of this test.

The minimum system consists of the 8k Basic in ROM and 2k of RAM giving a cost of £120 in kit form or £150 assembled. Of the available 2k of RAM, 512 bytes are used for the screen memory and 1k for the system, leaving only 512 bytes available for programs. That's not a lot of room, but a further 10k of static RAM (2114s) can be added to the unexpanded 2k Atom giving a total on-board RAM capacity of 12k. The price of 1k of RAM from Acorn is £9.50 and so you would do well to look through the adverts to compare prices. The other point regarding this extra expansion is that it doesn't all appear to be available for program space as a contiguous block.

The memory map is a bit weird and depends on the system configuration - See Fig 1. The unexpanded 2k Atom uses the 512 bytes from 8200H to 8400H as program space but when any expansion takes place (from 2800 upwards), the Basic sniffs out this new RAM and uses that to store programs instead. This in turn releases the previously used 512 bytes at 8200H for use by the system's high resolution graphics. There are thus two main areas of RAM.

<table>
<thead>
<tr>
<th>Unexpanded</th>
<th>Expanded</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 - 0400</td>
<td>0000 - 0400</td>
</tr>
<tr>
<td>8200 - 83FF</td>
<td>2800 - 3C00</td>
</tr>
<tr>
<td>8400 - 8FFF</td>
<td>8000 - 9000</td>
</tr>
<tr>
<td>A000 - AFFF</td>
<td>A000 - AFFF</td>
</tr>
<tr>
<td>C000 - CFFF</td>
<td>C000 - CFFF</td>
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<tr>
<td>D000 - DFFF</td>
<td>D000 - DFFF</td>
</tr>
<tr>
<td>F000 - FFFF</td>
<td>F000 - FFFF</td>
</tr>
</tbody>
</table>

System RAM
Program space
Graphics space
Spare ROM space
Basic
Floating point
Operating system
in the fully expanded system, a 5k block from 2800H to 3C00H and a 6k graphics memory from 8000H to 9800H, and at first sight you can't use any of the graphics memory for program storage. However, buried in the manual is a reference to shifting the program area; changing a byte at location 18H from 2911 to 82H will start program execution at address 8200H. This is a very good method of effectively providing a pseudo-turnkey system as you can use a spare 4k slot at A000H to install a ROM with some Basic program stored in it, change the data at 1811 to A0H and run the program. There is no reason why you couldn't have several Basic programs in RAM and execute whichever one you choose merely by changing this byte. The one drawback that I see — and cannot find any easy solution to — is how to combine the two areas of memory together into one effectively continuous block for very long programs. Another fact is that the full 6k of graphics memory is required for high resolution graphics... a point that is made none too clearly in Acorn's adverts.

The existing firmware can be expanded by a 4k ROM with all the floating-point handling routines, and colour routines — again, a fact that the adverts don't make particularly clear. However, this ROM costs only an extra £20, which is good value for money. The last aspect associated with expansion is the question of the DC supply required. The Atom technical description specifies 8 V at 800 mA for an unexpanded Atom and there's an internal regulator. A fully expanded system needs +5V at 1.8 A from an external supply and, presumably, the internal regulator is not moved — the manual isn't clear.

The remaining major chips in the system are the 6502 processor, an optional 6522 VIA (Versatile Interface Adaptor) that, incidentally, is needed in order to interface a printer, an 8255 that I presume looks after the keyboard and a 6847 video display generator to handle the screen video and graphics. Any data sheet on the 6847 will indicate that all the various clever graphic modes that the Atom offers are in fact nearly all done for you by this chip. But it suffers from the disadvantage of being designed for the NTSC standard and so generates a 60 Hz field rate as opposed to our own 50 Hz. The upshot of this is that you will almost certainly have to adjust the vertical hold of your TV set. This is of no great importance if the control has sufficient range but a lot of TV sets that apparently lock satisfactorily are in fact near the limit of their range with the result that some slight vertical jitter may be visible. Also, many TV sets have this control mounted inside the cabinet and so frequent tweaking to watch 'Crossroads' is out. I would also like to have seen to what degree of success Acorn has managed to produce a decent colour picture from this chip, but unfortunately my Atom didn't have the
First ever backside view of an Atom! Note the Acorn edge connector to the right.

necessary option.

The final chip (in the review sample) was a 68B64 ADLC or Advanced Data Link Controller, it's installed in the Atom as an optional extra when the Atom is to take part in the 'Cambridge Ring'. No, this isn't East Anglia's answer to Bayreuth but a communications concept that links several computers together.

After switch on, if you follow the instructions in the manual, then you may never get a picture. Unfortu- nately there is a totally meaningless jumble that no TV set will lock on to in a month of Sundays. At a guess, I'd say that the initialisation routine of the Atom is always happening but isn't possibly as a result of a power-on reset not always working. Hitting BREAK is the answer whereupon 'ACORN ATOM', a prompt and a cursor appear on the screen. The display format, a rather weedy 32 x 16, was effectively fixed the day Acorn decided to use the 6847 VDG. The chosen character set is fairly standard and lives inside 6847, but without lower case. It also uses the square 'O' that I personally think looks wrong on the screen.

The keyboard has a number of useful features like direct cursor control and a copy key. This is extremely useful as it simplifies correction of programs; you can shift the cursor to the beginning of the errant line, press COPY and REPEAT together, whereupon the cursor will beetle along the line and effectively re-enter it into the program store. When you reach the erroneous code in the line, you simply retype it and then press COPY and REPEAT again to finish entering the line. If you've ever used the Apple then you'll know what I mean. All the keys themselves have a very silky feel to their action...a pity then on my machine that several failed to operate reliably unless given a good thump.

Another aspect of the display that's potentially quite good is the fact that all numbers are right justified with an eight digit character field. Unfortunately the 32 characters per line means that the maximum number of columns you can have in a line is limited to only four. The number of characters per field can be altered with the @ key but I found that altering it from the standard value of eight generally detracted from the overall legibility of the display. Unfortunately there is no TAB function. I found the legend on the @ key rather amusing as it appeared to have been made from two Letraset characters...

I hope Acorn are getting some engraved keys made! The other feature of the display is the fact that carriage returns hardly ever happen and 10 PRINT "123" 20 PRINT "ABC" will result in a display of "123ABC" - the first of many inconsistencies with standard Basic. Since carriage returns seem few and far between, the prompt flits about the screen and you're never quite sure exactly where it will pop up next.

Reverse or inverse video and certain double-function keys are accessed with the aid of either SHIFT LOCK or the normal SHIFT keys; however the positioning of the SHIFT LOCK key could have been improved as it was too easily to hit it when aiming for SHIFT. Since SHIFT LOCK has a toggle action, quite a few inverse characters appeared!

Program or data storage on cassette is quite versatile and I shall go into that in greater detail later on. Fairly comprehensive setting-up routines are provided to optimise the cassette recorder volume control, although the manual isn't too specific as to whether it means playback or record; actually, they do mean playback. The replay side of the Atom is insensitive as my own recorder pushes out quite a few dB of signal and should have been more than enough to drive the Atom. I found I had to drive the tape well into overload in order to get sufficient signal to load programs reliably. Acorn is not alone in this aspect and it's about time computer manufacturers who rely on cassettes for storage woke up to the fact that there's a wide range of sensitivity and output level among cassette recorders. The input side of any computer needs an adjustable high gain to cater for this and a test-tape to be supplied with each computer.

Other system commands include a comprehensive LISTing facility, albeit at a relatively slow scroll and display speed. There is no AUTO line numbering, nor RENUMBER, although a program to do this is given in the manual - a bit fiddly. One joke in the manual is section 1.7 Editing: "One powerful feature of the Atom's text and program storage is that stored lines can be modified very simply by typing the same line number followed by the new version... To delete a line, simply type in the line number followed by return..." WOW! In fact, there is no delete facility so you'll have to enter an awful lot of line numbers. That's hardly what I'd call 'powerful editing features'.

Software

The minimum system comes complete with an 8k Atom Basic -- which includes an assembler and operating system within that space. As can be seen from the memory map, it's split into two 4k blocks. Firmware expansion is, as I said earlier, a simple matter of plugging a 4k EPROM into slot D000H.

As can be seen from the Benchmarks, Acorn's claim for high speed execution is certainly met, at least when integer Basic is used. Table II shows the actual timings. A closer examination of the individual programs shows that from Benchmark 3 onwards some of the routines will cause rounding up to occur by integer Basic. The timings, when repeated using the floating point routines, were much slower and not particularly exciting. However, the most interesting fact to emerge from running these programs was my initial difficulty in getting some
... and the idea of the 1-byte chunks - all great.

member, well it can also be used to pass as a variable to a sub-
array is that the vector to each array is used in 'word arrays' and stores num-
tions in one-byte chunks - all great.

will print the E from MIKE. Apparently especially as crops up again but this
decide which is the easier to comprehend elegant way" but I leave it for you to
PRINT?A is the same as PRINT PEEK A

PRINT #8000 will print 32768 and
PRINT3&32768 will print 8000;
PRINT& #8000 will print it in hex!!

This is a very worthwhile feature of the Atom. Unfortunately, the last prefix, $A, has two different functions, depending on whether it refers to integer or floating point. That's not strictly true, because in integer you'll find it between two variables whereas in floating point it will occur before - but it is easy to get con-
fused.

That means a total of six possible prefixes before a variable, which makes program comprehension (not to mention portability) very, difficult. I'd also have thought that all these prefixes have a single meaning. Now, perhaps I'm being a bit reactionary; if I'd never heard of Basic and perhaps had been programming in 'Softo' for a long time - then someone introduced me to the Atom - well, I just might have let up and down and thought it the best thing since sliced bread. But Basic per se has been around for a long time and I use relatively uncomplicated variables (them with $s and them without). As a consequence, the Atom seems more and more like an ego trip for a Cambridge don.

Arrays are also limited to one-dimension. This time 26 arrays can be used and they are accessed by prefixing each variable with itself, i.e. AA. Multi-
dimensional arrays are out although Acorn does provide a fudge routine to get round this problem; but surely the point is that these days you shouldn't have to.

I've already mentioned the position of the $ sign in strings and other differ-
ces as well. CH"A" will print the decimal equivalent of the ASCII code for A and should not be confused with CHR$(A) in normal Basic for its real equivalent is ASC(A$). CHR$ is not provided and neither is SPC - so for-
matting tables will be a real pig.

Concatenation is $A+LEN(A)-$B and not A$+$B. Substring handling is:

$A-N equivalent to RIGHT$(A$,N)

Concatenation is $A+LEN(A)-$B and

in the manual and leave the final deci-
sion on the ease of programming to you (see Fig.2 again).

There are other inconsistencies such as ; to delmit multiple statements on a line (instead of the usual ;) and in the Exclusive-OR statement) but perhaps I ought to talk about the good points.

The best of these is that you can enter assembler mnemonics as program commands and, therefore, when the program is run, the assembler part will be assembled and an assembler list- ing printed out. Should you so wish, the program will jump to the assembler with the LINK command and a return to other parts of the Basic program can be made with equal ease. Any parameters that Define or Define Word in the assembler are set up prior to assembly by other lines in the Basic program and passed as variables to the assembler. Labels are allowed but if a reference to a label is made before it has been de-

Figure 2

of them to run at all. Normally I run them without any problem so you can imagine my surprise when some of them started giving error messages. A trip into the manual revealed the problem but fundamentally revealed that ATOM Basic is non-standard in many, many ways.

There are only 27 integer variables allowed (@ to Z), stored in four bytes each with 32-bit precision. The maximum figure quoted that they can represent is 2,000,000,000 but in reality 2,147,483,647 is the true maximum - which will give you some idea as to how they are stored. This is a distinct improvement on most integer Basics with their maximum of 32,767, but 27 vari-

able is very sound. Machine

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...
programs when you upgrade.

The floating point routines are also interesting in their own right as they feature ARCSIN, ARCCOS and ARCTAN—which is quite unusual for a small computer. The accuracy of the floating point package is also exceptionally good and it's a pity it doesn't support degrees in addition to radians. Other facets of this package have been discussed elsewhere and I shall now turn to the graphics section.

There are many options available to the user, ranging from coarse graphics with mixed text and a low memory overhead through to high resolution graphics with no mixed text but a high memory overhead. Commands are available to move, plot and draw either black lines on white, white on black or even portions surrounds it which detracts from the overall effect.

Expandability

Apart from the internal RAM there is the further option of connecting up any of the other boards in the Acorn range. However you would be well advised to check with Acorn with regard to loading of the lines etc and also exactly what extras are needed in the way of buffer chips. Another fact that you should be aware of is that, due to the peculiar memory map, it is possible that some of an 8k static memory board will not be "seen" by the Atom as it conflicts with the Atom's memory which takes precedence. This is even more of a problem with the 32k dynamic RAM board that

**BASIC COMMANDS**

<table>
<thead>
<tr>
<th>AB</th>
<th>AND</th>
<th>BGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>CLEAR</td>
<td>DIM</td>
</tr>
<tr>
<td>E</td>
<td>EXT</td>
<td>FOR..NEXT</td>
</tr>
<tr>
<td>G</td>
<td>GET</td>
<td>IF</td>
</tr>
<tr>
<td>L</td>
<td>LEN</td>
<td>LIST</td>
</tr>
<tr>
<td>M</td>
<td>MOVE</td>
<td>OR</td>
</tr>
<tr>
<td>P</td>
<td>PRINT</td>
<td>REM</td>
</tr>
<tr>
<td>R</td>
<td>RND</td>
<td>RET</td>
</tr>
<tr>
<td>S</td>
<td>SPT</td>
<td>RETURN</td>
</tr>
<tr>
<td>D</td>
<td>DO...UNTIL</td>
<td>SHUT</td>
</tr>
</tbody>
</table>

**FLOATING POINT COMMANDS**

<table>
<thead>
<tr>
<th>FIF</th>
<th>FINPUT</th>
<th>FPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPUT</td>
<td>FINPUT</td>
<td>FPRINT</td>
</tr>
<tr>
<td>ASN</td>
<td>ATN</td>
<td>COS</td>
</tr>
<tr>
<td>HTN</td>
<td>LOG</td>
<td>SIN</td>
</tr>
<tr>
<td>VAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Documention**

The Atom comes with a very clunky book that starts off extremely well. It's billed as a beginner's course in Basic and machine code programming and generally it's very good and gives plenty of examples. However a lot of the programs could be better documented and a greater variety offered. There are far more mathematical programs that will leave the average punter cold; he doesn't want to know about Sierpinski curves and to put the following sentence in a beginners' book is just plain stupid: "This method has the advantage over the standard pivotol condensation technique that for integer coefficients the answers are exact integers or fractions". What did I say about an ego trip for a Cambridge don? There are no page numbers and without the index it's very difficult to find your way around. Also, there are several programs which use commands that haven't been explained before and therefore are very confusing. The programming analogy of making a cake is super and makes 'yer pivotals' look even more soppy. Error handling codes are available at the back and although they aren't all there (I got 89, which doesn't exist according to the book) this is in hand.

Generally, though, despite the maths overkill, a good effort which must have taken a long time to prepare. The technical manual is under preparation and if the standard of Acorn's documentation is anything to go by, then it should be good.

**Potential use**

Clearly the Atom has been aimed at the educational market. Its business applications are severely limited and I would like to see someone actually try and use it for some of the applications that Acorn suggests in its sales blurb. I can see it going into the educational field partly because of the "Ring" and partly because on paper it seems to offer a lot of facilities for the money—which will probably prove attractive to impecunious education authorities. Personally, I think that as a beginner's tool it has

**TECHNICAL SPEC.**

- CPU: 6502
- Video Display: 32 x 16, comprehensive graphics with expanded colour option promised.
- RAM: 2k minimum, 12k maximum
- ROM: 8k minimum, 4k floating point, room for another 4k
- COMM: cassette interface, can be used in Cambridge Ring
- KEYBOARD: 60 keys, direct cursor control, Copy key
- BUS: Acorn's own 64-way Eurocard socket.
- Disk: Not tested
- Printer: Not tested

**At a glance**

**FIRST IMPRESSIONS**

- Looks: ***
- Setting Up: ****
- Ease of Use: *

**HIGH LEVEL LANGUAGES**

- Basic: *** (see text)

**PERFORMANCE**

- Processor: ***
- Cassette: N/A
- Disk: N/A
- Peripherals: N/A

**EXPANDABILITY**

- Memory: *
- Cassettes: N/A
- Disks: N/A
- Bus: ***

**COMPATABILITY**

- Hardware: **
- Software: ***
- Documentation: ****
- Value for Money: ****

远太多的特性使其无法清晰地思考和理解。
**Introduction**

Taking on for a moment my role as a programming teacher — with a commitment to structured programming — it disturbs me that virtually all the schools that teach this noble art use Basic...a language without structured constructs. Proponents of Basic, however, argue that any other language is far more difficult to teach, requiring knowledge of editors and operating systems. Well, the Danes faced this dilemma by developing a structured Basic called Comal (Common Algorithmic Language), and this is where the Danish company, Dansk Data Elektronik come in. They've arranged where the Danish company, Dansk Data Electronics Ltd. (DDE), to market in the UK their SPC/1 range of microcomputers. The machine is programmed in Comal rather than the more usual Basic.

**Hardware**

The review system consisted of an SPC/1 computer, a Soroc IQ 120 VDU and a Texas 810 printer. The computer itself is extremely lightweight, contained as it is in an attractive aluminium box (dimensions 22.2h x 44.3w x 33.7d cm). The front, top, and back panels unscrew to reveal a frame and the inside of the computer. Visible are two BASF mini disk drives, a thirteen slot motherboard containing six 8x8 square (16A) boards, a power supply and a quiet fan. On the back of the box is an on/off switch (no reset button), a printer socket and a VDU socket. Ian Brunchmann, the DDE representative who delivered the system said that I was being lent a rather old machine and that anyone who bought one now would get a slightly larger box which would hold three drives and have a seventeen slot motherboard. The system bus has 100 pins but is not designed to the S100 specification. It can handle interrupts from up to 64 sources and cope with up to eight DMA channels. The CPU card contains a 2 MHz 8085A (a 5 MHz version is also available), two serial ports for a VDU and printer, a bootstrap loader in 2708 PROM and an AM9511DC arithmetic processor. Although the other benchmarks ran rather slowly on this system, benchmark eight, which tests the speed of mathematical functions (and used the arithmetic processor), was fast. The two RS232 ports can be set for transmission rates between 300 and 9600 baud.

The memory occupies three boards, the first a refresh module that can refresh any number of memory modules, and the other two both 32K dynamic RAM boards. The memory ICs are TMS 4116s and can be organised into one or two switchable banks. The bank-switch facility enables the system to address up to one megabyte of memory. Banks can be switched in or out in 3 microseconds.

The disk controller board interfaces up to three 5" drives or up to four 8" drives. The disk controller used is Intel's FDU 1791-A. The final board supplied in the review machine is a DMA control module which is said to speed up transfers between memory and disks to 4 to 16 microseconds per byte and memory to memory transfers to 660,000 bytes per second.

The BASF disk drives are single density single sided and have a capacity of 90K. When I copied disks, although the disk lights switched on and off, the typical 'click, click, click, click' of heads moving up and down was absent. When I asked Ian Brunchmann about this he said the heads were not lifted until 20 seconds after access and so during a disk copy the heads wouldn't go up and down. I wasn't overly successful when using these drives... surprising considering I'd had the BASF drives previously. The first untoward incident was that the door to the second drive stopped shutting properly. Accessing files from that disk frequently resulted in a 'disk not ready' error message. On closer examination I saw that one of the pins holding the door on had worked its way up and when pushed back in place the problem was solved.

The next incident occurred when the system failed to boot from the first drive. Fortunately it booted from the second drive, at which time it became clear that the first drive was not functioning. I pulled the system apart (everything is quite easy to get to) and saw that the belt had slipped off. After putting it back on, the system worked fine — for a while. Then the second drive stopped working. I pulled the system apart again, but this time could see nothing to fix (the read/write head didn't move). I had to continue working on a one disk system. Having to spend a fair percentage of my time using the single disk system I soon got to realise its severe limitations.

I don't have any explanation as to why the drives are so bad, because BASF have quite a good reputation. Perhaps it is because the review machine seems to have spent a great deal of time in transport (via plane and car), and it was rather old to boot.

The Soroc VDU supplied with the review machine is included in the basic price, but the sales literature does state provision and these are in very close proximity. As ESC generally aborts the current process, returning the user to the operating system, it's not all that difficult to produce disastrous results with the slip of a finger. There's no repeat key, but holding any key down will cause it to repeat. This feature was not particularly well implemented since the normal displaying of ASCII characters resulted from normal typing while with others (cursor control keys) it was easier to hit the key several times. I assume that a new IQ 120 would not have the uneven touch of a VDU that has been lent to a variety of people.

In the literature, an alternative to the Soroc is offered — a graphics board for use with a monitor and keyboard (like Research Machines). The graphics board has a 256 by 256 point resolution, with point 0,0 in the centre of the screen. According to the sales literature, the graphics can be easily accessed from assembler language, Comal and Pascal. Assembler subroutines can be called that implement Turtle Graphics (from UCSD Pascal). The calls are straightforward and can be interspersed with the normal displaying of ASCII characters. The Texas 810 printer had a few modifications. Danish characters replaced both square and curly brackets.
Unfortunately the review system was set up to expect an Anadex printer and so it was not always happy with some of the control codes sent to it.

System software

Two operating systems were provided with the review machine, the first being a dedicated Comal system. This is fairly similar to any dedicated Basic system; upon booting, Comal is loaded into memory. All messages in this system are in lucid and reasonably helpful English. This is the operating system included in the basic price and it gives no facilities for using the SPC/1 for any reason other than programming in Comal.

The second operating system provided with the review machine is called MIKADOS — DDE’s ‘modular-multi-programmed real time disk operating system’; it runs on DDE’s previous computer system, the ID-7000, as well as on the SPC/1 systems. Unlike the other operating systems that I’ve seen on microcomputers, this has clearly been designed for a larger, hard disk, multi-user computer system and pared down for a floppy based, single user system. It’s slower and more tedious to use than a specifically designed single user system and has several features which are completely useless in this environment. For instance, the documentation talks of re-entrant code, controlling synchronisation and scheduling, swapping priorities for processes and message exchanges.

To communicate with the operating system the user must first type ESC, at which time a ‘>’ appears on the screen. If this is forgotten, any further typing produces no response at all. During the execution of most programs, typing ESC will abort the current process (whereas typing ESC when in Comal aborts the current process but leaves the user in Comal). The intrinsic functions of this operating system are re-entrant 8080 subroutines. For most of the functions a user might want there exist programs that contain calls to these subroutines. These utility programs come on three disks, and are called by typing their name after a '>'.

- PLINI — a disk initialiser
- KATLG — a directory listing with several options
- PKOPI — a disk copier
- FCOPY — a file copier
- KOMPR — A disk compacter
- RENAME — for files
- FPURG — for purging files
- MONITOR — for executing a control file (like CP/M’s SUBMIT)
tating is that neither KATLG nor FPURG utilities would not load from the second wayward file. To the last one I got a message saying I TXTUD for printing the files. I then used the printer and then delete them. I used disk.

Before a file is written to disk, the user creates 'logical disks' located on a physical disk. The review system came with logical disks equal to the hard disk system. Also, whenever a line before the current one is required, disk accessing frequently takes place. This accessing might be acceptable on a hard disk system but is tedious when entering text on a floppy based system.

Three commands are treated by the operator communication module. These are .LI for choosing the list device (VDU or printer), .FE for choosing where to output error messages and .RU for loading and running named programs. The operator communication module is a resident part of MIKADOS and hence available from main memory.

A non-dedicated Comal system is available that appears to the user like the dedicated Comal. Like all the other languages, the user can be accessed by typing its name after '>'. The MIKADOS bootloader is entered automatically upon booting up (which can occur from either drive. The system can also set up to boot from a given file other than Comal or MIKADOS (e.g. a dedicated Pascal system).

Comal

Comal was designed in 1974 by Borge Christensen and Benedict Lofstedt to be a structured extension of Basic. The documentation states that all Basic facilities are retained in 16k Comal. This compatibility with Basic would be more helpful if there were a standard (say 8k) Basic to be compatible with. Comal is close enough to Basic to enable the running of the benchmarks, unlike CBasic which required alterations to obtain results.

As it is, different manufacturers produce different languages called Basic. In fact most micro Basics (including those from the Microsoft stable) show the strong influence of DEC whereas Comal looks as if it is based on Hewlett Packard's Basic. So programs written in other micro Basic's probably won't run in Comal. The biggest differences lie in string handling facilities. In Comal all strings must be dimensioned. DIM A$ (5) declares a string five characters long. If NAMES = "SUSAN" then A$(1) is S while A$(3:5) is SAN and A$(3:2) is SA. Although these string handling functions are neater than MID$, etc. from Microsoft, they will hinder programs being transferred from one micro to another. (Ian Brunchmann tells me that he has written procedures to transfer from Microsoft string handling to Comal string handling.)

Most micro Basics store each line upon input and only during execution does the interpreter try to make any sense of it. The Comal interpreter, on the other hand, attempts to translate each line upon input (sometimes called semi-compiled). If it can't translate a line, and Comal is quite strict, a 'beep' is emitted, a detailed error message appears on the top of the screen and the cursor is placed on the character suspected of being incorrect, ready for editing. Editing the user can 'escape' but cannot 'return' out of the line until it is correct. Typing just a line number is not legal Comal, so the standard Basic deletion doesn't work. Rather, DELETE line number is required. Regardless of the spacing used when typing in a program, when listing a program all statements with control structures are indented.

The Comal reserved word table shows the similarity with Basic. The Comal extensions include:

1. Sixteen character variable names (variables are not declared and are always global)

2. Three loop structures — taken from Pascal
   (a) FOR-NEXT looks like a Basic FOR-NEXT but the test is at the top rather than at the bottom e.g. 10 FOR I=1 TO 1 20 PRINT I 30 NEXT I doesn't print anything whereas in Basic, '10' is printed
   (b) REPEAT-UNTIL loop with any GOTO Page 115
Unique in concept - the home computer that grows as you do!

**New! The Acorn Atom**

£120 An outstanding personal computer kit

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The ATOM concept

Adding chips into sockets on the PCB allows you to progress in affordable steps to large-scale expansion. You can see from the specifications that the RAM can be increased to 12K allowing high resolution (256 x 192) graphics. Two further ROM chips, e.g. maths functions, can be added directly to the board giving a 16K capacity. In addition to 5 I/O lines partly used by the cassette interface, an optional VIA device can provide varied I/O and timer functions and via a buffer device allow direct printer drive. An optional module provides red, green and blue signals for colour. An in-board connector strip takes the ATOM communications loop interface. Any number of ATOMs may be linked to each other - or to a master system with mass storage/

hard copy facility. Interface with other ACORN cards is simplicity itself. Any one ACORN card may be fitted internally. So you can see there are a vast number of modular options and additions available, expanding with your ability and your budget.

The ATOM hardware includes:

- Memory from 2K to 12K RAM on board (up to 35K in case)
- 8K to 16K ROM (two 4K additions)
- 6502 processor
- Video Display allows high resolution (256 x 192) graphics and red, green and blue output
- Cassette Interface - CUTS 300 baud
- Loudspeaker allows tone generation of any frequency
- Channel 36 UHF Modulator Output
- Bus output includes internal connections for Acorn Eurocard.

The ATOM software includes:

- 32-bit arithmetic (±2,000,000,000)
- High speed execution
- 43 standard/extended BASIC commands
- Variable length strings (up to 256 characters)
- String manipulation functions
- 27 32-bit integer variables
- 27 additional arrays
- Random number function
- PUT and GET byte
- WAIT command for timing
- DO-UNTIL construction
- Logical operators (AND, OR, EX-OR)
- LINK to machine-code routines
- PLOT, DRAW and MOVE.

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PCW/7/80
Will IBM team up with Madame Tussauds to produce ‘living’ replicas of our dead relatives? This chilling spectre of a future in which loneliness and depression are countered by ‘plastic pals’ is just one aspect of ANIMISTICS as proposed by Neil Frude — lecturer in Clinical Psychology at University College, Cardiff.

ANIMISTICS

The scene is a man alone in the evening in a large computer installation, overturning teletypes, smashing equipment, destroying irreplaceable data tapes; he’s not a life-time Luddite of the new school, but a highly-trained operator with many years experience in programming and systems operation. The frustration he feels when things don’t operate to plan is an exaggeration of the emotion which many people experience when faced with the repeated failure of a system or a program. Such a scene has been realised a sufficient number of times, with predictably disastrous consequences, for IBM to now be financing large-scale research by psychologists into ‘user-friendliness’ in micro-based systems.

American psychologists Karl Scheibe and Margaret Erwin left a tape-recorder running in a room in which subjects played games with a micro. The spontaneous comments which emerged ranged from the affectionate to the downright hostile. The machine was referred to as ‘it’, ‘you’, ‘he’ and ‘Fred’ (never as a female) and, say the experimenters, “the use of profanity was common”. These psychologists concluded that the computer is very easily cast in the role of another person. Adrian Hope, writing in Everyday Electronics described an unconventional operation with the Texas Instruments voice synthesiser ‘Speak and Spell’. To expand the vocabulary there is provision for an additional plug-in ROM, accessible by a ‘module’ button on the keyboard. It appears that if this is pressed when a module is not inserted then the machine invents words and phrases. “So pathetic is the garbled sound”, writes Hope, “that only the hardest heart can fail to feel sorry for the confused electronics burbling as if in final, demented death throes.”

Each of these emotional and ‘personal’ effects of machines and programs is incidental to the design of the systems involved. Such reactions are secondary, and often unwanted. If we try to humanise a machine then the effects are far more devastating and may be very easy to achieve. Take the simplest of ‘programs’ in which there is displayed on a VDU the question “WHAT IS YOUR NAME?” with provision for a string variable input. The user types in “JOHN” and the machine, using this string, then prints “THANK YOU, JOHN, NOW LET’S HAVE SOME FUN!” Now no machine is likely to run out of memory on that program, and it doesn’t take a two-month programming course to write the software, yet the psychological effect on the naive user is often profound. With appropriate skill (and they are the skills of the playwright rather than of the high-grade programmer) the user, child or adult, is easily seduced into further interaction. Statements and reactions by the machine can arouse feelings of humour, affection, hostility, boredom, excitement and, in principle, the whole range of human emotions.

So far there has been relatively little interest in ‘humanising’ machines. Perhaps those interested in recent developments are more intrigued with the technological potential rather than the human potential of new technology. This will certainly change as machines increase in number and reach further than the ‘hard core’ of technologists and business systems people, as micro applications swamp into more and more fields and as the economic rewards of mass sales to the technically unsophisticated become apparent. Chips may now be invading homes in the form of calculators, television games and watches but there is a far greater potential market for pets (with the lower case ‘p’). When this is realised, then we can expect the parallel development of ‘micros as calculators’ and ‘micros as companions’. This scenario has no need to await future technological developments but would
involve rather a growth of interest and a realisation of current potential together with a leap, or several leaps, of the imagination. It needs psychologists, playwrights, technologists and programmers to cooperate to produce the viable machine. The prospect is both exciting and frightening, yet economic pressure seems inevitable. The dream of every chip salesman should be microcircuits, warm and fur-covered, contentedly purring away in every old lady's lap, leaping and snuggling. While this might seem impossible, the viability of the 'intimate machine' rests on two psychological premises: the desire for (and indeed the real benefits of) intimacy and the tendency of people to treat inanimate objects possessing certain vital features as if they were animals or people. These characteristics together ensure the viability, for a large number of potential customers, of the 'plastic pal', the 'micro friend'.

When social scientists conduct 'happiness surveys' to determine the correlates of happiness, and when they ask people about the most important things in their lives, it emerges that the people who are most happy are those with several friends and social contacts, particularly very close ones, and that people say that they value most highly (even above wealth and health) their relationships with other people. Psychologists have provided lists of the kinds of social contacts which seem to be of particular value, to help people and to make them happy. These factors, such as 'feeling close to', 'feeling responsible for' and 'feeling known by' the other person have been further analysed so that we understand something of the particular behaviours and interactions which foster such feelings.

These analyses might well provide the psychological groundwork for any attempt to simulate such actions of the 'other person' in a machine form. The practical benefits of intimate companions are undeniable and we can link this with the fact that those without such regular interaction seem psychologically vulnerable. Single people, the widowed and the divorced are at greater 'risk' of mental breakdown, depression, suicide and alcoholism.

Recent studies have indicated that relationships with pets may go at least some of the way towards satisfying the need for intimacy. The sad fact is that not everybody has a family 'on tap' - whether by choice or otherwise - and people, particularly among the old, and there is now good evidence to suggest that some people gain from their cats and dogs, budgies and tortoises many of the social rewards which most of us obtain from satisfactory relationships with other people. Now the limited behavioural repertoire of some of these creatures would have suggested that they would not be likely to be satisfying as companions and the fact that they do brings us to the next psychological premise in our argument - that people tend to 'read into' creatures and objects characteristics which are typical of higher forms. This process has been labelled 'animism' and it has been the subject of considerable study by psychologists and anthropologists.

In the 1940s the psychologist Michotte built a contrivance by which two shapes were seen as coming together at various speeds and 'colliding' with various patterns of reaction. What Michotte found was that people tended to interpret these visual patterns not only in a 'causal' way (they saw a 'billiard ball effect', a 'pushcart effect' and so forth) but also a 'human' or 'animistic' way. Thus one object might be said to push another one 'deliberately' or 'viciously'. There was then a tendency to attribute motives, emotional expression and intentionality to simple moving shapes. In other experiments short pieces of cartoon film have been produced, and once again it is easy to get people to report 'high level' interpretations - they ascribe 'animistic qualities to simply moving geometric patterns. It seems, too, that particular shapes often bring out a specific emotional response. A skilled cartoonist need only draw a few lines to create a babby rabbit or 'Bambi' figure, which is not only easily recognisable but also appealing' and of course doll manufacturers successfully recognise this tendency and turn it into product and cash.

It's not just visual presentations that produce such emotional reactions, either. Quality of voice, the nature of statements being made, physical warmth and softness or furiness may all produce positive emotional responses. If we combine several such characteristics then the overall psychological result is greatly magnified. Anthropological interest in animism has stemmed partly from the view that it is a characteristic feature of the 'primitive mind'. Certainly it is found most strongly in primitives and children, but that is not the end of it. The experiments described above indicate that the tendency exists, albeit in a somewhat quiescent form, in all of us. A few years ago one successful marketing company in the States launched the 'Pet Rock', an executive toy,expensively packaged and with instructions for care and feeding. The joke sold well. Scratch an executive, it seems, and you'll find a primitive. We can, however, overcome the sophistication which may normally hide the animistic tendency by matching it with sophisticated technology. Some of the possibilities here are indicated in fictional creations which capture the popular imagination. There has long been a fascination with 'humanoid' automatons; they are mentioned in Homer's Iliad and they are the stock-in-trade of much of today's science fiction, both in print and on the screen. Stars such as Robby of R2D2, Hal of 2001 and several of the characters of the 'Hitch-hiker's Guide to the Galaxy' endear themselves to viewers and listeners by virtue of their personality. Their fascination does not lie in their formidable computing power but rather in their typically 'human' utterances and foibles.

There are lessons to be learned from close examination of the characteristics of these popular creations. Almost all of these androids are conceived of as male, they are all primarily task-oriented or problem-solving machines with any incidental personality rather than being specifically contrived humanoid companions, and they are mechanically rather primitive with a sorf of whirring cabs and flashing lights. Some of their voices are far more stilled and sound far more artificial than the best of the voice synthesizers available currently. In a word they are in many ways too 'hard' and would be unlikely, were they realised, to be immediately acceptable as companions. The problems of 'softening' the technology, however, are not difficult and are largely surmountable with currently available methods. What is needed is imagination, research into mass-user acceptability and a belief that there is likely to be vast social and economic pay-offs.

Softening the hardware
It's undeniable that there is a 'machine
barrier'. People feel initially self-conscious and uncomfortable 'relating' to a machine. The feeling of self-consciousness is often found when one is discovered talking to a cat. Yet (in private at least) some people talk to their cats all the time. If they overcome the 'animals' barrier' in the sense of animals 'humanly' then they can probably also be seduced into treating machines in the same way. The 'human-ness' of sophisticatedly programmed machines with appropriate software is likely to be far greater than that of any animal, although the barrier, it is true, is likely to be more formidable, at least initially. Other body movements would be the ideal micro companion possess? What should it look like, feel like and sound like? Presumably people would relate more easily to a body shape which they were familiar with and so a human or animal form would seem to be most appropriate. A soft skin or fur covering would feel pleasant to the touch and a suitable body temperature could be maintained. Above all, the ideal companion would not look like today's computer, no shiny metal parts, no VDU or flashing lights. Facial features could be 'delicate' so that no machines actually looked alike (computer controlled production would make this easy and cheap) and voices could be treated as if they were human. A similar fashion is that no two sounded exactly alike. The state of the art in voice synthesis is now adequate for this aspect of the production of a good companion though the voices produced are a bit harsh and school-masterly. The user would want less perfection, more pauses, splutters, repetitions, coughs and giggles. We would expect 50% of production to be of female voices (and we would naturally want to combine these with female body shells unless we have a consumer with a rather particular need).

The possibility would exist for producing a model which not only looks human but which looks like a specific person, someone famous perhaps, or an absent member of the family. The psychological effects there are quite unexplored. Would schools keep an appropriately programmed Shakespeare replica in the cupboard to teach English? Perhaps there would be legislation to prevent the production of a person-like model 50 years after their death as in the existing copyright laws. The chilling thought of a lonely person sitting in conversation beside the fireside with a replica of a deceased spouse does little to assuage fears as to the possible social impact of the application of technology in the way we are envisaging. It may even give us cause to ponder the desirability of consciousness-raising in the present form; yet the elements for these developments are lying about us in separate packages and it cannot be long before somebody will put them together. There is, after all, a lot of money to be made.

At this stage it seems that realistic locomotion is one aspect of the hardware side of things which is not really achievable. Maybe the first generation of companions will be relatively sedentary. Other body movements may be complex but are not difficult in principle, as witnessed by the many successful of the achievements of the automata makers in the 18th and 19th centuries. Indeed automata making has a very ancient history and testifies to a long-established desire to create realistic humanoids. The then 'new technology' of clock-making gave rise to a great leap forward in the production of such machines in the 17th and 18th centuries and we can expect a similar and much greater impact-making leap with today's new technology. The problem with sophisticated machines of the old era was that they were hand-produced and made on a 'one-off' basis. The mass-produced automata were far simpler toys with very limited movements. Today, of course, it's possible to produce in quantity even the most sophisticated machines with a very much extended repertoire of movement. In St. Petersburg in 1799 the Academy of Sciences offered a prize for the first machine to produce the five vowel sounds. We can imagine the contrapotions which were produced, all bellows, bladders and reeds but nevertheless designed and constructed with a great deal of care and ingenuity. If yesterday's automata makers had had the opportunity to employ today's technology then their productions would have been truly astonishing. The old automata engineers were not content, however, to merely produce effective functional mechanisms; they took great pains to incorporate them into life-like models. This made them far more astringe and intriguing to a public which queued and paid to see those 'miracles of the modern age'.

**Softening the software**

The production of attractive and realistic dolls provides a vehicle for the output and display of the control systems which are the forte of contemporary technology. The animistic potential of an appealing voice and moving body is fulfilled only when the machine does not sound so realistic and appealing, too. Already there are successful attempts to simulate 'human' conversation, though in a limited form and via a VDU and teletype, in counseling and psychiatric programs such as Weizenbaum's ELIZA and in medical diagnostic programs. It's true that these have a very limited repertoire and generally work by searching for and recognising key terms. However, we probably overestimate the degree of complexity and the extent of the repertoire of normal social conversation. Certainly people do a great deal of isolated term-spotting and 'filling in' and we just don't know how sophisticated an informal conversational program would have to be in order to be pleasurable and user-acceptable. Conversation with young children or with the senile can be difficult and arduous but may, nevertheless, be pleasant. The type of errors which the machine would produce would certainly be somewhat different from those which children make, however, and it remains to be seen whether people's reactions to these would be of the same kind. What is certain is that errors in social chatting are not of the same practical importance as in task-oriented interactions; they may be amusing and easily tolerated, or perplexing and difficult to live with. It's likely that people would accommodate to the limitations of the machine, as they do with young children and other people with low comprehension, and alter their speech patterns so that they produce statements which will be understood. There is a natural process by which linguistic style is 'shaped up' in accordance with the perceived effects of former interactions, and of course we would expect the machine software to contain the potential for a similar accommodation and 'learning from' the input style of the speaker or teletype user.

The style of informal speech is not, of course, that which we see in the transcripts of a carefully written play (unless it's by a playwright of the Pinter school) but contains much repetition, pausing, restatement and imprecision. Thousands of recordings of 'ordinary' conversations have been analysed by linguists and psycholinguists and it's not difficult to produce a simulation of the style. But such a level of analysis need not in fact be necessary and the problem might be successfully solved in a more direct fashion by the programmer with a good ear and some of the skills of the dramatist and by a program with the right degree of flexibility and randomness. Without formal analysis a 'try it and see' approach would be employed.

Next we come to the 'personality' of the machine as implemented in the programming. The computer simulation of personality has a relatively long history. Loeb's program ALDOUS recognises situations, reacts 'emotionally' and in various versions is a decisive or hesitant reactor. There is also RADICAL ALDOUS, CONSERVATIVE ALDOUS and SAVI'T ALDOUS. We see here a good opportunity for the customisation of programs. The machine should be basically sympathetic and 'good' but...
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more efficient sort. One that sorts backwards as fast as it can, and is called the 'quicksort' (clever, eh?). The quicksort only doubles the sort time for double the number of items being sorted. Using our previous example, if it takes one second to sort 5 items, it will take two seconds for 20 numbers and 160 seconds for 1200 numbers, which is just over 2.5 minutes. It would take too long to explain how the quicksort works but here is the coding. In this example it will sort N numbers in ascending order in the array A(1), . . . A(N). It requires the B array as working storage, but this array only needs 24 elements. If there were 10 numbers so there is not a lot of extra space needed:

10 DIM A(N), B(INT(LOG(N)/LOG(2))+1), 2
20 1000 REM ** quicksort subroutine**
30 1010 B(1,L): L=1
40 1020 B(L,R): R=R(L)+1
50 1030 IF 11000 THEN 1070
60 1040 IF (A(I)>=X THEN 1050 ELSE I=I+1: GOTO 1010
70 1050 ELSE J=J-1
80 1060 IF L=R THEN 1070
90 1070 B(S,2)=J
100 1080 IF S=1 THEN 1090 ELSE S=S+1: B(S,1)=L:
110 1090 IF I<R THEN 1100 ELSE R=J: GOTO 1070
120 1100 S=S-1
130 1110 IF L=R THEN 1120 ELSE B(I,L)=L:
140 1120 L=L+1
150 1130 IF I>R THEN 1140 ELSE B(J,R)=R:
160 1140 R=R-1
170 1150 IF I>R THEN 1160 ELSE B(J,L)=L:
180 1160 L=L-1
190 1170 IF I<R THEN 1300 ELSE R=J: GOTO 1120
200 1180 IF S>0 THEN 1190 ELSE 1200 RETURN
210 1190 RETURN

Having decided that this is the sort to use, let's look at the problem a little more deeply. If we have 1000 customer records each of length 100 ch, say, we would require over 100 k of memory, which is just to sort the records. It's unrealistic to sort in memory because it's quite likely there will not be enough space. We will consider two alternatives: 1) sort entirely on the disk; 2) store the record keys in memory and then access the records in that order. Method 2 will be faster as it need not take nearly as long to swap disk and memory, but it may be worthwhile if the number of records is large. Method 2 will require that you read into an array the source code of the program, the key field, followed by the record address. For example, if the disk file holds as record 1, WATERS & CO LTD etc, and record 2, BLOGGS MOTORS etc, then in the array D$() will hold WATE1 and A$(2) holds BLOG2. We must distinct the number of characters to a suitable figure to allow the total amount of record data to fit into memory. That means, at eight characters per record we will need around 10k of memory to hold 1000 records. For example to read record Y from disk and store it in array element X we would use:

READ/1@Y,T; A$(X)$=LEFT$(T,8)$+STR$(Y)$

Because Basic is so different in various versions the statement READ/1@Y,T$ means read from file number 1 (disk file already defined maybe as OPEN1 ('CUST.DAT')) at record number Y (direct access address) into string T$. Once the array has been sorted the following program would print the file in sorted order:

100 DIM A$(1000)
110 OPEN1,'CUST.DAT',10,1000,1,TO 1,1000
120 =VAL(MID$(A(Y),5,6))
130 READ/1@Y,T$ 140 PRINT T$ 150 NEXT X 160 CLOSE/1

Advantages of this method are that the file remains intact, and that sort is quick. Method 2 requires that the file itself be sorted and hence it's best to sort a backup copy of the file in case the system crashes in mid sort. This method has the advantage that a file of any size can be sorted, and that the sorted file can be kept as a permanent file if needed. The program is very similar to above, and the changes are as follows:

100 I=1: J=1: R=1 110 IF I>R THEN 1300 ELSE 1200 RETURN 1200 RETURN 130 I=1: J=1: R=1 140 IF I>R THEN 1300 ELSE 1200 RETURN 150 RETURN

I hope these hints may help those who are struggling with sorts. If the above programs do not run then it's because of errors in transcription please write if you have any difficulties. S.W.

Bar codes

I am a teacher, and would like to link a bar code reader to a 380 Z micro. Do you know a source for a) a design (circuit diagrams, etc) and b) a specification for the bar code itself – perhaps D Benzies, Pershore, Wors.

Bar code is a way of storing machine-readable digital data on the printed page, as a stripe of alternating black and white bars. It's read by scanning with a hand-held wand, which can be used with a television camera and a point-focus light sensor. The alternating light level is detected, amplified and converted to digital logic levels. The bar code is self-clocking, so varying scanning speeds can be compensated for and digital data recovered. Depending on the code in use, there may be a different direction of scan, (which can vary from stripe to stripe to be read in either direction), and to provide error detection by parity or check digit. There are different codes, designed for various applications. Some are proprietary and some are in the public domain. Use include cheap mass distribution of software (Paperbyte), library books (Telepen, Penguins), groceries (UPC, EAN) and stock control and data entry (Code 39, Codabar and others). The best code for general use is Code 39, because of Paperbyte, especially since it gives access to Byte's software books. Details of the code and decoder routines in 6800/6502 and 8080 Z80 assembler are in Bar Code Loader and Data Entry Systems (01-591 6511), but no wand data. Byte. Demarest contains the original format and some wand ideas and circuits. A clever circuit by Moseley is in Byte, May 78.

There are some annoying mechanical and optical problems in building a wand. The sensitive area must be about the same size as the minimum bar, 1/2 inch for Paperbyte, so you can get light into and out of a pinhead spot. Paper is very abrasive, so the tip must be hard or replaceable. The wand must be robust, since this is the area exposed in drawers or swung by their cables.

You may be interested in some commercial products. SCAN-A-MATIC from the S27101, a T018 size coaxial source sensor with .01° resolution at £16.25; there's also a range of code pens, and decoding electronics for several commercial codes. The pen has a sapphire tip and the decoder is internal subassembly (needs a simple barrel and cable) at £60. Some are available at 40/41 Castle Street, Brighton. Hewlett-Packard have a TO5 reflective sensor, HEDS-P.
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A PL-eyed

I've heard people who work with mainframe computers using terminals referring to a new language called APL. Do you know anything about this language. Is it like Pascal?

I'd like to know if it is available on micros and in particular whether it can be used on a Tandy TRS-80, as it sounds as if it has some good features.

L. Davies, Cheshunt.

APL (it stands for A Programming Language... no kidding, that's absolutely true!) originated as a logical and mathematical notation. Does that get you anywhere? ... it's now an extremely powerful general purpose programming language. It is close to the actual language that we humans use, mostly for time-sharing applications on mainframes and the like. Unlike Pascal, it lends itself, and tends to push the programmer into writing short sub-programs (called `functions') which are called by each other and most of the time the programmer does not have to worry about the `main program'.

Pascal often forces you into doing things, such as the `modular' programming described above, APL only encouarges you to do so. If you want to do it differently, you can. Structured programming is common in APL - but not unavoidable!

Perhaps you've already noticed that I've been bitten by the APL bug. It's something experienced programmers rarely recover from! Probably it's because APL is powerful, concise, and once you've got the hang of it, simple. The power comes from the compactness.

The first is that it has a lot of very useful `operators' (somewhat misleadingly called `Primitive Functions') and a simple but effective data structure. In APL a simple variable is defined by the system as a multi-dimensional array, which can hold numeric or other kinds of data values without further definition. Variable names are usually at least eight characters long, making for easy to read programs, as with Pascal or Cobol, Function and operator names are simple. Unlike Pascal or Cobol, there's no need for a long initial `define' section to the program. Another powerful feature shared by APL with other languages, is the ability to use `local' variables, whose value is set only within one `function', or `macro' running throughout the whole program.

The other factor contrib-

buting to the power of APL is that the `primitive data functions' can be used to build up an almost unlimited range of user functions, which can all be given by name (as in Forth where new entries can be made to the `dictionary'). There is only one `primitive' data structure, other structures constructed to the reader in Pascal, and yet others not found in that language, can be readily defined.

Another feature of another feature of APL, its compactness, compare defining 16 or 17 numbers in Basic and APL: In Basic

| 30 | 0 | Z<br> | O | 110 FOR N=1 to 100 | 120 X=2*N | 130 Z=3*X | 140 TEXT N | In APL Z=+/100 | APL has only just recently become available in this country for use with micro-computers. The Superbrain features it as standard and it's available to run under CP/M. The only snag is that the interpreter (APL is always interpreted) takes up a fair amount of memory - typically you need 36-40K for the operating system and APL together. So this leaves you with 28K at the most for working memory. It's actually so compact that you can do a lot more with this space than you'd think!

The effect of the size of the interpreter is that a floppy minidisk system is really needed - even 36K is an awful lot to load from tape! A convenient feature of having the disk, which APL automatically takes advantage of, is that there is room to do a considerable amount of working memory on the SAVE command stores the entire contents of the working memory on the disk, the program, function, user data, variables, the lot. So you can even stop in the middle of a run (if the phone rings, or a meal's ready!) and then reload later and carry right on! Of course, you can also save individual programs (and 'functions'), and write to data tapes in the usual way (remember, it's all operating under standard CP/M).

The rule applies to TRS-80, in theory this should be possible, as CP/M is available for the Tandy. Also, if you have a Model I, then even with the maximum memory of 48K you wouldn't have enough working memory spare. Of course, with a Model II with up to 64K there should be no problem in that respect. I'm not sure whether an APL interpreter is yet available on the TRS-80 format disks. One place you could get more information on this would be AP Ltd, of Cambridge.

The one thing that is likely to prove a headache when putting APL on a TRS-80 is the special character set used by APL for the `primitive functions'. This causes no problems within the computer and peripherals, as the standard ASCII codes are used, but, at least, you will need a chart to show you which keys to press when entering the programs.

When it comes to displaying the program a special VDU or printer will be required. APL character generator chips are available for some VDU's while disk-based ASCII/AIP VDUS are also on the market. There is also at least one reasonably priced printer that can be obtained in this country which can print these characters. Of course, APL programs use the normal characters for the program output, it's only for listing the programs that the special characters are needed.

P.M. McI'moye.

Which programme?

Please could you advise me on the respective merits of the HP-67, Casio fx502P and TI-58 programmable calculators, comparing as regards number of program steps, value for money etc., since I am considering replacing a Sinclair Cambridge Programmable which is somewhat the worse for wear.

C. Marriott, Llandudno.

You have chosen an interesting range of programmable calculators to compare, and I think that Texas Instruments TI-58 does not store information externally on magnetic media, the Casio fx502P can make use of a domestic tape recorder for future programs and the Hewlett Packard HP-67 includes a built-in magnetic card system. As regards the number of program steps, the HP-67 has 224, the Casio 256, while the TI-58 weighs-in at 480. The situation is complicated by the number of steps not necessarily being directly comparable - some calculators can pack in more program steps ('bytes') than others - while there is usually a trade-off between program steps, and data storage. So the number of steps is not everything. Indeed, if you have a long program needing large numbers of steps then the ability to avoid having to re-enter the program by hand at each time you use the calculator is very important. Here the HP-67 scores, with its built-in magnetic card memory system. The calculator also scores by having both a non-volatile memory, that retains the program even when it's switched off, and the ability to store program steps and data on magnetic cassettes on a domestic tape recorder - via a $25 adaptor.

The TI-58 memory goes once it is switched off and as the re-creation of the program takes a few hours you will almost always have to re-enter your programs. Texas also make a £20 extra, retains the contents of memory on the disk - the normal Hewlett-Packard practice. As for value for money, one problem is that calculators are widely discounted, so it's not easy to be sure one is comparing a like with like. Also, some published prices include VAT, others don't! However, having the chance to get widely advertised discount prices, and adding on VAT, puts the Ti-58 at £30, the fx502P at £75, plus £25 for the adaptor, and the HP-67 at £250.

Your final decision as to which calculator to buy will, of course, depend on a careful weighing-up of which factors are most important to you for your application. In terms of price, the TI-58 scores, and even more so if the 'program and data' cassettes are included, but against it is the lack of the ability to store your own programs and data. It's worth mentioning here that Texas has now brought out the TI-55C, which, for about £20 extra, retains the contents of memory, both programs and data, when switched off.

The Casio fx502P offers the ability to store programs and data on magnetic cassettes, but this will (assuming you already have a tape recorder) cost you some £30 more than the TI-58.

At the top end of the range is the card-programmable calculator, the HP-67, also featuring an on-card programmable calculator, at three times the cost of the TI-58. If you don't like the look of the HP-67, or want a slightly larger, more powerful card-programmable calculator, then you should also consider the TI-59, also competitive with the HP-67 on price.
As fully paid up members of the New Microcomputing Front, it befalls all of us at one time or another to pass on some of our knowledge to the uninitiated—teacher to pupil, parent to child, or just plain person to friend.

To the untrained, having knowledge may be one thing—being able to instil it into someone else is quite another. Derrick Daines, Deputy Head of Carsic School, Sutton-in-Ashfield (and of course the new organiser of Young Computer World) tackles this tricky area in a new series that, although originally aimed at teachers, can clearly be used by anyone. The first part begins this month.

Introduction

The 1970's have been unprecedented in their speed of technological innovation. Never before have new devices and new ways of doing things flowed in such abundance from the research centres of the world. It was bound to happen, of course. There are more scientists living and working today than in all the previous history of mankind put together. Since they're not all devising new perfumes or plastic throw-aways, then by the law of averages they are certain to come up with something pretty far-reaching discoveries and inventions sooner or later.

Perhaps the one field in which this has been most marked has been in electronics and especially in the wholesale integration of circuits in the silicon chip. More than anything else, the chip seems to have caught the imagination of the world—and with justification, for it will have the most profound effects upon our lives, affecting every single one of us, even those who have never heard of it.

If we look back at history, it's clear that the world of 50 years ago was totally different from today. Very few could have foreseen the collapse of the Empire, the at least partial demise of the Church, the undermining of family life, the lawlessness of our city streets and the open sale of pornography. Few could have foreseen the boom of the Universities, the increase in the press is breathtakingly fast, you remember. The world was excited by the prospects of every kind is measurable by the law of averages they are certain to come up with something pretty far-reaching discoveries and inventions sooner or later.

If knowledge is increasing so fast that many people are unable to keep up with it, what hope is there? Take another look at the silicon chip. Just at a time when science is moving so fast it's outstripping anyone's ability to absorb it, just at the time when central government is proliferating so rapidly that even the highest-placed find it hard remembering how many quangos there are; just at a time when our own destiny seems to have slipped away from all of us; just when all this has happened, the silicon chip has arrived to give back all that we have lost and much, much more.

By itself the chip will do nothing. It's an inanimate object requiring additional, peripheral devices with which it can control its environment and through which it can be controlled. Above all, it requires the human brain. The chip therefore gives us the opportunity for control. Through it we can work an automated mine or fly a spaceship to Jupiter, effect the juxtaposition of words in a poem or the most complex library catalogue. It follows therefore that not only must we know something of the silicon chip, but also something about these peripherals.

It's reasonable to suppose that if a savage were to be given a motor car, he would shelter in the lee of it and admire himself in the wing mirror for a long time before he discovered that the door opened. It's also obvious that if ever he got the machine moving, his skill would be enormously improved were he not to labour under the delusion that 10,000 devils were trapped under the bonnet. The public at large is just beginning to open the door on the world of the silicon chip microprocessor and starting from now everyone leaving school must of necessity have been given a thorough grounding in the subject. Eventually the public will learn to drive—rather nervously—but if the chip itself remains a mystery, then at one and the same time too little and too much will be expected of it—rather like the savage who on one hand is content with 15mph, but who on the other is expecting the car to leap into a tree.

It's not necessary for everyone to know how to program a computer and still less is it necessary to know how to solder the bits together—any more than it's necessary for everyone to know how to repair a car. However it is necessary for everyone to have some idea of the basic principles and that is what this series intends to provide. All of the ideas presented are known to work and are ready for implementation, now.

There's nothing difficult about any of them. Some are suitable for toddlers while others will need to be imparted given a thorough grounding in the subject. Eventually the public will learn to drive—rather nervously—but if the chip itself remains a mystery, then at one and the same time too little and too much will be expected of it—rather like the savage who on one hand is content with 15mph, but who on the other is expecting the car to leap into a tree.

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Chapter 1: Logical Toys

It's no accident that the 1920s saw the growth and proliferation of mechanical toys such as Meccano, Trix, etc. it was a time when society was booming. The world was excited by the prospects and youngsters were (and always are) quick to absorb the excitement around them. Such toys proved a painless way of absorbing mechanical principles and play has always served the function of instilling ideas in the young.

The toys of today are at a crossroads on the one hand they have become more and more mechanical, and on the other they incorporate some very sophisticated electronic circuitry, a little more expensive, although parents seem quite willing to go on spending large amounts for them, possibly because size of output seems to have become confused with parental concern. It's not at all uncommon for quite young children to be given calculators, cassette tape recorders or even portable television sets; very soon computers will fall into
the same category. Dolls must be exponentially dressed and may also have short vocabularies, while toys for boys mimic the functions of spacecraft, Daleks and the like. All of these toys suffer from one basic defect—they make too little demand upon the child; (s)he's got little to do but sit back and admire. Needless to say, such toys don't last long. They either break down or run out of battery power, only to be discarded—and rightly so.

It cannot be stressed too strongly that to be successful a toy must stimulate the imagination of the child, must involve him/her in creative play and must in some measure presume the child's adult role. It must of course also be rugged.

There'll always be room for good mechanical toys such as Meccano, just as there will always be room for good mechanics, but it's interesting to note that there is more than one computer on sale right now at considerably less cost than the No.10 Meccano set. Several electronic construction-type sets of plug-in modules are available that will make up into radios, burglar alarms and the like; there are also sets designed to teach the principles of computing. These electronic toys and trainers will be dealt with later in the series.

For the younger child there is a set of toy bricks available that ought to be in every home, nursery, infant, and primary school as well as many secondary schools. I refer to Logic Blocks (I wish someone would think up a snappier name for them—Logiblox, perhaps?). As a toy they're first-class, while as a teaching aid, they're terrific.

Logic Blocks were invented by Professor Dienes, Director of the Department of Psycho-Mathematics, University of Sherbrooke, Quebec. In some ways I wish they weren't! If anything is guaranteed to kill a toy stone-dead, it's the news that it was invented by a professor. And as for him being a professor of something called Psycho-Mathematics, well, I ask you!

Don't let it put you off. They're enormous fun and they're not expensive. The basic set is intended to be used on the table-top, but there's also a pocket-size available and a demonstration or 'floor' size, which comes in a box some 18" by 12".

As originally designed, Professor Dienes' blocks come in three different colours—red, yellow and blue—two sizes, two thicknesses and four different shapes—square, rectangle, triangle and circle. Every block differs from every other block in one or more aspects so that we have a thick large yellow circle, a thin large yellow circle, a thin large yellow square and so on. It's tolerably obvious that 48 blocks make the set.

Other types, more suitable for very young children, make up their sets from different tree profiles, house shapes, various modes of transport or different types of people. The latter has two sexes, three colours and sitting, kneeling, walking or standing profiles. One manufacturer has added a hexagon to the basic set...all are made of high-impact plastic. A list of suppliers will be found at the end of this feature.

There's of course no reason why the larger pieces shouldn't be given to babies or toddlers to play with, since they're non-toxic, have no sharp edges or corners and can't be swallowed; but it's with the growth of language that the child is learning to discriminate colours (easy), sizes (harder), shapes (harder still) and thicknesses (tricky). More than that he is learning the language, with the parent or teacher repeating key words for him.
Given a few basic games as a start, children to make a train—a complete loop. played in four directions from the start—cult as it sounds. The game can also be among the players and one piece is laid which piece has been removed—and jumbled set while the child has his/her lot of adults!

AND and OR, but come to that, so do a lead on to the use of the word and conjunction with hoops. Chalk circles will serve, and can be sponged clean; while for the affluent there are plastic mats available with large circles printed while. One player answers, "No other, A plus B plus C must equal 10. The only way in which these conditions can be satisfied is for A to equal 3, B to equal 1 and C to equal 6. We may now deduce from the total of swimmers that D must equal 2. From the total class number we can work out that E is 9. Footballers total A plus B plus D plus E, which is 15."

At this point the reader might well be wondering what this is all about. What possible relevance is there to our technological future? What are we training? The short answer is that we are training logical thought. Primitive thought is largely confined to thinking in pictures ... what is desired is pictured in the mind; logical thought must proceed by the mental use of words. Emotion is a driving force, but as a rule of thumb, the more powerful the emotion, the more likely it is to preclude logic.) Now far too many children arrive at the secondary school unable to think at all, except pictorially; a fact long recognised and worked on by people such as Edward de Bono.

The trouble lies with our training — and especially that part that deals with logic and the non-acceptance of the exclusivity principle. The exclusivity principle, based on the 'exclusive or,' whether something is, or it is not; that block is red or it is not red. Every time a mother says, "EITHER you do so-and-so OR I will smack you," and then relents, she is undermining the exclusivity principle. She is actively teaching that sometimes, with a little wheedling, things can be both at the same time. It's odd that when the OR is seen to lead to something desirable, we feel compelled to keep our promise, yet when the OR is nasty or undesirable, we feel no such compulsion. No wonder there's a breakdown of law and order! I'm not necessarily advocating stricter sentencing or anything like that; just that we should not present the EITHER . . . OR without the determination to carry it out. If you say a thing, mean it!

Machines are totally logical and in order to understand (let alone manipulate) them we must be totally logical too. And that's where the biggest shock is coming.

More block games

If the teacher can make or obtain a matrix of six squares by eight, (s)he has the
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Begin by asking them to lay out the blocks in such a way that any one can be found very quickly — which implies some sort of order. Commonly, children will lay them out in three rows of colour or four of shape, but they are told that only one block is allowed per square. There are several acceptable methods. Alternating rows of the same shape with different size is good, as is four rows of each size. Other acceptable methods will be found.

Another way of tackling the same thing is to start a game of One Difference Dominoes on a corner and then ask for a suitable piece to go into the angle of the corner such that it has one difference from the piece to the North of it and one difference from the piece to the East (Fig.5). From this it's obvious that the process may be repeated until all the blocks have been laid.

All of these matrix games may lead on to a discussion on Carroll Mappings (Fig.6) and their advantages and disadvantages vis-a-vis Venn Diagrams. Since both are logical and capable of giving insights into logic problems, both are important to us as teachers — although it's clear the Venn Diagrams are easier to understand for the young child.

Machines or Black Boxes can be cascaded in twos, threes or even fours, as the children get better at using them (as judged from the accuracy of their forecasts). No real purpose is gained by extending it beyond this, however. Trackways are better and lead naturally to flowcharts (Fig.9).

Trackways are available commercially (see list of suppliers), but it's no great effort to make one's own. Obtain a bundle of thick cards of a standard size — say 6 inches square. Carefully draw a gate on each as per the figure and for clarity, paint the rest of the area. Always call it a gate, not branch or road or what-have-you because it has much in common with an electronic gate — as we will see later.

All we need to start with is one gate, a dock and a pile of logic blocks. For normally right-handed people it's best to have the dock on the left and start with the pile on the right. The idea is that we take each block in turn down the track until we reach the gate — where

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**Fig.10** Example of tracks in use

**Fig.11** Too many shapes lead to clutter and tiny spaces to colour in.

**Fig.11A** The bold contrast of black on white emphasises the interesting shapes produced from carefully spaced templates.
Have you ever actually cursed at the sight of your system displaying ***SYNTAX ERROR*** without it saying what is actually wrong?

Have you Apple programmers missed RETURN and hit RESET at the critical stage in a program — more times than you’ve had hot dinners?

You never feel like bouncing your TRS-80 out of the window when the keyboard bounces at the wrong moment?

If your reply to all the above questions is ‘no’, then you are allowed to stop reading for ten seconds to recall the most quirky and unfriendly thing about any computer or program which you use regularly, for the point behind this new series is to make systems as friendly to their users as possible.

Now there is more to this than just displaying ‘HELLO’ at the beginning of the program and the topics I shall be covering include:

- **Keyboard Design**
- **Display format and facilities**
- **Printer features and functions**
- **Design of input messages**
- **Design of output messages**
- **Design of screen layouts**
- **Dialogue style**
- **Error handling and reporting techniques**
- **Use of graphics**
- **Advanced dialogue techniques**

This list divides itself up nicely into two parts. The first three items concern the hardware and (unless you are a home-brew enthusiast) you cannot do much about them. However, they are included for two major reasons:

1. If you are buying a system with integral keyboard display facilities (or a VDU to use with a micro like the Black Box, Cromemco or Horizon), then knowing about these things could influence your decision and ensure that your choice is going to work well in practice.

2. A standard of ‘human factors engineering’ or ‘ergonomics’ in display terminals is appalling; I believe most manufacturers could benefit from a little feedback on this particular subject.

The rest of the checklist is more concerned with software and the way in which the user interacts via the keyboard and display with a particular control program or application package. Unlike the previous factors, here is a situation where (usually) you can do something about the problem. Not only is this series written for the programmer, it’ll also be of interest to users. In the latter case, they may well be involved in the design of new applications programs and in the selection of ‘off the shelf’ packages.

The purpose of this introductory article is to raise readers’ sensitivity to human factors in computer systems and to help do this I shall be calling upon my ‘Black Museum’ of bad examples which come from much bigger computers than the average micro; even IBM, the Jolly Grey Giant, can screw up this sort of thing. Let’s start with some keyboard examples:

### Case 1: The Perilous Pair

**Apple’s fatal oversight in putting the RESET key right over RETURN is a classic.** Reset keys are best off round the back of something — or at least well away from the main keyboard.

### Case 2: Non-standard keyboards

A classic case here is the original PET keyboard which was much smaller than the usual typewriter arrangement and used funny keys to boot (if you got angry with it).

The new Sinclair ZX80 is another example... it employs no keys at all.

What can be more disconcerting than size is the location of keys. PET succeeded in making programming easy by putting a lot of the graphics characters in the lower case shift. On the Apple however they are in the upper shift. The Superbrain is weird in this respect; the double-quotes is somewhere down the middle, not a very useful layout.

In the age of converging computer and communications technologies, it’s somewhat ironic that the two sides of this major historical trend should have made a balls-up of the relatively trivial job of getting their numeric keypads compatible. Just look at this:

<table>
<thead>
<tr>
<th>Data Standard</th>
<th>Telecommunications Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 8 9</td>
<td>1 2 3</td>
</tr>
<tr>
<td>4 5 6</td>
<td>4 5 6</td>
</tr>
<tr>
<td>1 2 3</td>
<td>7 8 9</td>
</tr>
<tr>
<td>0</td>
<td>* 0</td>
</tr>
</tbody>
</table>

Perhaps we should consider ourselves lucky that they got 40% of it the same! What do you put on the keyboard of a micro which has Prestel interface? If you make it the data standard (because you use that more), how are you going to use your Prestel television at home? Once decisions on this scale have been made, it’s just about impossible to get them reversed.

Here are keyboard examples:

### Case 3: Tandy tremors

It really is amazing what we can adapt to when faced with no choice. The quality of video generators in some systems is little short of disgusting. Even on expensive VDUs screen quality is often poor. Things to watch out for are:

- Screen shake (ala Tandy)
- Fuzzy characters in the corners of the screen
- Variation in character size between the centre and corners of the screen
- Funny shaped characters (e.g. no lower case descenders on the Super-brain)
- No lower case and so on.

### Case 4: Unhelpful error messages

I know that error messages take up a lot of space, but I want to scream when I see larger systems display:

**ERR**

True, sometimes you get ***ERR*** as if the much-abused asterisk had some psychic power. The next example should go in the Guinness Book of Records:

- CoAX ERROR followed closely by INVALID DATA

an all-time great (but unhelpful) message. Error messages should be clear and explicit. I once saw a system come up with NEGATIVE TRANSPARENCY Figure that one out!!

### Case 5: Unfriendly Input

This one is rapidly becoming a classic ANSWER YES OR NO
Case 6:
The pseudo-error

Consider this sequence (the user is trying to enter a date):

ENTER DATE: 12/8/46
ERROR - DATE MUST BE DD.MM.YYYY
ENTER DATE: 12.8.46
ERROR - DATE MUST BE DD.MM.YYYY
ENTER DATE: 12.8.1946
ERROR - DATE MUST BE DD.MM.YYYY
ENTER DATE: 12/8/1946
DATE ACCEPTED.

Phew! What a relief! Actually the date is wrong; what the user wanted to enter was 12/9/46 and the program could not or would not find that. So what were all the messages about? Well, the original date was only wrong because the program (or rather the programmer) decided it was only acceptable in one form. For most people 12/9/46 is perfectly reasonable, so why shouldn't the program accept it? These are what I call 'pseudo errors'.

Case 7:
Word processing

One of the major problems with most of the early word processing systems that are based upon general purpose microcomputers is that they've been developed by data processing specialists. There's an easy way of discovering if this is the case; write for details and if the covering letter you receive back with the brochure has been printed right-justified or (even worse) printed on a matrix printer, then get suspicious. It shows that the supplier is completely out of touch with the whole area of word processing. Even if the letter has come out of the system, it should still look as though it was produced by a sexy young thing on an IBM Selectric typewriter.

Word processing makes special demands on both system peripherals (VDU or sensible printer) and the dialogue. For these reasons, I shall later be allocating a complete article to the ergonomics of word processing.

Having said what I have about the attempts of data processing people at word processing, perhaps I should redress the balance by mentioning that Olivetti (who have been making and selling typewriters for donkey's years) have a special purpose word-processor which works with an awful single-line display. Word processing through a keyhole! Try moving a paragraph...

Case 8:

CP/M and Command Languages

What chances are there for end users if systems designers and programmers are unable to develop good system-level dialogues for themselves? The classic case is the JCL (Job Control Language). This is so unfriendly that I've known some top people in the industry give up programming in despair. JCL just got in the way; it made the system harder to use rather than easier.

Things have moved on a lot since then, and micro systems are considerably easier to use than the average mainframe. But this is the case for the user and the program. My reasoning is that I've seen some of the more popular command languages for disk-based microcomputers.

My reasons for reviewing all these examples of the malevolent human factor in micro systems is that the recognition of bad design is an essential first step towards learning techniques of good design. So, rather than finishing on a down note, I'll now consider those features that should exist in a user friendly system.

The following are ten key factors which can be used as an aid to assessing the human factors quality in an interactive computer based system.

1. Do the users judge the system to be easy-to-learn and easy-to-use?

This must be determined by the user (or would-be user) rather than by the system developer. If it takes longer than it should for users to get to know the elements of the system, then it's probably too complicated. The 'ease-of-use' criterion covers everything from response times, through consistency of coding and syntax to clarity of system messages.

2. Is the system easy to extend and modify?

The cost of keeping computer systems in step with application requirements has become a major component of overall dp costs. The only way in which this problem can be overcome is to ensure that the original software is designed in such a way that it can readily be extended or modified. Furthermore, such changes need to be possible within the structure of the existing dialogue; if the established formats and procedures are altered then operational activities will be disrupted.

3. Is the system designed to avoid errors as well as detect them?

Does the system operate in such a way as to encourage and assist the input of good data as well as preventing the input of bad?

4. Is the system efficient and economical?

Can data be entered and files manipulated with the minimum number of key-depressions compatible with the ease-of-use and ease-of-learning criteria?

5. Is the system effective?

This is not the same as 'efficient'; the most efficient system can be totally ineffective when it comes to solving the business problems for which it was intended.

6. Is the system adaptive?

Artificial intelligence techniques have now reached a level of maturity which justifies their introduction into routine commercial applications. A particular case is the development of systems which are able to learn from experience; by analysing patterns of good and bad data (as determined by the user) to decide for themselves what is good or bad. Such techniques can also be applied to making the dialogue itself more adaptive to the idiosyncrasies (or needs) of individual users.

7. Is the system helpful?

Is the system capable of learning from the user? Usually error messages are directed at telling the user what he cannot do. A smart system always provides constructive advice. In many cases, this can be implemented through the use of HELP facilities.

8. Can the system be 'personalized'?

When we talk about 'the user' we usually mean 'the user group' or some notion of 'average'. One of the things that makes people more interesting than computers is that they are not produced to some standard specification and the range of their experience and skills will vary considerably. How easy is it to modify the system to meet the needs of each individual user? Does the system do this automatically?

9. Is the system user-modifiable?

One way of overcoming the program maintenance problem described earlier is if the user can learn from the system. Usually error messages are directed at telling the user what he cannot do. A smart system always provides constructive advice. In many cases, this can be implemented through the use of HELP facilities.

10. Were the users (actual or potential) involved in the design of the system?

No one has yet discovered a means of forcing users to accept a system with which they do not identify. The key question is - do the users describe it as 'our system'?

This new series will I hope encourage developers to produce systems which meet the above criteria; I hope, too, it will help users to ensure they get the system they have in mind.

I recently received the following message from an IBM System/34; KAD-3000 HELP KEY NOT ALLOWED.

ED NOW

If you have ever introduced such a message in one of your systems, you have failed. Think about it.

I would be pleased to hear from any reader who can offer examples of both good and bad human factors in systems design. Write to me c/o The Editor, PCW.
Introduction

Steve Kemp, one-time shift leader on a large computer installation, went into the intruder alarm business some four years ago, thinking his computing days were numbered. Soon, however, business had grown to such a size that he and partner Bill Gainford began to feel the need for their own computer — if only they could afford one. Imagine then Steve’s joy when he was called to install burglar alarms in some very well-known microcomputer stores. He found that while he had been busy getting his business off the ground the price of computing had been dropping at such a rate that he could now afford one of his very own; partner Bill agreed on going ahead, leaving Steve to the gory details.

The company

A1 Security Systems is a small ten-man firm specialising in intruder alarm systems for home or business premises. Based in Harrow, they install, repair and service equipment anywhere in Greater London and the Home Counties and, at the time of writing, have some 500 customers on their books. Most people enter into a maintenance agreement which involves A1 visiting them at regular intervals to service the installation. A small number of clients don’t have maintenance agreements but A1 still keeps an eye on the interval between visits and sends a reminder letter if a system check is due.

Three main types of protection are offered: perimeter, trap and volumetric. Perimeter protection involves a series of wires, magnetic switches and inertia sensors which trigger an alarm if an intruder attempts entry. Trap protection is provided by a series of pressure sensitive mats and door contacts, while volumetric systems comprise an arrangement of beams aimed at the area to be protected. Any interference of the beam’s echo is detected by the sending device and the alarm sounded.

The way it was

As Steve’s business grew so did the paperwork . . . indeed it had reached a point where there was literally no end to the day’s work. All statements were being written by hand, and in total that was consuming three days out of every month; VAT returns were the traditional headache taking an enormous amount of time and effort, and daily maintenance schedules had to be typed to ensure that the engineers actually arrived at the right premises to service the alarms. There were, of course, many other aspects of the business in which sheer volume of paperwork threatened to engulf Steve, but that wasn’t all — the work was eating up something like £20,000 of materials each year, all of which needed controlling. Items frequently went out of stock because of the difficulty of remembering when to place orders to take into account delivery lead times and consumption. One option would have been to increase the number of staff, but this would have meant moving into larger premises, with all the associated expense, not to mention the cost of an additional person. Clearly, something had to be done and it was with this realisation that Steve found himself looking longingly at Apple’s, Commodore’s and Tandy’s offerings.

The decision

Once Steve had developed the taste for microcomputers he couldn’t really wait for one of his own. He had reached the stage where he was working solely on the admin side of the business with no time to go out installing alarms any more. While Steve was upset greatly, he did feel that his job was getting boring and some of the fun was going out of life. He sat down and tried to think of the most beneficial uses to which he could put a computer in the business and decided that, above all, a word processing system would be very handy to help him thrash out installation specifications far more quickly. After all, there are only so many variables in a burglar alarm specification — the rest is common paragraphs. One of A1’s clients turned out to be the Cream Microcomputer Shop in Harrow. Run by Alan and Jackie Savage, it specialises in ITT, Apple and Commodore products as well as a range of books, software and computer accessories.

Remembering this, Steve toddled along to Cream and was promptly per- suaded that the ability to control his stock, maintenance contracts and sales ledger would be a better place to start, with the word processing coming along later. Steve saw the sense of the proposals and, once shown the packages available on the Apple, he was quite convinced. He realised that the level of service to his clients would rise — partly because having the stock available and also because the computer could remind him whenever anyone was due for a maintenance call. He would also be able to maintain accounts far more easily because, with a computer system, data need only be captured once whereas with a manual system one has to continually re-enter the same figures in different ledgers. He also saw the computer as a far more secure way of holding sensitive information about clients and their types of installations. Finally, of course, he noted that a computer represented a significant tax loss. Apart from these wholly rational reasons for purchase there is some feeling that once Jackie — the ‘wife’ part of Cream’s team — had spun her feminine wiles, he actually stood no chance of escape anyway!

That was why Steve bought a computer, but why Apple? Well, he found the compactness and modularity of the equipment a distinct advantage, especially as he works in rather cramped offices. This, he figured, would allow him to scatter the various parts of the computer around a bit (in fact, his monitor ended up on a shelf and his printer on a brace of filing cabinets). The other main influencing factor was the sheer professionalism of the packages offered. All in all he felt confident with the whole deal, the packages, the equipment and the support offered by Cream.

Getting under way

One Wednesday in early January Steve convinced partner Bill of the need to buy. Bill agreed and by Saturday Steve had paid around £4100 for software and equipment. It was early days for Cream then and they had yet to reach the hallowed status of authorised service centre for both Apple and Commodore products; they, themselves, had to put the money for Steve’s machine ‘up front’. Steve understood this but when he told Bill what he’d done, Bill wanted to cancel the order. Steve procrastinated the next day he was rewarded by Cream announcing the arrival of the equipment.

On the following Wednesday it was installed and Steve began loading the sales ledger details; on Friday the machine fell over and he lost all the records he’d loaded. Most of Saturday was spent studying the manuals! Steve had learnt in a rather unfortunate way the need to take security copies.

He started again and spent the next two weeks of evenings and weekends loading his sales ledger file with customer details — some 500 records. The next task was to load details of all the maintenance contracts. Unfortunately, just as he was typing in the 200th record, the system reported that he’d run out of disk space. Gulp! He had to start again — again. This time, though it was the package that was at fault, there was something wrong with the record deletion function. Steve has now had to stop deleting records while the package is modified.

200th February everything was on disk, security copies had been taken and the computer
The system

The system is built around four master files - sales, maintenance, stock and suppliers. The sales ledger is used to maintain records of all customers who have entered into a maintenance agreement. The maintenance file contains details of every alarm installed whether the customer has a maintenance contract or not. The stock records speak for themselves (at least so far). The most important 200 stock items are held on disk to ensure that the system remains useful. All in all this is a very useful package.

The Cashier package

The computer system that Steve uses is a 48k Apple II with Applesoft, two disk drives, a Hitachi black and white monitor and a Printerm 879 dot matrix printer. He has battled with a number of early teething problems which were swiftly sorted out by Cream and Microsense but one intermittent fault remains on the printer, causing it to produce absolute gibberish from time to time.

Taking the Cashier package first - this was written for Apple by one of Stephen M. Williams and converted in the UK to suit the British way of working. Unfortunately, not all the conversion work was successful for example, to start with, name and address sorting caused a great deal of confusion. Steve says that once you've figured out the way it works then you can live with it, but it was a real nuisance at the beginning. Other than minor irritations (which have nothing to do with the original package) the Cashier system is very good.

It allows Steve to enter all his daily customer transactions, as well as stock receipts and issues. He can produce orders on suppliers, change stock prices and print daily, monthly and year to date totals of cash and sales. All these facilities, and more, are offered by the Daily Transaction module of the Cashier package.

Other modules enable maintenance of the data files and the index file - which keeps control of invoice and purchase order numbers, cumulative sales figures as well as system constants such as configuration details, VAT rates and passwords. The system also contains a printing module which allows the production of the following reports: product name and address list; these will print in any sequence and according to any selection criteria. This last report is most useful to Steve because he can print details by area of customers due for maintenance, thus greatly simplifying the daily task of preparing job sheets for the engineers. It's worth mentioning that, in order for this system to work, the addresses have to be held with the street first followed by the building number in the last five characters of the address. For example, the software will group together all of the 'Broadway' records with the building numbers in ascending sequence. Steve says that the only thing you have to be careful of is that you always enter the names of streets, towns and counties in exactly the same format.

Looking now at the file details, each customer record contains the name, address, telephone number and date of last visit. This last field was intended to mean the customer's last visit to the shop but Steve uses it to show when the alarm was last serviced. The supplier record contains a key, the name and address, the telephone number and the date of the last activity.

The stock record is the largest in the Cashier system, containing the following fields:

- Item Number
- Supplier Key
- Manufacturer's Stock Number
- Item Description
- Unit Cost
- Selling Price
- Stock On Hand
- Minimum Purchase Order Quantity
- Minimum Stock Level
- Last Change Date
- On Order Quantity
- Last Order or Delivery Date
- Last Order Quantity
- Last Order Date
- Customer Back Order Quantity
- Minimum Stock Level
- Minimum Purchase Order Quantity
- Turnover Quantity To Date
- Sales Value To Date
- Should the stock level drop below the minimum during any transaction then the computer hoots and flashes a reorder warning on the screen.

All in all this is a very useful package which, space allowing, I'd love to spend more time on. Instead, though, I shall move on to the Sales Ledger package which Steve uses to control the money side of the business.

Like the Cashier, the Sales Ledger package is a nice meaty one with lots of facilities, this time designed for the UK marketplace by a British company - Computech. The system allows the posting of invoices, credit notes, cash received and cash payments. All transactions are held on disk to enable production of full statements and audit trails. From time to time the Transaction File needs to be purged to free some disk space, so Steve ensures that all the transactions are safely copied to a security disk beforehand.

The package has a few odd quirks, some of which are being corrected by Computech at the time of writing. One of them manages to clear the turnover to date each time an account is rendered - perhaps there is a reason for it, but I'm biased if I can think what. On the statement run it produces statements even when the account balance is zero - a bit of a nuisance, not to mention a
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In addition to the above, the package DPATCH, ZAP, TDISC, RDISC, LABEL and SPACE follows:

- Respects.
- Proved very useful and, without going for any. It can't be restarted from where it went wrong, so it's a waste of trees! Also on the statement of cash, it never stops working.

Computech's Disk Utilities have proved very useful and, without going into too much detail, they are as follows:

- SPACE: Reports the space remaining on any disk
- LABEL: Reads, writes or updates a disk identifier
- RDISC: A non-destructive read test. Steve uses it whenever he gets a media error.
- TDISC: A destructive read/write test — used if the disk fails the RDISC test.
- ZAP: Zeroes all unused sectors — used after disk initialisation.
- DCOPI: The most useful function — copies a disk bit for bit, performing a read after write check as well.
- DPATCH: A naughty facility which enables modification of data held on disk.

In addition to the above, the package contains a disassembler and a couple of memory dumping programs.

These three packages enable Steve to look after his immediate system needs. He plans next to get a purchase ledger accounting system going, followed by a word processing system to enable him to prepare survey reports, quotations and standard letters.

One final point regarding these packages — they're all very well documented. Computech even manages to add a little humour into the proceedings with comments like "Should you type 'GO TO HARROGATE' or some such expression ...", or "In case you forget what you're doing, like entering cash, or eating an apple ...". Not everyone's cup of tea admittedly, but I found it refreshing.

**Conclusions**

Asked to identify the disadvantages of his system, Steve is hard pressed to find any. He does say that media errors are a constant risk and that security copies of all vital information must be taken regularly. He also says that the taking on of files is an enormous workload which shouldn't be underestimated. He expects it to be a full year before all his records are on the system.

On the benefit side, he understands that this has been very straightforward and few hiccups. Steve's previous computing experience has clearly helped, but the fact that he went for proven packages must have been the key to this very smooth implementation. He has, of course, that he has had to bend his business to the machine's way of working, but this doesn't seem to be as much of a problem as some people might think.

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The world of computer graphics takes a step nearer general availability thanks to the falling cost of memory and the new high resolution graphics card from Research Machines for the RML 380Z. Sheridan Williams reports.

I have to admit that I thoroughly enjoy reviewing equipment, and testing the hardware and software. But on this occasion, reporting on the Research Machines 380Z with high-resolution graphics board, the problem comes in trying to do justice to the HRG board in words; graphics are, after all, a very visual aspect of computing. For this reason all the remarks made about the graphics are subjective — although I have scattered this review with photographs to try and illustrate what I mean.

A problem that could not be overcome was that of movement. This system is powerful enough to allow virtually continuous movement of pictures; for instance animation, consisting of around 10 changes of picture per second, gives a flickering but obviously moving picture. How does one show that in print?

Research Machines make only one computer system — the 380Z and although it’s not my brief to review the whole system, I should mention a few aspects in order to make this review readable to those who are unfamiliar with the machine.

The 380Z is widely used throughout Britain by schools and colleges. It's considered to be one of the most suitable systems that can be used in education, for reasons that are largely beyond the scope of this article. Briefly, however it can be bought in any version starting with the 16k cassette based system and leading up to a 64k 8" floppy disk system with the high resolution graphics board; it can be expanded in easy stages as and when money allows.

The 380Z supports Basic, Algol, and Fortran and is building up a collection of applications software, although where you are at the moment. The machine uses the disk based CP/M operating system so A level students can learn a good deal from it. I know many other micros have these advantages, but I’m not here to argue the particular pros and cons of the 380Z.

The standard graphics capability of the 380Z is now termed low-resolution, although it has an 80 x 60 display. It uses the Prestel/Ceefax/Oracle system of displaying shapes and pictures, these being made up of a 3 x 2 grid for each character position. This is combined with an ideal plotting notation (in Basic) to make quite a powerful graphics capability in its own right.

Plotting in Basic is done using the PLOT X,Y,C command. The screen origin i.e. PLOT 0,0,C is conveniently placed at the bottom left-hand corner . . . far better than the top left corner. Also graphs may be plotted without having to fiddle the Y coordinate. The third parameter is the ASCII code of the character to be displayed. For example PLOT 10,30,65 will place an 'A' in position x = 10, y = 30.

The high-resolution graphics pack-
fitting instructions and within five minutes everything was working.

Although I specifically asked for Basic (which I thought would be of more interest to readers than either the Fortran or Algol versions which are also available) I was also given some programs written in Algol and was able to run them; I couldn't write any as I had no Algol compiler. Basic version 4 (an enhanced version, that's due for general release shortly) includes some very useful features that relate to both the high resolution graphics, and to ordinary Basic:

GET is a command that will look at the keyboard buffer before returning; GET(0) will look at the keyboard to see if a key has been pressed. PUT(10) will wait for that many hundreds of a second before returning; and GET# 10 will GET from device 10.

PUT is similar to print and will output characters, for example PUT 12 will clear the screen; PUT 12, "HELLO", 255 will clear the screen then display 'HELLO' followed by a white blob.

The low resolution graphics have been enhanced too:

LINE X,Y,I will draw a line from the previous position to position x,y at intensity I. If I is 0 a blank (invisible) line will be drawn.

POINT(X,Y) looks at the point x,y on the screen and will return a 0,1 or 2 or the ASCII code for the character at that point.

OFFSET(X,Y) returns the actual character rather than its ASCII code.

The rest of the commands refer to the high resolution graphics. As you will see they are very comprehensive and are identified by the CALL statement:

CALL "RESOLUTION", R, B Must be the first call to HR graphics. R=0 means high resolution and R=1 means medium. B is the number of bits per 'pixel' (a pixel determines the intensity of a point).

CALL "PLOT", X,Y,I Plot a point at X,Y with intensity I. I may have a value from -15 to 15 depending on the resolution and the value of B in the RESOLUTION statement.

CALL "LINE", X,Y,I Draws a line from the current position to the point X,Y, at intensity I.

CALL "FILL", X1,Y1,X2,Y2,I Fills a rectangle specified by the points X1,Y1 and X2,Y2 at intensity I.

CALL "COLOUR", I,N has other versions and can be used to specify colour settings.

CALL "SETCOL", N,I is similar to COLOUR except that the effect of this call is delayed until a call to VIEW is made.

CALL "VIEW" Transfers the colour changes as specified by the SETCOL statement.

CALL "UPDATE", P, V In medium resolution there are two pages of memory which can be written to or displayed independently. P specifies which page is to be written to by subsequent calls to PLOT, LINE, and FILL. There can also be 2 or 4 views of each page of memory depending which mode you are in.

CALL "DISPLAY", P, V specifies which page and view are to be displayed.

CALL "CLEAR" clears the current page and view.

CALL "OFFSET", X,Y changes the coordinates of the bottom left hand corner from 0.0 to X,Y and can be useful when plotting with the origin in the centre of the screen.

CALL "LOAD" and "GSAVE", A and "GLOAD", A are available only on disk systems and allow the saving of pictures on or the loading of pictures from disk.

Many people will feel that Algol and Fortran could provide faster drawing capabilities than Basic because they are compiled not interpreted. In fact this is not so as the CALL statement links a machine code subroutine into Basic — which of course will run at full machine speed. Line drawing is virtually instantaneous and filling rectangles is quite fast, too. I see no disadvantages to Basic for accessing these graphics.

I was supplied with quite a range of programs with which to assess the system's capabilities and I've included pictures of some of my favourite ones, although they were all impressive.

DEMO A collection of programs showing all the facilities of the high resolution graphics.

REVOLUTION Written in Basic, this shows a moving picture, or rather a revolving shape. It fills eight separate pages and then displays them in sequence giving the impression of movement.

CUBISM Written in Basic, it will draw cubist pictures although the effects are somewhat lost in black and white because many of the colours appear the same. The picture constantly changes which makes it fairly compulsive to watch, especially in colour.

STAR Written in Basic it draws n pointed stars. Each point of the star is joined to every other point.

3D Certainly the most interesting of all and written in Algol. Because I wasn't provided with source code I'm afraid I couldn't look at the program — only the object (intermediate) code. The program displays a church as a three-dimensional line drawing, and then (slowly at first) rotates it while zooming back. Later it changes from orthogonal to isometric projection and then zooms again, This program certainly shows off the graphics to good effect.

There were many other programs supplied but I thought instead I'd spend some time writing a couple of my own to find out how easy it was to use. My first attempt was to display an analogue clock face, together with real time movement. As I didn't have the real

RML, a high resolution graphics board for the 3802.
time clock board I had to find the correct display rate by trial and error. I also tried writing the program using only one page or view, whereas in hind-sight it would have been easier to be plotting the next increment in time while displaying the previous one. I started with the 'second' hand, and concluded that if the second hand posed few problems then I would incorporate the hour and minute hands later - using different colours for each of the hands.

I started by drawing a circle in HR, which was easy; then I displayed the numbers 1 to 12 in their correct positions using low resolution, again quite easy. Next step was to draw a straight line from the centre of the clock face around the face in increments of six degrees, thus stepping the hand in one second intervals. This would be easier than 'sweeping' the hand round. At the same time as plotting the hand I had to 'unplot' its last position. This wasn't too difficult and after about an hour I had quite a good working stop-watch. I discovered that by not unplotting the hand I got an effect similar to that used on clocks on TV showing elapsed time at football matches. I then enhanced this to show marks in the white swept area every one second. The verdict after writing this program is that the graphics are fairly easy to get used to, but they do give you sleepless nights.

The next task was to modify an existing low resolution program. I chose a program that plots mathematical functions. It's one that has been in constant use by me as a teaching aid and is quite impressive already in its low resolution mode. It'll plot any function whether expressed in cartesian, polar, or parametric form and will scale the output to fit the screen exactly.

Some of the plots are fascinating, especially the polar ones like spirals, cycloids etc. The modifications took very little time and soon I was left with a superb tool (What can I say? — Ed.) I've included a picture of a square wave as an example of its plotting capabilities.

Among the programs supplied by Research Machines were a set of four programs by Chelsea College and marketed by publishers Edward Arnold: they are currently on display at the Science Museum in London. The four programs are orbit simulation, siting of windmills, life ecology. They were all good and adapted to the HR graphics; apart from the orbit simulation, each of the remainder could be used for many hours in the classroom, provided suitable notes are available.

Another application for the graphics, provided a disk system is available, is the ability to save pictures for later use. Briefly, a picture is transferred from graphics memory to a previously reserved area of main memory called a cache. The memory required is declared within the program as a byte array, and this cache data is transferred to and from disk using the facilities built in to Basic, Algol and Fortran.

The manual supplied with the graphics was quite good; it leads you through the whole package in easy steps and gives short examples at each stage. I found only three errors, all text errors, which was easy; then I concluded that there are a deliberate errors, and that the correct version is at the end of the manual. The appendix contains some sample programs which for me were very helpful.

The manual also tells you how to use the graphics board as an additional 16k of memory when it isn't being used for graphics: it occupies a 16k segment from 7C00H to BBFFH inclusive and in order to switch from graphics to memory mode bit 4 of port 0 needs to be set.

A point brought out in this review is the necessity for a good monitor display. With the resolution of plotting available, even the slightest distortion can show up. You may not notice it in the enclosed pictures because of the camera angle, but even on a high quality Hitachi 17" monitor the screen distorts in the bottom left hand quarter of the screen. Taking measurements of plotted lines of the same length indicates around 10% distortion — which shows up in circles especially. This is a minor point but one which requires consideration if any measurements are being taken from the screen.

I thought that while reviewing the high resolution graphics it would be a good idea to test a flat-bed graph plotter as well — after all you don't need the HR graphics if you have a plotter, and most plotters have resolutions that are better than the graphics tested. Plotters would, however, be as good for displaying information. With this in mind I approached Bryan's Southern Instruments Ltd of Mitcham, asking to test their 'Computergraph' plotter (because I needed to think why the programs didn't work). I'd even recommend that Research Machines leave them in and put a note at the side saying that there are a deliberate errors, and that the correct version is at the end of the manual. The appendix contains some sample programs which for me were very helpful.

The HR board costs £299 for black and white, plus another £100 for colour. It'll work on any 380Z with 16k of memory although 20k is virtual.-essential. Research Machines will modify any existing C4100 machines that are still around for a small nominal charge.

The HR graphics board greatly extends the usefulness of the 380Z and I came away with entirely favourable impressions. Educationalists will have to get their fingers out now and start developing some useful software for it. I'd be interested to see the results, and indeed I could make anything good available to other users at a nominal charge — some of the proceeds to go to the author of course.

PCW 79
Malcolm Banthorpe offers a simple program for evolving three dimensional representations of trigonometrical and other functions on any computer which can plot graphics to a reasonable degree of resolution. The program listing shown is written for an ITT 2020, but can be used on many other computers with very little modification.

The program originally evolved out of an investigation into possible means of representing three dimensional curved surfaces on a VDU. A wide variety of functions can be plotted as long as their range of values is restricted, as described later. The results are frequently surprising (at least to a non-mathematician like me), sometimes beautiful (having an almost organic form) and nearly always interesting.

To understand how the program works, imagine a disc (Fig. 1) crossed by a series of parallel chords. If the disc is viewed obliquely it can be represented in two dimensions by an ellipse (Fig. 2). The vertical displacement $f$ of point $P$ from the chord $AB$ is a function of the distance $r$ of the point $Q$ (which lies on $AB$) from the centre of the disc. Now (if you're still with me), imagine a series of such points plotted along each chord, $f$ always being a function of $r$, e.g. $f = \sin (r)$. The result would be a family of overlapping curves. The program determines whether or not each point would be visible if we were actually viewing a three dimensional surface. Reference to the photographs should help to clarify how this actually works out in practice. As you can see, the program uses a series of curves parallel to the frontmost half of the circumference of the disc rather than a series of chords. This simplifies the programming and gives an arguably better display.

If you've been able to follow the explanation so far, the program listing should be more or less self-explanatory. The function to be plotted is written as line 80 and can be changed as required. Line 75 ensures that $R$ will always lie somewhere in the range 0 to 1. Care should be taken so that $F$ will evaluate within the range -1 to 1 as $R$ varies from 0 to 1.

**Notes for use on other computers**

The program has been written as far as possible in 'standard' Basic. The only possibly unfamiliar terms are as follows:

- HGR sets high resolution graphics mode
- HOME clears the four line text area of the screen
- HCOLOR = 3 sets the plotting colour to white
- VTAB (24): List 80 prints the function being plotted, at the bottom of the screen. (This may be omitted, parti-
cularly if resolution is limited, so that the whole screen can be used for plotting.)
HPLOT is equivalent to PLOT or SET in other versions of Basic. On computers lacking such a function, it will be necessary to write a routine to POKE a character to the appropriate screen location. H and V in line 10 must be set to the horizontal and vertical resolutions of the system. Hence to run the program on an Apple II the only modification required is to set H to 279 in line 10.

As mentioned earlier, the program can run on many different computers but obviously the higher the resolution of the graphics, the better the display. A TRS-80 should give worthwhile results and tests with ITT's low resolution mode (40 x 40) have indicated that PET should also be suitable for experimentation, particularly if a 'double density' (80 x 50) routine can be employed. On lower resolution systems best results will be obtained plotting simple curve functions.

Line 105 assumes that the point with coordinates 0,0 is at the top left hand corner of the screen. If, as on some systems, it is at the bottom left-hand corner then line 105 should be changed to:

105 M = Y: Y = Y1 + Y

This will prevent the image from being 'upside down'. However, as the surface displayed has no objective reality outside the computer, the question of just which side should be 'up' is open to debate. Have fun... and I'd be interested to see the results of any further experimentation.

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A major attraction at the Third Personal Computer World Show will be the first ever official World Microcomputer Chess Championship, held under the auspices of the International Computer Chess Association.
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The Third Personal Computer World Show is at the Cunard International Hotel, 4 - 6 September.
Objectives

This month I'm going to look at what stock can spell disaster and getting the balance right is one of the important ingredients of success and profitability! This month I'm going to look at what the packaged market has to offer in this important field.

Functional requirements

What should we expect from a stock control system?

1. The ability to create, delete and amend stock items. Additionally the movement of stock in or out should be recorded.
2. If our business depends on the transport of goods to our customer, either at home or abroad, then details such as location, weight and size of stock items will be essential for the production of despatch notes, delivery plans, customs declarations etc.
3. Whether we 'grow our own' or buy in items, we probably want to have information on the source of goods for use in purchase or manufacturing orders.
4. If we operate an 'off the shelf' business we will want to see details of orders taken to enable us to allocate goods to our customers.
5. Whether we manufacture or buy-in goods we will probably need to be able to group products for analysis purposes.
6. We will certainly need to see prices, VAT and discount information held in the system for use in stock valuation, invoice production etc.
7. And, finally, we will expect enough information to allow us to produce analytical management reports to enable us to keep well ahead of developments and take fast action should anything go amiss. In the next two sections, I shall look at nine packages to see how they measure up to the requirements; some of these were reviewed last December — in those cases I'll comment on any changes made since then.

PETSOFT STOCK CONTROL

This is also available from Petsoft and its dealers. The cost is £50 and it has the same minimum hardware requirements as Stock with Invoicing. These packages are very similar, the main difference being the invoicing facilities. Petsoft rely on their dealers to provide installation and training for all of their packages although they'll correct any bugs free of charge. Petsoft do not undertake any customisation themselves but their dealers are usually in touch with local software houses and will recommend customers accordingly. The clear operating instructions supplied with this package are fine for the first time user, but not really detailed enough for the already initiated.

Finally, no details available as yet, but Petsoft plan a mid-May release for their new Superstock.

STOCK CONTROL SYSTEM — MICROTEK

This is available from Microtek Computer Software, Orpington (Orpington 26803) and has been designed to run on two different types of hardware. The minimum configuration is a North Star Horizon with 40k RAM and two double density floppy disks — for a single user system. It will also run on the IMS 8000 for multi-user applications. Microtek has a basic program whose file structure can be altered to suit the user's requirements — at a cost from £250. The cost of minimum hardware is £1795. Free advice and guidance is provided on a continuous basis and full installation and training is available. Microtek offers full software maintenance and can arrange, too, for hardware maintenance. The company's packages are all fully integrated and they reckon to provide a full business system from £4500.

S.N.I.P.

This is the 'I' or Inventory control module of the S.N.I.P. package — a fully integrated Sales, Nominal, Inventory and Purchase system. I've looked at both the Purchase ledger (February 1980) and the package as a whole in Integrated Accounts (June 1980). This module costs £450 as a stand alone item, and the full deal costs £550. The system is supplied with full operating instructions, systems specification and security disks and the documentation is ideal for the first time user. The minimum configuration needed is a 32k North Star Horizon with 360k diskette, VDU and printer for around £3725. The package can be obtained from Benchmark Computer Systems Limited, St. Austell (0726 61000) or their dealers in Liverpool, Microtech Computer Services Ltd. At the time of writing, Benchmark are looking for more dealers, so it might be worth asking if there is one in your area.

TRADER

This integrated Stock-Control, Invoicing and Sales Accounts package is available from Bristol Software Factory (0272 23430) or any of their 84 dealers countrywide. There are two versions — the dual disk at £300 and the quad disk at £360; both are designed to run on the PET 3000 Series. Minimum hardware requirement is 32k PET, dual disk drives and printer for £2160. The package is supplied with an instruction set which is very clear and concise and full instructions are held within the program. Bristol Software Factory provides any back-up so far as corrupted files or bugs are concerned and the price of the package does include any necessary customisation. Installation, training and maintenance is left to the dealer and so
may vary. Standard stationery designed especially for the Trader system is available direct from Bristol Software Factory. The capacity of the system is dynamically distributed between stock items and sales accounts up to a maximum of 2200 for the dual drive version and 4400 for the quad drive version.

ADVANCED BUSINESS SYSTEM — STOCK CONTROL
This package is available from Isherwood Business Systems, Luton (0582 416202) and their dealers in Birmingham, Bradford and London. Supplied on disk, it costs £350 as a stand alone item, although it’s also available as part of an integrated Stock, Invoicing and Sales System for £1000. It’s designed to run on a 32k PET with dual disk drives and printer for around £2000 and can take expansion up to 1 Mbyte. Isherwood will supply a complete system including hardware and software; hard-ware training is included in the price. They don’t feel that software training is necessary as the programs are all menu driven and are supplied with an ‘idiot’s guide’ to the system; however, should the need arise they will be only too pleased to help. All packages come complete with a lifetime guarantee against bugs, corruption etc. and Isherwood maintain an SOS service both by phone and on site if required. They also offer a feasibility study service for those who need it — at a cost of course!

The following packages were reviewed in December 1979 and any changes are noted below:

APPLE STOCK CONTROL SYSTEM
No changes here. It’s available from Microsolve, London (01-951 0218).

STOCKPACK STOCK CONTROL SYSTEM
This package is now available in extended TSC Basic, making it much faster to use. It can now be run on a multi-user system. Cost for the basic system (allowing for 700 stock items) is £25; it rises according to the increase in the number of stock items. Prices are available on request from South West Technical Services (Computer Workshop) London (01-491 7507)

GRAFFCOM STOCK CONTROL
Graffcom are in the process of updating their entire suite of programs and are hoping to hold the prices constant. I can’t report on any changes at the time of going to press but Graffcom will be happy to answer any enquiries (01-734 8862).

Known but not reviewed

Amplicon, Brighton (0273 608337)
Basic Computing/Micropute, Keighley (0535 65094)
Commodore Systems, Slough, Berkshire (0753 7411)
Graham-Dorian (Teredec), Camberley, Surrey (0276 62506)
Great Northern Computer Services, Leeds LS1 4DL (0532 450667)

T & V Johnson Microcomputers, Camberley, Surrey (0276 62506)
L & J Computers, London (01-204 7525)

Microdigital, Liverpool (051-227 2535) Micro Management, Frinton, Essex (02556 4592)

Tridata Micros Ltd, Birmingham B5 6BS (021 622 1754)

Vlasak Electronics Ltd, Marlow, Bucks (062 84 74789)

NB: A month before going to press the above companies were asked by letter to submit all relevant information on their stock control systems. Vlasak sent insufficient data for inclusion, none of the others have so far replied.

<table>
<thead>
<tr>
<th>TASKS</th>
<th>Petsoft with invoicing</th>
<th>Petsoft Stock Control</th>
<th>Microtek</th>
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<th>Advance Business System</th>
<th>Apple</th>
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VOLUMES

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<td>3000</td>
<td>3400</td>
<td>3000</td>
</tr>
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</table>

PCW 83
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... to save operational error ...

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PCW 84
The most expensive parts of a microprocessor system are the memory, peripherals, power supply and the boxes that hold them; for any fairly large system, the cost of the processor itself is almost insignificant. Thus with powerful Z80 chips now available for under £10, when the time comes (as inevitably it must) to add another 8k of memory, why not also add a different family of processor. The extra cost involved will be small when compared with the benefits it will undoubtedly bring. R. M. Yorston explains.

Why, you may ask, should I add a second processor to my system when the one I already have spends most of its time in a loop waiting for input from the keyboard? There are two main reasons. Firstly, there's the increased flexibility in being able to run the machine language of two different processors; this eliminates the need for laboriously translating useful software written for one micro to run on a system designed around another. By adding a Z80 to my 6800 system, I'm able to use readily available 8080/Z80 software with only minor patches for input/output routines (which would probably be required even on a Z80-based system).

A second advantage is that the system throughput may be increased without the difficulties and expense required to increase the speed of a single processor. The difficulties arise because of the care needed in the design of boards and backplane to work at the high clock frequencies which have to be used. The expense comes in when you buy the fast memory...essential if you're to take advantage of the processor speed. With two processors working at slow speeds, these problems do not arise. However, the advantages are replaced with the difficulty of writing software which will share the burden of work fairly between processors so that each is working as near to its full capacity as possible.

The 6800 system sees the Z80 board as 8k of static RAM and a write only control latch. The Z80 is held up whenever the 6800 requires to access either of these. The control latch functions are given in Table 1. Switching of control between the two processors is achieved using a signal (B) derived from IC2a, b, and IC15 from the active low enables for 1XXX, 2XXX and A206H and two of the outputs of the control latch. These outputs allow the RAM to be deselected and effectively removed from the address space of the 6800. The Z80 is not affected. This feature may be used to permit switching of 4k memory blocks and thus extend the memory of the 6800 beyond 64k. The signal (B) goes low when the master processor attempts to access the RAM or the control latch, unless the RAM has been deselected. (The output IC2a (A) goes low for a valid RAM access.) The RAM enables are derived off the Z80 board using a 74LS154 (Fig. 2). The A206H enable is obtained from the TTY card in my system (an ETI System 68), but any other suitably decoded address may be used.

The main system data bus and the Z80 are separated by the buffers IC2, 3. IC2 is enabled when the switching signal (B) goes low and IC3 when it goes high. The inversion required to enable IC3 is provided by one section of IC12, a 74LS158 inverting 2-1 line data selector. Thus only one of IC2, 3 is switched on at a time.

The address and control lines to the memory are switched through IC10, 11, 12, 13. Normally the Z80 address lines A0-12 are connected to the corresponding internal lines A10-12. The read/write line to memory is then obtained by ORing together the Z80 control lines MREQ and WR. The memory block select is connected to the Z80 A15. Because of this partial address decoding the Z80 sees the memory as residing in the first 8k, and at all other 8k blocks in the lower half of its address space. A15 is pulled high by R4 to guarantee that the memory is deselected when the Z80 address lines are floating. When the 6800 has control of the memory, its address lines A0-11 are used. A12 is provided by the 1XXX enable. Thus the main system sees the 8k of memory at 1000H-2FFFH. If OXXX and 1XXX were to be used instead of 1XXX and 2XXX the memory would be the first 8k for both processors. However, if

| Table 1 |
| b7 | b6 | b5 | b4 |
| 1 NOT USED | DESELECT UPPER 4k | DESELECT LOWER 4k | DISABLE INTERRUPT |
| 0 NOT USED | SELECT UPPER 4k | SELECT LOWER 4k | ENABLE INTERRUPT |
| b3 | b2 | b1 | b0 |
| 1 NORMAL OPERATION | NORMAL OPERATION | NORMAL OPERATION | NORMAL OPERATION |
| 0 WAIT | RESET | NMI | INT |
both were to be operated simultaneously, this would lead to conflicts between the Z80's restart routines and the 6800's locations used for direct addressing. The memory block select is just the signal (A) described above. The read/write line is just the corresponding signal from the master system bus.

The control latch consists of two 74LS75s (IC4,5). The clock signal to these is obtained by NORing together the A206H enable and the read/write line. Four of the latched bits go directly to control inputs of the Z80. Two more are used for the memory select function. One output is used and the final one is gated with the Z80 HALT output to provide a maskable interrupt to the master system. When it's required to interrupt the 6800 the Z80 executes a HALT instruction which stops further program execution and pulls the HALT output low. If the other input to IC7c is also low the signal is passed through the open collector gate IC8c. The bus request line of the Z80 is tied high by R3 in the present design. If desired, BUSRQ may be connected to the unused control latch output.

The clock signal for the Z80 is derived from the \( \frac{1}{2} \) line of the 6800 system. The signal is gated by IC7a with the output of monostable IC9 and then applied to the Z80 clock input via IC8d. The resistor R5 is required to provide the necessary high clock voltage. A7409 rather than a 74LS09 is used to sink the current from this resistor. The monostable is triggered by signal (B) when the 6800 wishes to access a location on the board. The pulse from IC9 holds the clock input of the Z80 high until the 6800 is no longer using the memory or control latch.

The timing diagram (Fig.3) shows how the Z80 clock is stretched when the signal (B) goes low. The minimum monostable period, \( t_{\text{min}} \), is determined by the requirement that control should not be returned to the Z80 until \( \frac{1}{2} \) has gone high in the cycle after the 6800 access. This allows the Z80 time to complete any memory access which was in progress when the master took over the bus. The minimum period is thus 1\( \mu \)s, assuming a 1 MHz clock. The maximum period is fixed by the specifications of the Z80 which demand that \( \frac{1}{2} \) should be low for at least 180 ns. Meeting this requirement gives \( t_{\text{max}} = 1.82 \mu \text{s} \). The monostable should thus be set up with a period of about 1.41\( \mu \text{s} \). This value is not very critical, though, and allows a tolerance of \( \pm 29\% \).

If the 6800 performs a valid memory access of the Z80's 8k block on each cycle the monostable will keep being re-triggered and \( \frac{1}{2} \) will remain high. This should pose no problems, as the Z80 is static by design and, unlike the 6800, does not forget its data if the clock is stopped. However, the specifications only guarantee a high clock pulse width of 200 \( \mu \text{s} \). Such an extended period of access is very unlikely. Even if the 6800 were to be executing a program from the Z80 memory there are many opcodes which contain cycles used for internal operations and therefore do not access external memory. These cycles would allow the Z80 to continue processing, albeit at reduced speed.

The circuit was constructed on a Eurocard size Veroboard. The 8k memory is on a separate Eurocard — as supplied by Transam for their Triton PCW.
computer. The Z80 board is connected to this by two ribbon cables that terminate in 16 pin DIP plugs. Notice that it's not necessary for the address and data lines of the Z80 board to be connected to the correspondingly numbered lines of the memory board. This simplifies the wiring of the interconnections. Lack of space on the board prevented the use of the full capabilities of the Z80. In addition to the partial address decoding mentioned above there's no provision for the use of input/output instructions or for jamming a restart instruction on the bus following an inter-
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  COLOUR = RED and PRICE is less
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Harrogate, North Yorkshire HG3 5DP
The ASCII character in the (A) register
bytes must be interchanged. This memory locations, the upper and lower
from one processor to the other through a corresponding 6800 instruction. This fact is not widely appreciated, and the mistaken impression is sometimes given that the 6800 is an inherently slower processor — because its maximum clock rate is 2 MHz rather than the 4 MHz of the Z80.

The program of Listing 1 provides a simple means to start the execution of a Z80 program. The CPX instructions are included to give the Z80 the three cycles it requires to perform the reset. Since the 6800 routine provided resides in the Z80’s memory block it’s not possible to use NOOP instructions to provide the delay because this would not allow clock pulses through to the Z80. The 6800 next sets up the control code for normal execution with interrupts enabled and then enters a wait for interrupt state. This effectively turns off the 6800 until the Z80 signals that it requires attention by generating an interrupt. After processing the interrupt, the 6800 returns to its waiting state. Following the reset the Z80 starts execution of the program at location 0H. In a more complex application, in which the two processors were to run simultaneously, the WAI instruction could be replaced by a jump to the 6800’s program.

Since the Z80 has no peripherals, all its communication with the outside world must be dealt with by the master processor. Two simple interface routines are given in Listing 2. The first of these sets up a flag in location 01005H (1005H) and then interrupts the 6800 by executing a HALT instruction. The 6800 interrupt routine of Listing 3 examines the flag location. If it finds the value FFH it calls the keyboard input routine and stores the character thus obtained in the same location. It then generates a non-maskable interrupt to the Z80 to remove it from the HALT state. The Z80 NMI routine is a dummy, consisting of just a return from HALT state. The Z80 NMI routine is a non-maskable interrupt may only be used when the processor is not apparent to the user. All applications of the multiprocessor so far have involved only one of the two processors being active at any given time. One possibility currently being investigated is that of playing Space War with the 6800 while the Z80 chess program ponders its next move!

What possible applications are there for a multiprocessor system? The standard response to such a question would be that the applications are only limited by your imagination. This may frequently be taken to mean that the author has no idea what to do with the thing! I find the main use of the system is in running Z80 software which would otherwise be of no use to me. I now have a Z80 chess program and a text editor, in addition to my library of 6800 software. The text editor is interfaced to a coresident 6800 self-assembler which allows me to enter and edit source code using the Z80 and then assemble the resulting text file from memory with the 6800. The switching between processors is not apparent to the user.

Listings:

**Listing 1**

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<th>Instruction</th>
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<td>104A 860F</td>
<td></td>
</tr>
<tr>
<td>104C AC01</td>
<td></td>
</tr>
<tr>
<td>104E AC01</td>
<td></td>
</tr>
<tr>
<td>1050 A700</td>
<td></td>
</tr>
<tr>
<td>1052 0E</td>
<td></td>
</tr>
<tr>
<td>1053 3E</td>
<td>LOOP</td>
</tr>
<tr>
<td>1054 20FD</td>
<td>LOOP</td>
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**Listing 2**

<table>
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<tr>
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<tr>
<td>0008 3EFF</td>
<td>RST1</td>
</tr>
<tr>
<td>000A 320500</td>
<td></td>
</tr>
<tr>
<td>000D 76</td>
<td></td>
</tr>
<tr>
<td>000E 3A0500</td>
<td></td>
</tr>
<tr>
<td>0011 C9</td>
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</tr>
<tr>
<td>0018 320500</td>
<td>RST3</td>
</tr>
<tr>
<td>001B 76</td>
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<tr>
<td>001C C9</td>
<td></td>
</tr>
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**Listing 3**

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<tr>
<td>1068 B61005</td>
<td>INT68</td>
<td>LDAA $1005</td>
</tr>
<tr>
<td>106B 81FF</td>
<td></td>
<td>CMFA #RFF</td>
</tr>
<tr>
<td>106D 2608</td>
<td></td>
<td>BNE PRINT</td>
</tr>
<tr>
<td>106F BDE1AC</td>
<td></td>
<td>JSR INEE</td>
</tr>
<tr>
<td>1072 B71005</td>
<td></td>
<td>STAA $105</td>
</tr>
<tr>
<td>1075 2003</td>
<td></td>
<td>BRA DONE</td>
</tr>
<tr>
<td>1077 BDE1D1</td>
<td>PRINT</td>
<td>JSR OUTEE</td>
</tr>
<tr>
<td>107A 860D</td>
<td>DONE</td>
<td>LDAA #90D</td>
</tr>
<tr>
<td>107C B7A206</td>
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<td>STAA $A206</td>
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<td>LDAA #80F</td>
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<tr>
<td>1081 CE0000</td>
<td></td>
<td>LDX #0</td>
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<tr>
<td>1084 AC00</td>
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<td>CPX 0,X</td>
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<td>1086 B7A206</td>
<td></td>
<td>STAA $A206</td>
</tr>
<tr>
<td>1089 3B</td>
<td></td>
<td>RTI</td>
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**Figure 3**

The ASCII character in the (A) register bytes must be interchanged. This necessary because the 6800 stores 16-bit values with the most significant byte first, followed by the least significant while the Z80 reverses this order.

What possible applications are there for a multiprocessor system? The standard response to such a question would be that the applications are only limited by your imagination. This may frequently be taken to mean that the author has no idea what to do with the thing! I find the main use of the system is in running Z80 software which would otherwise be of no use to me. I now have a Z80 chess program and a text editor, in addition to my library of 6800 software. The text editor is interfaced to a coresident 6800 self-assembler which allows me to enter and edit source code using the Z80 and then assemble the resulting text file from memory with the 6800. The switching between processors is not apparent to the user. All applications of the multiprocessor so far have involved only one of the two processors being active at any given time. One possibility currently being investigated is that of playing Space War with the 6800 while the Z80 chess program ponders its next move!
### Apple Price List

**Product Code** | **Description** | **Retail Price (£)**
--- | --- | ---
A2S1016P | APPLE 16K VIDEO OUTPUT ONLY | 655.00
A2M003 | DISC DRIVE WITHOUT CONTROLLER | 349.00
A2M004 | DISC DRIVE WITH CONTROLLER | 695.00
A2M016 | 16K ADD ON RAM |

**Cards & Accessories**

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
<th>Retail Price (£)</th>
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</thead>
</table>
A2B003 | PROTOTYPE/HOBBY CARD | 15.00
A2B002 | PARALLEL PRINTER INTERFACE CARD | 104.00
A2B003 | COMMUNICATIONS CARD | 330.00
A2B005 | HIGH SPEED SERIAL INTERFACE CARD | 113.00
A2B006 | PASCAL LANGUAGE SYSTEM | 299.00
A2B007 | CENTRONICS CARD | 130.00
A2B009 | APPLE SOFT SOFTWARE CARD | 116.00
A2B010 | INTEGER CARD | 116.00
MHPX003 | MOUNTAIN HARDWARE CLOCK CALENDAR CARD | 160.00
MHPX006 | MOUNTAIN HARDWARE SUPER TALKER | 11.00
MHPX007 | MOUNTAIN HARDWARE ROM PLUS BOARD | 116.00
MHPX015 | MOUNTAIN HARDWARE ROM WRITER | 101.00
E2B100 | EUROCK SCRUB CARD | 79.00
E2B101 | APPLE BLACK & WHITE MODULATOR | 14.00
E2B102 | A140 DATA ACQUISITION CARD | 80.00
16-5 | ALF MUSIC SYNTETIZER CARD | 142.00
16-5-7 | ALF TIMING MODE INPUT BOARD | 14.00
15-32 | ALF ALBUM MUSIC DISKETTE NUMBER ONE | 12.00
15-34 | ALF ALBUM MUSIC DISKETTE NUMBER TWO | 12.00
15-35 | ALF ALBUM MUSIC DISKETTE CHRISTMAS | 12.00
A2M0015 | HEURISTICS SPEECH LAB | 122.00
A2M0019 | PROGRAMMERS ADD 1 | 22.00
A2M0027 | AUTO START RAM SYSTEM | 50.00
A2M0039 | GRAPHICS TABLET | 462.00
E2B104 | HEURISTICS CONTROLLER 70 | 52.00
E2B105 | HEURISTICS SPEECHLINK 100 | 160.00
E2B107 | IEEE INTERFACE | 512.00

**Software**

<table>
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<tr>
<th>Product Code</th>
<th>Description</th>
<th>Retail Price (£)</th>
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A2D0005 | CONTRIBUTED SOFTWARE VOLS 3-5 | 60.00
A2D0006 | CONTRIBUTED SOFTWARE VOLS 1-2 | 27.00
A2D0009 | MICROCHESS 2.0 CHESS DISK | 15.00
A2D0010 | DISC UTILITY PACK | 15.00
A2D0012 | APPLE BUSINESS CONTROLLER PROGRAM | 340.00
A2D0013 | APPLE POST PROGRAM | 27.00
A2D0018 | APPLE BOWLING DISCETTE | 9.00
A2D0025 | APPLE CASHER PROGRAM | 194.00
A2D0026 | APPLE WORD PROCESSING PROGRAM | 42.00
A2T0013 | MICROCHESS 2.0 CHESS CASSETTE | 15.00
E2D001 | VISICALC DISK & BOOK COMPLETE | 95.00

**Documentation**

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
<th>Retail Price (£)</th>
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A2L001A | APPLE II REFERENCE MANUAL | 11.00
A2L002 | 6502 HARDWARE MANUAL | 9.00
A2L003 | 6502 SOFTWARE MANUAL | 9.00
A2L005 | APPLE II BASIC PROGRAM MANUAL | 6.00
A2L006 | APPLE II REFERENCE MANUAL | 6.00
A2L012 | DOS 3.2 MANUAL | 6.00
A2L018 | APPLE II BASIC TUTORIAL MANUAL | 6.00

**General Accessories**

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<tr>
<th>Product Code</th>
<th>Description</th>
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A2D0000 | (10) BLANK APPLE DISCETTES | 32.40
A2D0009 | VINYL CARRYING CASE | 16.00
ADLB | MINI DISC LIBRARY BOX | 2.64
ADSD | DISCOFLEX FILING CASE—MINI | 12.64
APP1 | APPLE DESK TWO TIER | 145.00
APP2 | PRINTER TABLE | 92.00
APPLETEL | APPLETEL SYSTEM | 99.00
DUSTAPP | DUST COVER FOR APPLE | 5.35
E2B013 | APPLEJUICE RESERVE POWER SUPPLY | 148.00

**Printers & Accessories**

<table>
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<tr>
<th>Product Code</th>
<th>Description</th>
<th>Retail Price (£)</th>
</tr>
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</table>
A2M0034 | SILENTYPE 80 COLUMN GRAPHICS PRINTER | 349.00
A2C001 | 10 ROLLS OF THERMAL PAPER FOR SILENTYPE PRINTER | 28.00
HUSH100 | MICROHUSH 100 PRINTER C/W APPLE INTERFACE | 266.00
HUSHPA | 16 ROLLS THERMAL PAPER 80FT LONG | 22.00
HUSHPAVE | 2 ROLLS THERMAL PAPER 80FT LONG | 5.00
TIGER/G | PAPER TIGER PRINTER WITH GRAPHICS OPTION | 98.00
TIGER/C | CONNECTOR CABLE FOR TIGER PRINTER | 9.00
TIGER/D | GRAPHICS SOFTWARE FOR TIGER PRINTER | 20.00
TIGER/P | TIGER PAPER 2000 SHEETS 11" x 9½' SPARE | 35.92
TIGER/ | TEXAS OMNI 810 PRINTER | 1450.00
IPE | PAPER 2000 SHEETS 11" x 15" SPARE | 14.06
IPE | PAPER 3000 SHEETS 8½" x 12½" SPARE | 14.85

**Printers & Accessories**

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
<th>Retail Price (£)</th>
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MA1/29 | 12" BLACK AND WHITE VIDEO MONITOR | 189.00
VAR10 | 9" BLACK AND WHITE VIDEO MONITOR | 127.00
VM906 | 9" HIGH RESOLUTION BLACK AND WHITE VIDEO MONITOR | 148.00
VMAC | CABLE FOR VIDEO MONITOR | 9.00

---

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Dealer/OEM enquiries welcome.

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Network Notes

Sign On

The first of an irregular series of reports aimed at keeping PCW readers updated on microcomputer communications in general and the Personal Computer Network (PCN) in particular — presented by David Hebditch.

Reaction to the PCN project has been good, which is more than could be said for my progress in getting the network properly established. Shortly after the launch at the PCW Show last year, I moved house but the Post Office failed to move with me. As a consequence, developments of essential software were delayed.

However, interest has been encouraging and already more than a hundred readers have expressed a willingness to participate in the network activities. A preliminary profile of these would-be communicators proves very interesting. As Table 1 shows, 27% of participants are PET users compared with 16% with Tandy TRS-80s, 13% with Nascons and only 10% with Apples. Although this may approximately reflect the penetration of the UK marketplace achieved by each of these suppliers, it doesn't relate to the availability of communications features on those systems. For example, the PET is the least easy to interface to a modem and full-duplex IEEE/R5232 interface boxes usually cost £185 or more without including full modem control. On the other hand, the Apple II does have 'official' serial interface for as little as £110, (depending on the mood of the dealer). As with the PET interfaces, however, this does not include full modem control facilities. The fact remains that it is much easier to get started in low-level data communications on the Apple than it is on the PET.

Similarly the TRS-80 has no Tandy-provided R5232 arrangement (although an acoustic coupler is available in the United States). I'm not too sure of the availability of serial interfaces for the TRS-80 from alternative suppliers; perhaps readers could enlighten me.

I understand that a very sophisticated (but low cost) communications interface will be available for the Nascom very soon.

Nearly 40% of the PCN participants have some kind of communications capability already (interface and modem or acoustic coupler and the rest plan to 'go-on-line' as soon as it is economically/technically feasible for them to do so.

Seven participants are from outside the UK (Holland, West Germany and Norway) and there's a fair sprinkling of Radio Hams and disabled people.

On the question of economics, a small annual fee of about £2 should serve to cover administrative costs. For participants wishing to make use of the PCN Service Centre, a one-time set-up charge of about £10 and a usage charge of £2 per hour seems likely. I'd appreciate some feedback on the acceptability of these rates.

In the meantime, I'm in need of some voluntary assistance in the development of the Service Centre software for such activities as Electronic Mail, Teleconferencing and so on. The prerequisite is experience with DEC RSTS-E and Basic-Plus along with the necessary hardware to dial-up and operate at 300 bit/s. The centre is in Central London and is available 24hrs/day 7 days/week. If you are willing and able to help out, please write to me c/o The Editor. In addition to 'Network Notes', I will contact PCN participants directly.

Analysis of PCN Participants by System

<table>
<thead>
<tr>
<th>System</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commodore Pet</td>
<td>27%</td>
</tr>
<tr>
<td>Tandy TRS-80</td>
<td>16%</td>
</tr>
<tr>
<td>Other complete systems</td>
<td>14%</td>
</tr>
<tr>
<td>Nascom 1 and 2</td>
<td>13%</td>
</tr>
<tr>
<td>Homebrew and other kit systems</td>
<td>12%</td>
</tr>
<tr>
<td>Apple II</td>
<td>10%</td>
</tr>
<tr>
<td>Nothing</td>
<td>8%</td>
</tr>
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</table>

Table 1

Please register me as being interested in Personal Computer Networking.

Name: _____________________________

Address: ___________________________

Telephone No: _______________________

Computer System: ___________________

I have the following type of communications interface:

- [ ] I can transmit at the following speeds 110 bit/s
- [ ] 300 bit/s
- [ ] 1200 bit/s

- [ ] I have a Post Office modem:
- [ ] I use an acoustic coupler:
- [ ] I can act as an originating station:
- [ ] a receiving station:
- [ ] both:

Other comments: ___________________

Tick Date: _______________________

Signature: _______________________

PCW 91
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[ ] The PET business system collection
[ ] The Petsoft catalogue

Name: ____________________________
Company: _______________________
Address: _________________________
Tel. No.: _________________________

PCW 92
BLUFFING AND PSYCHOLOGY

It may sound strange to suggest that a deterministic animal such as a computer is capable of performing in a psychologically motivated manner, but those of us who believe that Artificial Intelligence is here to stay will argue that if you can do it, so can a computer (or microcomputer) program. This month’s article is devoted to a discussion of the ways in which the ‘thought’ processes of a game playing program may be modified to perform in a manner that takes advantage of its opponent’s psychological makeup.

Michie’s work

I have referred, in an earlier article, to Donald Michie’s paper A Theory of Evaluative Comments in Chess. In this paper Michie makes use of the fact that if you can do it, so can a computer (or microcomputer) program. This month’s article is devoted to a discussion of the ways in which the ‘thought’ processes of a game playing program may be modified to perform in a manner that takes advantage of its opponent’s psychological makeup.

The position was something like this. Both players had been very short of time and had been making their moves at great speed. White is clearly losing, and had his opponent not been in time trouble he would probably have resigned. But White tried one last chance. He played 1 Qa2-h2, giving check. The first thing that I should mention is that these two players were using a very large chess board and set. This had a bearing on White’s plan, because he hoped that his opponent’s gaze would be attracted to the black king, and that he would not notice the fact that the queen, way over on the other side of the board, was attacked by and attacking the white queen. Had Black not noticed this fact, he would have moved his king and allowed White to capture his queen on the next move, whereupon White would have won. In fact Black did notice, and knowing his opponent rather well, had been half expecting this surprising queen check on h2, so without a moment’s pause Black captured the White queen and our hero resigned. He had not lost anything by trying the ludicrous queen check, because his position was totally lost; he was merely hoping for a one in ten thousand chance.

Moving into the realm of tree searching, we shall now consider a similar example in terms more familiar to the reader.

A player has two moves at his disposal, M1 and M2. He is good enough to see that if he makes move M1 the result of the game will inevitably be a draw. So the expected result from making move M1 is 0.5. If he makes move M2 the player sees that his opponent can defeat him, but only by finding a 15-ply deep continuation that is very difficult to spot. Otherwise, our player will win. He assesses the probability of his opponent finding this 15-ply win as being 0.1. The expected result from making move M2 is therefore

\[(0.1 \times 0) + (0.9 \times 1) = 0.9\]

So even though, with correct play, M1 is theoretically better than M2, our player will be better off making move M2.

Michie analyzes his tree in the following manner (I am using a simpler example), See Box 1.

Let us assume that we are growing a 2-ply tree, with terminal positions P1, P2 and P3... etc., and terminal scores S11, S12, S13... etc., respectively. The program considers its possible move from the root position P0 to P1, and notes that its opponent will then have the choice of making the move M1, M2, and M3. Let us say that the program estimates the chance (or probability) of its opponent making move M1 to be C11, the chance of its opponent choosing M2 to be C12, and the chance of move M3 to be C13. Then instead of assigning to position P1 a score of S1 which is the minimum of S11, S12 and S13, the program assigns a value of

\[S1 = (C11 \times S11) + (C12 \times S12) + (C13 \times S13)\]

and it is this score which is backed-up to P0 (remember that the program, which ‘thinks’ at even depths, will always make the move with highest expected score). This part of Michie’s method will work perfectly well for a normal minimax search, but in an alpha-beta search there is the problem that a large number of branches are pruned from the tree so an accurate backed-up expected score is impossible to achieve. Possibly one could attempt an approximation for alpha-beta searching, but this could lead to extremely unreliable results.
Discernability

Consider the plight of an imperfect player trying to decide which move to make in a game. There are three aspects of his situation that may affect his decision:

1. How strong a player is he? If he is very strong then he will nearly always make the best move. If he is very weak then he will often make the wrong one.
2. How obvious is the right move? If you and I are playing chess, and you capture my queen, then he will often make the wrong one. However, if he is very strong then he will nearly always make the right move.
3. What are the factors affecting discernability? If there is something special about the position, in a "quiet" position, in which neither side has any direct threats or simple captures, the correct move is much more difficult to perceive, because there may be a number of moves of roughly equal merit.

Using these expressions, it would be possible for a strong chess program to make the best move in all known 1- ply positions, according to the rating of its opponent, taking greater risks against weaker opponents and being cautious against strong ones. At the start of a game it would need to be told its opponent's rating, or if it were extremely sophisticated it could estimate its opponent's strength by performing regression analysis on the moves he made as the game progressed, thereby enabling it to update its estimate of his rating on a move-by-move basis.

How to psych your opponent

A good player will sometimes use psychology to help him win games. He will make moves that are probably not the very best, but which will be difficult or unpleasant for his particular opponent to meet. In chess, for example, a player who is equally at home in quiet, clear positions or in sharp, tactical skirmishes, will himself choose quiet play against a tactical genius but sharp moves against a quiet player. How can this be achieved by a computer program, particularly when employing an alpha-beta search?

Let us assume that the program examines every 1-plly position with a search that analyzes only captures and checks. If the program counts the number of moves examined in each of these capture searches, it can compute a measure for the complexity or 'turbulence' of the 1-plly position. This measure might be some fraction of the logarithm of the number of positions in the capture search. The program can then add this turbulence score to the 1-plly position so that when conducting the full tree-search, the program assigns greater scores to the moves that lead to more complex positions, which in turn will encourage the program to head for this type of position. If the program's opponent dislikes 'quiet' positions, the program should subtract the turbulence measure, thereby encouraging it to play into quiet positions. It would even be possible for the program to psych-analyze its opponent during a game, by measuring his tendency to head for quiet or complex situations. It could then act accordingly, avoiding positions that suited its opponent's style of play, and aiming for positions that were less pleasant for the opponent to face.

Bluffing

In some card games it is important to try to mislead your opponent(s) some of the time. In others it is absolutely essential. The human player does this by bluffing, which in reality is little more than creating extra opportunities for the opponent to make a mistake. When you bluff at the card table you are not, in one sense, making the objectively best play, because your opponent may catch you out and punish you. So from a strict minimax point of view, a bluff is not a valid notion, because minimax depends on the assumption that each player will make the best move at his disposal, thereby indicating that all bluffs will be called.

On the other hand, everyone knows that in order to be a successful poker player it is essential to bluff from time to time. This is done for various reasons, one of which is that if your opponent believes he will meet with the winning hand, thereby allowing you to win the money despite holding inferior cards. There is also the point that if you are caught bluffing once or twice in a session, your opponents will be more inclined to call your big bets when you really do have a powerhouse, thus increasing your overall profits from good hands. To put a big question, of course, is how often and when should a player bluff? The human will plan his bluff on a intuitive basis, the computer program must do so in a more scientific manner. Let us now consider how a program might determine whether a bluff is likely to prove profitable.

Rummy

In one form or another, Rummy is one of the most popular card games in the world. Let us assume that our program is playing a game of Computer Rummy, which has the following rules:

1. Each player is dealt 12 cards and tries to form 'melds' — groups of two or more cards of the same denomination (three queens, four aces, etc.), or three or more cards of the same suit in sequence (4, 5, and 6 of hearts). Each player in turn may pick up a card from the face-up pile or from the face-down pile, and must then discard a card onto the face-up pile. When a player has melded all of his cards he wins the hand.

To play this game well it is important to remember which cards have been thrown by your opponent, as these give an idea of what cards he is collecting (or rather which cards he is not collecting, which information can be used by subtraction to estimate which cards he is collecting). There are many ways in which a Compu-Rummy program might work, a simple idea is for the program to use an evaluation function to decide which card to discard after it has thrown a card. The most important feature in this evaluation function would almost certainly
be the number of melds or part melds remaining in his hand after a discard. The program might score $n$ points for an $n$-card meld, and 1 point for a 2-card meld. Ben might later become a 3-card meld. In order to decide which card to throw on the face-up pile, the program computes a score for the cards remaining in his hand after each of the possible discards. It then makes the discard leading to the position (or holding) with the highest score. If two or more discards appear to be of equal value, the program can use its additional evaluation features to discriminate between these discards. Since the loser in a hand of Compu-Rummy is the one who takes the smallest number of points, it is advantageous for the program to contain in his unmelded cards, which would be advisable for the program to throw high point cards rather than low point cards.

These two heuristics are the most obvious features of a Compu-Rummy evaluation function. But there is another important aspect of rummy, which is known in the trade as "advertising". If Ben is hoping to make a meld that runs from the 3 of clubs to the 7 of clubs, but you are missing the 5 of clubs, you might be able to force him to discard it by discarding the 5 of clubs by making the discard of another 5, if you hold one. Your opponent, seeing (for example) the discard of the 5 of diamonds, will immediately assume that you are not collecting fives, and unless he has seen you pick up the other clubs in your potential meld he will be quite likely to discard the 5 of clubs. If you can turn this discard into discarding the 5 of clubs, he should hold this card in his hand or pick it up at a later stage. This type of play is made by all skilled rummy players, and should be included in a Compu-Rummy program. The simplest way to implement a bluff of this type is to give a small bonus for discarding a card that is close to a card that you hope to pick up. You might score 0.5 points for discarding a card of the same denomination as the card you need, or a card of the same suit but one pip removed, and it might be possible to score even more for a discard that was of the same suit but two pips removed from a desired card. One problem with an algorithm of this type is that your opponent will, if he is intelligent, soon learn what is going on, and will modify his play accordingly. So the frequency with which advertising is used should vary. In a sophisticated program it may even be adjusted dynamically as the game progresses, to take into account the manner in which the opponent is playing. An intelligent computer program can monitor its opponent's play and modify its own strategy accordingly. I have touched briefly on the subject of advertising should vary earlier in this box, and next month I will discuss learning techniques in more detail.

**Poker**

In my opinion, poker is the most skilful card game of all, I have played poker for many years and I enjoy it even more than chess. Part of the reason for my enjoyment comes from the psychological struggle that takes place at the poker table, and most of this struggle emanates from the bluffing aspect of the game. Bluffing in poker must be handled in a scientific manner, because each situation will depend on how much the program knows of the opponent in order to win or lose by its attempted bluff. Let us first look at a simple situation in a hand of 5-card stud poker.

**SITUATION:** Open pair facing a possible flush.

**PLAYER:** Ben Joe Fred Tim Dave Henry Mike

**PROB OF CALLING:** 0.3 0.6 0.7 0.4 0.3 0.5 0.2

**Investment** = 100 Amount currently in the pot = 100 Probability of opponent calling the bet = $p$

Probability of opponent calling the bet = $p$

Expected income = Expected gain = $(1 - p) \times 100 - p \times 100$

**Box 2.**

For Ben the probability of his calling the bet is 0.3, so the expected income is 70 - 30 = 40. For Joe the probability is 0.6, so the expected income is 40 - 60 = -20. So the program would not try to bluff in this situation against Joe, but it would against Ben, and it would determine whether or not to try a bluff against the other players in a similar manner. If you are writing a poker program and your computer system supports a cassette or disk, it will be possible for you to retain the information learned during one playing session for use in the next. Of course it is quite possible for one or more of the program's opponents to change his style from one session to another, but it is always useful to have some reference point at the start of a game. For players with unknown characteristics, the program will employ fixed estimates, stored in a table, which can be updated during a playing session for use in the program learns how each player acts at the poker table. It will also be possible for an intelligent program to make certain generalisations. For example, once Joe is quite likely to call a possible bluff in a parallel situation (the probability of the better having a cast iron chin being roughly the same as his having a flush when showing lower cards of the same suit). Again this is largely a matter of learning.

**Task for the month**

Those of you who completed the earlier tasks involving noughts and crosses programs, will find this month's exercise somewhat trivial, but nonetheless instructive.

Write a noughts and crosses program to play a perfect game by means of exhaustive tree search. Test this version of the program against a program that moves at random, playing a number of games and noting the percentage score. Modify the program to use Michie's method of backing up on the game tree, and based on the assumption that the opponent will be moving at random, and play this version of the program against the random version. The results should indicate that the perfect play can result in a better score than perfect play!
M68000 - MOTOROLA'S SWEET SIXTEEN

News has been coming in thick and fast recently about Motorola's forthcoming addition to the new range of 16-bit super micros, the M68000. But with something approaching a six month wait before any sort of general availability, has it arrived too late?
Nicholas Jarmany largely dodges that question and instead casts an appreciative eye over its capabilities.

The Intel 8086 was the first of the new 16-bit micros to appear, closely followed by the Zilog Z8000. At the moment there is still no physical sign of Motorola's contender, so presumably Intel and Zilog are rubbing their hands with glee. The only dampener for them is that the M68000 is almost certainly the most powerful of the three; in fact at one stage when some of the big manufacturers saw the advance specifications, it was said that Motorola just wouldn't be able to make it. It now looks, however, as if the scepticism was ill-founded.

The speed of the M68000 is also something to be marvelled at. It's faster than the 8086, the Z8000 and the PDP11/45 — and it can't be a lot slower than the PDP 11/70! It's twice as fast as the Z8000 on a 16-bit multiply (35 instruction cycles compared with 70 — maximum).

### Internal Operation/Layout

The M68000 internal structure is that of a 32-bit micro, making it very efficient with long word operations. There are 17 32-bit registers (apart from a 32-bit program counter and a 16-bit status register) comprising eight data registers for 8, 16 and 32 bit data and seven address registers. All 17 registers can be used as index registers and there is also a specific user and supervisor stack pointer.

There are two modes of operation, user and supervisor. In user mode certain instructions are illegal and areas of memory can be locked out by a memory management unit. When in this mode a switch to supervisor mode always occurs when an interrupt, bus error etc is received. In supervisor mode all instructions are available and the full status register can be accessed. This arrangement is similar to that of the Z8000.

A trace mode can be set in supervisor mode which causes a branch via a trace vector after execution of every instruction — very useful for program debugging! The lower 512 words of memory are reserved for a vector table containing 255 vectors, of which 192 are reserved for user interrupt vectors.

Interrupts, bus errors etc. all cause what Motorola calls 'exception processing', of which there are three levels of priority. In order of decreasing priority, Group 0 contains — Reset (highest), Bus Error, Address Error; Group 1 — Trace, Interrupt, Illegal Instruction and Privilege Violation; Group 2 (all equal priority) — TRAP, TRAPV, CHK, Zero Divide. All the exceptions cause branching via the appropriate vector, except for certain occurrences of Bus Error. If a Bus Error and a Halt signal are received simultaneously, the processor will re-run the current memory access on the negation of HALT.

### Instruction set

There are 56 basic instruction types and 14 addressing modes, and although this doesn't seem like many instructions, it's deceptive as there are many variations. For example MOVE caters for loading register(s), storing register(s), moving data in memory etc. The total number of useful instructions exceeds 1000! The addressing modes are extremely comprehensive and no programmer could envisage needing more. The format of the instructions is astonishingly simple and easy to use. With other micros you have to learn the code for each individual instruction — e.g. Load register (indexed) might be 0A and load register (immediate) FE. Not so with the M68000... All you need to learn are the numbers for the 56 basic instructions and the numbers for the addressing modes. The complete instruction is then made up of the code for the instruction, the data size, addressing mode and register number (if required). Dead simple!

### Speed

The speed of the M68000 is also something to be marvelled at. It's faster than the 8086, the Z8000 and the PDP11/45 — and it can't be a lot slower than the PDP 11/70! It's twice as fast as the Z8000 on a 16-bit multiply (35 instruction cycles compared with 70 — maximum).

### Omissions

Unlike the Z8000 the M68000 does not have on-chip refresh and multi-micro control. It could be that Motorola does not want to be seen to be abandoning its traditional approach in favour of...
Hardware
The M68000 has definitely been designed for large systems, although a small system could easily be based around it. The processor is contained in a 64-pin package (long!) which is needed because the type of processing currently being done in the CPU: IPL0 to IPL2 are inputs devoted to interrupts. Seven levels of interrupt are available (level 0 = no interrupt), level 7 being the highest priority. With all seven levels of interrupt the vector address for the service routine can either be supplied by the interrupting device — or else an autovector can be used. To my knowledge this is the most advanced form of interrupt handling available on a micro. On reception of an interrupt, an interrupt acknowledge code is placed on FCO-FC2 and a read cycle is entered with the interrupt level on the lower three bits of the address bus. The processor then expects the vector address to be placed on the data bus and DTACK to be given. If this does happen then the processor jumps to the location pointed to by the contents of

DATA ADDRESSING MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register Direct Addressing</td>
<td>EA = Dn</td>
</tr>
<tr>
<td>Address Register Direct</td>
<td>EA = An</td>
</tr>
<tr>
<td>Absolute Data Addressing</td>
<td>EA = (Next Word)</td>
</tr>
<tr>
<td>Absolute Short</td>
<td>EA = (Next Two Words)</td>
</tr>
<tr>
<td>Absolute Long</td>
<td>EA = (PC) + d16</td>
</tr>
<tr>
<td>Program Counter Relative Addressing</td>
<td>EA = (PC) + (Xn) + d8</td>
</tr>
<tr>
<td>Relative with Offset</td>
<td>EA = (PC) + d16</td>
</tr>
<tr>
<td>Relative with Index and Offset</td>
<td>EA = (An) + (Xn) + d8</td>
</tr>
<tr>
<td>Register Indirect Addressing</td>
<td>EA = (An)</td>
</tr>
<tr>
<td>Register Indirect</td>
<td>EA = (An) + An + N</td>
</tr>
<tr>
<td>Predecrement Register Indirect</td>
<td>An - N</td>
</tr>
<tr>
<td>Register Indirect With Offset</td>
<td>EA = (An) + An + N</td>
</tr>
<tr>
<td>Indexed Register Indirect With Offset</td>
<td>EA = (An) + (Xn) + d8</td>
</tr>
<tr>
<td>Immediate Data Addressing</td>
<td>DATA = Next Word(s)</td>
</tr>
<tr>
<td>Immediate</td>
<td>Inherent Data</td>
</tr>
<tr>
<td>Implied Addressing</td>
<td>EA = SR, USP, SP, PC</td>
</tr>
<tr>
<td>Implied Register</td>
<td>EA = SR, USP, SP, PC</td>
</tr>
</tbody>
</table>

NOTES:
- EA Effective Address
- An Address Register
- Dn Data Register
- Xn Address or Data Register used as Index Register
- SR Status Register
- PC Counter
- Contents of

There are 23 address lines giving 16 Mbytes of direct addressing; individual bytes are accessed via the UDS and LDS signals. A valid address is indicated by AS and the addressed device responds with DTACK (Data Transfer ACKnowledge). This also acts to stretch memory cycles (if necessary) by not being negated until the memory is ready. Memory read, write, read-modify-write cycles take 4, 5, and 9 clock cycles respectively. A great feature of the M68000 is its ability to interface directly with standard M6800 peripherals. If, at the beginning of a memory access cycle, a VPA signal is received, the processor switches to the M6800 form of addressing. VMA is taken low and E is equivalent to 0. Hence VPA can be derived from the address decoding logic on any M6800 peripheral boards. FCO to FC2 are outputs that show the type of processing currently being
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the memory location whose address is on the bus. If this does not occur then the CPU assumes an autovector and jumps using the autovector corresponding to the interrupt level.

BERROR is an input that can signify a non-responding device or an illegal access determined by an external memory management chip. The effect this signal has depends on certain conditions already described. Both the RESET and the HALT lines are bidirectional, allowing external devices to be reset via the reset instruction. An internally generated halt is caused when a Bus Error signal is received on two consecutive memory accesses. When this occurs an externally generated reset is required to restart the CPU. This feature provides useful protection in the event of a catastrophic system failure!

**Summary**

The strong points of the M68000 seem to be its simple, easy to learn instruction format and its useful range of instructions (including control of both stacks and queues), coupled with the ability to maintain linked stacks. With floating point instructions on the way, writing high level languages will be a piece of cake! This sort of instruction should enable more efficient programming and the introduction of many mainframe techniques.

Bus arbitration is also very comprehensive, allowing simple control of a multi-master bus. The direct interface to M6800 peripherals must appeal to a lot of people, as it will mean that most of their existing equipment could easily be used in a M68000 system, thus eliminating a lot of annoying and expensive duplication of costs.

And yet all this extra power results

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Variation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD</td>
<td>ADD</td>
<td>Add</td>
</tr>
<tr>
<td></td>
<td>ADDA</td>
<td>Add Address</td>
</tr>
<tr>
<td></td>
<td>ADDQ</td>
<td>Add Quick</td>
</tr>
<tr>
<td></td>
<td>ADDI</td>
<td>Add Immediate</td>
</tr>
<tr>
<td></td>
<td>ADDX</td>
<td>Add with Extend</td>
</tr>
<tr>
<td>AND</td>
<td>AND</td>
<td>Logical And</td>
</tr>
<tr>
<td></td>
<td>ANDI</td>
<td>And Immediate</td>
</tr>
<tr>
<td>CMP</td>
<td>CMP</td>
<td>Compare</td>
</tr>
<tr>
<td></td>
<td>CMPA</td>
<td>Compare Address</td>
</tr>
<tr>
<td></td>
<td>CMPM</td>
<td>Compare Memory</td>
</tr>
<tr>
<td></td>
<td>CPI</td>
<td>Compare Immediate</td>
</tr>
<tr>
<td>EOR</td>
<td>EOR</td>
<td>Exclusive Or</td>
</tr>
<tr>
<td></td>
<td>EORI</td>
<td>Exclusive Or Immediate</td>
</tr>
<tr>
<td>MOVE</td>
<td>MOVE</td>
<td>Move</td>
</tr>
<tr>
<td></td>
<td>MOVEA</td>
<td>Move address</td>
</tr>
<tr>
<td></td>
<td>MOVEQ</td>
<td>Move Quick</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Variation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOVE</td>
<td>MOVE from Status to SR</td>
<td>Register</td>
</tr>
<tr>
<td></td>
<td>MOVE to Status to SR</td>
<td>Register</td>
</tr>
<tr>
<td></td>
<td>MOVE to Condition to CCR</td>
<td>Codes</td>
</tr>
<tr>
<td></td>
<td>MOVE Move User Stack USP</td>
<td>Pointer</td>
</tr>
<tr>
<td></td>
<td>NEG NEG</td>
<td>Negate</td>
</tr>
<tr>
<td></td>
<td>NEGX</td>
<td>Negate with Extend</td>
</tr>
<tr>
<td></td>
<td>OR OR</td>
<td>Logical Or</td>
</tr>
<tr>
<td></td>
<td>ORI</td>
<td>Or Immediate</td>
</tr>
<tr>
<td></td>
<td>SUB SUB</td>
<td>Subtract</td>
</tr>
<tr>
<td></td>
<td>SUBA</td>
<td>Subtract Address</td>
</tr>
<tr>
<td></td>
<td>SUBI</td>
<td>Subtract Immediate</td>
</tr>
<tr>
<td></td>
<td>SUBQ</td>
<td>Subtract Quick</td>
</tr>
<tr>
<td></td>
<td>SUBX</td>
<td>Subtract with Extend</td>
</tr>
</tbody>
</table>

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You've seen the reviews... you've heard the excitement... now make the kit!

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* Excellent string-handling capability—takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input—request a line of text when necessary. Strings do not need to be dimensioned.
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<td>Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual. excludes mains adaptor.</td>
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With the advent of office computerisation, the great God 'productivity' seems set to invade the white collar world. Malcolm Peltu reports the possible consequences... 

After Your Job, a Socialist Worker Party's publication by Chris Harman; it's subtitled 'New Technology and the struggle for socialism'. This is undeniably propaganda. It provides, however, a reasonably potted summary of the nature of IT and its potential impact and uses. Depending on your point of view, perhaps because of it — this is an important contribution to the discussions on IT because it vividly highlights the negative 'gut' fears that lurk behind the responses from the 'responsible' trade union movement. In general, trade unions have welcomed the application of new technology but have asked for participation in its introduction: there is a sentiment that a framework be created to encourage its innovation while minimising the human costs and giving staff the benefits of improved productivity.

Harman, however, points out (in bold type) that, 'Workers of one sort and another have the power to impede the introduction of the new technology. The employing class cannot work it without us'. Even if workers do not use this power to further the Socialist Workers Party cause, it's clear that new technology will be used as a weapon in many industrial relations battles — and Harman provides a crude insight into the fears and reactions that may predominate.

In the numbers game which predicts the levels of unemployment that may result from IT, the potential for the generation of new jobs is a strong card played by the optimists. Last year, these optimists, including the British government, jumped with delight on a report produced by the Massachusetts Institute of Technology (MIT) which said that two-thirds of new jobs in the US were created by firms employing fewer than twenty people. This seemed to boost the idea that new innovative companies could balance the predicted job losses with job gains.

Less publicity has been given to a report published by the Centre for Environmental Studies (CES) called The Job Generation Process in Britain. Using detailed employment data from the...
### S100 HARDWARE

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### NORTH STAR SOFTWARE

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### APPLE HARDWARE

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<td>K 1083</td>
<td>Qume 45 R0</td>
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PCW JUL.
An interesting set of papers in the next few years. It has established a commitment to misuse that computer systems to fall into 'enemy' hands during some external or internal conflict. This committee concluded that it was not in the interests of Sweden that data processing operations outside the country affecting Swedish citizens, business and government should take place without Swedish control: "For certain types of data and particular applications, vulnerability risks are so high that processing abroad should not be permitted... The use of computer power abroad should in principle be preceeded by consultation" the committee concluded.

In his concise booklet, Freese explains why there is a growing international move towards establishing guidelines covering worldwide data flows. These guidelines are likely to include a clause which insists that information should be 'traded' with other countries only if the country in which the data is stored or processed has data protection laws. Britain, however, is one of the few Western countries without at least a draft bill on data protection. This leaves the door open for Britain to become a haven for 'dirty data washing' - in turn posing trading threats to British companies. It therefore sends its tentacles out into the entrails of new political conflicts as well as burrowing down into some old sores. Perhaps it will take an electronic Charlie Chaplin to bring to life the human (or dehumanising) face of IT.

Feared in Bookfare were: The Quality of Working Life in Western and Eastern Europe edited by Cary Cooper and Endi Mumford (Associated Business Press, £15.00), International Data Flow by Jan Freese (Input Two-Nine and Studentliteratur, £2.35), 64K A Machine After Your Job? by Chris Harman (Socialist Workers Party, PO Box 52, London E2 8DN), New Universities Quarterly, Volume 34 No 1, Winter 1979/80 (Basil Blackwell, Oxford, £3.50), The Jade Generation Process In Britain by Steve Fothergill and Graham Gudgin (Centre for Environmental Studies, London, £2.00).

With the approval of Sharp’s Microcomputer division manager, Mr. Paul Streeter, we are running the International Sharp User Group. Membership costs £3 (free if you buy your MZ-80K from Knights) and each member receives a free Space Invaders program and copies of the User Group Newsletter which details Sharp developments around the World. We already have members from Belgium, France and feel that the International Sharp User Group will play an important part in the development and use of the MZ-80K. The latest newsletter details how to copy the basic and explore the monitor program, shows how we use the MZ-80K to assist in servicing television sets, and details the new printer (£51.75 and disc system (£780).

The newsletter also explains the use of the machine language loader and the new assembler, relocatable loader and symbolic debugger system which has just been released and costs £45.

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Pressure points

"Dad, can I have five pounds?"

My father chucked on his dried egg
omelette and when he had recovered,
bellowed, "Five pounds?" To be sure,
that was more than his weekly wage,
but I thought that his reaction was a bit
extreme.

"Yes, dad. I'll pay you back. I want
to buy a record player."

"What do you want one of those
things for?"

"Well, I — er — I want to play any
music I like, Dad."

"Ho, yes? Right — I'll have Bing
Crosby singing La Traviata."

(You're guessed by now that this was a long
time ago, right?)

"I don't think he's made that one
yet."

My father pounced. "Ha — there you
are, then!" End of conversation, not to
mention my attempt to get funding. To
these days, quite sure as to what
point he thought he was making, but it
was clear that he thought that he had
won a great victory.

I mention this incident because my
father's attitude towards record players
is mirrored by the present-day record
players some people have towards the
home computer. I've every sympathy with
youngsters trying to get funding and,
substituting modern references, the
conversation that I had with my father
must have been repeated umpteen times
over requests for a home computer.

"What are they trying to get funding
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Letters

One interesting letter came from O. Gar-
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worth quoting in full. He writes:

"I find it both incomprehensible and
annoying that the Sunday Times Maga-
azine is running a competition entitled
'Young Computer Brain of the Year'.
However, far from wanting someone
who can use a computer with skill, they
are asking for 2500 words of waffie!
I hope I never find such an ambigu-
ous competition on your worthy pages."

(Aw, gee! We're all red in the face.)

Seriously, I think that Mr. Garland
has a good point. The competition is
ambiguous. The ability to write an essay
even a brilliant essay — on computing
does not of itself indicate the ability to
use a computer well and, therefore,
would not entitle the winner to be
called Young Computer Brain of the
Year.

Mind you, I can also see the viewpoint
of The Sunday Times. With pretensions
to being the leader of the nation, what
else could they call the competition?

Barry Graham (16) of Chigwell, writes
that if the reason the message facility is
going to be a bit extreme.

"Yes, dad. I'll pay you back. I want
to buy a record player."

"What do you want one of those
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these days, quite sure as to what
point he thought he was making, but it
was clear that he thought that he had
won a great victory.

I mention this incident because my
father's attitude towards record players
is mirrored by the present-day record
players some people have towards the
home computer. I've every sympathy with
youngsters trying to get funding and,
substituting modern references, the
conversation that I had with my father
must have been repeated umpteen times
over requests for a home computer.

"What are they trying to get funding
for these days?" is a perennial question and,
over requests for a home computer.

I mention this incident because my
father's attitude towards record players
is mirrored by the present-day record
players some people have towards the
home computer. I've every sympathy with
youngsters trying to get funding and,
substituting modern references, the
conversation that I had with my father
must have been repeated umpteen times
over requests for a home computer.
This time there's no argument, the pocket computer has arrived; indeed it says quite clearly on the case 'Sharp Pocket Computer'. No matter that it still looks like a pocket calculator, for close inspection reveals a QWERTY keyboard (and the real clincher) its use of Basic. Dick Pountain celebrates this oft-predicted occasion by conducting a Calculator Corner-type Benchtest.

**Hardware**

Your wise and (as it turned out) far sighted columnist remarked some time ago when testing the Sharp EL-5100 and then the answer to that (in so many words) it represented a step towards the pocket computer. It appears in fact to have been a dry run for the PC-1211, for both sport the same overnize LCD display and share a generally similar layout.

The display holds 24 characters, each formed on a 7 x 5 dot matrix - which gives good legible numerals and upper-case letterforms. The only small gripe here is that the zero is distinguished from the 'O' merely by a small tail (i.e. O) rather than the more positive O found on most computers. The input buffer holds 80 characters and so the display scrolls automatically to the left when its capacity of 24 is exceeded.

The keyboard is a miniature of a full QWERTY (upercase only), including punctuation symbols, shift and cursor left/right keys; there's a separate numeric keypad of standard calculator format and the ENTER key is equivalent to RETURN or CR.

A MODE key enables you to set the machine to one of four operational modes; annunciators in the display indicate these as DEF, RUN, PRO and RESERVE.

In the RUN mode, the PC-1211 may be used for manual calculations. However these are performed courtesy of the Basic and the only major difference between making calculations on this and on a normal micro is that the PRINT command isn't required. So to perform LOG2(2 + SIN 47.5) you type it in just like that. Depressing ENTER causes the answer to appear at the right of the display. If you make an error in entering, you can edit with the cursor and the expression can be recalled after evaluation by pressing the + or - keys.

Unlike a micro, the arithmetic is evaluated by pressing the . + or + keys, and the expression can be recalled after entering, you can edit with the cursor of the display. If you make an error in the evaluation of the expression, the answer to appear at the right of the display. If you make an error in entering, you can edit with the cursor and the expression can be recalled after evaluation by pressing the + or - keys. The 1424 bytes of RAM not being used for program storage may be utilised as additional memories (8 bytes per memory, 178 maximum). Just how much is available is revealed by the MEM command, which displays the amount of memory that is available in addition to line numbers (e.g. 100: "A": or 700: "HYPER"). If a single character label is placed in a program, that portion of the program may be assigned to an alphabetic key in the DEF mode, and executed by that key.

Software

The PC-1211 runs a subset of Basic which will be familiar to PET or MZ-80K users. It does however have some unique features which are worth remarking on (I must also apologise to calculator owning readers who aren't familiar with Basic; the next bit will be pretty dull!). The 1424 bytes of RAM are available in PRO mode to write Basic programs. After a line has been entered, the interpreter signals its acceptance of the line by putting a colon after the line number and spacing the instructions (if you didn't). Basic instructions are all stored as one byte (as with the Sinclair ZX80) and when being edited can be deleted with a single keystroke. Moreover they may be assigned to a key in RESERVE mode and entered with a single keystroke.

Line numbers are limited to the range 0 - 999, each line holding a maximum of 80 characters. Multi-statement lines are permitted with a colon separator (unlike the ZX80) and usually, labels of up to seven characters are permitted in addition to line numbers (e.g. 100: "A": or 700: "HYPER"). If a single character label is placed in a program, that portion of the program may be assigned to an alphabetic key in the DEF mode, and executed by that key.

The final point of hardware interest is the cassette I/O port. As on the Casio 502 this records program and data onto domestic cassettes via an optional cradle, the CE-121. Unlike the Casio however this adaptor has a remote lead, so a suitable recorder may be started and stopped under program control.

So far, Sharp has made no promise about a printer for the PC-1211, but it's conceivable that the software exists to be able to run one through the I/O port at a later date.

The only major scientific calculator functions missing are hyperbolics - which can easily be programmed. You may feel that these keystrokes to execute SIN is a bore, but read on. Any of these functions (and indeed any others you can think of, and know a formula for) may be assigned to a single key. The RESERVE mode allows 18 of the alphabetic keys to each have a function reserved to its SHIFT position. So SHIFT A could be SIN; SHIFT S could be A*A+B*B etc. These reserve functions are not programs as such; they require no line numbers, must be single expressions and are stored in a separate memory which is retained when program and data memory are cleared. A keyboard overlay is provided on which to write these assignments.

The remaining DEF and PRO modes are discussed later under Software.

The PC-1211 is provided with 1424 bytes of RAM plus 26 'fixed' memories (10 digit) and 48 bytes of RESERVE mode memory. All of this memory is continuous, non-volatile, protected... in other words it stays put when you switch off. Battery life is quoted as 300 hours, non-rechargeable.

The function memories are assigned letters of the alphabet and may be used like ordinary calculator memories in manual mode using Basic variable notation, i.e. A=5 puts 5 into memory A.

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Line numbers are limited to the range 0 - 999, each line holding a maximum of 80 characters. Multi-statement lines are permitted with a colon separator (unlike the ZX80) and usually, labels of up to seven characters are permitted in addition to line numbers (e.g. 100: "A": or 700: "HYPER"). If a single character label is placed in a program, that portion of the program may be assigned to an alphabetic key in the DEF mode, and executed by that key.

That portion of the 1424 bytes of RAM not being used for program storage may be utilised as additional memories (8 bytes per memory, 178 maximum). Just how much is available is revealed by the MEM command, which displays the amount of memory that is available in addition to line numbers (e.g. 100: "A": or 700: "HYPER"). If a single character label is placed in a program, that portion of the program may be assigned to an alphabetic key in the DEF mode, and executed by that key.

A variable may be defined as X or as A(24); these two expressions address...
the same memory since X is the 24th letter. A(79) may only be addressed as such — since it's not one of the 26 fixed addresses, program space encroaches far enough A(79) may not even exist. Indirect addressing is allowed, e.g. A(D) depends on the contents of D. Indirect addresses may be nested to 15 levels, though I can’t imagine why you’d want to define A(A(A(A(A(A(A(X))))))). Relative memory addressing is also provided, e.g. A(2*3+4) addresses A(10) or A(4+2x) offsets address A by the value of 2X; you can, by the way, omit the multiplication sign when handling variables.

String variables are defined in the same way, e.g. X$ or A$(24). They hold seven characters each, but the same memory cannot be defined as a string and a numerical variable; so with A$, there’s no memory problem (A(1)). No string functions are provided and neither is there any means of converting a numerical datum into a string, or vice versa. Strings may only be entered, stored and displayed, though string comparisons are possible.

Display is by PRINT or PAUSE commands; unusually, PRINT halts execution (whereby it may be manually restarted via the ENTER or CONT) so therefore PAUSE, which displays data for about one second and then continues execution, is more useful. Formal control for numerical data is by PRINT (or PAUSE) USING “###.###” ; the hashes specify the number of digits and position of the point.

A step is a standard FOR...TO...STEP...NEXT commands. Unconditional jumps are by GOTO, which can take a line number, a variable, an expression, or a label as its destination. e.g. GOTO A, GOTO (17), GOTO “HELLO!” This extra use compensates for the lack of ON...GOTO...Conditional jumps are performed by the IF...test (THEN is optional and executes only if the prior statement is ‘false’), e.g. GOTO B IF (A<0) IF may be accompanied by a logical test, arithmetical expression, string comparison or a string variable and followed by any execution statement; the latter is skipped if the prior statement is ‘false’ (A string variable is ‘false’ if empty, an arithmetical expression if =0).

Subroutines are called by GOSUB — which has the same extended meaning as GOTO (there is no ON...GOSUB). Four levels of subroutine nesting are permitted (and the same number of FOR...END loops). Subroutines are not named, but + may mean AND and + may mean OR as in X<2*Y<5. BEEP n produces n pathetic little squeaks from a built-in piezo element of the Sharp device.

Finally READ is a useful command which automatically READS into a variable when executing a program in DEP mode, thus replacing an INPUT and the accompanying ? and halt of execution. This is a calculator-type feature which allows data to be entered by single, labelled keystrokes.

In general, this is a creditably comprehensive Basic for such a tiny machine and one in which you can feel comfortable very quickly. Editing facilities are identical to PET (it (one dimension!) with a cursor moveable left and right and two keys for line advance and retreat. Unlike PET, both these functions go into fast step if held down for more than one second. The DEBUG command allows single step tracing, including display of intermediate results. Error messages are of all types, covering syntax, open loops, exceeding memory, exceeding depth of nesting, tape operation error, and incompatible numerical formats; the flashing cursor points to syntax errors. Programs may be listed on paper, by groups or single lines and even indirectly, e.g. LIST (A+2). There must be a use for that!

Tape operations are straightforward, though as so often happens, loading it is rather sensitive to the control positions of the recorder; a little fiddling will be necessary to get clean loads. The tape is partitioned to 128K, with 48K reserved as an auxiliary section, and run-in time is more useful.

Summary

There’s no doubt that the PC-1211 is a computer. It has the hardware to make it give way to Sinclair, Acorn and PET, etc are: a) limited, non-expandable memory, b) limited display capabilities, c) lack of string manipulation ability and d) lack of machine code access via PEK, POKE or USR.

The big question is, has Sharp produced a mere toy computer, to amuse wealthy Basic freaks (at a rumoured price of around £125) or is there some genuine application for this machine? Given its limitations, data and text processing is not on, so it must be intended to serve as a flexible professional calculator, in competition with TI, Casio and Hewlett-Packard. How therefore does it compare?

Using Basic has its pros and cons. On the plus side it’s more ‘human’ than the hieroglyphic assembler dialects of the competition. In particular, the string handling and input facilities make more comprehensive prompting available, and with much greater ease than with the HP-41C’s rather odd-ball alpha handling. This is very important in complex applications (I’ve lost myself many a time in programming which I wrote!). The volume of ‘typing’ demanded by Basic is not a real problem, given the RESERVE mode, and I’ve found QWERTY keyboard works well despite its minute size.

On the minus side, Basic is wasteful of program space. My experiments show that equivalent programs are 3.5 times larger on the Sharp than on the TI-59 (on average). Given this figure, it’s possibly rough to compare the real capacity of the PC-1211 against its rivals. For the equivalent of 256 Casio steps, the Sharp would have 92 free memories, the Casio, 22, and the TI-59, 87 (that’s slightly unfair to the TI-59 as its instructions are less fully merged than Casio’s). On the other hand, with 26 free memories (the ‘fixed’ ones) the Sharp would have 406 ‘equivalent’ program steps to the 709 and 615 steps in the TI partitioned to its maximum 100 memories it has 159 steps left to the Sharp’s 237 ‘equivalent’ steps (829 actual), should have thoroughly confused you — as it has me — but it seems to show that when a lot of data memory is required, the ‘naked’ PC-1211 has a clear lead over the ‘armed’ TI-59. When a lot of program is required, the situation is reversed, but with bulk cassette storage and the CHAIN command, the sky’s the limit. On the other, with the non-volatile memory, it’s clear that the PC-1211 has a very high real capacity, not far short of a fully expanded HP-41C but of course lacking the printing facility.

The final minus however is not easily overcome, and that is speed. The Sharp’s interpreter is painfully slow. I ran three of PCW’s standard Benchmarks (BMI, BM5, BM8) and their translated equivalents on my Casio. The results (with PET, Sinclair and Sharp’s MZ-80K thrown in for comparison) are tabulated in Box 1.

Timings like these mean that certain types of recursive or iterative procedures are out of the question on the grounds of time alone, even though they seem otherwise to be practical. I didn’t have time to compare the TI-59 but as reported in my earlier test, this runs between 1.5 and 5 times slower than the Casio, according to function.

Conclusion

Although the Sharp PC-1211 is a well thought out pocket computer, the prospective owner needs to think quite carefully about what exactly will be required of it. I personally would love to own one, and I feel the rumoured price of £110 plus £15 for the cassette interface makes it fairly attractive compared to the HP-41C. It comes with a quite comprehensive instruction manual that’s written in worse-than-usual English and a sizeable library of program listings covering maths, finance, engineering and science.
Kevin J.O'Connell takes over a regular page in the magazine to report events and news from the world of micro chess. Kevin is President of the Western European zone of the World Chess Federation and Director of two software companies specialising in intelligent games. He's also a prolific writer of books on chess.

In this new series about developments in the field of computer chess, I shall concentrate on micro - but not to the exclusion of more important events that happen to involve a 'large micro' like an Amdahl or Cyber IC! To begin, this month I think it appropriate to take a brief run through the history of programming computers to play chess.

1937-1945 Konrad Zuse, who was probably the first ever chess programmer, started, and did not fall far short of completing, a chess program. See K. Zuse, Der Computer - mein Lebenswerk, verlag Moderne Industrie, 1970.

1948-1950 Claude Shannon wrote, presented and published his famous paper: Programming a Computer for Playing Chess. Zuse may have been first but it's Shannon's paper (and its subsequent influence) that marks him out as the father of computer chess.

1951 The first game 'played by computer'. Alan Turning wrote two programs, but did not complete them sufficiently to be able to run them on Manchester University's Ferranti Mark 1. However, two games at least have been preserved which were played by laborious hand simulation.

1956-1957 A program to play a reduced version of chess, excluding the bishops, on a 6x6 board was developed at the Los Alamos Scientific Laboratory in New Mexico. Running on the quantity named Maniac computer, the program performed an exhaustive 4-ply search in an average of 12 minutes or so. For real chess, about three hours per move would have been required.

1958 The first program to play proper chess. This was developed at the Massachusetts Institute of Technology by Alex Bernstein and others. Running on an IBM 704, which could perform some 1 billion calculations per day, it took about eight minutes to produce a move. The program searched to a depth of 4-ply, examining only the best seven moves in any position, these moves themselves being selected by up to eight decision routines.

1959 Alan Newell, John Shaw and Herbert Simon, working at what is now Carnegie-Mellon University in Pittsburgh, published 'Chess Playing Programs and the Problem of Complexity'. The significance of their work was the development of an alpha-beta algorithm for tree searching. Rated as one of the greatest advances in the field of computer chess, this algorithm is now very well known. If you need more information on it, then consult p.85 of the March 1980 issue of PCW.

1961 The first well publicised program written in the Soviet Union made its debut, a description of the work being published in one of the bulletins of the World Championship Match between Tal and Botvinnik. This year is more significant for the involvement of two World Chess Champions, Dr Mikhail Botvinnik began to write on the subject of computer chess and started work on an algorithm. Dr Max Euwe became involved in a EURATOM research project in Italy. Thus the gap between the worlds of chess and computers began to be spanned, with many benefits subsequently accruing to both sides.

1961-1962 Alan Kotok wrote, under the guidance of John McCarthy, a chess program for his bachelor's thesis at MIT. The program performed a variable depth search.

1966 Kotok's program, further developed by McCarthy, played a four game match against a program developed at the Institute of Theoretical and Experimental Physics in Moscow. An outstanding success for the Soviet program, which won two and drew two games, the event was more significant for the publicity and attention it drew to the field; it paved the way for a proliferation of computer chess tournaments.

1966 Starting at the end of the year a program was developed on a PDP-6 at the Artificial Intelligence Laboratory of MIT. The program was written primarily by Richard Greenblatt. The program, named MacHack VI, was made an honorary member of the US Chess Federation.

1968 The famous Levy bet was born at a Machine Intelligence Workshop in Edinburgh. The bet was that no program would be able to beat Levy in a match by the end of August 1978.

1970 The first chess tournament for computer programs. This was held as part of the annual conference of the Association for Computer Machinery; it later developed into the annual US Computer Chess Championship.

1974 The first World Computer Chess Championship was held in Stockholm. It was won by KAISSA (USSR) with CHESS 4.0 (USA) in second place.

1975 The start of personal computing. Also oft-voiced idea began to take shape at MIT with the construction of a machine devoted to computer chess.

1977 The first commercial chess computer appeared on the market; Chess Challenger from Fidelity Electronics. A stone-age machine by today's standards, it was not able to play legal chess.

1977 The 2nd World Computer Chess Championship in Toronto was won by CHESS 4.6 ahead of Kaissa.

1977 CHESS 4.6 challenged Levy to a 2-game match which was played on April Fools' Day in Pittsburgh. Levy won the first game.

1977 The first game ever won by a computer program against a Grandmaster opponent - CHESS 4.6 beat Michael Stean, Britain's number 2.

1978 The final challenge under Levy's bet was made by CHESS 4.7 and a 5-game match was played in Toronto which Levy won by 3½-1¼, thus concluding the bet except for one minor detail - Mr Kozdrowicki has a 'debt of honour' to pay.

1978 The first PCW micro chess tournament was held in London.

1980 Anatoly KarpoK, the World Chess Champion, gives a simultaneous display against 25 chess computers in Bad Kissingen, West Germany. One of his opponents, the Chess Champion Super System III, obtained a winning position against him, although it subsequently lost.

1980 The first World Micro Chess Championship will be held in London as part of this year's PCW show. It will be followed, a couple of weeks later, by the 3rd World Computer Chess Championship in Linz, Austria.
number of statements in the body of the loop
(c) WHILE-ENDWILE loop — with any number of statements in the body of the loop
3. Conditionals — similar to Pascal
(a) IF-THEN-ELSE-ENDIF where any number of statements can come after a THEN or ELSE and nesting can occur up to 44 levels deep
(b) CASE-OF-WHEN ... WHEN ... END CASE picks out one of several statements to execute depending on the control variable. If none of the statements are appropriate, then Comal allows for an alternative statement to be executed.
4. Although GOSUB-RETURN is allowed in Comal, it’s only there for compatibility with BASIC. Rather, subroutines can be declared with PROC-ENDPROC and called with EXEC. Procedures can have parameters which can be called by reference or value. To call a procedure by value it’s necessary to pass an expression (with a constant as the first term) to the procedure. If a procedure is called EXAMPLE, to pass X by reference requires the call EXEC EXAMPLE(X) whereas to pass X as a value parameter requires a call such as EXEC EXAMPLE(0+X).

The CHAIN instruction allows one procedure to call another procedure (including within another procedure) and never go out of scope. Functions are not supported.
5. The file system supports direct (fixed length records) and sequential (variable length records) access to disk files. The status of each file can be ascertained with a STATUS instruction.
6. The CHAIN Instruction allows one program to automatically load another.
7. The EDIT command allows easy in line editing using the four cursor control keys. The EDIT instruction within a program is a combination of PRINT and INPUT.

e.g.
500 ANSWERS="NO"
510 REPEAT
520 PRINT "Do you want to continue?"
530 EDIT ANSWERS
540 IF ANSWERS="YES" THEN
550 EXEC GAME
560 UNTIL ANSWERS="NO"
will print out NO with the cursor positioned over the N. If the user presses <CR> ANSWERS retains its value — NO. If, on the other hand, the user wants to answer YES to the question when ‘Do you want to continue?’ NO comes on the screen, typing YES will overwrite the NO on the screen and give ANSWERS the value YES.

8. The CURSOR statement allows the cursor to be positioned anywhere on the VDU and DDE has also implemented UCSID style turtle graphics in Comal.
9. IN and OUT allow control of I/O ports in Comal.
10. CALL can be used to call assembler language routines. (Note there’s no POKE or PEEK.) Ian Brunclischmehl tells me that there is a standards committee meeting in Denmark to decide on standard Comal. DDE Comal is already very close and any differences will be implemented to bring it into line. He also thought that textbooks would come out once the standard was set.

Comal is not a block structured language, but it does allow a user to develop well structured, easily readable programs with the same ease as unreadable Basic programs.

Other languages
Besides Comal, DDE have four other language translators. These are: an assembler, a Comal-B interpreter and two Pascal systems. Although the SPC/1 is based on the 8085 the assembler is for 8080 code. It translates Intel 8080 mnemonics into relocatable code in two passes. The assembler has a primitive macro facility — if it specifies an operation code which is neither an op code nor a directive, it searches for a file with that name and if found inserts it at the current point of assembly.

Technical Data
CPU 8085A 2 MHz or 5 MHz with AM9511 floating point processor
Memory 32k to 1024k dynamic RAM
Keyboard Soroc IQ 120
Screen N/A
Disk Drives 2 BASF drives, 5" single sided, single density
Printer Texas 810
Bus 100 pin
Ports 2 serial RS232 ports
System Software MIKADOS operating system
Languages Assembler, Comal, Pascal

Benchtest Continued from page 55

<table>
<thead>
<tr>
<th>Time in Seconds</th>
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<tr>
<td>1</td>
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<td>2</td>
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<td>8</td>
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</tbody>
</table>

Comal-B, which occupies 4k bytes of space above the 16k required for Comal, is also of greater precision; and it has two data types not found in Comal: INTEGER and DBLREAL (double real). Integers occupy two bytes and must be declared in an INTEGER statement. Double reals give a precision of 13 significant digits, occupy eight bytes and are declared in DBLREAL statements. Reals, the only numbers in Comal, occupy four bytes to provide a precision of six digits and aren’t declared. Comal-B will support mixed type calculations but these operations carry heavy time overheads. The ASC function is used for converting extra data to numerical data. The CHR function has been expanded to take up to three arguments. The first is the value to be converted, the second the number of digits to the left of the decimal point and the third the number of digits to the right of the decimal point.

DDE Pascal is a modified version of UCSD Pascal. Programs are entered using the MIKADOS editor and compiled into P-code. If this translation is successful, the user can then use the P-code interpreter to execute the program. Although DDE use UCSD translators they have decided against using UCSD’s rather cumbersome operating system. DDE Pascal is a full Pascal (although the user is given the option to create a smaller interpreter leaving out those functions not required) containing all the UCSD string functions (including UCSD string extensions), direct access files and segmentation. DDE has also added a few features of its own (reminiscent of Comal). There are intrinsic procedures for editing a string on an output device, character manipulation (I think it’s strange to have both string functions and character array functions). CHAINing of programs and basic input/output operations. DDE have altered the character set to include six Danish letters. Brackets have also been changed, so instead of 

Potentially [ ] DDE Pascal uses (..). Comments can only be written between (* *).

The second Pascal system differs from the first primarily in the precision of its reals. In extended precision Pascal E, reals are held in 8 byte BCD code and numbers have 13 significant digits. Pascal E supports SQRT, EXP, LN, TAN, SIN, COS and ARCTAN not supported in the first Pascal system. READREAL and WRITEREAL are also supported for formatted I/O of reals. DDE’s Pascal both support turtle graphics.

Potential
The SPC/1 has several potential markets. It’s attractive enough for business but as there are no business application packages available in English, its sale as a turnkey business system is unlikely (although DDE are working on a word processor and have several business packages in Danish which will be translated

GOTO Page 121
### Direct Access

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

<table>
<thead>
<tr>
<th>Machine (Price from)</th>
<th>Main Distributor/s</th>
<th>Hardware</th>
<th>Software</th>
<th>Miscellaneous (Documentation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC 80 (£790)</td>
<td>CCS Microsystems</td>
<td>16-40K RAM, Z80A, C: 12&quot;</td>
<td>DOS: BASIC</td>
<td>Graphic loudspeaker with 128 effects: Viewdata compatible: (S)</td>
</tr>
<tr>
<td>Alpha Micro (£8,000)</td>
<td>Alpha Micro (UK) Ltd</td>
<td>1K ROM: dual 8&quot; F/D</td>
<td>O/S: BASIC: Pascal: M/A: Pascal:</td>
<td>multisegment Basic to 1200 MB, 32 terminal system: (E)</td>
</tr>
<tr>
<td>Altos ACS 8000 (£3,996)</td>
<td>Logitech: 02572 68603</td>
<td>1.5M RAM: 8&quot; F/D</td>
<td>CM: Pascal:</td>
<td>(£2,334)</td>
</tr>
<tr>
<td>Atom (£120)</td>
<td>Acorn.</td>
<td>11-1K RAM: 512: Full keyboard:</td>
<td>BASIC in 8K ROM: A:</td>
<td>High resolution graphics on bigger model: colour monitor O/P loudspeaker: (S)</td>
</tr>
<tr>
<td>Attias (£7,000)</td>
<td>R.H.Thorpe Ltd: 0276 29492 R.J.Spiers Ltd: 01-580 8841:</td>
<td>2-16 S/P:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canon BX-1 (£3,850)</td>
<td>Canon Business Machines (UK) Ltd: 01-680 7700</td>
<td>64K RAM: 6800: Single 8&quot; F/D</td>
<td>DOS: EX: BASIC: A:</td>
<td>Also supplied with integral thermal printer instead of VDU: (S&amp;H)</td>
</tr>
<tr>
<td>CBS Mk 28 £900 (£8,648)</td>
<td>Complete: 01-636 1392 N/A</td>
<td>64K RAM: Z80: dual 8&quot; F/D (1MB):</td>
<td>CM: BASIC: Forthran:</td>
<td>(£1,209)</td>
</tr>
<tr>
<td>Comp Workshop System (£1,600)</td>
<td>Comp Workshop: 01-491 7507 N/A</td>
<td>32K RAM: dual 512&quot; F/D</td>
<td>A: BASIC: U:</td>
<td>(£1,342)</td>
</tr>
<tr>
<td>Dynastyle DB8/1 (£1,400)</td>
<td>Dysbyte UK/Europe Ltd: 0723 65559:</td>
<td>32-64K RAM: Z80: 8000:</td>
<td>CP/M: BASIC: Comp:</td>
<td>(£1,000)</td>
</tr>
<tr>
<td>Equinox 200 (£7,000)</td>
<td>Equinox: 01-730 3157 (N/A):</td>
<td>16-256K RAM: 280: 10MB H/D:</td>
<td>CM: BASIC: Comp:</td>
<td>(£1,000)</td>
</tr>
</tbody>
</table>

### List of Abbreviations

- **F/D**: Floppy disc
- **A**: Assembler
- **B**: BASIC
- **C**: Cassette
- **E**: Extensive
- **P**: Parallel port
- **U**: Utility
- **V**: Video
- **D**: DOS
- **S**: Software
- **M**: Mouse
- **N**: Number pad
- **H**: Hardware
- **G**: Graphics
- **I**: Interface

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

<table>
<thead>
<tr>
<th>Machine</th>
<th>Main Distributor/No. of Dealers</th>
<th>Hardware</th>
<th>Software</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euroco (Ex)</td>
<td>Euroscale Ltd: 01-405 3113 (TBA)</td>
<td>64K RAM: £8000; dual 8&quot; F/D (1MB); 15&quot; 25x80 b/w VDU: 132 col 140cps printer</td>
<td>CP/M; CBASIC: A; U:</td>
<td>A year's maintenance and stationery supply inc: (£5)</td>
</tr>
<tr>
<td>Executive Minicomputer</td>
<td>Binatone 903 5211</td>
<td>See Video Genie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exidy Sorcerer (£48)</td>
<td>Liverpool Data Products 0736 798 157 (27)</td>
<td>0:16-4K RAM: £8000; dual 5&quot; F/D (32K0); 6100 controller</td>
<td>O/S: Ex BASIC (ROM); Editor: A; CP/M: Algol: Fortran</td>
<td>High resolution graphics capability in 64K: (£48, £49): User programmable character set: (£1)</td>
</tr>
<tr>
<td>HP 51 (£5400)</td>
<td>Hewlett-Packard Ltd: 0734 784 774 (16)</td>
<td>16-32K RAM: 20K; C:U:; 5&quot; 16x32 b/w VDU: C (200K): 64 cps printer: RS232 port: 4 P/F</td>
<td>BASIC:</td>
<td>Full dot matrix graphics: N/P: compact portable unit: (£6)</td>
</tr>
<tr>
<td>LSI M-One Model 5 (£9900)</td>
<td>As above</td>
<td>16K RAM: £800: dual 8&quot; F/D (2.4MB):</td>
<td>DOS: BASIC: A</td>
<td>One of the VDU's is for inquiry only: (£5)</td>
</tr>
<tr>
<td>LX-500 (£3,500)</td>
<td>Logasub Ltd: 01 965 0061 (13)</td>
<td>32K RAM: £804: dual 5&quot; F/D (160K): 12&quot; 25x96 b/w VDU: 100 printer</td>
<td>DOS: BASIC: A</td>
<td>Other printers available: (£8)</td>
</tr>
<tr>
<td>Megamicro (£6,800)</td>
<td>Byronics: 0252 726814 (5)</td>
<td>256K: £8080A: dual 8&quot; F/D (1MB): 12&quot; 20x80 b/w VDU: 100 printer</td>
<td>CP/M: U</td>
<td>(H&amp;B)</td>
</tr>
<tr>
<td>MS1 6800 (£11,203)</td>
<td>Strumech: 05433 4321 (5)</td>
<td>16K RAM: £800: 16x64 b/w VDU: 1 S/P</td>
<td>BASIC: Mini: A: U:</td>
<td>Up to 8 serial or parallel interface possible: (£6&amp;H)</td>
</tr>
<tr>
<td>MS1 System 7 (£7,500)</td>
<td>As above</td>
<td>56K RAM: £800: dual 5&quot; F/D (160K): 9&quot; 16x64 b/w VDU:</td>
<td>DOS: BASIC:</td>
<td>Choice of FDO, SDO or Flex: also option - 10MB H/D: (£6&amp;H)</td>
</tr>
<tr>
<td>Oxford Mini-computer</td>
<td>Binatone 01-903 5211</td>
<td>See Video Genie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panasonic JD740U</td>
<td>Teletronics: 01-282 5121 (10)</td>
<td>8K RAM: £805A: 2-4K PROM: dual 5&quot; F/D (1MB): dual 8&quot; F/D (2MB) JDB40U: 12&quot;: 24 x 80 b/w VDU: 3XRS232 ports</td>
<td>CP/M: BASIC: Microcobol:</td>
<td>Also available — JD700U with 10K memory £1,477; JD800U with £256 MB disc, £1750: (£8)</td>
</tr>
<tr>
<td>Pascal Microengine (£2,080)</td>
<td>Pronto: 01-599 3041 (TBA)</td>
<td>64K RAM: £804: 4ROM: 2-4ROM: dual 5&quot; F/D (1MB):</td>
<td>CP/M: BASIC:</td>
<td>CP/M has user written word set: (£6)</td>
</tr>
<tr>
<td>Rair Black Box (£5,300)</td>
<td>Rair: 01-386 4663 (N/A)</td>
<td>16-32K RAM: £808: 5&quot;: £850: 13&quot;: 25x40 b/w VDU: 1 £6502</td>
<td>CP/M: BASIC: Cobol: Fortran:</td>
<td>£1650 expansion, £250: dual 5&quot; F/D (£705), £1,000: (£N)</td>
</tr>
<tr>
<td>Machine (Price from)</td>
<td>Main Distributors/ Dealers</td>
<td>Hardware</td>
<td>Software</td>
<td>Miscellaneous (Documentation)</td>
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</tr>
<tr>
<td>S.E.E.D. System One (E25,175)</td>
<td>Strumtech: 05433</td>
<td>8321 (4)</td>
<td>DOS: BASIC: U; Porton: Cobol: M/A</td>
<td>Up to 8 I/O ports: max. of 4 F/D drives: option - dual 8&quot; F/D (250K), £500: (1)</td>
</tr>
<tr>
<td>Semel 1 (E2,900)</td>
<td>Strat Electrical: 0822</td>
<td>0543 (N/A)</td>
<td>BASIC: Porton:</td>
<td>Supports up to 8 drives option - single 8&quot; F/D (250K), £500: (1)</td>
</tr>
<tr>
<td>Sinclair ZX80 (E1100)</td>
<td>Science of Cambridge: 0223 314498 (N/A)</td>
<td>12-16K RAM: 80: 256 x 160 b/w TV: 66x200 b/w VDU: RS232 port</td>
<td>4K BASIC in ROM</td>
<td>CPU is NEC 3.25 MHz version of Z80A; available as kit, 280: mains adaptor E2500: (1)</td>
</tr>
<tr>
<td>Solitaire WP &amp; BS200 (E7,750, £7,950)</td>
<td>Solitaire KPG: 01-995 3573 (TBA)</td>
<td>64K RAM: 80: 14&quot; VDU (with own CPU): 45 cps printer: (E)</td>
<td>DOS: BASIC: optional on the &quot;WP&quot;</td>
<td>All Solitaire systems are compatible: graphics on 11x13 dot matrix: (S)</td>
</tr>
<tr>
<td>Solitaire/HS8100 (E9,500)</td>
<td>As above</td>
<td>64K RAM: 80: 10MB H/D: 14&quot; VDU (with own CPU): 200 cps printer: CPU port</td>
<td>DOS: BASIC</td>
<td>Up to 8 interface terminals can be used: also HS9200 with 20-80 MB H/D: HS100 limit is 40MB: (S)</td>
</tr>
<tr>
<td>Spot M223 (E3,500)</td>
<td>As above</td>
<td>64K RAM: 80: single 5&quot; F/D (340K): 12x24x64 b/w VDU:</td>
<td>O/S: BASIC</td>
<td>Option경 matching possible: extra F/D: E450: (1)</td>
</tr>
<tr>
<td>Tandberg EC10 (£5,000)</td>
<td>Tandberg: 0632 351111 (N/A)</td>
<td>50K RAM: 80: 80: single 5&quot; F/D (250K): 12&quot; 25x80 b/w VDU:</td>
<td>ExBASIC (24K): Multi-user BASIC: A:</td>
<td>(S&amp;H)</td>
</tr>
<tr>
<td>Tandy TRS 80 Level 1 (E280)</td>
<td>Tandy: 021 556 6101 (200)</td>
<td>4-16K RAM: 80: single 5&quot; F/D (500K): 12&quot; 25x80 b/w VDU:</td>
<td>BASIC: A:</td>
<td>Basic in 4K ROM: upgradable to level 2: (1)</td>
</tr>
<tr>
<td>TID94 (E150)</td>
<td>TI: 0234 67466 (TBA)</td>
<td>16K RAM: 26K ROM: 9000: 24x256 b/w VDU: 2:3 int: 16K RAM: 26K ROM:</td>
<td>O/S: BASIC</td>
<td>Various peripherals available soon: can run 16 colour TV screen: (S)</td>
</tr>
<tr>
<td>Triton L2.8 (E2611)</td>
<td>Transam: 01-402 8137 (N/A)</td>
<td>32 K RAM: 80: 80: 16x64 VDU: 66x200 b/w VDU:</td>
<td>O/S: BASIC: M/C: BASIC: CP/M</td>
<td>Graphics: 5&quot; or 8&quot; F/D are available: (S&amp;H)</td>
</tr>
</tbody>
</table>

**List of Abbreviations**

- F/D: Floppy disc
- P: Parallel port
- N/P: Numeric pad
- M/A: Macro assembler
- TBA To be announced
- U: Utility
### SINGLE BOARDS

<table>
<thead>
<tr>
<th>Machine</th>
<th>(Price from)</th>
<th>Main Distributor/s</th>
<th>Hardware</th>
<th>Software/Firmware</th>
<th>Miscellaneous (Documentation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adj 6SC</strong> (£265)</td>
<td>Pelco: 0273 721155</td>
<td></td>
<td>1K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: £212: RS232 port:</td>
<td>A: Dis A: T/E: 8K</td>
<td>Available as £100 system with A or BASIC in ROM (£480) from Portable Microns (02 M 8053 017): they also have kibecycle version (250)(S)</td>
</tr>
<tr>
<td><strong>Cromemco SC</strong> (£260)</td>
<td>Comart: 0480 215005</td>
<td></td>
<td>1K RAM: Z80A: 8K E/PROM sockets: RS232 port: 3 P/P: option — £100 int:</td>
<td>Monitor and control Basic in E/PROM</td>
<td>5 program interval timers: can put own BASIC programs in E/PROM (S)</td>
</tr>
<tr>
<td><strong>Micronet 65</strong> (£69)</td>
<td>Tangerine: 0353 3633</td>
<td></td>
<td>1K RAM: 6802: 16x32 T/V: int: options — 10K ROM: 6K RAM: 8K BASIC: 35/P:</td>
<td>1K TANBUG monitor:</td>
<td>Optional 64x64 pixel graphics(E)</td>
</tr>
<tr>
<td><strong>Nascom 1</strong> (£186)</td>
<td>Nascom: 02405 75155</td>
<td>4K RAM: 8080: full K/B: TV int: 2 P/P: 1 S/P:</td>
<td>2K monitor: BRASIC basic BASIC A: T/E:</td>
<td>Now available as Nascom 2 with 8K RAM and £800 microbasic in ROM, £295: (S&amp;H)</td>
<td>Expandable to any Nascom compatible system: (B)</td>
</tr>
<tr>
<td><strong>77/68</strong> (£90)</td>
<td>Newcom: 0635 30505</td>
<td>4K RAM: 6800: LED: C int:</td>
<td>1K monitor: BASIC</td>
<td>Expandable to any Nascom compatible system: (B)</td>
<td></td>
</tr>
<tr>
<td><strong>SBC 100</strong> (£135)</td>
<td>Aircom: 0294 57705</td>
<td>1K RAM: 8080: 8K ROM: £100 1S/P: 2 P/P: option — voltage regulator</td>
<td>1K monitor: DOS IN ROM</td>
<td>Kit: available assembled, £196 (E)</td>
<td></td>
</tr>
<tr>
<td><strong>SYM-1</strong> (£160)</td>
<td>Newcom: 0635 30505</td>
<td>1K RAM: 6502: 8K BASIC: A:</td>
<td>4K monitor: BASIC: A:</td>
<td>Can be expanded to 64K RAM (S&amp;H)</td>
<td></td>
</tr>
<tr>
<td><strong>Triton 4.1</strong> (£286)</td>
<td>讽: 01-402 8137</td>
<td>2K RAM: 8080: 8K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: option — 2K RAM: £30</td>
<td>1K monitor: 2K BASIC: U:</td>
<td>64 character graphics: 8 levels interrupt: kit (S&amp;H)</td>
<td></td>
</tr>
<tr>
<td><strong>Triton L5.2</strong> (£296)</td>
<td></td>
<td>4K RAM: 8080: C int: 16x64 VDU int: 15 P/P: 1 P/P:</td>
<td>1K monitor: 2K BASIC:</td>
<td>Graphics: kit: form: easily expandable (S&amp;H)</td>
<td></td>
</tr>
<tr>
<td><strong>UK 101</strong> (£219)</td>
<td></td>
<td>4K RAM: 6502: full K/B: 16x48 VDU or TV int: C int: RS232 port: option — 4K RAM: £49</td>
<td>1K monitor: 8K BASIC: A:</td>
<td>Graphics: will run Superboard software (S&amp;H)</td>
<td></td>
</tr>
</tbody>
</table>

List of Abbreviations
- **F/D**: Floppy disc
- **G/C**: Graphics card
- **M/A**: Macro assembler
- **S/P**: Serial port
- **B**: BASIC
- **H**: Hard disc
- **O/S**: Operating system
- **C**: Cassette
- **P/P**: Parallel port
- **E**: Extensive
- **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.
For sale

UK101... 6k, full working with printer, £50. Sold locally around £250, buyer collects. A. M. Saunders, SPB, Essex University, 0207 6809... simple board with 1k RAM, 1k ROM, £10. Better with space for 10k, 2400 baud cassette interface, keyboard, printer. Rs232 level shifters, with full documentation, £130, Ring Aaron James, 01-939 4851.

Accom... Basic comp. assy, tested with VDU kit and mains adaptor. New job - no time for hobby. Asking almost £18 on list, £180, Collect London (City) or Post. A. James, 01-605 2622 ex 254 or 0601 6132.

T135/P100... complete with system modules, documentation, carrying case/rust cover, manual for creating Ti programmer, editor, main keyboard, very good condition. P. Williams on 01-223 4812.

PET... £50 large keyboard, very good condition. P. Williams on 01-223 4812.

PET 101... 8k hardly used, with software and manuals. £400 or offer. Ring 01-567 6461.

Exidy Sorcerer... 16k, video monitor, Cenvox voice synthesizer, 21 synth voices, all sound effects producer. Full manual, £250. A. M. Saunders, SPB, Essex University, 0207 6809.

TRS 80 Level II... 16k, Complete system with manuals and variety of programs (system copy, word processor, etc) £450. Morris, 73 Christie Church, Cambridge, ph: 021 324 3516.

Ohio C2, CPU board with 8k Basic, 4k RAM, Rs232/20 mA, 44 way bus, case & PSU, £130. Offer £125. E. J. Tizard, 69 Park St, Cheltenham, Glos GL50 2AG.

Motorola 6800 family, Ohio Superboard, keyboard, power supply, VDU etc, kit barely used, not set up, books, carton electronics and computer magazines, £200 or nearest offer. Ring 01-741 2857 evenings, weekends, ask for John.

Texas T150... programmable calculator, magnetic cards, adapter, manuals, boxes, all as new. £230. Colin Payne, John Chevney House, Windsor Road, Slough.

PET 8001... £8k with many books and tapes, fully serviced and complete with latest ROMS. Will negotiate at around £420. Ring John, Hastings 757376 (evenings if poss).

Nascom 1... 3 A PET, Nas- socom 1 monitor, all in black case, one month old, bought in June, cost £220, first offer over £175 secures. Ring Reading (0734) 475542.

PET emulators - machine code program with sound - explore (0151) 315446, lo, or ring 0242-32455.

Microfax... machine code program with sound - explore (Exhibition Director), Dept. of Electrical Engineering, University of Salford, Salford M5 4ET. Tel: 016-736 5843.

Microprocessor... Crofton/AMP - controller board, £800 fully built, with 4k RAM and UHF modulator. Ring, Mike Price on 0484-44176, evenings.

Nascom 1... 152 monitor, 5amp PSU, buffer board, 8k RAM, all installed in smart case with high speed cassette interface, 4-slot motherboard, games tapes & all documentation, £250 - may consider split. Ring Bob on Ket- terting (0363) 1158 (evenings).

Compumak 6k... 5 months old, fully working with games tape, £250. Ring 01-781 4270.

Nascom 1... large capacity power supply, CUTS interface, professionally built, h-bug, digital cassette recorder, nicely all documentation, £350.

Ring Uxbridge 367555 evenings or letter to Room 510, Clifton Hall, Brunel University, Kingston Langley, Uxbridge (ask for Mr. Deakin). VDU case £50, ASCII keyboard £130 KIM 1 with PSU and VDU. £230. Owner moving. S. Noyes, 6 Osborne Road, Clifton, Bristol BS8 2HA.

Motorola 6800... single board S100 processor with 1k RAM 1k ROM 6809... single board S100 processor with memory emulator, blank magnetic cards, cassette (mainly games), £800. A. M. Saunders, SPB, Essex University, 0207 6809.

Software... 8k, UHF modulation, software & PSU. Offers around £230 or px Cassio 502P. Phone Kim on 01-290 0201, daytime.

Fowertran... Comp 80 scientific computer fully built, with 4k RAM and UHF modulator. Ring, Mike Price on 0484-44176, evenings.

Nascom 1... 20 monitor, 5 amp PSU, buffer board, 8k RAM, all installed in smart case with high speed cassette interface, 4-slot motherboard, games tapes & all documentation, £250 - may consider split. Ring Bob on Keterting (0363) 1158 (evenings).

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perhaps also have occasional moods of obstinacy or naughtiness. It should be predictable but not too predictable, vary through the day and accommodate to some extent to the mood of the user. It should have some degree of autonomy, e.g., when required and also occasionally suggest a game, and take both wins and defeats 'in character'.

The initial contact between user and machine may well be stiff but this will change as intimacy develops. First encounters are always very important and skilful programming would be required to establish a good mental image. There are, of course, already a number of programs which are designed to overcome even an initial hostility of a user. They spot hostile statements and swear words and undo them. Dienes' blocks.


of block. Children love this game and can be heard revving imaginary engines as they drive the blocks from East to West. The more able children will easily cope with several gates and three or more docks (Fig.10).

I hope that I've said enough to illustrate the enormous usefulness of Profs. Dienes' blocks. Ideally, every child should have his/her own table-top set (the pocket size get lost too easily) but failing that, each set can be used by four children at once. Of course, every classroom ought to have at least one large demonstration set.

Next month, Derrick Daines turns his attention towards the usefulness and implementation of Boolean Algebra.

List of suppliers

**Hestair Hope Ltd, St Philip's Drive, Royton, Oldham OL2 6A9** .

will supply logic blocks and a binary selection box.

**ESA Creative Learning Ltd, Pinnacles, PO Box 22, Harlow, Essex CM19 5AY** .

... suppliers of logic blocks, also logic people, trees, houses and logic cubes, of the Bullmastiff type (similar to Dienes'); also Trackways.

**El Arnold & Sons Ltd, Butterley Street, PO Box 22, Harlow, Essex CM19 5AY.**

... will supply logic blocks and a binary selection box.

**Taskmaster Ltd, Morris Road, Leicester LE2 6BR** .

number sentence cubes.

Note: Since writing the text of this series, the familiar suppliers of electronics kits (such as Philips) have ceased production, mainly because of Japanese and Korean competition. This particular market is now in a state of flux, with new products appearing (and disappearing) rather rapidly. At the time of writing, Heathkit (Gloucester) produce the only one of which we are aware. Older kits may still be found in toyshops, but no guidance can be offered.

Kits designed to teach about micro-processing are still about. Edukit is marketed by Modus Systems Ltd, 29a Eastcheap, Letchworth, Herts SG6 3DA. No doubt there are others. Readers are advised to shop carefully.

Motorola's Sweet Sixteen Continued from Page 99

in no extra difficulties in system design. More and more of the complications of circuit design seem to be disappearing into fewer LSI and VLSI chips.

Motorola has made it clear that it expects to extend the instruction set in the near future, to include instructions like FIX and FLOOR (floating point to integer and vice versa); it also expects to bring out a 16MHz version. But what about now? Small quantities of the M68000 are expected on the market in the next few months, but at the moment all the chips are going to the big firms for evaluation — not surprisingly in view of the new competition in this extremely valuable market. However, as soon as second-sources get into production the supply position is bound to improve. I was told by one of Motorola's distributors that they had achieved 98% functional chips from the very first masks — an astounding achievement for a chip of this complexity!

A memory management chip is also derived from Motorola Advanced Specifi
cation Data Sheets.

My thanks to Hawke-Cramer for helping to obtain information for this article. Technical details are based on data derived from Motorola Advanced Specification Data Sheets.

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Motorola's Sweet Sixteen Continued from Page 99

in no extra difficulties in system design. More and more of the complications of circuit design seem to be disappearing into fewer LSI and VLSI chips.

Motorola has made it clear that it expects to extend the instruction set in the near future, to include instructions like FIX and FLOOR (floating point to integer and vice versa); it also expects to bring out a 16MHz version. But what about now? Small quantities of the M68000 are expected on the market in the next few months, but at the moment all the chips are going to the big firms for evaluation — not surprisingly in view of the new competition in this extremely valuable market. However, as soon as second-sources get into production the supply position is bound to improve. I was told by one of Motorola's distributors that they had achieved 98% functional chips from the very first masks — an astounding achievement for a chip of this complexity!

A memory management chip is also derived from Motorola Advanced Specifi
cation Data Sheets.

My thanks to Hawke-Cramer for helping to obtain information for this article. Technical details are based on data derived from Motorola Advanced Specification Data Sheets.
THE FIRST DESKTOP COMPUTER TO STRIKE THE RIGHT CHORD!

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AT LAST! THE MICROPROCESSOR THAT BRINGS SOUND TO YOUR PROGRAMME. COME AND LISTEN TO THE DIFFERENCE

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NEW . . .

TYPE B200 Bi-directional serial interface
C.B.M. Disk compatible, software selectable Baud rates, switchable code conversion, RS 232C input and output handshake.

Type C
Serial interface – output only
PET disk, compatible, RS232 C Handshake (Printer Busy), switch selectable Baud rates, Listen Address link selectable.

All type C interfaces now incorporate switchable code conversion to match print to PET screen display.

Type G.P.I. A.P.
Micro-based, bidirectional with buffering. The General Purpose Interface allows free use of PET's INPUT # statement without hangup problems. Software changeable BAUD rates optional features include: Second Serial I.O. Port, 20 mA Loop I.O.

Addressable parallel (disc compatible)
for Centronics, Anadex etc.
Also available with switchable code conversion.

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32K

£186
£120
£249
£106
£45
£35
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£120
£249
£106
£45
£35

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IEEE-S100 Specification Timing
Transparent on Board Refresh
4Mhz Z80 Operation with no wait states.
Fully tested and Burned In
Bank Select versions available – North Star, Cromemco and Alpha Micro
I.O. Port Bank select
Bank Size to 64K in 16K increments

<table>
<thead>
<tr>
<th>Size</th>
<th>Standard</th>
<th>Bank Select</th>
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<tbody>
<tr>
<td>64K</td>
<td>£449</td>
<td>£595</td>
</tr>
<tr>
<td>48K</td>
<td>£398</td>
<td>£539</td>
</tr>
<tr>
<td>32K</td>
<td>£346</td>
<td>£483</td>
</tr>
</tbody>
</table>

P&T IEEE-488 Interface
Provides S100 computers with IEEE-488 Controller, Listener, Talker, Capability

SOFTWARE

PETE PET intelligent terminal package

£200

NEW . . .

BISYNC 80
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into English if there is any customer demand). The SPC/1 can be used for equipment control and for data logging as both the hardware boards and the high level software instructions are already part of the DDE repertoire. The biggest potential for the DDE graphics (rather than manuals) is the reduction in the education market. Comal and Pascal are both in line with modern programming philosophies. The greatest drawback as an educational machine used to be its lack of graphics but, since Turtle graphics are now being implemented, an SPC/1 with a monitor and graphics (rather than a Soroc IQ 120) should be suitable.

Documention

Ten nicely bound manuals were provided with the review machine. All are well laid out, have detailed tables of contents and are paginated. Provided were:

- Introduction to MIK and MIKADOS operating systems
- MIKADOS User's Guide
- MIKADOS Utility Programs and Subroutines
- A Short Survey of the Commands of the Editor
- ID-Comal (in Danish and promised in English)
- The Comal Programming Language-A Short Description

Comal-B System Description

Comal-B Assembler Interface

User's Guide to Assembler and Linker

Pascal User's Guide (comes with the Jensen/Wirth Pascal User Manual & Reports)

Unfortunately I found most of the manuals either too superficial or too technical. The short descriptions of Comal and MIKADOS are probably sales literature rather than manuals, although MIKADOS is a straightforward operating system to use, not requiring any assembler language programming in order to use the editor, file system, Comal or Pascal.

I learned how to use it from Ian Brighten when comfortable, but I was unable to locate any clear instructions in any of the manuals. In the introduction to the MIKADOS User's Guide one reads "The reader is expected to have a basic knowledge of 8080 programming... indeed, the manual is filled with detail on how to call a wide variety of 8080 subroutines. Although this level of description is ideal for the person who wants to configure his own SPC/1 system, it's not the level of detail to which British users of disk-based micro systems are accustomed. For example, the first chapter is about the sending and receiving of semaphores while the second is about I/O drivers.

The Pascal User's Guide is more useful although it does expect the reader to be familiar with Wirth's Pascal. Included are several sections taken from the UCSD manual. I wasn't impressed with the overall level of security in the manuals. Although they appear to be regularly updated, they don't actually describe the review system. The chapter on I/O drivers lists all the VDUs, printers and disk drives for which they are currently drivers, but doesn't include any of the peripherals provided with the new machine. I typed in one of the sample Comal programs and it didn't run as expected. The operator's manual must be in hand's readable form but this isn't mentioned. The utility program TXTUD is not mentioned in the documentation — there was no way to alter any parameters to prevent it from wasting paper.

As DDE obviously take documentation seriously (besides the nice layout the English is fine) I hope that they both clear up the inaccurate details and write an operating system manual that doesn't assume familiarity with machine code.

Expansion

Both the hardware and the software of the SPC/1 have been designed for use as a multi-user, hard disc based system; therefore expansion should be straightforward. The seventeen slot motherboard should be large enough to plug in any boards desired. Memory can be expanded to one Mbyte of RAM or PROM in sixteen banks and up to four 20 Mbyte cartridge driven can be added. The 2 MHz 8085 can be replaced with a 5 MHz microprocessor. An expanded system can support up to eight users.

Prices

The basic system consists of a box plus one disk drive that can hold 90 kbytes (and room for a second drive), a power supply and a 17-slot motherboard with four boards, CPU board, RAM refresh module, 32 kbytes RAM card and a disk controller. Also included in the basic system are a Soroc IQ 120 terminal with cables, a disk containing a dedicated Comal and an empty disk. The 2 MHz version of the basic system sells for £1995 while the 5 MHz version costs £2545.

Below are prices for some of the DDE range of hardware and software, which include a 12-month warranty.

- 16k Dynamic RAM £ 405
- 32k Dynamic RAM 590
- 4 ports async/synch 270
- 8 Channel DMA 305
- Graphics B/W video inc. software 590
- A/D converter 8ch/10bit 495
- D/A converter 4ch/10bit 355
- 8" 250k disk drive (IBM compat), master 1815
- 8" slave drive 860
- 5" 90k expansion drive 450
- 5" 250k disc drive, "A", master 1000
- 5" 250k expansion drive 630
- 20M cartridge disk system 7000
- 20M cartridge expansion drive 4700
- Texas 810 1865
- MIKADOS operating system + utilities 460
- Pascal software (single or double price) 275
- Comal-B 200
- Comal Assembler Interface 95
**Memory map**

<table>
<thead>
<tr>
<th>Address</th>
<th>User 1</th>
<th>User 2</th>
<th>User 3</th>
<th>User 4</th>
</tr>
</thead>
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<tr>
<td>4000-511F</td>
<td>32k</td>
<td>32k</td>
<td>32k</td>
<td>32k</td>
</tr>
<tr>
<td>5120-63FF</td>
<td>32k</td>
<td>32k</td>
<td>32k</td>
<td>32k</td>
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</tbody>
</table>

**Conclusion**

The DDE SPC/1 is a bus-based Danish computer system which has been designed independently of the American influence on either software or hardware. In its present state it is aimed at both the education and the program development markets.

With a 5 MHz 8085A microprocessor and hard disks, I think the multi-user SPC/1 offers a competitive micro alternative to some computing problems that to date have been solved by minis. The review machine was a pared down version of a multi-user system, shoe-horned into a single-user configuration.

Utilities required in this configuration took rather more time to use than comparable utilities on most single user set-ups. The major drawback of the single-user system must be the price... even standard hardware (e.g. BASF drives) are not competitive. Against this background is Comal, the structured Basic language.

I certainly prefer it as both a teaching and a programming language to Basic.

*Editor's Note: Since this review was written, DDE have dropped the single precision Pascal. They have also added the following features: Direct input; 16 byte message exchange between programs; up to 2k memory allocation; and access to assembler subroutines.*

### At a glance

**FIRST IMPRESSIONS**

- Looks: ****
- Setting Up: ****
- Ease of Use: **

**HIGH LEVEL LANGUAGES**

<table>
<thead>
<tr>
<th>Language</th>
<th>Basic</th>
<th>Cobol</th>
<th>Fortran</th>
<th>Pascal</th>
<th>Comal</th>
<th>System Software</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>****</td>
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**EXPANDABILITY**

<table>
<thead>
<tr>
<th>Memory</th>
<th>Cassette</th>
<th>Disk</th>
<th>Peripherals</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

**COMPATIBILITY**

- Processor: ***
- Cassette: N/A
- Disk: ***
- Peripherals: ***

**DOCUMENTATION**

- **

**VALUE FOR MONEY**

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

**PROGRAMS**

<table>
<thead>
<tr>
<th>Y.C.W. Program Continued from Page 109</th>
</tr>
</thead>
<tbody>
<tr>
<td>449 M=33318</td>
</tr>
<tr>
<td>450 L=33288</td>
</tr>
<tr>
<td>460 M=33318</td>
</tr>
<tr>
<td>470 GOSUB 792</td>
</tr>
<tr>
<td>480 GOSUB 790</td>
</tr>
<tr>
<td>490 TJ=&quot;00000*&quot;</td>
</tr>
<tr>
<td>500 JFT4&lt;088001 THEN 500</td>
</tr>
<tr>
<td>510 IFL=3325 THEN P=1</td>
</tr>
<tr>
<td>520 IFL=3325 THEN P=2</td>
</tr>
<tr>
<td>530 IFL=3345 THEN P=3</td>
</tr>
<tr>
<td>540 IFL=3345 THEN P=3</td>
</tr>
<tr>
<td>550 IFL=3371 THEN P=1</td>
</tr>
<tr>
<td>560 IFL=3360 THEN PRINT &quot;J&quot;</td>
</tr>
<tr>
<td>570 IFP=1 THEN L=L+1 2=L-1</td>
</tr>
<tr>
<td>580 IFP=2 THEN L=L+40 2=L-40</td>
</tr>
<tr>
<td>590 IFP=4 THEN L=L+1 2=L+1</td>
</tr>
<tr>
<td>600 IFP=4 THEN L=L+40 2=L-40</td>
</tr>
<tr>
<td>610 IFPEEK(L) =54 THEN 648</td>
</tr>
<tr>
<td>628 POKE 42, PKEKZ-06</td>
</tr>
<tr>
<td>638 GETH</td>
</tr>
<tr>
<td>648 IFRAO $TEN 490</td>
</tr>
<tr>
<td>658 FORD=170B</td>
</tr>
</tbody>
</table>
In the last resort I'm unable to pronounce a verdict. I liked playing with it and I think it's a step in the direction which calculators must go... though maybe not far enough. I venture I'll have to wait for the large scale LCD display, bubble memory (or built-in mini-cassette Stringy Floppy?) and 4 MHz processor before I'm finally satisfied.

Footnote

While I was writing this test, my flat was burgled and -- you've guessed it -- the PC-1211 ended up among the loot. As it's the only sample in the country at present, the Chelsea burglary squad would be fascinated to hear of anyone offering it to you in a pub! Finally, thanks to Sharp for taking the news so (relatively) calmly!

More please -- but different

A few months ago we asked you for more programs -- and we were promptly flooded with them. Even now they're still pouring in so if you're still waiting for more programs -- and we were promptly flooded with them. Even now they're still pouring in so if you're still waiting, you who answered our programs' plea, please keep on sending them. More please -- but different.

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Global string search/replace commands.
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All arithmetic, operators including multiply/divide.
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Listings line number/names excluding label.
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PCW 123
of keying in! If you must send us a hard copy then use plain white paper and put a new ribbon in your printer to give a clear, black impression.

Many readers omit all spaces etc from their listings to save memory space; these listings are quite difficult for others to decipher, however, and where possible you should aim for maximum legibility by including all spaces. If you can't afford to lose these, then send a second version on cassette with the original, this time with spaces included and split it into two if necessary - that's what you've done in a covering letter.

Generally we don't like to print long programs in the programs area of the magazine - we'd prefer a variety of shorter programs each month rather than a single, long one. However, that doesn't mean we don't want long programs! If you've written a lengthy one then we'd like to see it; accompanied by a suitable write-up, it might make a separate feature in its own right.

One or two other points: don't include a description of your program as REM statements within the program itself - describe it on a separate sheet. Pack it securely, using a Jiffy bag for a cassette and a hard envelope for a disk. If you want your cassette or disk returned then enclose a SAE!

So it's up to you now to suit up with something original. We keep hearing (and saying) that the microcomputer offers endless potential so let's see something of that potential expressed as programs in PCW.

**PROGRAMS**

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**PET Golf**

by J. Aughton

Another excellent program from the writer of our recent Backgammon

**PET Golf**

Another excellent program from the writer of our recent Backgammon

**PET Golf**

Another excellent program from the writer of our recent Backgammon

**PET Golf**

Another excellent program from the writer of our recent Backgammon
6010 IF RAND(2)>0.5 THEN JA = 1.27, 1.30 - 1.06
2500 FOR I = 1 TO 200: NEXT: RETURN
1770 PRINT "NTITHE TEE (OF COURSE DA"
1750 PRINT "N\NW GREEN"
1720 PRINT "O=RUG"
1540 GOTO 760
1510 INPUT "MDFIMOr41$
1440 GOTO 920
1410 GOSUB 2000
1360 FOR I = 1 TO 18
1200 C = K + 12 + FN(A(8)): U = 1
6080 FOR I = 40 TO 79, POKE KK + I; 99: NEXT
1010 IF PEEK(40*I + U) = 32 THEN U = U + 480: T = -1: GOTO 1130
1060 L = 1, GOTO 640
1030 IF G = 87 THEN 750
970 FOR I = 1 TO 9, POKE S; G: FOR J = 1 TO 99: NEXT J
905 T = R
885 T = A*TNC(Y - W)/(V - X) + Q - 0.0
860 Q = Q*1.5: U = 0.9: IF F = 2 THEN U = 0.1
840 0 = (H + 30)*(RND(1) + 0.1)*ff/500
810 M = INT((B*M*75/D) + 0.5): 0 = 0
750 PRINT "I SAID 0-100! WELL": GOTO 740
650 PRINT "OCHICH CLUB DO YOU CHOOSE;
610 IF RAND(1) > 0.6 THEN JA = 0.0 TO 6060
6010 IF RAND(1) > 0.6 THEN JA = 1.0 TO 6060
6000 PRINT "MN THE GREEN IN" A
2010 PRINT "M", RETURN
2000 PRINT "0", Z$: PRINT Z$: PRINT 2$: PRINT "N";
1780 PRINT "NA=NATER (LOST BALL!)
1730 PRINT "O=TRAPS (KEEP OUT! !A
1720 PRINT "alIWIREESA", RETURN
1700 PRINT +"=THE HOLE!
1690 PRINT =FAIRWAY!
1680 PRINT "NOTATION USED
1530 IF A$ = "D" THEN C10 = -0.15
1520 IF F4 = "F" THEN 00 = 0.15
1500 PRINT "FADE OR DRAW"
1430 PRINT "PENALTY 311
1420 PRINT "OUT OF BOUNDS -DROP BALL"
1400 PRINT "N": GOTO 920
1390 GOSUB 2500
1380 PRINT "PENALTY 316 STROKESW,A = A + 6
1370 PRINT TOO MUCH CLUB - LOST BALL
1350 IF Y < 0 AND Y > -11 THEN Y = 0, 0 TO 1410
1340 IF Y > 35 AND Y < 48 THEN Y = 35: GOTO 1410
1330 IF Y = 0 AND Y < 36 THEN 1410
1320 IF X > 79 THEN X = 79
1280 POKE C, 174: IF RAND(1)).4 THEN C = C + U
1210 IF RAND(1)).5 THEN C = C + 13, U = -1
1130 FOR I = 1 TO 12: POKE U + T, 40*FNA(5) - FNA(8); 193: NEXT GOTO 620
1100 U = K + 103 + FNA(11): T = 1: FOR I = 0 TO 4
1040 IF G = 193 THEN L = 4: GOTO 1130
1020 IF G = 102 THEN L = 2, GOTO 700
1010 IF G = 1600 THEN R = 43: THEN 600
1000 GOSUB 2500: IF X = V AND IN = W THEN 1600
980 POKES; U: FOR J = 1 TO 99: NEXT J: NEXT I
950 IF (X AND 1) = 1 AND (Y AND 1) = 0 THEN U = 124
940 IF (X AND 1) = 1 AND (Y AND 1) = 1 THEN U = 123
900 ',' = Y - SGN(V - X)*INT(M*SIN(T) + 0.5): X = U
890 U = X + SGN(V - X)*INT(M*COS(T) + 0.5)*U
880 IF V = X THEN T = ff/2, X = X - SGN(Y - W): GOTO 890
870 IF RAND(1) > L THEN 0 = 0
860 IF F > 2 THEN U = 0.5, 0 TO 870
850 IF V = X THEN T = ff/2, X = X - SGN(Y - W): GOTO 890
840 IF W = X THEN T = ff/2, X = X - SGN(Y - W): GOTO 890
830 IF RAND(1) > L THEN 0 = 0
820 A = A + 1: PRINT "114", PRINT A + 48)
800 M = 309 - FNA(12) - (11 + 30)*0.7 - C*8.3
790 GOSUB 2500: REM DISTANCE
770 IF L = 2 THEN B = B*AA, IF C.C3 THEN E = 8*.7
760 B = 8/100: IF F = 2 THEN B = 841.85
740 INPUT B: IF B > 0 AND B <= 100 THEN 760
730 PRINT "FULL SWING.. YOUR CHOICE"
720 PRINT "STANCE BY %AGE (0-100) OF "
710 PRINT " YOU MAY NOW GAUGE YOUR "
690 0070640
680 PRINT "NO SUCH CLUB IN THE BAG": 008U82500
660 INPUT C, C = INT(C)
640 GOSUB 2000
620 PRINT "ODIOI10111-111111111
1510 PROGRAMS
1410 ALL
1300 SPECIAL
1200 TOOLKIT £40 + VAT
1100 SYSTEMS LTD
1000 Telephone Brentwood 102771 810244
990 WILIAM Dower House, Billericay
970 LIMITED PERIOD AT
960 YOUR computer.
950 price: this is a top quality product which will transform
940 video circuitry for free advice. Don't be fooled by the
930 demonstration program for animated effects. All runs in Nascom
920 Colour display plus 8 colour independent background
910 functions.
900 forward programming of
890 powerful sub-routines for vector generation, demonstra-
880 tion program for straight-
870 effective. All runs in Nascom
860 without expansion.
850 Superior design allows connection to most other micro-
840 Modulator for operation with normal colour TV set.
830 Genuine bit-addressable "pixel" system for straight-
820 or UNCUT FOR OEM USE
810 NASCOM 1 & 2
800 Full documentation with FREE SOFTWARE:
790 Superior design allows connection to most other micro-
780 colourful sub-routines for vector generation, demonstration pro-
770 powerful sub-routines for vector generation, demon-
760 easy to program in Nascom
750 STOP PRESS: SUPERBOARD II,
740 or UNCUT FOR OEM USE
730 MICROMART
720 DISKWISE LTD
710 TBE Apple agents for Devon & Cornwall. Complete business systems
700 from £2250 ex VAT
690 EXCLUSIVE HOTEL
680 MANAGEMENT SYSTEM (inc Bookkeeping & Guest billing) & TV RENTAL
670 MANAGEMENT
660 Dealer enquiries welcome DISKWISE LTD. TREKENNER, LAUNCHESTON TEL 05797 628
650 16/32K PET ONLY
640 DISKWISE LTD
630 or UNCUT FOR OEM USE
620 COMPLETE BUSINESS SYSTEMS
610 FROM YOUR DEALER OR WRITE TO:
600 ANYTHING USEFUL
590 MICROCASE!
580 "YOU MAY NOW GAUGE YOUR DI"
570 FOR 6E45 + VAT
560 STUART
550 PROGRAMS FOR NASCOM 1 & 2
540 DAZZLING COLOUR GRAPHICS FOR NASCOM 1 & 2
530 Genuine bit-addressable "pixel" system for straight-
520 Colour display plus 8 colour independent background
510 Full documentation with FREE SOFTWARE:
500 powerful sub-routines for vector generation, demonstration pro-
490 easy to program in Nascom
480 or UNCUT FOR OEM USE
470 or UNCUT FOR OEM USE
460 FULL DOCUMENTATION WITH FREE SOFTWARE:
450 STOP PRESS: SUPERBOARD II,
440 or UNCUT FOR OEM USE
430 STOP PRESS: SUPERBOARD II,
420 STOP PRESS: SUPERBOARD II,
410 STOP PRESS: SUPERBOARD II,
400 STOP PRESS: SUPERBOARD II,
390 STOP PRESS: SUPERBOARD II,
380 STOP PRESS: SUPERBOARD II,
370 STOP PRESS: SUPERBOARD II,
360 STOP PRESS: SUPERBOARD II,
350 STOP PRESS: SUPERBOARD II,
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310 STOP PRESS: SUPERBOARD II,
300 STOP PRESS: SUPERBOARD II,
290 STOP PRESS: SUPERBOARD II,
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270 STOP PRESS: SUPERBOARD II,
260 STOP PRESS: SUPERBOARD II,
250 STOP PRESS: SUPERBOARD II,
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230 STOP PRESS: SUPERBOARD II,
220 STOP PRESS: SUPERBOARD II,
210 STOP PRESS: SUPERBOARD II,
200 STOP PRESS: SUPERBOARD II,
190 STOP PRESS: SUPERBOARD II,
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160 STOP PRESS: SUPERBOARD II,
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TRS-80 Graphics

by R A Develyn

This program introduces two more 'shift' keys to allow a range of graphic characters to be produced. Prefix any letter or a number from 1 to 6 with either the letter 'G' or ':' to reveal the graphic. A 'bogus' cursor is provided which uses the following controls:

* SPACE Moves the cursor one space for-
ward. If the end of screen is reached then it is cleared and the cursor returned home.
† Moves cursor up one line. If the cursor is already on the top line it displays "!!
Shift "!! Moves cursor down a line. If the cursor is already on the bottom line it displays "!!
Shift "C Backspaces cursor erasing as it goes. If cursor is on top left-hand corner it shows "C".
Listing courtesy of London Computer Centre

**UK101 Black Box**
by C McGregor

This is based on Waddingtons game and sits in just 4K if the instructions are removed. Very nice, all instructions in the program.

Listing courtesy of Comp Shop

---

**PROGRAMS**

| 10 CLS | 20 FOR X=15360 TO 16383 |
| 30 A=INT(X/16) | 40 IF A=91 AND X=15426 THEN POKE X,32:Y=X+64:GOTO 30 |
| 45 IF A=60 AND X=15360 THEN POKE X,32:X=X-1:GOTO 30 |
| 47 IF A=53 AND X=16319 THEN POKE X,32:X=X+64:GOTO 30 |
| 50 IF A=64 THEN GOSUB 100 |
| 55 POKE X,A |
| 70 NEXT X |
| 80 GOTO 10 |
| 100 DIM A(10,10) |
| 110 MOV=0:AL=0:13T=32:QU=32:HT=2 |
| 120 FOR I=1 TO X |
| 125 A=A+B |
| 130 A=A+1 |
| 135 IF J=10 OR J=9 OR K=1 OR K=9 THEN N=N+1:GOTO 130 |
| 140 A=A+E |
| 150 RETURN |

---

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COS 2.3 and COS 2.0 versions available.

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CURSOR — gets good control of cursor for drawing diagrams in graphics mode. £5.
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FOX INDUSTRIES (COMPUTER DIVISION)
DONCASTER AIRFIELD, S.YORKS.

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**TOPMARK**
Computers

PCW 127
Robot Nim for PET
by Bob Chappell

We include this program, not because Nim is particularly original nor because it is fast (it isn’t), but because the graphics are great fun.

```
5 REM#100 CHAPPELL###14/5/80###
10 DIM R(3,5)
20 PRINT: PRINT "NIM IS PARTICULARLY ORIGINAL NOR BECAUSE"
30 PRINT "WE INCLUDE THIS PROGRAM, NOT BECAUSE"
40 PRINT "IT IS FAST (IT ISN'T), BUT BECAUSE THE GRAPH-
50 PRINT "IC IS EFFECTIVE."
60 IF R=1 THEN GOTO 10
70 PRINT "NIM IS A GAME OF STRATEGY WHERE YOU AND YOUR OPPONENT"
80 PRINT "TAKE TURNS. ON EACH TURN A ROBOT IS REMOVED FROM THE ROW."
90 PRINT "YOU HAVE TO LEAVE YOUR OPPONENT WITH LESS THAN A ROBOT.
100 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
110 PRINT "A ROBOT IN YOUR ROW."
120 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
130 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
140 PRINT "A ROBOT IN YOUR ROW."
150 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
160 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
170 PRINT "A ROBOT IN YOUR ROW."
180 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
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210 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
220 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
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250 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
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900 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
910 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
920 PRINT "A ROBOT IN YOUR ROW."
930 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
940 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
950 PRINT "A ROBOT IN YOUR ROW."
960 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
970 PRINT "YOU WIN IF YOU LEAVE YOUR OPPONENT WITH"
980 PRINT "A ROBOT IN YOUR ROW."
990 PRINT "YOU LOSE IF YOU LEAVE YOUR OPPONENT WITH 0 ROBOTS.
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3. Use 2514 2532- 25 Core States
4. 164400/SELECTABLE WAIT STATES
5. Double sided PC Board with: crystal and mask
6. Printed circuit edges being joined to PC Board
7. 16x16 Characters
8. Under 15k Bytes Typical from the 16k Byte Block
9. Part number can be read as a logo on the surface of the kit.

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PCW 160
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Software is supplied for serial data transfers - which means that you can write an assembler for your favourite MPU in BASIC on your Superboard, UK 101, NASCOM, etc. and transfer the hex code directly to EPROM via SOFTY. The serial transfer program runs in the scratchpad and can be easily loaded from cassette, or the programming socket.

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

**MODEL UV141 EPROM ERASER**

- Fast erase times (typically 20 minutes for 2708 EPROM)
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- Build-on 5 to 50 minute timer to cater for all EPROMs
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<th>Price</th>
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<tbody>
<tr>
<td>8K User RAM</td>
<td>£998</td>
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<td>16K &quot; &quot;</td>
<td>1078</td>
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<tr>
<td>32K &quot; &quot;</td>
<td>1198</td>
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<tr>
<td>Additional Disc Drive</td>
<td>310</td>
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<td>Soundware (music)</td>
<td>30</td>
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<td>Assembler</td>
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PCW 166
Luddites rule... absurd news reaches us from the great publishing empire of IPC that any word-processor produced copy sent in by contributors to a certain monthly micro magazine has to be re-typed on an ordinary typewriter before being sent to the printers. Apparently these ink-stained worthies refuse to touch anything which has been tainted with these ink-stained worthies to the printers. Apparently typewriter before being sent re-typed on an ordinary micro magazine has to be butors to a certain monthly publishing empire of IPC

CHIP CHAT

Dear Sir/ Madam,

Harris says: "How impractical!" (Ho Ho - Ed.)... May was a lucky day for Mike Knight of Mike Rose Meros and 'Squire' Julian Allason. Both became proud fathers to, respectively, a girl and a boy. The Squire promptly named his offspring James Robert - our first JR of the year. First Tandy, now Sharp and Commodore; all around eyebrows are rising as fast as prices are falling; have YOU looked inside your corn-flake packet lately?... All change time - Hi-Fi heavyweight, Laskys, have bought biodegradable chops? Bewildered child heard outside famous London toy-shop complaining of sand trickling from the bottom of his new micro toy! "The toys felt insubstantial without it!"; says spokesman Harris. Hot news from Hanover - in a spot check of brands, Frau Gerfingerpoken was unable to detect any difference between the Siemens Personal Computer 1000 and the new Apple III; "Mein Gott, vot haff vehere" she is unreliably reported to have said... Commodore shake-up time; out go the whizz kids who make the company what it is (whatever that is), up goes Kit Spencer to Global Marketing Supremo...CRANK, a society devoted to cracking passwords and delving into the depths of databases, is being investigated by the fraud squad. It's hinted that they may have tired of 'just looking' and have started taken to modifying file contents...

Aspiring ruler of the world, Hein, is reported to have given up the unequal struggle and withdrawn their models 50 and 60 electronic type-writers from the US market. Our source tells us that these uncompetitive machines are likely to be sold off in South America - while the jolly grey giant ponders the success of Mears Olivetti and Xymex... From the under-world; small and not surprisingly un-named software houses with good products are planning on seeking 'professional help' in duffing up rip-off artists who steal their wares - they see no legal way out of the problem... Commodore again; paranoia seems to be striking Silicon Gulch about the growing army of plug compatibles; first it was holes drilled in PCBs and solder-filled sockets - now they are rumoured to be tweaking the software to make life difficult for people like Skyles (Programmers Tool-kit), Computhink (Disks) and MTU (Music and graphics). Seeing these guys are probably responsible for a lot of the PET's popularity, could big 'C' be cutting off its nose - along with its directors? Congratulations to "Spangles" Cary who, despite his hectic schedule, found time to get married at the end of May.
<table>
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<th><strong>NEW REDUCED PRICES</strong></th>
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<td>16K</td>
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<td>32K</td>
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<td>£295 for 32K</td>
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<td>ALL FOR ONLY</td>
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**TRS80 LEVEL 2 16K**

Fully converted to UK T.V. Standard. Comes complete with easy to follow manuals. UK Power Supply. cassette lends sample tapes. Special box to enable you to plug into your own T.V. Recommended for those who prefer to have their own hardware. £389 + VAT. 4K Level 1 - machine only £291 + VAT.

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**Microprocessors**

- Z80A 8 bit CPU. This will run as 8MHz but is selectable between 2.4MHz. The CPU has now been generally accepted as the most powerful, it does not require expansion.

**INTERFACE**

- Keyboard (extends expanded 57 key, Loox solid state keyboard especially built for Nascom). Uses standard Nascom, monitored controlled, decoded.
- T.V. Card: fitted - peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.
- I.O. On-board UART (16550) which provides general handling for the on-board cassette interface or the RS232/20mA teletype interface.
- The cassette interface is Kansas City standard at either 300 or 1200 baud. This is a link option on the NASCOM-2.
- The RS232 and 20mA loop connector will interface directly and is also fed to the on-board modulator.

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- NEC's high quality printer uses a print "mirror" that has less denter and inertia than a styly whee.
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