Australian Personal Computer

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APC SHOW - FULL REPORT

AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE

DICK SMITH BREAKS THE PRICE BARRIER

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inside

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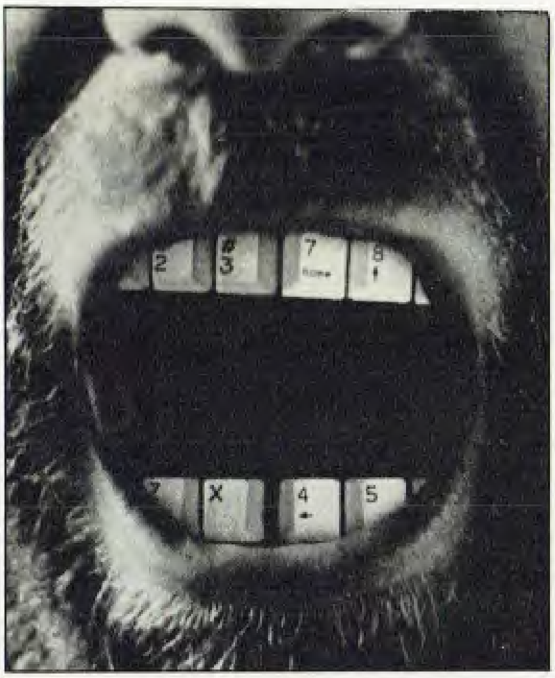

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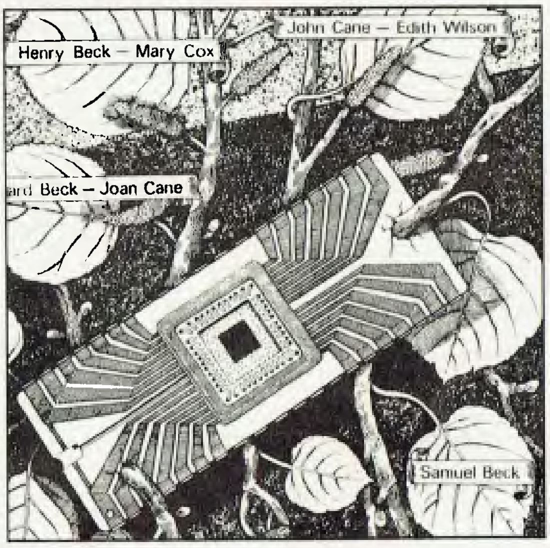

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APC reports on the latest news from the micro scene.

C IS THE KEY TO MORE PORTABLE SOFTWARE

A portable software strategy which makes it possible for *CP/M* systems to run *Unix* applications written in *C*, has recently been announced by Digital Research. President and founder Gary Kildall claims it will broaden the base of computers capable of using *CP/M.*

"Implementing the strategy revolves around the use of *C* which we have identified as the vehicle of portability in the microcomputer industry," said Kildall.

The initial version of the *C* compiler was designed by Digital Research for use with 16 bit 8086-based and 8088-based machines and is compatible with Bell Labs' *Unix Version 7*. The new language is a complete implementation of *C* including single and double precision floating point with 8087 math co-processor support.

CP/M-68k for the 6800 is the first in a family of Digital Research operating systems to be written in *C*, designed for computers like the *Apple Lisa*, Fortune Systems *32:16* and Hewlett-Packard *9816*.

The portable strategy, said the company, will also provide a bridge from *Unix* to *CP/M*, so that application written in *C* for *Unix* can run on *CP/M* systems.

A *C* compiler and *Unix Version 7* compatible run time library will be available with *CP/M-68k* and *Unix* applications can be recompiled for use with the *CP/M*. The compiler will also be upward compatible with Digital Research *C* compiler.

"Software authors who develop packages in *C* will have a much larger market for selling their applications," said Kildall, "because the installed base or *CP/M* systems will grow substantially with the addition of *CP/M-68k* and upcoming *CP/M* versions written in *C* for other processors."

The *C* compiler will be available in April.

'64 MEETING

This item has just come to hand and is too late for inclusion in the Users Group Index: There will be an inaugural meeting of Commodore 64 owners at Panatronics, 691 Whitehorse Road, Mont Albert at 7.30pm on Tuesday, May 17. All interested people are invited to attend and are asked to 'phone (03) 890 0579 to register their intentions.

68000 FOR BELL

A triumph for Motorola and its super 16-bit chip, the 68000, could prove a bit hard to manage from the publicity standpoint.

The good news is that the chip has a 32-bit big brother under development. The 68000 has been selected by America's biggest computer user, the Bell Telephone company.

Unfortunately, Bell has made it known that it is also evaluating 32-bit chips, with a view to the next generation – and that "the 32-bit version of the 68000 is one of two chips under consideration."

All very awkward for Motorola, which insists that the 68000 is a "true 32-bit chip" anyway.

KEYBOARD FOR '400

Flintech Computer Systems are selling Fullstroke keyboards for the Atari 400 at $90 including appropriate cables and connectors.

If you bought an Atari 400 just to play Star Raiders (as we did) but found that the machine wasn't too bad for general computing – except for the horrible keyboard – then it would probably be worth another $90 to upgrade the system. Details from P.O. Box 450, Nelson Bay 2315.

WHO WOULD BUY A PERSONAL COMPUTER

A family owning a colour television, automatic dishwasher, AM/FM car radio, component stereo, central air conditioning, microwave oven and/or a side by side refrigerator, and earning $25,000 per annum or more, is most likely to buy a personal computer.

This was revealed in a recent survey of personal computer owners conducted by Time Inc. A total of 8,000 Time magazine subscribers was asked to participate in the survey, and 7.5% of all respondents owned a personal computer as well as a notable number of the above items.

The survey showed personal computer owners were likely to be professional workers at either middle or top management level in the fields of trade, commerce, education or the services.

Almost half the personal computer owners surveyed stated games and hobbies to be the main use for their computer, with 30.8% nominating personal finance and taxes as a major use.

The Time survey showed a large percentage of personal computer owners to be married (69.2%), male (74.4%) and between the ages of 35 and 44 (31.9%).

A personal computer ranked sixth highest amongst the items shopped for during the six months prior to the survey. It was beaten by the need for a car AM/FM radio, video games, colour television, video recorder or microwave oven.

Of those owning a personal computer, 32% bought it during the last 12 months, 27% bought their computer one to two years ago and 16% bought it over two years ago, showing the fast growing rate of the personal computer market.

MAT-SUSHITA IBM LINK

In a surprise move IBM Japan has announced a new joint venture with industry leader Matsushita, better known here by its National brand name.

The two companies have formed a new firm with the objective of developing and marketing office automation products. IBM is a Japanese leader in large-scale mainframe computers, but lacks experience in the growing field of desk top systems. Matsushita is one of the leading companies in the OA (office automation) field.

The products developed and sold by the new company will be marketed in Japan under the IBM brand name. And both companies hope to benefit from the joint venture, by supplementing their know-how with expertise from the other company.

No new products have been announced, but new ones have been developed, and sales are planned for later this year. It is understood that all the new IBM brand products will have *kanji* (Chinese character) processing capability.

The suprise is that talks between the two companies started two years ago, but apparently came to nothing. Meanwhile, progress was being made behind the scenes, and the formation of the joint venture is the result of these negotiations.

The name of the company is not available, neither is the identity of its president known.

3D GRAPHICS PACKAGE

Anderson Digital Equipment unveiled a new three-dimensional graphics software package which runs on NorthStar personal computers, at the recent APC Show.

National distribution manager for ADE, Glen Cooper, said the new NorthStar graphics software package attracted a lot of attention: "Besides a large array of printers and other ADE products, we demonstrated the NorthStar Advantage personal computer and the new software package", he said.

"We were able to demonstrate three-dimensional graphs, bar charts and pie charts with this new software package, which runs on most CPM-based application programs".

Mr Cooper said the new 15 megabyte NorthStar Advantage desktop computer, with electronic mail capabilities, was also demonstrated at the Exhibition.

More details about the 3D package are available from ADE on (03) 544 3444.

SANYO HARD DISK

Sanyo Data Systems will be the exclusive Australian distributors of the DataFile hard disk system. It is manufactured in the US by Thought Works Inc and comprises a 5, 10 or 20Mb winchester with intelligent controller, power supply and software. The unit is suitable for Sanyo, Apple, IBM, NEC and DEC micros.

Suggested retail prices range from $4560 for the 5Mb up to $6600 for the 20Mb unit. More details are available on (02) 929 4644.

MICRO-FLOPPY BATTLE HOTS UP

Hitachi has started selling its own 3 inch floppy disk system in Japan, and is co-operating with 18 other Japanese and foreign companies to standardise the system.

Only Hitachi and Matsushita have adopted the format in Japan.

Sony, on the other hand, has already signed agreements with 13 other companies.

Hitachi's format gives 164 Kbytes of memory on a double-sided disk, using 80 tracks. The disk drives will be sold in Japan at ¥79,000 ($385).

Sony's disk drive format has already gained acceptance from ANSI for its 3½ inch disk format, but Hitachi's three-inch format has also been submitted to ANSI and acceptance is expected soon.

The scene is further complicated by IBM's plan to launch a 3.9 inch disk system. At the present time, Sony and its cooperators seem set to win the microfloppy battle.

SUPER-FAST EYE DECEIVING CHIP

Machines which take the best part of a second (or more) to display a screen of words are under threat by a special purpose processor from Intel.

Intel has followed the lead of Japan's 7220 graphics chip, which can be used as a super-fast and super-clever character generator – turning the ASCII codes stored in memory into the dots on a video tube that deceive the eye into seeing characters.

Intel's chip, however, includes full text processing functions in its features – including the ability to process text streams searching for words or formatting output to printers.

It also allows system builders to build smooth scrolling displays, where the screen does not flick every line directly into the space above or below, but moves it gradually up, dot by dot.

It will also permit the building of sophisticated window displays of the sort pioneered by the recently launched Apple *Lisa*, and before that, by the Xerox *Star* and other Palo Alto Reserch Centre derived systems.

According to Intel, the new 82730 'co-processor' chip will run side by side with absolutely every one ot its eight and 16-bit micros, freeing the main micro from the time-intensive text control jobs, and speeding up overall word processing.

NEW IBM PC

IBM launched their new IBM *PC* XT at the *APC* Show last month. The basic price of $7,892 includes a 10Mb hard disk and eight expansion slots (alleviating a major criticism of the standard IBM *PC)*. Additional features are an asynchronous communications adapter, more powerful DOS and application software and increased maximum RAM to 655k. The XT and associated options are scheduled to be available in May.

PC COMPATIBILITY IN QUESTION

Accusations of "foul play" against IBM are starting to appear amongst manufacturers of lookalike micros, who claim that the giant has deliberately modified *PC DOS* in order to prevent IBM software from running on rival machines.

According to both IBM sympathisers and IBM opponents, something like 80 per cent of *PC DOS* programs will run on the *Compaq* lookalike – a portable system costing rather less than the official IBM price.

Compaq is currently embroiled in a complex lawsuit against Texas Instruments, whose *Professional* microsystem also comes close to the IBM in software compatibility, and from where many Compaq executives and designers were recruited.

Inside Compaq, the 80 per cent figure is seen as proof of the dastardliness of IBM, with sources expressing the opinion that the incompatibility level was "done with great deliberateness".

However at Microsoft, where both *PC DOS* and *MS DOS* were written, Bill Gates believes that the level of compatibility is very high.

Gates was recently interviewed by the new *PC World* magazine, where one senior editor Harry Miller told us that they believed there would be "no problem" for the software industry in converting.

"I believe that even when *MSDOS.2* is generally available, there will not be any problem in moving applications software."

NO PLANS YET

We must apologise to NEC for pre-announcing their hand-held micros, the PC-8200 and PC-8201. The information was gleaned from a Japanese newspaper, and is correct, but a call from NEC (Australia) indicates that "there are no plans for an Australian release of the machine yet". Even if there were plans the earliest Australian release date would be later this year.

However, if you're desperate to buy something from NEC in the near future, they're released a 9Mb hard disk unit for their APC. Up to two units can be connected to an APC giving a total capacity of 18.6Mb. "The hard disk is expected to have a pre-tax recommended retail price well under $4000 which is extremely competitive," said Bill Botton, APC Product Manager for NEC. Oh, we almost forgot, availability should be around the end of June.

ASIAN SHOW

If you liked our Show in Sydney last month and are thinking of an Asian holiday later this year, think about taking-in PerCompAsia 83 at the Singapore World Trade Centre from October 19 to 22.

Some companies which have booked space are NEC, Honeywell, Wang Computers, Texas Instruments, IBM, ICL, Sord, Atari, Apple and Digital Equipment.

For more information telephone Richard Ho on Singapore 2213466-9.

HIGH SPEED DOS

Pnakotic Software has released

their High-speed Disk Operating System (HDOS) enhancement for the Apple II. The company claims it is compatible with almost all software designed to run under DOS 3.3 and speed improvements are in the order of 3 to 5 times over DOS 3.3.

The package includes a utility to place HDOS onto a DOS 3.3 disk and sells for $29.95. Further details are available on (08) 337 8575.

UNBELIEV-ABLE!

Hi-tech shoplifters are apparently the latest hazard facing micro retail stores. So great has the problem been for one Angus and Robertson business centre that A&R have decided to close the store. The company's retail development manager, Erwin Edel, told the Sydney Morning Herald that their Bondi Junction store has been raided three times since it opened just before Christmas. One member of the gang is thought to distract a shop attendant while another lifts calulators, typewriters, desk-top computers and other discreet items. Police told Mr Edel that there was little the staff could have done to stop the team of highly organised shoplifters. Mr Edel was also reported as saying: "We suspect the people who stole the computer have been trying to buy programs for the machine from our Pitt Street business centre." Presumably they were after a stock control system.

BUILD A BETTER MOUSE

Mouse-driven software has caught the imagination of American hardware designers, and as a result, there were plenty of new mice to be seen at the West Coast Faire. There was even one hedgehog.

Mouse systems produced a slight variant on the Apple Lisa design, with the Optical Mouse which needs a special encoded mirror surface to run on.

The company was demonstrating this mouse hooked into an IBM PC, effectively demonstrating both the considerable advantages, and the difficulties, of trying this trick.

Used as a graphics pointer, the mouse was unbeatable. Used as a human interface to WordStar, it became clear that the work done so far was not enough.

This mouse will connect to anything with an RS232 port, providing the right software has been written to read it. It has two light emitting diodes underneath (one is a spare, in case the other goes out) which count gaps in the grid on the mirror below it.

The hedgehog mouse was attached to the Logitech Lilith machine – the only one in existence which is actually not a clone of the Lisa (or its parent, the Xerox Star).

Logitech has built a machine around the new language which Niklaus (Pascal inventor) Wirth (pronounced "Veert") has released on a surprised world:

The difference between Pascal and Modula 2 is that where Pascal was designed to be a better 'teaching' language for programmers than Basic, Modula 2 is meant to be a better 'programming' language.

It uses a mouse (Professor Wirth himself uses the term 'hedgehog' instead) and has its own 'natural' language. The Lilith machine is built around this language.

Logitech/Switzerland was set up by Tony Gorrengourt with Wirth's assistance, and it now has a branch in Palo Alto, where the Lilith machine was built. But since this is really a minicomputer, not a micro, the company has now moved one step further, and has produced a program which turns the IBM PC into a Lilith/hedgehog/Modula 2 system.

The other mouse to appear was a far less innovative one: it uses a rolling ball underneath.

This was released by Canadians Corman Custom Electronics.

The product is not a mouse, but a box to interface it – the Mouse Trap – costing $345.

It does save an 'interface slot' by going in as part of the keyboard. Both keyboard and mouse plug into the Trap, which plugs into the keyboard hole.

But the price, said many, would indeed prevent them from beating a path to the Canadian door.

No home should be without a Waldo

The original dream of all microcomputer buyers – a robot which would run the house for them – has now appeared in tangible and purchasable form as a printed circuit board to plug into an Apple.

For a price of $600, Apple owners can buy a *Waldo* unit which will recognise spoken commands, a 'home control interface' with ultrasonic command modules and remote switch modules, stereo sound generators and amplifier, and full instructions.

The full instructions include, they say, a set of software on disk which will do the "voice and time processing" that controls the house.

What this means is that you can say things like "Waldo, turn on the television at five to eight, and call me." Then at five to eight, when you may be in the toilet or talking on the 'phone, the robot voice will suddenly announce, "You asked to be called in time for Dr Who, Sir." And the television will come on. The clock in the system has its own battery backup, so it will keep track of time and date even when the computer is switched off – but the one thing it cannot do is to switch the computer itself on.

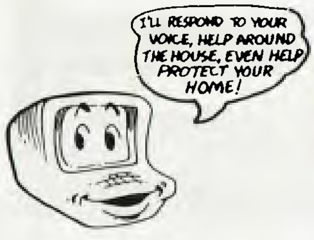
Presumably the more electronically literate will be able to take the control system and to make it do more sophisticated things than on/off, since the ultrasonic control can control 16 different devices.

For anybody who needs more than 16 control devices, *Waldo* can switch to a special control system of sending its command pulses down the mains circuit to all the things plugged into the electricity supply.

The robot type voice, "with unlimited vocabulary" costs an extra $200, while a "human quality voice" with a 206 word vocabulary, costs the same.

The mains electricity encoded system is an extra $70 (but is not available yet).

The maker is Artra of Arlington, VA, USA, (703) 527 0455.



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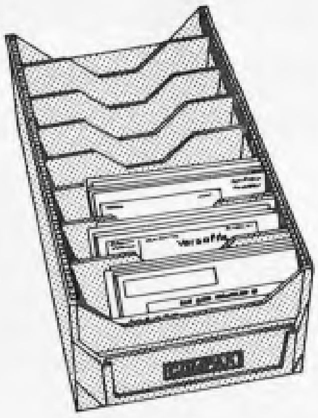

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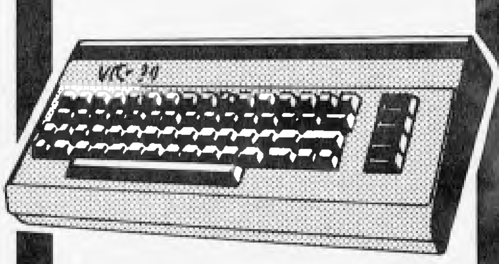

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The 1st Australian Personal Computer Show

SHOW REPORT

by Steve Withers

The 1st APC Show was a great success. Occupying four floors of Sydney's Centrepoint, the three day exhibition was attended by 22,539 people. Although the queues were not as long as those for the Personal Computer World Show in London (the world's largest microcomputer exhibition in terms of visitors) those business people who took advantage of the 'fast lane' saved a useful amount of time. I should stress that this is a personal view of the Show rather than a comprehensive report, so not all exhibitors will be mentioned.

Once inside, visitors were faced by the huge island stand taken by Barson Computers with their dealers, filled with any number of Siriuses, as well as the BBC Microcomputer and the long awaited Sinclair ZX Spectrum (remember, you saw it in the June '82 issue of *APC*). Anderson Digital Equipment were also near the entrance, demonstrating a NorthNet network consisting of a pair of North Star Advantages (one with a 5Mb hard disk). A minimal network perhaps, but one which attracted a considerable amount of business.

Japanese manufacturers Sord and Panasonic were represented by Mitsui and the Computer Company respectively. Sord's M23P has a dull name, but its inbuilt microfloppies and an optional liquid crystal display with 8 lines of 80 or 160 characters lift it from the mass of micros on the market. Their PL200 plotter coupled with the B Graph business graphics software could form a very useful graphing system, and for home use there was the M5 with colour graphics and plug-in program cartridges. Panasonic's new JR100 and JR200 are aimed at the same market, being book-sized units featuring colour and sound.

Business users might have been more interested in a telex adaptor distributed by Case Communication Systems. A combination of hardware and software provides auto-dialling and automatic transmission to one or more destinations, plus other benefits. Telecom approval is pending, and versions of the software are available for a range of micro and minicomputers as well as word processors.

The International Level was the home of several big names in the industry. IBM were there with the beefed-up XT version of the Personal Computer. Their Charlie Chaplin look-alike was probably the most photographed person at the Show – very cooperative, but never saying a word. Digital Equipment Corporation had their new range of personal computers on display, complete with huge pictures of that obnoxious child from the TV advertisements.

Osborne's stand attracted plenty of

About 10% of the queue.

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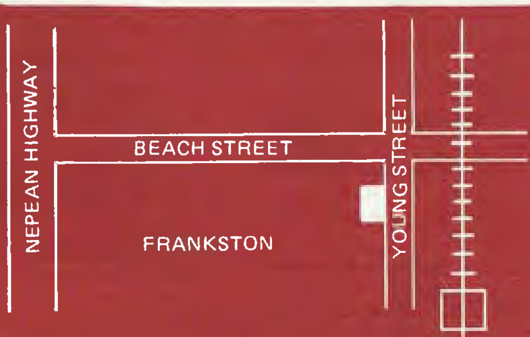

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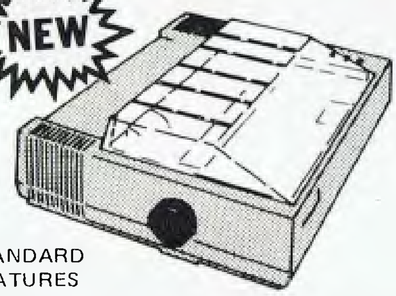

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WHAT THE PRESS SAID

Australia's general and trade press acclaimed the micro extravaganza – even going so far as to suggest that the attendance figures may have been conservative.

"The First Australian Personal Computer Show . . . was a great success" – The Australian.

The First Australian Personal Show is over, but not before nearly 25,000 people had the opportunity to see the latest in microcomputer technology available worldwide" – The Financial Review.

"Micro Show proves a stunner" – Australasian Computerworld.

"The First Australian Personal Computer Show was an outstanding success" – Pacific Computer Weekly.

IBM Australia's chief, Mr Brian Finn

Mr Selby said many of the large exhibitors had already contacted him about booking for the 1984 show which he hopes to hold in Sydney and Melbourne.

The audited figures for the first two days of the show were 6,401 for Thursday and 8,290 for Friday.

Saturday's figures were not available but estimates put it at considerably higher than either of the previous two days.

FINANCIAL REVIEW Friday March 11 1983

Show pulls them in

About 1,000 people an hour passed through the gate of the first Australian Personal Computer show which opened at Centrepoint in Sydney yesterday.

It was the first day of the show and although organisers were predicting a turnout of 15,000 over three days, by 2pm yesterday 5,000 had paid their money.

Organisers said the quality of the crowd was very good with an estimated 40 per cent being businessmen and the rest general public and school children.

Computers

About 90 exhibitors are displaying the latest available computer hardware and software in the world.

The show was given added impetus on Wednesday when IBM announced the worldwide launch of a new computer, and the local subsidiary had it on display yesterday.

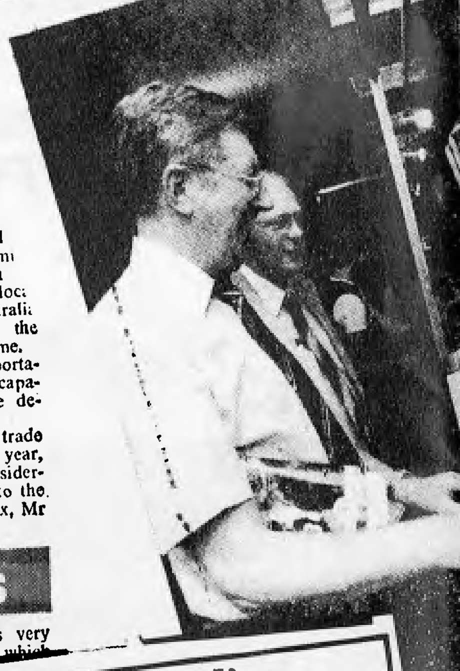
IBM's entry into personal computing and the recent entry of a number of other big names in the industry, such as Digital Equipment Corp, have focussed attention on the area of microcomputers.

At one display the arrival of the microcomputer was being likened to the introduction of the wireless.

— Richard Hubbard

The Sydney Morning Herald, Friday, March 11,

BUSINESS



Portabl didn't make it

One computer which did make it to the forthcoming show is the Chameleon even though potential local distributor Onyx Australia worked hard to get the machine to Australia in time.

The Chameleon is a portable system claimed to be capable of running software developed for the IBM PC.

First exhibited at a trade show in the US late last year, the Chameleon drew considerable interest according to the general manager of Onyx, Mr Tony Bowden.

Personals

"Timing was always very ...

THE AUSTRALIAN Tuesday March 15 1983

First personal exhibition voted a great success

LOUISE O'HARA

The Sydney Morning Herald, Monday, Ma...

Biggest names

AUSTRALIA'S long-awaited Personal Computer Show open for three days on Thursday, at Centrepoint, with a cast that includes some of the world's biggest names in microcomputers.

... interest in the computer industry is an understatement.

All the exhibition space was sold out more than two months ago and the standard industry farewell since the new year has been: "See you at The Show".

The 1st Australian Personal Computer Show
Centrepoint Sydney
10-12 March 1983

Attorney General, Mr Paul Landa presenting the opening address.

As promised, the 'lots of pretty girls'.

visitors, many of them commenting favourably on a direct connect modem that fits into one of the disk storage pockets, while across the aisle Wiser-Microsoft were demonstrating the new flight simulator program for the IBM PC. According to light aircraft pilots, it is a very realistic simulation. Considerable interest was also shown in MultiPlan, a spreadsheet program that won InfoWorld's Software Product of the Year award (shame about the acronym, a SPOTY award doesn't sound very complimentary).

While some stands were cluttered, Olivetti made sure they had plenty of room for visitors by setting up a very low-density display. Perhaps the idea was to remind people of the De Bono advert. Next door the Roland Corporation had an interesting range of computer controllable music synthesisers — not tacky little add-ons, but the genuine article at an affordable price. The most expensive was the Microcomposer, described as a two channel music computer with one synthesiser built in and the ability to control a second unit. Yours for $595.

The undoubted star of the Show was Lisa, the new professional system from Apple. Frequent demonstrations packed the area around the stand, much to the irritation of those trying to walk past. You have probably seen pictures of the Lisa screen by now, but they do nothing to prepare you for the shock of seeing menus popping up (and disappearing again), windows moving around the screen, multiple typestyles (that can be printed just as they appear on the screen), or the ease with which functions may be selected. It also seems incredibly easy to move from one function to another. For example, creating a pie chart from a column of figures in a spreadsheet requires just a few operations and only takes a few seconds. Sure, it's not the be-all and end-all, but it is a step nearer to my dream personal computer. Apple are encouraging software houses to develop further applications, and they are providing the information and the tools needed for full integration with existing Lisa software. Call me a 'trendy journo' if you must, but I reckon Lisa will be even more significant than the Apple II, especially when you consider that Apple have found that computer naive managers take on average just 22 minutes to master one of Lisa's functions (the project planning program, for example), and they pick up the other functions even more quickly due to the consistent user interface.

Commodore took a very large stand (second only to Barson) to show products old and new. One end of the stand was set up like an amusement arcade with a large number of VICs running a variety of games. My only complaint was that there were so many kids there that I didn't get a chance to try my hand! The Commodore 64 (looks like a VIC but is far more powerful) was there, running demonstration programs to show its sprite graphics as well as its musical

The real fake Charlie Chaplin. President (Columbia's better than IBM's PC) Office Machines sponsored a robot nick named 'Charlie'.

Déjà-Vu?

Commodore's crowd blockade — row after row of VIC-20s for visitors use.

Just what every executive needs.

abilities. Commodore's other new systems, the 500 and 700 were also on display, but the 500 was a static exhibit while the 700 was running a demo that did little to highlight the computer's features. Maybe they don't want people clamouring for the machine before they are available in quantity. The remainder of the stand was taken up by the established 4000 and 8000 series, complete with the relatively new hard disk system.

Although the Executive Level was the smallest of the four floors, it had its share of interesting items (I'm not talking about the Executive Hospitality Suite where the only bar was a Cafe Bar). For those on a low budget, Gametronics were showing all sorts of goodies for the ZX81, while Hewlett Packard were on hand for people with a generous equipment fund.

A product that may prove popular was on display on the EDP Imports stand. They are bringing the Genie removable hard disk subsystems to Australia. A system that packs 5 megabytes onto a cartridge approximately half the volume of a box of minidiskettes could be a convenient answer to the backup problems associated with Winchester disks, as well as being a worthwhile storage device in its own right.

CP/M Plus exists! Not only that, but there is an Australian single board computer that can take advantage of it. Ask RDM Computers for details of the 'Aussie Byte', as it has too many features to describe here.

Club Corner was also on this Level with several user groups publicising their activities and offering advice. I feel that the presence of computer clubs at exhibitions provides a useful source of information as well as acting as a foil to the commercial pressures.

There were a couple of robots at the show providing some light relief. Jaycar Electronics had a robot arm going through the motions of pouring from a beer can, while President brought along Charlie, their R2D2 style 'droid. Charlie's habits included walking into walls and wolf-whistling at females as he trundled around Centrepoint. I'm sure a carbon-based life form would have been thrown out for such behaviour.

I did overhear some complaints from visitors, the most common being that the staff on some stands did not have adequate knowledge of their products. Such remarks were aimed particularly at those exhibitors who were using women for decorative purposes. Other complaints were mainly about queuing and crowding, but this was due to the fact that the organisers expected around 10,000 people to attend, but more than twice that number materialised. One of the reasons for the huge attendance was the widespread publicity the Show received from the media. Newspapers, radio, TV, and the

trade press all carried features about the event.

Exhibitors were very pleased, reporting good sales and leads from the Show. They were particularly impressed by the quality of visitors, the majority being potential customers rather than casual browsers. Several companies booked space for 1984 before this year's Show had closed. In case you have already started next year's diary, the dates are March 15-17 (Sydney) and July 19-23 (Melbourne). See you there!

Proof that there was some elbow-room!

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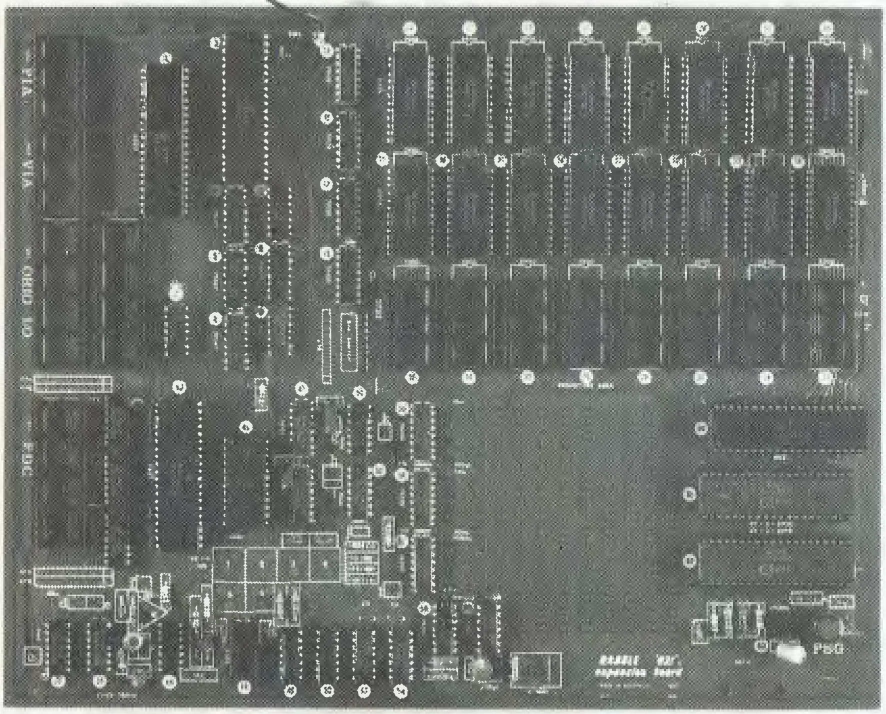

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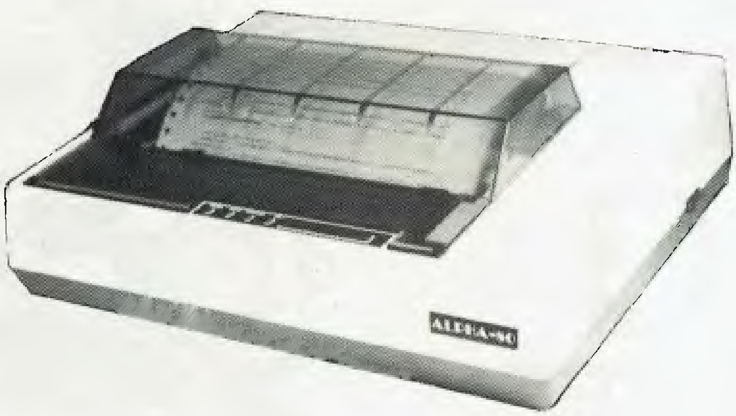

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The Case of the Plummeting Stockbroker

It had been a most difficult and exasperating week for Sherlock Holmes and myself. Moriarty, that arch fiend and master of disguise had, once more, given us the slip at Victoria Station disguised as an itinerant garlic salesman.

The clock chimed four, and Mrs. Hudson entered with the tea tray, as regular as a dog on Meaty Muesli Bites.

"I am inclined to think..." I began.

"I should do so." Holmes remarked impatiently.

"Really Holmes," said I severely, "you are a little trying at times." It was then that I noticed a man on the window ledge of the building opposite.

"Holmes!" I cried, "there's a..."

"Man on the window ledge opposite," drawled Holmes, his back to the window, his head in the clouds.

"Yes! And I do believe he is planning to..."

"Jump from it," added Holmes, laconically. "I shouldn't worry Watson, it's only Sir Fotheringay Granite-Smith."

"What? Not Granite-Smith the stockbroker and futures broker?"

"The same."

"And why, pray, is he planning to curtail his own future in such a drastic and ostentatious manner?" I enquired, rather pleased at my pun.

"It is a matter of futures that has driven him to the edge of his existence. Two lumps, if you will Mrs. Hudson."

"Very good sir. One biscuit, Mr. Holmes?"

"Stir yourself, man! The very least we can do is save him! Explain yourself!"

"I mean that Granite-Smith's precarious position has been precipitated by a paucity of precise printed matter. An iced vo vo, thank you Mrs. Hudson."

"Preposterous!"

"Perhaps. Granite-Smith has been dabbling, of late, in Patagonian peanut futures, in fact, he has sunk his whole fortune into the promise of a bumper ground nut crop. Late last night a telex arrived informing him of the impending failure of the crop. He never received it. The telex operator, a charming if scatter-brained lass, left the telex in the ladies room en route to his desk. A pity. A disaster that could so easily have been diverted."

"Thank you Mrs. Hudson," I sipped at my tea. "Pray continue Holmes, and supply the solution to Granite-Smith's predica...Good Lord! He's moving towards the edge!"

"A CASE TLX unit. A simple and remarkably inexpensive device that turns any word processor, computer or terminal into a telex station. The TLX means that any system with an asynchronous interface is able to send and receive telex messages. With a CASE TLX unit connected to his desk top terminal, Granite-Smith would have received the full story of the failure of the Patagonian peanut crop in time for him to divert his funds, also by telex, to some more lucrative venture."

"Count Moriarty's Madagascan Mangoes, perhaps," I suggested.

"An excellent return," Holmes added mournfully.

"Good Lord! There he goes Holmes, Granite-Smith is plunging pavementwards!"

"Fear not, dear Watson. I have taken the precaution of parking a large carriage containing several feather down mattresses in a position calculated to break his fall. Another iced vo vo if you please, Mrs. Hudson."

"Certainly Mr. Holmes sir. Dr. Watson, would you care for...wherever can he have gone?"

" Dr Watson has gone to inform Granite-Smith about the CASE TLX Unit, I imagine. And a good thing too. We can't have stockbrokers splattered all over the pavements of Baker Street, Mrs. Hudson, can we?"

"Certainly not, sir. It would frighten the horses."

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WATCH OUT FOR YOUR PROTOCOLS!

In the final part of his series on networks, Terry Lang delves into rings before getting down to the software which makes networks work.

This article is the third, and last, in a short series on the subject of networking. The first article discussed the basic characteristics of a network, and looked at a simple 'star' network with just one central controlling switch or 'node'. The second article discussed networks which switch 'packets' through a mesh of interconnected nodes. The present article will first describe the basic features of 'ring' and 'broadcast' networks, and then bring the series to a conclusion by looking at the all-important software requirements.

Round the circle line

Suppose we have to provide for the networking requirements of one large site (industrial, administrative, or research laboratories, or perhaps a mixture), possibly with a number of separate buildings. The networking requirements on this site may include the interconnection of a central computing facility with distributed mini and micro word processor systems and numerous terminals. (We will assume, at least for the moment, that there are few off-site connections, and that these are adequately catered for by some public carrier service, probably of the distributed packet switched type.)

If we return for a moment to the 'star' network with the central node which we considered in the first article, we can see two major disadvantages for our posited situation:

— much cable would be needed to connect every point of service to the central node (especially between buildings on a large site);

— a central node would have to work extremely hard to deal with our maximum total communication rates, possibly in excess of 10 Megabaud.

A way round the first of these problems is to provide for just one cable which threads its way through each point of service in turn. Suppose we wish to pass packets of information along this cable. (The structure of a packet is illustrated in Figure 1; the *raison d'etre* for using packets was discussed in the previous article.)

start of packet
indentifier of receiver
indentifier of sender
control information (eg, flow control)
character 1
⋮ } data
character n
checksum
end of packet

Fig 1 Structure of a Packet

If we are to pass the packets extremely quickly, then we will have to relax the restriction that before a node can send a packet along the next link of its journey it must wait until it has itself received and checked the whole packet. Rather we shall get maximum speed by allowing nodes whenever possible to pass on each individual *bit* as soon as it has been received. Finally, if a packet passing along this cable is to be able to reach any receiver from any sender, then we can provide for this by connecting the end of the cable round to its beginning, thus forming a complete ring, as illustrated in Figure 2.

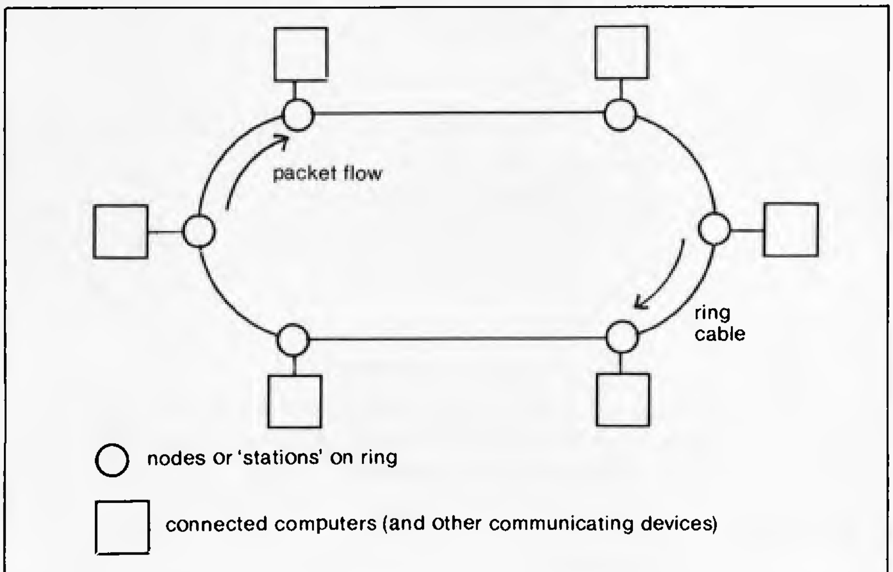


Fig 2 A 'Ring' network

As indicated above, a node on the ring will whenever possible pass on every part of the packet as soon as it is received. When the identifier (or 'address') of the receiver has arrived, then the node can decide whether the rest of the packet is in fact addressed to itself. If it is not, then the node can simply keep the rest of the packet moving as quickly as possible. If the node is the intended destination, however, it can take a copy of the data in the packet and pass this out to its connected computer (or peripheral of any kind). At the same time the node will also continue to pass on the packet, so that it can complete its cycle back to the original sender.

As the end of the packet is reached, the receiving node can insert a marker to indicate to the sender whether or not the message was correctly received (ie, the checksum matched). When the packet completes its cycle round the ring, the sender can check this marker to discover whether or not the packet successfully reached the receiver.

Because very high quality cable is used (eg, shielded twisted pairs, coaxial, or optic fibre) together with ultra-reliable node hardware, then very low error rates will be expected (eg, an error rate of 1 in ever 10^{11} bits might correspond to one error in every three hours of operation): the error checking mechanism can be designed appropriately. Typically packets are very small, eg, just two characters of data. This makes them more suitable for working with individual terminals in full duplex mode — see the discussion on 'packet assemblers/ disassemblers' in the previous article.

When a packet completes its journey round the ring, the sender extracts it, and replaces it with an 'empty' packet, which will continue to circulate until picked up and used by another sender. Of course, the

Illustration by Kevin O'Keefe

WATCH OUT FOR YOUR PROTOCOLS!

original sender might well have further packets ready to send, especially if it needs to make up one long packet (eg, 512 characters) out of many 'mini packets' (of two characters).

However, if the sender immediately sends round again the packet which has just completed the cycle, then all the other nodes on the ring will be prevented from transmitting, because all they will see passing is 'full' packets. Therefore a rule is imposed within the system whereby a sender can not retain use of a packet it has just cycled, but must pass it on as an empty packet, so that a node downstream is first given the opportunity to transmit. (There is an alternative mechanism which can be used on rings which employ very large packets. In this case what is sent round the ring initially is a small 'token' packet. The node which holds the token may then transmit a large packet, or alternatively pass the token on. This approach is particularly useful for 'synchronous' transmission, where the whole of a large packet has to be transmitted within some guaranteed time interval.)

In summary, then, the ring architecture provides a convenient approach to minimising the cable required. It also provides very straightforward mechanisms for routing (ie, a node either extracts a copy of a packet or simply sends it on) and for flow control (ie, via the 'empty packet' or via a 'token'). On the debit side, there must be concern about the reliability of the system, since the 'ring' is in effect common to all nodes, and one node fault or one cable fault could prevent the whole system operating. In practice, however, this does not turn out to be such a great problem. The node hardware is designed to be ultra-reliable. The node circuitry is kept distinct from the computer or peripheral interfaces connected to it, and DC power for the nodes can be distributed via the ring cable.

Generally a ring includes one special node, which is responsible for starting up the empty packet (except in 'long' rings, there will be just one packet circulating), and for monitoring the occurrence of errors. A break in service must be made when it is necessary to open the ring and insert a new node, but this can at least take place at an advertised time.

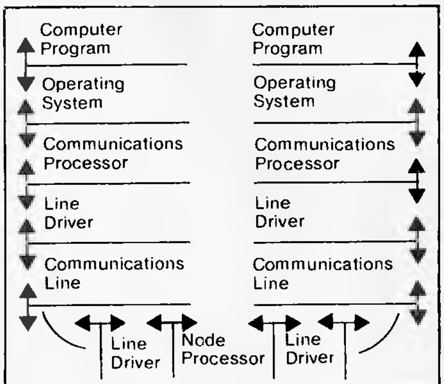


Fig 3 Hardware and software interfaces on path between two computer programs conversing using a Protocol.

The data rate on ring networks is typically between 1 Mbaud and 10 Mbaud. To ensure no significant waiting time before a node receives an empty packet and can send information, the average level of utilisation must, as demanded by queuing theory, be significantly below this level. In one large automated-office type of environment, short term average loads of around 35 percent were found at peak periods, with a 24-hour average of only a few percent.

Is there anyone out there listening?

The previous section described how the 'ring' architecture was evolved to meet the local area network needs of an organisation. There is, however, another approach to the problem of minimising the amount of cable required, and that is to start from the position of using no cable at all. This could be achieved simply by equipping every node with a CB style radio. Any node that wants to send a packet simply broadcasts it, including as usual the identity of the intended receiver at the start of the packet. All the radios broadcast on the same carrier frequency, and all nodes maintain a listening watch on that frequency. Thus, when the packet is broadcast the receiver will be expected to recognise its own identifier and to record and act on the rest of the message. (Of course this is hardly the most private means of sending messages, and any encryption has to be carried out privately in the sending and receiving nodes. The same considerations will also apply to ring networks.)

We also have to consider the situation where several nodes wish to transmit at the same time. The rule is simply that any node which wishes to broadcast must first listen to make sure that no one else is broadcasting (ie, there is no carrier signal being broadcast over the 'ether'). If necessary, a node must simply wait for the transmission in progress to finish. Of course there is still a small chance that two nodes will start to broadcast simultaneously (particularly if both have been waiting for some other node to finish). To overcome this, nodes must continue to 'listen' to the ether even while they are broadcasting. If interference is detected, then it can be inferred that a 'collision' of packets has taken place.

In such a case both transmitting nodes must stop their broadcsts. If they both restarted immediately then they would of course simply collide again, so what actually happens is that both wait for a 'random' time and then try again. Most frequently one will then start again before the other (on a random basis) and the second will simply wait its turn when it hears the carrier of the first. (Should both collide yet again then they simply wait once more. Provided the 'random' wait is indeed random then one of the two will eventually get started first.)

This approach to networking was first developed by Xerox, and is usually known

as Ethernet (again in both the specific and the generic sense). Sometimes it is also called 'CSMA/CD' which stands for Carrier-Sensing Multiple-Access with Collision Detection. In actual fact the use of radio would be prone to interference, and to provide very low error rates with very high transmission speeds the 'ether' is replaced by a high quality cable which connects every node in turn. In this respect it is similar to a ring system, but of course in this instance the ring is not closed, and the cable acts as a system 'bus'.

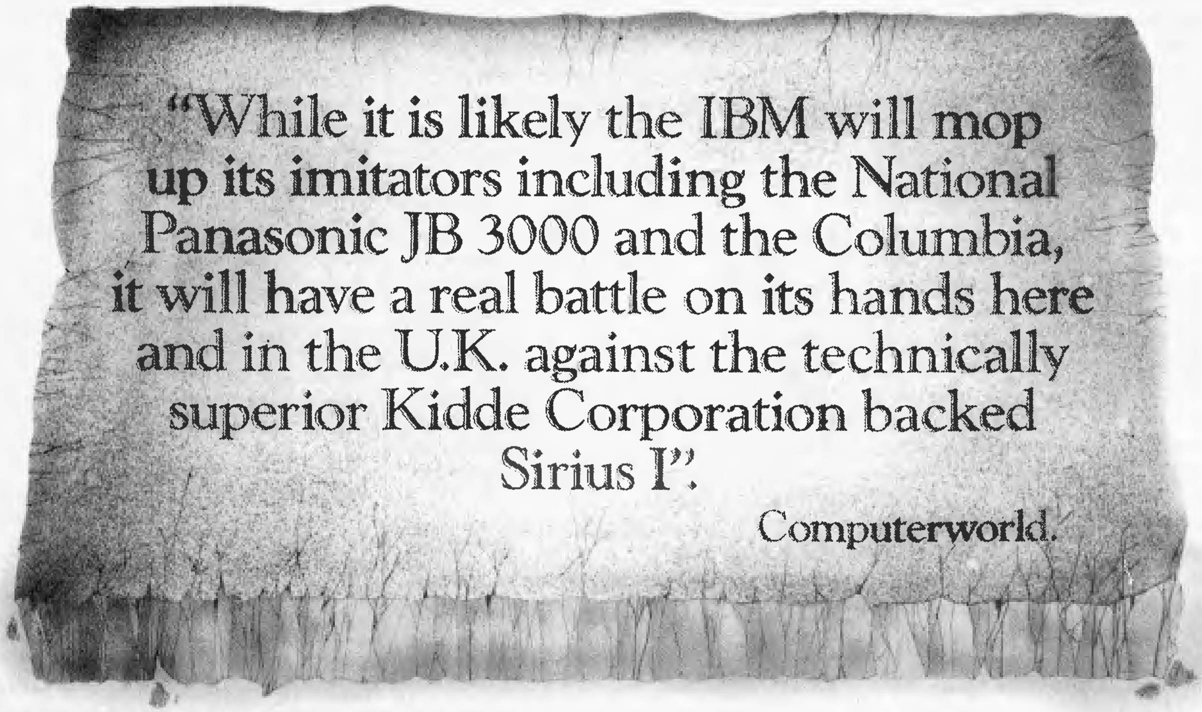
Also, if there is no transmission then the cable is quiescent and there are then no circulating packets. (As an alternative to the collision detection approach described above, the passing of a 'token' to give successive nodes permission to transmit can also be used on broadcast networks as well as on ring networks.)

Insofar as there is the one common cable or 'ether', considerations of reliability are similar to those of a ring. However, nodes which fail in a passive sense (eg, go right off-line) do not cause a network failure. Also, with suitable design, it may be possible to add nodes to or remove nodes from the cable with no disturbance in service. But a node which failed in a way which generated continuous carrier, or which short-circuited the 'ether' would still bring down the whole network. Depending on the actual transmission techniques used (eg, over twisted pairs, coaxial or optic fibre cables) there is a limit to the maximum length of cable, even with repeaters, because transmission delays can start to interfere with the collision detection mechanism. (In a ring system every node automatically acts as a repeater.)

Finally, in contrasting the distributed packet switched network described in the previous article with the ring or ethernet approach, we should note that the distributed 'wide area' network includes extensive error checking and recovery procedures across every link in the journey of a packet, whilst the 'local area' networks take advantage of high quality cable and shorter journeys to leave checking and recovery just to the sender and receiver at the ends of the journey.

Can I plug it in now?

That concludes our review of some of the major networking techniques. To us as end-users, network will present itself simply (at



A few objective words on the current punchup between IBM and the Sirius 1.

Computerworld is the industry's most respected publication. In a recent article it discussed the IBM PC personal computer. It stated "while it is likely the IBM will mop up its imitators including the National Panasonic JB 3000 and the Columbia, it will have a real battle on its hands here and in the U.K. against the technically superior Kidde Corporation backed Sirius I".

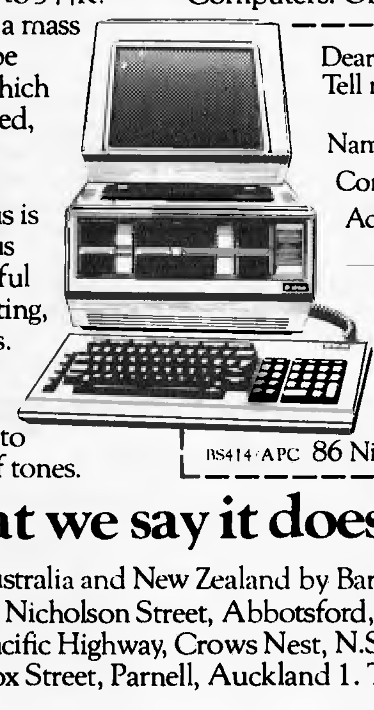
Why superior? To begin, the 16 bit Sirius could more properly be described as a minicomputer. The Central Processing Unit has a massive 128K bytes of RAM or Random Access Memory. And this maybe expanded to 896K. While the IBM PC has only 64K bytes which can be upgraded to 544K.

What's more the Sirius has a mass information storage facility which can be expanded to 10 M Bytes. It has ports which enables it to be simultaneously connected, for example, to a plotter, a printer, and another computer.

Another strength of the Sirius is its enormous software library. The Sirius has immediately available over 400 useful relevant programmes including accounting, scientific and word processing packages. However it's light on kids games. Using an 800 x 400 dot VDU, the Sirius has superb visual resolution, producing up to 50 lines of 132 characters as well as half tones.

Finally, back up. Sirius is a product of the $2.8 billion Kidde Corporation. So you can be sure it's going to be around long after most of its competition is long gone. Secondly Barson Computers have arranged for STC to provide maintenance support. (So there can be someone to fix your Sirius in under four hours.) Thirdly you are covered by a twelve month warranty.

What are the chances of a problem? Sirius I is showing a tiny .007% failure rate. Now you can see why IBM have a problem. And why you should own a Sirius. For more on the Sirius and the name of your nearest dealer phone Barson Computers. Or fill in the coupon below.



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first sight) as a socket into which we can plug our computer or our peripheral. When viewed in this way, it doesn't matter too much exactly which of our network architectures lies behind the plug, provided that our criteria for good networking are satisfied (as described in the first article in the series). That being so, we may be anxious to plug in and start working. However, anyone with any experience of plugging together any two pieces of equipment from different manufacturers will realise that there is still plenty to go wrong at this stage. In particular we have as yet paid little attention to the all-important question of the software which we will need to access the network.

If we are to be able to plug a whole range of computers and devices into our network, then we must first agree on:

a) The physical standards of the plug, particularly the number and configuration of pins and their relationship to the cable;

b) The electrical signal levels (currents, impedances, transition times, etc) to be applied at each pin;

c) The way these signals are to be interpreted to define the flow of information — both the data itself and the control signals which go with it.

These three definitions taken together are what constitutes an 'interface'.

However, as users we do not want our computer (or other device) to converse simply with a plug, but rather with some other computer or peripheral on the other side of the network. Here we have deliberately used the word 'converse', to imply firstly two-way conversation (in the general case), and secondly the ability to support complex or 'rich' dialogues. Therefore we must also agree on the rules by which a conversation is to be conducted. There is a strong analogy with the rules (both technical and social) underlying an ordinary telephone call between individuals A and B:

— A dials to establish the call;

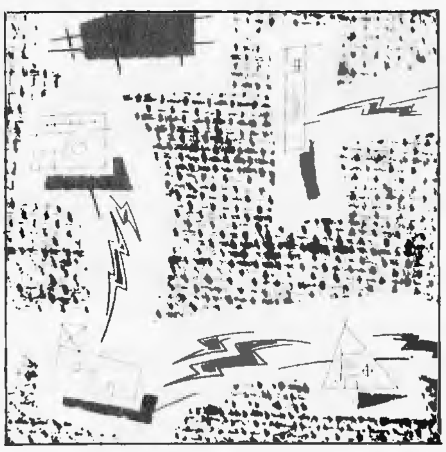
— B answers, identifies himself;

— A identifies himself, announces topic;

— B replies; A and B then talk alternately, until first one and then the other say goodbye;

— both A and B then hang up, breaking the call.

We also saw in the previous article how A and B have additional rules for dealing with noise on the line, a disconnected line, the call not getting through, etc. The equivalent set of rules for conducting a conversation between computer programs/



equipment is called a 'protocol'. The end-to-end link between the parties is made up of a series of 'interfaces', and the information passing according to the rules of the protocol passes through the interfaces. This is illustrated in Figure 3.

As implied in our analogy, a protocol has to fulfil several functions:

1) The 'high level' exchange of information between two **applications programs** to give effect to the user's requirements — eg, office automation activities, or the processing of a job on one computer as submitted from another.

2) The agreed common coding or **presentation** of data necessary to carry out the processing of level 1 — eg, the coding of document contents for word processing, including margin settings, paragraph breaks, page headings, etc.

3) The way in which a full conversational **session** or dialogue is to be carried out when commands and data are exchanged — eg, how a call is to be established, how the two sides of the dialogue are to be synchronised, how to deal with an apparently disconnected call, etc.

4) The **transport** of information from one end of the call to the other, dealing with such information as the relation between the identifiers or 'addresses' of the sender and receiver in terms of the network, the 'flow-control' limiting the amount of data in transit at any one instant, the buffering or blocking of data segments.

5) The requirements of the **network** level itself — eg, routing, error detection and recovery, maintenance of packet sequence

6) The transmission of data across individual **data links**, providing flow control, error recovery, etc, for each link (ie, for all the 'calls' which may be sharing the same link).

7) The **physical** communication of information from end to end of a single link.

What we have listed here are the seven levels or layers of protocol as currently proposed by the International Standards Organisation. These layers range from level 1, the top level nearest to the requirements of the end user, down to level 7, the physical requirements most intimate to the internal workings of the network itself. Each layer of protocol provides a means of communication between equivalent parts of the system responsible for providing the same function. Each layer utilises the level immediately beneath it in order to build up its own services, and in turn provides these services to the level immediately above. Thus Figure 3 can be redrawn, with the emphasis not on the physical interfaces but rather on the protocol layers; this is shown as Figure 4.

Where do we go from here?

Evidently the networking scene is going to remain in a considerable state of ferment for some time. The continuing development of electronic/computing technology is going to open new opportunities. While we have discussed in these articles some of the emerging network techniques, the relationship between these and the related developments in digital telephone exchanges and in cable television networks is as yet by no means clear. Just as for the hardware, the internationally agreed protocols are also going to take some time to merge in anything like their final form.

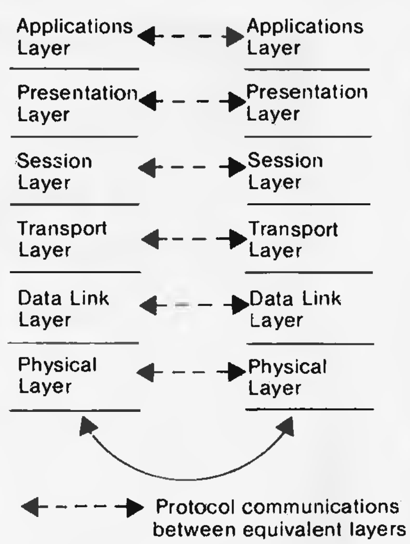


Fig 4 Use of Protocols to provide services at various levels across a network.

For users who need to purchase network facilities now, a number of systems using the techniques described in these articles are already available. Specific proposals should be judged not against the esoterics of network jargon, but on the way they will actually meet the current and perceived future end-user requirements (perhaps using the criteria discussed in the first article).

A major problem for the user is to try to gauge how a product will fare in relation to the future developments in network technology and protocol standards. It is at least a good sign if the system is implemented in modular fashion, with clearly defined interfaces and protocol layers. This should give maximum facility for upgrading or replacing parts or layers of the system as opportunity arises or need dictates. If the protocols are based on the latest thinking in probable or potential standard protocols, then future disruption should be minimised, and connections ('gateways') to later networks made with greater ease.

If we assume that the technology is going to come together, then the most important question of all is not just what it can do for us as computer users, but rather in what way we should direct the opportunities it offers in order to bring maximum benefit to society.

Various bodies with international membership have been working for some time to reach agreements on the protocols and on the interfaces involved. While the degree of agreement so far reached is, like the proverbial curate's egg, 'good in parts', it is at least heartening to contrast the current enthusiasm for general Open System Interconnection with the more defensive and parochial attitudes previously seen in some quarters during the early mainframe days.

END

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ALL IN THE FAMILY

CODING FAMILY RELATIONSHIPS

Genealogy is a 'natural' application for micros, as A Sandison reports.

Computerised filing and retrieval techniques are particularly appropriate for the large quantities of data involved in tracing a family tree or in transcribing and indexing such documents as parish registers, wills or old census records. In all such files, the relationships between individuals are important facets of the information to be manipulated. Any one individual record, whether in a family tree, a baptismal certificate or a will, nearly always contains several names of people. It is very much easier to retrieve the particular record required if the parents, the children, the witnesses, etc, are identified as such.

My own family records, for example, contain some 200 John Sandisons, of whom 20 had Alexander as the father's name and nine had it as a son's name. The ability to search simultaneously for records containing both names reduces the 'noise' of irrelevant entries by 90 percent. But ability in such a search to distinguish easily the sons from the parents can halve the remaining 'noise'.

Similar relationships can be important in some business contexts, where the levels of organisational hierarchy simulate the generations on a family tree, and responsibility simulates descent, with 'opposite numbers' equivalent to cousins.

Types of relationship

In my searches, the generation difference can be of major relevance. In looking for a father/son pair, the search should not exclude grandfather/father or son/grandson pairs. Beyond the direct lines of descent, the in-law, step, foster and adoptive relations need separate consideration.

Another most important feature of all relationships is their reversibility: father-son is the reverse of son-father. Searching for Johns with sons Alexander means looking for sons on all records for Johns. Unless you are absolutely certain that every cross-reference has been made, a search for fathers in all records for Alexander could also be worthwhile.

Coding is a well-established device for saving computer memory and ensuring interchangeability of data between systems. Perhaps the best known computer codes are those in the ASCII system for identifying printable and control characters. A useful feature is the easy conversion from capitals to lower case by adding 32 (20 hex) to the numeric equivalent. Similarly, absolute values are converted to the printable digits by adding 48 (30 hex).

Random ASCII codes

Several similar opportunities have been missed and codes for other groups of symbols are allocated in a surprisingly random manner. The main mathematical symbols surround the numerals but are intermingled with colon and semicolon. Any attempt to discover whether a string is entirely mathematical has to search for those two punctuation marks separately within the range '(' at 40 (28 hex) to '>' at 62 (3E hex). Likewise, the punctuation marks are scattered over the whole printable character range from 32 (21 hex) to 63 (3F hex). This makes routines to check whether the spaces following punctuation are normal quite unnecessarily complex as each mark has to be searched for individually. These deficiencies just show how much detailed thought should be given to all the possible applications before any standard coding scheme is adopted.

As far as the genealogy searching is concerned the search routines would be greatly simplified if the coding is carefully designed to recognise relationships between items in the same manner as ASCII codes recognise the need to swap upper and lower case.

KIN (incl in-laws, step, etc)		NON-KIN	
Spouse		Friend	
Sibling		Colleague	
Cousin		Other	
Parent	Child	Godparent	Godchild
Grandparent	Grandchild	Signatory	Witness
Uncle, Aunt	Nephew, Niece	Employer	Servant
Great-uncle, Great-aunt	Great-nephew Great-niece	Client	Lawyer, etc
		Patient	Doctor, etc
		Communicant	Priest, Incumbent
		Testator, Donor	Beneficiary
		Landlord, Host	Tenant, Lodger, Visitor

Table 1 Personal relationships

Family relations

Table 1 sets out the main relationships in family records. Note the reversed links shown, the fact that for some links the same term (eg, spouse) can be used for both directions, and that all are referenced from someone else, best considered as the 'subject' of the record. Note also that many of the terms (eg, aunt) imply the sex of the relation. Some non-familial relationships likely to occur in wills and households are also shown.

Filing needs

Most data filing programs use 'fixed-length fields', identified by their exact location in memory, to store different types of information. For family records this is both extravagant of memory and restrictive, because for some individuals information is full and detailed while for others it is notable mainly for its absence. I know of one man who married twice with 16 children in all: but I know no more about his mother than her name.

Providing a fixed field for every individual for a second marriage can only mean that it will be unoccupied in most of the records — even the first marriage field is empty for a substantial proportion. But more than two marriages cannot be ignored. Similarly, Pat Ash's names occupy as much memory as Gwendolyn Millicent Marjoribanks's.

The other main filing system uses 'variable-length fields' and identifies each type of information by a 'flag', the length of which has to be added to that of every occupied field — but empty fields can be omitted altogether. Good family and business files should always record the sex of every individual mentioned, because very few forenames are really reliable indicators. Because most relationships imply sex, that information can be incorporated in a relationship field.

Coding needs

There seems therefore considerable scope for designing a system of relationship codes, either in the flag for a variable-length, or within a fixed-length, name field. First, it should be easy to identify, and reverse, the sex. Secondly, it should also be easy to reverse the relationships. Thirdly, generation differences should be consistently conveyed. And fourthly, those of direct

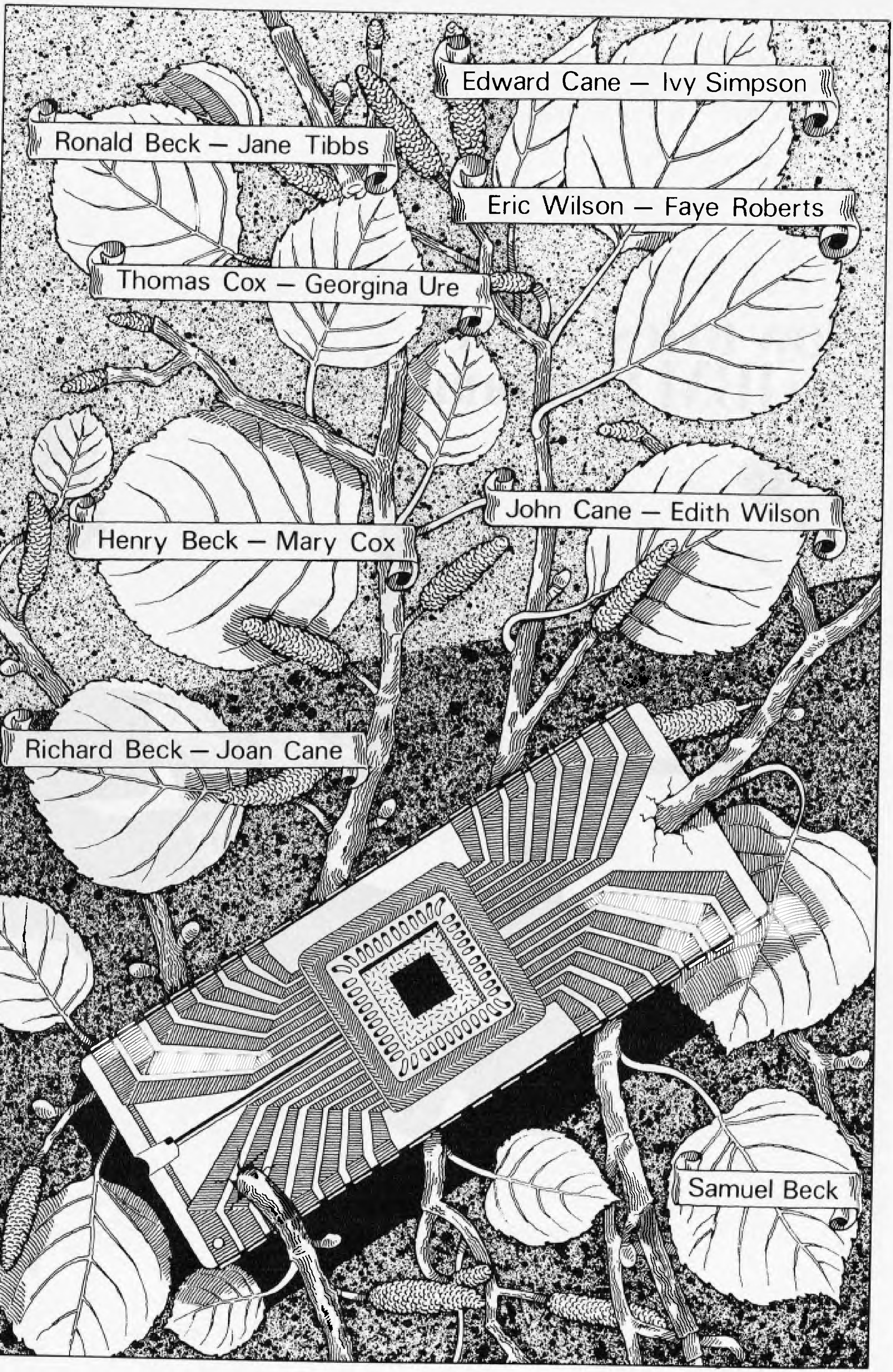

Illustration by Steven Wright

How to test drive the IBM Personal Computer.

ALL IN THE FAMILY

descent, the in-laws, the steps, and so on, should be associated.

Table 2 sets out a suggested scheme. I should emphasise that at this stage it is no more than a suggestion on which comments are invited. It is most important that no opportunities should be missed. We must proceed slowly. But when comments have been received and studied it should be possible to make positive recommendations.

The codes suggested are shown both as positive or negative numbers and as upper or lower case letters, grouped around that for the 'subject of the record' at zero, 'O' or 'o'. The letters can be used for print or display, the numbers for manipulation. Upper case is used for males, lower case for females. As a result, the sex indication can be reversed by adding or subtracting 32 (20 hex). Many standard retrieval programs can use or ignore case differences at will: this is instantly adaptable to sex differences. But it does restrict the number of possible relationships to 15 on either side of zero, or 31 in all. My personal view is that this should not be so restrictive as to invalidate the easy sex indication.

Coding patterns

When entering data from one source entry into records for each of the individuals named, relationships often have to be reversed. For example, data from a baptismal record goes into the child's record exactly as it is in the source, with references to the father and mother. But when the same data goes into the father's record, the parental relationship of 'father' must be reversed to 'son', and of 'mother' changed to 'wife'. The changes involved follow consistent patterns, most of which can be automated by a program provided the coding matches those patterns so far as possible.

To achieve this, the codes for reversed relations are placed equidistantly on opposite sides of zero, so that changing the sign of any code will reverse the relationship. Those terms which remain the same when reversed all imply the same generation and are set within the range -3 to +3. Other terms are grouped by the categories of relationship which imply the directness of the descent. Non-familial terms which carry no implications of descent at all, are placed beyond ±11. The group numbers can be used to lead to interactive routines to cope with such changes as son's mother to father's wife, wife to brother's sister-in-law, and so on.

Within each of the categories representing kin, a unit increase in the value of the numerical code represents one generation of descent, providing for five generations from grandparent, through parent, subject, child to grandchild. Few documents exceed that range in the people mentioned and personal records get far too complicated if they go beyond parents and children. The occasional references to great-grands can be coded as grands provided this wider meaning is remembered when search results are interpreted.

Code conversion routines

A major reason for structuring the codes in this sort of way is to simplify programs for coding and searching. The Basic routines set out below show that short routines have been achieved.

As already suggested, the letter codes are filed, displayed or printed; but for manipulation the numeric equivalents are used, with a sex indicator. Translation between alphabetic and numeric is straightforward:

```
10 REM Printable codes in P$,
20 REM numeric in C,
30 REM male as S=0, female S=32
40 REM Printable to Numeric
50 C=ASC(P$)-79
60 IF C>15 THEN S=32: C=C-S
70 RETURN
80 REM Numeric to Printable
90 P$=CHAR$(C+S+79): RETURN
```

Changing from male to female could hardly be easier:

```
100 REM Sex reversal
110 IF S=32 THEN S=0: RETURN
120 S=32: RETURN
```

Relationship reversal is a little more complicated, but not much:

```
130 REM Reversing relationship code
140 REM S1 is the 'Subject's' sex
150 REM his code by definition is 0;
160 REM C, S for a related person.
170 Z=S: S=S1: S1=Z
180 IF ABS(C)>3 THEN C=-C
190 RETURN
```

Some relationship changes involve a shift from one category to another (as with mother to wife). The category group number can lead to another routine, which may have to be interactive. It can be calculated as follows:

```
200 REM Get category group as G
210 IF C=0 THEN G=0: RETURN
220 Z=ABS(C): IF Z<4 THEN
  G=1: RETURN
230 G=INT((Z-2)/2)+1: IF G>6
  THEN G=6
240 RETURN
```

Many familial relations involve generation gaps. The difference from the subject's generation can be expressed betwen -2 and +2, as follows:

```
250 REM Get generation difference in D
260 REM C, G, as above
270 IF G<2 OR G=6 THEN
  D=0: RETURN
280 D=SGN(C)*(ABS(C)-2*(G-1)-1):
  RETURN
```

Standard for the future?

I hope that these sample routines demonstrate the advantages of a structured scheme of codes. Its full advantages can, of course, only be realised in programs specially written with its features in mind. Some existing variable-length field file management packets allow the operator to select his own field identification flags. With such programs, codes on these lines can be used with immediate advantages: both in searching and in exchangeability of data between systems.

The aim of this paper is to spark off trains of thought. If you can see snags or can make constructive suggestions to improve or simplify the scheme, please write to me, c/o the Editor, in the next few weeks.

END

Category	Relationship	Codes*	Relationship	Codes*
0	Subject of entry, record, etc	0 O o		
1	Cousin	+1 P p		
	Spouse	+2 Q q		
			Friend	-1 N n
			Other	-2 M m
	Sibling	+3 R r	Sibling-in-law	-3 L l
2 Direct descent	Child	+4 S s	Parent	-4 K k
	Grandchild	+5 T t	Grandparent	-5 J j
3 In-laws	Child-in-law	+6 U u	Parent-in-law	-6 I i
	Gndchild-in-law	+7 V v	Gndparent-in-law	-7 H h
4 Step-relations†	Step-child	+8 W w	Step-parent	-8 G g
	Step-gndchild	+9 X x	Step-gndparent	-9 F f
5 Collaterals	Nephew/Niece	+10 Y y	Aunt/Uncle	-10 E e
	Grt-nphw/Grt-nce	+11 Z z	Grt-aunt/Grt-uncle	-11 D d
6 Non-kin §	Godchild/Signatory	+12 [{	Godparent/Witness	-12 C c
	Servant	+13 \ |	Employer	-13 B b
	Client, etc	+14] }	Prof'l adviser	-14 A a
	Lodger/Visitor	+15 ^ ~	Landlord/Host	-15 @ `

* Capitals for males, lower case for females.
† Step-, foster and adoptive relationships.
§ Relationships — not, of course, occupations.

Table 2 Suggested codes for relationships between individuals

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MBasic sort

I was recently watching one of the clerks in my office sorting some dockets into numerical order when I realised that the method she was using could be used for a sorting routine in a program. The first docket was selected, then the second which was filed in relation to the first, then the third in order to the first and second, the fourth to the other three and so on. The program listed uses this principle by selecting a variable from an array and placing this in a new array in order relative to those already there. I have found that this routine works very well – so much so that 100 random numbers are sorted into ascending order in 30 seconds, whereas a bubble sort routine takes 60 seconds or more.

The program is written using MBasic, if the SWAP command is not available then line 1030 will need to be modified to carry out the swap. With MBasic this routine could also be used to sort strings. There is one advantage to this program; if anything does go wrong the original is still intact!

R W Bishop

```
10 DIM OLD(N),SORTED(N)
20       REM Where N is number of records
30       REM OLD is the file to be sorted
40       REM SORTED is the new file in sorted order
100 SORTED(1) = OLD(1)
105      REM First record in new array
110 FOR A = 2 TO N
120 SORTED(A) = OLD(A)
125      REM Read old array one at a time and place at the
              bottom of the new array
140 IF SORTED(A) >= SORTED(A-1) THEN GOTO 160
145      REM Check if larger than last item in new array
              If so then fetch next
              If not then Sub-routine to find position in new array
150 GOSUB 1000
160 NEXT A
170 END
180      REM Print routine can be inserted at 170
1000     REM Find position in new array
1010 FOR B = A TO 2 STEP -1
1020 IF SORTED(B) > SORTED (B-1) THEN RETURN
1030 SWAP SORTED(B),SORTED(B-1)
1040 NEXT B
1050 RETURN
```

TRS-80 renumber

Here is a short machine code subroutine to clean up the line numbers in a TRS-80 Basic program. It does not, unfortunately, affect GOTOs and GOSUBs. Maybe a reader could add this to the program. The machine code is loaded by Basic. The machine code itself is relocatable, and this could be done by changing line 100.

First turn off the machine, turn it back on, and reply to "MEM SIZE?" with 31999.

Next type in the following Basic:

```
100 POKE 16526,0:
 POKE 16527,125:
 X=32000
200 DATA 221,33,233,
 66,33,100,0,1,100,0,
 221,94,0,221,86,1,112,
 179,200,221,117,2,221,
 116,3,9,213,221,225,24,
 235,999
300 READ A: IF A=999
 THEN END
400 POKE X,A: X=X+1:
 GOTO 300
```

and then RUN the program.

To renumber a program, CLOAD it or type it in, and then use A=USR(0). The machine code renumbers the Basic program starting at 100 with increments of 100. This could be changed by POKEing 32005 with the start number (up to 255), and 32008 with the increment (up to 255). The GOTOS and GOSUBS will have to be changed manually.

Darrell Francis

Speedier Sargon

Given time, Sargon can play good chess; but it is just too slow to use the higher ply levels. This improvement will speed it up by typically 25 percent, ie, over one minute on ply 3. I have found that it spends most of its time in ATTACH and the subsequent call to PATH, so by integrating PATH into ATTACK and making other improvements in the locality, a large time saving was possible. The reserved version between ATTACK: and AT14B: is shown here. Further minor savings may be made in other parts of ATTACH (eg. by integrating with ATKSAV and PNCK), but additional major improvements can only be made by changing the algorithm of ATTACK.

Michael Jones.

```
ATTACK: PUSH    BC                  ;save BC
        LD      B,16                ;initial direction count
        LD      IY,TBASE            ;load index
AT5:    LD      C,(IY+DIRECT)       ;get direction
        LD      D,1                 ;init scan count/flags
        LD      A,(M3)              ;board start position
        LD      HL,M2               ;prepare for skip
        JP      SKIP                ;skip AT10
AT10:   INC     D                   ;increment scan count
        LD      HL,M2               ;get previous position
        LD      A,(HL)
SKIP:   ADD     A,C                 ;add direction constant
        LD      (HL),A              ;save new position
        SUB     -BOARD              ;get position address
        LD      L,A                 ;low byte
M2H:    EQU     M2/256
        LD      A,TBASE/256+M2H     ;get high byte
        SBC     A,H
        LD      H,A                 ;form pointer
        LD      A,(HL)              ;get contents
        INC     A                   ;in border area ?
        JR      Z,AT12              ;Yes-jump to AT12
        DEC     A                   ;not border-decrement
        LD      (P2),A              ;save piece
        AND     7                   ;clear flags
        LD      (T2),A              ;save piece type
        JP      Z,EMTPOS            ;empty ?-Yes,jump
        LD      A,(P1)              ;get moving piece
        XOR     (HL)                ;same colour ?
        JP      P,AT14B             ;Yes-jump to AT14B
        BIT     6,D                 ;(AT14A) same already ?
        JR      NZ,AT12             ;Yes-jump
        SET     5,D                 ;set opposite found flag
        JP      AT14                ;skip to AT14B
EMTPOS: LD      A,B                 ;get direction count
        CP      9                   ;knight scan ?
        JP      NC,AT10             ;No-jump
AT12:   INC     IY                  ;inc direction index
        DJNZ    AT5                 ;repeat if not done
        XOR     A                   ;no attackers
AT13:   POP     BC                  ;restore BC
        RET                         ;return
AT14B:  BIT     5,D                 ;opposite already found?
```

VIC piano

Typing in long programs from magazines can be a rather dreary business even though the VIC has a very nice keyboard. So here is a program to solve that problem and make typing a joy.

When this program is run the READY sign should appear after a pause of

TJ's WORKSHOP

about two seconds. Now try pressing a few keys. Yes, the VIC is now a piano and the good thing is the program itself does not use up any of the 3.5k for your own programs.

If you want to stop this program for any reason then just press STOP+RESTORE, and to re-run type SYS672.

This program shows you that even a tiny machine code program can do things that Basic programs can never do.

Shingo Sugiura

```
 10REM  *******************
 20REM  *** VIC  MELODY ***
 30REM  **** KEY BOARD ****
 40REM  *BY SHINGO SUGIURA*
 50REM  ** (C) 1983  JAN.**
 60REM  *******************
 70
 80FOR I=0 TO 44
 90READ A:POKE 672+I,A
100NEXT I
110SYS 672:NEW
120
130DATA 120,169,176,141,20,3,169,2,141,21,3,88,96,0,0,0
140DATA 165,197,201,64,240,12,9,192,141,12,144,169,15,141,14,144
150DATA 208,8,173,14,144,240,3,206,14,144,76,191,234
```

Moving message

Until recently I had access to an Apple II Plus whose disk 'hello' program had a moving message on the bottom of the screen.

I have since devised a simple method of moving a message along the screen that should be compatible with most micros. It was originally written for a TRS-80 Model I micro.

E. Hughes

```
900 M$="  HIT  ENTER  "
910 M$=RIGHT$(M$,13)+LEFT$(M$,1)
   :FORC=1TO50:NEXT PRINT@980,M$;
920 K$=INKEY$:IFK$=""THEN910ELSEIFASC
   (K$)=13THENRETURNELSE910
```

STATUS symbols

In the PC 1500 handbook STATUS 0 and STATUS 1 are explained – as program space remaining and program space used, respectively. No mention is made of STATUS 2, STATUS 3 and STATUS 4. The use of these is *essential* when programs involving PEEK and POKE are to be portable. The reason is that program space normally starts at 16581, whereas with the extra 8k memory program space starts at 14533.

STATUS 2 gives the first address after the beginning of program space. Thus, with no program in memory (and 8k attachments), STATUS 2 will give 14534. With program in memory, STATUS 2 – STATUS 1 will give 14533. Reference to (STATUS 2 – STATUS 1) rather than to a particular address will ensure portability of PEEK and POKE whether 8k attachment is present or not.

STATUS 3 gives the address after the end of program space. With 8k attachment this is not 22528, but 24576. This has one important use. When you write a program which DIMensions variables, STATUS 0 takes no account of this, and can return as available space a quantity which is not in fact fully available; and as soon as you run your program you may get ERROR 10. However, if you run the part of your program that does the DIMensioning, and then in RUN mode write (STATUS 3 – STATUS 2), the screen will display the *true* space available, since STATUS 3 moves to the front of space reserved for DIMensioned variables.

STATUS 4 contains the line number of the last line executed. This can be useful

TJ's WORKSHOP

with errors, in conjunction with ON ERROR GOTO. However, if the error occurs in a multi-statement line, and a statement of the line has been executed before the error occurs, then STATUS 4 will give the actual line number, as if it had all been executed.
Ronald Cohen

Circle drawing

Any point (x,y) on a circle of radius R can be defined by either (x,√R^2-x^2), or (Rsin0,Rcos0). However to use either of these to plot a circle is very inefficient, and slow, because the multiply, square-root or trigonometric operations are very slow. A more efficient procedure would be to use only plus or minus operations. J. E. Bresenham has developed such a method which is presented here as a subroutine in a short Applesoft program (Figure 1).

Line 100 of the program clears the screen and prompts for input of the radius and centre coordinates of the circle. Line 110 checks that the circle will lie entirely within the full high resolution screen. Line 120 sets full page high resolution graphics mode, sets the colour to white and calls the subroutine which actually does the plotting.

In the subroutine, line 5010 initialises all variables. These are all integers, but declaring them as integer types (e.g. X%) in Applesoft would slow the program down. Line 5020 starts the main loop. Line 5030 plots the current point and its seven images in the other octants of the circle. Lines 5060 to 5080 then increment the variables to give the next point to be plotted.

If you would prefer a filled circle merely change line 5030 to the following:

```
5030 HPLOT X+X0,Y+Y0
  TO -X+X0,Y+Y0:HPLOT
  Y+X0,X+Y0 TO
  -Y+X0,X+Y0:HPLOT
  Y+X0,-X+Y0 TO -Y+X0,
  -X+Y0:HPLOT X+X0,
  -Y+Y0 TO -X+X0,
  -Y+Y0
```

This subroutine should be easily convertable to other Basic dialects.

Reference: Foley, J.D. and Van Dam, A, 1982 "Fundamentals of Interactive Computer Graphics", Addison-Wesley Publishing Company, pp 441-445,478.
R. J. Rawlins

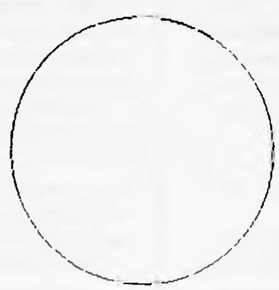
Figure 1

```
100  TEXT : HOME : INPUT "RADIUS = ";R: INPUT "CENTRE X,Y = ";X0,Y0
110  IF X0 < R OR X0 + R > 279 OR Y0 < R OR Y0 + R > 191 THEN  PRINT "PART
      OF CIRCLE OFF SCREEN": FOR I = 1 TO 1000: NEXT : GOTO 100
120  HGR : POKE  - 16302,0: HCOLOR= 3: GOSUB 5000: END
5000  REM

          DRAW CIRCLE:RADIUS R,CENTRE X0,Y0

5010 X = 0:R =  INT (R):Y = R:E = 1 - R:U = 1:V = 1 - 2 * R:X0 =  INT (X0)
     :Y0 =  INT (Y0)
5020  IF X > Y THEN 5090
5030  HPLOT X + X0,Y + Y0: HPLOT Y + X0,X + Y0: HPLOT Y + X0, - X + Y0: HPLOT
     X + X0, - Y + Y0: HPLOT  - X + X0, - Y + Y0: HPLOT  - Y + X0, - X + Y
     0: HPLOT  - Y + X0,X + Y0: HPLOT  - X + X0,Y + Y0
5060  IF E < 0 THEN V = V + 2:E = E + U: GOTO 5080
5070 Y = Y - 1:V = U + 4:E = E + U
5080 X = X + 1:U = U + 2: GOTO 5020
5090  RETURN
```

Figure 2: The end result as seen on an Apple's screen.



COMMUNICATIONS

APC welcomes correspondence from its readers but we must warn that it tends to be one way! Address letters to: 'Communications', APC, P.O. Box 280, Hawthorn, Vic 3122.

Easy deletion

I have recently started to use an Osborne 1 portable microcomputer, and am generally impressed by it. The keyboard is not as solid-feeling as I would like, but must obviously be light for portability. However, there is one curious and awkward omission, which is the lack of a DEL (or RUBout) key. This is particularly frustrating when using WordStar, as deleting the character just typed then needs Control-S to backspace, followed by Control-G to delete the character the cursor is then on, rather than just pressing DEL. Is there anyway to provide a DEL function on this machine?

(Name and Address withheld by request)

There are in fact at least two ways to overcome this problem. The first is to make use of the ability to program the numeric pad keys to generate the ASCII code for DEL (7F hex).

Alternatively, and much simpler, pressing Control together with the minus sign key will generate DEL.
P L McIlMoyle

Prestigious moves

As an enthusiastic follower of computer chess over the last few years, I much enjoyed 'Microchess' in the February '83 issue.

I assumed that Black's move 28 was Bd4 but am baffled by the Prestige's move 46. This is a mate in three position but Prestige seems to have missed it completely! How come?
Alan Wright

There are, in fact, two different mates in three — namely R-g7 and R-e7 — David Levy.

m/c- more complex?

I have heard a lot recently about games being better in machine code than in Basic, but because I have only recently come into the world of computers I have yet to grasp fully what machine code is, why it is faster and most importantly, how I get to use it. Also, are there any drawbacks to using it?
Leslie J. Lauw

Machine code is the language that the computer itself understands directly. Languages such as Basic have to be converted into machine code before they work. This means that a) you have more direct access to the computer itself, and b) time is not wasted while converting from another language to m/c. Using m/c is not particularly difficult, though the most convenient way of entering your own programs is via an assembler, which converts the m/c mnemonic into its respective hex codes (the form which the computer can execute) and then puts them into memory ready for easy access. The only drawbacks are the facts that some more complicated operations such as floating-point arithmetic are rather difficult unless you know how to access the FP routines in the ROM of the computer you are using (this isn't usually too difficult). Also M/c is a little less easy for the beginner to understand, but with the aid of a good book it isn't really that hard.
James Walsh

Packer fix

I have just completed keying in the *APC* Program Packer Utility, (published in *APC* August 1982) into my System 80. I have found one error in the listing, which I easily corrected. Subsequently, the program works beautifully.

The error is in line 10, where the numbers representing the MSB and LSB of the top of Basic memory pointer are associated with the wrong POKEs. Line 10 should read:

```
10 POKE 16561,132 :
POKE 16562,125
```

not, POKE 16561,125 : POKE 16562,132 as was published.

While in the process of typing in the Packer, I had cause to search through my back issue of *APC* for some information. By a strange coincidence, I discovered another case where an author put the MSB before the LSB when setting the memory size pointer in a Basic program for the System 80/TRS-80.

The error occurs in *APC* July 82, page 36 in the article "APC-80 version 7", where the author describes various useful PEEKs and POKEs. The last item in the article describes how to change the top-of-RAM pointer from Basic. The results of the calculations in the first two of the three lines of the method are being POKEd into the wrong locations.

The correct method of changing memory size is to execute:

```
POKE 16562,MS/256
POKE 16561,MS-PEEK
(16562)*256
CLEAR
```

where MS is either a variable or a constant whose value is the number of the highest memory location that Basic is to be permitted to use.

One final question about the Packer. What is the purpose of line 20?

```
20 POKE 16553,255
```

None of the references I have on the System 80 reserved RAM area say anything about location 16553 (40A9hex). Leaving line 20 out of the program produces no effect obvious to me. So, what does that line do???
T. Day

Satellite tracking

One of the most frustrating situations in the use of microcomputers is the sudden discovery, half-way through writing a program, that the machine which can supposedly maintain a nuclear power plant lacks a very basic mathematical function. Arc sine, Arc cos, and Arc tan are good cases in point. The Sinclairs and the BBC apparently posses these functions, but the UK 101 has only Arc tan, and many micros ignore all three.

If you are attempting to track the 'amateur' satellite Oscar-9 or engaging in similar trigonometric exercises, the absence of these functions makes your micro worse than useless.

However, all is not lost. The following short routine will nest this capability into your program by making use of the sine, cosine, and tan functions already present. (Although the list-

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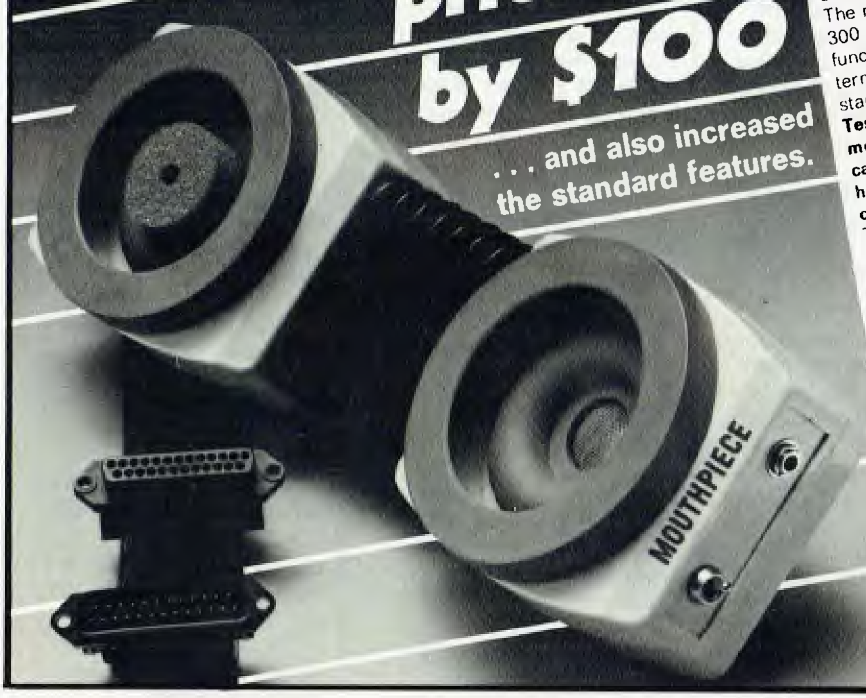
. . . and also increased the standard features.



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ing shows sine only — for cos and tan make the appropriate substitution).

If N is the sine of X degrees:

```
10 INPUT; N
20 LET X = 0
30 LET Y = SIN(X)
40 IF ABS(N-Y)(<0.001
THEN 70
50 X = X + 0.001
60 GOTO 30
70 PRINT (X* 57.296)
```

For results in radians, simply change 70 to PRINT X. The accuracy can be increased by adding more 0s in lines 40 and 50.

John Evans

Vic Forth

I was pleased and excited to see the "Forth Benchmarks" article in the January *APC*; FORTH is a language I first discovered in *APC*, yes, exactly two years ago, and I still believe that its golden age lies in the future/in contrast to the trinity of Fortran, Cobol, Basic, whose days are just about done); so, alas, had mine; for that two years, indeed longer, I've struggled to make my own micro work with, as yet, little success.

Evenually I despaired of its chances for survival from the extended surgery it's still undergoing, and bought a second-hand VIC-20 to play with colour graphics and games and to study up on Forth. What sold me on the VIC was price, support (over the counter, even in Darwin!) and the availability of a Forth ROM cartridge, by Human Engineering Software, which is a big-Forth with (of course) VIC extensions.

I must say I was entranced by finding at my local VIC shop not one but two Forth cartridges; the other is by AB Datatronics of Sweden and is an adaptation of their PET and CBM Forth; since it is disk-based, and powerfully so, and didn't fit the VIC quite as well, I bought the HES cartridge for $80.00 (the ABD cartridge by the way is also $80.00).

Naturally, as soon as I familiarised myself with the system, I typed in the benchmarks. They occupied 1½ of the two screens available on an unexpanded VIC, and left 256 bytes of the IK dictionary - not a trivial application for this tiny system!

Anyway, the Benchmarks: I ran each one four times, and averaged the results of the last three, based on measurements obtained with my thumb and a Citizen digital watch:

Forth Benmarks *APC* Jan. '83 for Commodore VIC-20 (all times seconds)

magnifier	2.2
do-loop	17.2
literal	26.6
literal-store	44.3
variable	25.7
variable-fetch	34.6
constant	25.9
dup	34.7
increment	59.0
text>	69.6
text>	45.4
while-loop	78.2
until-loop	79.6
dictionary search	17.3
arithmetic	65.2

While these times are not by any means exciting, it perhaps bears repeating that the configuration on which they were obtained is available over the counter for $380...

The Benchmarks were entered pretty readily, considering my inexperience, though there was one thing that confused me for a while; naturally I entered the code into one screen then LOADED it; DUP was redefined for BM8, then used in the while-loop and until-loop tests! I changed DUP's name to DUP*, I hope that fits in with your intentions.

I'd like to see some approach to Benchmarking I/O handling, something along the lines of : NUMOUT. "S" 10001 1 DO I. SP! LOOP. "C"; :STRINGOUT. "S" CR 10001 1 DO. "APC FORTH BENCHMARK" CR SP! LOOP . "E";

Times for the VIC are respectively 380 and 435 sec.

Thanks once again for furthering my and general interest in Forth!

Gary Woodman

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SYSTEM 80 MEMORY EXPANSION

by Geoff Lohrere

This project allows you to expand your on board memory to 32 or 48k at a maximum cost of $30.00 for 32k, so avoiding the expense of an expansion interface, where printer interface and disk controller are not required.

In this article, we will primarily be discussing the fitting of an extra 16k of RAM, since this can easily be accomplished on most System 80s, using only eight 4116 RAM chips, and existing spare gates on the CPU board.

The standard 16k of RAM in a System 80 or TRS-80 ranges from 4000H to 7FFFH, but not all of this RAM is available to the user, as 745 bytes are allocated for use by DOS operations, Device Control Blocks, I/O Buffer, Pointers, Flags, etc. Hence only approximately 15k is actually available to the user.

Most people find this an insufficient amount of RAM, and cannot afford the cost of an interface. Here we will describe in detail, the method and theory of operation to give an extra 16k of RAM, taking memory to BFFFH.

HOW IT WORKS

In the binary system, each binary digit or 'bit', represents a power of two, e.g: $2^{15} = 32768$, that's fifteen bits needed to address 32k of memory. So, one might ask, how is it possible to address 16k of RAM, using only seven address bits, or for that matter, to parallel an extra 16k of RAM on top of the existing RAM chips, totalling 32k of RAM, and still use only seven address bits? The answer to this question is 'multiplexing'. The address from the CPU (Central Processing Unit) is multiplexed into the RAMs in two parts, each being seven bits long. The internal logic within the RAM takes the two seven bit parts and merges them together, to form one address, using the total of fourteen bits.

The first part of the addressing is called RAS (Row Address Strobe) and the second part is CAS (Column Address Strobe).

Another signal involved with this addressing method is MUX (Multiplexer), which acts as a switching signal, between RAS and CAS. These three signals originate near the CPU, from the logic shown in Figure 1. Shown are the RD (Read) and WR (Write) lines running to pins 4 and 5 of the NAND gate, Z14. If a low is encountered on RD or WR, then a high will be outed on pin 6, which is connected to the clear inputs of Z39 and Z40. These ICs are "D" type flip-flops and are used to obtain the correct timing between RAS, MUX and CAS. Let us look at what happens if the CPU wants to write data to RAM, (refer Figure 2 for timing waveforms).

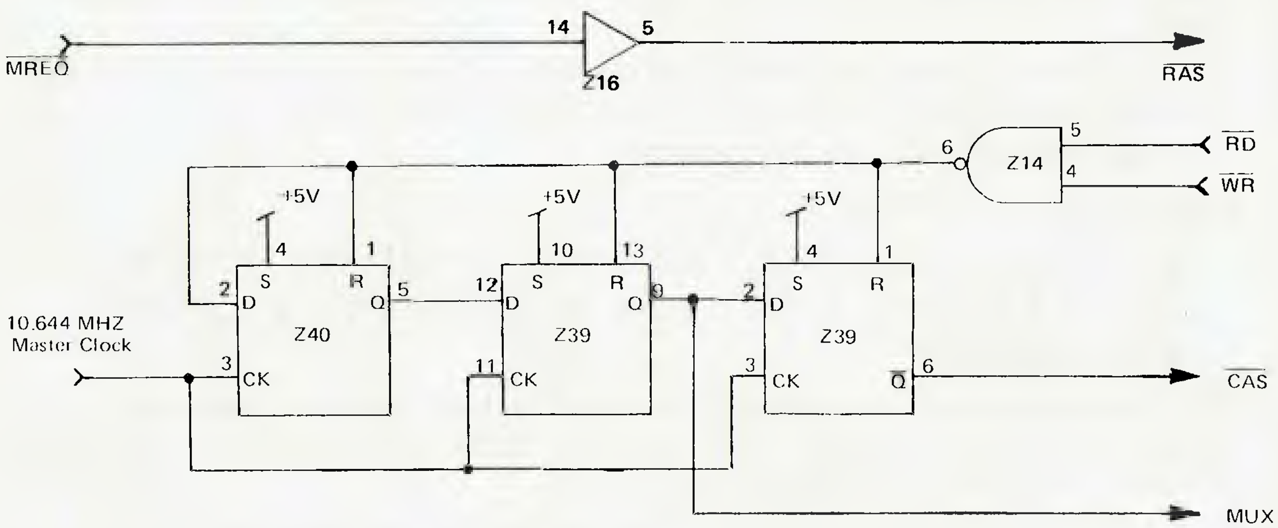

Figure 1. Logic to produce RAS, MUX and CAS signals.

WARNING. Blue Label owners, and people with Blue Label boards, will find one or both of the spare OR gates inaccessible. If fitting 48k of memory, or if you have Blue Label boards, then piggyback a 74LS32 IC on top of Z35, using pins 7 (Ground) and 14 (Plus 5 Volts). Z36 has at least three inverters unused, if needed. The pins of these three inverters are 1, 2, 3, 4, 5, 6, being in sequence of input, output, etc. For more information refer TTL Data book.

First MREQ will go low, Z16 pin 14 (same signal as RAS), and a short time later 'write' will go low, Z14 pin 4, and the output of this NAND gate, pin 6 will go high.

The flipflops, now with a logical high applied to their clear inputs, are free to operate, controlled by the

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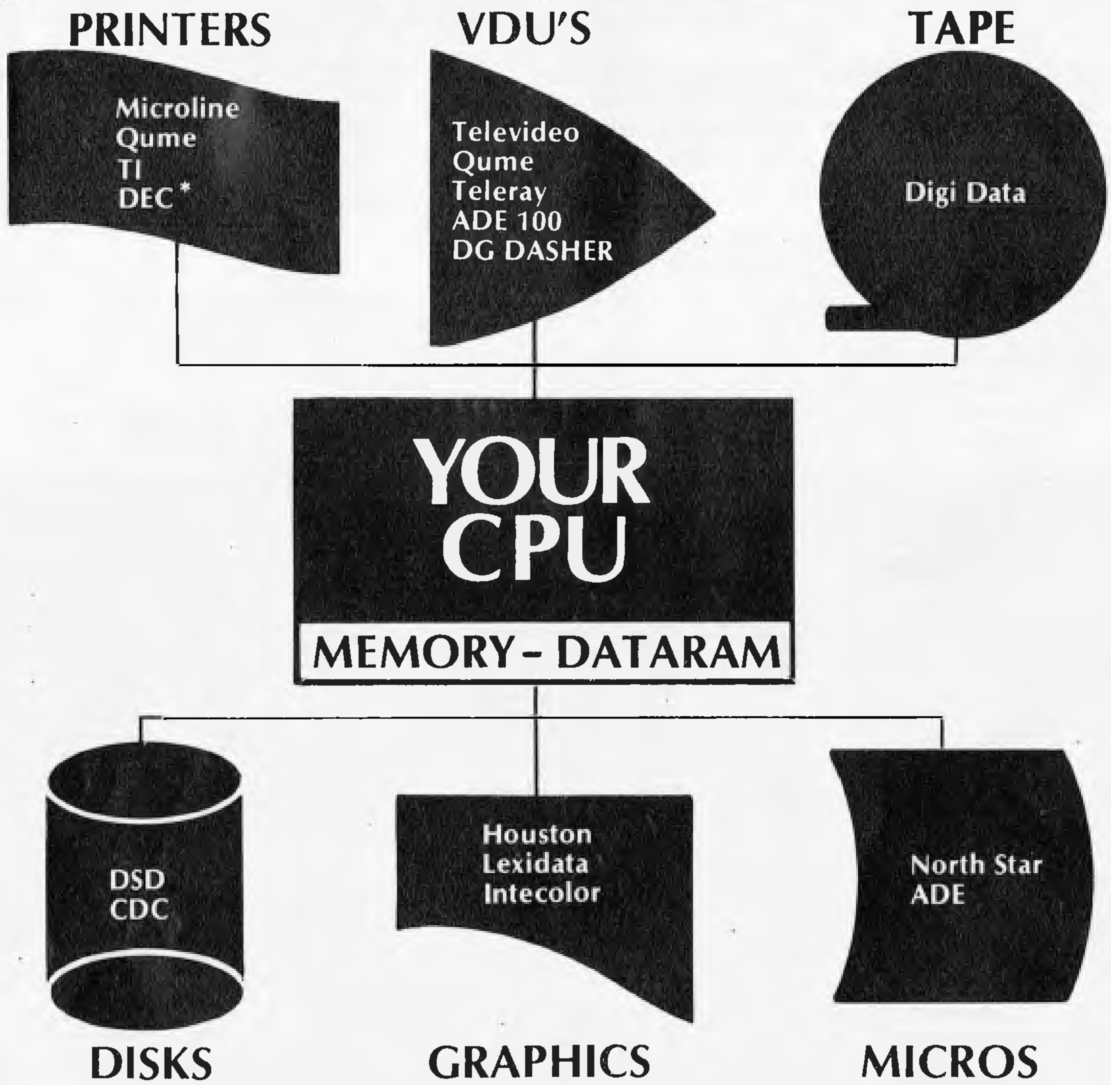

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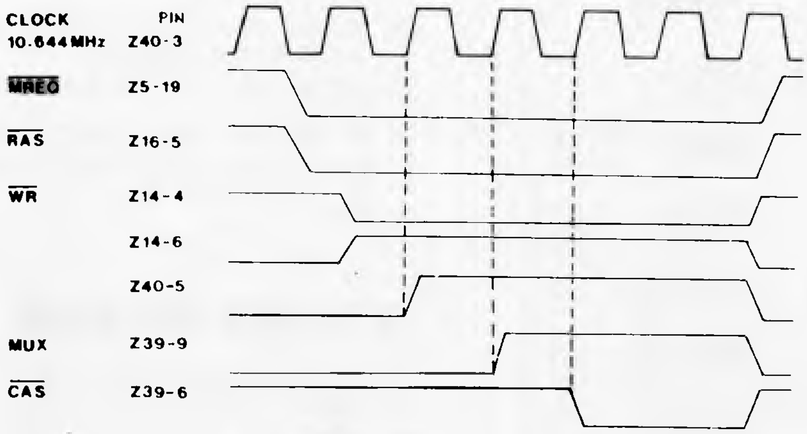

Figure 2. Timing Waveforms for RAS, MUX and CAS.

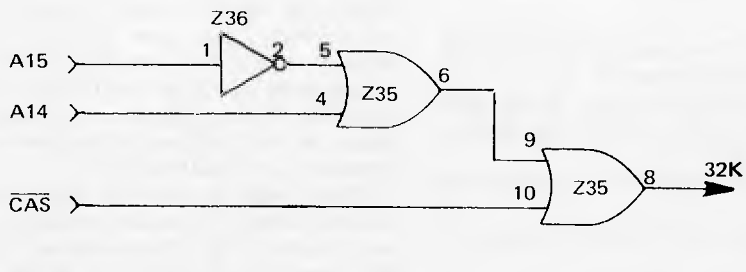

Figure 3. 32k Decoding Logic.

10.644 Mhz Master Clock waveform.

On the next rising edge of the master clock, Z40 pin 5 will output the same logical level that was present on pin 2 of Z40. This will be a high, since pin 2 had a high applied to it from pin 6 of Z14 when write went low. Pin 12, Z39 is now high, so on the next rising edge of the master clock, pin 9 of Z39 will go goes high, causing a low at pin 6 of Z14, and on the clear inputs of the flipflops, making them reset back to the clear condition.

In summary, RAS goes low first, giving the 4116 RAMs their Row address, then MUX changes states and switches the multiplexers, ready to let the RAMs receive the Column address,

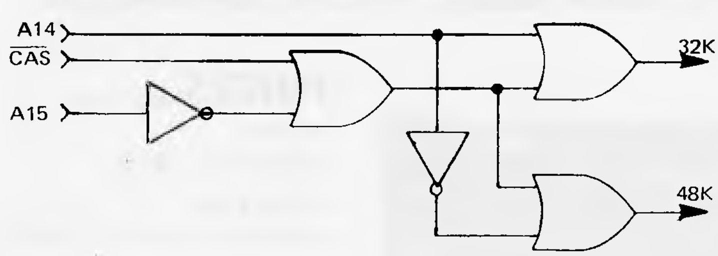

Figure 4. 48k Decoding Logic.

high. This is where our MUX signal originates. This high is applied to pin 2, Z39, and once again on the next rising clock edge, we will have a low on pin 6 of Z39, a low because it is taken from pin 6, which is an active low output. All three D type flipflops have changed states, since WR went low and will stay in their changed states until write one clock cycle later. The RAMs, now having a complete address, will now accept the data on the data bus into the location addressed. The read cycle is much the same as the write, with the main difference being RD goes low instead of WR, and the RAMs, on receiving the Column Address Strobe, will present the data at the location addressed, onto the data bus for the CPU to read and decode. This is why it is possible to parallel all the lines on the RAMs, except for pin 15, which is CAS, which acts as the chip select. All that is really left to do, is to produce the logic to decode the address for our extra RAM to be fitted, and enable the read buffers, while addressing this area of memory. These buffers will be switched out completely by existing logic, after 7FFFH (End of first 16k Block).

The logic to decode the second 16k block of RAM (8000H to BFFFH) is shown in Figure 3. It consists of two OR gates and one inverter. To enable this 16k block, we require a low on pin 8 of Z35. This condition is fulfilled if A15 is high, which is inverted to give a low at pin 5 of Z35, and A14 is low, and CAS coming from the flipflop Z39, pin 6, is low.

A15 will always be high, addressing any location above 7FFFH and A14 will be low from 8000H to BFFFH and will go high from C000H to FFFFH. Therefore A14 can be used to toggle between the second 16k block (8000H to BFFFH) and the third 16k block (C000H to FFFFH) of RAM, refer Figure 4.

CAS from the flipflop Z39, pin 6, is required to ensure that the RAMs do not get their column address until three clock cycles after the RAMs receive their Row address, as the timing between RAS and CAS is very important.

Enabling the read buffers is not a difficult task. Looking at Figure 5, we see two NAND gates. To switch the read buffers on, we need a logical low on pin 8 of Z21. Being a NAND gate, to get a low, we need all inputs to be high, but after 7FFFH a demultiplexer feeding the other section of Z21, places a high on all its inputs, producing a low on pin 6 of Z21. This low will, of course, give a high on pin 8 of Z21, disabling the read buffers.

It is very convenient that one section of Z21 has two unused inputs, which are currently joined to the other two inputs of the same gate. By separating one of these inputs, we can run the output from our decoding logic, into this input, so that when we address our extra memory, the low from our decoding logic will serve not only to enable our extra RAM, but also to give a high on pin 6 of Z21, giving us the low we require on pin 8 of Z21, to enable the read buffers. The other two joined inputs can also be separated and used if 48k of RAM is being fitted.

CONSTRUCTION

1. The first job is to piggyback the new set of 4116 RAMs, pin for pin, except pin 15, on top of the existing RAMs. This is best done by removing the existing RAMs and

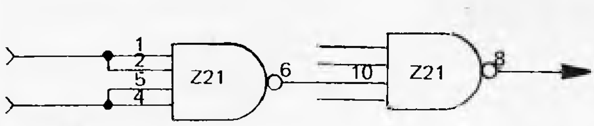

Figure 5.

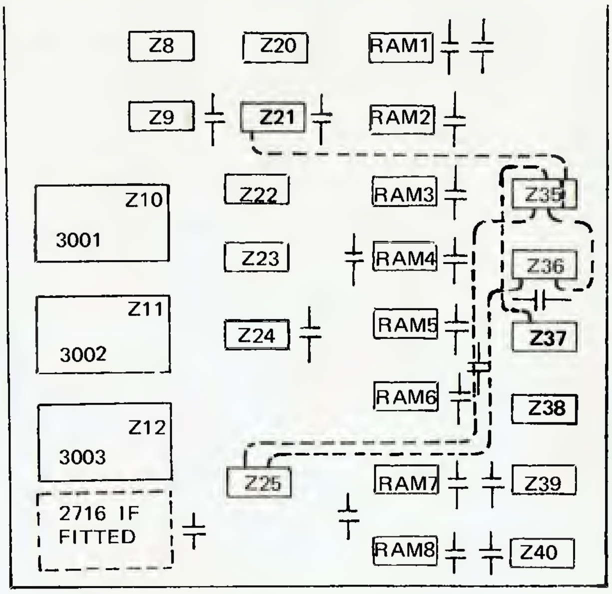

Figure 6. CPU Board.

inserting them into polystyrene covered with aluminium foil. This will prevent the solder running down the pins of the RAM chips, and guard them against static charges. Be sure to take note which way the RAMs are inserted, before removing them from their sockets, and to piggyback the new set of RAMs in the same direction as the existing RAMs or you will find yourself eating cooked RAM (chips) for dinner.

2. Reinsert the piggybacked RAMs in the correct direction.
3. Using seven small one inch lengths of wire, link up all the RAMs, using pin 15.
4. Connect pin 14 of Z25 to pin 4 of Z35.
5. Connect pin 13 of Z25 to pin 1 of Z36.
6. Connect pin 2 of Z36 to pin 5 of Z35.
7. Connect pin 6 of Z35 to pin 9 of Z35.
8. Connect pin 14 of Z37 to pin 10 of Z35.
9. Separate pins 1 and 2 of Z21 by cutting the track between.
10. Connect pin 8 of Z35 to pin 1 of Z21.
11. On the top side of the board connect pin 8 of Z35 to pin 15 of one of the new RAMs, previously linked.

IF IT DOES NOT WORK

There really isn't much to go wrong, so carefully go over your work, making sure that you have all the wires connected to the right points and that there are no dry joints or solder blobs shorting cut any pins. If you can read and write some numbers to the new RAMs but cannot write zeroes, then you probably have one or more bad memory ICs. Try switching RAMs around until you find the faulty RAM or RAMs. If you still have no success, please do not call me unless you are prepared to pay a labour fee.

People who do not feel technically minded enough to tackle this project, may contact Z80 Programming, (03) 543 1485. A set of 4116 RAMs is available from me for $20.00, including post and packaging. Write to 57A Stanley Avenue, Mt Waverley 3149.

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NEWS EXTRA

Real men don't use micros

Larry Magid finds he is no longer on the receiving end of laughter from mainframe operators. Now they're queuing up trying to get jobs from him.

I've had three calls this week from people in the mainframe computer business — all looking for jobs or new opportunities. Apparently, a lot of companies are laying off their Data Processing Departments. The micros are taking over. By putting the whole computer on each person's desk, and making it simple to operate, there's less need for the high priests of computer power — and the equipment they drive. As a result, lots of mainframe people are coming around, trying to figure out how they can re-tool and cash in on the microchips.

I wish them well. There are plenty of opportunities in the microcomputer business and, in many cases, the experience gained working with mainframes can be put to use with only a little bit of re-orientation. I'm trying to be as helpful as I can, but I can't help but remember my experience two years ago, when I walked into the computer consulting office at a large university and announced that I was going to buy a microcomputer.

"So you're going to buy a video game," the system consultant gasped. "No, I'm shopping around for a 48 computer — either an Apple or a TRS-80" (they were state of the art back then). "We only work with real computers," chimed another consultant. There was a room full of computer jockeys smugly enjoying their little jokes — guardians of the Mainframe Empire. The phrase hadn't been coined at the time, but if it had, one of them surely would have chided "real men don't use micros."

I was already a misfit at the computer centre. I was a user, not a programmer. Sure, I had logged hundreds of hours on the keypunch machine. And had entered plenty of code on the terminals. Except I 'programmed' in SPSS (Statistical Package for the Social Sciences). That's one of those 'user friendly' mainframe packages that allows sociologists, historians, and other non-technical types an opportunity to crunch numbers without having to learn to program. The scope and topic of my federally funded study didn't interest the consultants. They were unimpressed because I wasn't using Assembly language, Fortran, or even Basic.

Theirs was a world of hi-tech jargon and obnoxious smuggness. Though their doors were 'open', their minds were closed to all but a select group of aspiring clergy.

There were a few professionals at the Centre who cared about users and were eager to help. I even found one computer consultant who was interested in the results of my research. Were I not able to ferret out these gems, I surely would have aborted my programming — and probably would have developed a terminal case of computer phobia.

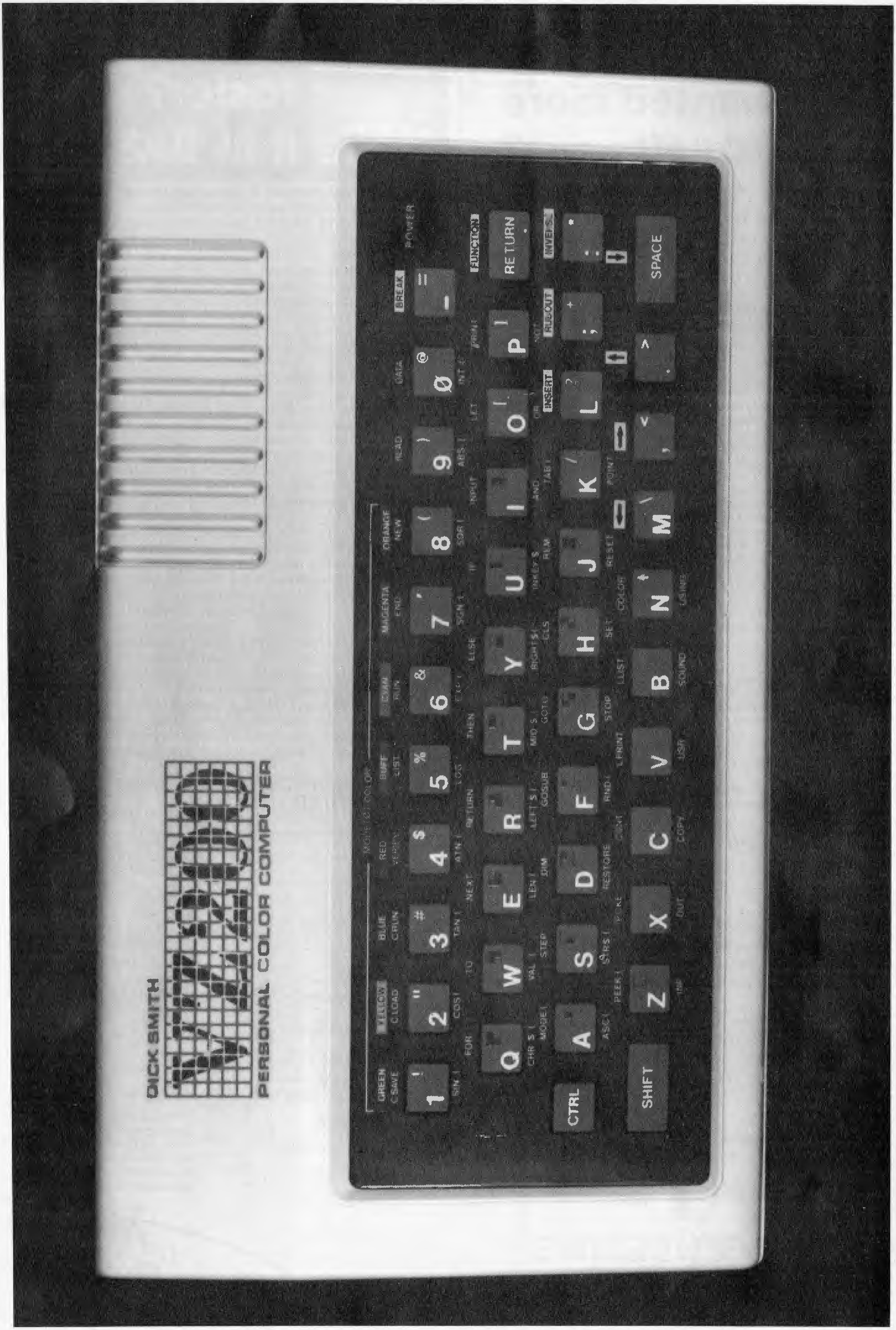
They aren't laughing any more. IBM — The High Church of Computer Gurus — sanctified the microcomputer by introducing its own *PC*, and since that day in August, 1981, mainframers have taken a second look at their little cousins. Now that people are switching over, some of the folks who built their careers on the big computers are having to do a little thinking — and some retooling.

Now they're calling me. And they aren't making jokes about Apples or any other microcomputer. "How long did it take you to transition over to your PC?" one of them asked me recently. "Do you know of any technical writing jobs — I'm having trouble finding them," queried another. Last week someone asked me to help him get involved in microcomputer software training. He was about to be laid off from his job as an in-house trainer for a major mainframe vendor.

Luckily for these folks, there are opportunities. The creative ones should have little trouble finding work in the micro industry. But those as arrogant as the ones I spoke of earlier, won't do too well. Micro users don't have the time, the patience, or the inclination to put up with technical jargon, computer trivia or smart alecs.

There is a lesson to be learned from all of this. The world is not static. Who would have predicted that the mainframe boom of several years ago would start to crumble? Who would have predicted that America's giant steel, auto and aircraft industries would go to the government for handouts? And who would have guessed that a couple of guys in their garage could launch a multi-billion dollar micro industry? But let's not get smug ourselves. The ever changing world of technology makes no excuses for obsolescence. And none of us is exempt, even if we are on top.

Lawrence J. Magid is the Editor of Computer Media Service and the Vice-President for Curriculum of Know-How Software Learning Centers, USA.


DICK SMITH
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CTRL

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VZ 200

Dick Smith has surprised Australia with a price/performance breakthrough in home computers. Tim Hartnell reports.

INTRODUCTION

A colour computer for less than $200? It sounds hard to believe, but Dick Smith has done it with the VZ-200, which will be released in Australia towards the end of May. Manufactured in Hong Kong by Video Technology Ltd to Dick Smith's specifications, this small computer is certain to send shivers of dismay up the spines of dealers in other small computers, such as the VIC-20 and the Sinclair Spectrum.

HARDWARE

The VZ-200 is tiny. Smaller than a telephone directory (29cm long, 16.5cm from front to back, with a height of just 2.5cm at the front of the keyboard, rising to 5cm at the back), the unit is built from cream plastic. The computer is light, but does not feel excessively fragile.

The keys are rubber (much like the Spectrum keys), in light brown, with easy-to-read white legends on them. A red LED in the top right hand corner of the keyboard lets you know the machine is on (and the on/off switch is located under the 'lip' of the keyboard, down the right hand side, in a position where it would be almost impossible to turn it off accidentally).

Each key has one or two things written on it, generally a letter (the computer works all in upper case on the screen) and a symbol (such as & or *), or a graphics element. These are a series of squares, each the size of a letter, with various quarters blocked off, to give a total of 15 different fairly coarse shapes. Above most keys are key words (such as FOR, INPUT and PRINT) while below the keys is another set of words, the functions (such as CHR$, SIN and LOG).

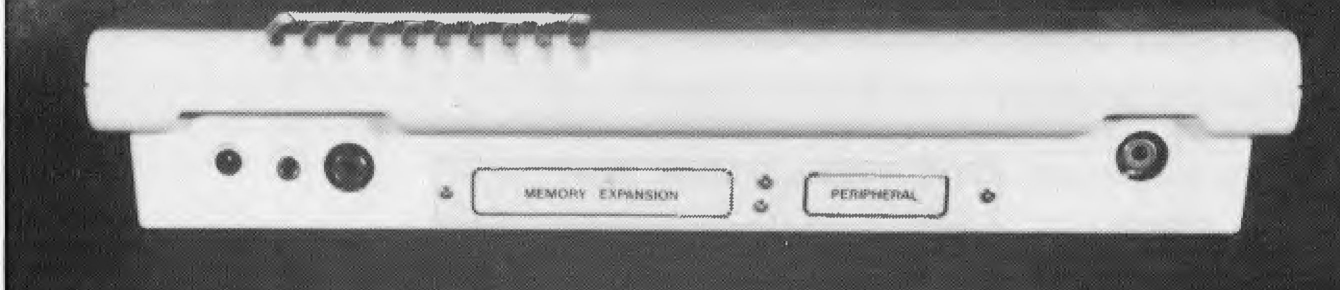
This single element on the VZ-200 shows the influence of Sinclair, who pioneered the 'single touch, key word' entry system back with the ZX80. In contrast to the ZX81 and the Spectrum, the VZ-200 does not demand you use the single-touch keys. If you feel happier typing out words in full (which is almost certain to be the case if you decide to move from another computer to the VZ-200), this Dick Smith machine will allow you to do so. You can even mix single-touch entered words, and spelt out words, in the same program line.

As you can see from the photograph of the keyboard, there is a SHIFT key in the bottom left hand corner, and above that is the control key (marked CTRL). If you hold down CTRL and then touch another key, you'll get the key word written above the key. Underneath the power LED is the RETURN key, and written above this is FUNCTION. If you hold down the CTRL key, then press RETURN/FUNCTION, and then press a key, the word underneath the key will appear on the screen.

The keys numbered one to eight have a further set of words above them. These are the colours (green, yellow, blue, red, buff, cyan, magenta and orange) and above these is the message 'Mode 0 only'. We'll be discussing the modes in the software section.

You may feel, on reading this description and looking at the keyboard and its bewildering array of words and symbols, that the VZ-200 will be extremely difficult to get used to. I felt that way when I first tackled the Sinclair Spectrum keyboard (which is even more complicated), but discovered that it became remarkably easy to use after a very short time. I am sure the same thing will happen with the VZ-200. Even if you start programming on it without using the one-touch key word entry system, you'll probably soon find yourself using some of the 'pre-programmed' words (such as RUN above the 6 key, and LIST above the 5) rather than type out the whole word every time. From there, it won't be long before you're introducing more of the single keys into your programming.

The keys feel good. Although they are a sort of 'dead rubber', they are extremely responsive, requiring only the slightest touch to trigger (in contrast to the Spectrum, whose keys have to be squeezed slightly to get the finger pressure to register). The keyboard beeps when each key is pressed, giving good audio feedback to your typing, although there is no tactile feedback at all. Of course, a keyboard of this type can never really compete with a real keyboard such as the one provided on the VIC-20, but when you're buying a colour computer for $200, you have to



Left: The VZ-200 in actual size less about 10%. Above: The rear end showing sockets for the monitor, TV, cassette and plate covered edge connectors for peripherals and additional memory.

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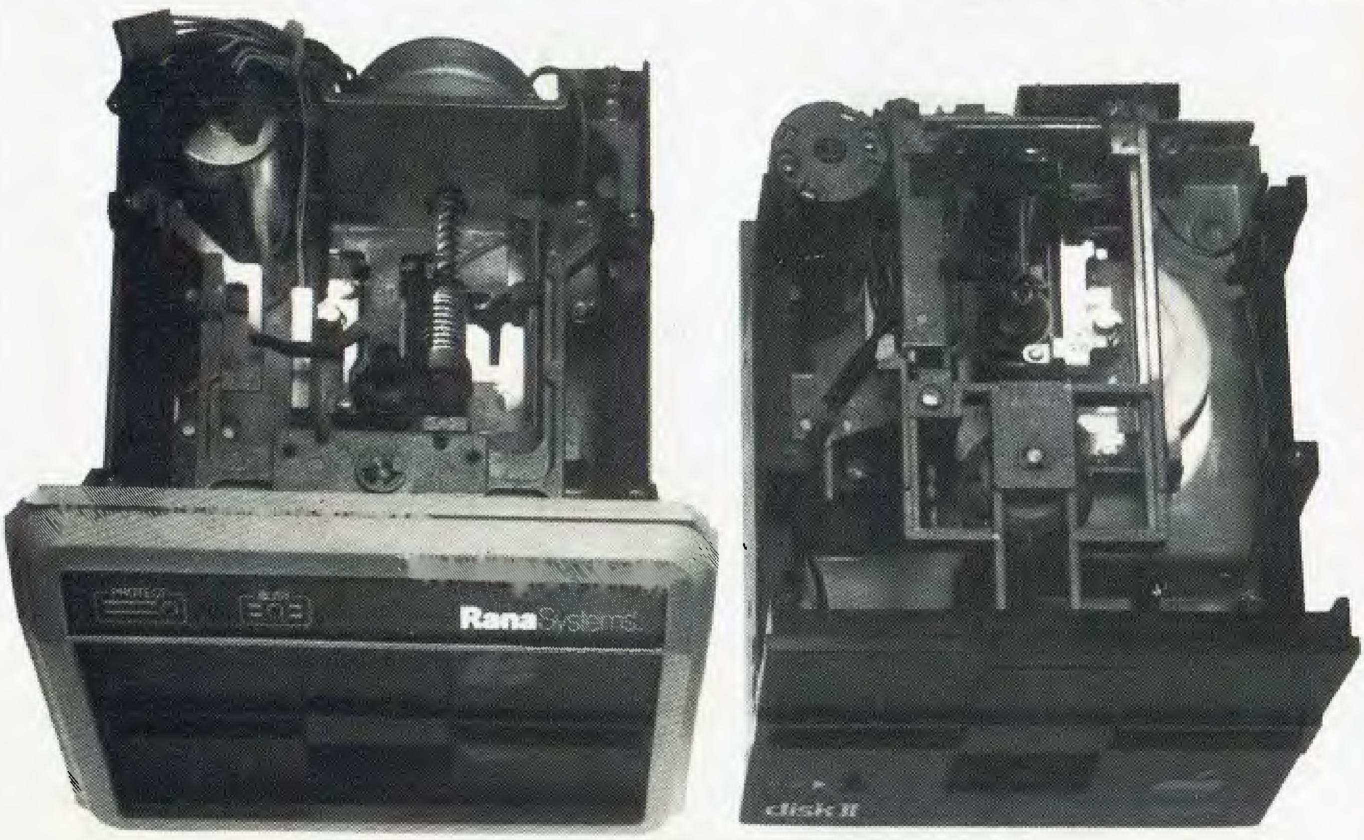

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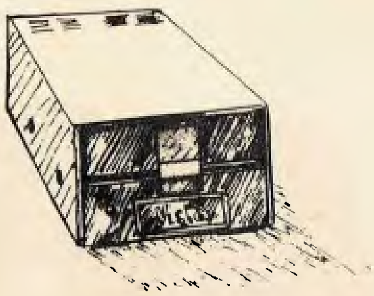

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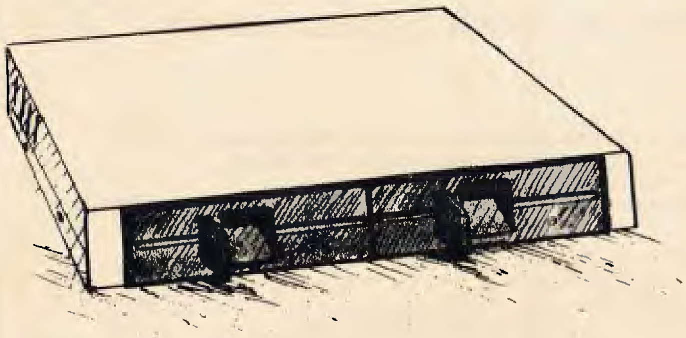

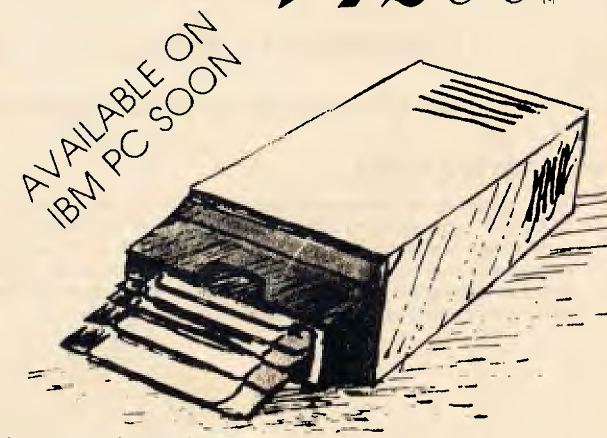

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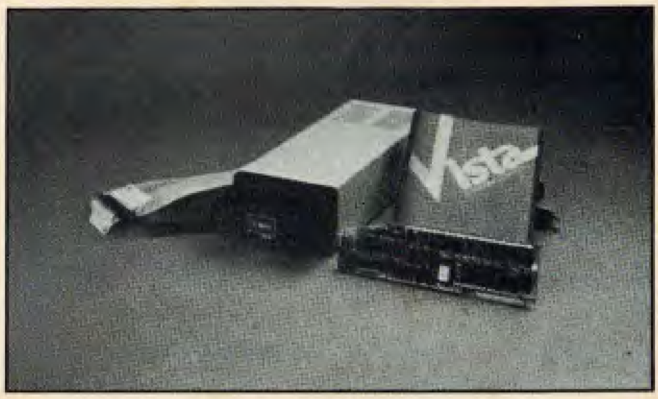

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Model Configurations:

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for the Apple II Computer

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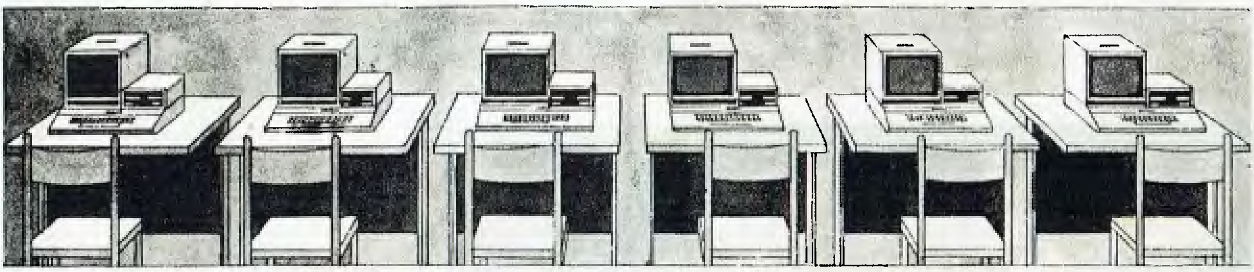
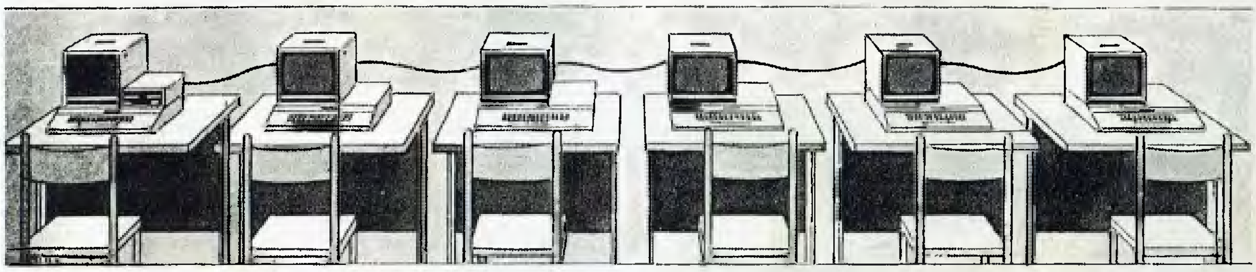


This classroom uses a separate disk drive for every Apple II.



This classroom uses the REMOTE OPERATING SYSTEM (ROS) to provide disk storage for programs.

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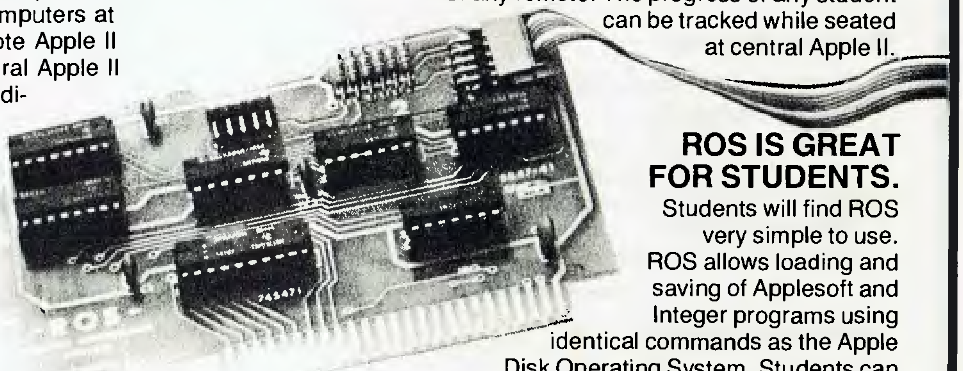
ROS simplifies instruction when using more than one Apple II. One diskett can supply all programs to the remotes instead of loading multiple copies into each separate system. ROS also allows the central computer to monitor the activity of any remote. The progress of any student can be tracked while seated at central Apple II.



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be willing to make some compromises.

The computer comes with a separate power unit (producing 10 volts at 800 milliamps) which plugs into the rear of the machine. This is supplied with a generous three metre cable (unlike some computers which come with leads so short manufacturers must imagine you like sitting on your power point to do your computing). A much shorter (around a metre) cable is provided to connect a cassette player to the VZ-200. A 'stereo' plug goes into the computer socket which is marked TAPE and the other end of the cable branches into two 3.5mm plugs, one each for the earphone and microphone sockets.

There are two video outlets. One connects your computer to a standard television, and while I did have a little difficulty locating the correct channel for the picture, once I'd found it, the picture was clear and steady, and did not drift. The second video output is to drive a monitor, allowing a somewhat superior picture to be produced. Providing both these outlets is a good touch, allowing you to upgrade your picture quality if you have a monitor, without having to adapt the modulator output for it.

When you turn the computer on, the screen comes up with a black border framing a green central area, with white writing (VIDEO TECHNOLOGY BASIC V1.1 READY). The letters tend to be fairly large and square, rather like those produced by the TRS-80 Color Computer. The cursor is a flashing white oblong.

The computer comes with 8k of RAM on board of which approximately 6k is available to use (in contrast with the VIC, which has only 3.5k or so of user RAM on the unexpanded model).

There are two sockets at the back of the machine which are protected by small panels, held in place by a couple of Philips screws. They are marked 'memory expansion' and 'peripherals'. The 16k memory unit (which will cost $79.00) is rectangular, somewhat larger than a cigarette box, in the same pale cream plastic as the computer. The memory module fitted easily into place, and sat in position fairly firmly, although I would not advise waving the computer around in the air with the extra memory in place.

The 'peripherals' bus will take plug-in ROM cartridges. As well, it can be used to interface (via an optional unit which will sell for $49.50) to any Centronics-type printer.

The computer case is held together with six screws, fitted underneath. There are a few ventilation grills in the base of the machine, which is supported a few millimetres above the table surface with four tiny rubber feet. Inside the computer, much as you'd expect, there is the normal assortment of chips and other components which are always incomprehensible to people like me who find the whole hardware area a forbidding jungle.

The keyboard unit, which is fastened solidly to the top half of the computer case, is linked with the main body of the machine via a short, 16-wire cable. It appears it would be a simple job to tap into this to connect up a larger, full key keyboard if you wanted to do so. There is a small heatsink which lies under the grill you can see in the left hand corner of the computer, when looking at it from the front. I am constantly surprised by how tiny modern computers are, and the VZ-200 reinforces that surprise. The case isn't even full.

The memory map is as expected. The Basic ROM occupies the first 16k (up to 16384, 3FFF) with the next 14k or so divided up into 10k for the ROM cartridges, 4k for the keyboard, cassette port, video controller and sound, and 2k video RAM. Next comes the inbuilt user 6k RAM. The memory of the unexpanded machine ends at 36863 (8FFF). The computer can be expanded by a further 16k, using the module mentioned earlier, to 65535 (FFFF).

SOFTWARE

The computer has a 16k ROM, of which 8k is a good implementation of standard Microsoft Basic, with the second 8k holding the commands for accessing the sound and colour. Additional text and graphics commands, such as PRINT @ (to position a character in an exact

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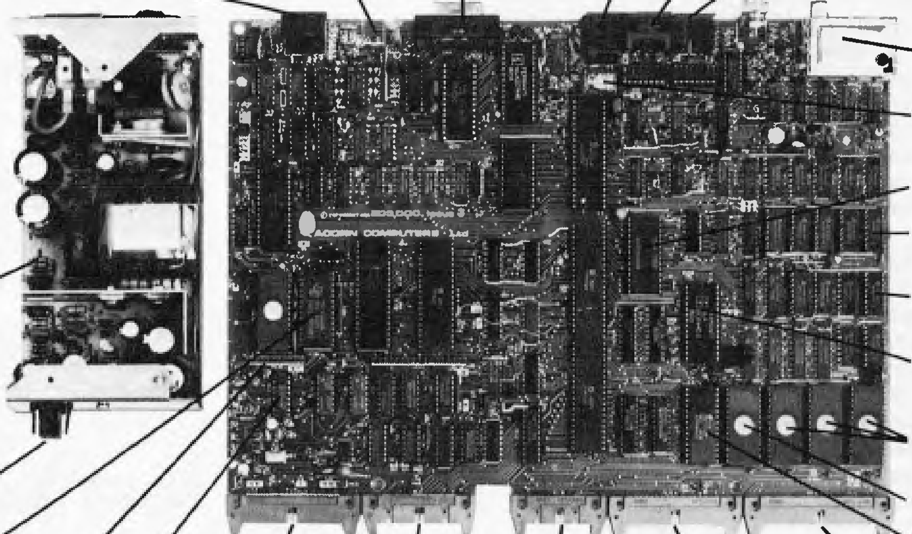

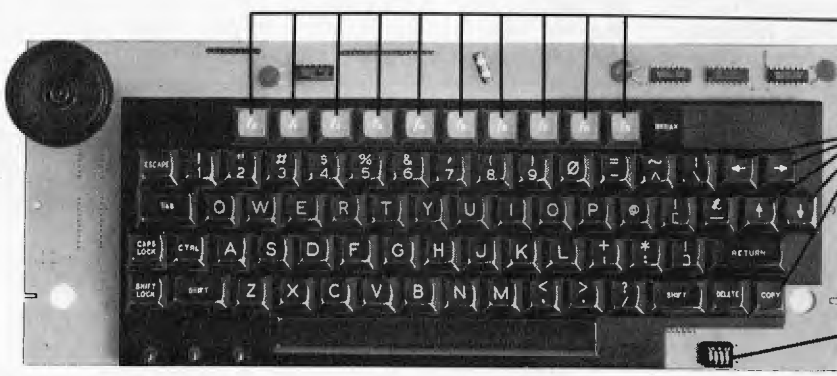

CODE:
Model A and B = (A & B)
Model B = (B)
Optional = (Opt.)

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position on the screen; an ideal and easy way to create moving graphics) and PRINT USING are also supported.

As I said earlier, the screen comes up green, with white writing. Holding down the CTRL key, then pressing the key second from the bottom right hand corner (marked INVERSE) produces green letters on little white oblongs. These inverse letters come out as lower case letters when the computer output is dumped to a printer. Holding down CTRL, then pressing INVERSE again changes the letters back to white on green.

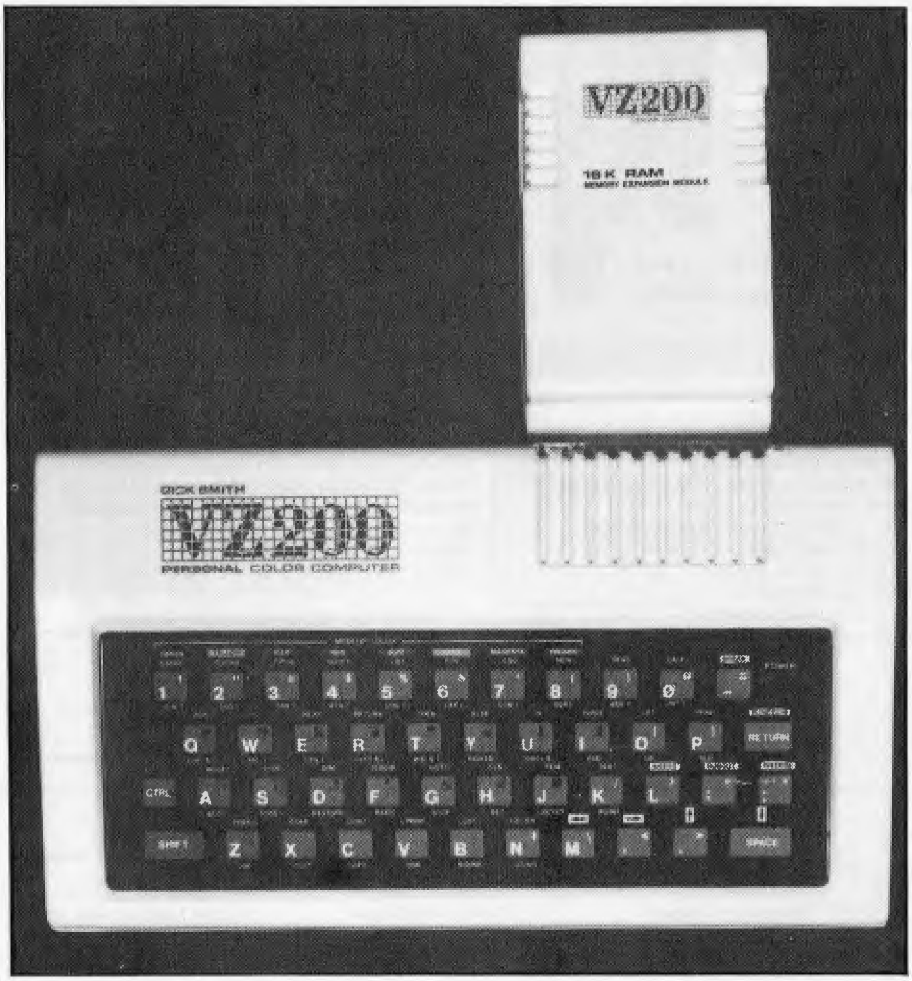
The VZ-200 works in two graphics modes. The display in text mode is 32 by 16, while in the higher graphics mode you have a resolution of 128 by 64. This is not particularly high, but is adequate for many applications.

The computer defaults to the text mode (MODE 0) when you first turn it on. The colours are easy to use in this mode. You simply include the command COLOR n,m (where n is a number between one and eight, and m is either zero or one) and the VZ-200 prints the following text in that colour.

There are only two background colours, and these are controlled by m. The two backgrounds are green (0) and orange (1). COLOR 1 will switch the background colour, no matter which one is currently in place. The computer will stay in the specified colour until a new one is evoked.

The cursor position is controlled by four arrowed keys (all grouped together conveniently in the bottom right hand corner of the screen). Holding down CTRL, then pressing one of these will cause the cursor to move rapidly about the screen, inverting any letter or symbol it moves over. Once you've got the cursor where you want it to be to edit a program line, you can either use the INSERT key (still holding down CTRL) to make room for new material you wish to add (the new spaces stream off from the right of the cursor) or RUBOUT (which 'draws in' material from the right of the cursor, causing it to vanish underneath the cursor). The arrow keys are easy and swift to use, and allow program lines to be edited simply.

The SET and RESET commands are used in the higher resolution mode to turn on (SET) and off (RESET) specific points on the screen. The command is of the form SET (X, Y) where X is from zero to 127, and Y is zero to 63. The dots are printed in specific colours. (The Spectrum, by contrast, boasts a 256 by 172 screen, but the colour resolution is only 32 x 22). POINT is used in conjunction with SET and RESET to return the state of a particular position (that is, to tell if it is 'turned on' or not).



The 16k RAM expansion module is quite large as compared with the VZ-200 itself.

Of course, PEEK and POKE can be used to directly access the display file, for fast moving graphics. (The display file starts at 28672 in both modes, ending at 29183 in mode 0 and 30719 in mode 1). You need to POKE with numbers between 127 and 255 to get coloured graphics, while POKE codes 64 to 127 hold the inverses of the letters, numbers and symbols which precede 64.

SOUND

The musical output of the computer, and the beeps when you press the keys, come from a tiny inbuilt sound device. The volume is just adequate (although louder than the Spectrum's sound) but is far better than having no sound at all. The VZ-200 sound is, however, woefully inferior to the sound produced through the TV loudspeaker by the VIC-20, where you have three voices and white noises to play with (even if the VIC sound must be accessed through tiresome and complex POKE statements).

The VZ-200 sound is controlled by a SOUND statement, of the form SOUND n,m – where n is the pitch (1 to 31) and m is the duration (1 – shortest – to 9). The following, two-line program will put the VZ-200 through its musical paces forever:

```
10 SOUND RND(31), RND(9)
20 GOTO 10
```

CASSETTE HANDLING

Cassette handling on the VZ-200 is quite sophisticated. The computer dumps the programs to cassette with the command CSAVE "nnnn", where "nnnn" is a file name. The command CLOAD – again qualified by a file name – is used to get programs back from tape into the computer. The computer will print up the names of other programs found on the tape before the one you have specified, and while loading prints up the message LOADING:nnnn. I have used (and cursed at) a variety of cassette interfaces in my years of working with computers. The VZ-200 performed faultlessly for me once I had worked out the right setting for my cassette recorder, and when I used good quality audio or computer cassettes. It did not work so well with ordinary, cheap audio tapes. Tapes made by companies like TDK should give consistently good results.

A third cassette command, VERIFY, is provided so that you can check the quality of a SAVE before wiping the program from the computer. This compares the program on the tape with the one in the computer and reports VERIFY OK if the two correspond exactly.

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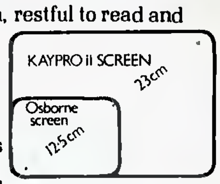

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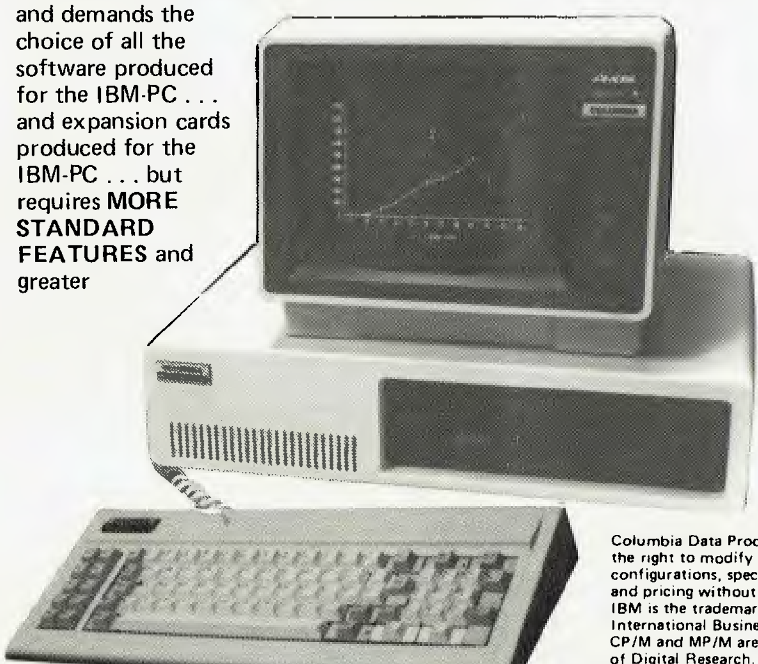

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command (used as CHAIN "nnnn") which is a 'load and go' command. The command finds the specified program on the tape or disk, loads it, and then starts running the program automatically. The VZ-200 command CRUN provides this facility.

The hash (#) symbol, in conjunction with INPUT and PRINT, can be used to put and get file data from tape. This is an advanced feature which could substantially extend the potential uses of the VZ-200.

DOCUMENTATION

The computer comes with a hefty manual, which covers the entire VZ-200 Basic language, touching briefly (but relatively clearly, given the complexity of the subjects) on PEEK and POKE, INP and OUT (for returning the content of a port, and for sending values to an I/O port) and USR (to call a machine language subroutine).

The manual starts with a two-page explanation of the major parts which make up a computer system. This is not needed in order to use the computer, and first-time users are advised to skip over it (as it contributes nothing to getting your VZ-200 up and running) with the idea of perhaps coming back to it later.

The manual is clear. It has been written by Video Technology under strict instructions from Jime Rowe of Dick Smith Electronics. The intention has been (and this is supported by the notes I saw which have gone back and forth from Hong Kong to Australia) to make everything as clear as possible for the first-time user.

A book 'Getting Acquainted With Your VZ-200', is in preparation. This will introduce programming in a more informal style than that provided by the manual, which will remain the standard source of information for users.

A series of software packs, mostly games, will shortly be available from the manufacturer, and Dick Smith has commissioned several more original programs from Australian programmers. A users' club has been organised (with the co-operation of, but not under the control of, Dick Smith) and members will be entitled to free copies of the club's newsletter.

CONCLUSIONS

Overall, this is a great little machine, and one that is likely to change the face of Australian personal computing. With one move, it has attacked the market of every machine under $1000. Assuming the promised support materialises (and Dick Smith has a reputation for delivering) VZ-200 users should shortly find that their computer is better supported (in terms of available software, books, magazine articles and a users' club) than any other machine in this country.

Purchasers who buy the machine, knowing that for $200 they won't be getting the sound output or keyboard quality of a more expensive machine, will probably be well-pleased with their purchase.

When the editor of *APC* came over to my place to see the machine while I was writing this review, he said: "I'm certainly going to buy one." I am sure this will be the reaction of a great number of Australians. I have a feeling we are going to be hearing a whole lot more of the Dick Smith VZ-200 Personal Color Computer in the coming months.

BENCHMARKS

The standard eight Benchmark tests were applied, and produced the following results:

BM1 loop 1.5 seconds
BM2 loop/addition 6.7 seconds
BM3 loop/addition/arithmetic 17 seconds
BM4 loop/addition/arithmetic numbers 17.5 seconds
BM5 as above/subroutine call 19 seconds
BM6 as above/dim/inner loop 31 seconds
BM7 as above, fill array 47 seconds
BM8 trig functions 72 seconds (1000 loops).
Average -- 26.5 seconds.

Comparing these with the VIC-20, we find that they are very close, with the VIC's average time of 28.7. However, they are significantly faster than the Spectrum, coming in with an average of 58.5 for the eight Benchmarks. As Dick Pountain pointed out in *APC* in November, 1982, the result of the Benchmarks tests does not necessarily prove very much, although the results are interesting.

TABLE OF RESERVED WORDS – VZ-200

ABS AND ASC ATN
CHR$ CLOAD CLS COLOR CONT COPY COS CRUN CSAVE
DATA DIM
ELSE END EXP
FOR
GOSUB GOTO
IF INKEY$ INP INPUT INT
LEFT$ LEN LET LIST LOG LLIST LPRINT
MODE MID$
NEW NEXT NOT
OR OUT
PEEK POKE POINT PRINT
READ RED RESET RESTORE RETURN RND RUN
SET SGN SOUND SIN SQR STEP STOP STR$
TAB TAN TO THEN
USING USR

VZ-200 TECHNICAL SPECIFICATIONS

PROCESSOR:	Z80, 3.58 MHz
ROM:	16k
RAM:	6k, expandable by a further 16k
Keyboard:	Rubber keys. 45 keys with auto repeat, contact 'beep'
Mass Storage:	Standard audio cassette recorder 600 baud
Screen:	Television (colour) or monitor, 32 x 16 (text mode), 128 x 64 (graphics mode)
Sound:	Internal speaker
Ports:	Two expansion edge ports, one has full address, data and control lines, the other is just an I/O port
Language:	Microsoft Basic (8k) plus screen, cassette and sound handling (second 8k)

The bright light now on the Australian scene.

The Torch Microcomputer.

A new British microcomputer designed specifically for business. A high-performance machine handling all possible office procedures — word processing, data processing and high level communications, around the office or internationally.

The TORCH computer comprises two powerful microprocessors and 800K of disc storage with high-resolution colour display all combined in one small desk-top unit.

One processor handles word processing, financial planning and general ledger systems, while the other simultaneously communicates with other computers via the built-in telex and telephone modems, and network connection.

The system is capable of expansion with the addition of hard disc units.

16 Bit Upgrade

The upgrade path for Torch users is a new board providing Motorolas' powerful 68000 processor together with a Z80 allowing complete compatability to existing Torch software.

The advanced 16-bit processor will access at least 256K of memory and will support UNIX System 3.

Technical specification.

Twin processor and memory.

Main processor: Z80A 6MHz with 64K bytes RAM and 4K 'Shadow ROM' for bootsrap.

TUBE interface to 6502 peripheral processor.

Peripheral processor: 6502 2MHz with 32K bytes RAM and 48K ROM for machine operating system, BBC Basic interpreter and communication software.

Display: 12-inch colour monitor with software selectable modes.

Scrolling and general screen handling are performed by the peripheral controller. Graphic display operations such as DRAW LINE and FILL AREA are also handled by the peripheral processor.

Keyboard: Expanded QWERTY layout keyboard with numerical pad, cursor control and editing pad, 16 user-definable keys plus all normal functions.

The keyboard is interrupt driven, allowing type-ahead.

Disc drives: The standard drives are double sided, double density 5¼-inch floppy units.

The TORCH is also available with hard disc storage capacities of 10 and 21 megabytes.

Power supply: Switch-mode power supply.

Interfaces:
- Parallel printer port to Centronics specification.
- RS232 serial port with nine software selectable baud rates.
- Four 12-bit analogue to digital converter channels.

Communications: Torchnet interface for local networking with other TORCH computers. Inbuilt modem for connection to telephone and telex lines, Software selectable baud rate.

Internal units: Sound generator and loud speaker capable of producing three independent channels of sound over a three octave range, with level control and envelope shaping.

Real-time clock with 10ms resolution and 100 year range.

Advanced speech synthesis unit, using phoneme encoding to produce realistic speech under program control.

Software.

The TORCH discpack operating system is called CPN (Control Program Nucleus) and appears identical to CP/M when running application programs. Because both the operating system and the 20K of screen RAM reside in the 6502's memory area nearly 63K of user RAM is available; a considerable improvement on conventional CP/M systems.

CPN also gives access to the advanced sound, speech and peripheral capabilities of the BBC machine, and has modes to allow the tracing of inter processor commands.

The operating system resides in 16K of ROM and loads directly into memory, so no disc tracks are required. This allows the systems to be re-booted in less than a second.

CPN configured software has already been locally produced for the following Micropro packages:
● Wordstar ● Mail Merge ● Spellstar ● Calcstar ● Datastar ● Supersort 1 ● Supersort 11 ● Infostar.

Price: $6,590 plus sales tax (Post devaluation).

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Artworks MCH/3/45/B

PASCAL BENCHMARKING

A suite of standard Benchmark programs has long been a feature of APC's Benchtests but as they're written in Basic they were obviously unsuitable for this month's Benchtest of the Sage II. Chris Sadler and Sue Eisenbach – authors of our Pascal series – have therefore devised a set of Pascal Benchmarks, which will be used in all future APC Benchtests of machines which run Pascal.

When comparing the performance of different microcomputer systems, it is helpful to try to identify the different elements which contribute to that performance. Firstly, however, it is important to categorize those properties which characterize 'high' performance and, for the purpose of this discussion, the following definition will be adopted: a system will be considered to have demonstrated high performance if its operation (relative to competing systems) is fast, efficient and reliable; and if it can produce correct results with convenience of operation. These terms take on varying degrees of relevance when considered in relation to the different components of a system. It is therefore necessary to separate out those factors which may contribute to, or detract from, these qualities in different contexts.

Starting with the hardware, it is clear that the speed of execution will depend on the particular processor used and on the design of the outlying system – eg width of the bus, I/O cycles, etc. Likewise, reliability in this context, together with the correctness of results, will depend on decisions made by the designers of the entire configuration – have they cut corners on the quality of various system components for instance? The next major element to consider is the operating system and here reliability can be interpreted as consistent behaviour (eg does it always give the same error message when the same condition arises under different circumstances? Do default values apply globally or only for specific commands?). Convenience of use implies that interaction with the user is unambiguous, flexible and 'friendly'. Finally, the speed of operation at system level depends crucially on the efficiency of the system routines and utilities, particularly those that deal with disk access and other I/O activity.

The third element is the language translator which, for the purposes of this article, is a Pascal compiler. Once again, it is the competence of the designer which is being judged. An efficient compiler will produce code which executes rapidly, while reliability and correctness here refer to the legality of the source code which the compiler will accept. Convenience of operation might imply, for instance, that effectual error messages and supporting diagnostics are provided.

The above discussion (summarised in Table 1) should place into perspective the role of the Benchmarks to be analysed in the next section. These don't cover everything one needs to know about a system – instead, they concentrate specifically on the skill with which the compiler writer has implemented certain features of the language, with particular reference to the execution speed of the ensuing object code and, additionally (inevitably), on the performance of the processor in handling that code. They are perhaps analogous to the petrol consumption tests given in car advertisements – a necessary (and objective) set of statistics, but by no means enough information with which to judge the whole car.

The Benchmarks

The idea behind these Benchmarks has been to try to isolate specific features of the language (ie instructions) so that the performance of any particular compiler in dealing with these features can be measured. Every attempt has been made to eliminate extraneous system-specific factors (like disk transfers) so that it is only the effect of the processor executing the compiled code that will be detected. In each case execution begins with the letter S (for start) and finishes with E (for end). These characters indicate when the stopwatch button should be pressed and are inevitable overheads in the process – a system with slow I/O will fare relatively worse than a speedier system, regardless of the quality of the compiler.

In addition, in order to give meaningful intervals for timing, each process is embedded in a loop (1...10000 in most cases as opposed to the smaller loop in *APC's* Basic Benchmarks). The first test is called MAGNIFIER and consists solely of the S and E signals and the loop. By subtracting its time from those of the ensuing Benchmarks, the timing for 10,000 instances of the single instruction or feature under consideration can be calculated. The specific features can be grouped under broader 'construct' headings as in Table 2. The individual Benchmark names are intended to be self-explanatory.

Figure 3 contains a listing of the Benchmark which can be input as individual programs and 'run by hand'.

Compiler design

Now that the goals of the Benchmarks have been fully declared, it would be as well to review some of the features of compiler design which may affect the results produced. It is worth noting that no account has been taken of the speed with which the compiler performs, al-

	Hardware	Operating System	Compiler
Speed	processor and bus	efficient utilities	–
Efficiency	processor and bus	efficient utilities	Benchmarks
Reliability	good design, high quality components	consistent structure	good design
Correctness of Results	good design, high quality components	consistent structure	legality of syntax
Convenience of Operation	packaging and finish	friendly and flexible	effective diagnostics

Table 1

Category	Benchmark name	Function
Overheads	MAGNIFIER	Measure of overhead involved in timing other benchmarks.
Loops	FORLOOP	10 iterations of FOR—DO loop.
	WHILELOOP	10 iterations of WHILE—DO loop.
	REPEATLOOP	10 iterations of REPEAT—UNTIL loop.
Assignments	LITERALASSIGN	10 assignments of constant value.
	MEMORYACCESS	10 assignments of a stored value.
	REALARITHMETIC	Single assignment of expression in which all arithmetic operations occur on constant values.
	REALALGEBRA	Single assignment of expression in which all operations occur on symbolic values.
	VECTOR	10 assignments involving array element access.
Branches	EQUALIF	10 operations of IF—THEN—ELSE in which each branch is executed with equal frequency.
	UNEQUALIF	10 operations of IF—THEN—ELSE in which the THEN branch is executed only once.
Procedures	NOPARAMETERS	5 nested procedure calls with no parameters.
	VALUE	5 nested procedure calls with call-by-value parameters.
	REFERENCE	5 nested procedure calls with call-by reference parameters.
Library calls	MATHS	2 calls to library functions.

Notes:
1 All timings can be offset by the MAGNIFIER measurement which takes account of the common overheads.
2 In MATHS, the MAGNIFIER loop has been reduced to 1000 to give a more reasonable figure.
3 The assignment and branch Benchmarks are all embedded in FORLOOP so an additional adjustment is necessary.
4 IF—THEN—ELSE has been given two tests because it is often faster to place the more frequently accessed segment in one branch or the other.
5 The procedure calls have been nested in order to investigate the build-up of the stack (and its effect on processing).
6 In VECTOR, matrix elements are employed on both sides of the assignment to investigate index addressing — compare with MEMORYACCESS. The initial assignment occurs only once so should be too short to affect the measurement.

Table 2

though this is a significant factor, especially to someone doing a large amount of development work. Instead, the Benchmarks investigate the performance of the target (object) code, but it is not only speed that needs to be reckoned with. Some compilers are written to produce p-code — the machine code of a (hypothetical) pseudo-machine. To run these objects on a real machine, a p-code interpreter is required which dynamically translates the p-code instructions into the native code of the host machine at run-time. Clearly, these compilers can be expected to produce slower times (all else being equal) than their alternatives which translate directly into native code, cutting out the overhead of the p-machine. As a variation of the latter approach, some compilers generate assembler language macros which are subsequently submitted to a macro-assembler which, in turn, produces the object code. This extra step lengthens the time taken to prepare a program for each execution but offers great flexibility during overall development, particularly for optimisation and 'system' work.

'Help! It's the micro revolution!'

The second point has more to do with those language features whose implementation is open to a much freer interpretation on the part of the designer. In particular, the idea of sets and set manipulation, packing and unpacking, dynamic allocation of space (the heap) and garbage collection have not been incorporated into Benchmarks because it was felt that the variations in implementation were likely to be so wide as to defy comparison. Additionally, these are among the features most frequently left out of certain compilers which would not, in consequence, be comparable at all. The arithmetic operators are looked at in REALARITHMETIC and REALALGEBRA and some typical library functions are referred to in MATHS. Considerably more could be made of the mathematical facilities available, but only at the expense of a substantial increase in the total number of Benchmarks could such features as the precision and speed of different modes of data representation, the accuracy of the function results and the performance of any floating point hardware be investigated.

Thirdly, certain features have not been considered suitable for Benchmarks because they tend to be intrinsically non-standard. In particular, the issue of disk-file access has been passed over because there are too many contributory variables to allow any meaningful measurements. This is not to say that non-standard features (like random access facilities) are necessarily a bad thing. In fact, they are usually more of a help than a hindrance — provided the user sticks to a single system. The compiler designer would not go to the trouble of implementing them if this were not the case. However, it is not possible to design 'objective' tests to compare such variable features.

Finally, compilers may differ widely in terms of the types and sizes of the source programs which they will accept, and these are not investigated in much detail in the Benchmarks. Legality can be checked for with Dr Wichman's suite, but this will give no indication of what size program will bring the compiler to a standstill. The compiler writer will have had to have made a number of decisions about how to apportion the compiler's work-space into stack space, variable lists and tables, etc, and these parameters, although crucial to a consideration of the development environment which a system offers (how deep can procedure nesting go? How big can an array be? ... etc), are not easily accessible to tests of this nature. Perhaps a future set of tests could be devised which investigates the space-utilisation of compilers as opposed to their time-efficiency as measured here.

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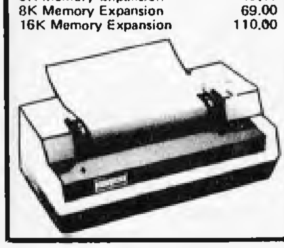

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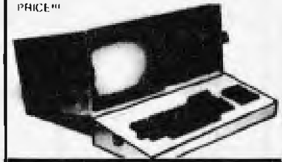

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Conclusion

In the meantime, the Benchmarks are offered as a means of testing some aspects of a compiler's performance against those of other compilers. Below are the measurements for several popular Pascal systems.

Pascal Benchmarks

	Apple USCD	TRS80-I UCSD	M-Engine UCSD
magnifier	6.4	7.2	0.8
forloop	74.3	86.6	9.5
whileloop	70.9	79.2	9.3
repeatloop	63.3	70.8	9.1
literalassign	88.5	101.4	11.0
memoryaccess	91.0	107.0	11.4
realarithmetic	93.0	103.1	8.7
realalgebra	83.4	98.0	6.8
vector	203.3	217.1	26.4
equalif	116.7	133.4	16.0
unequalif	115.3	131.7	15.8
noparameters	50.2	46.3	4.5
value	54.4	51.8	5.0
reference	55.3	52.3	5.0
maths	66.0	52.5	7.0

```
program magnifier;
var k:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do;
    writeln ('e')
end.
```

```
program forloop;
var j,k:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
        for j := 1 to 10 do;
    writeln ('e')
end.
```

```
program whileloop;
var j,k:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
    begin
        j := 1;
        while j <= 10 do j := j+1
    end;
    writeln ('e')
end.
```

```
program repeatloop;
var j,k:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
    begin
        j := 1;
        repeat
            j := j+1
        until j > 10;
    end;
    writeln ('e')
end.
```

```
program literalassign;
var j,k,l:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
        for j := 1 to 10 do l := 0;
    writeln ('e')
end.
```

```
program memoryaccess;
var j,k,l:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
        for j := 1 to 10 do l := j;
    writeln ('e')
end.
```

```
program realarithmetic;
var k:integer;
    x:real;
begin
    writeln ('s');
    for k := 1 to 10000 do
        x := k/2*3+4-5;
    writeln ('e')
end.
```

```
program realalgebra;
var k:integer;
    x:real;
begin
    writeln ('s');
    for k := 1 to 10000 do
        x := k/k*k+k-k;
    writeln ('e')
end.
```

```
program vector;
var j,k:integer;
    matrix:array[0..10] of integer;
begin
    writeln ('s');
    matrix[0] := 0;
    for k := 1 to 10000 do
        for j := 1 to 10 do
            matrix[j] := matrix[j-1];
    writeln ('e')
end.
```

```
program equalif;
var j,k,l:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
        for j := 1 to 10 do
            if j < 6 then l := 1
                     else l := 0;
    writeln ('e')
end.
```

```
program noparameters;
var j,k:integer;
procedure none5;
begin
    j := 1
end;
procedure none4;
begin
    none5
end;
procedure none3;
begin
    none4
end;
procedure none2;
begin
    none3
end;
procedure none1;
begin
    none2
end;
begin
    writeln ('s');
    j := 0;
    for k := 1 to 10000 do
        none1;
    writeln ('e')
end.
```

```
program unequalif;
var j,k,l:integer;
begin
    writeln ('s');
    for k := 1 to 10000 do
        for j := 1 to 10 do
            if j < 2 then l := 1
                     else l := 0;
    writeln ('e')
end.
```

```
program value;
var j,k:integer;
procedure value5 (i:integer);
begin
    j := 1
end;
procedure value4 (i:integer);
begin
    value5 (i)
end;
procedure value3 (i:integer);
begin
    value4 (i)
end;
procedure value2 (i:integer);
begin
    value3 (i)
end;
procedure value1 (i:integer);
begin
    value2 (i)
end;
begin
    writeln ('s');
    j := 0;
    for k := 1 to 10000 do
        value1 (j);
    writeln ('e')
end.
```

```
program reference;
var j,k:integer;
procedure refer5 (var i:integer);
begin
    j := 1
end;
procedure refer4 (var i:integer);
begin
    refer5 (i)
end;
procedure refer3 (var i:integer);
begin
    refer4 (i)
end;
procedure refer2 (var i:integer);
begin
    refer3 (i)
end;
procedure refer1 (var i:integer);
begin
    refer2 (i)
end;
begin
    writeln ('s');
    j := 0;
    for k := 1 to 10000 do
        refer1 (j);
    writeln ('e')
end.
```

```
program maths;
var k:integer;
    x,y:real;
begin
    writeln ('s');
    for k := 1 to 1000 do
    begin
        x := sin (k);
        y := exp (x)
    end;
    writeln ('e')
end.
```

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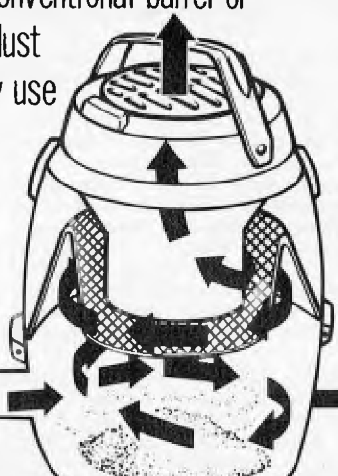

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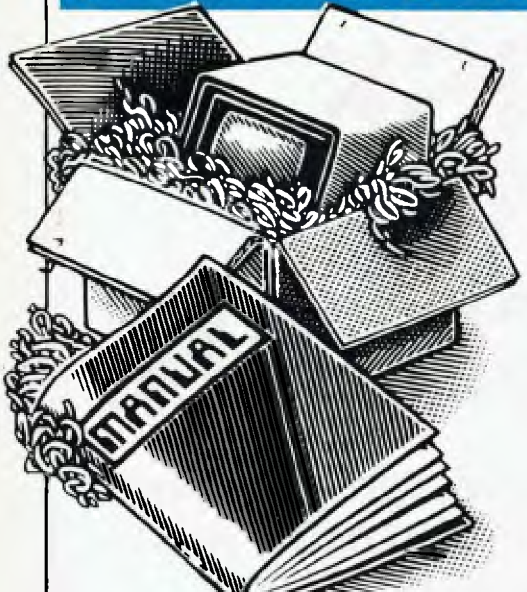

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in APC. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, APC will be publishing this guide — every month.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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APC SUBSET

This is your chance to help build a library of general purpose routines, documented to the standards we have developed together in this series. You can contribute a Datasheet, improve one already printed or translate the implementation of a good idea from one processor to another. APC will pay for those contributions that achieve Datasheet status. Contributions (for any of the popular processors) should be sent to SUB SET, APC, P.O. Box 280, Hawthorn, Vic 3122.

Z80 CALENDAR

When we started Sub Set, it was suggested that date (DAY/MONTH/YEAR) to binary date conversions, for easy comparison and scheduling, would be useful. It is strange that, after all this time, the first routines on the subject should arrive in the same month from two readers, Andrew Bain and John Edwards.

We deal here with Andrew's Datasheets, CVDAYS to convert Day/Month/Year to a number of binary days from a base Day 1, and CVDATE to convert a number of binary days back to Day/Month/Year. Base Day 1 must be 1 January of any year that is the first after a year exactly divisible by four. Base Day 1, for example, could be 1 January 1621, when, to get the number of days to 20 September 1679 (21082 or 525A hex if you must know) you would put day 20 (14H) month 9 (09H) and year 58 (3AH) to CVDAYS. Andrew usually uses 1 January 1901 as his base Day 1, when input of day 20, month 3 and year 83 will give the number of days to 20 March 1983.

The routines are accurate for years 1 to 179 inclusive but do not attempt the Gregorian correction by which the extra day in February is dropped each century year, except in the years whose numbers are exactly divisible by 400. Fortunately, the year 2000 (exactly divisible by 400) is a leap year, so no Gregorian correction is required for it. The routines will therefore function correctly until 2079. All the same, Andrew would like to know of any slick solution to the Gregorian correction problem. He would also like to see a shorter and faster CVDATE routine, which he calls frequently.

Holding dates as a number of days from a base day has several advantages. It is compact, and calculating the number of days between two events is simply a matter of subtraction. The remainder, after dividing the number of days by seven, indicates the day of the week. Whatever base Day 1 you work from, you can find out which remainders represent which days of the week by getting the number of days mod 7 for each day of the current week or some other week whose days you know.

```
MONTAB:
.BYTE 1FH, 1CH ;Jan=31  Feb=28      1F1C
.BYTE 1FH, 1EH ;Mar=31  Apr=30      1F1E
.BYTE 1FH, 1EH ;May=31  Jun=30      1F1E
.BYTE 1FH, 1FH ;Jul=31  Aug=31      1F1F
.BYTE 1EH, 1FH ;Sep=30  Oct=31      1E1F
.BYTE 1EH, 1FH ;Nov=30  Dec=31      1E1F
```

Table 1

Datasheet

```
;* CVDATE - Convert days since 01/01/01 to Day/Month/Year

;/ CLASS:  2
;/ TIME CRITICAL?:  No
;/ DESCRIPTION:  Takes a date as a count of days since a nominated
;/               Day 1 and converts it to Day/Month/Year, held
;/               as integers in registers A, B, C respectively.
;/ ACTION:  Copies days-since count into HL.  Divides out the
;/          years by repeated subrtaction.  Tests leap years and
;/          adjusts for 29 Feb.  Loads BC with month lengths
;/          and subtracts repeatedly to calculate the month number.
;/          Finally loads registers with values and returns.
;/ SUBr DEPENDENCE:  None
;/ INTERFACES:  None
;/ INPUT;  Days since 1 Jan in Year 1 held in BC
;/ OUTPUT:  Day-of-month in A; Month-of-year in B; Year No in C
;/ REGs USED:  A F , B C
;/ STACK USE:  6
;/ LENGTH:  67 (and 12 for month look-up table)
;/ TIME STATES:  A reasoned average would be 550 + 64 for each year
;/ PROCESSOR:  Z80

CVDATE:   PUSH   HL          ;save D E                          E5
          PUSH   DE          ;H L registers;                    D5
          LD     H,B         ;HL    count                       60
          LD     L,C         ;of days since Day 1.              69
          LD     BC,0000H    ;Initialise the count regs.        01 00 00
LOOP:     LD     DE,016H     ;DE    365 days.                   11 6D 01
          INC    C           ;Add 1 to year count and           0C
          LD     A,C         ;get it in A to test               79
          AND    03H         ;year count mod. 4.                E6 03
          JR     NZ,CV2      ;Skip if year not a leap.          20 01
          INC    DE          ;DE = 366 days.                    13
CV2:      SBC    HL,DE       ;Subtract a year's days.           ED 52
          JR     Z,CV3       ;Jump if this results in zero      28 02
          JR     NC,LOOP     ;else loop until negative.         30 F0
CV3:      ADD    HL,DE       ;Replace final year for rem.       19
          OR     A           ;Repeat the test for leap,         B7
          JR     NZ,CV4      ;and jump unless leap.             20 0B
          LD     DE,03CH     ;DE    (31+29) days.               11 3C 00
          SBC    HL,DE       ;Compare HL with                   ED 52
          ADD    HL,DE       ;the Feb value.                    19
          JR     C,CV4       ;Skip if date is Jan or Feb.       38 03
          JR     Z,FEB29     ;Jump if Feb                       28 18
          DEC    HL          ;otherwise drop Feb                2B
CV4:      PUSH   BC          ;and then ignore.                  C5
          LD     DE,MONTAB   ;Point to table of month days.     11 XX XX
          XOR    A           ;Clear accum.  for month count.    AF
LOOP2:    INC    A           ;Add 1 to month-of-year count.     3C
          EX     DE,HL       ;                                  EB
          LD     C,(HL)      ;C    Length of next month.        4E
          INC    HL          ;                                  23
          EX     DE,HL       ;DE now points to next entry.      EB
          SBC    HL,BC       ;Subtract a month's days.          ED 42
          JR     Z,CV5       ;Jump to finish if zero,           28 02
          JR     NC,LOOP2    ;else loop until negative.         30 F5
CV5:      ADD    HL,BC       ;Add final month for day cnt.      09
          POP    BC          ;Restore year count.               C1
          LD     B,A         ;B    month of year.               47
          LD     A,L         ;A    day of month.                7D
END:      POP    DE          ;Restore                           D1
          POP    HL          ;D E H L registers.                E1
          RET                ;Return.                           C9
FEB29:    LD     B,02H       ;B    Month no 2 (Feb).            06 02
          LD     A,1DH       ;A    29th day of month.           3E 1D
          JR     END         ;Jump to closedown code.           18 F7
MONTAB:   as for CVDAYS

YEAR1:    LD     DE,MONTAB   ;Point to table of mnth days.      11 XX XX
          DEC    B           ;Count only complete months.       05
          JR     Z,MONTH1    ;Jump if January.                  28 09
MONTH:    LD     A,(DE)      ;Length next completed month.      1A
          INC    DE          ;Point to next month.              13
          ADD    A,L         ;Add                               85
          LD     L,A         ;month                             6F
          JR     NC,MONTHS   ;length                            30 01
          INC    H           ;to HL.                            24
MONTHS:   DJNZ   MONTH       ;HL = 365y +d +leaps +M(m).        10 F7
MONTH1:   LD     B,H         ;BC    count of                    44
          LD     C,L         ;days since 01/01/01.              4D
          POP    DE          ;Restore                           D1
          POP    HL          ;D E H L registers.                E1
          RET                ;Return.                           C9
```

Andrew leaves his calendar routines running for weeks at a time. His micro has a 12-hourly interrupt from the internal clock, to set or reset the AM/PM flag in RAM. Andrew uses this to update the number of days, after having initialised them at switch-on with CVDAYS. He can then get the current date, whenever required, with CVDATE.

These calendar routines and the clock controller routines (below) should bring a software clock/calendar within the scope of all Z80 owners, with the minimal hardware specified for the clock control.

Datasheet

```
;= CVDAYS - Convert Day/Month/Year to days since 01/01/01

;/ CLASS:  2
;/ TIME CRITICAL? No
;/ DESCRIPTION:  Takes a date in the form Day/Month/Year, held
;/               as integers in registers A, B and C respectively,
;/               and converts it to a count of days since a
;/               nominated Day 1 (must be 1 Jan in the first
;/               year after a year exactly divisible by four -
;/               called Year 1).
;/               The routine is accurate for years 1 to 179
;/               inclusive, unless a century year not exactly
;/               divisible by 400 lies inside the range.
;/ ACTION:  To the count of days-into-the-month in HL, adds 365 for
;/          each completed year and 1 extra for each completed
;/          leap year.  Loads A with the length of each completed
;/          month in turn and adds that to HL.  For a current leap
;/          year adds 1 day more if the date lies beyond 29 Feb.
;/ SUBr DEPENDENCE:  None
;/ INTERFACES:  A 12-byte month table, addressed absolutely by
;/              the routine, must be held in memory.
;/ INPUT:  Day-of-Month in A; Month-of-Year in B; Year No in C.
;/ OUTPUT:  Number of days since 1 Jan in Year 1 held in BC.
;/ REGs USED:  A F , B C
;/ STACK USE:  6
;/ LENGTH:  57 (and 12 for the month look-up table)
;/ TIME STATES:  A reasoned average would be 450 plus 24 each year
;/ PROCESSOR:  Z80
CVDAYS:   PUSH   HL           ;save D E                          E5
          PUSH   DE           ;H L registers.                    D5
          LD     H,00H        ;HL    day of month (=d).          26 00
          LD     L,A          ;test for this being a leap        6F
          LD     A,C          ;year (ie, the least sig two       79
          AND    03H          ;bits = year no mod 4).            E6 03
          JR     NZ,LEAP      ;Jump if not                       20 06
          LD     A,B          ;else test if month                78
          CP     03H          ;Jan or Feb and if it is           FE 03
          JR     C,LEAP       ;skip adding extra day;            30 01
          INC    L            ;if not, add extra day.            2C
LEAP:     DEC    C            ;for no of complete years (y)      0D
          JR     Z,YEAR1      ;jump if was year 1.               28 12
          PUSH   BC           ;Save month & year counts.         C5
          LD     B,C          ;Set loop count = no of yrs.       41
          LD     DE,016DH     ;DE    365 days.                   11 60 01
YEAR:     ADD    HL,DE        ;Add a year's days to HL,          19
          DJNZ   YEAR         ;for each completed year.          10 FD
          POP    BC           ;Restore month & year counts.      C1
          LD     A,C          ;A     years                       79
          RRA                 ;completed                         1F
          RRA                 ;divided by 4                      1F
          AND    3FH          ;to give the extra leap days.      ED 3F
          LD     D,00H        ;DE     total number               16 00
          LD     E,A          ;of completed leaps.               5F
          ADD    HL,DE        ;HL    365y + d + leaps.           19
```

Z80 CLOCK CONTROLLER

Sub Set has come a long way without touching much on control routines, yet this is an area of microprocessing many of us would like to learn more about. The problem is that control routines can only be 'general-purpose' to those who have the devices they control and they can rarely be tested because the preparation of these routines for publication does not allow for the time and risks of my hardware interfacing.

The next Datasheet, a collection of routines for a real-time clock controller from Michael Jones is included, untested, by way of an experiment. Let us know whether or not you find code of this kind interesting or useful. These routines are not heavily device dependent, requiring only a CTC, generating interrupts at 1 kHz.

Datasheet

```
;= ON, OFF, CLEAR, READ - real-time clock controller
;/CLASS: 2 (not position independent)
;/TIME CRITICAL? No except ISR
;/DESCRIPTION: Set of routines to turn on, turn off, clear
;/             & read a 1/1000 sec real-time clock using a spare
;/             CTC channel
;/ACTION: (ON) Initialise interrupt structure (mode 2);
;/             appropriate vector and CTC. Does not clear
;/             time automatically.  ISR increments memory,
;/             working from low to high address if carry. No
;/             check for overflow but 4-byte storage will last
;/             for about 7 weeks
;/        (OFF) Internally resets CTC
;/      (CLEAR)  Zeroes all four bytes
;/       (READ) Reads outvalues into DE, HL
;/SUBr DEPENDENCE: None
;/INTERFACES: Z80A CTC channel & 6 bytes RAM (4 for time &
;/            2 for vector)
;/INPUT: None
;/OUTPUT: (READ) HL= least significant word
;/              DE= most significant word
;/       (OTHERS) None
;/REGs USED: (READ) DE, HL
;/          (OTHERS) I set up by ON
;/STACK USE: 4,2,2,0 (+ 6 at any time for ISR
;/LENGTH:78
;/PROCESSOR: Z80 running at 2 or 4 MHz
;
VECT:     EQU    X              ;Location of interrupt vector in
                                ;  RAM (2 bytes)
RTIM:     EQU    X              ;Location of 4-byte time storage
CTCO:     EQU    X              ;CTC port on channel 0
CTCN:     EQU    X              ;CTC port free
ON:       PUSH   HL             ;Save registers            E5
          PUSH   AF             ;                          F5
          IM     2              ;Z80 vector mode           ED 5E
          LD     A,VECT/256     ;Initialise I with         3E XX
          LD     I,A            ;  top byte of vector      ED 47
          LD     HL,ISR         ;Initialise vector with    21 YY YY
          LD     (VECT),HL      ;  address of ISR          22 XX XX
          LD     A,VECT         ;Send low byte of          3E XX
          OUT    (CTCO),A       ;  vector to CTC           D3 XX
          LD     A,85H          ;Initialise CTC            3E 85
          OUT    (CTCN),A       ;  in timer mode           D3 XX
          LD     A,250          ;For 4 MHz sys or 125      3E FA
                                ;  for 2 MHz sys
          OUT    (CTCN),A       ;                          D3 XX
          POP    AF             ;Restore registers         F1
          POP    HL             ;                          E1
          RET                   ;                          C9
;
ISR:      EI                    ;Re-enable interrupts      FB
                                ;  interrupt response
          PUSH   HL             ;Save registers            E5
          PUSH   AF             ;                          F5
          LD     HL,RTIM        ;Start (LSD) of time       21 XX XX
LOOP:     INC    (HL)           ;Incr time                 34
          INC    HL             ;Point to next digit       23
          JR     Z,LOOP         ;Incr next digit if carry  28 FC
          POP    AF             ;Restore registers         F1
          POP    HL             ;                          E1
          RETI                  ;Return from interrupt     ED 4D
;
OFF:      PUSH   AF             ;Save AF                   F5
          LD     A,+3           ;To internally reset CTC   3E 03
          DI                    ;Prevent spurious ints     F3
          OUT    (CTCN),A       ;                          D3 XX
          EI                    ;Re-enable interrupts      FB
          POP    AF             ;                          F1
          RET                   ;                          C9
;
CLEAR:    PUSH   HL             ;                          E5
          LD     HL,+0          ;Zero RAM                  21 00 00
          LD     (RTIM),HL      ;                          22 XX XX
          LD     (RTIM+2),HL    ;                          22 XX XX
          POP    HL             ;                          E1
          RET                   ;                          C9
;
READ:     DI                    ;Prevent time changing     F3
                                ;  while being read
          LD     HL,(RTIM)      ;Get low word              2A XX XX
          LD     DE,(RTIM+2)    ;Get high word             ED 5B XX XX
          EI                    ;Re-enable                 FB
          RET                   ;                          C9
```

6502 REGISTER INDIRECT

XYMOD from David Heale provides the 6502 with a 6-byte equivalent of the Z80's (HL) type instructions. It can be used to turn any instruction using a 16-bit address operand into one using the value held in the X and Y registers, making available such powerful commands as ADC (XY), CMP (XY), EOR (XY), etc. Perhaps even more importantly, it allows JMP (XY), JMP ((XY)) and JSR (XY).

The routine stores the contents of the Y register in the second byte, and the X register contents in the third byte following JSR XYMOD. The 3-byte instruction executed on return then uses the values copied from XY as the 16-bit address.

For example, if X contains $AB and Y contains $CD then

JSR XYMOD
ROL $FFFF

will become

JSR XYMOD
ROL $ABCD

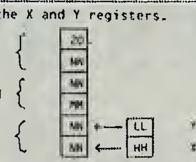
without X or Y being affected. If that piece of code is written in a loop which alters the value of X and Y then a different byte of memory will be rotated each iteration.

I fault the routine for modifying code — the routine itself is ROMable but any code calling it is not. However, each to his own, and any short routine which comes up with 24 'extra' instructions at one throw can't be bad.

Datasheet

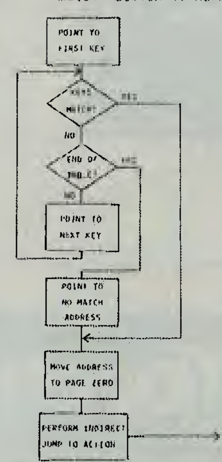
```
;= XYMOD - Modify operand to (XY)
;/ CLASS:  2 (alters code)
;/ TIME CRITICAL?:  No
;/ DESCRIPTION:  Replaces the 16-bit address operand in a 3-byte
;/               instruction following JSR XYMOD with the contents
```

```
;/                of the X and Y registers.
;/ ACTION:  JSR
;/
;/XYMOD ADDRESS
;/
;/ 3-BYTE INSTRUCTION
;/
;/ 16-BIT ADDRESS
;/
```




```
;/ SUBr DEPENDENCE:  None
;/ INTERFACES:  None
;/ INPUT:  XY contains desired 16-bit address
;/ OUTPUT:  Value of XY replaces 16-bit address in instruction
;/          following JSR XYMOD.
;/ REGs USED:  M1-4, X, Y
;/ STACK USE:  None
;/ LENGTH:  29
;/ TIME STATES:  61
;/ PROCESSOR:  6502

XYMOD   STA  M1       ;Save A                               85 ZZ
        PLA           ;Copy stacked Return Address - 1      68
        STA M2        ;into M2 and M3                       85 ZZ
        PLA           ;                                     68
        STA  M3       ;                                     85 ZZ
        PHA           ;                                     48
        LDA  M2       ;                                     A5 ZZ
        PHA           ;                                     48
        STY  M4       ;Save Y and use it as index           84 ZZ
        LDY  £2       ;to 2nd byte of 3-byte instruction,   A0 02
        LDA  M4       ;get Y entry value in A               A5 ZZ
        STA  (M2),Y   ;and put in 2nd byte.                 91 ZZ
        INY           ;Index 3rd byte,                      C8
        TXA           ;get X entry value                    8A
        STA  (M2),    ;and put in 3rd byte.                 91 ZZ
        LDY  M4       ;Restore Y                            A4 ZZ
        LDA  M1       ;and A                                A5 ZZ
        RTS           ;                                     60
 ;= CASEOF - Case structure table handling routine
 ;/ CLASS: 1
 ;/ TIME CRITICAL?:  No
 ;/ DESCRIPTION:  Branches to action associated with matched key
 ;/               Else to 'no match' action if no match.
 ;/ ACTION:
```




```
;/ SuBr DEPENDENCE: None
;/ INTERFACES: None
;/ INPUT: X = search key; MO,1 = case table base address
;/ OUTPUT:  Branch to correct action; M2,3= action address
;/ REGs USED: X, MO, M1, M2, M3
;/ STACK USE: 5
;/ LENGTH: 49
;/ TIME STATES: If match 38 + 35 * key position
;/              If no match 57 + 35 * number of keys
;/ PROCESSOR:   6502

;/ STACK USE:  5
;/ LENGTH:  49
;/ TIME STATES:  If match 38 + 35 * key position
;/               If no match 57 + 35 * number of keys
;/ PROCESSOR:    6502

CASEOF  PHP             ;Save registers                      08
        PHA             ;                                    48
        TYA             ;                                    98
        PHA             ;                                    48
        TXA             ;                                    8A
        PHA             ;leaving input key in A.             48
        LDX    $00      ;Index to byte 1 (table length)      A2 00
        LDY    £$03     ;Index to 1st key.                   A0 03
TSTNXT  CMP    (MO),Y   ;Test for match and                  D1 ZZ
        BEQ    FOUND    ;exit loop if found                  F0 10
        PHA             ;else save input key.                48
        TYA             ;Get key pointer and                 98
        CPM    (MO,X)   ;test for end of table.              C1 ZZ
        BEQ    ELSE     ;Branch out if end,                  F0 07
        PLA             ;else restore key to A.              68
        INY             ;Increment key index to next key     C8
        INY             ;                                    C8
        INY             ;                                    C8
        SEC             ;                                    38
        BCS    TSTNXT   ;and repeat.                         B0 EF
ELSE    PLA             ;Remove stacked input key.           68
        LDY    £$00     ;Adjust index to no match.           A0 00
FOUND   INY             ;Copy address from following         C8
        LDA    (MO),Y   ;two bytes into M2 and M3.           B1 ZZ
        STA    M2       ;                                    85 ZZ
        INY             ;                                    C8
        LDA    (MO),Y   ;                                    B1 ZZ
        STA    M3       ;                                    85 ZZ
        PLA             ;Restore registers.                  68
        TAX             ;                                    AA
        PLA             ;                                    68
        TAY             ;                                    A8
        PLA             ;                                    68
        PLP             ;                                    28
        JMP    (00M2)   ;Branch to selected action           6C ZZ 00
```

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A LOOK AT C

Peter Rodwell continues our occasional series on computer languages with a look at C.

The microcomputer world is pretty well off these days as far as languages are concerned. Although Basic still reigns supreme, we have inherited a good range of languages from the mainframe world. Falling memory prices and the advent of 16-bit computers have given us the room and power to get to grips with some of the larger and more exotic languages, giving access to the large pool of software written for the big machines.

In a perfect world there would, of course, be only one computer language. Unfortunately, nobody has yet produced the perfect language (although there are several who claim to have done so), hence the proliferation of languages: one programmer's meat is another's poison.

So it is that from time to time a new language appears, designed to fulfill a need not met by other languages or aimed at a specific area of programming — writing operating systems, say, or accounting packages. Such a language is C, now making itself felt in the micro world although it has been available on big machines for some time. It's the language in which the Unix operating system is written (apart from a few hundred lines of assembler code) and that should give you a clue to C's main purpose in life.

There are three levels of computer languages. At the lowest level is the binary code which the computer 'understands' directly but which is impossible for humans to get to grips with. Above this is assembler language, in which each of the binary codes is represented by a cryptic, but human-understandable, mnemonic. These mnemonics are translated by a piece of software called an assembler into the binary codes. Tedious though assembler programming can be, it does, however, give the programmer complete control over the system and, provided he knows his stuff, produces the most efficient code possible.

Assembler programming does, however, require considerable computing knowledge and takes a hell of a long time to produce the goods — there's a lot of writing to be done and finding bugs can be a nightmare. High level languages have therefore appeared to overcome these problems. Rather than write pages of code to perform a simple operation such as displaying a character on the screen, the programmer needs only to write a single, English-like word such as 'PRINT'. This is translated into binary code by a program called a compiler or by a translator. The difference between these two is simple: with a compiled language, you write your program with a word processor or text editor, save it on disk and then get the compiler to translate it all in one go. A translated language, of which the most popular is Basic, allows you to type in your program and then turns each line into binary code a line at a time as the program is running. Compiled programs generally work more quickly than translated ones because the translation takes a hefty amount of processing time. But it's a lot easier and less troublesome to debug or alter a translated program.

The disadvantages of most high level languages is that the code produced by the compilation or translation isn't always very efficient and usually takes up more memory than a well-coded assembler equivalent. Translated languages not only run more slowly but need the language translator to be held in memory at the same time. These problems may not be particularly important if you're using a mainframe machine but they do matter in the micro world where processors are slower and less powerful and there's less memory to play with.

C seems not to fit into any of these neat categories, though. It's a high-level language, sure, but lacks some features found in other languages. However, it gives very nearly the control which assembler languages offer. This means that while it would be tedious to write, say, a stock control package in C, it is a very handy language for producing operating systems, compilers/interpreters for other languages, and certain types of applications packages such as word processors.

C comes from the people who were responsible for giving us Unix, Bell Labs in the USA. It stems originally from the British-produced language BCPL via an intermediate product called B. Some controversy appears to exist as to whether the next language in the family should be called P or D.

First impressions

Although C is a structured language, at first sight it looks absolutely awful. Take a look at Listing 1, a simple program which counts the number of words in a text file and prints out the total. As you can see, C makes little concession to readability, preferring cryptic symbols to English words for many operations (although not taking this to the extreme of APL).

A closer look reveals that C has some distinct similarities to Pascal, especially when you realise that the '{' and '}' symbols serve the same purpose as Pascal's 'begin' and 'end'. (In fact if you're a Pascal freak you can define 'begin' and 'end' to mean '{' and '}' and use them instead of the symbols, if you like giving yourself extra typing.)

There is a major style difference between C and Pascal. Pascal demands that your program starts with all the subroutines and that each one be defined before it is used. The final part of the listing is, therefore, the main program itself. This is theoretically a neat, orderly way of doing things and makes the compilation process easier but it doesn't make the listing easier to read. C imposes no such restrictions; you must identify the main module by called it 'main' but you can put it anywhere and you can write your subroutines in any order you see fit. To my mind it's preferable to start with the main module, but this is more a matter of personal taste than programming dogma. C also imposes no restrictions on the way the listing is laid out and you are left to devise whichever method of indentation and general layout you find best.

Let's take a closer look at the language, then. In the style of our series of language articles, this isn't intended to be a detailed tutorial but more of an overview of the language's features and potential.

C basics

As with Pascal, C demands that all variables are declared before they can be used and that their type is specified: **char**acter, **int**eger, single-precision **float**ing point and **double**-precision floating point are the standard types. So,

int number;
char c;

declare 'number' as an integer and 'c' as a character. Arrays are defined as

int matrix[10];

which defines an array of 10 integers.

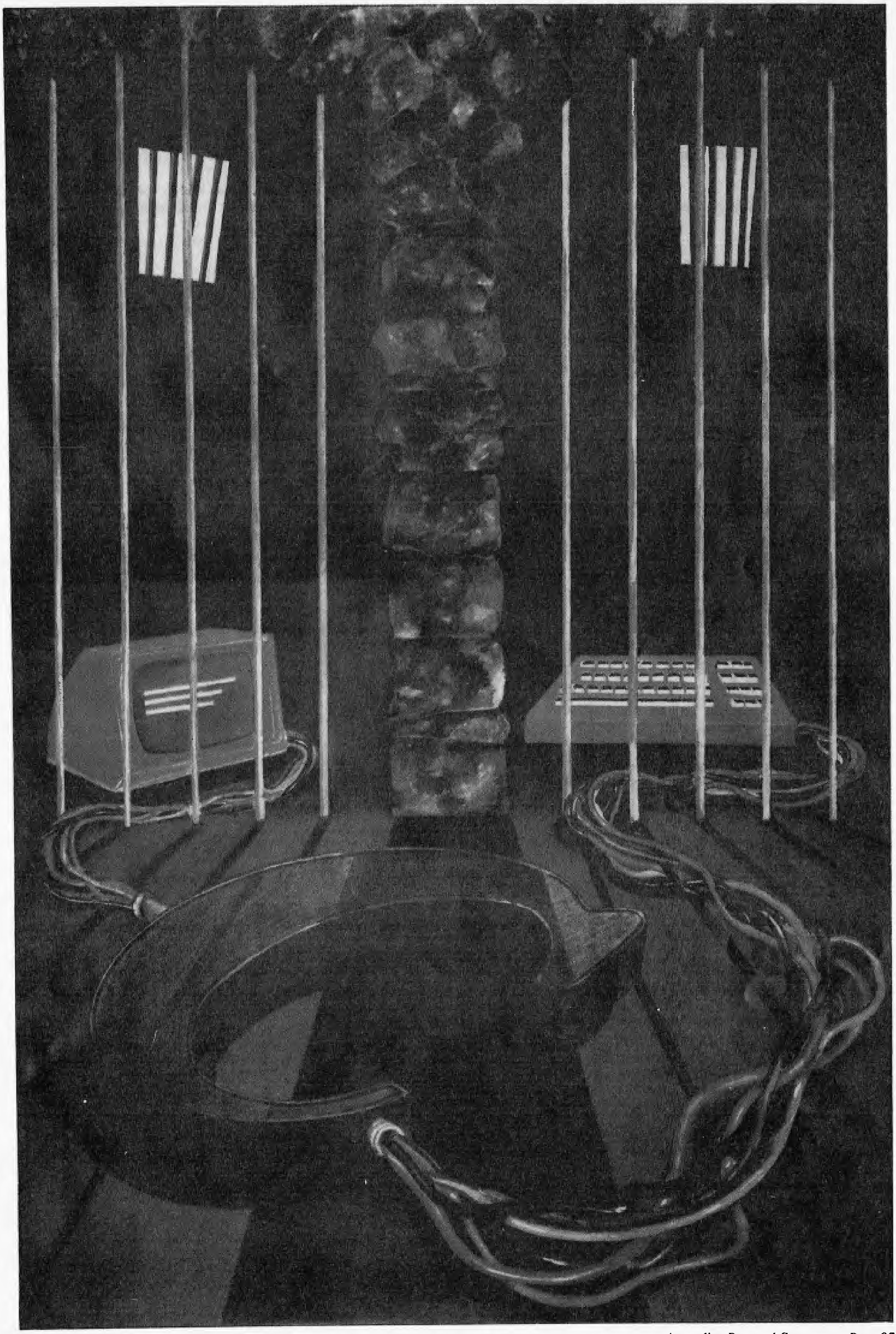
C contains no provision whatsoever for handling strings as complete units. Instead, strings are defined and handled as arrays of characters, which is a little awkward at times but generally very useful for the types of applications for which C is most suited.

A typical C program comprises a main section and a number of functions (rather like Basic subroutines) which are called either from the main function or from other functions. Variables defined within a function, eg:

```
funct()
{
int fred;
char K
.
.
.
```

are 'automatic'; 'fred' and 'k' appear only when the function is called and disappear when it ends — they are completely independent of any other variables called 'fred' and 'k' elsewhere in the program. If you want an internal variable to retain its value between function calls, you declare it as type **static**.

So how does C pass parameters to



A LOOK AT C

functions? One way is through external variables, declared outside of the main program and any functions and re-declared within each function which uses them. A usually handier way is to pass the value with the function call:

```
funct(value);
```

which is handled within the function by:

```
funct(value)
int value;
{
.
.
.
```

Functions can similarly return values, with the **return(value);** statement. This has interesting implications: you can declare a function as though it were a variable and use it in the same way:

```
int x, funct(), value;
.
.
.
x=funct(value);
```

Operators

C provides a useful range of operators. There are the usual arithmetic ones (+, −, * and /) but the language's syntax allows some operators to be used in unusual ways. To increment and decrement a value, for example, instead of

x = x + 1;

or

y = y − 1;

C allows you to say

++x;

and

−−y;

But '++' and '−' can be suffixes as well as prefixes, in which case they take effect *after* the variable has been referenced.

So, if a = 6,

x = a−−;

will give x = 6 but a will then be equal to 5. It is this economy of expression, which permeates the entire language, which makes C a satisfying language in which to program. It does, however, need to be used with care and can produce almost unreadable source code if overdone.

Relational operators, used in testing conditions, are the familiar >, >=, < and <= with the addition of == and !=, tests for equality and inequality respectively. Logical operators include && and | | for AND and OR and there are operators to work down to the bit level and shifting left and right.

Control flow

Program statements consist of a single line, terminated by a semi-colon but groups of statements can be enclosed between braces ('{...}') and treated as a single statement in certain cases.

One example is the **if** statement:

```
if ( a == 1 )
  {
  statement1;
  statement2;
  }
else
  statement3;
```

The expression used with if is evaluated to true (1) or false (0), so that the example above could be re-written:

```
if ( a )
  {
etc.
```

Using the negation operator '!' turns

if (x = 0)

into

if (!x)

— ie, 'if not x'.

Three types of loops are available, **for** and **while**, which test the controlling condition at the top of the loop, and **do...while**, which tests at the bottom.

for (x = 1; x = 20; ++x);

would be equivalent to Basic's

FOR X = 1 TO 20 STEP 1

but the condition needn't be simply numeric — any expression which can be evaluated to true or false could be substituted, so that searching for a character in a string array could be done with

```
for ( i = 0; c != 'a'; ++i )
  c = array[i];
```

which would search through array[] and stop when it found an 'a' (array subscripts start with 0 in C).

The while loop is similarly handled:

```
i = 0;
while ( c != 'a' )
  c = array[i++];
```

for example. But with C's economy of

```
£define         YES             1
£define         NO              0
£define         EOF             -1

main(argc,argv)         /* Count words & chars in named file(s) */
int argc;
char *argv[];
{
int     c,nw,nc,inword;
FILE *fp,*fopen();

fprintf(stderr,"\nWord count program\n");
if (argc == 1)
  {
  fprintf(stderr,"You didn't specify which file you want counted!\n");
    goto stop;
  }
else
  {
  while (--argc > 0 )
    {
    if ((fp = fopen(*++argv,"r")) == NULL)
      fprintf(stderr,"Can't find file `%s'\n",*argv);
    else
      {
      fprintf(stderr,"\nCounting words in `%s'...\n",*argv);
      inword = NO;
      nw = nc = 0;
      while ((c = getc(fp)) != EOF)
        {
        ++nc;
        if (c == ' ' || c == '\n' || c == '\t'
        || c == '\n'  || c == '/' || c == '-')
          inword = NO;
        else if (inword == NO)
          {
          inword = YES;
          ++nw;
          }
        }
      }
  printf("File `%s%s", *argv, "' contains ");
  printf("%d%s", nc, " characters, ");
  printf("%d%s\n\n", nw, " words.");
    }
  }
stop:   exit(0);
}
```

Listing 1

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```
i = 0;
while ( array[i++] != 'a' )
  ;
```

the final ';' being in effect a dummy statement as all the work is done in the condition test!

The **do...while** loop should be obvious by now:

```
do{
  c = array[i];
  ++i;
  } while ( c != 'a' );
```

would be one way, although similar code-cutting techniques could be used to reduce this.

C also gives you a **goto**, hated by programming fundamantalists but useful sometimes nevertheless, especially for escaping from deep nests of loops.

Pointers

As well as referencing a variable's value by the variable name, C allows you to access it with its address, using pointers. Andrew Stephenson's review of C/80 (following) contains an example of this, in the sample program. The array *msgtxt[] contains not the strings which follow it but the addresses of the first character in each string. Each string is accessed by obtaining the appropriate address or pointer from *msgtxt[], placing it in 'msgptr' and using this to find the string itself, which is then printed out character by character. In a situation like this, the programmer doesn't have to worry about where the actual strings are stored — the compiler does it automatically. Likewise, the compiler adds a null byte to the end of the string to provide a method of detecting its end, used in Andrew's program in the statement **while (code = *msgptr++)** — can you figure out what this does?

The example is a typical use of pointers — accessing an array, often via an array of pointers to arrays. Generally, using pointers instead of array subscripts results in faster, more compact code but can lead to inpenetrable source code!

I/O facilities

The C language provides no I/O facilities whatsoever, a rather surprising attribute at first sight. I/O is in fact handled by a standardised library of I/O functions: **getchar();** in Listing 1 is an example, as is **fprintf();**, the latter being a powerful print-out command with formatting capabilities.

As C was developed for the Unix environment, it naturally has Unix-type I/O characteristics. I/O is carried out through files and can be re-directed by changing the filenames. I/O can also be controlled from the command line. The word count program, when called, must have the name of the file to be counted in the command line — up to 20 files can be specified in the line, in fact — and if you tag '>PRN:' on the end, output goes to the printer instead. Change this to '>filename' and the output is written to a disk file of that name; '>>filename' appends it to the file.

Because I/O is handled in this way, it is totally machine-independent. So unless your program contains machine-specific features (screen handling, for example), you can be almost certain that it will be completely portable. And it is this portability which is one of C's greatest assets and one reason for its increasing popularity; I think it's fair to say that C is more portable now than Pascal, judging by the number of different Pascals around.

Learning and using C

C's major drawback as far as the novice is concerned is its lack of documentation. There are,to my knowledge, only two books on the subject. The standard work is *The C Programming Language* by Brian W Kernighan and Dennis M Ritchie (Prentice-Hall 1978, ISBN 0-13-110163-3), which defines the language and gives a sort of tutorial. It is, however, quite terse and assumes you are already familiar with programming terms and concepts. The section on pointers is particularly obtuse and, despite ploughing through it several times, I still feel uneasy using pointers — strange things can happen if you don't get it right! On the plus side, the book contains a large number of sample programs and functions to aid understanding, has a practical rather than academic approach to the subject and contains a full, formal definition of the language at the end.

The other C book is *The C Puzzle Book* by Alan R Feuer (Prentice-Hall 1982, ISBN 0-13-109926-4). This assumes familiarity with the language and is devoted to pointing out potential snares for the unwary C novice. It is to the same format as *The C Programming Language*, and contains extensive cross-referencing to the latter's language definition. Please don't ring me up to ask who sells these books — you can order them through any good bookshop.

To get to grips with C, I was fortunate enough to borrow the C86 compiler from Computer Innovations Inc (75 Pine Street, Lincroft NJ07738,USA (201)530 0995. The compiler is available to run under CP/M-86 and MS-DOS; under CP/M-86 it produces '.CMD' files and '.EXE' files appear for MS-DOS. (Or so it says in the manual — I haven't yet found a way of transferring the MS-DOS version from its 8in disk to the Sirius.) C86 costs $395 but add $20 for postage.

The compiler comes complete with an I/O library plus utilities to create and maintain your own libraries of functions, and adheres to the standard defined by Kernighan and Ritchie. Sensibly, Computer Innovations imposes no royalty conditions on the sale of programs developed with C86 and using the supplied library functions. The manual assumes you are familiar with C and is confined to a description of each function in the library (for which the source code is also supplied, incidentally) plus, of course, instructions for using the compiler.

C86 is a three-pass compiler, which makes writing, testing and debugging very tedious even if you use CP/M's submit facility to do it. The final stage involves linking the compiler's output to whatever libraries are required, to create your '.CMD' program. The compiler provides reasonably obvious error messages (not all of which are documented in the manual) and it can be quite amusing to watch these whizzing up the screen because you left out a '{' near the start of a long program'.

Conclusion

I have tried here to give a taste of C and to describe some of its main capabilities and points of interest. As you should have gathered, C is certainly not the perfect programming language in that it is not suitable for every application. Its strengths lie in the areas for which it was designed — systems software and applications programs such as word processors, in which its more esoteric features such as pointers make for very efficient programs. It would be perfectly possible to write just about any application in C but, although facilities exist for handling things like, for example, random file access, there are other languages designed for — and therefore more suited to — this sort of work. C does, however, offer much of the control of assembler programming while providing the speed and ease of a high-level language combined with complete portability.

SOFTWARE TOOLWORKS C/80

Andrew Stephenson investigates a low-cost C compiler.

In searching for a C compiler, I looked at several but, by comparison, The Software Toolmakers' C/80 looked too good to be true, promising an amazingly compact, complete, accurate — and cheap — implementation.

Deriving from Ron Cain's 'Small C', a stripped-down compiler released into the public domain a few years ago, it has been developed by a group of academics intent on providing good software at low prices. The C/80 dates from at least April 1980, version 2.0 from around February 1982. No further revision has yet been announced.

The CP/M edition, the only one I have tried, is supplied on 8in disk; ask about different disk formats. Other editions are available for Zenith computers (the authors started with Heathkit products) and the Osborne. Variations are minor, since the C/80 is written in C, and stem mostly from factors such as DOS limitations and disk capacity. Osborne 1 owners have a smaller selection of sample C programs.

One of the charming traits of academic programmers is that they tend to be less tolerant of imprecision than their hasty commercial cousins. The C/80 has proven very reliable in the five months I have had my copy. In the early stages I was able to provoke it into fits of diagnostic hysterics; but more orthodox source code appears to give it no real problems.

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A LOOK AT C

Differences from the full standard are mostly harmless. The C understood by C/80 is more a subset than a variation:
names restricted to seven characters (not eight);
no floating point data types;
no bit fields in structures and unions;
no variable definitions other than at head of a function;
no initialisation of automatic or register variables;
no use of **sizeof** in setting array dimensions;
no **#line** preprocessor command;
no recursive substitution in **#define**;
no macro parameters in **#define**;
no **typedef** operator or **entry** keyword.
Unless you are involved in scientific work, the lack of floating point data types is unlikely to be a problem. The price of having them is compiler complexity, slowness and cost. The world is more measurable in integers than might be supposed.

That said, some users may regret the fact that all data types other than characters are two bytes in size. And characters are signed, so conversion to an integer extends the sign: eg, 80 hex becomes FF80 hex.

Functions must be called with a full complement of parameters, thanks to C/80's back-to-front stacking of them.

The compiler will supply in the HL register the value of any variable named just before **#asm**.

Finally, C/80 users obviously own some ancient equipment: command line **#UPPER** allows normal C code to be written in upper case only. Oh, and some notational anachronisms are accepted (eg, =+ etc).

Using it

C/80 is simpler to use than some of its rivals. One error-free compiler runs produces an 8080 Intel assembly code file. Library fuctions are in a separate file, CLIBRARY.ASM, automatically incorporated later at assembly time, unless you have chosen to compile into a format compatible with Microsoft's Macro-80 relocatable assembler.

CLIBRARY holds a mixture of routines, some essential, some required only by input-output (I/O) facilities, file handling and other system-specific tasks. Careful editing can be worthwhile, since this is nearly 2.4 kbytes in size. You may even wish to create versions with your own mixes to routines.

The next stage is assembly, either with the absolute 8080 assembler supplied as part of the C/80 package, or with another. The final 'COM' file runs on its own.

During compilation, any error causes the display of the offending source code line with the problem site marked and a summary of the problem. Messages are succinct but the manual enlarges on them individually, sometimes humorously: 'too many active **whiles**: Well, congratulations. There's only one table in this compiler that isn't expandable, and you have overflowed it by nesting 20 **whiles**, **fors** and/or **switches**. Simplify your program.'

That remark about table expansion refers to the amount of memory assigned to the compiler's working scratchpads. These are set by default values in patchable C/80 locations (revealed by one of the ancillary files) or by command line flags.

The options are mostly useful. Apart from five for table sizes and one for Macro-80 compatibility, they are:
Include source text as comments in assembly code file;
Treat 'global' variables as external to file being compiled;
Offset all labels by a specified amount, to avoid clashes with other separately compiled files;
Do not initialise 'static' and global variables to 0, to save intermediate file space;
Do not merge duplicate text strings;
Seek CLIBRARY.ASM on a particular drive;
Generate a runtime profile.

Only the last is not too clever in practice. Either of two special files can be included. One causes the running program to display calls to functions (but little else); the other gives the duration and quantity of function

```
#define ERRMSG  0                       /* The preprocessor will replace all
                                           occurences of ERRMSG with '0'    */
#define MAINMSG 1                       /* Main message text's number       */
#define CONDIS  6                       /* CP/M BDOS function 6             */
#define ERROR  -1                       /* Err code in o/p message string   */
#define OKAY    0                       /* No error found in message string */

int     dismsg(), cpmbyt();             /* These are functions which return
                                           integers                         */

/* The program itself starts here...                                        */

main()
{
if ( dismsg(MAINMSG) != OKAY )
  dismsg(ERRMSG);
}

/* ...and ends here!  It calls function dismsg(), passing the single
   parameter MAINMSG.  C allows you to use the function call itself in
   place of a variable - a function which returns a value effectively
   becomes that value.  If dismsg() is not equal to OKAY, it's called
   again to report the error, this time using ERRMSG as its parameter.
   Now we have to define the function dismsg()...                          */

dismsg(msgnum)
int     msgnum;                         /* Define msgnum, the parameter
                                           passed to the function, as an
                                           integer.                         */
{
char    code, *msgptr;                  /* code is a character pointer,
                                           msgptr is a pointer to characters,
                                           denoted by the '*' prefix        */
static  char    *msgtxt[] =             /* msgtxt is an array of pointers to
                                           the following text strings...    */
        {
                {"\n* * * BAD MESSAGE CODE ENCOUNTERED IN TEXT * * *"},
                {"\nThis\202displays\203 recursion.  Good, eh?\n\n"},
                {" function "},{" messages,\204"},{" using "}
        };
/* Any character with high bit set is a modified message number which
   causes that message to be displayed before completing the current one.
   Hence dismsg() must call itself recursively.  '\' followed by a three-
   digit number defines an octal character.                                 */

msgnum &= 0x7F;                         /* ie, msgnum = msgnum AND 7F hex   */
if ( msgnum >= (sizeof msgtxt / sizeof (char *)))
  return(ERROR);
msgptr = msgtxt[msgnum];
while (code = *msgptr++)                /* *msgptr is incremented after
                                           being referenced                 */
  {
  if ( code & 0x80 )                    /* AND code with 80 hex             */
    {
    if ( dismsg(code) != OKAY )
    return(ERROR);
```

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Library

It must be said that the C/80 package's support library is no more than adequate, although at the price no one should feel cheated.

CLIBRARY.ASM has some interesting input/output routines. These emulate Unix, in that I/O can be redirected to/from any of CP/M's logical devices or any file by opening a data 'channel' to/from program. (Redirection applies during compilation, too, so error messages can go to disk instead of console.)

Ten functions handle the bare bones of character and file I/O, and memory allocation. The average user would be happy for a while but would soon need to augment them, such as for file deletion. (Kernighan & Ritchie contains more, in the section on the Unix interface.)

Formatted output of mixed text and values is provided by file PRINTF.C, for optional inclusion. This is useful. (Again, K&R is worth looking at.) Other files provide CP/M2+ random file access and chaining of programs. And, apart from some minor demonstration samples, that is that.

```
    }
  else
    {
    if ( code == '\n' )
      newlin();
    else
      dischr(code);
    }
  }
return(OKAY);
}

/* Now define the function newlin(), which simply prints a carriage
   return and line feed.  See how unreadably squashed C code can be if
   you really put your mind to it!                                    */

newlin(){dischr('\r');dischr('\n');}

/* This function displays the character passed to it, using the
   customised function cpmbyt().                                      */

dischr(c)                          /* Display the single character c  */
char    c;
{
cpmbyt(c, CONDIS);
}

£undef  MAINMSG                    /* 'Forget' the definitions of     */
£undef  CONDIS                     /* MAINMSG and CONDIS              */


/* This function shows how assembler code can be incorporated using
   '£asm...£endasm'.  This routine is not portable except when using
   CP/M and C/80                                                      */

cpmbyt(DEparm, Cparm)
int     DEparm,                    /* CP/M DE register parameter      */
        Cparm;                     /* CP/M C register parameter       */
{
£asm                               /* This switches to in-line assembler
                                      code.                           */
BDOS    EQU     5
        POP     H                  ; Save return address.
        POP     B                  ; BC = Cparm
        POP     D                  ; DE = DEparm
        PUSH    D                  ; Return values to stack
        PUSH    B
        PUSH    H
        CALL    BDOS               ; Call CP/M
        MOV     L,A                ; Prepare to return status value
        MVI     H,0
£endasm                            /* Switch back to C code - the
                                      compiler provides a RET         */
}
```

Sample program illustrating various aspects of C. Note that '£' here replaces the normal '#'.

System requirements

C/80 needs 40k or so of RAM, so 48k CP/M should be fine on most computers. Extra memory allows more complex programs to be compiled. No other special needs have become apparent.

Documentation

The 35-page manual is businesslike and forthcoming with hints on using the compiler, optimising code size and speed, error messages, flags, the library, and so forth. The essentials of C are also summarised in an admirably compact form.

Unfortunately, my copy predates my version of C/80. This now seems to have been corrected.

Efficiency

The example program compiled to 381 bytes, excluding the essential routines in CLIBRARY, amounting to few dozen bytes. Ignoring 125 bytes attributable to text strings, 256 bytes of code are left. A quick hand-compilation produced some 85 bytes. However, this is not quite a fair comparison. Large programs developed rapidly can easily justify their greater use of RAM. What is dramatised is the price of using the stack to pass parameters.

Some hand optimisation is always possible, though in this case only three bytes could be saved by a quick inspection of the assembler code. A different program, of 5.5k, had deadwood of only 100 bytes.

On the whole, C/80 seems inherently efficient, though no apparent optimisation is done. Experience shows that, where size and/or speed is paramount, development time can still be saved by debugging algorithms in C, then hand-compiling.

Conclusion

This package has proven its worth, in hobby and commercial work. The absolute 8080 assembler supplied free (?) is a nice touch and worth something on its own.

Anyone who already has a large investment in code using all data types and/or bit fields may prefer to avoid the conversion job that would be necessary.

For everyone else, as a value-for-money deal C/80 knocks the spots off the competition. However, in future releases The Software Toolworks should seriously consider allowing for the features they so far have not implemented. Why leave a wall only 98 percent painted?

The Software Toolworks' C/80 package costs $50 (US). Updates are promised at nomimal sums.

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Benchtests: VIC-20, Tandy TRS-80 III/TRS-80 Monitor software compared/Computer Games: Backgammon on micros/Tree access routines explained/Gateways to Logic, Part 8: Peripherals/How Computers Communicate, Part 1: What is I/O?/Profile:Gary Blom of the Computer Company/ Part 1 of 2: Defining program specification needs/6502 Assembler in Basic/Wordpower wordprocessor program for the PET/Programs: PET Arithmetic Test, Apple Mondrian.

Volume 2 No 5, 1981
Benchtest: IBM Personal Computer, NEC PC8000/WP Benchtest: Spellbinder/Gate array design and firmware modules: an upcoming generation of chips/ Winchester hard disks explained by Rodnay Zaks/Computer Games: Poker on micros/Gateways to Logic, Part 9 (end): Typical teaching projects/ Artificial Intelligence/How Computers Communicate, Part 2: The I/O Bus/Storing alphanumeric records under CP/M/ Part 2 of 2: Defining program specification needs/Apple "booby trap" documented/ Make PET disassembled programs more readable/ Explaining the WAIT function for OSI and PET machines/ Putting a bell tone onto the Superboard/Programs: TRS-80 Sailing Simulation, ZX80 Eldorado, PET Gomoku.

Volume 3 No 1 1982
Benchtest: Tandy TRS-80 Color/Checkouts: Hitachi Peach, Sharp's Microtranslator, BBC Proton/Profile of Rodnay Zaks/Sorting alphanumeric codes from disk to disk/Computer Games: GO-MOKU on micros/Generating Patterns with a computer/How Computers Communicate, Part 3: The parallel interface/Review of Forth Language/A neat way to describe programs quickly and logically/Speech Synthesis for the TRS-80s, System 80s, Part 1/ Cassette utility for System 80 on Eprom/An easy route to shape tables for the Apple/ Rubik Cube Simulation for the Apple/How to implement "Turtle" graphics on an Apple/ Programs: Get Simulation (Apple), Bug Bug (TRS-80), Cryptography (Microsoft Basic).

Volume 3 No 2, 1982
Checkout: Apple III/Fitting a smooth curve to complex data plots/Speech synthesis for TRS-80s, System 80s, Part 2/ "Bridge" on micros/Relocating assembly language programs/ Binary sort explained/ Programmable rhythm generator project for PET/Large number calculations on micros/Basic interpreters explained/Checkout: ZX81 printer/APC-80 overview and debounce routine/ Storing arrays on tape/Frames of Reference, Part 1: A DP manager's guide to micros/How Computers Communicate, Part 4: The IEEE interface/Overview of microcomputer databases/ Programs: TRS-80 Alien Seabattle.

Volume 3 No 3, 1982
Benchtest: Hewlett Packard HP-125/WP Benchtest: Scripsit 2.0/Checkout: Dick Smith Votrax Type 'N Talk, The Australian Beginning/Videotext overview/Frames of Reference, Part 2: Hardware and Software Suppliers/Profile: Jim Warren of the West Coast Computer Faire/How Computers Communicate, Part 5: The BCD Interface/Installing hi-res on the TRS-80/Bridge playing program reviewed/Programs: Galacti-Cube (3D Maze in fairly "standard" Basic), PET Fantasy, ZX80 Labyrinth, PET Juggle.

Volume 3 No 4, 1982
Benchtests: Osborne 01, Micro Bee/APC-80: Command mode syntax error recovery/How Computers Communicate, Part 6: The RS232 interface/ 80 x 24 display controller project/Preview of the Commodore 64/Atari 400 games reviewed/Profile: Adam Osborne/ANS Basic's features/ Solving the hidden surface problem in 3D graphics/Frames of Reference, Part 3: Micros in mainframe company/Hewlett Packard's networking capability/Programs: TRS-80 Reaction Timing, ZX81 Graphplot, PET Cheese, Superboard Spin-Fighter, TRS-80 Extra.

Volume 3 No 5, 1982
Benchtests: Texas Instruments TI 99/4A, Xerox 820/ Database Benchtest: FMS-80/TRS-80 Model I games reviewed/Frames of Reference, Part 4: Software standards/How Computers Communicate, Part 7: Interrupts in micro systems/ How to use 3D graphics/ Equation solving program/80 x 24 display controller project, Part 2/"Logo" Overview/Printer survey/Casio's calculator printer/Programs: TRS-80 Double Precision Maths and Trig, Apple 3D Maze/Atari Sums for Kids, Apple Air Flight.

Volume 3 No 6, 1982
Benchtests: Sinclair ZX Spectrum, Sirius I/Database Benchtest: dBase II/7th West Coast (microcomputer) Faire/ Checkout: F-10 Daisywheel printer, Arfon Expandaboard/ How Computers Communicate, Part 8: Direct memory access/ Frames of Reference, Part 5: Buying micro hardware in a DP department/Self learning program/80 x 24 display controller project, Part 3 (end)/How to get more on Apple disks/Lisp – an artificial intelligence language/ VIC-20 games reviewed/Implementing CP/M system calls from Microsoft Basic/APC Subset (first on new monthly column for assembler language routines)/Programs: TRS-80 Invader, PET Mini-animate, VIC-20 Trailblazer, ZX81 Book Index, Weebug Monitor (TRS-80), VIC-20 Large Characters.

Volume 3 No 7, 1982
Benchtests: Sharp MZ80B, Monroe OC 8820/Checkout: Sharp PC1500, The Micro-Professor/Apple II games reviewed/APC-80: Various PEEKs and POKEs explained/ Reversing images on computer screens/Frames of Reference, Part 6: Putting your micro to work/How Computers Communicate, Part 9: Character codes/Educational arcade-type game/Programs: ZX81 Hypocycloids, TRS-80 Truth, PET Doc, TRS-80 Screen Dump, PET Boxes, Atari Earth.

Volume 3 No 8, 1982
Benchtest: Sord M23/Checkout: TI-83, Sony SMC-70/NCC Show Report/Sirius Graphics/ Advanced graphics techniques/ UCSD p-System overview, Part 1/IBM PC users talk/Taxonomic classification on an Apple/How Computers Communicate, Part 10: The software of I/O/ Abbreviated execution version of APC-80/RS232 overview, Part 1/Checkout: Apple II Screenwriter/Programs: TRS-80 Quadrangle, PET Mopup, Randomization Tests (ZX81).

Volume 3 No 9, 1982
Benchtest: ICL Personal Computer/Checkout: E40(CP/M data compression utility, Daisywriter printer, HP 11C & 120 calculators/BBC micro graphics capability/Best of APC's cartoons/How to use Benchmarks/Logo program (Microsoft Basic)/Computer generated textures/RS232 overview, Part 2 (end)/UCSD p-System overview, Part 2/Memory-saving utility for Apple/How Computers Communicate, Part 11: Interrupts and buffers/ Programs: System 80 Extended Basic, Apple Trees, ZX81 Alphabetising, PET File Companion, PET German Game.

Volume 3 No 10, 1982
Benchtests: Hewlett Packard HP-86, National Panasonic JB3000/Checkout: Sharp PC-1211/UCSD p-System overview, Part 3 (end)/How to implement 3D graphics on a micro/CP/M-86 vs MS-DOS: Relative merits of these 16-bit operating systems discussed/ Designing your own database/ Monitor for TRS-80/System 80/ File searching method/"Laws of Form" – a novel form of logic/ How Computers Communicate, Part 12 (end)/Benchmarking high level languages/Programs: TRS-80 Cardshuffler, PET Knockout, PET Trains.

Volume 3 No 11, 1982
Benchtests: Hewlett Packard HP75C, Kaypro II, DEC Rainbow/Programs for the HP41C and Casio fx702p/Algebra checking program/More on MS-DOS vs CP/M-86/Predictions in the micro industry/Clock/ calendar card for the Apple II, Part 1/Benchmarks summary/ Programs: Apple II Piano Computer, Moon Module (Apple II, correction in Vol 4 No 1), Walls (Atari, correction in Vol 3 No 12).

Volume 3 No 12, 1982
Benchtests: Epson HX-20/Database Benchtest: Cardbox/Checkout: E.T. Atari game, 80 column cards/Comparison of micro databases/Intelligence test for computers/Apple II clock card, Part 2 (end)/"Ada" language overview/Tiny printing on a Centronics 739/Arithmetic program for the Sharp PC1211/ Programs: TI 99/4A Teepee Textpro, PET Firebird, Atari Colour Selector.

Volume 4 No 1, 1983
Benchtests: Jupiter Ace/NEC/ APC Manhunt competition/ Tokyo Data Show/"Forth" Benchmarks/The perils of micro-addiction/Charles Babbage, the man who almost invented the first computer/ 'Expert Systems' – advice and intelligible explanation of its decisions/Warnier-Orr: Program design technique/Programs: PET Search and Rescue, VIC Connect-4, Atari Character Set Mover.

Volume 4 No. 2, 1983
Benchtests: Sharp PC1251/ Database Benchtest: Hi Data/ Micros as best friends/A major boost to the standards of 'user friendliness'/Computing can be a health hazard/'Expert Systems'–part two: appraisal of 'intelligent' computers/Networks: Part 1/The Logo Turtle checked-out/Getting the most from the BBC's graphics/Are home computers just a passing fad?/The Prestige vs The human: micro chess/Programs: Apple Character Plotter, System Tape Copier (TRS-80/System 80).

Volume 4 No. 3, 1983
Benchtest: Corvus Concept, IBM 9000/Checkout: IBM PC vs Columbia MPC, IBM PC vs Hitachi Success/Visi-On and Apple's Lisa compared/Visi-On: Visicorp's new general purpose program/CP/M '83: The first software product exhibition/ Transforming unused RAM into pseudo disk drives/Pascal Benchmarks/Eprom/RAM board for the TRS-80/System 80/Direct graphics entry for the TRS-80/ System 80/Networks: Part 2/ The Consumer Electronics Show review in Las Vegas/Portable Computer World: Hexadecimal madness/Programs: Atari Animation.

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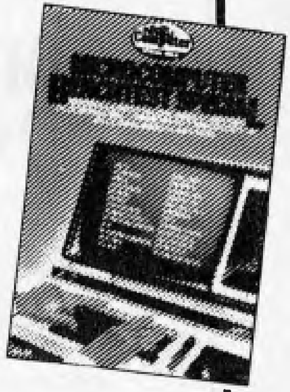

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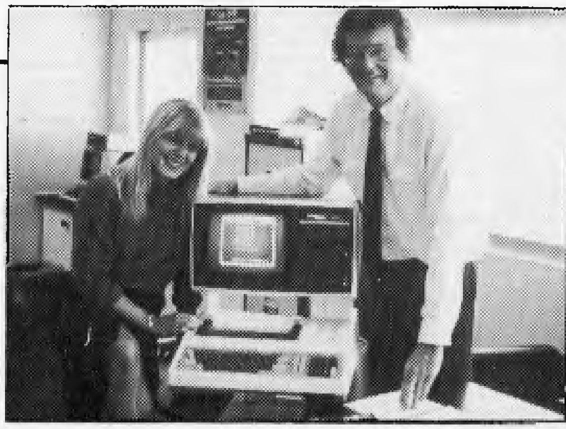

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FILING THE FILLINGS

Michael H Rich describes how micros can help improve dental health.

Using any kind of computer in a dental practice neatly divides itself into two compartments: use in the office, which is comparable to using a micro in any small business, and use for clinical records. This latter use involves a far wider concept than 'ordinary' business use as the software is highly specialised and, as will be described below, needs the use of combined graphics and text on the screen to be fully effective.

Before the advent of the microcomputer there was very little hard/software available for the dentist to be able to introduce computerisation into a dental practice.

What there was was in the nature of a large 'mini', complete with the necessity for an air-conditioned 'cubicle' for the CPU which used fixed/removable hard disk cartridges. This, of course, allowed a multi-user facility but in the context of a small dental practice was far too expensive to be cost-effective.

Minicomputers are still available for dental practices; they are smaller in size as well as being slightly cheaper in price, and the suites of software with these systems do a reasonable job of helping the dentist to run his practice. The argument about being cost-effective still applies and thus they are for the larger practice only.

The micros of the Apple/PET/Tandy variety (and this list is by no means exhaustive) have, of course, opened up the world of computerisation for the small business, and it should be realised that a dental practice is precisely that. Many of the available software packages for running such a business can be applied to a dental practice. The management of accounts can be dealt with in a standard manner, as can stock control; although a practice employing half a dozen people hardly needs payroll software!

What distinguishes the dental practice from a small business is the clinical aspect of treating patients and the paperwork that this generates. When examining patients a dentist records the clinical information derived from the teeth in a form consisting of various shapes to designate types of cavity, fillings present, teeth to be extracted, dentures present and a variety of other conditions. This pictorial representation of a mouth is easy to scan and assess and is an internationally standard method. To record this information in written form, although suitable for a standard database software package using routine file handling procedures, would be very long-winded and would mean abandoning the standard procedures used.

There is software available for use on micros which does do this graphic charting of the clinical conditions in a mouth and this is allied with space to write clinical notes of treatment to be done, or which has been done. This is often conjoined with a suite of programs which will price the work done, whether under the NHS or privately, and will produce bills for patients and carry out the usual reconciliation with payments, aged debt analysis and so on. The software will often include a facility for routine recall of patients at a standard time interval and this raises the other major aspect of the application of computerisation of a dental practice — the appointment book.

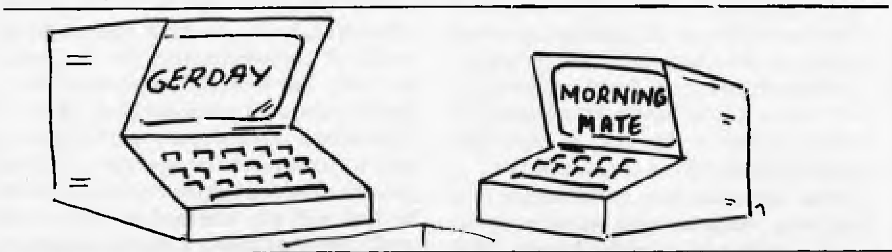
It is necessary to realise that anything other than the appointment book in a dental practice is capable of being replaced or renewed in the event of a complete disaster, eg, a fire. To take an extreme example, if the premises are totally destroyed one can set up a tent with a telephone line outside the front door and with a list of patients due one can reconstruct records and re-schedule appointments until the premises are fully functional again. Without this book a dentist might as well go home. Consequently a dentist has to consider very carefully whether to commit this vital aspect of his/her practice to an electronic form which may be subject to the vagaries of an irregular power supply, corruption of storage media and the sundry other faults which can occur. To back up one's records every time a fresh appointment is made or one deleted from the 'book' would be counter-productive in terms of time even though it is essential if the possibility of either missing a vacant time slot or double-booking is to be avoided. An actual appointment book can be kept in a fire-proof safe for peace of mind.

In addition to this, the software available at present for this function will only display, at best, one day per VDU screen (some only half a day) per dentist. A good receptionist can keep a visual image in mind of the black spaces in an actual book and can turn a page to 'bring up' a whole week at a time much quicker than any software can on a screen.

To go back to the function of computerisation of clinical records, one has to realise that for this to be fully effective there has to be a terminal and screen in each surgery with central mass storage as well as a terminal, etc, at the front desk. This again raises the question of cost: even using micros for only two surgeries and reception on this basis with, say, 10Mb storage will put the cost towards the five-figure mark, which becomes very expensive in the context of a small dental practice. The actual storage figures for dental records with chartings for each patient may be in the range of 500-700 bytes per patient per course of treatment and this multiplied by approximately 3000 patients per dentist gives some idea of the basic storage needed to keep clinical records. Details of treatment have to be kept for at least two years after completing a course of treatment and this, allied with all the other office functions needed, suggests that the 10Mb mentioned above could be a conservative estimate for a practice containing three or more dentists.

The only other main office function for which a computer is often used and not yet mentioned in connection with a dental practice is the use of word processing. This is not generally a great necessity in a dental practice. Recalling patients every six months is often a feature of a dental software package and would incorporate a print-out (hard copy) format.

In summation, one can state that the small system with a couple of disk drives, screen and printer (not necessarily of letter quality) with a good database software package at about $5000 is a viable proposition for even the single-handed practitioner. The limitation of use to office procedures only is still worthwhile, even solely on the basis of eliminating lots of pieces of paper. Clinical records require considerable mass storage, sophisticated software and even provision in the actual surgeries to accommodate the extra terminals needed. END



NUMBERS COUNT

POWERFUL NUMBERS AND A PROBLEM OF STEINHAUS

Mike Mudge poses another problem for mathematical wizards.

The positive integers consist of 1,2,3,4,5···; these are each ordered sequences of the ten digits 0,1,2,···9. When n denotes a positive integer the product of n-factors each equal to x and called the n-th power of x is written x^n. Thus the fifth power of three is written $3^5 = 3x3x3x3x3 = 243$.

Given two positive integers n and k, a third positive integer, denoted by $p_n(k)$, may be defined as the sum of the n-th powers of the digits of k — eg, $p_3(271) = 2^3+7^3+1^3 = 352$.

A positive integer, k, which is equal to the sum of the n-th powers of its own digits is called a Powerful Number (PN) of degree n. It is defined by $p_n(k) = k$. Note: 1 is a trivial PN for all k since $1^k = 1$. For example, if n = 3 the PNs are given by

$153 = 1^3+5^3+3^3 = 1+125+27$
$370 = 3^3+7^3+0^3 = 27+343+0$
$371 = 3^3+7^3+1^3 = 27+343+1$
$407 = 4^3+0^3+7^3 = 64+0+343$

while if n = 10 there is known to be only one PN.

$467\ 930\ 7774 = 4^{10}+6^{10}+7^{10}+9^{10}+3^{10}+0^{10}+7^{10}+7^{10}+7^{10}+4^{10}$

The name 'Powerful Number' is due to J Randle, *The Mathematical Gazette,* Vol III No 382 December 1968, while the number of non-trivial PNs corresponding to each n <= 10 is reprinted here from M R Mudge, *Computer Bulletin,* II/33, September 1982.

n	3	4	5	6	7	8	9	10
Number of PNs	4	3	6	1	5	3	4	1

The Steinhaus Problem

Professor Hugo Steinhaus of Wroclaw, Poland has denied being the originator of the following problem, although it carries his name throughout the literature.

What pattern of digits is determined by repeating the operation of summation of the n-th powers of the digits from an arbitrary initial value k?

Special case n =2 (A Porges). A set of eight numbers, *American Mathematical Monthly* 52, 1945. From an arbitrary initial value k one either reaches the trivial PN 1 or enters the loop of length 8 given by 4 16 37 58 89 145 42 20.

Special Case n = 8 (I Takada). 'Computation of Cyclic Parts of Steinhaus Problem for Power 8', Mathematical Seminar Notes of Kobe University 7, 1979.

From an arbitrary initial value k one either reaches the trivial PN 1, one of the non-trivial PNs 24678050, 24678051 or 88593477, or enters the loop of length 3 given by 54642372 7973187 77124902 or a unique loop of length 25 or a unique loop length 154.

It should be noted that the total CPU time for analysis of this problem is quoted by I Takada as 216.6 seconds on the NEC ACOS-6 Fortran system at Kobe University.

Problem

Submit a program which investigates the pattern of digits determined by repeating the operation of summing the 8th powers of the digits from the initial values of 2 and 3 —these leading eventually to the Takada loops of length 25 and 125 respectively. Extend the knowledge of the Steinhaus Problem by commencing an investigation of the 9th powers in particular generating the four PNs referred to in the above table: each has nine digits.

All submissions should include program listings, hardware descriptions, run times and output; they will be judged for accuracy, originality and efficiency (not necessarily in that order). A prize of $20 will be awarded to the 'best' entry received within two months of the appearance of this article.

Entries to arrive by May 1, to: M. R. Mudge, *APC,* P.O. Box 280, Hawthorn, Victoria.

Submissions will only be returned if suitable stamped addressed envelopes are included.

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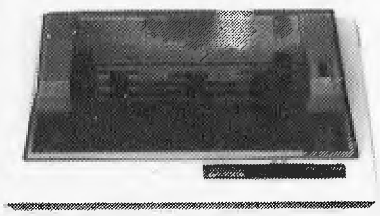

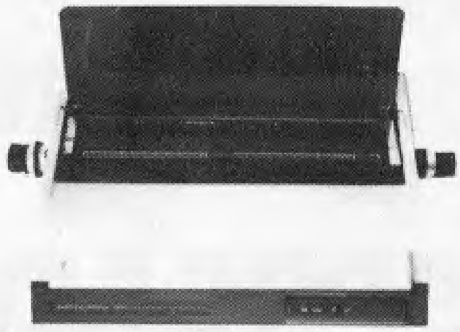

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Characters – 116 upper/lower case characters, numerals and symbols
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Character codes – 8-bit ASCII
Cheracter size – Height: 7 dots (2.82mm), Width: 5 dots (2.11mm)
Print speed – 50 character/sec lleft to right, unidirectional)
Mex. number of columns – 80 columns
Character spacing – 10 characters/inch
Linefeed spacing – 6 lines/inch – Cheracter mode, 9 lines/inch – Graphic mode
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Character set – 128 ASCII, 88 printable
Character spacing (Pitch) – 10 CPI or 12 CPI
Printing – Unidirectional
Paper width – 13" (33cm) maximum
Writing line – 10.5" (26.7cm) – 105 character lina in 10 pitch, 126 character line in 12 pitch
Line spacing – 6, 4.5, 3.0 lines per inch
Paper feed – Friction
Paper thickness – maximum .022" peper thickness
Impression control – Operator selectable 5 levels
Interface
Parallel – 7 bit parallel deta, 3 control line (data strobe, busy, acknowledge)
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WHICH SPREADSHEET?

Michael Liardet tells you what to look for in a spreadsheet system and introduces a new series on the subject.

Over the next few months, we'll be putting a different spreadsheet system on the testbench and give you a complete rundown on it. First in line for the treatment will be Multiplan (Microsoft's entry to the spreadsheet fray), but more on this next month. First, let's explain some basic concepts and outline the hows, whys, whats and wherefores of what we are going to be doing.

What is a spreadsheet system?

Some of our readers may already be using a spreadsheet system, or at least be familiar with the term. But as the word is such a recent addition to the language we had better define what we are talking about.

The word 'spreadsheet' is used to describe a range of software packages that greatly facilitate pencil/paper/calculator calculations. The underlying principle of these systems is that the VDU screen operates as a highly mobile 'window' (refer to Figure 1) on a very large (say three metres square) 'sheet' which is divided into a grid of small rectangles (known as 'cells') containing numbers, text or formulae. Each cell can be uniquely identified by a fairly obvious coordinate scheme (eg, A1 is the top left cell, Z99 the bottom right) and these identifiers are used in the formulae. For example, if it is required that cell C3 display a value double the sum of cells A1 and A2, then the formla 2*(A1+A2) is required at C3. Note that if a cell contains a formula, the formula is not (normally) displayed, but the result of the calculation is shown instead. Thus the overall display appears as a neatly tabulated array of numbers interleaved with text where required.

In most speadsheet systems one particular cell in the display is uniquely identified by flashing or highlighting, etc. This signifies the current 'cursor' position — ie, the cell at which new values or formulae can be entered. This cursor can be moved very rapidly from cell to cell, using single keystrokes — in most cases the 'arrow' keys, available on most VDUs, are used for this. Attempts to move the cursor outside the bounds of the VDU cause no problems — the display shifts to accommodate the new position. Imagine a tortoise in a box with no bottom, only a lot faster! (Incidentally 'cursor' comes from the Latin — meaning 'runner'. Perhaps I should have mentioned a hare instead, but that's another story!)

It should be remembered that neither the window nor the sheet 'really' exist — they are just simulated by the spreadsheet system controlling the VDU display — but after a few minutes working with such a system the concept is easily grasped. Anyway, with a few keystrokes the user of a spreadsheet system can position the cursor where required, make an alteration to a particular cell and then witness the effects of this change permeating through to each cell using this cell in a formula, and on to any cells that reference them in turn, and so on until the sheet is brought completely up to date.

'Is that all?' I hear you say. Well, like many brilliant and innovative ideas, spreadsheets fall into the 'so simple I could have thought of it myself' category! In fact nobody did think of it until about three years ago, when two students at Harvard Business School, Dan Bricklin and Robert Frankson, unleashed a software package called Visicalc. A hundred thousand-plus sales and a score of Visicalc imitators later and spreadsheet systems look like supplanting pencil and paper calculations in the same way that word-processing systems are taking over from the typewriter.

Who needs one?

Anybody with a problem of the 'What-if?' variety reaps enormous benefits from using a spreadsheet system. Once the basic structure of the problem has been set up (an exercise limited only by your own typing speed and your ability to formulate the calculation rules, etc), it is possible to experiment freely with different data values or modified calculation rules and instantaneously (well almost — see Benchmarks!) have the ramifications of the changes filter right through from the top to the bottom.

Perhaps the most common application area for spreadsheets is in budgeting, either personal or company budgets: if you have ever tried to draw up a budget manually you will know the massive recalculations needed to adjust it for just one small modification near the top line — just about every following line, subtotal and total seems to need recalculating!

However, use of spreadsheets is not just confined to this — for example one of the Visicalc sales leaflets lists a hundred others ranging through business, personal, scientific, financial and technical applications. All levels of decision-making right through from strategic planning in multi-nationals down (up?) to personal beer budgets can be catered for. Next time you have your pocket calculator out for more than 10 minutes ask yourself if you might be in need of a spreadsheet system. (By the way is anybody out there still using a slide-rule or even — gasp! — log tables?)

Choosing a spreadsheet

Once you have decided that you need a system, how do you go about choosing one? Well in the first instance, you should follow the same basic guidelines that would apply to the purchase of any software package:

1) Find a system that ties in comfortably with hardware and software you already (or will) have.

2) Consider your possible future needs as well.

3) Obtain an understanding of what is available in general.

4) Look for a system which satisfies the exceptions and peculiarities of your own application in particular.

5) Look for reliability, robustness and support if things go wrong.

6) Look for well-presented and clearly written manuals.

7) Look for well-presented and 'user-friendly' software.

8) Give price as low a priority as you can afford. If you can find two systems that exactly fit the bill on 1-7, then buy

the cheaper one!

9) Last, but by no means least, follow this series avidly!

Selecting the hardware

If you have not yet purchased a computer you may wish to consider the general hardware requirements to run a spreadsheet system satisfactorily. You will of course need to balance these requirements against your other needs, etc.

A high-speed VDU is a must. Since with spreadsheet systems the entire display is frequently changed by a single keystroke, the VDU must be able to respond in about the time it takes to make a key-stroke. Most modern VDUs and micros with an integral screen (like Osborne, Apple, Superbrain, Sirius, Tandy, etc) fall into this category anyway. VDU speed is measured in 'Baud', and 9600 Baud generally gives satisfactory results.

You may also look for a numeric keypad to speed data entry and a graphics display too. Make sure the spreadsheet system can in fact do graphics with the display of your choice.

Disk capacity is usually unimportant (only with respect to spreadsheets, though!), since even a 100k (ie, about the lowest capacity on the market) disk drive can be used to store several different spreadsheets.

Spreadsheet systems have a tendency to consume all the internal (RAM) memory, typically long before the 'three metres square page' mentioned above is anywhere near filled in. Until about 12 months ago, most micros had an upper limit of 64k of RAM but a new generation of micros and extension facilities for the old can provide some help if you anticipate setting up a largte application.

Spreadsheet systems certainly work very satisfactorily on a single-user desktop system, where the central processor is solely dedicated to maintaining the VDU display and performing calculations. If you intend making extensive usage of a spreadsheet system with a multi-user micro then, for the same processor, it would be reasonable to expect some degradation in responsiveness.

It is highly desirable to have a printer that can print as many characters across a line as possible, obviating the need to run off reports in sections and paste them together later. Most of the cheaper dot-matrix printers can handle at least 80 characters across, many providing 132 if switched into a smaller character font or condensed mode. Slightly more expensive printers can handle 13in wide stationery, permitting around 200 characters across a line if condensed mode is available as well.

Speed and print quality are likely to be less important for spreadsheet calculations, as most reports are fairly short anyway, and usually are just used for internal consumption. Most matrix printers are quite satisfactory in this respect but there is generally no special difficulty with using other types of printer if necessary.

Finally, if you have already been considering having graphics, then you will naturally need to select an appropriate printer or even separate plotter to cope with this.

Spreadsheet Benchtests

Having read this far, you are probably asking yourself how you are ever going to be able to assimilate enough information to make a sensible purchase decision. Obviously, most suppliers will provide information leaflets on request or a dealer may be prepared to give a short demonstration, but in neither case will you be getting wholly impartial advice, nor will you get a chance to really see if a system is exactly what you want. Enter the Spreadsheet Benchtests!

In future issues, we shall take a look at different spreadsheet systems, indicating for which hardware or operating systems they are available, then giving a complete rundown on what they are like to work with, facilities provided and facilities not provided and finally giving the results of some Benchmark tests. Here's the checklist to be used in the forthcoming reviews.

DOCUMENTATION: No software package is complete without adequate documentation. Ideally, documentation should include both tutorial material for the out-and-out beginner and well-indexed reference material for the experienced user to get the most out of the system. Illustrations and diagrams are always of great value to all levels of user and a simple reference card can also save a great deal of page-thumbing for the expert in a hurry!

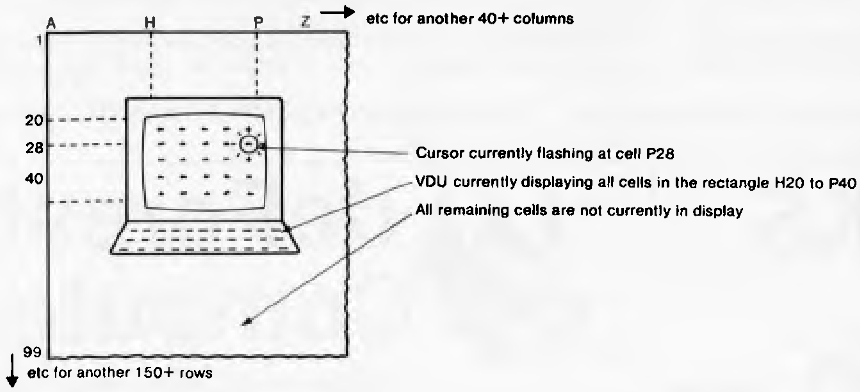

Fig 1 Demonstration of the 'window' principle in spreadsheet systems.

USER-FRIENDLINESS: It's very important that the user be able to assemble quickly, in his own mind, a 'model' of what the system can do for him, knowing what the possibilities and options are at any given moment. To achieve this, the system must at the very least outline clearly the commands available to him, warn him what is about to happen, enable him to reverse a decision if he wishes and generally behave in a consistent fashion throughout (eg, if the escape key has a special function at one point it is confusing in the extreme if it has a different function elsewhere).

ERROR HANDLING: Really this is a special aspect of user-friendliness but because it is so important we have it in a separate category. Basically, the spreadsheet systems must be able to deal correctly with erroneous keyboard input (eg, entering text instead of numbers), disk errors (eg, loading files that are not there) and printer errors (such as the facility to stop printout if there is a paper jam). In all cases, the user should be warned of the mistake and then allowed to correct it and try again as if nothing has happened. The ultimate disaster is to make a minor slip-up and be faced with a 'dead keyboard' or a garbled display and be forced to restart the system from scratch!

FACILITIES: Having defined the essence of spreadsheet systems earlier, it's obvious that a lot of other facilities need to be available to make a complete up-and-running software package. The newcomer to spreadsheets may not immediately appreciate the value of some of the extra facilities provided by some packages, so we shall suggest likely usages for them.

Arithmetic: All spreadsheets should be able to handle simple addition, subtraction, multiplication and division between cells. The better systems allow arbitrarily complex expressions to be used in a sort of 'keyboard' version of the usual mathematical notation taught at school. In addition to simple arithmetic many systems provide trigonometry, logarithms, row or column sum, minimum or maximum values and so on.

Configuration: It is important for systems which are available on a range of equipment to have a good configuration option, so that you can get the best out of them on the equipment that you, in particular, have. Configuration may relate to specifying the amount of internal memory in your computer, special features available on your VDU, or facilities provided by your printer.

Graphics: Some systems enable the results of a calculation to be plotted out as a graph, bar-graph or pie-chart. In some instances the software to achieve this may be an optional extra, or even a separate package. If you are considering the use of graphics then make sure your hardware selection matches exactly with the specified requirements for the software. Most graphics software works on only a limited range of hardware.

Interface to other software: Frequently the basic input data for the

WHICH SPREADSHEET?

spreadsheet system has already been produced by some other software on your computer (eg, current selling prices, stock-levels, sales-figures, etc). Ideally the data should not need to be re-entered direct at the keyboard, but should instead be transferred from file directly. Likewise, the results of the spreadsheet system should, if need be, be directed into other data files such as word-processing document files, etc.

Spreadsheet overlays: In general, it is very useful to be able to overlay data from one spreadsheet file onto a prepared spreadsheet in main memory, without it being completely cleared. (Of course some bits of it will be overwritten.) This enables different spreadsheet applications to inter-communicate.

Turnkey system: Systems which are completely self-sufficient and operate automatically from switch-on are the easiest to learn. All too often certain activities, particularly disk copying or initialising blank disks in preparation for use, are not provided as part of the spreadsheet system and you are forced to 'refer to your computer manufacturer's instructions' as they say in the manuals. Systems written for computers using the CP/M operating system seem to be particularly bad in this respect.

Insertions and deletions: It is quite common to have spent some considerable time setting up an application only to realise that a line has been missed out somewhere near the top, or else a row has been misplaced. Without proper row or column deletion and insertion facilities, this sort of correction can only be made by extensive retyping. It should be noted that insertion and deletion should also automatically adjust all relevant formulae.

Replication: Commonly, spreadsheet applications are built up by experimenting with just one column (the month-1 column if you are budgeting). Once this has been set up satisfactorily, it would be very tedious to retype virtually the same formulae, but shifted one column along, for all the other columns. Systems with proper replication facilities in effect do the retyping for you, adjusting all the formulae to account for the column shift as well, if you wish.

Display flexibility: Most systems allow the displayed column widths to be altered so that if you are working with small numbers you can accommodate many more columns across the screen. Some systems permit different columns to be displayed at different widths, and also various display formats for numbers — scientific notation, varying numbers of decimal places, negatives in parentheses, etc.

Another valuable display facility is the ability to have a split screen — your VDU simultaneously displaying completely separate parts of the model — thus enabling you to keep the 'grand totals' at the bottom line continually in view while you are making changes somewhere near the top.

Protected Cells: Some systems permit specified cells to be protected. This prevents them from being changed, either by accident or design. This facility is particularly useful if an application set up by an expert is to be used by inexperienced users, or even as protection from your own stupidity! Remember, though, that whatever disasters you may perpetrate at the keyboard, you will not lose a great deal if you have saved a copy of the original onto disk.

Formula printout: It is very useful to keep a hard-copy record of how the application was set up — for instance to be able to check the validity of the formulae used or as the basis for documentation on the application.

Formula editing: The adventurous user may find himself creating fairly long and complicated formulae — say 50-plus characters long. It is very irritating to have to retype from scratch to correct for a missing bracket or whatever. Many systems permit a fairly primitive but effective means for editing-in the correction without retyping the whole lot again.

Automatic/Manual recalculation: After a value has been changed, most spreadsheet systems automatically do a recalculation and amend the display 'instantly'. This is very impressive when the application is fairly small and it does really happen instantly. But as the application grows larger and it starts to take longer to recalculate for each change, it is preferable to switch this facility off, and do the recalculation only when several changes have been made.

Out of memory: It is relatively easy to generate an application which exceeds the capacity of the computer's memory. To mitigate this problem, spreadsheet systems should always keep the user informed of the remaining memory available, and should also most certainly not go haywire if this is exceeded.

Long Jumps: When moving about the spreadsheet in a fairly local region (say in a ten by ten square of cells) it is quite convenient to use the normal cursor/window move commands. Moving across longer distances, it is quicker to make use of a special 'jump' command and simply enter the cell coordinates to be jumped to.

Searching and logic facilities: Some spreadsheet systems have a 'lookup' facility for searching for a particular value and others provide logic and comparison ('and's, 'or's, 'less than's, etc) operators. If you get as far as using these, then you can call yourself a programmer.

BENCHMARK TEST AND OTHER MEASUREMENTS: Having devoured all the previous information you may still be concerned as to whether the application you have in mind will fit in, or the calculations be accurate or fast enough. With the tests and measurements here we will try and provide answers to these questions, but please be careful when comparing different times — it will not be possible to run all spreadsheet systems on the same hardware, so unavoidably we will be simultaneously Benchmarking hardware and software together.

We shall be giving details of the spreadsheet size (maximum number of rows, maximum number of columns) and numeric precision in calculations, as well as other measurements such as maximum column widths, etc.

It should be emphasised that most spreadsheet systems permit an excessive number of rows and columns, but run out of storage space long before they have all been used. The more important figure is the total area that can be filled (see Benchmarks below).

Numeric precision can be very important if you anticipate the need to handle large numbers to a high degree of accuracy — eg, if you wish to work with financial figures up to the million dollar mark, but want calculations to be accurate to the nearest cent, they you will require 8-digit precision for display purposes alone (six digits before, plus two after the decimal point), and a system specified precision of nine digits at least as soon as any calculation is to be performed (at least an extra digit and preferably more to cope with round-off error).

Benchmark 1: The purpose of this test is (a) to ascertain the true capacity of a spreadsheet system and (b) to time its performance — recalculation times, etc, when it is running at full capacity. It is designed to simulate a typical 12-month financial calculation, involving 12 columns plus a 13th column as the sum of the other 12.

When the test is running, the spreadsheet displays the numbers 1 to 12 in the first row with a column sum (78) at the end, followed by 13 to 24 in the second, then its column sum, followed by 25 to 36 in the third row, and so on up to as many rows as the system can fit in before running out of memory.

This display is not generated in the simplest way possible, but by a formula which uses each of the four basic arithmetic operators just once. Assuming the spreadsheet uses letters of the alphabet to identify columns, and numbers for rows:

Cell A1 contains the number 1.
Cell B1 contains (12*(A1-1)/12)+2 (which evaluates to 2).
Cell C1 contains (12*(B1-1)/12)+2 (which evaluates to 3), etc, up to cell L1.
Cell M1 contains A1+. . .+L1 or SUM(A1 to L1) if it exists (that completes row 1).
Cell A2 contains (12*(A1-1)/12)+13 (which evaluates to 13).
Cell B2 contains (12*(B1-1)/12)+13 (which evaluates to 14), etc, up to cell L2.
Cell M2 contains A2+. . .+L2 or SUM(A2 to L2) if it exists (that completes row 2).

The remaining rows are specified in the same manner as row 2, each row per-

WHICH SPREADSHEET?

forming its calculations on the back of the previous row. The measurements for this Benchmark will be:

a) Maximum number of rows accommodated.

b) Recalculation time after changing A1 from 1 to 2 (tests integer, ie, whole number, calculation speed).

c) Recalculation time after changing A1 from 1 to 1.5 (tests floating point — ie, decimal or fractional number — calculation speed).

d) Vertical and horizontal window scrolling speed (by timing cursor move from A1 cell to bottom left, then from bottom left to bottom right).

Benchmark 2: This tests the capacity of the system with respect to textual information only. Most users of spreadsheets will set up only a few cells with text — for row and column headings, comments, etc.

Basically the test involves setting up the first row of the spreadsheet with 13 cells each containing the same eight character text 'ABCDEFGH', then repeating this row for as many other rows as possible. We shall simply measure the maximum number of rows accommodated by the system.

Benchmark 3: Just as Benchmarks 1 and 2 test the formula, and text capacity for the system, this will test the numeric capacity of the system. We shall record the maximum number of 13 column rows, with each cell containing the number '123456.78'.

LAZING AROUND

Quickie

No answers, no prizes.

A saucer is floating in a bath tub. Which raises the water level more — dropping a one cent piece into the saucer or into the bathtub?

Prize Puzzle

If a 2-digit number is reversed and added to itself, and the process repeated, eventually a palindromic number will result (ie, one which reads the same forward as backward).

Thus, consider the number 19.

When reversed, gives 91.

19 + 91 = 110

110 + 011 = 121, which is palindromic after only two operations.

Which 2-digit number requires the most number of operations before a palindromic sum is reached — and how many are required? (Clearly there are two answers — since one will be the reverse of the other. We'll accept either.)

January Prize Puzzle

A fairly easy puzzle in January — well over 100 responses received.

The problem can easily be solved by both analytical and micro methods. Many readers sent in the necessary programs. The answer is that there were 288 runners in the race and his number was 204. (Hardly the Big M Marathon!)

The winning entry chosen from the pile came from Mr R Maneschi of Cremorne Point, Sydney. Congratulations are in order, and of course a small matter of a prize, which will be on its way pronto.

DIARY DATA

DIRECT ACCESS

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printer's errors, etc. Organisers are requested to notify APC of forthcoming events well in advance to allow time for inclusion in 'Diary Data'.

Perth	The Perth Computer Show Contact: White Star Promotions (09) 443 1381	May 12–15, 1983
Sydney	Data '83 Contact: Graphic Directions, 28 Foreaux Street, Surrey Hills 2010. Tel: (02) 212 4199	May 17–19, 1983
Adelaide	IREE Conference: Creating Intergrated Systems, An Australian Silicon Workshop. Contact: Conference Secretary, Box 56, North Adelaide 5006	May 23–25, 1983
Melbourne	CETIA & DATCOM '83 Contact: (02) 467 1949	May 31–June 3, 1983
Melbourne	Business Efficiency Fair '83 Contact: Exhibitions and Trade Fairs, 44 Cardigan Place, Albert Park 3206. Tel: (03) 699 9100	August 9–12, 1983
Brisbane	Computer Expo '83. Contact: Robert Woodland Exhibitions (07) 372 3380	November 4–6, 1983

NETWORK NEWS

Here is a list of all Australian personal computer networks. As more networks appear — and as more facilities are added to existing ones — we'll report them in this section, which appears monthly.

MICOM CBBS. Operator: The Microcomputer Club of Melbourne, P.O. Box 60, Canterbury 3126. Facilities: Computer bulletin board system, allows users to exchange messages on subjects of mutual interest. Free of charge. Hours: 24 hours/day, 7 days/week (single 'phone line only). Access number: 762 5088. Protocol: full duplex ASCII, 8 data bits, 1 stop.bit, no parity.

The Australian Beginning. Operator: The Australian Beginning Pty Ltd. 364 LaTrobe Street, Melbourne. Tel: (03) 329 7998. Facilities: Information service, electronic mail, software storage and software downloading. Hours: 24 hours/day, 7 days/week.

INFONET. Operator: Network Services Division of Computer Sciences of Australia Pty Ltd, 460 Pacific Highway, St Leonards, NSW. Tel: (02) 439 0033. Facilities: Access to databases produced by the Australian Bureau of Statistics and the Institute of Economic and Social Research. Hours (E.S.T.): Monday to Friday (7am to 9pm), Saturday (8am to 5pm) and Sunday (8am to 11.30am).

AUSINET. Operator: ACI Computer Services, P.O. Box 42, Clayton, Victoria. Tel: (03) 544 8433. Facilities: Medium to database whose subject coverage includes agriculture, education, energy, industry, public affairs, science and technology and an online Australian database directory. Hours: 8.30am to 9.00pm E.S.T. Monday to Friday.

IP Sharp Associates Network. Operator: IP Sharp Associates Pty Ltd, 13th Floor, 175 Pitt Street, Sydney. Tel: (02) 232 6366. Facilities: The network is an international time sharing data processing network, the host computers being located in Toronto, Canada. Hours: 24 hours/day, 7 days/week.

USER GROUPS INDEX

Below is a list of alterations and additions to the list of user groups published in the January issue. The next full listing will be published in the June issue of APC.

TASMANIA

The Devonport Computer Interest Group will hold its first meeting on April 18 at a time and place to be notified in the local paper. For further information contact John Stevenson, RSD 422, Sheffield 7306, or telephone 004 92 3237.

QUEENSLAND

The Texas Instruments Brisbane User Group has changed its postal address to P.O. Box 396, Nundah 4012. The contact telephone numbers are 263 4989 or 263 6161.

Another change is the Commodore Computer User's Group's (QLD) new postal address: P.O. Box 274, Springwood 4127.

VICTORIA

We've been publishing incorrect details of MICOM. The ammended listing is below:

MICOM (the MicroComputer Club of Melbourne) is a club catering for a wide range of computers and interests. MICOM can be contacted by writing to P.O. Box 60, Canterbury 3126. The Club meets on the third Saturday of each month at the Burwood State College on Burwood Highway from 2 to 5pm.

CPMUG (the CP/M User Group of Melbourne) is a special interest group of MICOM for CP/M users. CPMUG meets at 8pm on the fourth Tuesday of each month at Hawthorn Community House, 39 William St, Hawthorn. Further enquiries may be directed to MICOM.

Peach User Group of Melbourne. A special interest group of MICOM for Hitachi Peach users. The group meets at 8pm on the first Friday of each month at the Templestowe Technical College, Cypress Avenue, Templestowe and also at MICOM meetings. Enquiries, MICOM or Greg Hudson on (03) 429 3216 (decent hours only).

NEW SOUTH WALES

The New South Wales Peach User Club holds weekly meetings on Saturday at 2pm at Cybernetics Research, 120-122 Lawson Street Redfern. The Club offers memberships at $10 for a six month period which entitles members to newsletters, access to the Club software and technical library, and technical advice.

The Sydney based Osborne user group has now been established as the "Ausborne User Group" and publish a monthly newsletter. The Group also has an 80 diskette library available to members containing utilities, games, application programs, system patches etc. For further information contact Ian MacCulloch on AH (02) 81 1908 or write to P.O. Box C530, Clarence Street, Sydney 2000.

The Illawarra Super 80 Users Group will conduct an open day on Sunday, May 29 at the Senior Citizens Hall, cnr of Princes Highway and Collaery Road, Fairymeadow, Wollongong from 10am to 4pm. Enquiries and advice regarding attendance should be phoned to (042) 20 2783 (BH) or (042) 96 8050 (AH).

MICRO EXCHANGE

Our micro "Trading Post", published bi-monthly in Direct Access.

All Micro Exchange ads must be submitted by readers on the appropriate form (or a photocopy). Maximum of 30 words. Print one word per box, very clearly. Contact name and telephone number/s must be included in the 30 words. All ads must be accompanied by a fee of $5.00 for Australian Personal Computer or $7.50 for inclusion in both Australian Personal Computer and Australian Business Computer. Make cheques or Postal Orders payable to Micro Exchange. Ads cannot be repeated (unless sent on another form) and we cannot guarantee to print an ad in any specific issue. Please help the typesetter by printing very clearly. Send your form to: Micro Exchange, P.O. Box 62, Middle Brighton, Vic 3186.

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As all programs in APC are checked either by a referee or by one of the editorial staff, it can take some time for a program to actually appear. If you don't hear from us within two months or so, it usually means your contribution is in the referee pipeline. It's essential to ensure that your program is fully debugged before you send it in – get a friend to try it out first – and all programs we publish are paid for at a regular rate. Send contributions to: APC Programs, P.O. Box 280, Hawthorn, Vic 3122 – and please enclose an SAE if you want material returned.

Program of the Month

PET Billy

by Bob Chappell

Maths teaching programs have been featured within these pages before. But this one is probably the most comprehensive we've ever had. It's for children of early primary school age. Not only does it handle addition/subtraction, but it also deals with multiplication/division.

Sums are printed in large-sized and easily read characters which attract and keep attention easily. Wrong answers are explained and corrected with a 'revision' facility. Billy is, if you like, an arithmetic teacher in a computer.

The graphics are clear and a wide choice of difficulty levels/types of sum combinations are possible. It would certainly come in useful in a classroom where the novelty of having a computer replace the teacher for half an hour or so could well reinforce what is learnt by the pupils.

Billy presents no complications in its use — all necessary explanations are given. It was tested on a 3000 series PET.

```
10 REM**BILLY**BOB CHAPPELL**************14/2/82*****
20 POKE59468,12:A=RND(-TI)
30 DEFFNA(X)=INT(X*RND(1)+1)
40 DEFFNB(DL)=INT((DU-DL+1)*RND(1)+DL)
50 GOSUB930
60 WT=0:GOSUB640
70 AL=LV(LV):DL=DV(LV,0):DU=DV(LV,1)
80 T=0:GOSUB520:FORJ=1TOTQ:PRINT"S"TAB(12);Q$;J"█ "
90 ONSGGOSUB140,200,260,290,320:NEXT
100 GOSUB830:PRINT"T████████YOU SCORED"T"OUT OF"TQ"█."
110 GOSUB520:GOSUB520:GOSUB830:IFT=TQTHENGOSUB580:GOSUB830:GOTO60
120 GOSUB830:PRINTMQ$:GOSUB520:GOSUB830:GOTO1620
130 REM**ADD
140 N3=FNA(AL)
150 N1=FNA(AL):IFN1>N3THENY=N3:N3=N1:N1=Y
160 IFN1=N3THEN150
170 N2=N3-N1:GOSUB330
180 RETURN
190 REM**SUBTRACT
200 N3=FNA(AL)
210 N1=FNA(AL):IFN1<N3THENY=N1:N1=N3:N3=Y
220 IFN1=N3THEN210
230 N2=N1-N3:GOSUB330
240 RETURN
250 REM**MULTIPLY
260 N2=DT(FNB(DL)) N1=FNA(12):N3=N1*N2:GOSUB330
270 RETURN
280 REM**DIVIDE
290 N2=DT(FNB(DL)):N1=FNA(12)*N2:N3=N1/N2:GOSUB330
300 RETURN
310 REM**MIXED
320 SG=FNA(4):ONSGGOSUB140,200,260,290:SG=5:RETURN
330 REM**GRAPHIC NOS
340 N1$=MID$(STR$(N1),2)
350 N2$=MID$(STR$(N2),2)
360 N3$=MID$(STR$(N3),2)
370 GOSUB830:K1=11:LN=LEN(N1$):IFLN=3THENK1=6
380 FORK=1TOLN:N=VAL(MID$(N1$,K,1))
390 PRINTLEFT$(EC$,K1);N$(N);:K1=K1+6
400 IFN=1THENK1=K1-4
410 NEXT:PRINT:PRINTNC$;S$(SG);
420 K1=30:LN=LEN(N2$):IFLN=3THENK1=25
430 FORK=1TOLN:N=VAL(MID$(N2$,K,1))
440 PRINTLEFT$(EC$,K1);N$(N);:K1=K1+6
450 IFN=1THENK1=K1-4
```

```
460 NEXT:PRINT:PRINTS$(5);
470 GOSUB860:PRINTMD$:GOSUB850:IFVAL(B$)=N3THENT=T+1:PRINTRA$:GOTO510
480 PRINTWA$:GOSUB520:PRINTMD$:GOSUB850
490 WT=WT+1:WG(WT,1)=N1:WG(WT,2)=N2:WG(WT,0)=SG
500 PRINT""TAB(10);N1;SS$(SG);N2;"=";N3
510 GOSUB520:RETURN
520 FORK=1TOPP:NEXT:RETURN
530 PRINT""N1;SS$(SG);N2;"=";N3
540 PRINT" PLEASE PRESS THE SPACE BAR ";
550 GETA$:IFA$=""THEN550
560 IFA$<>" "THEN550
570 RETURN
580 PRINT""BP$:GOSUB520
590 FORJ=1TO40:PRINT""TAB(7)"***";TAB(27)"***"
600 PRINT"";NM$;TAB(19)"●";TAB(38-LEN(NM$));NM$:PRINTBP$
610 PRINT""TAB(7)"——";TAB(27)"——"
620 PRINT"";NM$;TAB(19)"";TAB(38-LEN(NM$));NM$
630 PRINT"";BP$:NEXT:RETURN
640 GOSUB1550
650 PRINT"1.  +  ADDITION
660 PRINT"2.  -  SUBTRACTION
670 PRINT"3.  ×  MULTIPLICATION
680 PRINT"4.  "SS$(4)"  DIVIDE
690 PRINT"5.     MIXED
700 PRINT"6.     START AGAIN
710 GOSUB1610
720 SG=VAL(B$):IFSG<1ORSG>6THEN640
730 IFSG=6THENRUN
740 GOSUB1550
750 PRINT"1.  EASY
760 PRINT"2.  HARD
770 PRINT"3.  DIFFICULT
780 PRINT"4.  MIXED
790 GOSUB1610
800 LV=VAL(B$):IFLV<1ORLV>4THEN740
810 PRINT"";:FORK=1TO24:PRINTF$:NEXT:PRINTNC$
820 PRINT"";NM$;TAB(38-LEN(NM$));NM$:GOSUB830:RETURN
830 PRINT"":FORK=1TO9:PRINTE$:NEXT
840 PRINT:FORK=1TO7:PRINTNS$:NEXT:PRINT""S1$:PRINTS2$
850 FORK=1TO3:PRINTM$:NEXT:RETURN
860 PRINT"";:B$=""
870 GETA$:IFA$=""THEN870
880 A=ASC(A$):IF(A=13ORA=20)ANDB$=""THEN870
890 IFA=13THENPRINT:RETURN
900 IFA=20THENB$=LEFT$(B$,LEN(B$)-1):PRINT"  ";:GOTO870
910 IFA<48ORA>57THEN870
920 PRINTA$;:B$=B$+A$:GOTO870
930 PRINT"";TAB(12)" BILLY "
940 PRINT"MY NAME IS BILLY.":PRINT"PLEASE TYPE IN YOUR NAME AND
950 PRINT"PRESS THE RETURN BUTTON.":PRINT"IF YOU MAKE A MISTAKE,
960 PRINT"PRESS THE DELETE BUTTON.
970 PRINT"";TAB(12);:NM$=""
980 GETA$:IFA$=""THEN980
990 A=ASC(A$):IF(A=13ORA=20)ANDNM$=""THEN980
1000 IFA=13THENPRINT:NM$=LEFT$(NM$,14):GOTO1030
1010 IFA=20THENNM$=LEFT$(NM$,LEN(NM$)-1):PRINT"  ";:GOTO980
1020 PRINTA$;:NM$=NM$+A$:GOTO980
1030 GOSUB1550:PRINT"1.  2 SECOND PAUSES
1040 PRINT"2.  5 SECOND PAUSES
1050 PRINT"3.  8 SECOND PAUSES
1060 PRINT"4.  10 SECOND PAUSES
1070 GOSUB1610
1080 PP=VAL(B$):IFPP<1ORPP>4THEN1030
1090 PP=PP*2000
1100 GOSUB1550
1110 PRINT"1.  10 QUESTIONS
1120 PRINT"2.  20 QUESTIONS
1130 PRINT"3.  30 QUESTIONS
1140 PRINT"4.  40 QUESTIONS
1150 GOSUB1610
1160 TQ=VAL(B$):IFTQ<1ORTQ>4THEN1100
1170 TQ=TQ*10
1180 DIMN$(9),S$(5),SS$(4),DT(11),LV(4),DV(4,1),WG(40,2)
1190 FORJ=0TO9:READN$(J):NEXT
1200 N$(0)=N$(0)+"      ":N$(8)=N$(8)+"      "
|"
1220 DATA""
1230 DATA""
1240 DATA""
1250 DATA""
1260 DATA""
1270 DATA""
1280 DATA""

1300 DATA""
1310 FORJ=1TO5:READS$(J):NEXT
1320 DATA"",""
1330 DATA"",""
1340 DATA""
1350 FORJ=1TO11:READDT(J):NEXT
1360 FORJ=1TO4:READLV(J):NEXT
1370 FORJ=1TO4:READDV(J,0),DV(J,1):NEXT
1380 DATA2,5,10,3,4,6,11,7,8,9,12,10,20,100,100,1,3,4,7,8,11,1,11
1390 FORJ=1TO4:READSS$(J):NEXT
1400 DATA+,-,"×",""
1410 FC$=""
1420 NC$=""
1430 F$=""
1440 E$=""
1450 NS$=""
1460 S1$=""
1470 S2$=""
1480 M$=""
1490 MD$=""
1500 RA$="WELL DONE! THAT IS RIGHT.
```

```
1510 WA$="SORRY. THAT IS WRONG."
1520 MQ$="LET'S DO SOME REVISION."
1530 Q$=" QUESTION"
1540 BF$="****** I AM SO PLEASED ******" RETURN
1550 PRINT"";TAB(10)"";:FORJ=1TOLEN(NM$)+2:PRINT" ";:NEXT:PRINT
1560 PRINTTAB(10)" "NM$;" "
1570 PRINTTAB(10)"";:FORJ=1TOLEN(NM$)+2:PRINT" ";:NEXT:PRINT
1580 PRINT"PLEASE PRESS ONE OF THESE NUMBERS THEN
1590 PRINT"PRESS THE RETURN BUTTON.IF YOU MAKE "
1600 PRINT"A MISTAKE,PRESS THE DELETE BUTTON.":RETURN
1610 PRINT"WHICH NUMBER DO YOU WANT? ";:GOSUB860:RETURN
1620 REM**REVISION****
1630 FORJ1=1TOWT:N1=WG(J1,1):N2=WG(J1,2):SG=WG(J1,0):PRINT""
1640 ONWG(J1,0)GOSUB1900,1800,1660,1670:NEXT:GOTO60
1650 REM**DIVIDE & MULTIPLY*****
1660 NL=N1:NC=N2*2+1:N3=N1*N2:GOTO1680
1670 N3=N1/N2:NL=N3:NC=N2*2+1
1680 IFNL>10THENRETURN
1690 FORJ=1TONL:PRINT"";:FORK=1TON2:PRINT" ";:NEXT
1700 IFJ=NLTHENPRINT"";:GOTO1720
1710 PRINT""
1720 NEXT
1730 FORJ=1TONL:PRINT"";:IFJ>1GOTO1750
1740 PRINT"┌";:FORK=1TONC:PRINT"─";:NEXT:PRINT"┐":GOTO1770
1750 PRINT"├";
1760 FORK=1TONC:PRINT"─";:NEXTK:PRINT"┤"
1770 PRINTJ;TAB(4)"│";TAB(NC+5)"│":NEXTJ
1780 PRINT"└";:FORK=1TONC:PRINT"─";:NEXTK:PRINT"┘":GOSUB530:RETURN
1790 REM****SUBTRACT REV***
1800 N3=N1-N2:PRINT"";
1810 K=0:FORJ=1TON1:PRINT" ";:K=K+1:IFK>9THENPRINT:PRINT"";:K=0
1820 NEXT:PRINT:GOSUB530:PRINT"";
1830 K=0:FORJ=1TON2:PRINT"";
1840 K=K+1:IFK>9THENPRINT:PRINT"";:K=0
1850 FORK1=1TO100:NEXT:NEXT
1860 K=0:PRINT"";:FORJ=1TON1:PRINT"";:K=K+1
1870 IFK>9THENPRINT:PRINT"";:K=0
1880 NEXT:PRINT:GOSUB530:RETURN
1890 REM****ADD REV**
1900 N3=N1+N2:PRINT"";
1910 K=0:FORJ=1TON1:PRINT" ";:K=K+1:IFK>9THENPRINT:PRINT"";:K=0
1920 NEXT:FORK1=1TOPP:NEXT
1930 FORJ=1TON2:IFK>9THENPRINT:PRINT"";:K=0
1940 PRINT"";:K=K+1:FORK1=1TO100:NEXT:NEXT
1950 PRINT:GOSUB530:RETURN
READY.
```

ZX81 Molecular Weight

by Mike Whitcombe

Those of you whose occupations are scientific will find this program useful.

It works out molecular weight and atomic percentage for various compounds. It runs on a 16k ZX81 but could be modified to run on a ZX80 with an 8k ROM.

The program is entered from the keyboard and then saved by entering GOTO 630. Loading it back from tape will then run it automatically. Initially only four elements are 'known' by the program, but more can be included up to a maximum of 20. This is done by increasing the sizes of arrays A$ and A. Elements 'learned' are retained by the program as long as CLEAR or RUN are not used. An updated version of the program is saved by entering GOTO 630. After exiting the program it can be run again by typing GOTO 120.

```
5   DIM C$(1,2)
1Ø  DIM A$(2Ø,2)
2Ø  DIM A(2Ø)
3Ø  LET A$(1)="C"
4Ø  LET A$(2)="H"
5Ø  LET A$(3)="N"
6Ø  LET A$(4)="O"
7Ø  LET A(1)=12.Ø11
8Ø  LET A(2)=1.ØØ79
9Ø  LET A(3)=14.ØØ67
1ØØ LET A(4)=15.9994
```

PROGRAMS

```
110 LET A=5
120 CLS
125 PRINT "ENTER NUMBER OF ELEMENTS IN YOUR COMPOUND"
130 INPUT B
140 PRINT B
150 DIM B(B,3)
155 SCROLL
160 FOR C=1 TO B
170 SCROLL
180 PRINT "ENTER ELEMENT SYMBOL"
190 SCROLL
200 INPUT C$(1)
205 IF C$(1)="" THEN GOTO 200
210 PRINT C$(1)
220 SCROLL
230 PRINT "ENTER NUMBER OF ";C$(1);" ATOMS"
240 SCROLL
250 INPUT D
260 PRINT D
270 LET B(C,1)=D
280 FOR E=1 TO A-1
290 IF A$(E,1)<>C$(1,1) THEN GOTO 320
295 IF LEN C$(1)=1 OR A$(E,2)<>C$(1,2) THEN GOTO 320
300 LET B(C,2)=E
310 GOTO 420
320 NEXT E
330 SCROLL
340 PRINT "I DONT KNOW THIS ELEMENT ";C$(1)
350 SCROLL
360 PRINT "PLEASE ENTER ITS AT. WT."
370 INPUT F
380 LET A(A)=F
390 LET A$(A)=C$(1)
400 LET A=A+1
```

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```
410 GOTO 280
420 NEXT C
430 CLS
440 LET TOT=0
450 FOR C=1 TO B
460 LET B(C,3)=B(C,1)*A(B(C,2))
470 LET TOT=TOT+B(C,3)
480 NEXT C
490 SCROLL
495 IF TOT=0 THEN GOTO 580
500 PRINT "M.W.= ";TOT
510 SCROLL
520 PRINT "EL"; TAB 4;"NO","PC"
530 FOR C=1 TO B
540 SCROLL
550 PRINT A$(B(C,2)); TAB 4;B(C,1),100*B(C,3)/TOT
560 NEXT C
570 PAUSE 100
580 SCROLL
590 PRINT "ANOTHER COMPOUND ? Y/N"
600 IF INKEY$="Y" THEN GOTO 120
610 IF INKEY$="N" THEN STOP
620 GOTO 600
630 SAVE "MW"
640 GOTO 120
650 REM MOLECULAR WEIGHT AND ATOMIC PERCENTAGE PROGRAM
660 REM COPYRIGHT M.J. WHITCOMBE 1982
```

Adventure in 1 k

by Ian Stansfield

This is the ultimate transportable program. With an absolute minimum of adaptation (or none at all) it will run on any micro you might care to name (apart from those which don't support Basic, but there's only one of those at present). In fact its transportability is quite sickening.

Furthermore it's a whole adventure in well under 1k of memory. It will provide hours of fun and entertainment for all the family as long as they are either schizoid or possessed of an IQ below 30. It's also very easy to understand and modify. Just key it in and run. . .

Oh, and for the connoisseur, there's also a version written in C, for the sake of a little linguistic variety.

```
10 REM*****1k ADVENTURE*****
20 PRINT"YOU ARE IN A CAVERN..."
30 PRINT"NORTH, SOUTH, EAST OR WEST?"
40 INPUT A$
50 GOTO 20
```

C VERSION

```
main()
{
char c;
START:
printf("You are in a cavern...\n");
printf("North, South, East or West");
c=getchar();
goto start;
}
```

TRS-80 Word Scrambler

by Derek Clarkson

Here's how to find out if your name (or those of your friends) contain any rude or naughty words. It was written for a TRS-80/ System 80 with at least 16k of memory.

It's easy to use — all that has to be done is for the user to enter the word to be scrambled and press 'newline' to prompt the computer to start its dirty work. The scrambled words then appear on the screen. Large words can result in a vast number of permutations and not all of these may fit into memory. In such cases, the machine will carry on outputting random words until its memory is full, when it gives an 'out of memory' error.

The program includes a check to make sure the same permutation is not printed more than once. This is contained in lines 330 to 350. If you have a printer, simply change line 370 to LPRINT instead of PRINT and all output goes to the printer instead of the screen.

```
10 CLS:CLEAR 11000:DIM P$(999):M=1:N=1
20 PRINT"THIS IS A SYSTEM FOR SHOWING
   PERMUTATIONS OF A WORD."
30 PRINT
40 INPUT"YOUR CHOSEN WORD IS..";W$
50 L = LEN(W$)
60 PRINT"YOUR WORD HAS ";L;"
   LETTERS"
70 IF L = 0 THEN 10
80 LA = L: LB = L
90 LA = LA - 1
100 IF LA = 0 THEN 130
110 LB = LB * LA
120 GOTO 90
130 PRINT"AND HAS "; LB ;
    "WAYS OF BEING WRITTEN."
140 DIM W(L),R(L)
150 REM RANDOM ROUTINE
160 FOR J = 1 TO L
170 W(J) = ASC(MID$
    (W$,J,1))
180 NEXT J
190 N=1
200 R=RND(L)
210 FOR J=1 TO N
220 IF R=R(J) THEN 200
230 NEXT J
240 R(N)=R:N=N+1
```

PROGRAMS

```
250 IF L+1>N THEN 200
260 FOR J = 1 TO L
270 X$ = X$+CHR$(W(R(J)))
280 NEXT J
290 FOR J = 1 TO L
300 R(J)=0
310 NEXT J
320 REM MEMORY STORE
    & CHECK
330 FOR J = 1 TO M
340 IF P$(J)=X$
    THEN 390
350 NEXT J
360 P$(M)=X$
370 PRINTM" = ";X$
380 M = M + 1
390 X$=""
400 IF M = LB + 1
    THEN END ELSE 190
```


CHIP CHAT

Wow! Did we have a Show! 22,539 of you filed through the entrance door (which doubled as an exit) in the three days making it the country's most successful micro show ever . . . naturally the queues were very long causing such confusion in the Centrepoint public areas that it was heard over a loud speaker that the long queue was for the computer exhibition and the short queue was for the ride to the top of the tower for a panoramic view of Sydney. Unfortunately one couple didn't hear this and after waiting a *very* long time, reached the cashier, paid their way into the Show and asked an attendant 'Where's the lift?' . . .

What with fights breaking out in the aisles between rival groups of schoolkids all wanting to play PacMan, pensioners piling up in their hundreds on the escalators, (and the end of the upward escalator resembling a freeway exit at peak hour because of Commodore's fabulously popular games arcade), brawls between President Computer's fake fake and IBM's real fake Charlie Chaplins, the Show was similar in conception to the outer circle of Hell. However, penance duly suffered by all, the Editor's nightmare broke all the records and was a booming success (Even Les Bell liked the Show) – for everyone, that is, apart from the claustrophobic among us who finally ended up cringing sweatily in loos, lounges and other people-free recesses, unable, by force of extreme paranoia, to tolerate any more . . .

Our sincere thanks to all of you who braved the queues and the crush to help make the Show a success; we hope to see you all again next year. Our thanks also to Australian Exhibition Services for organising the Show. And to the rest of the computer press, thanks from the Catering Manager (Alcoholic Beverages Div).

Finally, a tit bit from the US which reflects the latest micro dogma that 'name is everything': Mad Computer Inc has launched the MAD 1. Sooner or later you'll be buying your software from Bozo Research, your printers from Psycho Peripherals and your interfaces from Schizo Components. We're going to persuade some lunatic to bench-test the MAD 1 if we can get hold of it.

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