

**your computer**  
MAGAZINE FOR BUSINESS AND PLEASURE

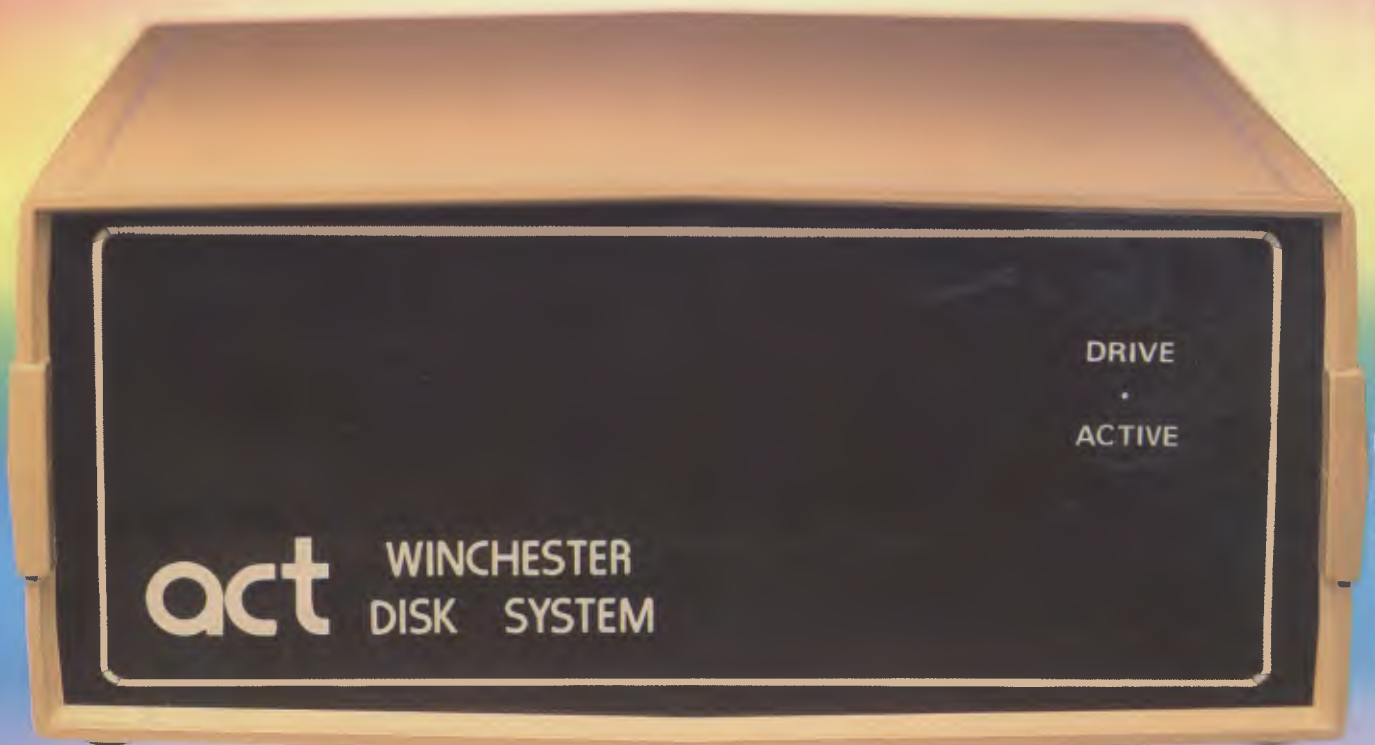
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# INTRO

Five years ago, could you imagine yourself sitting down to read a magazine about computers — computers that you could easily walk into a shop and buy? All but a very few keen enthusiasts would probably say no.

The computer revolution is in full swing. With its arrival has come a whole new world of issues to be decided, facts to be learned, areas to be explained. Nobody under 70 years of age can afford to ignore this new phenomenon.

This magazine was designed to meet the needs of all those people who are interested in learning more about computers, be they rank beginner or experienced hobbyist. Some of the articles in the Yearbook have been reprinted from *Your Computer* magazine, which is published monthly. Many of them have been extensively updated, and new articles have been written to cover some special interest areas.

There are articles on how a computer works, computers and education, word processing, databases, the history of computers and a few pieces of classic *Your Computer*. We hope you enjoy and get some benefit from the information you find, and will continue your enlightenment by keeping up with what's happening in the personal computer world by reading more of *Your Computer*.

**Evan McHugh**  
Editor



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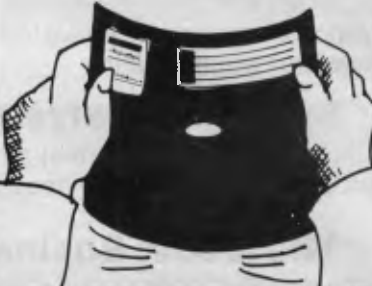


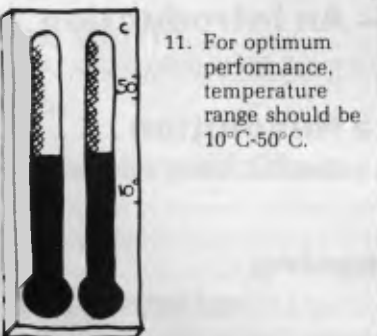

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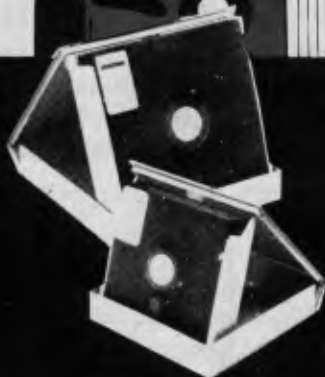
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# Diskette Storage & Handling

 <p>1. Avoid touching Diskette surface — Contamination may cause errors.</p>	 <p>2. Avoid writing on labels attached to Diskette — Always use felt tipped pens if necessary.</p>	 <p>3. Do not bend or twist Diskette.</p>
 <p>4. Never expose Diskette to any form of magnetism — This will result in loss of data.</p>	 <p>5. Do not use paper or spring clips with Diskettes.</p>	 <p>6. Always replace Diskette in envelopes for protection.</p>
 <p>7. Do not use multiple labels — Peel old label off.</p>	 <p>8. Never place heavy, sharp or damp objects on Diskette.</p>	 <p>9. Do not use liquids to clean Diskettes.</p>
 <p>10. Insert Diskette carefully into disc drive — Do not force — consult your computer supplier if necessary.</p>	 <p>11. For optimum performance, temperature range should be 10°C-50°C.</p>	 <p>12. Always avoid excessive heat and/or sunlight.</p>



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# HOW COMPUTER SYSTEMS WORK

*If you're new to computers, start here. What was shrouded in mystery, involved secret and mystical rites practised by weird druids and assorted flunkies, can now be revealed as Personal Computing. Your Computer asked Collyn Rivers to deliver words of wisdom from his lofty abode (Balmain).*

A COMPUTER system consists of hardware and software. Hardware is the name for the mechanical and electronic components and assemblies. The computer itself, printers, disk drives and so on are all examples of hardware.

Software tells the computer what to do and how to do it. For instance, a computer may be used as a word processor if it has word processing software. Games software enables that same computer to become a recreational toy.

Software is generally supplied in the form of programs stored on magnetically coated tapes or disks. These are accessed by the computer when required.

## The Essence Of The Machine

The basic element (virtually the brain) of the computer is a microprocessor chip containing the CPU (Central Processing Unit). This chip is known technically as a large-scale integrated circuit. It contains the equivalent of tens of thousands of individual transistors and diodes, yet is only a few millimetres square.

The CPU does the computations, makes logical decisions, and controls

the computer system overall.

There are several types of microprocessor chips. Among the most common are the 6502 (used by Atari, Apple and Commodore), the Z80 series (Sinclair, Tandy, Cromemco), and the 8088 (Sirius, IBM).

By and large the 6502, Z80 series and the 8088 do much the same things but in their own individual ways. Only dedicated computer buffs and business users need let the type of microprocessor seriously influence which computer they buy.

## Keeping The Knowledge

A computer needs places to stash information. It uses three types of storage to do so (no single technology at present combines all the characteristics re-

quired). In all instances the information is stored as sequences of ones and zeros.

This arithmetic system, using only ones and zeros, is called the **binary** system.

All data is computed and stored using this simple one or zero binary code. In the digital circuits used by computers a 'one' is represented by the presence of a signal, a 'zero' by the absence of a signal ('ones' and 'zeros' may also be represented by two different levels of voltage).

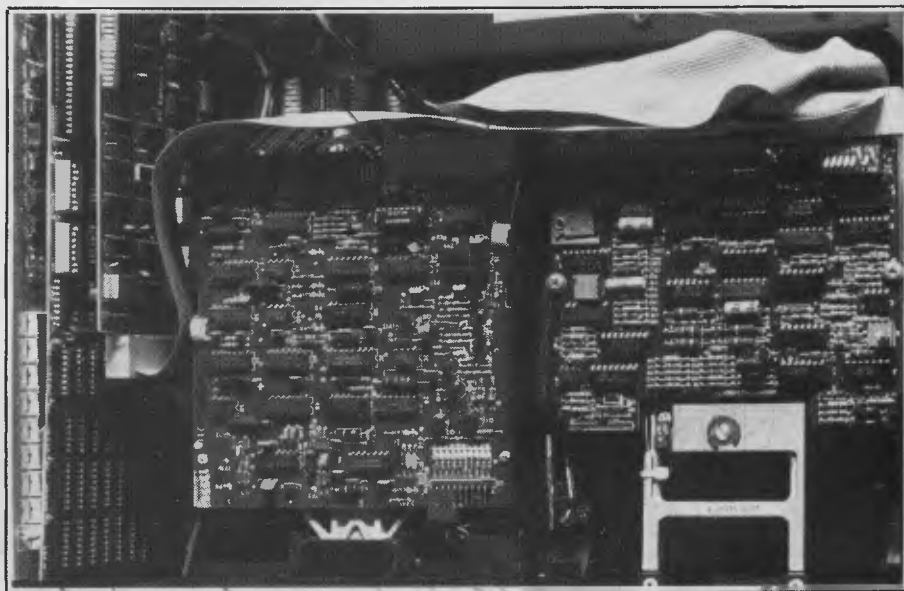
Each signal, whether a one or a zero, is called a **bit**. A **byte** is a sequence of eight bits, and for all practical purposes one digit, character, or one unit of space requires one byte for its representation and/or storage. There is also a half a byte which, no kidding, is a nibble.

The term 'byte' is used frequently in computer parlance and an understanding of its meaning is essential.

The average word has five characters – requiring a byte for each. The space between words also requires one byte. Thus a page containing 1000 words will need 5000 bytes plus a further thousand for the spaces between the words.

Computer storage is expressed in terms of bytes – or more commonly multiples of bytes. One thousand bytes is shown as one kilobyte (often abbreviated to 1K), one million as 1M (from megabyte), and one thousand million as 1G (gigabyte). Thus 156,000 bytes is expressed as '156K'. These abbreviations are not strictly accurate – 1K is actually 1024 bytes (two to the power of 10 in binary numbering).

The scientific among you will recognise the use of 'K' as the temperature measure 'Kelvin'. Since one almost ▶



Horrifying, isn't it? Even the most simple computers are a mass of circuitry.

never speaks of computers and temperature measurements from absolute zero in the same breath, this confusion does not occur in practice.

Until recently, most personal computers had CPUs which controlled eight bits at a time. The latest microprocessors, however, process 16 bits at a time and are inherently faster and more powerful when used with appropriate software.

### Types Of Memory Read Only

The first and smallest form of computer memory is read only memory (ROM). This is a solid-state memory chip which may be considered as software in hardware form! (ROMs are sometimes called 'firmware'). ROMs are pre-programmed and, as their name implies, their data may be read, but not altered, by the computer or user.

A ROM is used, in a personal computer, to initiate and control a few elementary functions immediately after the machine is switched on.

ROM chips are also used to store the elementary programs used in video games and the very simplest home computers.

ROM chips are invariably non-volatile – continuous power is not required for data retention. Today's typical ROM chips hold 1000-4000 bytes of information.

Plug-in ROM chips are available which contain extra programs. The OSI Challenger IIP, for example, uses ROM chips to hold that machine's computer language – BASIC (see below).

### Random Access

The second type of memory is random access memory (RAM). RAM is the 'working memory' or 'working space' of a computer. It is currently the only practical way in which data may be (temporarily) held and rapidly manipulated. Programs and data may be copied into RAM from cassettes or floppy disks, or entered from the computer keyboard, and then worked on as required.

Unlike ROM, RAM is volatile. Data is only retained when power is switched on: all data is lost if power is removed – even momentarily. Hence the random access memory is cleared out every time the machine is switched off – even accidentally! This is not necessarily a desirable attribute – it's just the way RAM currently is.

### Mass Storage

The third type of storage retains programs and data permanently, unless they are accidentally deleted or destroyed. It is usually called mass storage and takes the form of cassette tape, floppy disks, or hard disks.

Mass storage is cheap compared with RAM. It is always non-volatile, but data takes much longer to access – far too slowly to allow this form of storage to be used as a direct medium like RAM.

### Operating System

The operating system is a series of programs which you must have either on disk or in ROM. The operating system looks after the general 'running' of the computer and its peripherals. It maintains files and directories, controls disk drives, the keyboard, printer, and

the display, enables copies of disks to be made, and transfers programs. The operating system's function is often and aptly described as 'looking after the housekeeping'.

There are several different operating systems. The most common is called CP/M (Control Program for Microprocessors). Unix is another. The choice is largely dictated by the microprocessor chip used in the CPU. Note, however, that computer programs are written for use with specific operating systems – although different versions are generally available for all popular systems and programs.

Every time a computer is switched on, a small program permanently stored in the ROM chip starts loading a copy of the operating system, from a system software disk, into the random access memory. This initially loaded part of the operating system contains instructions necessary to continue loading the remainder.

The operation is called **booting** because it's like pulling yourself up by your bootstraps. (Some very basic computers have the complete operating system held in ROM).

Once the operating system is booted – which takes just a few seconds – the computer is ready to do meaningful work.

For this it needs a **language** and/or **application programs**.

### Computer Languages

The only language a computer understands directly is a sequence of ones and zeros. This is known as machine language (or code).

Machine code can be learnt and used, but is tedious in the extreme; a sequence of sixteen digits might be required just to enter one tiny step of an instructional sequence.

Some people use machine code because the computer understands it immediately and directly – no intermediate steps are required and it runs quickly and efficiently.

Assembly language is one step closer to human language. It is a shorthand way of writing machine code often used by computer professionals and buffs because it's a good compromise between time and efficiency.

Most of us who bother to learn a computer language (and it's not really necessary for business use) settle for one of the so-called high-level languages. BASIC, Pascal and COBOL are well-known examples.

High-level languages are really interpreters. They allow humans to use human-like languages to express the required commands and automatically translate the words and phrases used



Examples of the more common software packages available on floppy disks.



into the machine code that the computer understands.

These languages are relatively easy to learn and use but are inefficient in the sense that they use a lot of bytes in the translation process. An instruction sequence needing a few score bytes in machine code might require several thousand in BASIC. This inefficiency may also be reflected in operating speed.

Computer languages, then, at various levels, provide humans with the facility to communicate with computers. Their goal, however, is always to facilitate the writing of machine code.

The various languages are generally supplied on cassettes or floppy disks and loaded into RAM on command. Very simple stripped-down versions, such as Tiny BASIC, are also available. These are suitable for beginners.

### Applications Programs

Nowadays, computer languages need only be learnt by people intending to write or modify programs.

For all other purposes all that's required is to learn an application program - a far simpler task.

These are programs, often written in a high-level language, for specific tasks or functions. Visicalc, Wordstar, and dBase II are examples of applications programs.

These programs are stored on cassettes or floppy disks and are usually supplied with documentation which purports to tell you how to install and use them - we say 'purports' because the quality of program documentation often leaves much to be desired.

The disk containing the applications program is put into the disk drive and an identifying command entered on the keyboard: WS for Wordstar, for example.

The operating system searches the disk for the required program and loads a copy of all, or part, of that program into RAM (Random Access Memory).

From here on all work is carried out using the copy of the program held in RAM. The original program remains intact on the disk.

Data or text resulting from the use of the program (like this feature, written using an applications program called Wordstar) may be permanently saved in files.

As with applications programs, files may be given names (usually of eight or so characters) and saved and retrieved using these names alone.

Files are stored on tracks and segments created on the magnetic surface of the disk or cassette tape - by the operating system. The operating system



A typical personal computer set-up: dual floppy disk drive, terminal and keyboard, printer (in this case letter quality).

allocates and keeps track of the various segments (and their file contents).

### Peripherals

Peripherals enable the computer to make contact with the physical world. The keyboard and the printer are peripherals, as are video display terminals, also called video display units (VDUs or VDTs), disk drives, hard disks, acoustic couplers, modems, robot arms and so on.

At present people communicate with computers via keyboards. Computer keyboards vary but most are similar to the conventional QWERTY typewriter keyboard. The later ergonomic Dvorak keyboard is also occasionally available.

The more sophisticated keyboards have a numerical pad, like a calculator's, in addition to dual-purpose number/character keys. The pad is handy when entering large amounts of numerical data.

Function keys may also be included. These can be allocated (generally via software) for specific purposes. Spellbinder, for instance, uses them for word processing commands, which otherwise require several keystrokes to achieve the same results.

Video terminals are either dumb or intelligent. A dumb terminal can be used only for entering data or text which must be stored or manipulated by the central computer. It is simply a keyboard with no capability for manipulating data - for which an intelligent terminal is required.

Printers are of two basic kinds. They can be fast, with poor to medium print quality, or slow but with good print quality.

Most personal computers use dot matrix printers, in which a bundle of individually controlled time rods selectively hit the printing ribbon, thus forming characters and digits. A typical dot matrix printer uses 63 rods in a 9 by 7 formation. High-quality units use far more.

These devices operate at surprisingly high speed; two hundred or more characters a second is not uncommon. Dot matrix printers cost from a few hundred up to several thousand dollars.

Letter-quality printers have a petal-like daisywheel or thimble as a print element. Characters and digits on the daisywheel are selectively struck by a computer-controlled hammer. These printers produce letter-quality results but are slow (typically 25-50 characters a second). Prices start around \$1000.

Paper may be fed through the printer by roller friction alone, as in a conventional typewriter, or it may have perforated edges engaging in a computer-controlled tractor-feed mechanism which positions the paper with total and repeatable accuracy.

Tractor-feeds are essential for handling continuous forms, address labels and so on.

Sheet feeders enable printers to produce runs of letters or data on separate sheets of paper - such as with company letterhead. Sheet feeders are invariably costly.

### Storage

Cassettes are the cheapest but least satisfactory form of mass storage. The cassettes are similar to the standard Philips audio cassette. The tape formula is claimed to be more suited to digital ▶

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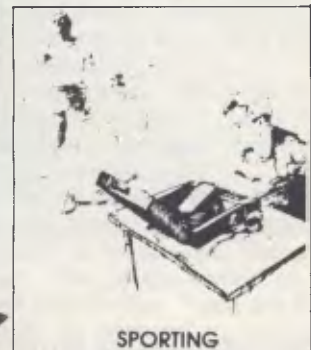
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A basic 300 baud modem. This device connects the computer to the telephone line directly.

operation – in practice audio tapes usually work fine.

The big drawback with tape cassettes is that they take forever to load, and that data can only be accessed by running through all that goes before.

These limitations eventually become totally unacceptable and the cassette drive is usually the first part of a computer system to be upgraded – or hurled through the window.

Before a floppy disk is ready to record data or programs it must be formatted. This is a process of dividing the magnetic coating into magnetically defined segments and tracks using a program included within the operating system. Programs and data are stored in these specific segments, their exact location being noted by another of the operating system's programs.

### Floppy Disks

Floppy disks are thin magnetically-coated Mylar disks which rotate within an outer light-cardboard sleeve. The inside surfaces of the sleeve are coated with a substance which attracts (and retains) dust from the disk surface.

Initially, individual molecules of magnetic material on the disk surface are randomly aligned. Data is stored by a magnetic head (which is in physical contact with the rotating surface) causing

tiny groups of molecules to be specifically oriented. This non-random orientation is subsequently 'read' by a second head. Molecule groups oriented to the right might for instance be read as 'ones', those oriented to the left as 'zeros'.

Disks may be single-sided or double-sided. They may also be single or double density, referring to their ability to hold data; double density disks hold twice the data. Quad density disks are also obtainable.

Floppy disk are 13 cm or 20 cm diameter. Ten centimetre disks have also been recently introduced.

A double-sided double-density 13 cm disk stores up to 500,000 or so bytes (0.5 Mbyte). A similar 20 cm disk stores up to 1.2 Mbytes – sufficient for well over 200 closely typeset pages the size of this publication – about 200,000 words.

Before a floppy disk is ready to record data or programs it must be formatted. This is a process of dividing the magnetic coating into magnetically defined segments and tracks using a program included within the operating system. Programs and data are stored in these specific segments, their exact location being noted by another of the operating system's programs.

First-time users should be aware that

formatted 13 cm disks are not interchangeable between different types of machines. They will fit mechanically but will not always allow data to be recorded or retrieved.

In particular be wary of salespeople's frequent claims that CP/M format disks are interchangeable. This is only true of one particular type of 20 cm disk (single-sided single-density IBM format).

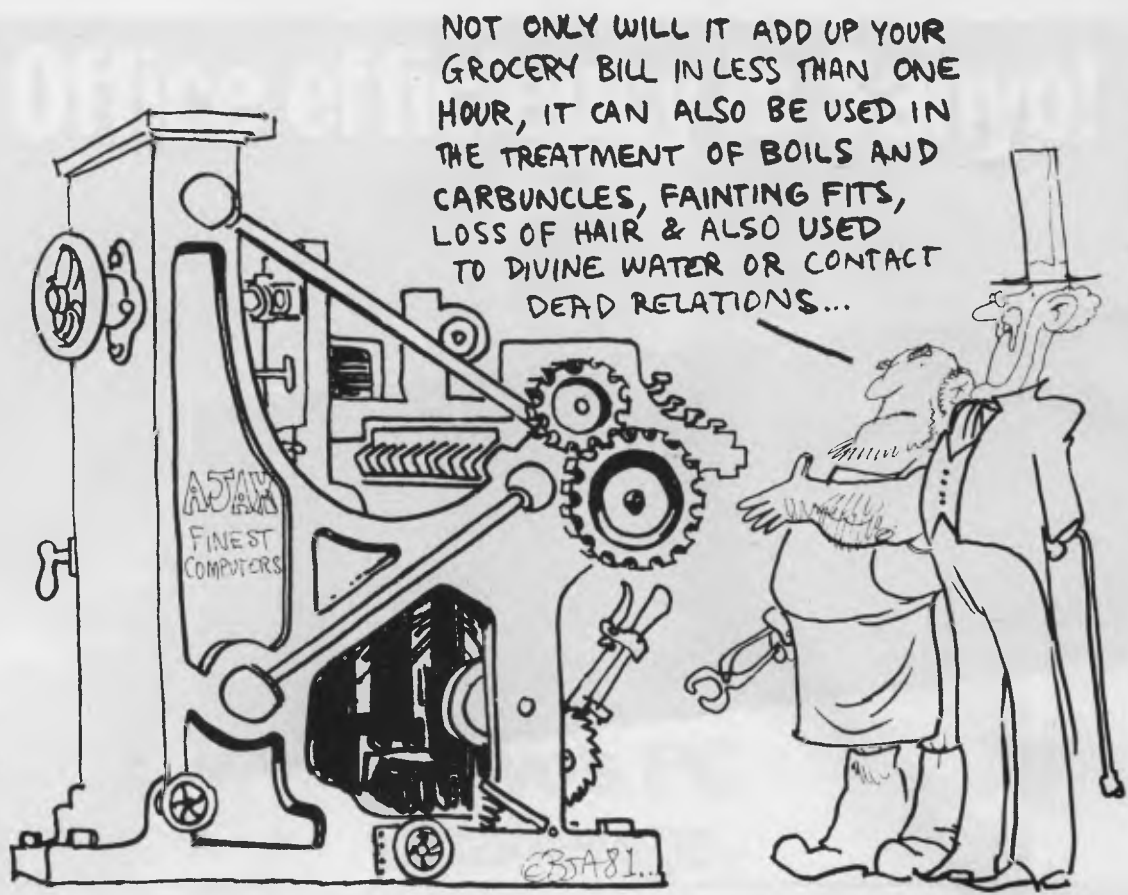
Disk drives house and read floppy disks. Personal systems ideally have two disk drives, business systems always require at least two.

Hard disk drives store five megabytes upwards; the upper limit is in the tens of thousand of megabytes. These devices are often totally sealed so you can't load another disk. These are called fixed disks as opposed to removable disks. Many arrangements combine both.

Computers and peripherals can inter-communicate (slowly) via standard telephone handsets and lines using an interface called an acoustic coupler.

A modem does the same thing only faster. It also connects the computer to the telephone line directly.

Acoustic couplers and modems also allow users to connect their machines to large public access database systems such as The Source (or the newly revived Australian Beginning).



# COMPUTER GROWTH

## The Art of Getting Smaller

*Computers have caused an intra-generation technological change, having been with us for less than 40 years. The impact on society has been massive, but most people are still unaware of the full applications of computers in business, industry and the home.*

*The changes have been so rapid in technological research that equipment is 'dated' as soon as it appears.*

*JOHN MELLOR, in Melbourne, and TONY BLACKIE, in Sydney, have been looking at these changes, and talking to academics involved in the building of the first computers in this country and the subsequent modification of those machines.*

IN THE folklore building up around electronics, it is said that if the aviation industry had developed as fast as electronic technology, the Jumbo jet would have taken off a few weeks after the Wright brothers first rose above the earth at Kitty Hawk.

While the timing might need tidying up by a week or two, the analogy is a valid illustration of the most rapid development in technology seen by man since 100,000 Egyptians, and sundry slave drivers, developed the principles of trigonometry in blocks of rock, near the banks of the Nile.

Few people in this country are as aware of the pace at which this technology — the science of the useful — has accelerated than Dr Trevor Pearcey, Dean of the School of computing and Information Systems at the Caulfield Institute of Technology in Melbourne.

Dr Pearcey was a member of the team which built Australia's first computer during the late 1940s and early '50s, and now

trains 750 students in the latest computing techniques.

He says digital technology has developed at such a fantastic speed over the last 30 years because the computer was such an effective tool for designing even better computers and electronics componentry.

The pace was also very rapid as there were so many potential uses for digital technology, and these uses were only realised once electronics was going.

Dr Pearcey first began working on computers during World War Two, when rudimentary computing devices were used for cracking codes, and for heavy computations involving weapons development and radar wave optics.

### The First Wave

He worked with differential analysers, of which there were only two full scale versions in Britain at the time. These were mechanical incremental devices, with





**Pic 1. CSIRAC's control panel operation. The computer was fed coded punch tape. Pic 2. Operator on left uses a special ticker tape keyboard to punch out coded instruction tape for CSIRAC.**



screw shafts and gear wheels driven by an electric motor. They were in a class called analogue calculators, and were non-digital.

These devices were the first wave of a series of evolutions towards the true computer, and were followed by the electro-mechanical punch-card machines. These were digital and had electro-magnetic wheel counters. They could transfer from countr to counter, add one counter to another, and subtract in a controlled way.

The progress was specified by plug board. The programs were very short, and in that sense the machines were more calculators than computers. They operated at about two operations a second, at most.

Towards the end of the war, the Bell System, which knew all about relays from its telephone exchanges, built an electro-magnetic system. This was a sequenced calculator, using thousands of telephone exchange relays.

Calculations were made by relays opening and closing and setting up a network through the controls and interconnections.

It was an expensive machine, but at between four and five operations a second, it was twice as fast as the IBM punch card system. The relay machines were punch-tape fed, and were very reliable.

Dr Pearcey said: "You could load your program tapes into the readers, leave it running, and close up for the night. There would be a load of punch-tape results to pick up in the morning."

At this stage, still the late 1940s, these machines were still used mainly for military work (the relay machines ere used extensively for ballstics calculations), and had not graduated into business or civilian fields.

### **18,000 Radio Valves**

Around the same time, another US

development was the ENIAC — the Electronic Numerical Integrated Automatic Calculator — which was electronically sequenced, and used about 18,000 radio valves. It ran at 5000 instructions per second. The amount of work ENIAC could do in an hour would take the relay machine at least a week.

But it was far from reliable, and the best you could expect with ENIAC was about an hour of fault-free running, where the relay machine would go for days without a fault.

However, these machines were not true computers in which instructions were internally stored. The early true computers came out of Britain.

The first was a rudimentary device at the University of Manchester used as a test bed for storage systems, using a cathode ray tube for storing digits.

At the same time, about 1948, researchers at Cambridge University built EDSAC (the Electronic Delay Storage Automatic computer), and this became the first computer to produce useful results for public scientific use, rather than military use.

It was available to any users who were prepared to programme it, and as a result of this arrangement, a considerable amount of today's basic programing principles (such as the sub-routine) were developed by EDSAC.

The development of these thermal vacuum tube (radio valve) computers could never have taken place without the mass production of valves for the then prospering radio industry, as the machines used thousands of valves. But they were notoriously unreliable, and in the late '40s the Bell System in the US deliberately set out to produce a reliable and compact semiconductor device.

### **The Transistor Arrives**

They came up with the transistor in the early 1950s.

Transistors improved through the '50s, and by the early 1960s, stimulated by the Cold War, the first elementary integrated circuits were developed. Then miniaturisation began to accelerate. Large scale integration saw thousands of transistors on a slice.

Then came the chip, initially hosting just a few transistors. By the late 1960s the chip was in service on the market in non-military applications.

## The Rise of the Processor

THE USE of machines for information processing can be traced well back into history. The ancient abacus was followed by mechanical calculators of the 17th Century, developed by people like Blaise Pascal (a name computer users will no doubt recognise) and William Von Leibniz.

These inventions were limited to the technology of the time, and were therefore extremely unreliable. But they provided the prototypes for modern calculators and computers.

One of those who is mentioned in literature as being the father of computers is Charles Babbage, an eccentric British mathematician, with a genius for inventions.

He created the Difference Engine and the Analytical Engine. These were steam driven calculators which solved difference equations.

In 1944 Howard Aiken, of Harvard University, completed the Harvard Mark 1 Automatic Sequence Controlled Calculator.

The Mark 1 was outdated before it was completed because it was too slow. The mechanical parts took too long to move from one position to another. For example, it took six seconds for a multiplication, and 12 seconds for a division. The Mark 1 was a massive piece of machinery, filling a large room with banks of complex wiring.

A short time later one John W. Mauchly designed ENIAC, Electric Numerical Integrator and Computer. ENIAC used vacuum tubes for computing and memory. For control it used an electrical plugboard, like a telephone switchboard.

It was 500 times faster than the best electro-mechanical computers, and rendered all the mechanical computers obsolete.

The next in the race to perfect the computer was EDVAC, the Electronic Discrete Variable Computer. It was built around the basic framework provided by the brilliant Hungarian-American mathematician John von Neumann.

Two of the advances made with EDVAC have been incorporated in almost every computer built since. The first was binary notation and the second was the storage of programs within the computer's memory.

In the late 1950s the greatest advance in computer technology was made – the use of the transistor.

It allowed researchers to reduce the size of computers, and therefore make them more acceptable to business and commercial use. At the same time magnetic core memory was introduced, allowing for safe storage of information, and easy and quick retrieval of data.

In the early 60s integrated circuits were used, and hundreds of transistors were placed on a single silicon chip. This allowed the size of computers to be reduced even more, so the home and office computer were born.

As technology advanced, and more and more transistors could be placed on a single chip the microprocessor and micro-computer came into being.

After a slow start, computers have now taken off. Innovations are coming at such a rate they make a machine produced today 'old fashioned' within months. □

Today, says Dr Pearcey, there are tens of hundreds of thousands of transistors on the chip, with increasingly complex interconnections.

The computer project on which Dr Pearcey was a joint designer – known as CSIRAC – was put together in the CSIRO's division of radiophysics on the campus of the University of Sydney.

The theoretical design was completed at the end of 1947. While it was developed quite independently of the Cambridge EDSAC, both computers used mercury delay-line information storage, in which bits circulated down columns of mercury about a metre long.

The computer was housed in two huge steel cabinets, about seven metres long, a metre deep, and a little under three metres high. It used so many radio valves it was necessary to have forced fresh air cooling to control the heat rising from bank after bank of these glowing vacuum tubes. CSIRAC was a hungry beast, consuming between 30,000 and 40,000 watts of power.

Information circulated through the

machine in a series of timed and amplified pulses, read off 12-hole and five-hole tape (ticker tape). This tape was punched out on a coding machine, before being fed to the computer itself.

CSIRAC began operating late in 1950 and found a number of homes for itself. It was finally decommissioned in 1964, while in the hands of the University of Melbourne, then spent 16 years in exile in the vaults of the Melbourne museum. CSIRAC is now in a sizeable display area at the Caulfield Institute of Technology.

### The Shrink Continues

When Dr Pearcey casts his mind back to CSIRAC, and compares it with today's technology, the Jumbo jet analogy takes on a new meaning.

He says ignoring the input and output, which still have to be tailored to a size humans can handle, the same computing capability today would fit inside a matchbox. As a bonus the speed would have risen from 1000 instructions a second to 100,000 instructions a second,

and the power consumed would be about a million times less – milliwatts instead of kilowatts.

'If you design a lot of chips together, using a special kind of architecture, it is possible today to get 50 million instructions per second', he says.

A Control Data Cyber 205 has been rated at 800 million instructions per second.

Dr Pearcey estimated CSIRAC would have cost about \$300,000 to buy. Yet the same capability would cost only a few hundred dollars just 30 years later. He says a desk-top business computer worth about \$5000 in 1981, would, in 1960, have consisted of bank after bank of cabinets taking up a large amount of floor space, and would have cost about \$500,000.

'But in those early days the field was entirely new. Everything you did was new, and because it was a completely new field, it really didn't take very bright people to do new things.

'On the other hand, what is left now are the difficult problems; very sophisticated techniques that will only be carried out by the very bright people, because all the easy stuff has been done by the people like me.

'It might end up like the motor car. It did not take long for the car to become a defined shape and for the technology to be established. Then all that was left was applying refinements and changing fashion.

'But I think there are still some major advances yet to be made in electronics. We may, for example, combine our electronics with genetic engineering, and produce a race of people better than ourselves. We humans might die out. There are now a small number of people working on this.

'The major development will be the spread of the computer into every field. Beyond ten years ago, computers were big, expensive and hidden away. They were having effects on our economy and our business procedures that were quite revolutionary. They affected everybody, but no-one noticed them.

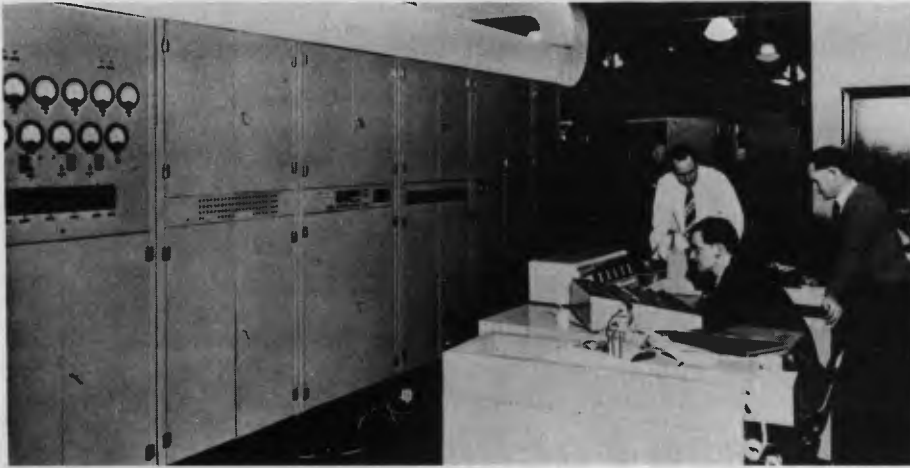
'Now the computer has come out into the open and everybody can make contact with them and they can see them.

### Shortsighted Seers

Turning the clock backwards for a moment, in 1951, the US Defence Department released a statement saying five Univacs 1s, the computer then in use, would be able to handle computing needs for the foreseeable future.

This was shortsightedness in the extreme, given the myriad of computers the US armed forces now use to operate their massive array of highly sophisticated weaponry systems; but it was not an un-common view in those 'dark ages' 30 years ago.

One of the huge cabinets housing the works. There is a second bank, just as big, behind the one pictured. Today the lot could fit into a matchbox, use a million times less power and be 100 times more capable.



But, according to Professor V.X. Gledhill, Dean of the Faculty of Mathematics and Computing Sciences at the NSW Institute of Technology, the changes in computer technology were predictable.

'From a computer scientist's view the most interesting aspect of the evolution of computers has been the predictable nature of their growth,' he says.

'And there is no doubt that computers will continue to grow at a predictable rate. There will always be forecasters who can accurately predict what will happen with computers.' Professor Gledhill says academics have plotted the changes which have occurred in the area of computer technology, and the changes which will occur in the future.

'If you plot out the changes in computers on a plotter on semi-log paper, they all fall on a straight line,' Professor Gledhill says. 'Technically, from the academic's point of view, it has all been fairly transparent.

'This method of plotting also show up the forecasts, such as the continued miniaturisation of computers and the lower costs. For example, we can accurately predict that there will be one megabyte of power in a wrist watch by the year 2000.'

### Available, But Usable

'What exactly they will do with all that power is not known, but we do know that it will be available!

Professor Gledhill says the transparency of advances in computer technology is shown by looking at how changes came about.

'We used valves until 1958, but we knew about transistors long before that, and we knew they would be used in computers.

'Now we know optical discs are there, and Josephsen Junction machines are there. All the technology is available,

and we know they will be used in computers of the future; they just won't be working for a while.

'Anyone who does their homework wouldn't be surprised by the changes.

But while the technological changes have come as no surprise to the academics, the use of computers, and socio-economic change they have caused, has been (and will be) far greater than perceived.

The rate the community has adopted the new technology has been so wide spread and rapid that none of the seers could have picked it.

Professor Gledhill admits no-one could have predicted the impact of home computers and their functions.

### Predicted Shrinkage

'The predictions now are for a factor

of ten reduction in size and price each year, and the sorts of things computers will be capable of will increase at a much faster rate,' he says. 'The computer manufacturers see the market is well below saturation point. IBM, for example, see one computer in every home before the end of the century.

'And the future is not for one computer in every home, but one computer in every room.' When Dr Pearcey looks forward, he talks about the spread of robots – not only in processing industries, but in the service industries as well – and the paperless office.

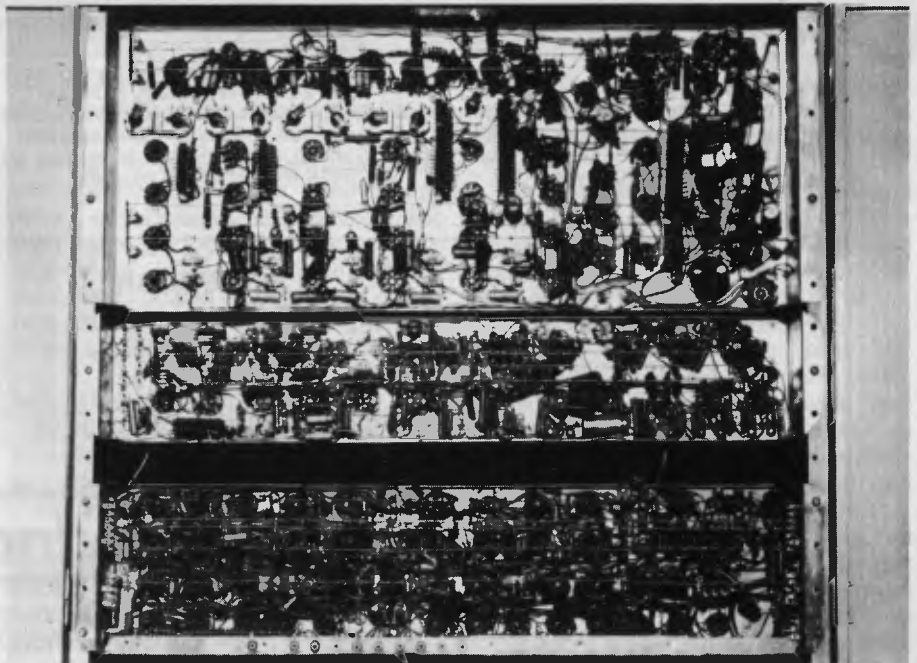
But possibly the most significant development in computers will be the spread of a high-speed communication system, which will eliminate the need for many of today's normal personal face-to-face transactions within the office and the community.

All departments within a company will be integrated through the one central computer. Communications like reports, memos, instructions, messages and so on will be electronic, rather than on paper. This communication will spread between branches, and then between companies, where letters, orders, billings and normal inter-company actions will be carried out on the cable network.

### The Office Eliminated

The need for the traditional central office will be eliminated. Employees will work, if not from home, then from suburban computer centres, where they will have an office containing their communication system.

Electronics within the home will also ►



Bulk wiring! This panel measures a little less than a square metre. These days its capability would come close to fitting on a pin head.





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## The Secret of Colossus

Many of the technical and scientific advances which had the greatest impact on society were born in times of war, when researchers appeared to make the supreme effort to produce ideas.

An obvious example is the jet engine, a less well known one was the advancement of the electronic computer.

Finding out what the enemy was doing, through what he was saying to his commanders in the field in secret codes, was all important. So machines were built to break these codes.

In 1943 British Post Office researcher T.H. Flowers, a specialist in high speed switching, and Cambridge mathematician M.H.A. Newman, of the top secret decoding centre at Bletchley Park manor house, near London, collaborated on the design of what was the world's first electronic computer – Colossus.

In terms of its size, the name was rather apt. Colossus was huge, filling a room in one of the huts at Bletchley.

The machine came about as a result of work on deciphering messages from the German Geheimschreiber, or secret-writing machine, which was used for German Foreign Office dispatches and sending strategic plans.

Some messages were solved by laborious pencil and paper methods later by comparing certain 'runs' in the messages or with an imitation of what the enciphering machine did on the 'other side.' Around 1942 a mechanical switching device was built at the British Post Office Research Station, to do this work for the cryptanalysts.

This machine, nicknamed 'Heath Robinson', because of its whirling tapes and pulleys, was superseded in 1943 by

Colossus.

Flower said of his machine: 'It occurred to me that electronic equipment, including valves, could be made to do the same function as mechanical switches very much faster and more reliably, and that this would solve our problems.' The machine had 1500 valves (where 'Heath Robinson' had between 30 and 80) far more than any single device built at that time, and it required a small army of operators.

The machine used ten 'rings' of thyatron triode valves, containing argon gas, to act as high speed switches and mirror the ten encoding 'wheels' of the German Geheimschreiber. Only one valve in a particular ring was conducting at any time, then the electrical pulse passed to its neighbor, simulating the rotation of the Geheimschreiber rotor wheels.

As each thyatron conducted electricity, pulses were passed to other circuits, which performed counting in binary arithmetic and Boolean logical operations. All this reproduced the enciphering telegraph keycode, which was subtracted from the figures in the garbled message, to reveal it as text.

The machine read tapes, punched in the Murray code five-unit tape at a then staggering 5000 characters per second.

The method of operation was the now familiar 'on line' programming system, taking the form of synergy: a dialogue between man and machine. This has only become general with modern computers relatively recently, because the details of Colossus were kept secret for 33 years by British Intelligence.

An improvement to the Geheimschreiber machine, and lessons

learned from the first Colossus, led to a Mark II Version, which had a built-in function of conditional (branching) IF logic. Colossus II could make decisions; an ability of course fundamental in modern computers, but Colossus was the first to have it.

The machine had 2500 valves and by paralleling five readers, it could read at 25,000 characters per second – a speed not matched by postwar commercial computers for a decade. By mid 1944 there were ten Mark II Colossi at Bletchley Park, supported by 20 cryptanalysts, 20 engineers and 250 operators.

The British Office of Public Records did not release any details of Colossus until 1976, 33 years after it was built. Some photographs were released, with very basic captions. In a lecture to Britain's National Physical Laboratory, Teddington, in 1976, Colossus was said to have been 'capable of 10' consecutive elementary Boolean (and/or) operations without error.

It's contribution to the war effort – how many important messages were intercepted – has never been revealed; that's still ultra-secret.

So, after the war, computer technology was forced to go through a teething period again, as no information was available from intelligence organisations. But scientists picking their way through the rubble of Germany, found huge air-defence radars, which were then given new electronics and allocated to universities. One was used to discover the Hydrogen line on 23 centimetres, founding the new science of radio astronomy, which has since discovered Pulsars, Quasars and Black Holes and reached to the far limits of space. □

integrate. First of all, appliances will continue to increasingly be fitted with their own electronic controls. Right now there's the home computer, intruder alarms and security systems, the answering machine, the video recorder, and controls on cooking and heating/cooling systems – all separate and self-contained. These will be integrated into a single central control system, installed during home construction.

The real breakthrough in the home will take place when each home has access to a co-axial cable network. Not only will there be access to the knowledge of the information banks, it will see the end of mail. Bills and 'letters' will come by cable and be paid or answered at the touch of a button.

The scenario goes on.

Take the normal weekly shopping list, punched into the home computer rather than scratched on the back of an envelope. The computer has access to all

supermarket pricing and selects the warehouse that can supply that list at the best price.

But the list is over budget. The essentials (based on previous ordering patterns) are included, but luxuries and their prices are highlighted, for selection or rejection. When the choice is made the order is placed for delivery or collection, and the household account debited by the supermarket.

### Intra-Generation Change

Professor Gledhill believes that computer literacy is perhaps the most important educational function of the 80s.

He points out that computers are the first intra-generation technological change, and they have created gaps in knowledge not only between parents and children, but also between children in one generation.

And he says the projected advances in computer technology will mean

people being trained now for certain occupations will find, before they retire, their qualifications will no longer be relevant.

Despite this, Professor Gledhill doesn't see a backlash against computers, as he says the advantages will far outweigh the disadvantages.

In short, the modern computer will increase the quality of life.

Dr Pearcey foresees the bionic man, robot dump trucks in open cut mines, robots at the coal face controlled from an air conditioned office, robot tractors that plough and harvest from laser reference beams; the scenarios you can draw are as big as your imagination.

In fact, just about anything you can dream up for the computer is possible right now. It is simply a matter of waiting for it to become an economic possibility before that dream will be put into place, and become a reality.

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# SOURCEWARE

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# THE SOFT SELL...



*You don't have to be a genius to sort out what's going on where in the world of computer programs. We know, because we sent computing novice Mark Camm out to investigate. We picked a beginner to write the story so that he could produce a comprehensible rundown for newcomers: surprisingly, he succeeded.*

*"What! Me write about computer programs?" he yelled at us in disbelief. But a week later he trudged back with the story, proving once and for all that even*

*the most timid beginner can find out quickly, and in a language approaching the Queen's English, what can be bought to make a home computer do for you whatever your heart desires.*

IT'S SCARY OUT there in the world of computers. Lots of jargon, different systems, different computers. Information whiz-bangs past your ears like a mortar attack. I'm not a one-week wonder, an instant expert. I played it cool in my information collecting. I learned that there is more to this game than meets the bubble memory (slight pun there, very slight), but if you have the time and the

inclination, you'd be able to amass enough knowledge to dazzle Dick Smith.

There are thousands, tens of thousands of programs available. Under the loose heading of software you can buy a program to tell you how much you are going to be in debt for, and for how long, or you can buy educational packages to help the kids write, THINK! That's the important bit, computers make you use your brain. Most of the time, making you do it is fun.

Places to buy programs from are still breeding like rabbits. A program, or piece of software, won't work on every computer. You probably know that, but I didn't, until recently. The program, or ►



instructions for the computer, come in cassette form, or in a disk form. I'm told the cassette is fairly slow, the disk rapid. But to be able to use a disk, you need a disk drive for your computer. Cassette recorders are cheaper; many home computers have them built in.

For small businesses, programs to look after book-keeping, accounts and general administration abound. They don't cost much, but you might have to modify your business's operation. The trick to programs is that they're written to suit most applications, such as in business. They don't cost very much because they're mass-produced. If you want a program made especially for you (for a small business, for an example) then it's going to cost a small fortune. Writing a program can be extraordinarily complicated and time consuming.

These things I know. I asked.

Apparently, one of the best things you can do with your home computer is write your own programs. There are over-the-counter programs to help you write one. I have to be honest, for the home computer enthusiast, who doesn't own a small business and hasn't the mortgages and debts to warrant a program to keep tabs on them, commercial programs are a bit thin on the ground, except for games; thousands of them. If you have children, things are a bit dif-

ferent, educational programs are freely available. Most are good – well, those that I saw were good. There are speed-reading courses. I enjoyed that one. I can now get through Ethel the Aardvark Goes Quantity Surveying in rapid time.

### Applications

Apple Computer is a name well known in the land of microchips. The software available for it is vast. But, as the honest manager of ComputerLand in Sydney, retailer of the Apple, pointed out, most of them are rubbish. That still leaves a hell of a lot that aren't.

Six 'S' Business Advisory Pty Ltd, of Geelong, produces a heap of software for computers that run on UCSD Pascal. That means machines such as the Apple, IBM PC, DEC, Wang, Texas Instruments and Osborne Executive. Apparently, most new machines can run under the UCSD p-system.

The company's programs for business include:

- **Creditors and General Ledger.** A program for you to keep an eye, and a brain, on cash flow, profits, who owes what – with this baby you can ask the computer what's happening to the business, and it'll tell you.

- **ASK!- Accounting Scenario Key.** A brand new program that operates as a business evaluation tool. Allows you to

access the financial position, worth and earning power of your business at any time.

- **General Payroll.** Whatever paymasters do, this program does it for them. Find out where your company's income is going...

- **Debtors and Inventory.** Account selection, customer master record, sales territories and transaction entries.

Six 'S' also has a complete business package. It sells for \$1490 and includes programs for payroll, debtors, creditors, inventory and word processing. Six 'S' programs are available in many computer stores, including Computerland stores throughout Australia.

Computerland also has a Real Estate program written in Australia for the Apple II. Called Real Estate Agent, the program sells for around \$795 and looks after rental properties, receipts, expenses statements, agents fees and ledgers; up to 200 properties can be stored on one disk.

Computerland also has a new graphics system, the Robocom Bitstik, which is a package combining hardware (that's computerspeak for things like computers, monitors and ashtrays for chain smokers) and software and retails for around \$995. The system is a very powerful graphics unit which can produce detail fine enough to be used by ►

# THE AFFORDABLE HIGH PERFORMANCE PLOTTERS - FROM ROLAND.

If you've travelled overseas, then you would have heard about Roland Corporation's high-performance, low-cost, multi-pen, color plotters. Now, you won't have to travel because they are available here from Roland dealers in all States.

Roland's high performance 8 pen plotter also comes with a single pen variant (DXY101). These flatbed X-Y plotters are the most compact units of their kind and come in a portable carry case.

They have an effective plotting range of 360mm x 260mm (A3) and can operate on an incline up to 60° a practical application in the work situation.

Maximum operating speed is 180mm/sec, very fast for this type of plotter. Optional speed settings allow adjustment for different types of pen and paper. Additional pen holders are supplied allowing use of a wide variety of pens with the DXY800.



Roland X-Y plotters feature a wide variety of command applications; vector commands, character commands, graphic commands and pen exchange commands.

Both RS-232C Serial and Centronics parallel interfaces come built-in as standard features, making Roland X-Y plotters compatible with virtually every model on the market. And we have support graphics software.

But the most pleasing aspect about Roland plotters are their prices. Give us a call ... you'll be amazed.

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Telephone: (03) 417 1800.  
23 Cross Street, Brookvale, 2100.  
Telephone: (02) 938 3911.



Some of the software available from 'Six-S'.

draftsmen. For example, you can draw a door and then zoom in on the door to draw in the wood grain and then (wait for it) draw the door handle and zoom in on that to draw the grain of the metal handle! Electronics draftsmen can use it to draw circuit diagrams as it has component symbols on a chart in its memory which can be inserted in the scale diagram.

It's also smart enough to keep track of the diagram as you progress so that if you want to erase something, you don't have to worry about erasing it by 'rubbing' or blocking out on the screen, you can simply take the particular line out with a command. An extremely sensitive joystick-like instrument to communicate commands.

Some more Apple software (I found these ones at Imagineering):

Home Accountant. A home finance package to help balance your cheque book (this has to be worth a lot of money...). The programs allow you to maintain 100 budget categories, keep track of five cheque book systems and maintain separate cash balances for five cash cards and all credit cards. It can

also print cheques. For those of you with enough money to warrant it, this program is a beauty. Unfortunately, it's useless for me.

Zardax. A word-processing program for the Apple with features such as a glossary that allows you to store frequently used names and addresses for recall at the touch of a single key, edit text with simple commands, print your text with a range of formats - just about everything aside from folding up your letter and putting it in an envelope.

I suppose I'd better tell you, in case you hadn't worked it out, that to have a word processor, you need a printer so you can actually put the thing to some use. Amazing things, word processors. Ask someone who's used one....

Executive Briefing System. A business graphics program that enables the user to create graphics (using the keyboard) for display in a predetermined order as a slide show. It has features such as spirals and graphs and 'curtain up' simulation and can also display text. It would be a useful gimmick at a seminar or conference.

Apple's range of software is huge. There are more management programs than you can poke a stick at, word processing packages galore, mailing lists, educational programs in plague proportions, but they're by no means the only people on the block. The descriptions of Apple software are a good guide to what's available elsewhere.

Computerland Melbourne gave me a huge pile of pamphlets on the software it had available. Much of it is for the Apple, with programs from Six 'S' Business Advisory Pty Ltd.

Tandy's TRS 80 is, apparently, a popular bit of hardware. Buying programs for it is no problem and, interestingly enough, I'm told that most programs for the TRS 80 will run nicely on Dick Smith's System 80. Don't you just love the technical talk?

One strong warning that came from my venture into the world of software is that, as in most retailing fields, you should be very wary of the unidentified seller.

You could be buying some terrible rubbish (both hardware and software) by dealing with people who trade only with a telephone number or a post office box - it's all right dealing via the phone and Australia Post, as long as you know the company's address and can visit it if you want to.

Copyrights on programs are easily breached, and if you buy something that doesn't work from a Fly-By-Nighter, you can kiss your money goodbye. Back-up service; consider it strongly when buying anything for your computer.

I hate putting the idea in someone's head, but the range, complexity and understanding of programs is an area so great that you could write a magazine about it.

### Personal Enrichment

Texas Instruments is one of your all-American HUGE multi-national corporations. It's no surprise then that its education programs are described as Personal Enrichment Programs. But, for all of that, it does offer programs in Early Learning Fun, Beginning Grammar, numbers, graphs, chess, getting fit, making music, losing weight, teaching yourself to program and even how to play Bridge.

Its business programs are, in the main, aimed at you at home: controlling your income, keeping to the household budget, keeping personal records, mailing lists, keeping the bank account under control, under one or more programs all of these are at your fingertips.

The TI machine, like the TRS 80, the Apple, the IBM-PC and other popular computers, has a devastating range of software available. Some of it is direct ►



# FOR THE SOFTWARE, UTILITIES AND ACCESSORIES YOU'LL ONLY FIND RELEASED THROUGH OZI SOFT, CHECK THE DEALERS LISTED FOR THE ONE NEAREST YOU.

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# The Company Computer and The Company Network...



## Your Linc with the future.

Your first Vector computer is the first building block to your future network.

### Dual Processors

The Vector 4, The Company Computer, has dual processors, both 8 and 16 bit, meaning that it is going to be around a lot longer than some other computer systems and the Vector 4 range is flexible enough to fit any business, be it large or small.

LINC, The Company Network allows you to network up to 16 Vector 4's together so that everybody in your Company is always working with the latest information.

### Low Initial Investment

LINC eliminates high initial investment because it takes advantage of existing resources. It lets one Vector computer communicate with another Vector computer, sharing data bases, software and peripherals.

While other networks require a large capital outlay for expensive and complicated file servers, LINC uses the disk drives in the stand alone computers that are attached to the network.

# LINC™

## THE COMPANY NETWORK.

### Simple, Yet Sophisticated

No dedicated master control station is required, reducing the investment required and preventing network shutdown due to failure of one or more stations.

### Distributed Information

LINC improves inter-office communications. You can exchange information instantly with other departments.

Automate one department at a time, adding computers and peripherals as the need and budget dictates.

### Flexibility and Growth

LINC meets your requirements today and has the flexibility to grow right along with your Company. Add workstations when and where they're needed. Individual workstations may be moved to another department without time consuming reconfiguration procedures.

This mobility assures full use of all network resources to solve real business problems.

### Shared Peripherals

LINC allows every workstation to have access to any printer located anywhere on the network. As your system grows, you will continue to save thousands of dollars by sharing

printers, plotters, modems, hard disk drives and other peripherals.

### The Complete Range

The Vector 4 is available with one or two 630 k floppy drives, or a 5 or 10 megabyte hard disk drive. For business where you need a large amount of storage, Vector have also included a 36 megabyte hard disk.

### Applications Software

Vector combines state-of-the-art computer technology with the kinds of applications software you need to be successful in your business. The Vector Professional Series is a fast, efficient and sophisticated series of applications programs for the Company Computer.

### Personalised Service and Support

You don't have to be a computer expert either, as Dicker Data makes it simple, simple to use and simple to understand, allowing you to concentrate on your business.

Dicker Data have been selling and servicing Vector Graphic products for 5 years. Vector were one of the first companies to enter the micro-computer business. Our experience is invaluable to first time users or advanced programmers.

# VECTOR

## THE COMPANY COMPUTER.

For more information contact:

HEAD OFFICE: Dicker Data Projects Pty. Ltd. 78 Captain Cook Drive, Caringbah. N.S.W. 2229. (02) 525 2122

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Port Melbourne — 64 1372. ADELAIDE: (08) 223 4950. WESTERN AUSTRALIA: Leederville — 381 4444, Victoria Park — 362 4249.

QUEENSLAND: (07) 391 9209

from them to you, other times it's farmed out to agents.

There are businesses that have less software, or are more specialised, but are no less important if you're in the market for computer gear.

A good example of the small, specialised company is Dicker Data Projects of Sydney. Operating on the Vectorgraphic Vector 4 computer, the company is oriented towards business but has had various contracts, including one to supply the West Australian government with programs for that states education department and another for the Royal Children's Hospital in Sydney for programs from accounting to word processing.

Its main business package is called Execuplan, for financial and sales reporting product by product. Built-in formulas allow you to manipulate figures to keep records accurate. This package is included with the Vector 4 computer, or retails separately for around \$250.

There's also a word processor, Memorite 3. It's sophisticated, the program alone costing about \$699, but included with the Vector 4.

### For Enthusiasts

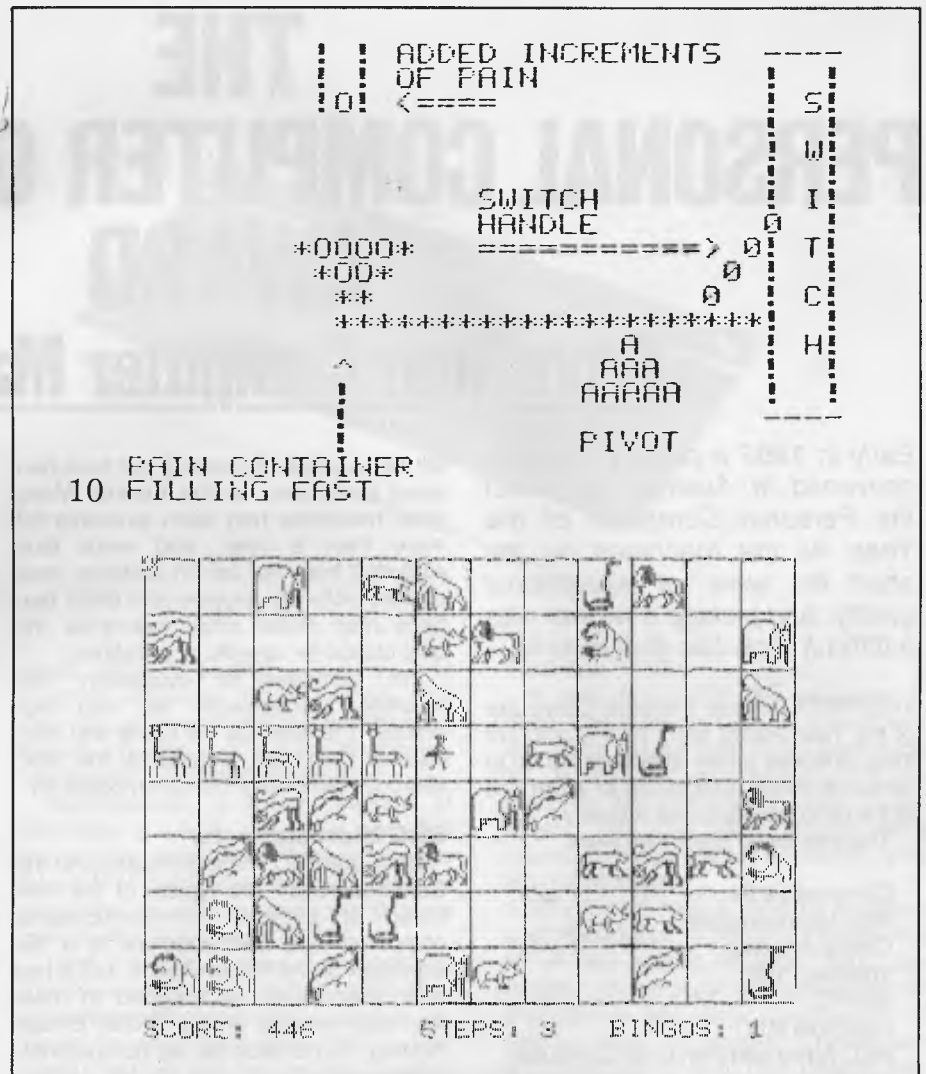
Applied Technology of Sydney is another exclusive mob, taken one step further: all hardware and software is designed and produced in Australia using Z80 microprocessors. I still get completely bamboozled by computer technospeak, but Z80, like 8085, is the name given to the microchip on which this or that computer might be based.

Fear not if you're out in the world searching for the right place to go while trying to figure out if any of it makes sense. None of it does to begin with, but there are any number of helpful people to talk to.

Applied Technology boasts the MicroBee, an increasingly popular computer with a great following of budding programmers. The 'Bee, as it is affectionately known in computing loops (another small pun), has the added attraction of regular monthly columns in Your Computer and our sister publication Electronics Today International. These columns offer software for enthusiasts to enter into their computer and give hints on how to write your own programs. They tell me this isn't so hard; I am a little dubious.

Software for the MicroBee is available in ready-to-load cassette form too and Mytek Computing, a West Australian company, has a comprehensive catalogue of software for this computer.

Programs include the Mytek Wordprocessor, a Touch-Type-Tutor and one called Composer Bee which allows the user to enter the actual notes



Games. What every computer is used for at some time or another.

on the staffs on the screen - it can be transposed or modified and the resulting score is then displayed and can then be played or saved.

Less serious programs available from Mytek include games such as Frogger, Backgammon, Meteor Rescue and Asteroids Plus. Mytek programs are available from computer shops throughout Australia - there's even an outlet in New Zealand stocking these programs!

DeForest Software, from that unrivaled place, Nunawading, near Melbourne, stocks over 1000 programs for a number of machines and are the sole Australian distributors of the Genie computer. The software for this fairly new computer is CP/M based and is Tandy compatible.

### What You Need to Know

In my search through the software currently available, it was made crystal clear to me that the more you learn, the more you need to know.

All I discovered, really, was that the novice to microcomputers could get horribly confused and easily jaded by the range of software available, and the fact that not all software will "run" on all computers is just one more problem sent out to baffle you.

I walked out thinking a program was like an LP record and could be played on anything. Wrong.

But I had some fun looking at various programs. The games were interesting but the serious programs proved to be an education. There are books on how to write your own program, programs for business, home and pleasure. The kids can get a buzz from them, you can save money using them, in fact, if you're thinking of buying a home computer, I'll make this promise:

*Life will not be the same any more.*

Now go out and buy a program for that!



# THE PERSONAL COMPUTER OF THE YEAR AWARD

## From Your Computer Magazine

*Early in 1983 a panel of experts convened in Australia to select the Personal Computer of the Year. All the machines on the short list were of exceptional quality, and picking a winner was a difficult task. Les Bell reports.*

THE FIRST Annual Personal Computer of the Year Award from *Your Computer* magazine was a new award designed to stimulate public recognition of advances in the personal computer industry.

The shortlisted machines were:

Commodore 64  
BBC Microcomputer  
Otrona Attache  
Toshiba T100  
IBM-PC  
Columbia MPC  
NEC Advanced Personal Computer  
Sirius  
DEC Rainbow 100

Each machine had at least one feature which represented an advance in the 'state of the art'.

This does not mean, however, that we

felt these were necessarily the best personal computers on the market. Many good machines had been available for more than a year, and were thus excluded from our list. In addition, specialised software support and other features may make other machines the best choice for specific applications.

For purposes of evaluation, the machines conveniently fell into four groups. The first was the home and educational computer, typified by the BBC Microcomputer and the Commodore 64.

### **BBC Microcomputer**

Both the BBC Microcomputer and the Commodore 64 are typical of the new breed of personal home/educational computer. The BBC machine is a descendant of the Acorn Proton, but it has been extensively re-designed to meet the requirements of the British Broadcasting Corporation for its computer-literacy project.

Several key features stand out about the Beeb, as it is known. First, there is its almost unique position in having the backing of a British Government corporation in the generation of educational materials. Already, there is a vast

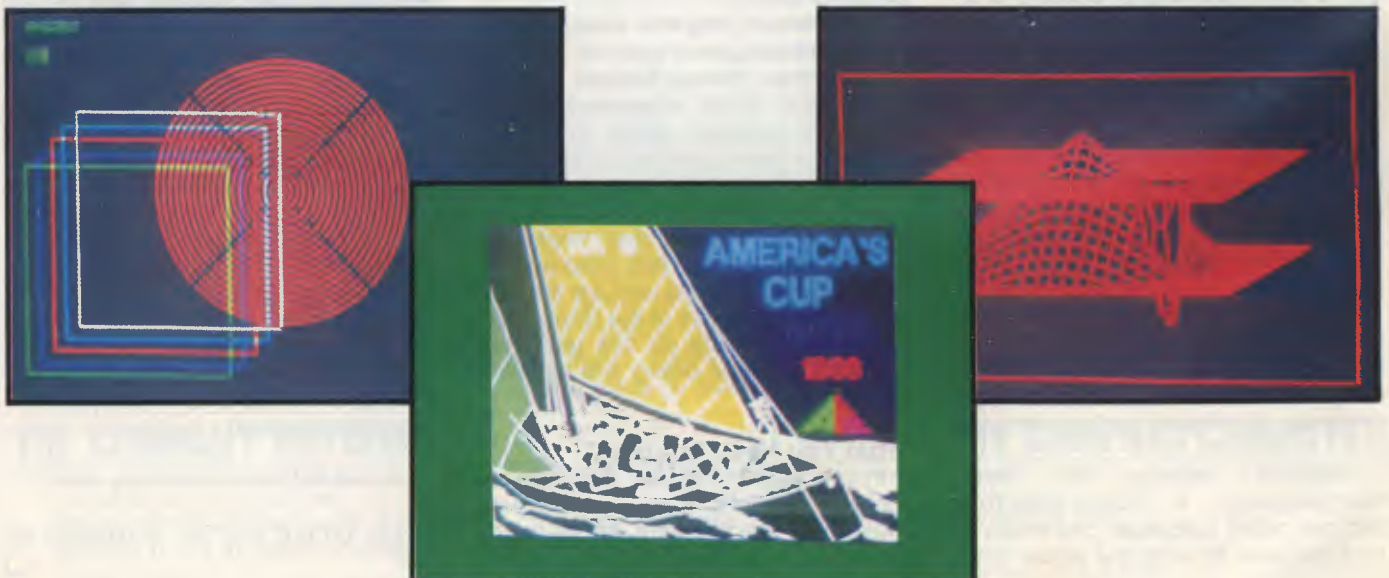
amount of educational software, games and applications, generally oriented towards the first-time user. In other words, a first-time user can take the machine home and put it to work immediately.

Secondly, the machine is highly expandable. Interfaces are provided for almost every conceivable peripheral, including a Teletext/Prestel converter, bit pad and even a robot arm. Internal expansion can include additional ROMs to provide extra languages, word-processing or other applications. Built-in interfaces include serial, parallel and four 12-bit analogue inputs.

The BBC Microcomputer incorporates an unusual expansion interface in the form of "the tube", a specialised high-speed serial interface to a second processor. Presently, a Z-80 processor is available, but the BBC's designers are working on a board featuring the 16032, National Semiconductor's "VAX on a chip".

The BBC also operates on the Acorn Econet, which can support up to 255 computers. Though originally designed for educational applications, the Econet is quite useable in an office environment.

BBC BASIC is a structured "superset"





(with some differences) of Microsoft BASIC. It has some very interesting features, such as in-line assembly language, multi-line functions, local variables, full recursion and, of course, support for the Beeb's high-resolution colour graphics and sound generation.

The BBC Microcomputer is a rather different design concept to the more conventional machines currently available. It offers very high performance in a general-purpose package and, because of its affiliation with the British Broadcasting Corporation, a level of software support which could exceed virtually all other machines.

### Commodore 64

Perhaps the price/performance bargain of the year, the Commodore 64 packs an amazing amount of performance into a tiny, low-cost package. Despite the superficial resemblance, this is more than a Commodore VIC-20 with more memory.

Based on Commodore's 6510 micro-processor, the 64 has a full keyboard and a colour display with 320 by 200 pixel, 16-colour graphics. The 64 kilobytes of memory are not all accessible at once: under BASIC, 39 kilobytes are available to the user, while machine-code programs can get at 52 kilobytes.

The graphics chip in the machine allows the user to create up to eight independently controllable sprites. Each sprite is a shape, up to 21 by 24 pixels and in up to three colours, which the user can direct to move. The machine will automatically ensure that foreground objects pass in front of background ones, and will take appropriate action when objects collide.

Another impressive feature of the Commodore 64 is the speed with which Commodore has provided support for software developers – already, technical manuals and software development packages are available. A number of developers, including Commodore itself, have been putting these materials to use, and there is a vast area of software already on the market for the 64, ranging from games to word-processing and business packages.

The support extends to peripherals, too: there is a wide range of devices, including disk drives, cassette units, a printer and a four-colour printer/plotter – plus, of course, the expected joysticks, games paddles and a light pen.

The Commodore 64 has the much-vaunted ability to run CP/M – yes, well, it does run CP/M, but, owing to the slowness of the IEEE-488 bus to the disk drives, it takes 20 seconds to load PIP (versus half a second on any S-100 machine). And after a program has run, CP/M warm-boots – a process that



BBC

takes about 30 seconds. Once a CP/M program is loaded, it runs just fine; but can you imagine WordStar, which relies heavily on disk overlays for its menus, running on the Commodore 64?

Nevertheless, a special version of WordStar is said to be on the way. But the judging panel couldn't really take the 64's CP/M capabilities seriously and, in any case, the 64 can easily stand on its own merits regardless of CP/M.

From the point of view of ergonomics, the 64 is not too hot, with a rather cluttered keyboard and a maze of wiring between its peripherals (plus their power cords), but we can forgive this, bearing in mind its low cost and high expandability.


### Toshiba T100

A very interesting little package, indeed. The Toshiba T-100 is a small unit, not much bigger than the Commodore VIC-20 and still small enough to fit in a briefcase, but which really does run CP/M and has one other feature which especially lends itself to portability: a liquid crystal display.

The T-100 has a full-size keyboard and, above that, a pair of cartridge slots which will accept ROM or RAM cartridges. At the back are connectors for disk drives and other peripherals, as well as video out sockets. There's also a couple of slots which are used to support a hinged liquid crystal display.

This display, which simply plugs in ►

**PERSONAL COMPUTER**



The Final  
Analysis

**OF THE YEAR**

**The Award Criteria**

THE WINNING machine must have been released on to the Australian market during the year immediately prior to the award. We distinguish between announcement of a new product and its first sales: the machine must actually have been sold to end-users during the period of time under consideration.

The major criteria which the panel use in judging the machines are (not necessarily in order):

1. Ergonomic design, in terms of both hardware and software.
2. Technical excellence in design, engineering and provision of advanced or new features.
3. User support, documentation and training.
4. Value for money.
5. Performance.

In addition, the panel may evaluate additional features as necessary.



**Columbia MPC**

using a subminiature DIN connector, has eight lines of 40 characters, both upper and lower case, together with punctuation symbols. Using this display, the machine is completely independent of a video monitor, and can be used virtually anywhere.

BASIC is provided in ROM inside the machine, and additional 32- and 64-kilobyte RAM cartridges can be inserted. When removed from the machines, the RAM contents are maintained by a battery. An inverter attachment is available for portable operation in a car.

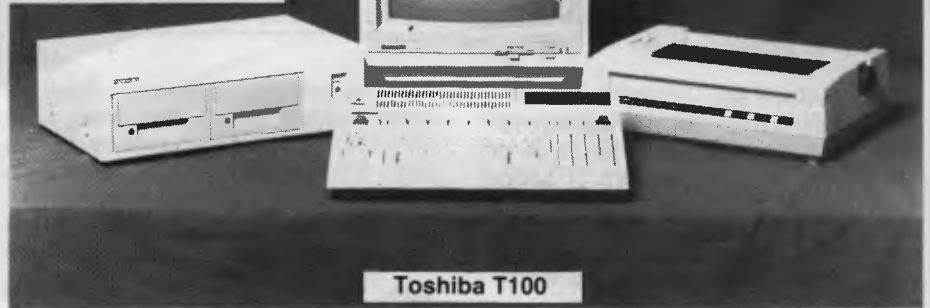
The other DIN connector provides RGB colour video (640 by 200 resolution, eight colours), and Toshiba has a matching monitor which provides a high-quality display. Two operating systems are provided: TBASIC, which is Toshiba's version of stand-alone Microsoft BASIC, and CP/M, which provides MBASIC and other languages.

A wide range of CP/M 2.2 software is available. The demonstration packages included Software Solutions' Office Costing system and Sapphire MARS (reviewed last issue). This means the T-100 can be put to work immediately for serious business tasks.

The T-100 highlights one of the most important features of the next generation of personal computers – portability. An executive can use it in the office during the day, and then take it home at night and continue to use it without disturbing the family's television-viewing. It can even be operated in a car.

The major drawback with this kind of machine is that it is a black box. Japanese manufacturers, for some reason, seem to think that people will only write their own programs in BASIC, and only supply CP/M as an afterthought – even then, there is a lack of information about screen-control codes, serial port addresses and other vital statistics.

However, for its high-resolution colour graphics in such a small package, its portability and its innovations, such as



battery-backed RAM cartridges and LCD display, the T-100 deserves serious attention.

### **Otrona Attache 512**

The Otrona Attache 512, reviewed in the November 1982 issue of *Your Computer*, is a small, portable machine which you can easily carry around – you could probably fit two of them under an airline seat!

The most obvious point of the Otrona is its attractive styling and neat packaging. Taking the covers off reveals the engineering quality continues inside. This is a quality machine. The keyboard, which unfolds *a la* Osborne, is small but has good spacing and feel, while the tiny screen is quite readable and produces high-quality video for external monitors.

The two disk drives have a total capacity of around 800 kilobytes, which is quite adequate for most applications. The operating system is CP/M 2.2, based on a Z-80A 4 MHz processor with 64 kilobytes of RAM. On power-up, the Otrona goes into terminal mode if no disk is inserted, and can be used as a terminal on a remote system.

A unique feature of the Otrona which impressed the judging panel was its Valet software package, which is partly ROM-based and partly resides on disk. By pressing the control and escape keys together, the user can obtain a small menu at the bottom of the screen. This labels the top row of keys to perform such functions as adjusting the screen brightness, controlling the tone and volume of the key-click and bell, and adjusting the baud rates on the serial ports.



**Otrona Attache 512**

In addition, a real-time clock and calendar is displayed. By now pressing the tab key, the user obtains a menu of additional functions. The most familiar of these is a screen-dump utility, which can be installed for the Epson MX-80 and other popular printers. Rather more unique are the other two functions – an alarm system and calculator.

Up to nine alarms can be set for any time and date in the future, and stored in memory. Associated with each can be a message line. Alternatively, the machine can be instructed to run a program, interrupting the current task if need be.

The calculator facility is similar to Hewlett-Packard's pocket calculators, with nine memories and an eight-level stack. Three of the memories are pre-initialised to common constants such as pi. Use of these Valet functions doesn't abort a running program – the operator can be in the middle of editing, using WordStar, and can then use the Valet calculator, returning to WordStar immediately.

Standard software supplied with the Otrona includes WordStar, Microsoft BASIC and a neat little graphics package called Charton. The Otrona screen boasts a 320 by 240 graphics resolution, which is assisted by plotting functions built into MBASIC, but Charton (which is written in MBASIC with source code supplied) extends its capabilities to provide simple business graphics such as line, bar and pie charts.

These software packages combine to provide a tremendous amount of functionality in a small package. This, along with the quality of design and construction of the machine, brought it to the shortlist.

### IBM-PC

The IBM-PC personal computer is a comparatively recent entrant on the Australian market. However, it has enjoyed meteoric success in the United States, where it has spawned an entire industry and sub-culture of its own in a way that few computers ever have.

It is, in many ways, a standard against which the others are judged. The engineering design of the machine is first-class, with high-quality construction and a pleasing design. The low-profile keyboard, sitting in front of the system unit, which supports the display, results in an ergonomic design which is aging well and has been copied by countless others.

The IBM-PC already has a vast array of software from third-party vendors, plus a growing range of hardware additions. However, the judging panel was less concerned with the quantity of software available than with its quality, and the ways in which the machine supported recent software techniques, such as the use of user-definable keys and graphics.

From the point of view of the award

criteria, the IBM-PC is really a fairly conservative machine. The hardware used in it could have been designed in 1978-79, and there are some things that the designers would undoubtedly do differently today.

What is outstanding about the IBM-PC is that it does a lot of things right. It was designed around disks, and is really the first popular computer that doesn't assume the user will start with a cassette system (although that's possible). It has a real disk operating system that is not an afterthought. It uses a 16-bit processor and can support memory-intensive programs such as spreadsheet calculators.

Its graphics are nice, particularly when viewed on a colour monitor, though many purchasers are confused or bemused by the variations of colour graphics and monochrome printer adaptors. In particular, it can sometimes be difficult for an owner to decide whether his machine is adequately "optioned up" to run a particular software package.

Its real plusses are less technical, less to do with the machine of itself and more to do with marketing and the snowball effect of gathering support for what is already a successful machine. In the eyes of its intended market, its major, dominating, feature is the IBM name tag on the front.

Next is the realisation that by buying an IBM, the user is joining a large, well-supported and mutually helpful group with no shortage of information, software and hardware options. The IBM support and dealer selection is also important.

The IBM-PC is almost completely devoid of failings. I could live with the keyboard, I could get by with 320 kilobytes/disk, and it shares with other 16-bit machines the surprising, and unnecessary, sloth of Microsoft's BASIC

interpreter.

The IBM-PC seems destined to take over the position now filled by the Apple II - a good all-rounder which can play games, be used to write simple BASIC programs, and which can also be introduced into the corporate environment as a personal workstation running such applications as VisiCalc or Multiplan.

In the eyes of the judges, then, this machine can be summed up as a conservative hardware design, not spectacular in itself, but with one major and significant contribution - the IBM-PC makes it safe to buy a personal computer.

### Columbia MPC

The Columbia MPC is the most successful of the IBM-PC "clones" - machines which feature at least software, and often hardware, compatibility with the IBM-PC in order to capitalise on the huge snowballing aftermarket of add-ons.

Certainly, one of the major questions in the judges' minds was that of compatibility, and so part of the time was spent swapping software between the two machines. As far as can be told, the user can buy the Columbia secure in the knowledge that it behaves just like an IBM-PC.

Even programs which rely heavily on hardware features like graphics, such as Microsoft's Flight Simulator, run perfectly on the Columbia MPC. We tried booting up Context MBA, which is a UCSD p-system program, and only failed because we hadn't enough memory on the test machine (128 kilobytes is a small machine already?).

Our test machine had an integrated 10-megabyte hard disk, which significantly improved the utility of the machine - no more changing disks.

The major feature of the MPC, in the ►

## PERSONAL COMPUTER OF THE YEAR COMPARISON CHART

Attribute/Computer	Weight	NEC	DEC	Otrona	Sirius 1	Columbia	IBM PC	Toshiba	Commodore	BBC Micro
Memory Capacity	.8	7 5.6	6 4.8	4 3.2	8 6.4	6 4.8	6 4.8	4 3.2	6 4.8	5 4
Disk Capacity	.8	8 6.4	6 4.8	6 4.8	7 5.6	5 4	5 4	4 3.2	4 3.2	4 3.2
Disk Compatibility	.5	7 3.5	4 2	3 1.5	3 1.5	7 3.5	7 3.5	3 1.5	4 2	3 1.5
Processor Speed	.8	9 7.2	6 4.8	6 4.8	6 4.8	6 4.8	6 4.8	4 3.2	6 4.8	6 4.8
Graphics	.8	9 7.2	7 5.6	6 4.8	8 6.4	7 5.6	7 5.6	5 4	6 4.8	5 4
Graphics s/w support	.8	8 6.4	5 4	6 4.8	7 5.6	7 5.6	7 5.6	5 4	7 5.6	5 4
Mechanical Design	.6	7 4.2	8 4.8	8 4.8	7 4.2	7 4.2	7 4.2	7 4.2	5 3	5 3
Electronic Design	.8	7 5.6	8 6.4	9 7.2	7 5.6	7 5.6	7 5.6	6 4.8	6 4.8	7 5.6
Construction Quality	.7	8 5.6	8 5.6	7 4.9	7 4.9	7 4.9	7 4.9	6 4.2	5 3.5	5 3.5
Software Innovation	.8	6.4.8	6.4.8	8 6.4	5 4	4 3.2	4 3.2	3 2.4	5 4	7 5.6
Software Ergonomics	.7	5 3.5	8 5.6	5 3.5	6 4.2	5 3.5	5 3.5	5 3.5	4 2.8	5 3.5
Keyboard Ergonomics	.7	6 4.2	9 6.3	6 4.2	7 4.9	6 4.2	6 4.2	4 2.8	4 2.8	5 3.5
Portability/utility	.8	4 3.2	5 4	9 7.2	5 4	5 4	5 4	7 5.6	6 4.8	4 4
Value for Money	.8	7 5.6	7 5.6	5 4	6 4.8	6 4.8	5 4	5 4	8 6.4	6 4.8
Total Weighted Score	.8	73	69.1	66.1	66.9	62.7	61.9	50.6	57.3	55



judges' view, is that Columbia is treading a fine line between providing IBM-PC compatibility and providing additional facilities or performance. For example, the MPC provides two serial ports and a parallel port as part of the main board; on the IBM-PC, these are optional boards.

The MPC has more slots available for expansion than the IBM-PC, has more memory as standard, and is supplied with a colour graphics adapter and RGB direct-drive monitor as standard. In addition, it comes with a bundle of software covering word-processing, spreadsheet, games, macro assembler, graphics, diagnostics and a tutorial on the operation of the machine.

Both MS-DOS and CP/M-86 operating systems are provided, giving the user access to a wide range of software. In addition, the Columbia supports MP/M-86, permitting multi-user operation of CP/M-86 software.

In summary, then, the Columbia MPC has many of the features of the IBM-PC. Its designers cannot provide the IBM logo on the front, but in many other respects the MPC out-IBM's the IBM-PC. It certainly provides equivalent performance at a price advantage, and offers very good value-for-money.

The machine's designers have done an excellent job, and the thought uppermost in the judges' minds was: what could Columbia have produced had it not felt constrained to provide IBM compatibility?

In the Seventies, IBM set a standard for its own computer architecture as well as that of many "plug-compatible" manufacturers with the System/360. Even its most recent machines are still based on the old 360 architecture, and the new XA (Extended Architecture) is really only a set of patches to bring it up to date (rather like the 24-bit addressing on the S-100 bus). The IBM-PC has had the same effect: it is now decreeing the personal-computer architecture of the Eighties.

Which led to a "moral dilemma" for the judges: can an award for advancement be made to a machine which deliberately avoids certain advances in order to maintain compatibility with an older design?

### **NEC Advanced Personal Computer**

The Advanced Personal Computer, or APC, from NEC Information Systems Australia, was reviewed in the October 1982 issue of *Your Computer*. It is another 16-bit machine, but, unlike the Columbia, eschews compatibility and aims for performance.

It is a large machine, with an integrated colour display and two vertically

mounted 20 cm disk drives. The processor, unlike the other 16-bit machines on the shortlist, is an 8086 with a full 16-bit external bus. And from these hardware features follow the three major advantages of this machine.

First, it is fast. It completed our BASIC prime-number benchmark in just over nine and a half minutes, as opposed to 14 or 15 minutes for the other 16-bit machines. This raw speed is not significant in many applications (who cares if it runs WordStar faster?), but it's put to good use in graphics applications, as the judges later found.

Next, due to the use of 20 cm floppy disks, the APC has much greater disk capacity than the other machines – 1 megabyte per disk. Though a 10-megabyte Winchester disk is available, many users will be able to get along without it, whereas the other machines would require a \$2000 or \$4000 investment for a Winchester.

The most noticeable feature about the APC, however, is its colour graphics – they are nothing short of superb. The graphics resolution on screen is 640 by 475 in colour, and this is only a scrollable window into a bit plane of 1024 by 1024. Colour saturation is superb, and the integrated display is obviously of very high bandwidth.

The display is managed by a pair of 7220 graphics-controller chips – runner-up in last year's *Infoworld* Hardware Product of the Year contest (the IBM-PC won). The graphics is, therefore, very fast in operation, since a lot of work which is done in software on other machines is done by this chip.

The graphics demonstrations supplied to us were outstanding. The APC presently supports CP/M-86, and one set of demos was written to run under Digital Research's GSX-86 graphics kernel. These ranged from standard business bar and line plots to an office floorplan and scientific three-dimensional planar plots. All executed very quickly, indeed, with appropriate labelling, sideways printing and changes of typefaces and colour.

NEC Information Systems will release MS-DOS for the APC later this month, and this will be followed by a full graphics-extended BASIC, *a la* BASICA. In the meantime, NEC Information Systems has, since the release of the machine, put a lot of work into locating and supplying CP/M-86 software, either under the NEC label or from other vendors.

Already available are a number of word-processors such as Benchmark (which has integrated communications facilities) and WordStar, languages such as CBASIC-86, CB-86, Janus/Ada, CIS/COBOL-86, RM-COBOL, Supersoft

FORTRAN and Pascal/MT+86, and a wide selection of database, accounting, communications and other applications programs. Coming up in the next few months are Digital Research's PL/I-86 and C-86, the DRI Graphics Support System packages, and of course, a wide range of MS-DOS programs such as Multiplan.

The indications are, then, that the APC is not the software orphan that the panel feared it might be. The biggest drawback the judges saw for the APC was the lack of provision for a Z-80 processor to give access to the range of CP/M 2.2 software – the 16-bit bus design of the machine may make this difficult or impossible and, of course, with the passage of time, this will be less important.

The APC scored highly in several areas: speed, capacity, graphics (especially), local support and excellence of design.

### **Sirius**

Marketed in Australia through Barson Computers, the Sirius is a very neat and compact 16-bit machine. It has been on the local market longer than the other 16-biters and has established itself strongly in that time.

The outstanding feature of the Sirius is the snowball effect, combined with an aggressive marketing plan both in Australia and overseas. The local agents were well aware of (and encouraged) all the third-party market activity around their machine, and produced an enormous software catalogue – really two catalogues for local and overseas software.

The Sirius has a tremendous range of software to support it, both in the general commercial area and in scientific and technical fields, where its high-resolution graphics have strong appeal. The graphics resolution is 800 by 400 – sufficient to provide virtually a grey scale or shading just by spacing out dots.

This high-resolution graphics capability has been one of the most attractive features of the Sirius. The demonstration programs supplied threw up some amazing graphics images, moving them about rapidly. Among enhancements to take advantage of these graphics capabilities is a video digitiser, or frame-grabber.

Several software packages are available to enable the user to take advantage of the graphics capability. Utilities allow the user to create special character sets, control graphics through escape sequences or create business graphics presentations – including organisation charts, a unique feature.

An interesting word-processing package called Vuwriter takes "what-you-▶



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see-is-what-you-get" screen formatting to its logical conclusion by allowing on-screen super- and sub-scripting, special characters, underlining and bold face and even mathematical equations (volume integrals yet!).

Like the Otrona, the Sirius has software-controlled brightness and also contrast control. The hardware design is neat, well-engineered and features considerable attention to ergonomics. There were a few small things that were "different" about the keyboard, such as a missing "control" key which turned out to be the ALT key, but overall it was quite convenient and easy to use.

The Sirius is also available with an integrated 10-megabyte hard disk which is broken up into volumes, allowing a mixture of CP/M and MS-DOS volumes on the disk. The hard disk is quite quick in operation, particularly under MS-DOS.

The software people at Sirius have been quick to take advantage of new techniques - for example, their latest version of MS-DOS includes a CP/M-86 emulator which allows CP/M-86 software to be run. The particularly neat feature of this implementation is that the emulator automatically loads and runs when required, transparently to the user.

Sirius Technologies has lined up a wide range of software for communications with mainframes (3270, RJE, asynchronous), micros (IBM-PC, Sirius) and networks (Omninet). There is a vast array of other CP/M-86 and MS-DOS applications programs.

The Sirius has a couple of unique features. Perhaps the best-known of these is its disk drives which vary their rotational speed in order to allow constant density recording. Using this technique, the Sirius designers have managed to

cram 640 kilobytes capacity on to each disk, a more than respectable figure. The only major drawback of this technique is the complete impossibility of providing IBM-PC compatibility.

Another innovative feature is an on-board CODEC (coder-decoder) chip which allows speech input-output. This is not the same as speech synthesis - it's more like low-quality digital recording - but it can be very useful. When the Sirius network is introduced later this year, it will provide the ability to send voice-grams between work-stations.

All of this adds up to a technically very sophisticated machine. It's easy to see why it's so well received - its advanced graphics features and the wide range of applications packages make it a very versatile computer. ▶



IBM-PC



Commodore 64

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## DEC Rainbow 100

The DEC Rainbow 100, first discussed in *Your Computer* in June 1982, is a striking piece of equipment. From the point of view of ergonomics and styling, it's a very well-designed machine, indeed.

The main system unit is about the same size as the IBM-PC and is made of Lexan, an extremely tough and resilient plastic. It incorporates the main processor board, together with a dual disk-drive unit and power supply, with room for a second disk unit.

The system unit can be placed on top of the desk with the display on top, but a more stylish (and practical) solution is to slide the unit into a vertical floor-stand which hides all the cables at the back and sits on the floor beside the user's desk. The front name badge even rotates through 90 degrees!

The display is very neat, with a non-glare shield and, at the back, a small carrying handle. The keyboard plugs into the back of the screen, and the screen-computer cable carries the video signal, power for the screen and the keyboard data.

The keyboard is a joy — it easily the best of those on the shortlisted computers. It has a full QWERTY pad, then cursor and special functions and, at the extreme right, a numeric pad. Across the top of the keyboard is a set of program-definable keys — some are dedicated to special codes like DO and HELP.

Even as just a terminal, the DEC Rainbow is superb; it fully emulates the DEC VT-102 terminal. Pressing the SET-UP key displays the first set of user-alterable tab stops. Pressing NEXT PAGE reveals a set of miscellaneous

parameters, such as hard/smooth scrolling, screen width (80 or 132 characters), enable/disable auto-wrapping, change baud rates and so on.

On power-up, the Rainbow performs a diagnostic test which is quite comprehensive and supplies the user with comprehensible error messages — the judges know because they got one. Their machine refused to boot, and the error message referred them to the user manual, which informed them that the heads on drive A were not stepping correctly. Possible cures: check the drive cables, replace the disk-drive unit or contact DEC for a service call.

The beauty of the Rainbow is that the user can check the cables himself — in fact, the entire machine can be taken apart, down to its functional modules, with no tools at all. A couple of spring clips remove the cover, some thumb-screws release the main board, and a clip releases the disk drives. After checking the cables, the test machine still wouldn't respond, so we phoned DEC's Hotline number and described the problem.

Two hours and 20 minutes later, a technician had arrived. Within 10 minutes, the disk drive was removed, heads slid into their proper position and replaced, and the system booted. However, a full diagnostic test revealed a further problem and so the drives were replaced.

The basic problem was that the transport card which protects the heads was pushing them too far out. When they stepped out to the home position, they were already past it and moving away. Result: a step error.

Full marks to DEC's service organisation; as far as we can tell, we were

treated as an ordinary user. Later the same day, the Hotline phoned back to check that the problem had been rectified to our satisfaction.

The Rainbow is a dual-processor machine (Z-80 and 8088) which has the ability to run both CP/M-86 and CP/M 2.2 software. It does this through a special version of CP/M called CP/M-86/80, which detects what kind of processor will be required for the program being loaded and automatically switches processors. This is a particularly elegant way of providing users with a bridge between the eight- and 16-bit worlds.

DEC itself takes advantage of this. While some of its software — for example, RED, the Rainbow screen editor — is written in 8086 code, other programs, like the DUMP utility, are written in Z-80 code. Assemblers, loaders and debuggers for both processors are provided, and when we ran DDT (the Z-80 debugger), a quick scan of memory revealed nothing that didn't look like a conventional eight-bit CP/M system.

But there are some problems with this approach. There is no Z-80 BIOS, for example, so programs which do direct-disk I/O won't work, though the Z-80 actually does the disk I/O. And what happens when a CP/M-80 program uses BDOS function 31 (Get address of Disk Parameter Block)? Chances are the DPB isn't even within the 64 kilobytes which the Z-80 addresses — or is it? We weren't inclined to try to find out.

The documentation supplied with the Rainbow is excellent — far better for the novice user than the Digital Research manuals — but they do leave the Rainbow as something of a black box. That it works beautifully well is undeniable, but sometimes the user needs to make ▶

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decisions based on a knowledge of how it works. And that information is not forthcoming from DEC.

A graphics upgrade is available which provides high-resolution mono or colour graphics. Digital Research has also demonstrated its GSX graphics kernel on the Rainbow, but that isn't yet available here. However, the potential is there for some superb colour graphics.

To date, DEC has been a bit slow in providing software to run on the Rainbow. The standard utilities are excellent; there's a nice disk-maintenance program which allows group deletion, re-naming and the like, and which is much nicer than any of the public-domain utilities such as SWEEP. The screen editor, RED, is really nice – it's reminiscent of the UCSD Pascal editor, good enough to use as a word-processor and certainly much better than ED (which is also supplied).

An introductory course supplied with the machine teaches the user about the keyboard – how to use the DO and HELP keys, for example – as well as about files, directories, how to run programs and the other skills needed to get to grips with the machine. However, the care that went into designing this program hasn't been carried over to such small tasks as augmenting the CP/M-86 HELP command to cover the RED, DUMP and MAINT utilities – an easy couple of hours work for the right person.

This is the major drawback of the Rainbow – the software potential of the machine is not being realised quickly enough. Perhaps it needs a key individual with a lot of drive to convert packages off other machines, or perhaps it's because many software vendors are scared of the "blackbox" mysterious inner workings of the machine.

However, it scores highly for its well-engineered construction and ergonomic design, the innovation of the dual-processor design, the fantastic screen, its user-friendliness and the DEC thoroughness that underlies all this.

### Choosing A Winner

By now, it should be obvious that selecting a winner from these machines was not an easy job. The judges pored over the machines, lingering over one, going back to another to check and compare.

Gradually, we narrowed the field down. The eight-bit machines were just not competing with the 16s – they didn't represent enough of an advance. A points-scoring system served to confirm

this, though the Otrona does have sufficient innovations and performance to make it into the new, shorter, shortlist.

The IBM-PC was similarly excluded. Its major advantages, and the major innovations that it brought to the market, are not part of the product itself (unless you count the three initials on the label). They are the IBM name and reputation, and the support of IBM and its dealers. The newer 16-bit machines held all the aces in other areas.

That brought the shortened shortlist down to five: the Columbia, the Otrona, the Sirius, the DEC Rainbow and the NEC APC.

The points system was brought into play again, this time combined with a forced-ranking system for scoring. Each of our objective selection criteria was compared against each of the machines in turn, and a table was constructed. The results clarified the situation considerably.

The Columbia now dropped out – its major advantage is IBM-compatibility, and it did not represent a major advance in any other area when compared against the remaining contenders.

Next to go was the Sirius, which to some extent surprised us. Despite its marvellous high-resolution display and the tremendous degree of hardware and software support, the newer machines technically out-classed it in several key areas. The Sirius is presently near its peak; the Sirius team has assembled a vast array of software, but that same software can be converted to run on the other 16-bit machines and, in time, almost certainly will. As the machine with the longest history on the market, it gained an advantage, but the others will catch up.

The Otrona, still in the running up till this stage because of its innovative Valet software, coupled with a high-performance BASIC and graphics in such a handsome and portable little package, was now being steadily outclassed by the opposition. It's a marvellous little machine, but the newer machines had some major advantages.

That left NEC and DEC, and again the selection panel ground to a halt as it bogged down in masses of incomparable detail. It was then decided to take the machines to bits, examine the innards, and then study them again.

The DEC machine represents a triumph of design. Ergonomically, it is superb. The keyboard and screen are stylish and a delight to use, and the documentation is superb. The mechanical design supports ease of maintenance,

and the diagnostic software backs this up. The dual processor gives an enormous potential for running widely-available software. And DEC has an enviable reputation as a minicomputer manufacturer. Against this must be set the "blackbox" character of the machine, and the current software vacuum.

NEC's Advanced Personal Computer has three major plusses: its much greater disk capacity, its processor speed and its incomparable high-resolution graphics. The APC excels in each of these areas. NEC is working hard in both Australia and the United States to port software on to the machine, and the documentation for the packages so far released is superb – not at all Janglish. The existing software availability under CP/M-86 is excellent. When MS-DOS is released this month, we expect NEC to firmly grab that ball and run with it, too.

So, on balance, after considerable debate, the selection panel has decided to award the 1983 Personal Computer of the Year Award to NEC Information Systems Australia for its Advanced Personal Computer.

The APC clearly excels in three areas which are critical to the performance of any computer system. It may well succeed in the world market in a way that no Japanese computer has done before – because of co-operation between the Japanese hardware designers and the United States office, which worked on software.

We at *Your Computer* would like to thank the various computer companies involved for supplying machines for evaluation, as well as for their patience in waiting for the result to be announced.

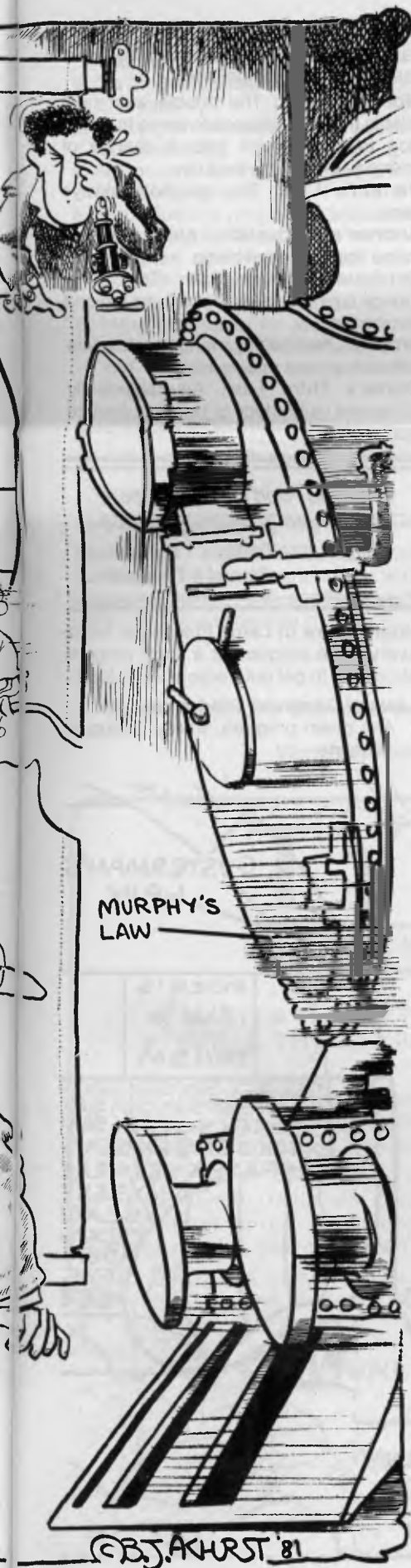
Because of deadline dates and other constraints, this award has spanned the period May 1, 1982, to April 30, 1983. Starting from next year, we intend to work on calendar years. Therefore, the next Personal Computer of the Year Award, to be presented in February 1984, will cover the period from May 1, 1983, until December 31, 1983.

At the same time, we propose to make an award for the Software Product of the Year – software is just as important as hardware in getting a job done.

So until January 1984, the hardware and software companies can get prepared. In the meantime, congratulations to NEC Information Systems Australia, the winner of the 1983 Personal Computer of the Year Award from *Your Computer*. □







Ever been stuck for an excuse? Never been able to put into words just why nothing goes right? Lost for a reason when something unreasonable occurs? Puzzled by all that happens about you? Curious as to why something that shouldn't happen invariably does? Join Your Computer in plotting the answers to these questions, and many more, in this selection of trueisms, quotes and homilies stolen, filched and plagiarised from people, places and magazines you've never heard of.

# THE REAL LAWS OF LIFE...

Logic, that great cornerstone of our society, has absolutely nothing to do with day to day reality — it's all a plot begun with Plato and carried on by Norman Gunston and Sartre to convince us that one and one does make two.

It doesn't, never has, never will, but if you try to program your computer to work it out, it'll explode.

Computers work solely with logic, but logic has nothing to do with:

**Murphy's Law:** If something can go wrong, it will.

**Murphy's Law of Thermodynamics:** Things get worse under pressure.

**Anthony's Law of Force:** Don't force it; get a large hammer.

**Yale Law:** Under the most rigorously controlled conditions of pressure, temperature, volume, humidity, and other variables, the organism will do as it damn well pleases.

**Horwitz's First Law of the Admiralty:** A collision at sea can ruin your entire day.

**The Golden Rule of Arts and Sciences:** Whoever has the gold makes the rules.

**The First Rule of CP/M Alteration:** CBIOS's for 32K CP/M aren't.

**Weiler's Law:** Nothing is impossible for the man who doesn't have to do it himself.

**Fitzgibbon's Law:** Creativity varies inversely with the number of cooks involved with the broth.

**Chisholm's Law:** Any time things appear to be going better, you have overlooked something.

**Shanahan's Law:** The length of a meeting rises with the square of the number of people present.

**Finagle's Law:** Once a job is fouled up, anything done to improve it makes it worse.

**Rerdin's Law:** In a crisis that forces a choice to be made among alternate courses of action, most people will choose the worst one possible.

**Ross's Law:** Never characterise the importance of a statement in advance.

**Salinger's Law:** Quit when you're still behind. When you're in a hole, don't dig.

**Allen's axiom:** When all else fails, read the instructions.

**Patrice's Theorem:** If the experiment works, you must be using the wrong equipment.

**Skinner's constant:** That quantity which, when multiplied times, divided by, added to or subtracted from the answer you got, gives you the answer you should have got. (Also known as Finnegan's Finagling Factor).

**Homer's Five Thumb Postulate:** Experience varies directly with the amount of equipment ruined.

**Gusterman's Law:** The probability of an event occurring is inversely proportional to its desirability.

**Timely Order Principle:** Those supplies necessary for yesterday's experiment must be ordered no later than tomorrow noon.



2. Any given program costs more and takes longer.
3. If a program is useful, it will have to be changed.
4. If a Program is useless, it will have to be documented.
5. Any given program will expand to fill all available memory.
6. The value of a program is proportional to the weight of its output.
7. Program complexity grows until it exceeds the capability of the programmers who must maintain it.
8. Make it possible for programmers to write programs in English, and you will find that programmers cannot write English.

---

*This time it will surely run.*

Anon.

---

**Weinberg's Law:** If builders built buildings the way programmers wrote programs, then the first woodpecker that came along would destroy civilisation.

**Quotable Quotes:**

A virtual data base is a segment of your imagination

Sigmund Freud.

A flat file is not a list of apartments.

Euclid.

---

*The generation of random numbers is too important to be left to chance.*

Robert Coveyou

---

I strongly recommend the use of chains.

Marquis de Sade.

A lexicon is a small Irish dictionary.

Faith Begora.

On a clear disk you can seek for ever.

SDD Song Center.

Hollerith got us into this hole mess.

US Census Bureau.

This time it will surely run.

Anonymous.

I just found the last bug.

Unanimous.

---

*It is impossible to make anything foolproof because fools are so ingenious.*

Edsel Murphy, DEC.

---

**Ellenberg's Theory:** One good turn gets most of the blanket.

**The Point of No Return Law:** The light at the end of the tunnel could turn out to be the headlight of an oncoming train.

The generation of random numbers is too important to be left to chance.

Robert R. Coveyou,  
Oak Ridge National  
Laboratory.

It's redundant! It's redundant!

R.E. Dundant.

I don't know any reason why we couldn't do it, but maybe we can think of one.

Mark C. Davison.

Bug? That's not a bug, that's a feature.

T. John Wendel

I write all my critical routines in assembler, and my comedy routines in FORTRAN.

Anonymous.

---

*Always listen to experts.  
They'll tell you what can't be done, and why, then do it.*

Lazarus Long

---

It is impossible to make anything foolproof because fools are so ingenious.

Edsel Murphy, DEC.

If debugging is the process of removing bugs, then programming must be the process of putting them in.

Dijkstra.

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# HIDDEN BEHIND THE SCENES

## An Operating System Called

# CP/M

*Most computer freaks have heard of CP/M, even if they don't actually run it. It's even available for the Apple, and is the most popular operating system for the TRS-80 Model II. Les Bell fills in the background for first-time users.*

IN 1976, vague rumours started to circulate about a new piece of software: a floppy disk operating system which enabled the microcomputer owner to use floppy disks to store data and programs for fast access. The rumours turned out to be true and Gary Kildall's Control Program for Microprocessors (CP/M) was released soon after. In fact, it had been released to OEMs (Original Equipment Manufacturers) for some time and was reasonably well debugged.

CP/M is now the most popular operating system in the world, with far more installations than any other. What is it? To understand that, we'd better start with the basics of floppy disk operations (talking about eight-inch (20 cm), single-sided, single density disks initially, to keep it simple!).

A floppy disk stores information in 77 concentric tracks, each of which contains data plus extra information to identify the sector, track and so on. The trouble is, you can't treat a floppy disk the way you would a cassette tape; you can't just position the read/write head over a particular section of the disk and say, "Okay, computer, write that text file here." For a start, the disk is rotating at 360 rpm, and secondly, you don't know what may have been recorded on that spot previously.

This is the beauty of disk operating systems. A DOS program will automatically keep track of what areas of the disk have been used, and will only write to unused areas. What's more, you never have to know exactly where on the disk a particular file is stored – the DOS will read and update a directory of the files on the disk. All you have to do is remember the name of the file.

### Using CP/M

CP/M does all this and more. Assuming you have a working and installed copy of CP/M on your system, then it's easy to use. Once you reset the system, it should automatically boot CP/M into memory from the disk and run it. The console should display a sign-on message, followed by the prompt A.

This indicates CP/M is running and that drive A is the current drive; in other words that all file references are to files on drive A unless otherwise specified. To run a machine code utility program, all you have to do is type in the name of the program: to run Microsoft BASIC, for example, one just types MBASIC, and BASIC should sign on shortly after.

File names in CP/M all follow the same pattern; up to eight characters of primary name, followed by a period and a three-character extension. Looking at the disk I'm editing this article on, for example, I can see: MBASIC.COM, a command file; WSMGS.OVR, the word processing program WordStar's messages OVERlay file; CPMINTRO.BAK, a backup version of this article; VB3.ASM, an assembly language source file; CMAC.LIB, a macro assembler library file; GRAFIX.C, a C (language) source file; GRAFIX.CRL, a C relocatable object file; ICRT.SYM, symbol table file, and so on.

Generally speaking, file names cannot contain punctuation symbols – the reason for this will soon become clear as we look at CP/M's wild-card matching of file names.

The command DIR will print a directory of all the files on the current disk drive. To obtain a directory for another drive, the drive name is merely appended to the command, e.g. DIR B: would give a directory of drive B.

If you don't want a full directory, but merely want to know the names of the files you've generated while working on a video board driver, for example, you might just type DIR VB3.\* to get a listing of all files with that prefix.

This \* matches any extension; similarly, you can type DIR \*.ASM to get a catalogue of assembly language files on the disk.

The Kaypro II derives much of its power from the CP/M operating system.



The command `DIR W*.*` would match all the files with names beginning with W.

To refer to files that are not on the current disk drive, prefix their names with the name of the drive; for example, `DIR B:*.ASM` would list all the assembly language files on drive B.

### Built-in Commands

CP/M has a number of built-in commands; DIR is one example. Another is TYPE, which lists the contents of a file (this command will not accept wild-card matches). ERA erases a file, or group of files, from the disk (see Table 1).

REN renames a file, for example `REN S.BAS = SINEPLOT.BAS` will rename SINEPLOT.BAS to S.BAS. SAVE n filename will save n pages (256 bytes) from the transient program area and name it filename. This is useful for saving the debugged versions of machine language programs.

### PIP

The other major utility supplied with CP/M is PIP (Peripheral Interchange Program). Although most people use it simply to transfer files between disks, PIP is capable of a lot more.

To transfer a file between disks, type:

```
PIP B: = A:filename.typ
```

which copies the file from drive A to drive B. After the file name, one can choose to put a string of parameters in square brackets. These parameters give PIP a lot of its power.

For example, the V parameter causes PIP to verify that a file was written correctly to the destination disk. The L parameter will translate all upper case letters to lower case, while the U parameter does the converse. The N parameter adds line numbers to a file. Using the various parameters, one can change the lengths of pages in a file, and a number of other quite fancy tricks. The trouble is, one uses these techniques so infrequently one tends to forget what is possible.

PIP recognises CP/M's wild-card expansions, and can transfer a number of files at a time. For example:

```
PIP B: = A:*.COM
```

will transfer all the command files on A to B.

As well as transferring files between

disks, PIP can also operate between the various peripheral devices such as the console, paper tape reader and punch, and the printer. The command:

```
PIP A:TFILE.COM = RDR:
```

will read the contents of a paper tape from the reader into file TFILE.COM on drive A.

### Other CP/M Utilities

The CP/M editor, ED, is a very straightforward and simple editor, based loosely on the editors found on most mainframes. It makes no assumptions about the console hardware, and so doesn't have any cursor move or video editing functions. Most users will soon buy a more sophisticated editor, so I don't propose to describe ED here.

The CP/M assembler is an 8080 assembler, with conditional assembly, but no macros. It reads input from a file called name.ASM and outputs an 'Intel hex format' file called name.HEX.

The user then runs the LOAD utility to convert the hex file into an executable program file called name.COM. The COM file can now be run, just by typing 'name' after the console prompt. ▶

The complete CP/M system normally lives on the outermost two tracks of the floppy disk, and has to be put there by a special program called SYSGEN. When sysgen is run, it asks the user whether the source of the system is one of the disk drives, in which case the resultant system is a straight copy, or whether the system is already in memory following modification. This facility allows the user to customise the system in various ways.

CP/M is normally located at the top of the memory in the user's computer, so that depending on how much memory you have, your version of CP/M will be located at a different address. If you should add more memory to your system, you will have to relocate CP/M in memory in order to use it. This is done using the MOVCPM utility, which can automatically relocate CP/M for any size of system.

A DUMP utility is provided to display the contents of a disk file on the console in hex. Another useful utility is SUBMIT, which allows you to automatically execute a whole string of system com-

mands, one after the other. This is particularly useful when you are debugging a machine code program, then editing, reassembling, linking, loading and executing a file time and time again. Instead of having to type the commands at the console repetitively, you just put them into a submit file, and SUBMIT it.

### Transient Commands

As well as the built-in commands, CP/M supports what are called transient commands. These are actually programs which load into the 'transient program area of memory, which starts at location 0100H for standard systems and 4300H for TRS80s and the like. Several of these transient commands are supplied with CP/M: the editor, for example, as well as the assembler.

The names of transient command files end in .COM (command), and they are run simply by typing in the primary name of the command. Some of the transient commands are very powerful indeed, particularly STAT and PIP.

The STAT utility provides statistical information on the amount of free space

left on the disks. Simply typing STAT, for example, will return a message like:

```
A:R/W, Space: 276K.
```

To get the amount of space on drive B, you type STAT B:

STAT does a lot more than that, though. It will also provide information about individual files. For example, STAT WUMPUS.BAS tells you the file WUMPUS.BAS occupies 24 records and is 4 Kbytes in length, that it is contained in one logical extent and is read/write, as opposed to read only.

If the filename appears in parentheses, it would indicate that the file has the system attribute set, and would therefore not be shown in a directory listing.

```
Recs Bytes Ext Acc
24 4k 1 R/W A:WUMPUS.BAS
Bytes Remaining On A: 276k
```

STAT can be used to set a file to read only; for example, STAT WUMPUS.BAS \$R/O would make the previous file read only. It can also make entire disks read only, at least between warm boots. To remind yourself of the capabilities of STAT, you can use the program itself; STAT VAR will type:

```
Temp R/O Disk:d = R/O
Set Indicator: d:filename.typ R/O $R/W
$$SYS $DIR
Disk Status: DSK: d:DSK:
User Status: USR:
Lobyte Assign:
CON: = TTY:CRT:BAT:UC1
RDR: = TTY:PTR:UR1:UR2
PUN: = TTY:PTP:UP1:UP2
LST: = TTY:CRT:LPT:UL1
```

### File Access For Programs

A disk operating system, by itself, isn't much good unless its facilities for loading and storing files are available to programs, as well as the operator at the console. CP/M has two levels of interfacing complexity, at each of which the power of the disk system is made available to programs running in the system.

First, it's necessary to understand the way CP/M works. CP/M is made up of

Table 1.

#### Built-in commands

ERA	erase a file
DIR	list directory to console
REN	rename a file
SAVE	save a binary image
TYPE	list a file to console

#### Transient commands

STAT	statistics about storage, status of peripherals
ASM	the standard CP/M assembler
LOAD	loads an Intel hex format file into a COM file
DDT	Dynamic Debugging Tool
PIP	Peripheral Interchange Program
ED	editor program
SYSGEN	puts system image onto a fresh diskette
SUBMIT	batch processing command
DUMP	display the contents of a file in hex
MOVCPM	moves the CP/M system in memory
XSUB	extended SUBMIT feature

Certain other utilities may be supplied with your copy of CP/M:

FORMAT	formats a diskette
EBASIC	BASIC-E compiler
RUN	BASIC-E run-time package

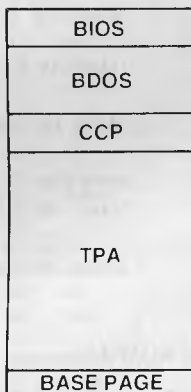
as well as files of code:

BIOS.ASM	standard BIOS for Intel MDS -800
DEBLOCK.ASM	deblocking algorithm for double-density systems
DISKDEF.LIB	disk definition library



four parts: the BIOS (Basic I/O System), the BDOS (Basic Disk Operating System), the CCP (Console Command Processor) and the TPA (Transient Program Area). The first three components move around in memory (see Figure 1), depending on how much memory is available in your system; but they always live at the top end of memory, while the TPA always begins at location 0100H. Obviously, the higher the CCP and the other parts are, the bigger the TPA is.

Figure 1.



At the very bottom of memory, below the TPA, are 256 bytes of RAM used for system parameters and a couple of jumps, interrupt restarts, and miscellaneous variables. In particular, location 0 contains a jump to the warm boot loader of CP/M, and location 0005 contains a jump to the entry point of the BDOS. Note that on the TRS-80 and other 'special' versions of CP/M, the system information and TPA will be much higher in memory (usually 4300H), and will require modified versions of most programs to run.

The BIOS is the part of CP/M that varies from machine to machine, and contains subroutines to perform console I/O, home the disk head, select a disk drive, set the track and sector number, read a sector, write a sector, and other 'primitive' functions (see Table 2). The operation of the BIOS is conceptually quite simple (once you've played around with it for a while), but in practice, it contains quite a lot of tricky code which is very hardware-dependent. For most users, the BIOS is a bag of worms that is best left alone.

Table 2.

jmp boot	:entry point from cold boot load
jmp wboot	:warm start
jmp const	:check console status
jmp conin	:console input routine
jmp conout	:console output routine
jmp list	:list device output routine
jmp punch	:punch output
jmp reader	:reader input
jmp home	:move to track 0 on selected disk
jmp seldsk	:select disk drive
jmp settrk	:set track number
jmp setsec	:set sector number
jmp setdma	:set dma address
jmp read	:read selected sector
jmp write	:write selected sector
jmp listst	:return list status
jmp sectran	:sector translate subroutine

BIOS entry points.

Table 3.

BDOS Function Summary

Func	Function Name	Input Parameters	Output Results
0	System Reset	none	none
1	Console Input	none	A = char
2	Console Output	E = char	none
3	Reader Input	none	A = char
4	Punch Output	E = char	none
5	List Output	E = char	none
6	Direct Console I/O	see def	see def
7	Get I/O Byte	none	A = iobyte
8	Set I/O Byte	E = iobyte	none
9	Print String	DE = &buffer	none
10	Read Console Buffer	DE = &buffer	see def
11	Get Console Status	none	A = 00/ff
12	Return Version Number	none	A = version
13	Reset Disk System	none	see def
14	Select Disk	E = disk number	see def
15	Open File	DE = &fcb	A = dir code
16	Close File	DE = &fcb	A = dir code
17	Search for First	DE = &fcb	A = dir code
18	Search for Next	DE = &fcb	A = dir code
19	Delete File	DE = &fcb	A = dir code
20	Read Sequential	DE = &fcb	A = err code
21	Write Sequential	DE = &fcb	A = err code
22	Make File	DE = &fcb	A = dir code
23	Rename file	DE = &fcb	A = dir code
24	Return Login Vector	none	HL = login vect
25	Return Current Disk	none	A = disk no
26	Set DMA Address	DE = &dma	none
27	Get &alloc_vec	none	HL = &alloc_vec
28	Write Protect Disk	none	see def
29	Get R/O Vector	none	HL = R/O vector
30	Set File Attributes	DE = &fcb	see def
31	Get &dpb	none	HL = &dpb
32	Set/Get User Code	see def	see def
33	Read Random	DE = &fcb	A = err code
34	Write Random	DE = &fcb	A = err code
35	Compute File Size	DE = &fcb	fcb.ranrec, fcb.ovflow
36	Set Random Record	DE = &fcb	fcb.ranrec, fcb.ovflow

BDOS Functions. Notes: 'see def' means that the reader is referred to the Digital Research manual 'CP/M 2.0 Interface Guide' for full details. The '&' symbol means 'address of'. 'fcb' = 'file control block'; 'dpb' = 'disk parameter block'; 'alloc\_vec' = 'allocation vector'; 'fcb.ranrec' and 'fcb.ovflow' refer to the random record number of a file control block.



The BDOS, of course, like the CCP, is supplied by Digital Research and is *not* to be tampered with. The BDOS is a collection of routines which operate at a much higher level than the BIOS, to do things like renaming files, searching for files, reading sequentially from files and so on. A complete list of the BDOS functions is given in Table 3.

Ignore all the more complex functions for the time being. Let's just look at console I/O: how would you write a program to copy the input to the output? The console input and output functions are numbers 1 and 2 respectively. To call CP/M's input routine, you load the function number (1) into the C register of the 8080 or Z-80, and call location 0005. This location contains a jump to the BDOS entry point. When control returns to your program, the accumulator will contain a character which has been input from the console. The console input routine will not return to the calling program until a character has been typed.

To output that same character, move it into the E register (MOV E,A in 8080 assembler), load C with the value 2 (the function number) and call location 0005 again. When control returns to your program, the character will have been output. To complete your program, all you need is a jump back to the beginning of the program, so that the program will keep looping round, echoing its input to its output.

The basic program is shown in listing 1. If you are an experienced program designer, you can probably see at least one problem with this simple program. The program will never end as it stands; it will just keep on looping around and around. A simple fix is to do a comparison with ↑C (control-C) and return to CP/M if the zero flag is set.

#### Listing 1.

```

; demonstration program for cpmintr2.doc
; copies input to output

0001 =    input  equ    01          ;input function code
0002 =    output equ    02          ;output function code
0005 =    bdos   equ    0005h       ;bdos jump vector

0100                org    0100h    ;start at base of tpa

0100 0e01    start: mvi    c,input   ;ready for input
0102 cd0500    call    bdos
0105 5f      mov    e,a           ;move char into e
0106 0e02    mvi    c,output      ;ready for output
0108 cd0500    call    bdos
010b c30001    jmp    start       ;round and round...
010e                end

```

Listing 1 Copy input to output using BDOS functions.

#### Listing 2.

```

; demonstration program for cpmintr2.doc
; copies input to output, without echoing, and checks for ^c

0001 =    input  equ    01          ;input function code
0002 =    output equ    02          ;output function code
0005 =    bdos   equ    0005h       ;bdos jump vector
0003 =    ctrlc equ    03          ;ascii value of ^c

0100                org    0100h    ;start at base of tpa

0100 0e01    start: mvi    c,input   ;ready for input
0102 cd0500    call    bdos
0105 5f      mov    e,a           ;move char into e
0106 fe03    cpi    ctrlc        ;is it a ^c?
0108 c8      r2                    ;if it is, return to cp/m
0109 c30001    jmp    start       ;round and round...
010c                end

```

Listing 2. Cleaned-up version of listing 1.



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The other problem is even more obvious: the console input routine also automatically echoes the input characters to the output routine. To fix it, just remove the output section of the code; it's redundant. The finished version of the program is shown in listing 2.

### Getting Fancy

As an example of something a little more sophisticated, take the case of printing an error message on the console. BDOS function 9 allows outputting a string in one go; take a look at listing 3.

At the beginning of the program, equates are used to set the ASCII values of carriage return and line feed. The program is much more readable if constants are symbolically defined in this way. The two CP/M entry points are defined at the beginning too, as well as the print string function number. Then the program really starts.

The DE register pair is used in many BDOS calls as a pointer to a block of information in memory – in this case, the block of information is the string we want to print. The program sets up DE, then puts the print function number into C, and calls the BDOS. When it returns after printing the string, rather than returning, in this example the program exits by jumping to the CP/M warm boot entry point, which reloads the system.

Notice that the string ends with a '\$' character. This is the character that the BDOS looks for to signal the end of the string, and it is not printed.

### Disk I/O

The preceding example showed how to do simple console I/O through the BDOS. Disk I/O is much more complex, but still done through simple steps in the same way. Here's how it works.

CP/M keeps a *directory* on the disk, which contains information about each file: its name, where it is on the disk, its length, R/O status, and so on. Accessing a file is done in several stages. The first step is to read the directory information into memory in order to locate the file on the disk. This is called *opening* the file, and the in-memory copy of the directory entry is called a *file control*

Another machine that relies on CP/M is the Osborne.



*block*. Once this is done, CP/M now has the information it needs to read or write from or to the file.

Writing to a file often has the effect of making it longer; this means that the directory information is now wrong, and so when the file has been updated, it is then *closed* by writing the file control block (fcb) out to the directory. Reading a file does not affect the accuracy of the directory entry, and so it is not necessary to close a file that has been opened for reading only.

### What's In An FCB?

As explained above, the BDOS keeps information about files in memory in a data structure called a file control block. The file control block is 36 bytes long,

**BEGINNERS**

and contains the following information:

Byte 0: Drive code (0 for current drive, 1 for A:, 2 for B:, and so on).

1 – 8: File name, in upper case ASCII

9 – 11: File type, in upper case ASCII. The most significant bits of each of the first two letters also indicate whether the file is read-only and whether it is a system file.

12: Current extent number, normally set to 0 by the user.

13, 14: Used internally, normally set to 0 by the user.

15: Record count for the current extent.

16 – 31: Used internally by CP/M.

32: Current record number for sequential I/O, normally initialised to 0 by the user.

33 – 35: Optional random record number in the range 0 – 65535.

All the file access BDOS functions operate by passing the address of a file control block to the BDOS. For example, function 17, *Search for First*, will find the first directory entry that matches a wildcard filename in an fcb. So the user can initialise an fcb with the name 'A?????.COM' and the function will load into memory the directory sector containing the first matching entry – say, ASM.COM

Listing 3 shows an example of a program that uses the BDOS disk primitives. This simple program reads in a

text file, a sector at a time, and lists it to the console. In other words, it does exactly the same job as CP/M's 'type' command.

This program is run by typing 'LIST filename' (assuming it is called LIST.COM), and the CP/M console command processor will automatically set up a file control block at location 05CH, and initialises it with the name 'filename'. So when this program starts running, the file control block is initialised with the name of the file to be listed, and the program can open it straight away.

The first thing the program does is to save the stack pointer in a temporary location and replace it with its own, local stack. It then calls subroutine 'Open'. This sets the file record number to zero, so that it points to the beginning of the file. It then calls the BDOS open function, which will either open the file or return 255 on an error. If there is an error, the main program will print an error message, otherwise it proceeds to set up a pointer to the end of the CP/M 128-byte buffer.

We now enter the main loop, 'PLOOP'. This first tries to get the next character from the buffer. Since the buffer pointer is at the end of the buffer, there is no next character, and so the character read routine, 'GNC', will call the sector read routine 'DISKR'. This has the side effect of zeroing the ac-

cumulator (if there was no error or end-of-file), so that the buffer pointer now points to the beginning of the buffer again, and so the next character is returned to 'PLOOP'. If either a physical or a logical end of file is encountered, the routine returns with the carry set.

The character is saved in B while the program checks to see if a key has been struck, and then it is printed. When the end of the file is encountered, the program jumps to 'Done', which prints a carriage return and line feed, and then restores the original stack before returning to the console command processor.

Although this program doesn't do much, it does illustrate the basic methods used to interface a program to CP/M. The program could be the basis of a much improved 'list' program by employing a few simple modifications: for example, a counter could be set up to count the line feeds in the file, and insert a form feed character after every 66 lines. This would format the listing into pages, instead of a continuous listing, as the CP/M 'TYPE' command provides. Another improvement might be the (optional) addition of automatic line numbering.

The information given here has been extremely rudimentary and incomplete; nonetheless it may help to convince the reader that CP/M isn't as complex as it looks! □

## Explaining Ourselves. . .

CP/M IS an operating system — that is, a program that provides input/output and disk storage and retrieval functions for microcomputers — for the 8080 family of microprocessors. The program is stored on disk and loaded into memory when the computer is powered up, and allows the user to save information in named files, catalogue disks, erase and rename files, check how much storage space is left on disks, and so on.

It also provides the standard input/output functions that programs use — which is why it is possible for programs written on one system to be transported to another. Because of this capability, a lot of software is available for computers which have CP/M.

In this article, we describe the way programs can call the CP/M functions.

The example programs given here are written in 8080 assembly language. This is the set of instructions that the computer actually executes, and is a much more tricky language to program in than BASIC.

The BIOS referred to in the article is normally supplied by the manufacturer of the floppy disk interface or the computer, and the user would only rarely have to tamper with it.

The examples don't actually do very much, but they do demonstrate how a lot of the work can be done by CP/M. All that is required is for the main program to set up the information the right way in the microprocessor's registers, and then call CP/M. When control returns to the main program, CP/M will have output or input a

character or performed some other function.

Incidentally, CP/M now has a big brother, called MP/M, which allows several people to use a computer at one time. MP/M uses exactly the same techniques as CP/M, so that programs written for CP/M can run on the bigger system. Of course, MP/M has many extra functions, but they work in exactly the same way.

There's also a version of CP/M for computers based on the Intel 8086 16-bit microprocessor, and it uses a broadly similar technique to interface programs.

CP/M is available for many of the popular microcomputers, including the TRS-80 (although it's a modified version), the Apple (requires a Z-80 Softcard) and Heathkit systems. It's also being used by many business computer manufacturers, including Xerox and Adler. □

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# MICROS AND MAINFRAMES

**By Les Bell**

*In times past 8K of memory was the envy of major computer manufacturers. It meant you were dealing with a machine of considerable power. Now the average microcomputer has eight times that, and a mainframe has several megabytes of memory. The boundaries between micros, minis and mainframes are not clear-cut any more, so **Your Computer** decided to look at what makes a micro a micro and a mainframe heavy.*

THE DIFFERENCES between mainframe computers (such as the IBM 3033 and other 'big' machines), minicomputers (like DEC's PDP-11 and others) and microcomputers are wide in some areas and surprisingly narrow in others. Let's start by defining a few terms of reference.

The boundaries between micros, minis and mainframes have become less distinct in recent years, to the extent that some micros currently entering production are as powerful as many quite large mainframes which are still in service. For example, an eight-processor configuration of Intel's forthcoming APX-432 (a 32-bit multiprocessing chip set) is estimated to provide equivalent or higher performance than an IBM 370/158 — by most standards a large mainframe.

A microcomputer, as I use the term, is a computer based on a MOS (metal oxide semiconductor) microprocessor chip or set of up to four chips (this extension to the definition is intended to bring the DEC LSI-11 within its scope). My definition makes no statement whatsoever about performance — it can be as slow and painful or fast and powerful as you like, as long as it's based on a microprocessor. Thus a computer based on the Motorola 68000 chip would be a microcomputer, although its performance is equivalent to or exceeds a number of minicomputers. ▶



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... To this. The Microbee 64K, a micro (above) and a Facom M190, a mainframe (below).

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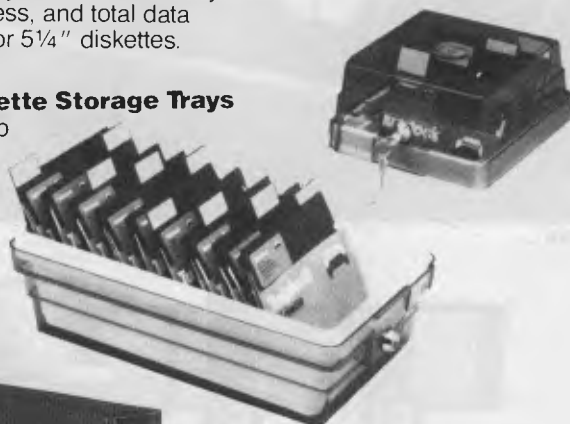
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In the middle are mini computers.

A minicomputer, to move up the scale slightly, is based on a processor comprising discrete logic components, usually bipolar TTL (Transistor-Transistor Logic). The CPU is faster by a factor of around ten or more, and the word length is 16 bits or more.

Another distinguishing mark of the minicomputer is the level of software support offered by the manufacturer, typically several languages, a database system and one or more operating systems. The microcomputer vendor, on the other hand, tends to rely on software designed and supported by third parties (for example Microsoft BASIC, CP/M). Many minicomputers have multiple users, and most mini operating systems are for multi-users.

The mainframe is almost always a multi-user system, with a CPU fabricated using bipolar TTL or ECL (Emitter-Coupled Logic) components. Although the instruction time is the same or slightly faster than that of minicomputers, each instruction accomplishes a lot more, as the instruction set is richer (often including floating point instructions), and operates on words of up to 60 bits or even more.

The amount of memory on mainframes is measured in megabytes (Mbytes) rather than the kilobytes (Kbytes) more common on minis and micros. Mainframes usually have a selection of operating systems, languages, applications packages and utilities provided by the manufacturer as well as independent vendors.

### Operating Systems

Operating systems on micros originally consisted of the bare essentials – single-user low-level interfaces between

program and machine. They were simple, efficient file handling operations and not much more. They gradually grew more sophisticated, some becoming multi-user and nearly all incorporating more and more utilities.

Typically these systems when purchased have been pre-configured to run on a particular machine. Micro owners need only switch 'er on and away they go. Furthermore, one of the most popular micro operating systems, C/PM, was written to support assembly language development as well as BASIC and other languages.

Fundamentally, these systems were oriented to the personal computer user. As such the responsibility for controlling the processing that went on lay in the hands of the user.

Minicomputers are more typically aimed at multi-user environments, and their operating systems are therefore more like those of later-generation micros in their concentration on resource allocation and sharing.

Mainframe operating systems are huge. The range of utilities is almost endless, the facilities incredibly comprehensive. An attempt is often made to allow for all conceivable contingencies, which of course results in a very complex system. The device handling, interrupt mechanisms, accounting functions, security arrangements, job control, recoveries procedures and so on are just the tip of the iceberg. Compilers for a dizzying number of programs are available, as are all manner of file handling facilities, and so it goes on.

### It's All Greek To Me

Some more esoteric definitions revolve around the marketing strategy

employed with a specific machine. Micros have tended to be cash and carry, while minis have been considered professional machines which have commanded a high level of after-sales service and software support. Mainframes tend to have a very close relationship (in most cases) between customer and computer vendor which exists for the entire life of the machine and frequently beyond.

Another suggested criterion for definition is price – up to \$10,000 it's a micro and so on.

As time goes on differences will become less and less obvious. With increasing amounts of distributed processing and networking going on, a 'virtual' machine that is actually made up only of quite small machines for processing and a lot of switching machines for communications may well be thought of as a large machine.

With more and more being crammed onto chips each day, mere physical size may in the future be the last consideration in describing the class a computer fits into. Mainframes could well be small enough to fit on a desk; only the peripherals will take up space.

Ultimately the defining terminology – mainframes, minis or micros – may have to change. 'Personal', 'business' or 'scientific' may well be the best labels to define computers with. We would therefore classify, for example, Apples and IBM-PCs as personal, Facoms as business and Cyber 205s as scientific computers. Games and information access would come under the 'personal' heading, word processing, databases and planning aids would be classified as 'business' and number crunching would be done on 'scientific' machines. □



# WHEN MICROS RULE THE WORLD

*Look out, 1984 – we're coming, ready or not! Bill Bolton takes a cautious peek into the not-so-distant future of the microcomputer ...*

WHEN I WAS first asked to write this story, I was very enthusiastic. I thought about all the truly enormous technological possibilities, and started to do some hard research ... which, of course, included finding out what most of the industry gurus have to say about where computers in general, and microcomputers in particular, are going.

I hadn't read too many of those stories before I got the old 'been there, done that' feeling. The predictions were admittedly different, but the style was the same as it had been back in the early days of micros, circa 1976.

So I dug back into my stacks of *Byte* (which, curiously, has carried very little long-term predictive material), *Interface Age* (it was worth reading in those days), *Kilobaud* and the like, and read some of the predictions made back in the mid-Seventies.

I don't intend to bore you with just how far off-course the great majority of those predictions were. (In fact, the only ones that were reasonably accurate were made by Adam Osborne, the founder of what was then one of the most spectacularly successful microcomputer companies in the industry – since, unfortunately, bitten the dust.) Mostly, however, the predictions were along the lines that by 1980 every home would have several small computers doing everything from mowing the lawn to educating the kids.

Well, here we are in 1983 and there's still no relief in sight for me in the fortnightly battle with that weed patch I laughingly refer to as a lawn. There are a lot more people using microcomputers today than in 1976 when I bought my first micro, but on the whole it's still people with a predisposition toward

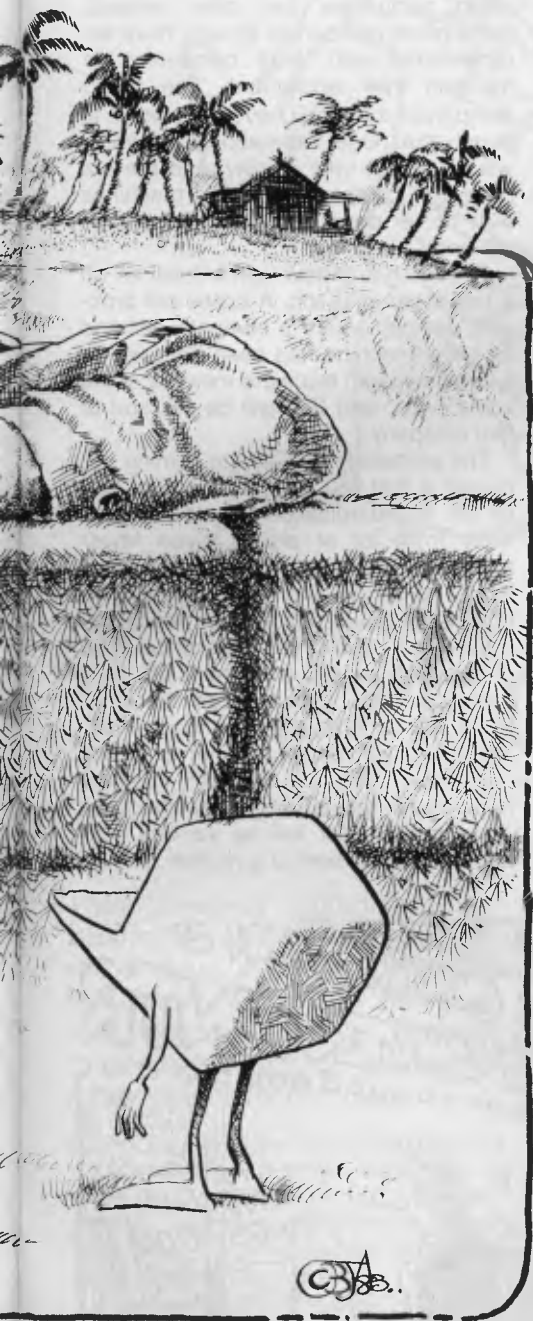


computers (either vocationally or as a hobby) who make up the bulk of computer users.

The technology to do all the things the 1976 writers predicted is certainly available, so why hasn't it happened? There's no simple answer (except perhaps '42'), but I believe the major reason is related to the nature of product-manufacturing and marketing. In

short, the computer industry still hasn't been able to find out what is needed to make computers attractive to 'everyone' – that is, to achieve the golden goal of at least one computer in every home (or at least every home that can afford one).

The great majority of people can see no earthly use for a computer in the mundane details of daily existence. To that fundamental question, "What will it



do for me?" the industry has only very poor answers. Computers are very good at manipulating numbers, but most people have a minimal need to manipulate numbers much at all. What needs they do have can mostly be met with \$20 pocket calculators.

Now, a computer that would clean your shoes, say "No" to the bill collector, wash the car ... well, that would be

really useful. But while the hardware to do all these things is readily available, the software is non-existent.

The real problem is that computers can't 'think' in any meaningful way, yet most of the things we'd like them to do require an awful lot of thought, even if it's that boring sort of thinking like remembering to wash the top of the car first and winding the windows up.

Until we understand a whole lot more about how humans think, it's unlikely that we'll be able to make computers do anything perceived as really useful by the average Australian.

What I'm trying to get at is that the stuff that makes up much of the content of 'Future of Computing' articles in the popular press is just pie in the sky. Trying to predict the real world is much harder. Most of the people who can do it successfully are not telling you their predictions at all; they're quietly living off their considerable fortunes somewhere very sunny and pleasant, getting a lot of people to think up new ways to be nice to them.

Since I obviously haven't reached that exalted state (and really have no aspiration to), you may have by now guessed that whatever I have to say from here on in is said with a fair degree of scepticism on my part. However, it's my best attempt to look into the development paths that micros will follow for the next few years.

### And So, The Future ...

The 16-bit machines will dominate all market areas within 18 months. It won't cost any more to manufacture a 16-bit machine (even if it's a pseudo 16-bit machine based on an 8088) than it does to make eight-bit machines, so most manufacturers will swing all production across to the 16ers.

The 16-bit software will get much, much better and we will start to see the promise of 16-bit machines really delivered.

Eight-bit software development will effectively cease - all new development will be for 16-bit machines.

Programming in Assembler will start to become a rarity. Almost all programming will be done in high-level languages.

The 32-bit micros will start to appear, but they'll take a long time to gain market acceptance. It's possible that there will be stiff market resistance at moving to 32-bit machines until everyone feels comfortable about 16-bit machines.

An industry standard, *de facto* or otherwise, for local area networks (LAN) will finally emerge. It will probably come from IBM, and it will very quickly be widely adopted. LAN support will be essential for business applications.

IBM will come under increasing competition as the largest computer company, but it will hold the top spot.

Japan will start to generate small but significant amounts of first-class home-grown software and, in the process, scare the hell out of the United States manufacturers.

Japanese microcomputers will start to decimate the United States micro-manufacturing market in the same way that Japanese cars, high-fidelity sound systems and cameras have. Too many American manufacturers will yet again stick their heads in the sand and not realise the threat until it's too late.

The Motorola 68000 series of microprocessors will continue to be dominated by the Intel 86 family, which has more support, and the NatSemi 16000 family, which has better performance (the 6800 story all over again).

New printer technology will replace impact technology and cheap, fast, letter-quality printers will become a reality.

New disk-storage technology using vertical recording will appear and take small disk storage capacity to new heights.

The 20 cm disk systems will continue to remain the only generally useful disk interchange medium between microcomputers.

The 10 cm and smaller disk systems will appear in increasing numbers but it will take a while before there is any standardisation.

Networked microcomputers will dominate in the small to medium microcomputer area. In future, a small VAX-style machine will be the smallest viable minicomputer.

The educational software market will continue to show great promise but will fail to deliver the goods.

### Over To You...

Okay, that's it. For those of you who are now feeling that you already knew all this, or that I'm totally wrong, you can write next year's article. We'll see how good your predictions are ...

I believe that probably about 50 per cent of my predictions will come to pass. If I really knew which ones, I'd be putting a deposit on a tropical island right now! I certainly believe that, given the present position of the market, all the predictions are very real possibilities rather than pie-in-the-sky guesses.

Now that my credibility for the next couple of years has been put well and truly on the line, I think I'll just go back to writing nice safe articles about operating systems and communications and leave this predicting stuff to others. I wonder what *The Hitchhiker's Guide to the Galaxy* has to say about predictions ... hmmm!

# COMPUTING, RED IN TOOTH AND CLAW

With the recent upheaval at Osborne Corporation a lot of people think the micro industry is about to experience a shakedown. **Your Computer** looks at a marketplace where only the fittest will survive.

THE WRITING has been on the wall for some time now for a lot of people in the micro industry. When IBM made its appearance on the micro scene all the signs pointed to some radical changes in the very near future. Up till then the industry had grown erratically, fast, and unpredictably; this has now started to change.

The history of the microcomputer industry is one of small being beautiful. Small companies (such as Apple) grew out of enthusiastic hobbyists selling to their friends. They developed entrepreneurial flair and presented packages of steadily increasing power, size and convenience of use. Because they were small they were adaptable. As the market's needs became clear they quickly changed their products to suit. Sometimes it wasn't clear which came first, the chicken or the egg – a machine would appear, a market would develop around it, or vice versa.

Today there is a proliferation of companies. Some people have struck it rich with computers they have put together in their garages. Others have got out of the used car trade and are cleaning up the sucker market. People are laying out considerable sums of money without much idea what they are buying – and their confusion is understandable in an industry that barely understands itself.

## Big Companies And Small Machines

Most major companies will move into micros soon following IBM's lead. When they do they will bring with them some significant changes. Sales will be through reputable dealers and department stores in much the same way as hi-fi equipment is sold today.

After-sales service and customer support will be major selling points. Standard software will increasingly be given 'free' with your micro. In some cases the hardware may even be free, or rented, and you will pay for access time to some other major database facilities. The French version of Telecom already has the right idea, with advanced plans to computerise the telephone directory and place a terminal in every subscriber's home. It is surely only a small step to use that terminal for access to other databases and other communications facilities.

financial muscle to provide a quality of service well above what the smaller micro companies can offer. Indeed, some micro companies already have arrangements with large companies to maintain their equipment. The micro companies that don't have the service to match the huge international networks will disappear very quickly, and the era of micro companies selling machines with no, or poor, back-up maintenance will end.

Research and development will kill off a few companies too. A scene will probably develop where a company will find its latest machine has been bettered by a computer with twice the memory at the same price, and that will be the end of that company.

The probable result of the coming upheaval is that you and I will be a lot better off. Standardisation should be more likely in a lot of areas; given fewer machines, interfaces will be more commonly available and work better. The quality of service will also be much improved and, of course, it will all be even cheaper because of economies of scale. Confusion will be reduced because there will be a lot less to choose from. There will still be all manner of exotic machines, but these will sell in small numbers to the purists, while the general-purpose user will be content with the 16-bit equivalent of a Holden. □



\* OUI, FROGGY SNAILS AVE WWW FOOT....





# Care for Computers

*With personal computers appearing in more and more offices these days, everybody wants to know how best to look after them and their peripherals. Les Bell gives some tips on preventive maintenance for the micro.*

MOST people's idea of maintaining office equipment consists of: first, blowing some of the paper dust out of their typewriter; second, unjamming the photocopier; and third, ringing the repair man if anything more complex goes wrong.

Preventive maintenance consists of not spilling your coffee into the adding machine.

The introduction of computers into this scenario sounds like a recipe for disaster, but it needn't be. The enemies of small computers are fairly well known. They're mainly the kind of things which make you feel uncomfortable yourself — heat, dust, and the like. So here are the best ways to deal with the dangers, beginning with heat.

Like most pieces of electronic equip-

ment, computers run into problems if they get too hot. The life expectancy of a semiconductor device halves with every few degrees of temperature increase, so not keeping a computer cool is simply inviting trouble. Keep the computer in an air-conditioned room and the result will be vastly improved reliability.

If air conditioning is not possible, then at least use a cooling fan in the area of the equipment. Larger systems should have a cooling fan built in, to circulate air over the components.

Some small systems such as Apples are sometimes fully expanded with multiple cards, to the extent that they are operating well above their design temperature. In this case, the addition of a small 'Muffin' fan will greatly improve the situation.

## Dust In The Works

Site your computer in as clean an environment as possible, and preferably away from dust-traps such as bookshelves and baroque-style furniture. In particular, even though your computer may be responsible for inventory control, *don't* put it in the

main warehouse area which is full of dust.

If dust is likely to be a problem, then any cooling fans in the equipment should be fitted with filters and equipment covers should be put in place when the equipment is not in use.

Dust is an anathema to disk drives, which are predominantly mechanical devices full of high-precision, high-speed moving parts. The surfaces of floppy diskettes are also prone to damage by dust particles. Diskettes should be kept in their jackets when not in use and stored in proper library boxes.

Floppy disks can also warp like records. Temperature extremes can make them expand and contract, losing their tolerances and causing errors. The answer again is constant temperature air conditioning.

Floppies should not be written on, as ballpoint pen pressure will be transmitted through the cover to the disk inside. Likewise, they should not be bent, stapled (heaven forbid), or paper-clipped to other documents.

Some suppliers produce a card which shows the no-nos for handling floppies. ►



Stick it up on the wall beside your computer.

Keep back-up copies of all disks. When your computer is new and everything is perfectly aligned and working at peak, it's easy to get over-confident about this. But one day...

I've also banned smoking in the immediate vicinity of my computer. It's very convenient, as people who don't mind offending others with their cigarette smoke seem to consider the feelings of the machine much more important. Strange.

### Static — Mind The Carpet!

Static electricity is less of a problem in Australia than it is in colder climates. Many of the MOS (metal oxide semiconductor) circuits inside a computer are particularly susceptible to damage by static, particularly if they are removed from the computer. While everything is wired up and working, there's usually no problem. But if you disconnect, say, a disk controller cable, the risk of damage increases.

Static is generated by dry surfaces rubbing together. The worst culprits in offices are certain types of nylon carpets, combined with some rubber-soled shoes. Nylon underclothes have also been identified as troublesome (*now don't be silly — you know what we mean*). The answer is generally to choose your carpet with care or, if you're stuck with it, to experiment with your shoes and only wear those which don't generate static.

It may also be an idea to restrict access to the computer to those staff who know the requirements re static and clothing.

Another solution is to place conductive mats under the computer, thereby ground the computer and operator, and eliminating the static.

### Power Line Problems

Other maladies that can affect the small computer are power line glitches. These take a variety of forms, from interference signals, through over-voltage spikes, to brown-outs or blackouts.

How can these be fixed?

Interference signals and spikes can generally be fixed by a line conditioner circuit (supplied by any electrician). This will filter out the interference and flatten out the spikes. End of problem.

Brown-outs aren't so easy. They happen when, for example, a large motor is on the same power circuit as your computer. Then, when the motor is switched on, it draws a high current, thus depriving the computer of much-needed voltage. Some computers don't mind momentary brown-outs — they have large reservoir capacitors which keep on supplying the computer in the meantime.

Computers with switched-mode power supplies (the Apple again, in particular) don't have these capacitors, so momentary interruptions cause problems. The answer is to add the capacitors inside the computer. Talk to your service guy about it.

Connect your computer to a circuit of its own, if possible, and as near to the main fuseboard as possible. That will help a little.

Blackouts? Well, there's not much you can do about them. Uninterruptible power

supplies are available, but they're expensive, and you'd still have to work in the dark.

### Maintenance Contracts

Maintenance contracts are usually a good idea for small business computers. Costs will vary from \$400 a year up to \$3000 or more.

Now before you say, "Hell, I can buy a new computer for that", just stop and think. What's important here is not the value of the computer, but the value of what your computer does. If all your invoicing is done by the computer, even a week's disruption can have serious effects on your cash flow.

Service contracts come in several flavours. They can cover the whole system, or just parts of it. You can have round-the-clock, top-priority service, 'fix-it-in-a-day' service, or 'we'll-do-our-best' service.

In addition, look for the following points in a service contract: can you obtain a 'loaner' machine while yours is in the service shop? Can you obtain a replacement for an 'unfixable' machine (yes, they do exist — but more often it's an 'unfixable' technician that's the problem). How about preventive maintenance checks (disk head cleaning, and such)?

If you're trying to cut corners on a maintenance contract (not good, but we don't live in a perfect world), then I'd be inclined to cover the electro-mechanical parts such as the disk drives and printer in preference to the purely electronic parts in the processor itself. In many cases, these can be 'fixed' by a simple board replacement.

# DOS AND DON'TS OF DISKS

**Don't touch the recording surface:** Fingerprints leave residues on the magnetic surfaces; these in turn will cause irretrievable data losses.

**Don't try to clean your disks:** Keep your disks in a dust-free environment – vacuum or wipe with a wet cloth regularly – and you won't encounter the problem of *needing* to clean them; obviously you can't get at the surface of a disk to clean it without destroying its plastic case.

**Don't eat, smoke or drink near the disks or drives:** Crumbs, coffee and cigarette ash are not likely to improve the performance of your disks or drives.

**Don't pull labels off:** Damaging adhesive residue remains when labels are removed, which could damage the drive heads. Always write on the labels with felt-tipped pens, preferably before placing them on the disk. Don't use pencil and erasers as they leave contaminating particles.

**Do not attach paper clips, staples, rubber bands or other foreign material to the disk:** Any of these objects can damage the sensitive disk through the plastic jacket.

**Store your disks carefully and don't bend them:** The read/write mechanism is only micro-inches above the surface of the disk, so any warps or dents will affect their performance. Store your disks in their envelopes, standing on their edges, in the box they came in or in a specially designed container. *Never* stack them on top of each other or put heavy objects on top of them.

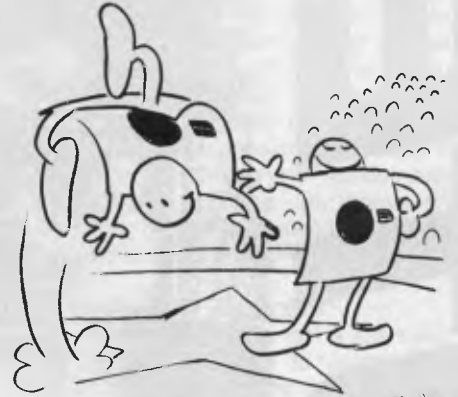
**Keep the temperature controlled:** The ideal environment for diskettes is between 10 and 50 degrees C at a relative humidity of 20 to 80 per cent – in other words, the optimum conditions are the usual 'cool, dry place'. Never place

disks in direct sunlight or near a direct source of heat.

**Keep them away from electromagnetic sources:** Store disks at least 10 cm away from motors, transformers and power cords, which generate intense electromagnetic fields that can change or distort data. Don't store disks on top of the drives for the same reason.

**Handle disks carefully when loading:** Insert disks gently into the disk drives to ensure they don't bend or crack the plastic covering.

*Our thanks to Nashua for advice on care of computer storage media.* □



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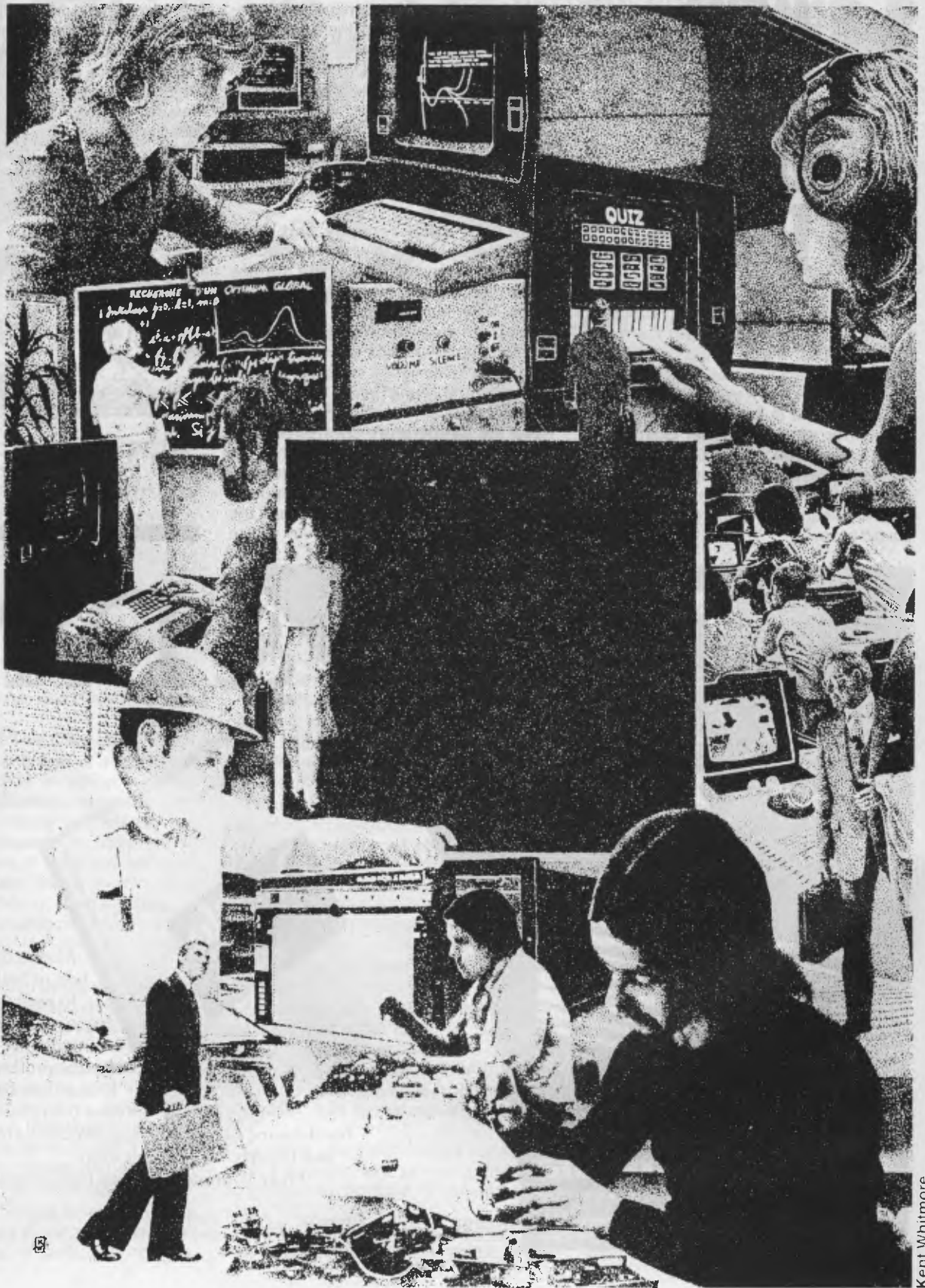
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# COMPUTERS



# AND EDUCATION

Since its beginning **Your Computer** has always tried to increase awareness of computers and computing in education. Here Phil Carter presents an overview.

WHILE COMPUTING technology is changing at such a frantic pace, education is generally slow to embrace change. Any marriage of the two must, of necessity, be volatile, ill-defined and different things to different people.

From the time prices of computers got low enough for schools to afford them, the debate has never stopped as to how this new wonder could be used in the classroom. Do we teach the kids to program or let them use the computer as a tool in other subject areas? Is it best to network micros or time-share on a mini? BASIC or LOGO or Pascal or ...? What comes first, the machine or the software? Should there be an overall, long-term plan? By whom?

We in Australia aren't the only ones to grapple with these problems. We're behind what may be happening overseas, but at least this lets us learn from their mistakes and, hopefully, copy the best features that have come out of the various overseas programs.

Until recently, it was thought that we had to teach about computers – how they work, how to program them, how to initialise disks, and so on. But the greatest impact occurs when we teach with computers. This shift in emphasis has occurred/is occurring/will occur throughout the educational system as educators see the importance of the computer as a tool to be used throughout the spectrum of learning.

There will always be a place for learning how to program, but the availability of good, cheap software reduces the need for this skill. Rather, students will come to use the computer for their word processing, spreadsheet problem solving, database management, graphics work, music arrangement, simulation, communication, and so on. They should be able to experiment, become creative and inventive, to explore and discover for themselves.

## Computers For Users

The use of computers as tools does have its problems. The trouble is, computers are still such a new-fangled thing that the raw beginner is not yet catered for. How many of us know what goes on under the bonnet of our car? Who needs

to? We jump in, turn the key and off she goes. If something inside needs looking at, we go to the expert – trained and paid to know how the insides work. But we do have to learn to drive.

A machine can be advertised as everyone's home computer with marvellous music and graphics capabilities, but how do you get it to sing and dance? By poking obscure numbers into strange memory locations – an insider's language imposed on the unwitting buyer. Machines like the BBC computer at least provide BASIC language statements for creating music and graphics, but it still has to be programmed. The user needs to be able to do his/her thing without having to learn and absorb information which is irrelevant to and complicates the task in hand.

## Problems/Policies

Even though computers are getting cheaper, friendlier and with better software, a more basic problem still lies before us. To quote La Trobe University's Geoff Cumming, writing in the September 1983 issue of 'COM-3':

*"The current problem is not simply one of inadequate software, or even that we have not yet found a good mechanism for developing and proving software. It is more fundamental: we don't have good educational theories to guide the design of educational computing experiences. If class teaching can be described as a matter of intuition based on folklore, developing computer materials is even more so, but without even much folklore yet. On top of this the computer offers a way to tackle new and different goals, not simply automation of some things we do at present, so the distance we have yet to travel is even greater."*

With the ever decreasing price of

micros (or the increasing power per dollar spent) the availability of equipment means that schools can rush out and buy something. This encourages the philosophy of "let's buy a computer now and then work out what we can do with it. Everybody else is getting one – we can't be the only school without a computer".

This reduces the likelihood that any long-term planning has gone on before the purchase, and the computer arrives without anyone even knowing what can be done with it. (How many schools bought Apples in early 1983 when the special offer was on simply because it was a bargain?) Is it any wonder that the terrific possibilities for innovation and creativity are not realised before the computer is bought?

## Computers As Teachers

Using computers as a tool is one thing and teaching students to program is another. But what of the role of computers in doing the actual teaching? What of computer-aided instruction (CAI), computer-aided learning (CAL), computer-managed learning (CML), and so on – and on? Is the computer an alternative to the teacher? Geoff Cumming doubts so because the art of teaching is itself so ill-defined. Even worse, he says that:

*"... the teaching strategy is a stumbling block. We need here a practical theory of learning and this, despite lifetimes of effort with rats and pigeons, we just do not have."*

How can the computer teach if we don't know how students learn?

Not that CAI is totally useless. The American experience has given us some interesting findings. To quote from the August 1983 issue of 'Personal Computing':



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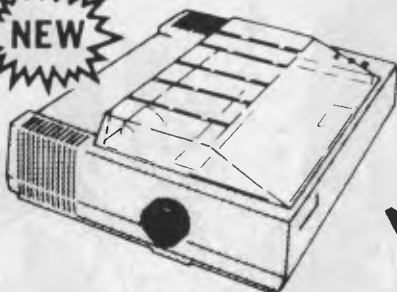
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*"The effects of computer-based teaching seemed especially clear in studies of disadvantaged and low-aptitude students ... whereas effects appeared to be much smaller in studies of talented students."*

Other US studies have likewise shown that children from low-income homes benefit the most from CAI. The danger, however, is that schools for the poor are often down the list when computer money is being handed out.

### The Australian Scene

So what's happening in Australia? Are there any policies? How are educators being trained to use computers in the classroom?

Not until very recently have there been government plans for Australia (in this respect, we're ahead of the US). Generally, teachers or schools have done their own thing and only after sufficient prodding has the state educational hierarchy formulated some policies and guidelines.

Whilst in-service training for teachers helps in gaining a basic fundamental grounding, I believe the best place for this is through the teacher training courses provided by the Universities and CAEs.

The UK experience was that micros were first placed in primary schools, then the secondary schools and finally the teacher training institutions. They would now say that it should have been done in the reverse order.

There doesn't yet seem to be enough emphasis in Australia on the primary objective of training the teachers who train the students. If the teacher up-front seems uneasy with the newly arrived computer, then the students' own attitudes towards it will be similarly shaped. Likewise, how will students see the usefulness of computers as tools if they see the school front office (or the tertiary computer centre) timetabling by hand, keeping records on cards and ignoring the word processing facilities available to them?

### Issues And Development

The current thinking amongst educators now is away from debating the pros and cons of which computer is best or which computers are to be recommended. More and more, educators are becoming concerned with the issues of how to use the new technology effectively in education.

Governments would like to include a buy-Australian clause in their recom-

mendations, but there are really very few Australian companies around which can or could produce machines that compete with the overseas offerings. The Apple Lisa is said to have cost \$50 million to develop, and that sort of money isn't around in Australia.

In August 1983, the Commonwealth Schools Commission Guidelines were released by the Federal Minister for Education, Senator Susan Ryan, and they provide \$18 million for the years 1984-86 for the Computer Education Program. This Program is currently being looked at by a National Advisory Committee on Computers in Schools, which will provide advice on the whole area of how to involve computers in education. By the end of 1983, it is expected that the Schools Commission Report on Computer Education will be finished and how that \$18 million is to be spent will be announced.

Finally, it should be said that the use of computers in education has really only just started. There are still many mistakes to be made and new insights to be gained. Whilst computers will play an increasing role in education, it should be remembered they are only one component of the educational process. It is the use and development of that component that we have to grapple with.

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# Cash & Carry Computers



# - or, The Slashers Strike Again!

*As prices drop in the home computer market, the competition is hotting up. Here Les Bell looks at the latest crop of under-\$500 machines to see what's what ...*

TWO YEARS AGO, we ran a story on 'Slashing the Cost of Home Computing', as we were amazed at the price reductions and new low-cost computers that were appearing. Well, we're still amazed. It is hard to believe that you can get so much real computing power for so little money!

Of course, at these low prices, you don't get - for example - the mass storage facilities afforded by disk drives. By and large, your mass storage takes the form of cassettes. However, disk drive controller cards are starting to appear as an option on an increasing number of small home computers.

Virtually all these machines have colour displays and will accept plug-in games cartridges, so they will do double duty as educators and entertainers. When the kids get bored with creating coloured shapes, they can always blast away at some for a while!

Another new feature that has started to appear only recently is the built-in joystick, mounted next to the keyboard. This often doubles as a cursor controller. I doubt that it will be long before low-cost home computers are supplied with a mouse!

Anyway, read on, and compare these little tykes with your \$10,000 S-100 boat anchors. Eat your heart out, Altair!

## Microbee IC

If you've been in Australia for a while and haven't heard of the Microbee, you haven't been reading the papers or magazines or watching television. The Microbee was launched on an unsuspecting world in the February 1982 issue of *Your Computer*, and proved to be an enormous success. Initially available in kit form at just under \$400, it has since been upgraded and improved, repackaged and generally changed into a bigger computer than it used to be.

The Microbee IC is the latest incarnation of the little mite, and offers the most popular enhancements and options, together with a few improvements, all in one package. The IC is faster (3.375 MHz clock) than earlier models, and incorporates as standard both the WordBee word processor ROM and the NETWORK communications ROM.

The IC uses MicroWorld Colour

BASIC V5.22, which includes additional commands to set the foreground and background colours and modes. Thirty-two colours are available for the foreground, not all of them describable, and eight for the background.

Listings can now be set to be in either upper or lower case, according to the user's preference; typically, I find lower case easier to read.

It seems that Applied Technology is planning to release more software in ROM form for the Microbee. Up to (theoretically) 256 different ROMs can be plugged in, and the command *PAK n* will select the appropriate ROM pack by outputting the value of *n* to the memory bank select port.

In the IC, two ROMs are provided as standard. Most useful probably is the WordBee version 1.2 ROM. WordBee is loosely modelled on WordStar and Electric Pencil, and incorporates a surprising number of useful and powerful commands for such a small system. Version 1.2 contains several new features, such as the ability to vector output to one of a number of outputs, which gets round a major problem for many Microbee owners. In addition, touch typists can select input from an external keyboard which they may prefer.

Other new WordBee commands include underlining and double striking, and a new command allows the user to move the cursor to the end of the current line.

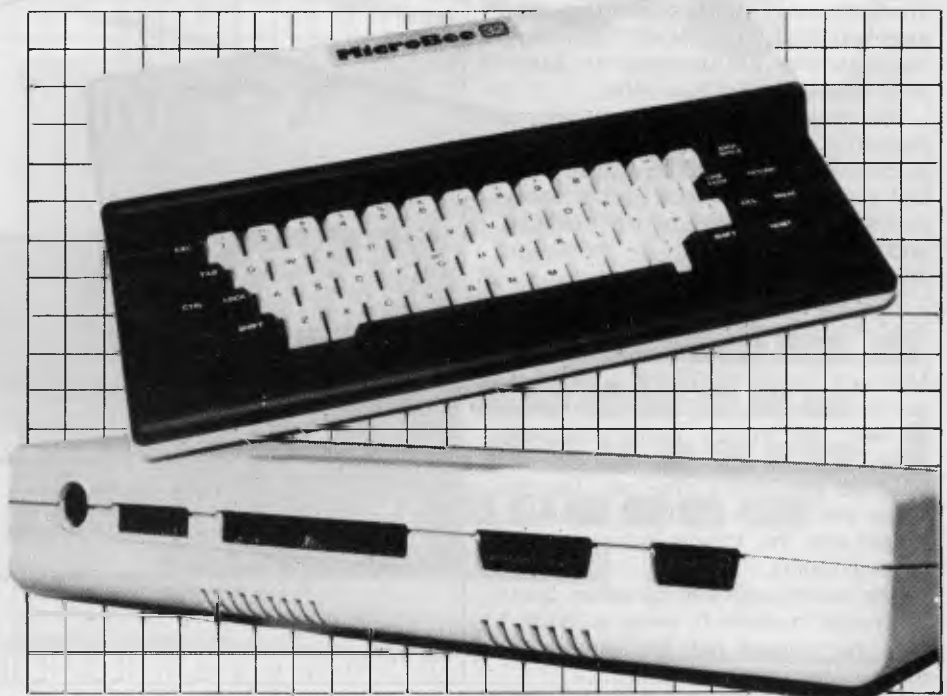
The other major addition is the terminal/network ROM which not only provides communications facilities, but provides a number of other general tricks accessible from BASIC or elsewhere. The general NET command will turn the Microbee into a full or half duplex terminal with an 80 by 24 screen which emulates most of the codes of the Televideo 912 terminal.

The baud rate is settable at 110 to 4800 baud, and parity can be odd, even or off. Best of all (to us here at YC particularly) the NET ROM implements file transfer using the Christensen protocols, so that Microbees can now communicate with each other and the popular bulletin boards.

The network ROM is accessible from BASIC or from within WordBee, providing a range of extra communications and screen formatting options.

The documentation for the Microbee is continually improving, and the latest versions of the user manuals are very good indeed. The Microworld BASIC manual is well organised for both tutorial and reference use, and is quite readable.

The Microbee has always been a powerful and capable little computer, but this latest version really is a winner. Its design is oriented towards useful activities, such as word processing and communications, rather than game playing - but a heap of games are available if you want them!







### Dick Smith VZ200

At just under \$200, Dickie's come up with another winner here. The VZ200 is a neat little computer indeed.

The VZ-200 is virtually a totally non-technical machine for the user who wants a gentle introduction to BASIC programming and home computing. For example, nowhere in the manual does it say what kind of processor is under the hood! Indeed, there is virtually no technical detail at all anywhere in the manual.

All this is possibly to the benefit of the completely non-technical novice who could do without that kind of intimidation. But it bodes ill for the future availability of professionally written games and utility software. I'd say that for the near future at least, and excluding whatever Dick Smith may release, the VZ200 will remain a BASIC-only machine.

The VZ200 is probably based on the ubiquitous Z-80, and is supplied with 8 Kbytes of RAM as standard. A 16 Kbyte memory expansion module is available for \$79.

The BASIC interpreter used is, of course, Microsoft's Extended BASIC, complete with colour graphics and sound commands. The screen displays 16 lines of 32 characters each, and the keyboard is a calculator-style QWERTY with a soft action. Like most of the machines covered, the spacing between keys was less than I would have liked; obviously they are designed for somewhat smaller fingers than mine.

Two graphics modes are available: in mode 0, the graphics resolution is 64 by 32 pixels with nine colours available and text displayable. In mode 1, the resolution is 128 by 64 pixels in eight colours, and this is a better mode for games and more complex graphics.

The graphics statements are the standard kind used in the TRS-80 Colour Computer and other machines with Microsoft Colour BASIC. A point is set with the statement SET (X,Y) and turned off with the RESET (X,Y) statement. POINT(X,Y) will return true if a point has been set and false if it has not. The colour is set using the COLOR statement, which sets the foreground and background colours.

The background can be either green or orange in mode 0, while in mode 1 only four colours can be selected for each background colour.

The SOUND X,Y statement will generate a tone of pitch X and duration Y. By using data statements, it is possible to create quite complex little tunes.

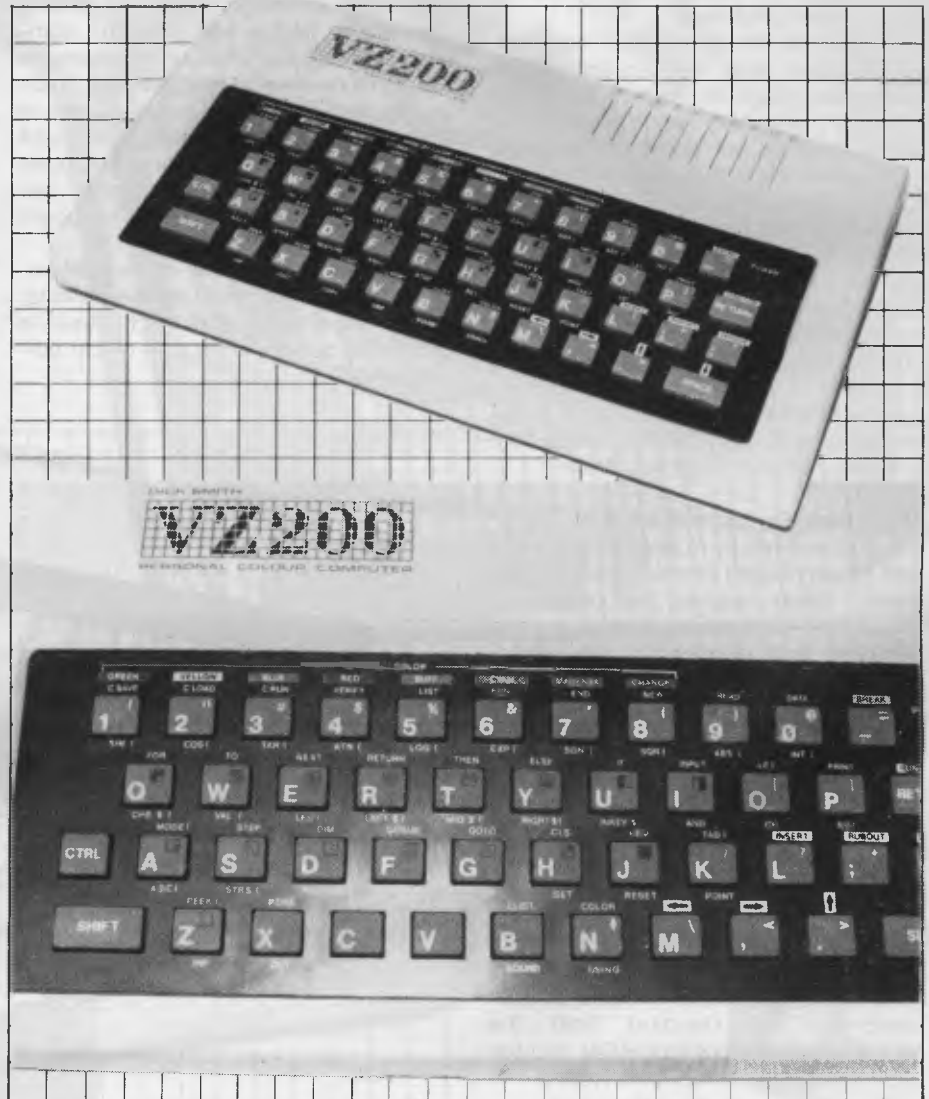
For those who want to dabble in some PEEKing and POKing, the manual does give the addresses of the screen RAM, so some fast updating can be done that way, though this will require some experimenting.

The manual is well written, and is organised as a tutorial text, bearing in mind the likely audience for this kind of machine. There are no signs of the Janglish that usually mars manuals on this kind of machine.

Expansion is limited on the VZ-200;

there is a socket on the back for the plug-in 16K RAM module, and a peripheral connector, obviously intended for a printer. Apart from the cassette cables, that's it. For parents who don't want their kids to get carried away buying more and more extras, that's probably a blessing!

While this computer probably won't do much for the dedicated enthusiast who wants to get into machine code programming and interfacing all kinds of peripherals, it's just right for those who want to learn some programming and not get bogged down in unnecessary details. Run a business it won't; draw you in to the joys of programming it will!





### Spectravideo SV-318

This little package starts off with quite a small personal computer, but it is expandable into a full computing system of quite useful proportions.

The basic console, which contains the computer proper, is only a few inches deep and not that much bigger than, say, the Sinclair machines – but it includes 32 Kbytes of ROM and 32 Kbytes of RAM as standard. The keyboard is a calculator type with a soft feel but a reassuring amount of travel, and is easy to use.

The keyboard includes all the standard QWERTY characters, including the tilde and the escape and control keys, but it also includes five shiftable function keys (which are pre-programmed for BASIC keywords) and some miscellaneous keys for functions such as character insertion and deletion. In addition, the 71-key keyboard is marked with a set of graphics characters.

An unusual feature of the keyboard is the joystick/cursor control pad at the right, which can either be used as a cursor pad for editing, or with the joystick plugged in to double as a games controller.

Inside the box there's a Z-80A micro-processor running at 3.6 MHz, with 32 Kbytes of ROM containing Microsoft BASIC and 32 Kbytes of RAM, half of which is dedicated to graphics. The ROM is expandable to 96 Kbytes using plug-in cartridges, while the RAM can be extended to 256 Kbytes.

The graphics capability of the SV-318 is impressive. The screen resolution is 256 by 192 pixels, with 16 colours available. Most important to games creators, however, are the 32 sprites which are available. These movable shapes can collide with each other and other objects, or can pass in front of or behind each other.

The SV-318 also provides three sound channels, fully controlled by the built-in BASIC, which will allow the user to write music or provide background sound effects for games. The sound circuitry is capable of background operation, so that the BASIC can continue the action in games while a sound is being synthesised.

A major plus of the SV-318 is its expandability; a range of plug-ins and accessories is available that would make many other manufacturers green with

envy. These range from a wide selection of games to an expansion chassis which will accept an RS-232 port, Centronics interface, extra RAM, a disk controller and 80-column card. Other options include a graphics tablet, games keypads and joysticks, data cassette recorder and dot matrix printer.

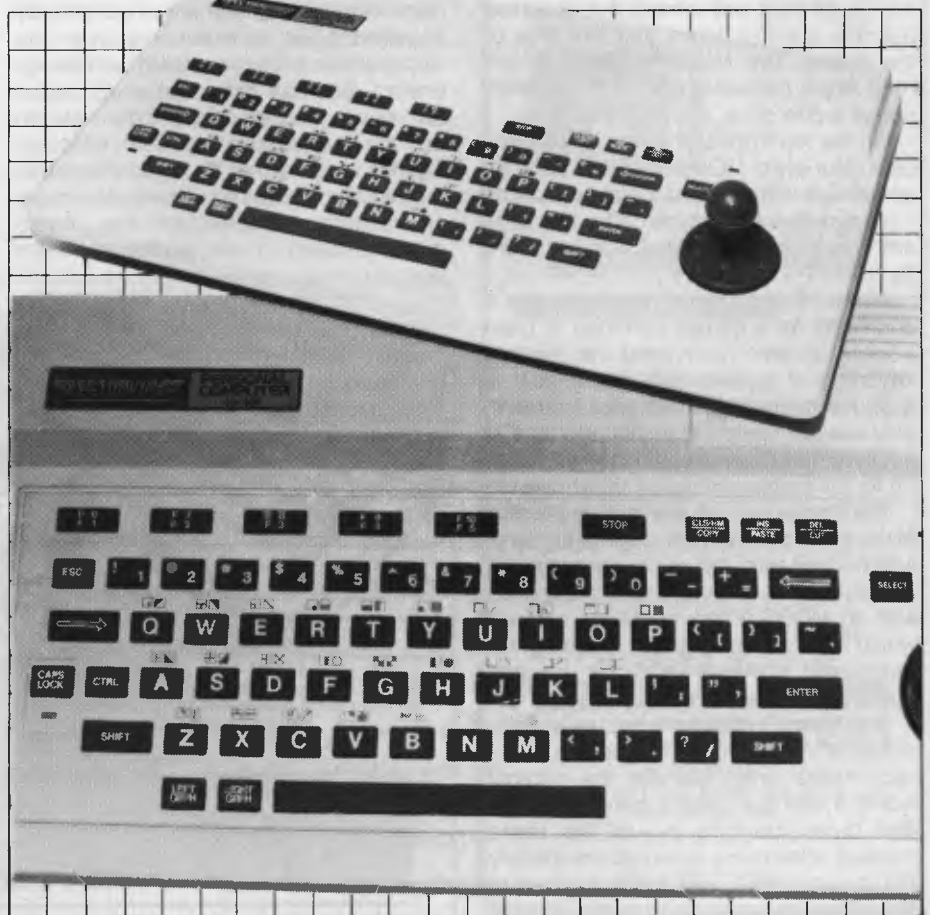
When used with the optional disk drives, the SV-318 uses the CP/M operating system, so that a wide range of software is available. The disks have a capacity of just over 160 Kbytes (formatted).

Setting up the SV-318 is just a matter of plugging in the power supply and modulator and wiring it to the back of the TV set. Immediately you're up and running. Attaching more of the peripherals and options might lead to a rat's nest of wiring, but this isn't a problem providing you don't want to move it all too often.

The SV-318 has an extended version of Microsoft BASIC, which includes all the usual graphics commands and the music macro language similar to that found in the IBM PC. It also includes provision for interrupt handling.

The manual for the SV-318 is nicely produced, and teaches the user BASIC through the use of the graphics statements – certainly a more interesting method than the usual mathematical approach. It progresses nicely until the end, when more complex statements, such as the `SPRITE$` statement, are demonstrated by example but not explained. The user is left to try to deduce how the statement works.

The SV-318 is a nicely put together system; it has enough expansion capability to satisfy a wide range of requirements, and would be a good choice for the person who knows he wants a personal computer, but can't decide what for...





## Micro-Professor II

There has been much talk recently about so-called 'rotten Apples' and Apple look-alikes. We have generally kept quiet on the subject; the legal complexities of registered designs make it a tricky subject, and even where such designs are legal, we feel it is very much a case of *caveat emptor*. These machines may suit some buyers, but in general, would you buy a car which claimed to be a copy of the Holden Commodore yet sold for only \$3000?

One machine which seems to be able to stand on its own merits, yet offers a high degree of Apple compatibility, is the Multitech Micro-Professor II. This little (175 by 240 by 30 mm) box contains a 6502 microprocessor with 64 Kbytes of RAM and 16 Kbytes of ROM containing a monitor program and BASIC interpreter which accepts Applesoft BASIC programs.

The screen display looks just like the Apple's and the memory map (where the ROM fits, and where the graphics memory is) also looks just like that of the Apple. The Micro-Professor II can read Apple cassettes and, with the addition of a disk drive, floppy disks.

On the top front of the box is a 49-key calculator-style QWERTY keyboard, which – as with most of these keyboards – will horrify a touch typist. The tiny keys are closely packed with a non-standard layout.

The left-hand side of the case has a connector for a games cartridge, a Centronics printer port and a remote keyboard or joystick port. At the rear is a 50-pin connector which looks remarkably like an Apple expansion slot, but is subtly different and could not be relied on for full compatibility.

The major use of this slot is for the Micro-Professor II disk controller card, which connects the disk drive to the computer. The disk system is supplied with an MDOS II disk operating system, which bears more than a passing resemblance to Apple DOS 3.3 – but is obviously different in several ways.

The Micro-Professor II display is composed of 25 lines of 40 characters each, upper case only, just like the original Apple II and II+, and it provides lo-res and hi-res graphics in just the same manner. However, it is not completely Apple-compatible, and some mention of the differences may be in order.

While the Micro-Professor II can accept Applesoft programs, many such programs perform PEEKs and POKEs of memory locations associated with the monitor and graphics routines. These locations are different on the Micro-Professor II, and so such programs will not work, as a rule. However, if you understand the purpose of these PEEKs and POKEs, you can probably rewrite the program to work on the Micro-Professor II.

When it comes to machine code programs – the vast majority of good fast action games – the situation is even worse. These programs always use monitor routines and I/O port addresses to perform their I/O, and there's no way you can find those references and change them to work on the Micro-Professor II. The original author, who has the source code, could do it – if he thought it was worthwhile.

In summary, the Apple compatibility of the Micro-Professor II is probably of most use to someone who has already acquired a lot of experience with the Apple and is fully conversant with its operation. Such an individual could probably rewrite his/her own software to run on the MP without much difficulty. There's certainly not enough information in the Micro-Professor II manuals to get along without some of the Apple documentation as well, particularly when

trying to use the graphics features such as shape tables.

In short, less than 100 percent compatible is not compatible; being slightly incompatible is like being slightly pregnant. And of course, where Apple is concerned, being 100 percent compatible is dangerous!

Someone should tell Multitech that quantity of documentation is no substitute for quality. The User's Manual and Introduction to BASIC Programming are reasonably well organised and take a good stab at providing plenty of reference material and technical background. The trouble is the translation into decidedly non-idiomatic English.

Thus we are presented with interpretation problems: what does the translator mean? What is a 'straight-thinking person'? How about 'Even if I were presented with a computer as a gift. I would be troubled as to whether I had enough room in my study to for it'.

The Micro-Professor II is, nonetheless, an interesting little machine which offers the ability to take advantage of the huge amount of software published in magazines and books. It also offers good value for money. It can run some quite good games cartridges and be a lot of fun – but I certainly wouldn't try to replace an Apple as a small business machine with an MPF-II.







### COMX 35

The COMX 35 is a very interesting machine indeed. For one thing, it's the first personal computer (other than simple single-board types) I've come across that uses the 1802A microprocessor. For another, it doesn't use Microsoft BASIC, but one that I've never seen before.

The COMX 35 has 16 Kbytes of ROM containing BASIC, and 32 Kbytes of user RAM, plus the screen RAM of 3 Kbytes. The display is 24 lines of 40 characters each, and eight different colours are available. The COMX display is unusual, in that computer output and echoed user input are displayed in different colours. As the user's manual points out, this is a useful feature for beginners.

The COMX 35 keyboard is a rubber type with a spongy feel, and a slightly non-standard (but still basically QWERTY) layout. At the right side of the keyboard is a built-in joystick. The computer has a built-in sound synthesiser and speaker.

Most micros use Microsoft BASIC; it's almost a novelty to find one that doesn't. COMX 35 BASIC is rather unusual. It is based on the ANSI standard, but with several extensions. Interestingly, it's an incremental compiler design. This means that when the user types RUN +, the interpreter does a scan through the program source code, and replaces all jumps to line numbers with jumps to an absolute address in memory.

This means that the program will run significantly faster, as much of a conventional interpreter's time is spent searching for the next line to be executed. Of course, if a program is edited, all the absolute addresses are changed, and so it will return to normal operation next time the program is run.

Graphics control is available in the COMX 35 through a user-definable

character set, using special BASIC statements to manipulate it. This allows complete control over shapes and colours, including the creation of multi-colour shapes. The accompanying blurb also stated that the COMX 35 had "enhanced graphics developed along the Logo language" which I presume means turtle graphics, but I could find no mention of this in the manual and wasn't able to try it.

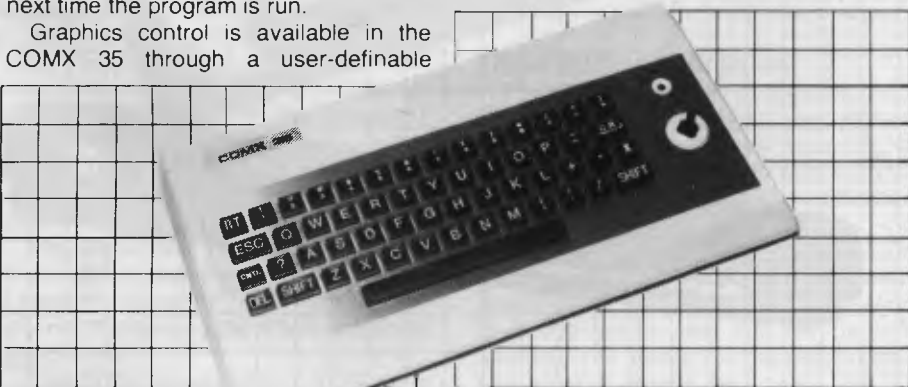
Other features of the language include the ability to set timer interrupts - great for game design - and the ability to save the entire data area of a program onto cassette. This presumably does away with the need for data files, although it means that data sets are restricted to the size of memory.

For those who find BASIC a bit limiting, the COMX 35 will also run Pascal or FORTH, so collectors of linguistic esoterica will be happy.

Various options are available for the COMX 35, including plug-in ROM packs, RS-232C and parallel printer interfaces, and a disk controller and drives. A speech synthesiser is also available.

Many programs are available for the COMX 35, including an electronic spreadsheet, simple databases, financial and statistical functions, a range of education programs and, of course, games - heaps of them - such as Othello, Hangman and various shoot'em-up, eat'em or catch'em variants.

An interesting machine, this; perhaps it will appeal best to the buyer who is happy to write his/her own software and will never want to key in programs straight from magazine pages without conversion. It's certainly an interesting one. . .



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## Sinclair Spectrum

Worthy successor to Uncle Clive's ZX-80 and ZX-81, the ZX Spectrum is one of the tiniest personal computers around. It's hard to obtain in Australia, as the United States market apparently has first claim on production, but hopefully the situation will ease with time.

The Spectrum has a rubber-type keyboard, which has so many functions, symbols and letters it can be rather confusing at first. And, of course, it has a colour display, a major leap forward over the old '81. Eight colours are available, in two intensity levels.

For those who keep filling memory with their programs, good news: the Spectrum has 16 Kbytes of RAM as standard, and that is factory upgradeable to 48 Kbytes. The BASIC interpreter is in a 16 Kbyte ROM.

The Spectrum BASIC is a superset of the ZX-81 BASIC, with some additional statements. These include statements to change the colour of the border, the background and the foreground, as well

as invert the colours, flash, and draw lines, circles and arcs.

The user can define his own character set by using the BIN statement, which allows him/her to specify which points to turn on in an eight by eight matrix.

The biggest let-down about the Spectrum is its sound capability – or lack of. It can synthesise a single tone through software, which of course stops the action while it makes sound effects.

The major form of mass storage is a cassette, but low-cost 'micro-floppy' drives are available – in fact these use a stringy-floppy style of tape wafer. An electrostatic printer is also available, which can print graphics off the screen.

The Spectrum has achieved remarkable success in Britain, where it seems almost everybody has one. Because of this, there is a fantastic amount of software appearing for it, plus books, magazines and the general support a home computer owner needs. It's going to be a successful machine.





### Commodore VIC-20

Well, what can one say? This is the machine that really turned Commodore around; it was getting a bit staid with the old PET series of machines, but the VIC really breathed life into the company.

The VIC has 5 Kbytes of memory – not a lot, these days – and can display up to eight colours. The memory is expandable to 32 Kbytes, using an external expander, and there is a plug-in ROM socket at the back.

Perhaps the best feature of the VIC is its full-sized keyboard, which even a fussy typist like me finds enjoyable to use. The keys are labelled clearly with alternative meanings like the graphics shapes and colours. At the side is a games port for a joystick, while the rear of the case boasts a row of cassette, user, serial and video ports.

The range of plug-in cartridges for the VIC is tremendous, and they really show the high-resolution graphics capabilities of the machine off to good advantage. The user can get at them with a super expander cartridge, which gives a 176 by 176 resolution.

The VIC's sound effects set a new standard in their time, with three voices of music. The whole package was quite revolutionary, and has done well in the intervening years – just look through the ads in this magazine . . .



### Tandy Color Computer

This beastie reached our shores in late 1981, and provided a look at an alternative way of putting together a home computer. The Color Computer boasts a resolution of 256 by 192 under Color Extended BASIC, with nine colours, and as with the VIC, some of the games really make good use of that display.

The standard amount of ROM is 16K (with Extended BASIC) and most machines will have either 16 Kbytes or 32 Kbytes of RAM. The microprocessor used is the Motorola 6809E, an exceptionally powerful chip that is used to do a lot of the legwork inside the CoCo and save on hardware costs.

The CoCo can be expanded with a disk system, and many TRS-80 Model I programs could be run on it with virtually no modification, so it has quite a lot going for it.

The CoCo never really caught on in

a big way (probably because the VIC was just so much cheaper), which is a shame as it really is a nice machine. It has a dedicated user group which does all kinds of weird and wonderful things with it and it really has a high level of support behind it, both from Tandy and elsewhere.

### Texas Instruments 99/4A

The 99/4A is rather a problematical machine. It's almost sent Texas Instruments broke – figuratively speaking – yet it is a nice machine with all the things we are told a home computer ought to have.

The 99/4A has a 16-bit processor (though its BASIC is unaccountably slow) and a special graphics processor chip which looks after the 256 by 192 graphics and drives the sprites (moveable shapes) around the screen. The 'A'

model features a decent keyboard compared to the earlier model.

A user-definable character set allows the user to create chess pieces, card symbols and other shapes.

The TI machine's manuals are well written, and TI arranged for additional material to be published by traditional publishing companies. Perhaps the greatest effort has been poured into software, with the release of a vast range of games, home applications and utilities, including TI Logo, a full implementation of that most interesting language, which really takes advantage of the graphics capabilities.

Other options include a speech synthesiser, expansion box, memory, disk drives and various I/O boards.

The machine has a definite following, with a large national user's group which has branches all over Australia. It's well supported and has great appeal. ▶



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*Not being a great game player, Les sought out an expert to deliver judgement on Dick Smith's Wizzard games machine. He dragged Mark Burnicle out of the pub for long enough to write this report . . .*

SOME TIME ago, at a somewhat hard to remember party, Les Bell turned to me and said something about me writing an article for *Your Computer*.

Upon my enquiring on what the heck I would be able to scribble about, Les muttered 'Wizzard'. This brought an instant quizzical look from me as I'd been called many things, but wizzard - never!

'No, you can review the Wizzard!' he beamed at me, presenting me (almost magically) with a black cardboard box about the size of a beer carton and splashed with colour. Although not having a clue what I was holding, but not wishing to appear ignorant, I returned his excited banter about the black box with the pictures of Dick Smith, and muttered the word 'Wizzard' several times.

Eventually all appeared fine so, black box tucked safely under my arm, I set off to (as it turned out) review the Dick Smith Wizzard.

Once out of its package the Wizzard takes on the appearance of a quite simple, compact unit, complete with two joysticks, touch pads and firing buttons.

I decided, in a fit of irrational confidence, to connect the cords to their various points; but when all my efforts had failed, I reverted to the instructions and was soon under way.

To become accustomed to the machine I opted for a familiar invaders-style game called Sonic Invader. Since I was quite proficient at this style of game and had kept one particular hotel in Ultimo from going out of business with my patronage of its machine I decided this would provide a good idea of the Wizzard's ability.

To warm up I decided on battle number one of 16, a singles game which is Invaders at its most basic. The invaders move slowly from side to side, dropping slow moving tracers at you as they get cut to shreds. Definitely a good warm up. So on to battle number five, another singles battle - this time, however, the little devils kept disappearing. This was a bit tougher but I still managed to rack up points without much trouble.

At this point, full of confidence, I tried number 13, the hardest singles battle. The invaders move very quickly, rain you with bombs and disappear. This took a few goes before I managed to get the idea, but I soon had them under control.

I was impressed. The graphics were as good as the pub and milk bar versions, the controls moved quickly and accurately and it performed as well as you could hope for.

The doubles games were extremely challenging, with your opponent firing at exactly the same time as yourself

Having warmed to the controls and the enjoyment of the competition, I tried the next game, Planet Defender, a variation on another of the standard games found in pubs and the like.

#### **It Gets Harder . . .**

Planet Defender finds you appearing from hyperspace to confront aliens which bear a remarkable similarity to bats and Halloween pumpkins. The game itself is a step up in ability and reflexes. Not only do you get to eradicate these little nasties on sight, you also plan your defence with a 'radar' device at the top of the screen. This is a game which tests the reflexes to the limit at the maximum difficulty stage.

The multi-colour bats and the green Halloween pumpkins glide in and out and then engulf your craft until you disappear in a thousand little pieces. A good game with very good graphics, the normal invaders type sound effects - though on the Wizzard these don't sound tinny but clear and crisp.

Finally (around 2 am the first time I played) I tried Tennis. This one really got me in. No longer is a video game of tennis restricted to two hyphens moving back and forth preventing a full stop from going past - no way! Things have progressed slightly.

I switched on the set and fell off my chair (*drunk again, Burnicle - Ed*) - there before me was a tennis court complete with net, crowd, Wimbledon sign (why settle for less?) and two little tennis players complete with racquets who run around actually hitting the ball over the net. The graphics are so damn great that the ball even casts a shadow.

The games got progressively harder, faster and more frustrating. You may compete against another player or (if you like a challenge) against the

machine. Believe me, the machine likes to win.

Playing an early level game I had it under control: serve, volley, volley again and the machine hits the ball right into the net. So, feeling capable of wiping McEnroe off the court I progressed up a few grades and followed my successful game plan. Serve, volley, volley again, and the machine hits a top spin lob over my player. While the early games play fairly predictably, the higher level games appear to hit at random patterns.

This game will turn you on (for hours), it will enthral your little sister, your big brother, your mum, your dad and anyone else you may happen to show Wizzard Tennis to.

But be warned, if you sit down and try to beat the machine before you go to bed, you'll be there for a while. You will need a good supply of Scotch, a very comfortable chair and the patience of a saint.

This one will have you playing for hours. It's a Wizzard.

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5. The ability to locate words or other combinations of characters and/or digits throughout lengthy text and, if desired, to change those words to others – for example, 'Charles I' to 'Charles II'.

6. To arrange final printing format as required – line spacing, line width, aligned right-hand edge (justification), centred copy, complex tabulations, bold typeface and so on.

7. A final requirement, not achieved until the advent of the electronic word processor, is the ability to show text as it is keyed in, on some form of visual display.

Not all users need all these facilities. A writer rarely has the need for elaborate formatting; legal secretaries, on the other hand, make extensive use of the ability to retrieve and insert standard clauses in lengthy documents.

Mail order companies value the ability to personalise letters (by merging address lists with standard letters).

Some word processors include basic arithmetic functions – handy when including financial data within text; others include the ability to sort lists alphabetically or numerically. Some even include facilities for checking grammar, spelling, and punctuation.

### Word Processing Vs. Typing

Despite all their facilities, word processors are not necessarily faster typewriters – rather they are brighter typewriters. They can do more than typewriters, but do not necessarily replace them.

It is still quicker for a fast typist to prepare a few single-page business letters, address a few envelopes, or type short memos, using a typewriter rather than a word processor.

Word processors really score where written material is the principal or an important aspect of the operation – especially where clean text is a prerequisite. Legal offices are prime examples – and were in fact the first large-scale users.

### Hardware

There are two main types of word processor, both are based on generally similar equipment.

The first (and original) is the so-called 'dedicated' word processor. This is a small computer programmed (by software) to do nothing other than word processing.

These machines are intended for handling routine office work. They are easy to learn and work quickly and efficiently.

Commonly used addresses, salutations and phrases may be stored in memory and inserted by pressing a single key. Other functions such as underlining, bold face, centring, aligned right-hand edge and so on are selected by keys used for that purpose only. There may also be facilities for complex tabulations.

Some dedicated processors include basic arithmetic functions.

The second and increasingly common form of word processing is via a personal computer and one of the many proprietary word processing software packages.

These programs tend to be harder to learn than those used by dedicated machines, primarily because more functions are often available.

The earlier programs of this type are also slower in use, especially for deletions and insertions. This slowness is due to the need to use multiple keys to select various functions.

Later and more sophisticated programs, such as Benchmark and Spellbinder, utilise the computer's function keys in the same manner as with a dedicated machine, and permit much the same speed.

Dedicated processors perform best where they will be used continually for preparing documents and other lengthy material.

However, there is a rapidly increasing trend to the use of personal computers in business and other organisations, and this is resulting in a corresponding increase in the numbers of such machines including word processing as part of an overall range of functions.

### Software

Word processing software is available for every personal computer on the market. This software varies from brilliant to barely adequate.

The very best software (arguably Spellbinder, Benchmark and the latest release of Wordstar) will only run satisfactorily on a limited range of computers. As with computers generally, it is best to choose the software first as this will determine the machines to consider.

### Choosing A Machine

Whatever the choice, the computer will need at least 48 kilobytes of random-access memory and facilities for connecting a printer.

There must also be an adequate-sized video unit, (12" minimum if the

machine is to be used constantly), with the ability to display 80 characters across the screen, and 25 or more lines down the screen. There should be an adjustable brilliance control.

If there's a lot of numerical work the keyboard should include a numeric keypad, preferably with the standard accounts-type layout. There's a lot to be said for having the keyboard separate from the display unit – particularly for users with less than perfect eyesight.

### Storing Text

The next requirement is somewhere to store the text after it has been keyed in.

As text is entered it is initially stored in the computer's random access memory. A 64K machine will hold about 18 single-spaced pages of typing.

Random access memory is limited in capacity and volatile (contents are lost if power is removed). Because of this, users copy text onto a floppy or hard disk at frequent intervals for more permanent storage. Copying also occurs automatically if the memory capacity is exceeded.

The ideal situation is to have two disk drives, as this has several advantages. Firstly it makes it much easier and quicker to make back-up copies of important material. Secondly it enables one disk to be retained for the operating system and the word processing and associated programs, whilst the second drive is kept solely for data.

### Choosing A Printer

A letter-quality printer is essential for business correspondence. These operate at 20-55 characters a second and cost from \$1000-\$5000.

Letter headings may be handled by having them specially attached to fan-fold paper guided through the printer by a so-called tractor-feed attachment, or by using standard-sized letterheads fed to the printer one at a time by a 'sheet-feeder' or typewriter like friction-feed mechanism.

It is well worthwhile considering a maintenance contract for your printer. Currently this will cost about 10-15 per cent of the printer's cost per year.

### The Right Package

**Wordstar:** This is one of the earlier word processing programs, yet somehow the programmers got most things right first time!

Its major failing is that it was apparently written by computer programmers

with no writing or secretarial experience. Some of the resultant problems have been remedied but Wordstar is still hard to learn and clumsy to use.

Wordstar is the antithesis of the term 'user-friendly'. Sales people will point out that 'help' menus are available on the screen at all times – but if you can understand them you don't need them.

The earlier handbooks are impossible. Later versions are better but far from lucid.

Despite all this Wordstar has an extensive and fiercely loyal following. Once learned, its idiosyncracies tend to be forgiven, for its programmers thought of almost everything. Even today the program out-performs most of its rivals.

The latest version removes some of the criticisms but Wordstar is, regrettably, now surpassed by the best of the new breed.

Nevertheless Wordstar is still an excellent product. More people know how to use it than most of the other programs combined and this alone is a sound reason for buying it.

Wordstar costs around \$600 plus \$250 or so for the optional spelling package. It may be used with any computer using the CP/M operating system.

**Spellbinder:** This is probably the best of the current new word processing programs – it's a toss up between that and Benchmark.

Theoretically, Spellbinder runs on any computer using CP/M but, in Australia at least, the vendors limit sales to specific makes and types of computers. This is because Spellbinder allows keys to be allocated for specific functions – as with dedicated machines – which can only be done by tailoring the software specially for each type of machine.

Hewlett-Packard supplies Spellbinder already installed on its personal computers – but calls it by a different name.

Spellbinder is more than a word processing program. The distributors describe it as an 'office manager'. Apart from a wide range of word processing functions, Spellbinder creates and stores forms and report outlines, has arithmetic abilities, can sort lengthy files alphabetically and numerically, and offers programming facilities for those who know how to do it.

Documentation is no better than most and first-time word processing users should expect initial difficulties because of this. But the effort's worthwhile. Excellent value at \$575 or so.

**Benchmark:** As with Spellbinder, Benchmark may be tailored for specific

computers to exploit the function keys included on the more expensive keyboards.

This is exceptionally valuable with Benchmark as this program can store up to 52 commonly used addresses, clauses, or phrases (of up to 2000 characters), and retrieve and insert them by a simple key sequence.

The date of creating and revising text is automatically added to each file, and the directory automatically increments reference numbers of revised texts.

Benchmark also merges name and address files with standard letters, and has some arithmetic functions. An unusual and valuable feature is the ability to include non-printed-out 'comment' lines to be inserted into text.

Benchmark is exceptionally easy to learn and the documentation is easy to understand. Sufficient functions are provided for all normal word processing uses. This program is particularly suitable for large-volume users. Price is good value for around \$600-\$650. It runs on CP/M machines (but see above regarding tailoring keyboards).

**Visiword:** This word processor is an offshoot of Visicalc and related programs, and one of its most valuable features is that it is integrated with some of the other Visi programs.

This means, for example, that you can include a spreadsheet in your text and manipulate it using your word processor. By so doing you can produce quite useful and visually attractive reports using the results of your spreadsheet calculations.

You can also merge data, such as mailing lists, from the Visifile program.

There is an 'undelete' feature that allows you to retrieve a previously deleted record. This is a particularly useful feature that protects text from being accidentally deleted.

Visiword allows you to work on documents while the printer is busy, thus saving a great deal of time while you wait for a document to print.

Visiword also supports function keys.

## Learning Word Processing

Word processors and programs vary considerably – not so much in what they do but rather in the way the functions are achieved.

This is not as big a problem as it might seem. Most of the learning is spent absorbing the range of functions provided – finding out how to invoke these functions is easier. As an example, Wordstar has over 750 sep-

arate commands – but few people regularly use more than a quarter of them.

Some word processors have teaching programs built in. Some of these are of sufficiently high standard to get you well on your way in under two hours. You can study the manual provided and go by trial and error or you can enrol in a course (many TAFEs offer courses free, but they are very popular). Some word processors, such as Wordstar, have instructional cassettes that you might also like to try.

## Productivity

Word processors enable many slow typists to type faster. This is because slow typists are only too aware of the time and effort required to correct the inevitable mistakes if they typed faster. They therefore type slowly. Many such people will type faster using a word processor, since errors take just a second or two to correct – and do not result in a messy final page.

Experienced word processor operators average 65-70 words a minute; corrections barely reduce this at all. Fast typists average 60 words a minute but corrections reduce this to 40-45.

Time savings can be greater where changes must be made in lengthy copy – such as legal documents – as only the changes have to be re-typed, not the entire document. The processor will automatically respace and repaginate the whole copy and will produce a totally clean copy regardless of the number or extent of the changes.

Offsetting this is time spent initialising word processing files, saving files, printing out results (unless the machine allows the user to print out whilst entering other text), and making back-up file copies. Allowance must also be made for the far higher cost per hour of word processing equipment.

## The Market

Adequate word processing hardware and software costs from \$5000 upwards. With few exceptions the computer will cost a minimum of \$4000 (including two disk drives), a printer will add a further minimum \$1500, and software a further \$500-\$1000.

The computer industry is currently undergoing a mammoth shake-up and it is probable that less than a third of the current vendors will be in business in two years time. This being so it is wise to purchase from the major companies only – and their products are not usually the cheapest. □



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# SYSTEMS ANALYSIS IN SMALL BUSINESS

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*Many small businesses are now facing a momentous decision. As prices of small computers have fallen, they must now decide whether or not to computerise. But which applications to computerise, and what kind of computer to buy, are decisions fraught with danger for the unwary. LES BELL tells how to avoid some of the traps. . .*

---

MANY BUSINESSMEN observing the falling price of small computers and reading articles in the weekly news magazines, are now contemplating the introduction of a micro-computer into their business in some way. Deciding whether to jump or not, and which computer to buy (with which software package), is a difficult decision for the untrained or inexperienced.

The situation is further compounded by the cost of a micro-computer being low in comparison to the fee charged by a consultant for analysing the decision and recommending a computer. On the other hand, the headache is eased by the low cost of a micro making possible the gradual introduction of the system into a business. Thus the computer's initial impact

is reduced, and it can initially be operated in non-critical areas, where manual back-up is possible, if necessary.

In this article, I shall try to set out some guidelines which will be of use to the small businessman who is contemplating the purchase and installation of a small (under \$10,000) computer system, and who is prepared to involve himself in the

introduction of the system. That pretty well describes most *Your Computer* readers in business.

I shall try to avoid dogma as much as possible, and present a set of decision-making criteria which the reader can use when investigating possibilities for his own business. At the same time, I cannot resist a certain amount of iconoclasm!

The system analysis procedure for a small business is iterative. That is, the analyst will probably have to repeat the process several times, until his decreasing expectations meet increasing system capabilities and cost.

Initially, inexperienced people tend to have unrealistic expectations. "I want to keep order processing and inventory in-

formation for 10,000 product lines, with an average of 700 orders per day, and I want to do it on a ZX-80. Of course, I realise I'll need the extra 16K RAM pack".

### The Analysis Loop

The next time around the loop, the problem definition might be "I want to keep inventory information for one department with 1,000 products, only 50 orders per day, and I'll use a TRS-80 with one disk drive."

Successive iterations will finally produce a workable compromise. And compromise is the name of the game with small computers.

What's in the system analysis loop?

Define system requirements. Be realistic; if you haven't much experience with micros, find out the kind of jobs they are currently doing. Don't push beyond what is currently possible.

Contact other small business users of micro-computers, and find out what they are doing with their machines. Read the case histories in *Your Computer*.

Be specific in your definition, and don't leave room for errors. When you write your definition, test each statement for validity and sense.

Is it really sensible to process 500 orders per day, on a system with one screen and printer? In a seven-hour day, that's 50 seconds per transaction, before you've allowed time for production of reports, printing and other jobs.

Can you fit inventory information on 10,000 items onto the disk space on your prospective computer? What information is required, what is useful, what is nice to have, and what is just plain useless?

Try, if possible, to base your system on current procedures. Very rarely does a company buy a computer without having been in business for some time, and

therefore having existing ways of doing things. If you change your procedures to fit the computer, and let's be honest, you will probably have to, what will be the impact of that change?

Analyse your current forms and reports. What information are you collecting that is not being used? What information are you not getting in reports that would be useful?

Determine your exact business needs. Examine your personal motivation, too. If you really are fascinated by computers and like the ideal of playing around with one, then be honest and buy it for that purpose — it's perfectly legitimate and healthy!

Don't saddle your business with an executive toy.

### Hardware and Software

The hardware and software of a computer system are irretrievably interlinked and intertwined, and cannot be considered totally separately. Some people would have you believe the software is all; that it is the only consideration, and that the machine itself is unimportant.

I tend towards this view, but cannot wholeheartedly support it. It sometimes happens that the software you want is only offered in conjunction with a machine insufficiently robust for the job, or not capable of expansion to meet your future needs. In that case caveat emptor...

Formulate your software approach. Will you use off-the-shelf software, will you have a package modified to meet your requirements, or will you go the whole hog, and have a package specially written for you?

I would suggest the latter option removes much of the incentive for buying a micro-computer in the first place. Software is more expensive than hardware.

In a typical commercial environment, the software on a system costs more to produce than the hardware did. But it doesn't take long to design and assemble a micro-computer; writing a good piece of software is a much bigger task. For this reason, I have restricted my comments to the purchase, and possible modification of, a standard package.

Modification of software is only possible when it is purchased from the original designers/vendors. It is possible to modify other people's software, but it is time-consuming and expensive. In many cases, source code is not available.

### Canned Software

That really leaves the local purchaser of a micro with no alternative but to use 'canned' software. The rules are: Obtain the documentation for the package. Read it and try to understand

it. Is it orientated towards the technical user or the untrained operator? Which are you?

Ask the vendor to put you in touch with other users of the product, and ask their opinions. Don't waste their time, but you should find most people will appreciate the possibility they will want this kind of advice themselves some day.

Observe the product in action on a computer system similar to your choice. Most packages will run much faster on a hard disk system than on 20cm (eight inch) floppies, for example. Is it capable of the throughput required? Does it cater for any special cases you may have?

Thoroughly investigate all the alternatives. Try to weigh up the pros and cons of each one, and make an objective decision about which fits your needs best.

The standing of the supplier doesn't matter that much with micro-computer software. It is unlikely such software will ever require maintenance in the way that big system software does; that is revision to run under new operating systems, or with new peripherals.

Finally, for those who aren't faint-hearted, there is one further alternative — roll your own software. For small and unusual applications (where packages aren't available) it is perfectly feasible for the owner/user to write his own software. This is only suitable for those non-critical areas, where you've cruised along by manual methods, but a computer would allow much more sophisticated analyses and reports, for example.

A marketing manager could write his own programs to do moving averages of sales figures, or even progress to exponential smoothing and linear regression





programs. But I'd still recommend leaving general ledger programs to the experts.

For roll-your-own software attempts, the major decisions are the selection of the language and the operating system. These are rather more technical considerations, so I don't propose to cover them in depth here.

### Hardware Requirement

Formulate your hardware requirements. The processor in a system is not vitally important, but it must support the software of your choice.

You must allow sufficient memory to accommodate the operating system, language processor (such as BASIC in-

terpreter) and program. Even more memory is required when large amounts of data must be kept, such as when sorting or using large arrays.

When examining the choice of mass storage devices, such as 13cm (5.25 inch) mini-floppies, 20cm floppies, or hard disks (or even cassettes, if appropriate) use arithmetic, not guesswork to work out your requirements. Work out the length of a record of information to be stored:

name	30 characters
address line 1	40 characters
address line 2	40 characters
address line 3	30 characters
postcode	4 characters
type of purchase	4 characters

This gives a record length of 148 bytes.

Many systems would force the user to make this record 256 bytes long.

If details on 1500 customers are to be maintained, what size disk should be used? Well, 1500 x 148 is 222 Kbytes, which will just fit on a single-density 20cm disk. With a two-drive system, this might be acceptable.

If you're cutting costs and only have one drive, it must be double-density to allow space for the operating system, utilities, language processor, and of course, your program.

Examine your peripherals requirements carefully. Can one VDU handle the workload?

If you need multiple screens, this will influence your software possibilities enormously. What speed of printer will be required, and what quality of type?

Examine the documentation carefully. Enquire about support services and maintenance. Unlike software, it pays to have your hardware supplier still in business when your computer breaks down.

Allow for future expansion. Can you add more memory, a hard disk drive? Can you attach more screens and make the system multi-user?

### Bell's Handy Hints!

Each application has its own special requirements, which have not been covered here. Avoid applications which will involve custom hardware; these can prove expensive. Let someone else take the risk first.

I have a few other words of advice which can be classified as dogma, and consequently the discerning reader may choose to ignore them. They are based on experience, both good and bad (some real horror stories!), but may not apply to your particular situation.

Avoid 13cm (5.25inch) minifloppies! If you only want to store that much information, you may as well memorise it, and run the business in your head. Mini-floppies are really okay in their place, which is beside a thumping great hard disk.

Stick with industry standards in software, such as CP/M. This way you have access to the largest software base, with more chance of finding the right package for your needs.

Beware of the advice of people (even/especially consultants) who have ingrained mainframe modes of thinking, which necessitate a minimum of one Mbyte of RAM and 10Mbyte of disk, just to run a short BASIC program.

And don't believe everything you read.



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The microbee Series 2 was specifically designed to serve the needs of the EDUCATION MARKET. Let's face it, the primary non-business use for most personal microcomputers is to increase our learning capabilities either about computers (computer awareness) or about life itself. microbee Series 2 has now been officially approved by Education Departments in NSW, WA and Queensland and is being carefully considered in virtually all other states and by the National Schools Commission at the time this ad was going to press.

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- DUD – ONE**  
Another two programs for the price of one from Dreamcards. One side has poker, and the other is Casino which is a three reel poker machine. Both use Hiras graphics. Excellent value.  
Cat. XE-7052 **\$15.95**
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The advent of the microcomputer has changed all that. There's now a new way available to, and beneficial for, all three.

Financial planning using a commercial software package — selling for as little as \$200 — is at one time both a simple yet extraordinarily powerful solution to this universal problem.

In this article we examine several of the most popular financial planning and modeling packages available on microcomputers, from several viewpoints — ease of use, range of applicable problems, convenience of output, versatility, and so on.

The packages under consideration are:

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*The low cost of microcomputers and the availability of easy-to-use software makes it possible for every businessman to use a personal computer as a decision-making tool. One of the first areas where this is happening is in financial planning and modelling. YOUR COMPUTER investigates...*

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Visicalc, the progenitor of the ubiquitous 'financial spreadsheet' programs; Supercalc, a similar program available for a larger number of machines; CalcStar, another spreadsheet program with advanced capabilities; Planfin and Profin, two new planning packages for budgeting and capital project planning respectively; Desktop/plan II, another Apple modelling program; MicroModeller, a planning and analysis package which features graphic display; and Target Planner, a sophisticated planner

which falls between the 'spreadsheet' and 'structured' camps.

The objective is not a point-by-point comparison; rather it is to provide some basic information as to which package will best suit particular uses and users.

## Basic Principles

The packages described here are intended as 'decision support' tools for executives.

While none could ever claim to provide answers out of a hat, they give the manager the ability to manipulate many more variables and more complex relationships, while freeing the creative side of the mind to build and examine the model.

Perhaps most significantly, their ability to carry out all the repetitive re-calculation and leg-work promotes an inquisitive approach to the budgeting task.

The fact you can ask 'what-if' questions — and get an immediate answer — encourages you to do exactly that; even if you don't find a better alternative you'll gain a better understanding of the figures and the impact of the variables.

	A	B	C	D
1: Acme Widget Co's 5-year Forecast				
2: Quarter		1	2	3
3:				
4: Product A: Widget				
5: Sell price	19.95	19.95	19.95	
6: Volume	20000	21000	22000	
7: Revenue	399000.00	418950.00	439800.00	
8:				
9: Var cost	6.75	7.09	7.44	
10: Fixed cost	20000.00	20000.00	20000.00	
11: Cost of goods sold	153000.00	168837.50	184093.34	
12:				
13: Profit contribution	244000.00	250112.50	255806.66	
14:				
15: Product B: De-luxe				
16: Sell price	24.95	24.95	24.95	
17: Volume	1500	1575	1654	
18: Revenue	37425.00	39296.25	41261.06	
19:				
20: Var cost	9.47	9.94	10.44	
21: Source location C6, Adjust B6?				
22: No Adjust., A(sk for Adjust.), V(alues)				
23: 1.85=B6				

Preparing the Acme Widget Co's budget  
(see story below).

## Visicalc Version 3.1

Visicalc is the original spreadsheet calculator program. More recent planning software draws much of its format and style from this trend-setting success story.

It is available for the Apple II and III, Tandy TRS-80, Commodore CBM, Atari 800, Hewlett-Packard HP-85 and HP-125 computers, and possibly others as well. Our Acme Widget Company example illustrates how a Visicalc model could be set up.

Visicalc's spreadsheet is always visible on the screen. The four keyboard control arrows (two with an Apple II) move the cursor anywhere on the screen; when it reaches the edge, the worksheet 'moves', figuratively speaking, to keep the cursor in sight. A simple command will move the cursor anywhere in one jump.

With the cursor positioned over an empty cell, the user is ready to make an entry. This can be text, entered simply by typing it, or a number or formula, which is generally signalled by an initial plus sign or number. Text can happily appear in the middle of a row (or column) of numbers — it has a numeric value of zero.

As an entry is made it appears on an edit line at the top of the screen, so that errors can be corrected. Once the entry is complete and correct, it is transferred into the worksheet (by hitting the return key or one of the cursor control keys) and the cursor moves on to the next entry.

Also at the top of the screen is a line showing the current coordinates of the cursor, the format of the entry (on which more later), the entry type (value, label or repeating label — such as a line) and the

## Budgeting For The Acme Widget Company. . .

*A simple example of how a financial planning package is used as an 'electronic spreadsheet' might look like this:*

ALBERT SMITH, marketing manager of the Acme Widget Company, has to prepare a forecast, showing quarterly figures for the coming five years. This year, for the first time, he plans to use his personal computer to prepare the forecast.

His manual calculation method is to estimate sales volumes for the company's two products and multiply this by their respective prices, giving the revenue for each product. He then calculates the cost of the goods sold, based upon two elements; the fixed cost and the variable cost per unit (we did say this would be a simple example).

Subtracting costs from revenue gives each product's profit contribution. Adding these gives the company's net income before tax. Next, he calculates depreciation on capital equipment, as well as investment allowance, and subtracts these from NIBT to give the taxable income. He calculates the tax at 46 percent of taxable income and subtracts this from the NIBT to give profit after tax.

This tedious calculation is repeated for each quarter — a waste of Albert's time. Worst of all, supposing Albert wants to investigate the effects of a price cut he has to repeat all the calculations again, from the point at which the change is introduced.

For this reason, budgets have never been regarded as exploratory tools.

### Enter the Personal Computer

This year, Albert has a personal computer on his desk. With the aid of his financial spreadsheet program, the report will be done in a few hours.

Instead of the analysis sheets Albert would normally use, the program turns the computer's display into a window on a gigantic electronic analysis sheet. It has rows running across the sheet and columns running down. Columns are lettered from A to Z and then from AA to BK, while rows are numbered 1 to 254.

Numbers can be entered anywhere on the sheet and, most importantly, so can formulae — whenever a formula is entered, it is immediately calculated out and the result displayed. The formula itself is always stored, however, ready for recalculation if the figures it relates to change.

At the left of the screen, column A will be used to label the various rows (Price, volume, Revenue, and so on). Columns B onwards will be used to contain the figures for each quarter of the five-year plan, while the top few rows will be used for ancillary information, added later.

Moving down column A from location A4, Albert enters his labels:

**Product A: Widget**  
**Sell price**  
**Volume**  
**Revenue**

**Var cost**  
**Fixed cost**  
**Cost of goods sold**

**Profit contribution**

With the labels in place, Albert starts entering data.

Moving to location B5 (opposite 'Sell price'), he enters the figure: 19.95. In the location below (B6) he enters the volume: 20,000. B7 will contain the first quarter's forecast revenue; here he enters B5\*B6

— the computer automatically multiplies together his price (B5) and his volume estimate (B6) and displays the result at B7.

It also stores the relationship B7 = B5\*B6, so whenever B5 or B6 is changed, B7 will automatically be recalculated and displayed.

Moving down to the costs section, Albert enters the variable cost per unit at B9 (6.75), and the fixed cost at B10 (20,000). The total cost is variable cost times volume, plus fixed cost, so Albert keys this in as B9\*B6+B10. The answer automatically appears.

Finally, the profit contribution (B13) equals revenue (B7) minus cost of goods (B11), so Albert keys in B7-B11.

That completes the calculation for product A for the first quarter; this must be repeated for the next 19 quarters. The first thing to do is to number the quarters across the top of the sheet. Moving to B2, Albert keys in the first quarter number, 1. Moving on to C2, he defines the next quarter number in terms of the previous one: B2+1. The number 2 appears, correctly.

Albert's next command illustrates the tremendous power of the spreadsheet calculator. Using the **replicate** command, he copies that formula from C2 right across the sheet as far as U2, indicating that the formula is to be relative rather than an exact copy. Thus D2 equals C2+1, E2 equals D2+1 and so on.

This produces the digits 1 2 3 . . . 19 20 across the top of the sheet — a simple example which gives some insight to the potential power of the replicate command.

At this stage Albert intends to keep the price constant, but forecasts that volume will increase by five percent per quarter. By using the same replicate command on row 5, he makes C5 equal B5, D5 equal



contents of the entry under the cursor.

It is important to distinguish between the contents of an entry and the displayed form of that entry on the worksheet/screen. An entry will often contain a formula, for example, but the display will show the result of the calculation. The entry contents line, on the other hand, will show the formula explicitly.

Below the entry contents line is the prompt line. As commands are entered into Visicalc, the prompt line will change to display the possible next commands. Each Visicalc command begins with a slash (/); as the slash is entered the prompt line changes to show the choice of letters which the program will then accept. Once one of these is chosen, the line changes to prompt for more information, guiding the user.

Each location on the spreadsheet, or a row or column, can be formatted to display information in a particular way. An entry can

be formatted for display as an integer, in dollar-and-cents format, left or right justified, global format (same as rest of sheet), default (usual format for that entry type) or for graphical display.

Visicalc has a rich set of commands. Briefly, these are:

**/b** Blanks an entry, without affecting its format

**/c** Clears the entire worksheet, ready for a fresh start

**/d** Deletes either the row or column on which the cursor lies

**/e** Enters *edit mode*. This copies the contents of a location to the edit line, where it can be altered before being returned to the current location.

**/f** Sets the format of an entry, as described above.

**/g** Global commands, allowing the user to set the column width, global default format, order of calculation (row/column first), and automatic or manual recalculation when an entry is changed.

**/i** Inserts a row or column.

**/m** Moves a row or column from one position to another.

**/p** Prints a report (to printer or disk). The report may be a subset of the complete sheet, and various flexible options are provided for setting up the printer.

**/r** Replicate: allows entries to be copied. Replication allows a range of entries to be copied. It will ask whether copied formulae should always refer to the same absolute locations or whether the source is relative to the destination (for example, always the preceding column).

**/s** Storage commands, allowing the saving and loading of files.

**/t** Allows the setting up of title areas at the top and/or left of the screen. No matter how far the screen is scrolled, these will stay on the screen, so titles are always visible above or to the left of the appropriate entries.

**/v** Returns the Visicalc version number.

**/w** This command allows the screen to be split into two windows, either horizontally or vertically. This allows entries which are widely separated on the worksheet to be brought together for comparison.

**/-** Repeating labels are often used to draw lines (---- or =====) on the screen to break up reports.

Obviously, the user has considerable control over the worksheet. The replicate command, in particular, is exceptionally powerful, allowing huge expanses of blank worksheet to be filled in in a few seconds.

The formulae which can be entered into any location can use any of the arithmetic operators (+, -, \*, /) as well as the exponentiation operator. Expressions can include constants or can refer to the previously-calculated contents of another cell. As well as these operators, Visicalc includes a comprehensive selection of functions.

A function name is preceded by an @ sign during formula entry. Some of the functions operate on a collection of values known as a *list*. A list consists of a series of entries and ranges of adjacent entries, such as B2..B5 (the second to fifth entries in column B). This facility is particularly useful when entering additional rows, as they will often be automatically included into a function list.

The functions include many of the standard calculator functions, such as SIN, COS, TAN and their inverses, plus PI, ABS and INT. Other are uniquely designed for spreadsheet calculators, and include:

**SUM** Calculates the sum of the values in a list.

**MIN** Calculates the minimum value in a list (also MAX).

**COUNT** Counts the number of non-blank entries in a list. ▶

C5, and so on, copying the price into each column.

Volume is just as easy: C6 should be five percent greater than B6, so at C6 he enters  $1.05*B6$ . Then he uses the replicate command to copy the formula across the next 18 columns, again indicating relativity, so that each entry is 1.05 times the preceding one.

All the figures appear in the right places. Copying the revenue calculation is easy, too; the replicate command copies the formula across the columns, so each cell contains the product of the two cells immediately above it.

By repeating the replication commands, Albert copies the cost calculations, too — all the figures are now filled in for Product A.

Here's where the program's power really starts to show. By using the replicate command three more times, he can copy the complete set of calculations for product A into a separate area of the worksheet. Then, simply by changing the initial variables, the complete calculation is repeated for product B in less than two minutes!

The final deductions and tax calculations are a simple exercise.

With all the relationships between the rows (variables) and columns (quarters) defined, Albert can then change any of his initial assumptions and the sheet will be recalculated showing the effects.

For example, a price rise might be due on both products two years in the future. Albert can simply key in the new prices in the appropriate column. Because of the way this model is constructed, the new values will be carried into the following quarters.

The construction of this aggregate col-

lection of formulae, relationships and data (which we call a model) frees Albert to think creatively about the relationships.

For example, is assuming a flat five percent growth per quarter over-simplistic? With previous manual methods of calculation, this was a pointless question — Albert had little chance of correctly calculating a whole row of exponential growth figures anyway.

With the spreadsheet calculator, however, the formula need only be keyed in once, then replicated. It can be tested against historical data to prove its validity, and accepted or rejected.

This is the essential quality of the spreadsheet calculator — its capacity to let the user play with the model and fine-tune it. The user does the creative thinking while the machine does the repetitive dog-work. Even for first-time users a model can be set up more quickly than manual calculation. For example, it took longer to write the above account than to do it!

Not all of the financial planning packages operate in this way. The 'spreadsheet' approach requires that the executive develop his own model. That's not always necessary, and it requires a time investment to master the commands of the package.

PLANFIN, for example, interacts with the user through a question-and-answer session, based on a pre-destined internal model. Thus the user need not know any special commands to operate the system, nor need he spend time setting up the model.

Every package has its pros and cons, which is why we have examined each separately, pointing out the benefits, and where they exist, any drawbacks (though anything has to be better than manual calculation!) □

### Supercalc Commands :

**B(Blank)**-----)Removes contents of cells.  
**C(copy)**-----)Copies contents of cells.  
**D(delete)**-----)Deletes entire row or column.  
**E(edit)**-----)Allows editing the contents of a cell.  
**F(format)**-----)Change display format of cells, rows, or entire worksheet.  
**G(global)**-----)Change global display or calculation options.  
**I(insert)**-----)Create new row or column.  
**L(load)**-----)Read worksheet (or portion) from disk.  
**M(move)**-----)Swap rows or columns.  
**O(output)**-----)Display contents or values of cells on printer, console or disk.  
**P(protect)**-----)Prevent future alteration of cells.  
**Q(quit)**-----)Exit Supercalc.  
**R(replicate)**-----)Reproduce partial rows or columns.  
**S(save)**-----)Write worksheet to disk.  
**T(title)**-----)Lock first rows or columns against scrolling.  
**U(unprotect)**-----)Allow alteration of protected cells.  
**W(window)**-----)Split or unsplit the screen display.  
**Z(zero)**-----)Clear worksheet and all settings.

Supercalc is very similar to Visicalc. At any time during use you can call up the Supercalc commands for reference.

**AVERAGE** Calculates the average of the non-blank entries in a list.

**LOOKUP** Picks the entry from a list which corresponds to a particular value. This function allows the creator of a model to create lookup tables for, say, volume discounts.

**NA** Gives a 'Not Available' display for this location and all locations which depend upon it in their calculations.

**ERROR** Gives an 'Error' display in this and all dependent locations.

Visicalc 3.1 also provides a set of functions for dealing with Boolean (that is, true/false) conditions. These include AND, OR, NOT, IF, ISNA and ISERROR as well as the usual comparison operators.

The full flavour and power of Visicalc is almost impossible to describe to someone who has never used it. The program has a logical consistency and elegance which makes it easy to use. Once you've used it, you can see why it has taken the personal computing world by storm.

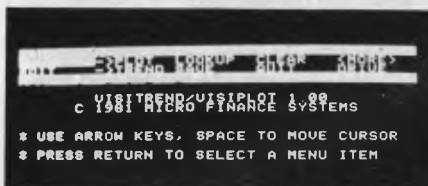
A major factor in the success of Visicalc is its documentation. The user's manual is designed as a course, with four lessons which guide the user through all the program's features.

The earlier Visicalc manuals suffered from badly thought-out typographics, making it easy to lose your place in a tutorial; at that stage the machine often wouldn't do what you expected. The latest manuals are much improved and very much thicker.

An important benefit of the Visicalc manual (for the Apple II, at least) is it also gives information on setting up the computer, care of floppy disks and so on. This means the owner who is purely interested in running Visicalc can virtually forget the computer manuals!

	JUNE	JULY	OCTOBER	NOVEMBER
CH	189	28	22	22
IMTC	127	127	127	127
COSTS	18349	18649	19249	19649
...	...	...	...	...

Visicalc's split screen brings opposite ends of the model together. Putting your figures into graph form — Visitrend/Visiplot is a comprehensive analysis/plotting package.



### Onward and Upward

Although Visicalc will produce a beautifully-formatted report (amaze your bank manager!), it still basically consists of a dense table of figures. As we all know, humans are best at pattern recognition, so figures always have more impact if they're converted into charts or graphs.

Visicalc distributor Personal Software, never one to ignore another market, has the answer. VisiPlot will convert planning data into full-colour charts and graphs on the screen of an Apple personal computer. The package will produce line graphs, bar charts of several varieties and the ever-popular pie charts, even with a slice cut out.

For many managers, Visiplot charts could make the difference in a presentation to the board or senior management. Nothing, but nothing, succeeds like a line moving from bottom left to top right!

Included in the package is VisiTrend, a statistical analysis program which can

perform various kinds of regression analyses, curve-fitting and so on.

### Supercalc

Supercalc, by Sorcim, is a spreadsheet calculator very similar to Visicalc, but intended to operate on computers using the CP/M operating system — machines like the Xerox 820, Wang, DEC VT-18X, as well as the many S-100 'boxes' with external terminals.

Installation of Supercalc basically consists of choosing the terminal type from a menu, providing some information on the printer width and so on. The INSTALL program then patches Supercalc in the appropriate places and it is ready to run.

Supercalc is philosophically similar to Visicalc. Because it is intended for 80 column by 24 row terminals it is able to display more information at one time. The status information is at the bottom of the screen, but otherwise the display is similar to Visicalc's.

Many of Supercalc's commands are different in detailed operation from Visicalc's. For example, the replicate command is rather more powerful, and where many of Visicalc's commands only operate on the location under the cursor, Supercalc commands will operate on any cell (including the cursor cell).

Perhaps Supercalc's most obvious feature, particularly if you read Sorcim's advertisements, is the '?' key, or help feature. If at any stage the user needs assistance, this will provide a capsule summary of possible actions and definitions.

For example, after pressing '/' to initiate a command, pressing '?' will produce a listing of commands with explanatory notes. After a command is selected, pressing '?' again will produce more detailed information on that particular command.

This help feature means that, once the basic tutorial material has been covered, the Supercalc manual can be relegated to the bookshelf, except in rare cases.

The primary differences between Visicalc and Supercalc are differences of detail. The worksheet is organised in exactly the same way and commands are entered with a '/' prefix. However, when the first letter of the command is entered, Supercalc will complete the word on the entry line as confirmation.

Supercalc does not have as rich a set of functions as Visicalc — in particular, it is lacking the CHOOSE function.

On the other hand, Supercalc's implementation of formatting and editing commands is rather 'nicer' than Visicalc's. For example, Supercalc allows the width of an individual column to be altered, which is not possible with Visicalc.

Another useful feature is the ability to 'protect' rows, columns, blocks or individual entries, making it impossible to over-write them. Such protected entries are displayed at half brightness or some

other highlighting method, depending on the terminal used.

The concept of a 'block' is new with Supercalc. A block is a rectangular area of cells, specified by the coordinates of its top-left and bottom-right corners. Blocks can be copied, loaded, protected and otherwise manipulated.

Supercalc distinguishes between numbers, formulae and text at entry time by a simple method: text begins with a " symbol. Text can be up to 110 characters in length; it will be 'hidden' behind an adjacent cell if the cell is occupied, otherwise it will be displayed.

Formatting is slightly more refined than with Visicalc; numbers may be left or right justified, as may text, and column width may be 0 to 126. Formatting may apply to an individual entry (highest level of priority), rows, columns or globally (lowest level of precedence).

The Supercalc manual uses a tutorial approach, with 12 lessons. The latter section of the book is devoted to reference material. A reference card is also provided.

Interestingly, three sample worksheets are supplied on the disk and one of these, which calculates the performance of an air curtain at the door of a freezer, illustrates the potential non-financial applications of what most people would see as an exclusively financial package.

## Target Planner

Target, from Advanced Management Strategies, is based on a spreadsheet, although it takes a slightly different approach to the entry of data and formulae. It 'feels' rather more like a language than a spreadsheet calculator.

Target, which is able to run on virtually any machine which uses the CP/M operating system, operates in five different modes.

On power-up it asks the user a few questions about the format of his model, then displays a menu of possible activities.

At this stage the user can create a model, get a disk directory, erase, load or store a model, continue working on the current model, change the initial parameters, or exit. Target frequently returns to this main menu.

When you choose to create a model, Target goes into entry mode and blanks the screen. The model can now be entered, line by line. Target uses three kinds of commands for creating models: LINE commands, COLUMN commands and HEADING commands.

A line command always begins with the word 'LINE', followed by the line number. This is then followed by the line name. After the name, Target will usually expect an equals sign, followed by a sequence of data values or a formula.

The use of line numbers allows extra lines to be inserted anywhere, after the fashion of BASIC line numbering. In addition Target includes a simple (but effective) editor which can be used to change lines.

After entering the model, the user will probably return to the main menu to save the model, then CONTINUE. To obtain the results of the model, the user types RUN, and Target will begin calculating the model. The results will appear on the screen, formatted in columns. The display can be moved up and down using the 'U' and 'D' keys to examine a large model.

An attractive feature is the use of the ESC key to switch the display back and forth between the model (DISPLAY mode) and the results (RUN mode).

If the number of rows or columns exceeds the capabilities of the screen, the cursor control arrow keys can be used to move the display around for examination.

Where the Visicalc-style calculators refer to entries by their coordinates, Target generally refers to an entire line at once. For example:

```
?LINE 7 MNTLY'PROD= 90 90 100 80
?LINE 8 LABOR'COST= LINE 7 * 4.00
```

Target also uses relative column referencing. An example, based on an accounts receivable collection schedule:

```
?LINE 1 MNTLY'SALES= 100 200 400 300
?LINE 2 CASH'SALES= .10 *
MNTLY'SALES
?LINE 3 RCPTS'30DAY= .70 *
MNTLY'SALES[-1 COLUMN]
?LINE 4 RCPTS'60DAY= .15 *
MNTLY'SALES[-2 COLUMN]
?LINE 5 RCPTS'90DAY= .05 *
```

```
MNTLY'SALES[-3 COLUMN]
?LINE 6 MNTLY'RCPTS= SUM OF
LINES 2 THRU 5
```

If you ran this model the resultant print-out would look like this:

```
LINE 1 MNTLY SALES 100 200 400 300
LINE 2 CASH SALES 10 20 40 30
LINE 3 RCPTS 30DAY 0 70 140 280
LINE 4 RCPTS 60DAY 0 0 15 30
LINE 5 RCPTS 90DAY 0 0 0 5
LINE 6 MNTLY RCPTS 10 90 195 345
```

Target's print menu offers considerable flexibility in output formatting.

A subsection of a report can be isolated for printing; the number of columns, lines per page and printer width can be specified; and the user may print to a disk file for subsequent editing if required.

The model itself can contain a number of formatting commands, including PRINTDATE, UNDERLINE/OVERLINE and SKIP. These allow the detailed format of a report to be predefined.

As well as the results, the model itself may also be printed for analysis and refinement away from the machine.

Target is a large system comprising multiple program files and overlays; so it is apt to become disk-bound at times, and the user can find himself twiddling his thumbs while waiting for the disk drives to stop whirring.

We also gained the impression from the way Target's prompts operate that it is written in some dialect of BASIC. It always requires the user to press 'RETURN' and can be rather pedantic about matching responses at times.

For example, on quitting the system, it asks for a confirmatory YES/NO response. It will not accept 'Y', 'y' or yes — just YES. If you're used to more forgiving

```

TARGET MODEL NAME: BUSYTALC  #= 802  C= 6  H= 1  D= 2  MODE:  DISP
BUSYTALC
A DIVISION OF IMPERSONAL PRODUCTS
PROJECT ANALYSIS
-----

```

	YEAR '1	YEAR '2	YEAR '3	YEAR '4	YEAR '5
20.0 INVEST	9000.00	0.00	0.00	0.00	0.00
21.0 TOT'INVEST	9000.00	9000.00	9000.00	9000.00	9000.00
22.0 INT'FACTOR	1.00	0.85	0.72	0.61	0.52
23.0 IND'PV	3798.09	4570.84	6062.02	7533.47	10224.20
24.0 TOT'PV	3798.09	8368.93	14430.90	21964.40	32188.60
25.0 NPV	-5201.91	-631.07	5430.95	12964.40	23188.60
26.0 DEPREC	1800.00	1800.00	1800.00	1800.00	1800.00
27.0 TOT'FLOW	5598.09	7177.46	10190.30	14067.00	21386.40
28.0 NET'FLOW	-3401.91	7177.46	10190.30	14067.00	21386.40
29.0 CUM'FLOW	-3401.91	3775.54	13965.90	28032.90	49419.20
30.0 PAYOUT	1.00	2.00	2.51	2.51	2.51

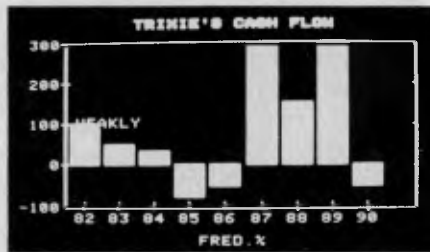
Target Planner falls somewhere between the "do-it-yourself" modelling packages and the pre-designed plans.

programs Target can seem rather tedious.

While this is a minor irritation in the main system, Target's installation program uses similar prompts in a most unforgiving and tedious manner; we installed the program twice and wild horses couldn't force us to do it again. Black marks to the designer for bad human engineering.

Target can be installed on virtually any CP/M system with a minimum of 56K of memory and one disk drive of at least 180K capacity. Some systems will require two disk drives. The TGTGEN utility will set up the program to drive the user's terminal or, if the terminal is not on the menu, the appropriate control codes and key definitions can be patched in.

Once installed, Target is certainly easy to use and quite powerful. The documentation covers all the functions in depth, although the manual organization isn't too hot. There's also a quick reference card and a selection of sample models to practice on.



Visiplot uses Apple's graphics to advantage.

One thing still puzzles us, though — Target kept rejecting one particular model as 'incalculable'. It was a demo supplied with the program!

### MicroModeller

Possibly the most sophisticated program of those reviewed, MicroModeller was written by UK company Intelligence (UK) Ltd, and is sold in Australia by Intelligence (Australia) Ltd.

MicroModeller is available in two versions to suit most machines: one, written in UCSD Pascal, for the Apple II; the

other in Pascal/M runs under CP/M on the HP-125, NEC PC8001, Panasonic, ABC, Superbrain, Altos and other systems.

MicroModeller can handle up to 1919 cells in memory, or over 32,000 cells in a 'virtual memory' mode. In this mode, intermediate results are stored on disk, and so it is recommended that a hard disk be used for maximum speed. The program's advanced consolidation features and ability to handle multiple spreadsheets has enabled at least one user to produce monthly reports on 80 companies.

Micromodeller is made up of eight major subsystems, which operate on separate logic, data and report format specification files.

The initial model is entered using MicroModeller's line-oriented text editor, which has a comprehensive range of commands for the manipulation of models. These include the ability to produce 'pretty-printed' listings, concatenate files, globally search for and replace strings and do sophisticated 'in-line' editing.

The logic file consists of comments, row definitions, row calculations and column calculations. Row definitions consist of a row number and name enclosed in single quotes, and are used to define input variables. A row calculation is a row definition followed by a row expression. Rows are referred to by integer numbers, while real numbers (i.e. numbers with a decimal point) are taken as constants.

A wide range of operators and functions is provided, including the usual arithmetic operators and SUM, financial functions such as NPV, MULTINPV (computes several NPV's at different discount rates), IRR, IRRPERPET (assumes perpetual cash flow), PAYBACK (computes payback period for a cash flow), DEPR (straight line or declining balance, with/out automatic switchover), SYD (sum-of-the-years-digits depreciation), INTEREST, PRINCIPAL, PAYMENT and BALANCE, which calculate mortgage type loan amortizations, and LOSSCF, which computes a year-by-year tax loss carry-forward.

Other functions provided include Fortran-style comparison operators, AND, OR, MIN, MAX, THRU and LOOKUP. There's also a set of cross-column functions such as LAG, LEAD, SPREAD, CUM, and COL (which refers to a specific column within a row).

Once the logic file has been created, it is actually compiled by the 'logic analyst'. Once compiled, a file can be used repeatedly to run a model.

The data file is set up by the data entry subsystem. Values can be typed in for each time period in a row, or a

### (Not Quite) 101 Ways To Use Your Planning Package...

WHAT CAN you do with a financial modelling package or spreadsheet calculator such as Supercalc or Micromodeller? Here's a few suggestions:

#### For financial analysis:

- Forecasts of territorial potentials
- Sales forecasting by leading indexes, such as Dow-Jones
- Sales forecasting by projection of trends
- Sales department budgeting by product, by rep, by customer
- Inventory increase or decrease budgets
- Production budgets
- Capital expenditure budgets
- Cash budget
- Profit and Loss budget
- Small business accounting
- Tax records
- Cash flow analysis

#### Other business applications:

- Advertising media analysis
- Forecasts of market demand based on market factors
- Sales distribution analysis
- Expense account management
- Insurance analysis
- Commission calculations
- Management training
- Warehouse space analysis
- Statistical research
- Inventory control
- Quality control analysis
- Queuing theory
- Regression analysis
- Stock market analysis
- Price Lists/structures

#### Scientific and Technical:

While most of the attention is focussed on business/financial applications of these packages, bear in mind that they can be used for virtually any type of calculation:

- Fourier analysis of temperature gradients
- Field theory
- Motoring log-books (fuel consumption, distances, costs) analysis



starting value and a growth rate can be specified. The same value can be applied repetitively using the "" operator. An update command can be used to change only those columns required, while the system can also interpret text editor files.

The matrix handler subsystem is used to manipulate data, perform calculations, and solve those 'what if?' questions. The very sophisticated commands of this subsystem are used to actually run a model, as well as performing other transformations on the data in the work area.

For the analyst who has a good grasp of numerical linear algebra, the matrix handler's 'raw' commands allow entire files to be added, subtracted, multiplied and divided. The system can also solve sets of simultaneous equations. In addition, there are simpler data manipulation commands, allowing information to be abstracted from and saved to other files, values changed, and rows and columns changed by a specified amount or percentage.

These features of MicroModeller make it particularly strong in the area of sensitivity analysis and calculation of year-to-date variance from forecast. As Roger Walker, of Intelligence (Australia) pointed out to me, MicroModeller is not so much a spreadsheet calculator as an "accountant's pad", with its ability to operate on multiple files representing an extra dimension of a problem.

Reports are printed using a report generator which offers considerable flexibility in the layout of a report. Numbers can be formatted to print with or without commas, with brackets or minus sign to indicate negative numbers and a whole range of other options. Many of the formatting commands have similar effects to the print formatting commands (often 'dot' commands) of a word processor. Text and information such as the date, case name and comments can be prompted for and inserted into the report.

MicroModeller has the ability (called the 'GEN' facility) to preprogram and execute strings of commands, so that a completely untrained user can run a model prepared by an experienced modeller. The gen commands include #WHEN and #ENDWHEN commands which permit control of execution flow, as well as prompting and computational statements.

Perhaps the most impressive facility in MicroModeller is its graphics generator, which can abstract information from results files and produce colour bar charts, line graphs and pie charts. Charts can be separately created, or graphics specifications can be created to display results from dif-

ferent runs of the same model. Best of all, charts can be combined with sections of reports into a 'slide presentation' which can be taken into a meeting and used in exactly the same way as a conventional slide show (right down to the hand-held remote controller which is part of the package).

MicroModeller's documentation is well-organised and extensive. Organised primarily for reference, rather than a tutorial style, it is terse but easy to follow. They have brought out a new and comprehensive manual with tutorials and much more detail than previously.

Intelligence (Australia) Pty Ltd, as well as supplying the system, will also support it with training seminars and a consulting service for complex applications.

There is also an extended version, MicroModeller16 which supports a higher level of logic. IF THEN ELSE is implemented GOTO, table lookup and indirect addressing are just a few of the new facilities.

### Planfin/Profin

Arising from work done by NSW Institute of Technology's Dr. Robert Graham, these two programs have recently been released by new Sydney software house AY Systems Pty Ltd, an offshoot of the international accounting firm Arthur Young and Co.

The smaller of the two packages, Planfin, has specifically been designed for such functions as product marketing and market planning, where budget preparation, cost analysis and variations, income projections and discounted cash flows are of key importance.

Profin, on the other hand, is a larger and more sophisticated package designed to assist executives who are directly involved in the evaluation of financial investments, particularly large capital projects.

According to the company's managing director, Mr Richard Cousins, they are positioned 'between the very simple to use systems that offer very limited facilities and the very advanced and flexible packages that require a lot of learning and often some computer experience'.

Both packages are dedicated to specific job functions, and the 'model' logic is embedded in the program, so that the user does not have to construct a model. The programs are menu-driven at the entry level, but prompt the user with questions from there on.

AY Systems claim that most executives, with a clear understanding of their own job but with no computing experience, can start to meaningfully use

both systems with as little as five to ten minutes training.

Planfin allows the manager to model a number of products over monthly, quarterly or annual periods. Product volumes may be entered as a base volume with a growth rate or as specific volumes. The base selling price for each product may be entered as Australian dollars or as a foreign currency with conversion factor. Inflation percentages may also be entered.

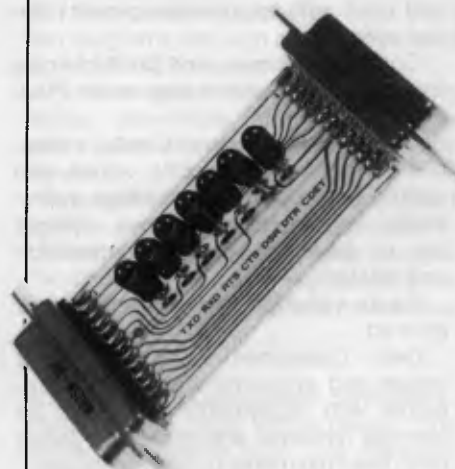
For each cost category, the cost may be entered as a cost per unit, a percentage of revenue for a product, a fixed cost or specific cost values, together with provision for increases and inflation.

Interest or depreciation may be entered as specific values with provision for percentage variations. Options are provided for entry of an income tax rate and discount rate for cash flows (which may be received in the middle or at the end of each period).

Once all this data has been entered, Planfin will generate an operating income statement and net income and discounted cash flow report, either to the printer or the screen for review.

An interesting provision is the automatic logging of the dialogue between program and user, so that the user can

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## PROJECT FINANCING

### YOU MAY CHANGE:-

1. REVENUE
2. COSTS
3. CAPITAL EXPENDITURES
4. EQUITY
5. DEBTS
6. TAX PAYMENTS

### YOU MAY DISPLAY:-

7. INCOME STATEMENT
8. INTEREST SCHEDULE
9. CAPITAL EXPENDITURE REPORT
10. TAX SCHEDULE
11. DISCOUNTED CASHFLOW ANALYSIS

ENTER YOUR OPTION

### YOU MAY PRINT:-

12. INCOME STATEMENT
13. INTEREST SCHEDULE
14. CAPITAL EXPENDITURE REPORT
15. TAX SCHEDULE
16. DISCOUNTED CASHFLOW ANALYSIS
17. ALL REPORTS

### YOU MAY ALSO:-

18. SAVE THIS CASE ON DISK
19. CHANGE CATEGORY NAMES
20. RETURN TO MAIN MENU

### Profin's menu - helpful to the user.

later print this out to review his assumptions and thought processes as the model was 'filled in'. Cases may be saved on disk and later recalled for revision.

In the most recent version Planfin allows for multiple cases and for the consolidation of several cases.

Profin provides for more sophisticated analysis, usually of capital projects over a much greater time scale (up to 30 years). The major input items are:

Revenue - based on product volume and price with appropriate growth/inflation options

Costs - Expenses and product costs expressed in the same way as for Planfin

Capital Expenditure - Capital expenditures entered as specific values with options related to the percentage depreciable, investment allowances, straight line or declining balance depreciation and inflation.

Equity - specific equity values may be entered.

Debt Categories - specific debt values and applicable interest rates together with repayments expressed as blended (principal and interest), interest only, fixed payments or specific values.

Tax - As well as a normal income tax rate, a supplementary tax may be expressed as a percentage of taxable income, a percentage of revenue, or with specific payments.

Reports may be produced to screen or printer. These are:

- Income Statement
- Interest Schedule
- Capital Expenditure Report
- Tax Schedule
- Discounted Cash Flow Analysis

As with Planfin, Profin prompts the user continually, and incorporates the

'model' in the program itself. In addition, if the user is unsure what response is required, a 'help' facility will provide explanatory notes at the bottom of the screen (this is also provided in Planfin).

Some additional features are Planfin's ability to interface with other spreadsheets, create disk files and the option of entering costs as a percentage of other costs.

It may be supposed that the integration of a pre-defined model into the program makes it less flexible or applicable to only a small set of problems. This is partly correct, but bear in mind the time involved in creating a model to handle some of the functions built into these programs (particularly some of the interest calculations), as well as the time involved in learning to use a modelling language.

It also seems likely that Profin could handle the majority of business planning problems - it has already been used for applications ranging from planning the finances of a sheep station to evaluating the re-opening of a gold mine. Also bear in mind the old saw - 'A good plan today is better than a perfect plan tomorrow'.

Documentation is of good quality although the programs, by their nature, require very little support of this kind. The programs use current Australian financial terms, so the prompting is easy for a financial executive to follow.

Both programs run under the CP/M operating system and have been installed on an Apple II (with Softcard and Vision-80 card), HP-125, Xerox 820 and DEC VT-18X, with the Wang and IBM Personal Computer to follow. Other machines will also be supported.

### CalcStar

CalcStar is manufactured by MicroPro International Corporation, those wonderful

people who brought you WordStar. Written in Pascal (as were many of the programs we saw), it offers an accuracy of 14 digits, with a 127 x 255 spreadsheet.

CalcStar follows WordStar's format of displaying a menu of commands at the top of the screen, with 10 rows of the spreadsheet immediately underneath, then about four rows of information and the editing line for input. With the menu disabled, 15 rows can be displayed.

The program basically falls into the same category as Supercalc and Visicalc, although it does not adhere as closely to the 'Visicalc standard' as Supercalc. Its functions basically offer the same facilities: for example, text can be right or left justified, or (a unique capability) centred. Column widths and precision can be set, but there aren't as many other formatting options as the other 'calcs'.

Automatic recalculation is not provided: this will not bother many people who find the pauses while the program recalculates already slows up their data entry.

Replication operates in a similar way to the other 'calcs', with absolute or relative field references. A useful capability is to be able to force some field references to remain constant, so for example, if the line +SUM(A3 A7)+A8!B17 is replicated, all the variables except the reference to A8 will be translated relative to the new position. The ! symbol forces constant field references.

CalcStar offers a number of unique and well-thought out functions: for example, spreadsheets can be merged, allowing overlays to be created for common problems. The 'what' function will provide the row and column headings when they are not displayed on the sheet. Alternatively, the row and column headings can be 'locked into position on the screen in the same way as Visicalc.

Conditionals are provided, and rows/columns can be inserted. An interesting feature of the 'delete' command is that it will not allow the deletion of a row or column which has dependent calculations. All references to the 'redundant' row/column must first be deleted so it really is redundant.

A significant advantage of CalcStar is that it uses similar control keys to WordStar, particularly for cursor movement. This means those who are familiar with WordStar will find CalcStar easy to learn.

An interesting facility, similar to the 'programming' facility of Panaplan and MicroModeller, is CalcStar's Auto mode. In this mode the creator of a model can lay out a 'path' around the independent variables of the model; subsequently, a user can set the auto mode and the program will follow that track, only allowing him to change those critical variables. This is time-saving and fool-proof.

CalcStar has a large set of functions: all



MicroPro's CalcStar — similar elegance to WordStar, and a lot of power.

the usual functions are there, with the notable omissions of trig functions and LOOKUP. Most business users would have no use for trig functions, unless they want to do some complex analysis of seasonal variations, but LOOKUP is a handy function.

One function which is unique to CalcStar is the linear regression function REGR. This will perform a linear regression analysis on two sets of data, returning the mean of the first set in the target cell.

After that, three functions can be used: PROJ will calculate a projected value for the dependent variable, given a value of the independent variable; DEPD provides the reverse function, calculating the value of the independent variable required to produce a particular value of dependent variable; and SLOPE, which gives the slope of the straight line fitted to the dependent variable data set.

The two sets of data need not 'line up', allowing the regression analysis to include leads and lags, a particularly useful trick. One suggestion back to MicroPro: instead of making the result of the REGR function be the mean of one data set, why not return the correlation coefficient? This would provide a measure of the 'goodness of fit' of the regression, a figure which is not presently available. The mean can easily be calculated by the SUM and CNT functions.

CalcStar was designed to be compatible with WordStar, and can print a text file to disk for subsequent editing. In addition, a file can be disk-printed with commas to delimit the fields, making it compatible with BASIC and other languages.

Another interesting point arising from the WordStar Compatibility: CalcStar can

be installed very simply for a range of different terminals, but if you've already installed WordStar, the installation program can read the terminal control codes out of your copy of WordStar and plug them into CalcStar. For non-standard terminals, this makes installation a snap!

Disk files can be password protected under CalcStar. This is a good idea when you consider that financial analysis programs are the key to some extremely sensitive data.

The print facility offers a number of options, including all/part of a sheet, comments, ordinates at the edges and user-set page breaks.

CalcStar documentation is written in an easy-to-follow, chatty style. The examples are good and provide clear instances of the way the program can be used for different applications, such as inventory control and advertising research.

The program is easy to use, logical, and comes with examples which can be put to work immediately.

### HP-41C Financial Decisions Pac

ALTHOUGH it is not a full financial modeling package, in the sense of doing two-dimensional analysis, we felt it was worth including the HP-41C Financial Decisions Pac software because it is still a worthwhile time-saver for the executive.

The pac actually consists of a plug-in module for the Hewlett-Packard HP-41C(V) pocket calculator. It contains a number of programs which are instantly accessible, and which deal with time and money problems.

The major program in the pac is MONEY, which can solve a huge range of problems involving up to five standard compound interest variables: n (number

of time periods), i (interest rate), PV (present value), FV (future value) and PMT (payment). Once three or four of these are known, they can be keyed in and the fourth or fifth calculated.

MONEY will calculate these variables for such financial transactions as mortgages, lease (with/out buyback), savings accounts, pension funds, amortization, annuities and others.

A second program, AMORT, will calculate and display (or print) an amortization schedule for a loan, calculating the interest and principal portion of each payment as well as the remaining balance.

Three programs calculate the Internal Rate of Return, Modified IRR and Net Present Value of up to 239 individual cash flows or 119 groups of cash flows. The Modified IRR program discounts negative cash flows at a safe rate, but assumes positive cash flows are re-invested at a somewhat higher rate.

Depreciation schedule can be calculated by three different methods — straight line, declining balance, or sum-of-the-years-digits.

The remaining programs calculate the number of days between two dates, using either a 365-day year or a 360-day financial year, and perform a number of calculations associated with bonds and debentures.

All the programs work well and at reasonable speed. The documentation is excellent — up to the usual HP standards — with considerable explanation of the cash flow diagrams and sign conventions used by the MONEY program.

All the programs use the alphanumeric display capabilities of the HP-41C to prompt for information and to identify results.

If your forecasting requirements won't justify a personal computer, then an HP-41C with printer and the financial Analysis Pac could be the answer at a total price less than many of the software packages listed here.

### Spreadsheet Calculator Suppliers

**Visicalc:** Your local Apple dealer. Our review copy came from City Personal Computers in Sydney.

**Supercalc:** Our copy was supplied by Archive Computer Services, Clayfield, Brisbane, Qld.

**Calcstar:** John F. Rose Computer Services Pty Ltd, PO Box 745, Crows Nest, NSW 2065. Tel: (02) 439 1220

**Target:** Computer Campus Pty Ltd, 11 Rundle St, Kent Town, SA 5067. Tel: (08) 42 4826

**Planfin/Profin:** AY Systems Pty Ltd, 4th Floor, 1 Help St, Chatswood, NSW 2067. Tel: (02) 419 6077

**MicroModeller:** Intelligence (Australia) Pty Ltd, 4th Floor, 204 Park St, Sydney, NSW 2000. Tel: (02) 267 1711

*If you own a computer system that's been built up from different boards — like an S-100 bus system, for example — then you'll probably find it difficult to remember just what bits connect where, and where you have to jump to run a particular routine. According to LES BELL, the solution is clear-cut; it's*

# DOCUMENTATION OR DISASTER

## The Choice is Yours!

I DON'T know about you, but my computer is in a constant state of flux. There are always new bits and pieces being plugged into it and old ones coming out.

In particular, I'm forever changing I/O driver software, especially the video board driver. As a result, I've never been quite sure of what software and hardware I'm actually using at a given time.

The whole thing came to a head a couple of years ago. I'd recently installed my disk drives and was virtually rewriting whole chunks of I/O code when I realised I couldn't remember which wire was which from the keyboard. Nor was I sure exactly where the memory-mapped video board was located. More to the point, I wasn't quite sure where the manual that would tell me was located!

It took me a day of searching through piles of magazines, tracing ribbon cables, peeking and poking memory locations, and generally fiddling, until I was sure I really knew what was located where and how the keyboard was connected. A whole day wasted, when I could have been playing Star Trek!

I learned my lesson. Ever since then I've kept folders full of notes and updates to documentation. Last month I did another update, moving my keyboard input to another port and installing a new video board driver. This time it only took a morning, and I knew exactly where I was at all times — because my documentation told me.

When you buy your computer system, or any part or board, you will generally receive some manuals, schematics or other documentation; although I've heard of people buying stuff without manuals —

and suffering for it. These manuals are the bare essentials.

### De-Bugging The Manual

The first thing I do when I get one of those 32-page stapled manuals is to pull the staples out, punch three holes in the left edge, and put the pages in a ring binder. Schematic diagrams receive special treatment — I reinforce the holes with pads, because they'll take a pounding.

Next (and I still haven't plugged the board in yet) I compare the markings on the dip switches with the notation given in the tables in the manual. Often, switches are marked on/off, while the switch setting tables are marked open/closed or 0/1. Worst of all, they don't always correspond in a logical fashion. After working out which is on and which is off, I mark the manuals so they correspond to the switches. This saves a lot of time and confusion later.

Generally, I also add a little map of the board to the manual, showing the locations of S1, S2 and such. Often, they're not marked on the board, and having the information in the manual helps.

Finally, in the case of a memory board, for example, I record the settings for the board as I install it. This means, should I later move the board to a different location or change some settings, I can restore the system quickly.

Although this might seem a long diatribe on the subject of simple switches, remember just one switch being in the wrong position can render the system completely inoperative, with no clues as to what's wrong.

The only solution, in the total absence

of documentation, would be to permute the settings on upwards of 60 or 80 switches. At the rate of one every 15 seconds, that would take 550 billion years! My conclusion is it's worth a few moments to jot down switch settings!

### Noting The Colours

Next, I make a note of the colours of the ribbon cable attached to each connector, and what the signal is. On a keyboard connector, for example, I note which bit of data goes to which pin, and what colour the cable is. Some manuals notate data bits as D0 to D7, others D1 to D8. I always re-number drawings to use D0 to D7, minimising confusion.

Likewise, I don't just mark a pin 'keyboard strobe'. I also say whether the strobe is negative or positive-going. On a keyboard input port, I note whether it expects negative or positive strobe. And on the port documentation, I note which bit signals data available, and whether it goes high or low. Just to make it super-easy to use, I also note the short routines used to read the keyboard status and data (and put the routines in a library file on disk).

On serial ports, I find it useful to stick to the EIA RS-232C standard pin connections. But I'm also careful to note whether the connector is wired as a modem or as data terminal equipment. If I deviate from that arrangement, for example to bring power through the connector for an acoustic coupler, I make careful note of that too.

Any special connectors I make up, such as DIN connectors for joysticks, are also described; together with a description of



what pins (and signals) connect where on the input port, and what signals appear on what bit of the port.

An essential part of my library is a TTL logic data book. The best is the Texas Instruments book, although Fairchild's is pretty good too. It can be extraordinarily frustrating when a manufacturer's schematic doesn't show pinouts and you have to refer to the data books.

I generally check to see whether boards have any special purpose LSI (large scale integrated) circuits, or any unusual one, then obtain copies of the data sheets and file them with the manuals. Often manufacturer's manuals don't explain the internal operations of some of the ICs they use, so the IC manufacturer's data sheets and application notes are particularly helpful.

This applies particularly to devices like disk controllers, programmable interfaces and interval timers, interrupt controllers and, of course, the CPU itself.

### On The Soft Side

All these tips are most useful to the hardware hacker who is forever taking things to bits and changing them around. For the software guy, things can be just as awkward, if not worse.

With hardware you can always trace back along wires or printed circuit board tracks. With software the same process can be done, but it's very hard work.

With commercial software, I always bind the manuals so they can be opened flat, because I *know* I'll be spending hours searching through them for some arcane piece of software trickery. With well-written commercial software there isn't much need for extra documentation (and with games not much desire to document them), so most of your documentation work, like mine, will probably be in the area of I/O drivers.

To start with the I/O drivers of the operating system first: in the case of CP/M, your system should be supplied with the source code of the BIOS (the Basic I/O System), so you can freely modify it (unless you write your own, of course). Manufacturers who supply a preconfigured CP/M without BIOS source code are, more often than not, trying to hide a rather scrappy implementation.

If the source is not available for some other reason (such as Microsoft's unwillingness to reveal the secrets of the Soft-card), then at least the manufacturer should supply some other way to allow patching of device drivers (Microsoft did, though it still makes me feel uncomfortable). Without these facilities, you're doomed to disaster.

### Customising Your BIOS

When customising your BIOS, do it by updating the source and commenting it, not by means of object code patches —

they're merely band-aid measures. Once your CBIOS is relatively stable and bug-free, print out a .PRN file of it for reference purposes. Make notes in the source about any hardware dependencies, including which status bits appear where on what I/O port.

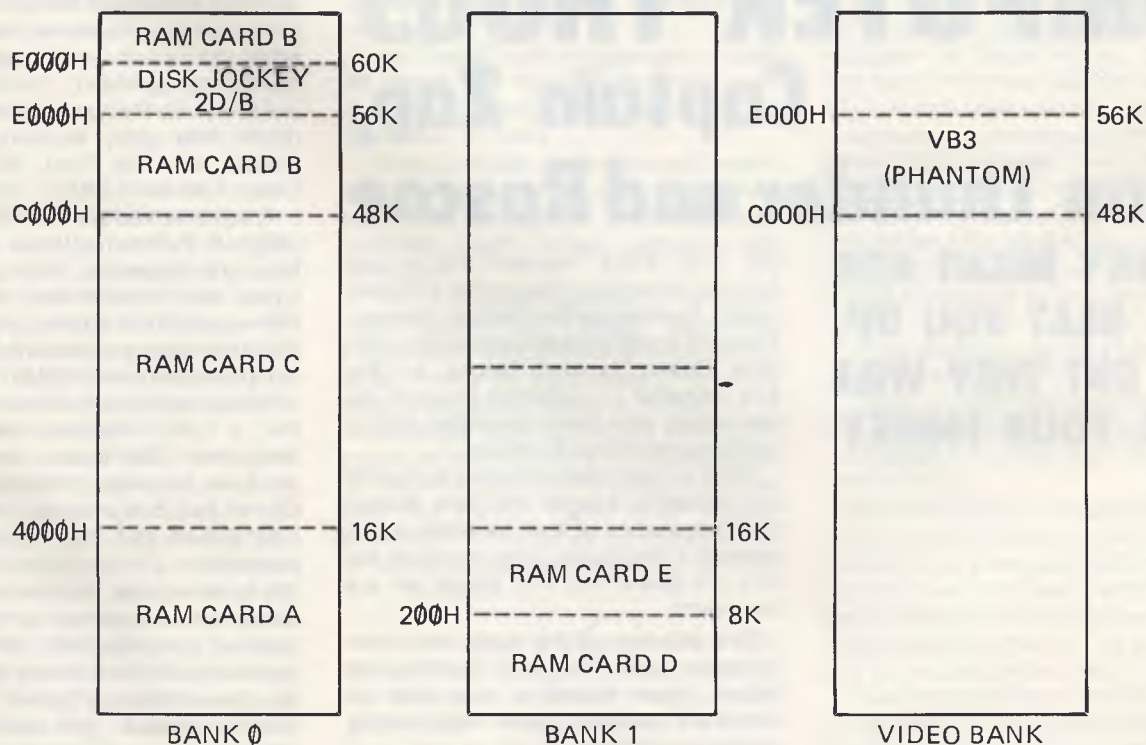
All source code should be liberally commented in any case, regardless of the language used. All hardware dependent features, such as cursor control strings, should be defined at the top of the program to make subsequent changes easier. Better still, put all your hardware definitions into a separate file, which you can include into your programs either at compile time or using a text editor.

In the case of languages, I buy the recommended texts which complement the manual. In the case of most Pascals, that's the *Pascal User Manual and Report*; for C it's *The C Programming Language*, and so on. These should be kept close at hand for those late night bug-hunting sessions.

Really, that's what most of this article is about. If anything can go wrong, it will happen late at night, when your capacity to remember details is severely impaired; and when, with a deadline looming, panic is apt to strike in.

Having everything written down as a precautionary measure will make those problems so much easier to overcome. □

System Memory Map



Memory Maps are very important when trying to establish faulty memory chips, or, what program goes where.



# COMPUTER THUGS

## Captain Zap, Susan Thunder and Roscoe

**THEY MIGHT NOT  
BEAT YOU UP,  
BUT THEY WILL  
STEAL YOUR MONEY!**

ON THE FBI's "wanted" list in Los Angeles are some of the names of a gang calling themselves the System Hackers. They are known only as Captain Zap, Vladimir, Susan Thunder, Roscoe, and the Sys Cruncher — a strange group of desperadoes who have committed crimes involving more than \$1 million.

What is particularly irritating to the FBI and academic experts who have studied the complexities of their methods is that several of the 20-odd gang members are only 15 years old, and almost all are teenagers.

The activities of the gang, and other "phreaks" and "hackers" as they are known, have added a new item to America's crowded police files: juvenile computer criminals.

They inhabit a curious counter-culture world of esoteric jargon and incomprehensible computer "languages",

spending thousands of hours hunched over the screens of computer terminals, immersed in calculations that blot out all other activities normally associated with healthy youngsters.

As well as their penchant for pseudonyms, they glory in computer "passwords" such as Prog, Wook, Boppy, Crow, Juice and LLXX.

A self-invented glamor, for they are not happy in their surreptitious work, "these kids are mavericks, loners, introverted types, often from broken homes," says FBI agent Robin Brown, a qualified accountant and graduate of an intensive computer course with IBM.

He has spent six months on the track of the LA System Hackers, without making one arrest. "But please don't call them geniuses," he says, "because they're not. Clever, yes, but geniuses, no."

Mr Brown and others concerned with adolescents and computer crime are anxious to erase what they believe has been media encouragement of the idea of "genius" computer kids. It began, they maintain, with the publicity several years ago given to Captain Crunch, leader of the "phone phreaks". His case is easy to romanticise — but it has cost him three terms in jail.

His real name is John Thomas Draper, now well into his thirties, but a product of

by Christopher Reed



the sixties counter culture. He earned his nickname by discovering that a toy whistle from a box of Captain Crunch breakfast cereal vibrated at exactly 2600 cycles a second, precisely matching the "beep" needed to unlock the vast network of the world's computerised phone network.

He was first caught when he made a free call to Sydney to ask a stranger in a call box the latest hit tunes in Australia. For that he got five years probation, and became a folk hero of the "phreak" set.

The crunch came for the captain when he used his computer to break into AUTO-VON. (Automatic-Voice Network), the military's secret phone system. He was caught and went to prison.

Gone perhaps, but not forgotten, for the latest example of Crunch-style computer capers has taken place at Palo Alto high school in Silicon Valley — a school Crunch attended.

Two pupils, one 16 and the other 17, used their access to the school district's Hewlett Packard 3000 computer to probe its secrets. It is used to store confidential information, including assessments of teachers and gradings of students. It can be used by students who outgrow the district's HW 2000, a less complex model used only for educational purposes.

The high school hackers committed

what amounts to electronic burglary by "breaking in" to the system. After cracking the 3000's store of information, they could have wiped out records, changed reports, or given themselves higher grades. "They could even have altered the principal's salary," said Mr Richard Carey, the district's director of research, testing and computer services.

It is significant that the two pupils owned up; they were not caught.

It is also astonishing to some societies that students at high schools like Palo Alto receive computer lessons as part of the usual curriculum from the age of 11. The town may be unique — 85 per cent of the parents have university degrees and many work in computer research and technology.

"These kids go home to their own computer terminal in their bedrooms in many cases," says Mr Carey. "They shut themselves in and spend all evening on it. These are the hackers and the parents don't mind. I suppose they're glad the kids aren't playing rock music. Computers are at least quiet."

Some people like Stanford Research International's Donn Parker, senior information system management consultant and tutor to the FBI on computer crime, are beginning to worry about the wisdom of teaching youngsters about computers.

But with the increase of home computers — half a million TRS-80s and Apple IIs have now been sold for domestic use — people like Mr Parker can only expect to keep one step ahead in the never-ending security battle in the computerised society.

And "battle" is no exaggeration — both Mr Parker and the FBI's Mr Brown used the word "enemy" when talking of the computer "phreaks".

While computer crime in the adult world costs industry and Government millions each year in electronic embezzlements, juveniles seem largely satisfied with vandalism.

The LA System Hackers, for example, have broken into Digital Equipment Corporation (DEC) systems used nationwide, mainly by businesses. They may have made some money with the theft of copyrighted data, which can fetch good prices for the work they represent, but in Mr Brown's opinion the gang has done little for profit. "They have caused hundreds of thousands of dollars worth of lost business purely by being destructive," he says.

In one case, the gang got into a DEC system which stored the entire genealogical records of millions of pedigree dogs and horses. "They just wiped the whole thing out. Years of records gone, pffft," said Mr Brown.

The young computer groupies of Palo Alto, Los Angeles and elsewhere are also

going largely unrestrained through the reluctance of district attorneys to prosecute 13-year-olds for system hacking — and then lose the case. "We are now investigating the Palo Alto case," said Mr Parker. "but generally the DAs just don't want to know."

The hacker is an enigmatic fellow, too, and not what one would expect from the normal adolescent.

He cares little for his appearance, tending towards long straggly hair sometimes bound in a pony tail for convenience, a wispy beard, not because he has grown it, but because he hasn't bothered to shave, jeans, sneakers, and wool plaid shirts.

He tends to be pale from being indoors all the time, and wears thick spectacles, having strained his eyes from watching small green luminous letters on a screen since the age of 11.

He is not a healthy lad. He regards exercise, games and the eating of meals as unwarranted intrusions on system hacking. He wolfs junk food at odd hours, preferring Yummy Yuk Bars and Koofiz because these are easy to eat while sitting at the terminal.

He is not interested in rock music, preferring to use his radio to tune into police wave bands because it is technical and illegal. The messages, of course, do not interest him.

Conversation is spattered with "buzz words," the curiously ugly jargon of computer language, in which "input" is received in order to "interact" better at "access time".

"I'm afraid," sighs Ms Nancy Palmer, for 12 years a co-ordinator of computer education in Silicon Valley, "that some kids think of nothing else but computers. they become obsessed because the computer becomes a substitute person. There it is with its 'brain' but it is non-judgmental.

"These boys are very knowledgeable but it's not horizontal; it's vertical. I try to limit the time the worst hackers spend with the computer, but they go home and spend all evening in their bedrooms with their own. Their parents have bought one — these days you can get a computer with a disk drive for \$1500 or so."

These strange creatures, then, are the first computer generation. Some, as they grow older, will apply their knowledge in a criminal way.

Stanford's Mr Parker said: "A new safeguard against computer crime is a new challenge for these people. I'm investigating 800 cases at present, and that's just a small collection. We don't know how much computer crime there is; it's an empirical war that waxes and wanes."

The computer crime of the future should be spectacular. Mr Parker forecasts that within a few years a major computer crime will result in the total failure of a large corporation or a major Government department. □



---

# WHICH LANGUAGE FOR YOU?

WE'VE COME a long way from the dark old days of 1976, when BASIC first became available for the 8080. Now you can choose from more languages than processors, and it's tempting to try some against the old standby, BASIC.

In his excellent book, *Programming Proverbs*, Henry Ledgard lists, as number 25, 'Consider another language'. That's true, but it doesn't really go far enough. Which language should you consider for the job you're contemplating? For microcomputers there are now so many languages on the market, each with its own following, that a new one seems to appear every week: BASIC, FORTRAN, Pascal, COBOL, C, APL, PL/1, FORTH, PILOT, ALGOL and so on.

Although the processor inside the computer is actually programmed in binary patterns, very few programmers ever work at that level. Some, working on applications that are speed- or size-sensitive, use a language called assembler, but the majority use high-level languages.

Assembler corresponds to the actual codes used internally by the microprocessor. Each instruction is fairly crude, and it takes a lot of instructions to do even quite simple things. An example of an assembly language program is shown in Fig. 1. This program just adds two numbers together in memory. Since the average programmer generates only 10 lines of *debugged and documented* code per day, regardless of the language used, it is obvious that a high-level language increases productivity dramatically.

HOW DOES a high-level language work? Well, there are two ways of getting

a sophisticated language to make sense to the byte-crunching microprocessor. In each case, we get the computer to do most of the work itself.

Fig. 2a shows the operation of a program called a compiler. The input to the compiler is a *source file* written in the high-level language, probably using a text editor. The compiler reads through the source file, and using various grammatical rules is able to construct a machine code program that performs the required function. This output from the compiler is then loaded back into the computer and run.

The way that most microcomputers work, though, is with a program called an interpreter. The operation of an interpreter is illustrated in Fig. 2b. Here, the source program is loaded into memory along with the interpreter. Like the compiler, the interpreter reads the source line by line, but instead of generating machine code to do the job the source code specifies, the interpreter just goes ahead and does it there and then.

There are advantages and disadvantages to each method of running a high-level language program. With a compiler, there is an extra stage of preparation before arriving at a running program, and the program has to be re-compiled each time a change is made. On the other hand, the machine code program produced by a compiler typically runs ten or more times faster than the equivalent program running under an interpreter.

An interpreter scans and 'decodes' the source code line by line, including each time it goes around a loop. The compiler,

though, only compiles the loop once, avoiding all that overhead.

Bear in mind that all languages can be either compiled or interpreted (or both), so that the speed difference between compiled and interpreted code is not a function of the language.

Here's a quick guide to some of the various languages available for microcomputers, and some notes on the pros and cons of each:

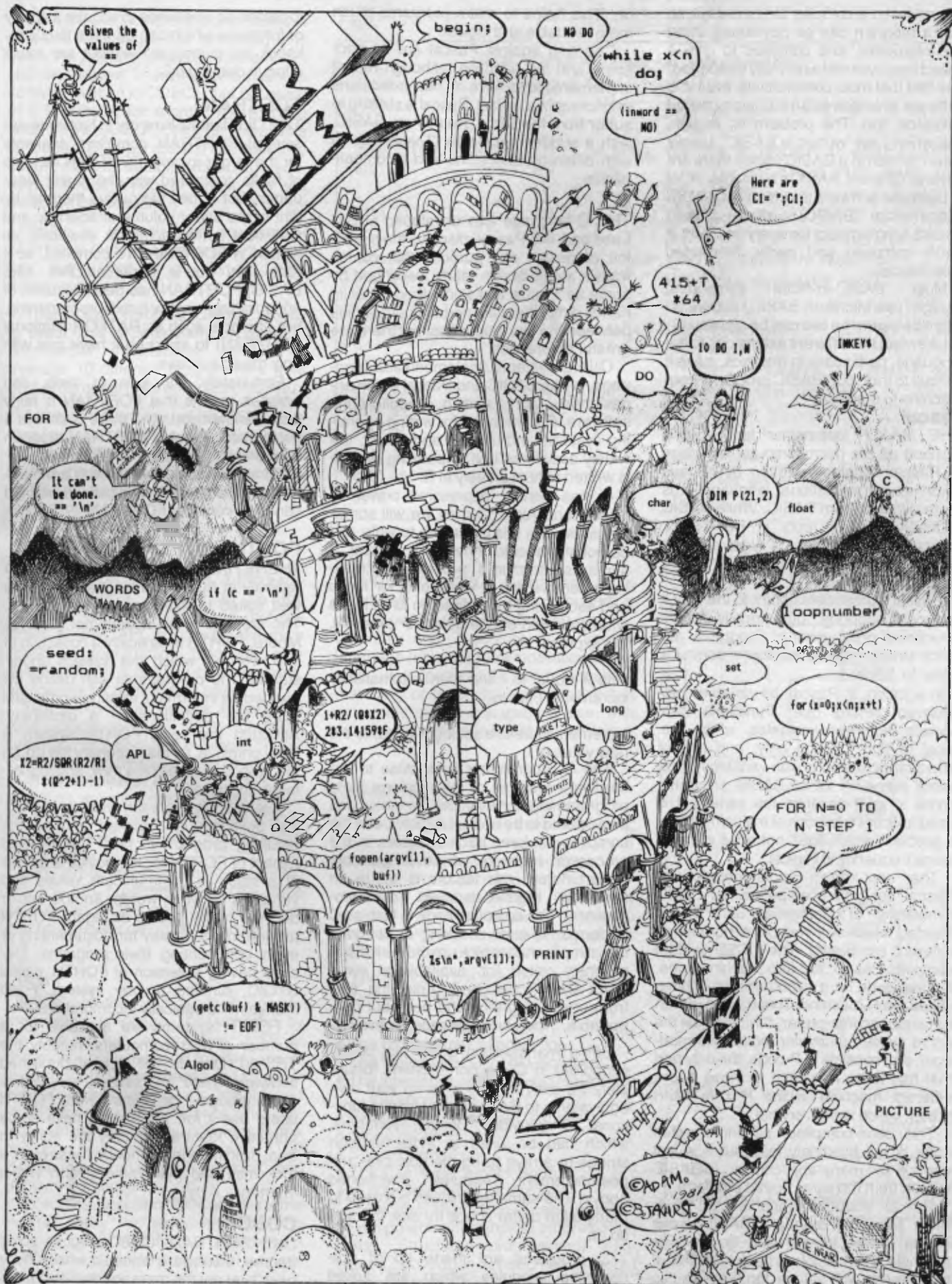
BASIC IS, of course, the lingua franca of the microcomputer world. Just about every microcomputer has a BASIC interpreter available for it, and in many cases BASIC comes as standard. Most of the common home computers, for example, have BASIC in ROM (Read Only Memory) so that it is available on switch-on. What has BASIC got going for it?

For a start, as its name suggests, BASIC is simple. It is easy to learn, and there are plenty of simple examples in the magazines to help you learn.

The language itself will help too; most microcomputers use a BASIC interpreter, which means that the program that's running is exactly what you typed in, line numbers and all. This means that when the BASIC interpreter comes across an error, it can print out an error message, complete with the line number where it occurred. And, of course, the original code is still in the computer so you can quickly edit the error out and continue testing your program.

The fact that BASIC is usually interpreted counts against it in the speed stakes, where it loses against compiled languages, particularly for business applications. On the other hand Microsoft





has released a compiler for its BASIC, so that a program can be developed using the interpreter, and compiled to give a speed improvement when fully debugged. The fact that most commercially available software is written in BASIC is a powerful influence, too. The problem is, though, that when I say 'written in BASIC', I really mean 'written in a BASIC', since there are several different BASICs available. A lot of business software is written in CBASIC (Commercial BASIC), which doesn't require line numbers for every line, and is partly compiled and partly interpreted (see Pascal).

Most BASIC-in-ROM computers, though, use Microsoft BASIC, and translation between the two can be a pain.

Likewise, the different extensions to the language, particularly in graphics, make it difficult to transport BASIC programs from machine to machine.

## Pascal

THE MAJOR competitor for BASIC's position as *the* microcomputer language is Pascal. Originally written by Niklaus Wirth as an educational language, it is quite different from BASIC. While BASIC probably has its roots in FORTRAN, Pascal is a descendant of Algol, and has similar control structures and a similar flavour.

Pascal's proponents point to the way it not only supports, but virtually *forces* structured programming. Programs are block structured, and the flow of control is easy to follow.

In addition, in Pascal, all variables are declared before use. Functions can declare their own variables, which are local to that function only, and do not affect other functions with variables of the same name. A lot of BASIC programs come to grief because the variable *I* is used to count two loops at the same time – a problem which does not arise with the same frequency in Pascal.

The best-known implementation of Pascal for microcomputers is UCSD (University of California, San Diego) Pascal, which will run on a number of different computers. The UCSD system compiles Pascal, not into machine code, but into code for a hypothetical machine, called the P-machine. This P-code is then run under an interpreter. Since almost the entire system (compiler, editor, file manager, etc) consists of P-code, the only part that has to be re-written to move it to a different machine is the P-code interpreter, which is not very big.

This semi-compiled, semi-interpreted code is not blindingly fast, but it is fast enough for many applications. (CBASIC suffers from the same speed problem).

Pascal supports variables of types other than the standard BASIC types (string, array, integer and so on. For example, it is possible to have variables of type *month*, with values Jan, Feb, and so

on. This helps to make programs much more readable and logical.

Counting against Pascal are its poor string and file handling, although recent implementations have all had extensions to improve this. In fact, Pascal is starting to suffer from the same problem as BASIC, with a sudden explosion of versions, all with different extensions and incompatibilities.

## C

THE C language was developed at Bell Labs and, like Pascal, displays the cohesion of design and purpose that comes from a small design team. Described by some as 'Pascal that's not afraid to get its hands dirty', there are certainly similarities between the two languages, but there are greater differences.

C is a systems implementation language, unlike BASIC and Pascal which are designed for writing applications software. C is intended for writing operating systems and utilities, and in fact, the widely acclaimed UNIX operating system is written almost entirely in C.

C has similar expressive power to Pascal and Algol, and so we will sometimes use it in this magazine to write and demonstrate algorithms. Like Pascal, it supports structured programming, making extensive use of 'while' and 'for' loops and eschewing the vulgar 'go to'. It has a wide selection of operators; for example, the expression

```
X = i++;
```

sets X equal to i and then automatically increments i, while

```
X = ++i;
```

increments i *before* setting X equal to the new value of i.

The C programmer lives close to the hardware features of the machine he is programming; for example, variables can be declared to be of class *register*, and the compiler will keep such variables in the processor registers wherever possible (unfortunately, this feature is not much use on register-deprived microprocessors). The compiled code is fast, as C performs no error checking at run-time; the compiler has to pick up all the errors. A program called *lint*, available at some UNIX sites, is designed to pick the 'fluff' from one's programs and point out non-portable, tricky, or stupid programming.

String manipulation is not just poorly supported in C, it's non-existent; fortunately it's easy in C to whip up your own equivalents to BASIC's set of string functions. C provides *pointer variables*, which can be used to index through strings or arrays using the auto pre- and post-increment features mentioned above. The same techniques are used to manipulate buffer space for disk I/O and so on.

C programs are made up of pre-compiled modules which are linked

together, so one tends to acquire a library of functions which can be used to quickly knock up a program without too much effort in debugging.

## FORTRAN

THE OLD faithful lives on; in fact there are several FORTRAN compilers available for the larger micros. FORTRAN has lots of faults compared with the newer languages, but it may yet outlive them all by dint of the sheer volume of scientific and statistical software that is available, all written in FORTRAN. It's compiled, so it runs fast, but is non-interactive. Like BASIC, FORTRAN has been accused of encouraging unstructured programming, but attempts such as RATFOR (Rational FORTRAN) to structure it have met with only mixed success.

Fortunately, its lack of bells and whistles means that FORTRAN is fairly well standardised, and there is always a good chance that a FORTRAN program from one shop can be run in another.

Small computer owners who are interested in scientific applications should seriously consider FORTRAN.

## FORTH

THERE HAS been an upsurge of interest recently in FORTH, a language which is well suited to extremely small systems. The creation of an astronomer, Charles Moore, FORTH is basically a collection of 140 *words* which the system understands. The programmer can define his own words in terms of existing words, and store the definitions in a *dictionary*. Although the basic FORTH system is fairly primitive, as the dictionary fills up, so the language takes on a new, and higher-level, character.

Interestingly, as each word is defined, the definition is compiled and so the resulting program is fast. The trickiest aspect of FORTH for the novice is its use of a stack to communicate values and variables between words. Another major difficulty is the casual disregard FORTH programmers display for documenting or even commenting their programs. Despite having a version of FORTH, called STOIC, running on my system, I still maintain it is basically incomprehensible.

FORTH systems are available for a number of microcomputers, notably the TRS-80. Despite the lack of published software, there are several very active users groups. I don't know what FORTH users use it *for*, but it does have some attractive features, notably the ability to treat disk memory as though it was core, a trick mini and mainframers term *virtual memory*.

## COBOL

LIKE FORTRAN, COBOL is, to some degree, a software dinosaur whose body hasn't yet got the message that its brain is

dead. COBOL (Commercial and Business Oriented Language) has for a long time been the primary language for commercial installations. There is a lot of business software written in COBOL, but not much of it is suitable for micros. There are at least three COBOL compilers available for 8080/CP/M computers, but their only buyers must be established COBOL software houses trying to break into the microcomputer boom.

COBOL is virtually the opposite of FORTH, in that it is extremely verbose, to the point that it is almost self-documenting.

Thanks to its verbosity, COBOL is easy to read. This is particularly important in commercial installations, where, on average 10 different programmers work on a program at different times of its life.

Another advantage of COBOL is its excellent file handling. On the whole, though, COBOL does not seem to be setting the microcomputer world on fire, as BASIC can do anything that it can, and quite a lot more.

## APL

KEN IVERSON'S brainchild, A Programming Language, is said to be the language of choice for many professionals at IBM. APL is possibly the most powerful programming language ever designed, with a rich set of instructions, particularly for dealing with arrays.

Two things count heavily against it; it uses special symbols for its functions, symbols not commonly available on terminals; and its devotees, even more than FORTH followers (if such a thing is possible), delight in not documenting their programs. To make things even worse, the lines of an APL program read from right to left.

APL programmers delight in writing one-line APL programs that do the same as 500-line Pascal programs. No matter that no-one else can understand them.

## LISP

LISP IS another comparatively incomprehensible language, characterised by the use of lots of brackets. LISP is commonly believed to stand for Lots of Insane, Stupid Parentheses. In fact, LISP is a list processing language, mainly used at MIT for artificial intelligence research, although it now has its devotees in the microcomputer community, with LISP interpreters available for the 8080 and 6800 microprocessors.

One of its most significant abilities is the innate ability to write self-modifying programs; this is ordinarily considered a dirty trick in other languages, but is one of LISP's strengths.

Fig 1.

;Example program to add two bytes together			
;Both bytes in RAM			
0100	ORG	0100H	;Start program at address 0100 hex
0100 211001	ADDER: LXI	H, BYTE1	;Set the HL register to point to BYTE1
0103 7E	MOV	A, M	;Load the contents of BYTE1 into the accumulator
0104 23	INX	H	;Set HL pointing at BYTE2
0105 86	ADD	M	;Add BYTE2 into the accumulator
0106 23	INX	H	;Set HL pointing to RESULT
0107 77	MOV	M, A	;Store the accumulator there
0108 DA0C01	JC	OFLO	;If there's a carry, then jump to OFLO
010B C9	RET		;Otherwise, return to the calling program
010C 23	OFLO: INX	H	;If there is a carry, increment HL again
010D 3601	MVI	M, 1	;Store 1 in that location
010F C9	RET		;Return
0110 04	BYTE1: DB	4	;First value to be added
0111 07	DB	7	;Second value
0112 00	DB	0	;Place the answer here
0113	END		;The end. . .

## PILOT

COMPUTER-AIDED instruction is a significant application of computers in education. PILOT (Programmed Inquiry, Learning and Teaching) is a special language for use in the preparation of CAI texts. It is particularly good at pattern matching of students' responses, yet is extremely simple and easy to use, with most keywords being in fact a single letter.

## SUMMING UP

THIS ARTICLE has only covered a few of the most popular languages, and not in any depth. We have not mentioned, for example, PL/1 (a rising star in microcomputer languages), nor PL/M, the original microcomputer high-level language, nor more obscure tongues like MUMPS, SMAL or TRAC.

The choice of the appropriate language depends on several factors:

- What's available
- The programmer's knowledge
- The time available for development
- The interactive or batch requirements of the application
- Floating point or integer arithmetic
- String handling
- Screen formatting
- The size of the target system and countless other variables.

Basically, interpreters speed program development, but compiled programs run faster. Structured programming techniques also reduce development time, but produce larger, slower programs. □

Fig 2A. The compiler

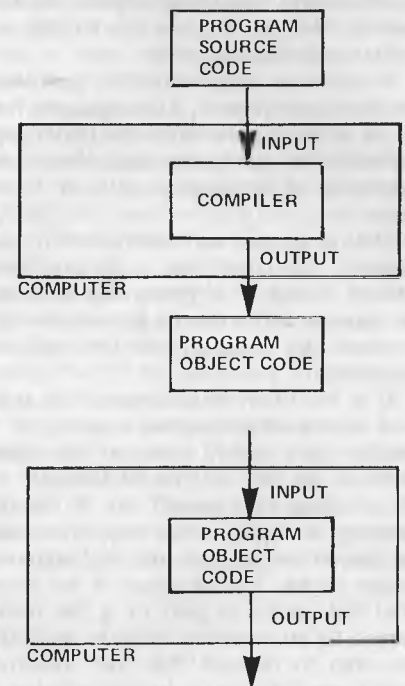
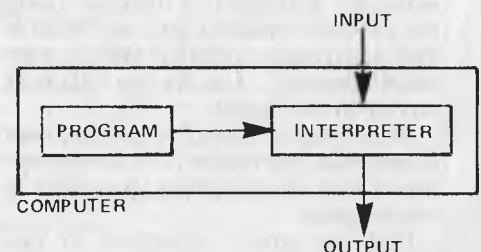


Fig 2B. The interpreter









rect access files may or may not be maintained in alphabetical order.

Here's a very simple example. Consider the problem of maintaining a set of debtors' accounts for a small company. Suppose we have 500 customers and that the most active of these places orders daily, while the quietest orders monthly. We need to be able to look up any customer's balance on demand. Here's one conceivable file organisation using direct access files:

Customer Name	25 bytes alphanumeric
Street Address	25 bytes alphanumeric
Town	20 bytes alphanumeric
Postcode	4 bytes alphanumeric
Order 1 description	30 bytes alphanumeric
Order 1 amount	4 bytes floating point
Order 2 description	30 bytes alphanumeric
Order 2 amount	4 bytes floating point
Order 3 description	30 bytes alphanumeric
Order 3 amount	4 bytes floating point
...	
Order 28 description	30 bytes alphanumeric
Order 28 amount	4 bytes floating point
-----	
Total record length	1026 bytes
times 500 accounts	501 Kbytes

That's bigger than most 13cm floppy disks. But more importantly, well over half the space in that file is wasted. The vast majority of customers might place only 4 orders a month, while we have reserved space for 28. That means that in many records 816 bytes are wasted. There has to be a better way!

And there is. Instead, we have one file containing the name and address information for each customer, plus a pointer value, which we'll explain in a moment. Then we create a second file, which contains all the order information for all the customers. Each record contains the order description and amount, plus another pointer. How do we tell which orders are for which customers? That's where the pointers come in.

We now have two files, organised like this:

<u>Customer File</u>	
Customer Name	25 bytes alphanumeric
Street Address	25 bytes alphanumeric
Town	20 bytes alphanumeric
Postcode	4 bytes alphanumeric
Pointer	2 bytes binary word
-----	
Total record length	76 bytes
times 500 accounts	38 Kbytes
<u>Order File</u>	
Order description	30 bytes alphanumeric
Order amount	4 bytes floating point
Pointer	2 bytes binary word
-----	
Total record length	36 bytes
times 5000 orders/month	180 Kbytes

The total for the two files is only 218 kilobytes. Now look at Figure 1, which shows the way the pointers work. The pointer for the first customer's record is the number of his first order record in the order file. Its pointer, in turn, is set to the number of his second order, which in this case is the third record in the order file. It, in turn, chains to the fifth record of the file.

A similar approach shows that the second customer has placed two orders, located in records 2 and 6 of the order file. Customer number three has also placed two orders.

Now, while, at a stroke, we have saved 300 kilobytes of file space, we do have to pay a price. Firstly, although we can locate all orders placed by a given customer, we cannot easily find the customer who placed a particular order.

Similarly, the pointers form a rather tenuous thread linking various parts of the file system together. If any of the pointers is accidentally damaged, a part of the file is lost to us, and with this simple file structure, there is no way of restoring it short of recreating the file from scratch.

In practice, a commercial system would get around both of these objections by providing links in both directions, allowing tracing of a particular order to a customer, as well as providing redundant links which will enable reconstruction of any broken pointers.

A modification of this technique allows each record to contain multiple pointers in what is called a tree structure. By using trees, it is possible to artificially overlay, say, alphabetic ordering on an otherwise random file.

### At Last, The Database

Until the early seventies, most programs were written using these techniques. However, there are a number of problems associated with this way of doing things.

First, data associated with a particular account is scattered across several files, and often cannot be accessed without knowing the particular key (in the example above, customer name). It is difficult to work out what data, where, relates to what else, and it is difficult to create a set of files and logical file structure which meets realistic needs and yet is simple enough to understand.

Second, the easiest way to meet access requirements is often just to store the same data repeatedly in several

files. The result is a lot of expensive wasted disk storage.

Third, the data formats used by different programming languages and utilities are often incompatible, and as we have seen above, it is up to the programmer to remember what data goes where and in what format.

Fourth, these kinds of large systems in the real world have a habit of growing like Topsy. As they do so, it becomes more and more difficult for the programmer to remember all the variable names and data formats and other peculiarities such as file relationships. And if a file structure is changed, then all lines, in all programs which use the file must also be changed - often a mammoth task.

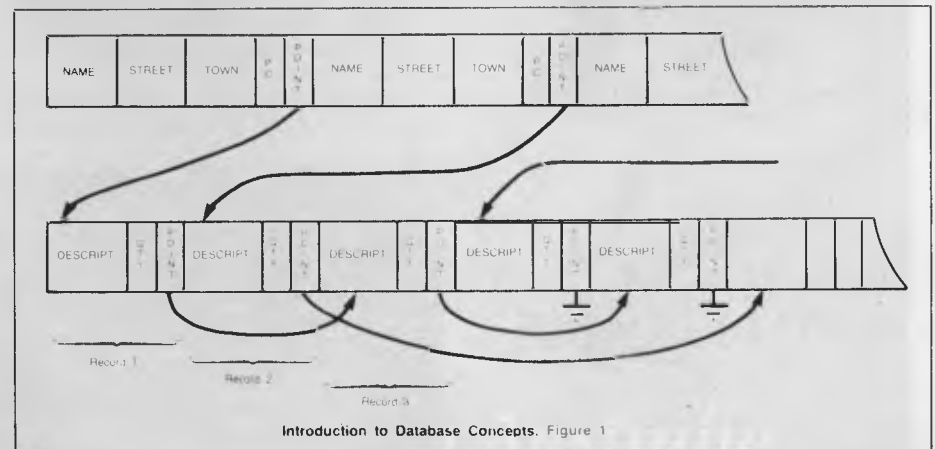
Finally, data in the files is completely raw and has no meaning; we cannot tell what each field represents - even if we can identify where a field begins and ends.

The database management system provides a solution to this situation.

A DBMS completely manages the storage of data, with no need for the user to know how it organises it. The user need not know how many bytes are devoted to a particular field (although he can originally specify this) or where it is located in a record. He need only know that a field called name contains the customer name.

This property is called data independence. If a user decides that he would prefer data presented in a different format, then a simple command to the DBMS will result in data being reformatted. This is possible through a unique facility which is not provided in conventional programming languages - that is, information about the record layout, including field names, types and sizes, is embedded in the database, and is available to all programs using it.

This information may be stored in a separate file, as in FMS-80 or InfoStar, or may be stored in the first few hundred bytes of the database file itself, as dBase II does. The result is that the user (and his programs) need know nothing



of the actual database layout, and changes to the database organisation will not affect the running of the programs.

Two distinct classes of database system are available: those which simply provide a sophisticated file access method, such as TOTAL on mainframes or MDBS on micros; and those which also incorporate a special language which may be used to manipulate the database, query it and provide reports – such as FMS-80, Condor 20 and dBase II.

Within each of these groups, there is a further subdivision into two major database models: hierarchical and relational. The hierarchical model corresponds basically to the simple example given in Figure 1, where each order is part of a list which belongs to a master record.

It suffers from the same problem mentioned above: that all orders for a particular customer are easy to find, but that all customers who have purchased a particular product are difficult to discover. Note, though, that if orders were chosen to be the master file which links to the customer file, the reverse would be true.

This basic limitation means that this model is not good for representing one-to-many or many-to-many relationships. However, for many-to-one relationships

(like many orders to one customer), it is obviously well suited.

The relational model, despite the name, has nothing to do with the relationships between data items. In fact, the term relation is another mathematical name for a table. Consider the example above, expressed as a table:

Cust No	Name	Street	Town	Postcode
C1	J Brown	10 Albert St	Mosman	2088
C2	H Smith	114 Kirk Rd	Bankstown	2200
C3	L Wentworth	67 Boston St	Sydney	2000

Cust No	Description	Amount
C1	20 widgets	\$85.00
C2	45 grommets	\$1.35
C1	30 Widgets	\$130.00

By creating two relations, we can view the columns as fields, and the rows as records. The records are accessed by key; in this case customer number. The relational model is purely an abstract mathematical concept, and in practice, relational databases have to rely upon pointers and indexes in order to physically construct the database. However, it would be possible to build a true relational database using a contents addressable memory, which, although it is horrendously expensive, is an approach being investigated by ICL for its next generation of mainframe computers.

In the meantime, bear in mind that there is no such thing as a true relational database running on microcomputers – at best, a system will hide the pointers which make it a hierarchical database, but usually micro databases simply provide data independence, leaving it to the user to implement pointers as he would in any language, like the BASIC example above.

### Commercial DBMSs

In this article, the discussion is confined to microcomputer software products, so I look elsewhere for coverage of mainframe products such as TOTAL or IBM's IMS and DL/1.

Condor Series 20 is a relational database which is available in three

levels. The full system offers a wide range of file management and transaction processing capabilities. Like most micro DBMSs, it includes a report generating package.

FMS-80, from Systems Plus, would have to be regarded as a relational database system in comparison with other systems which make that claim, but its name actually stands for File Management System, which is much more realistic nomenclature. Primarily menu-driven, it incorporates a data manipulation language called EFM, which can be used to generate extremely sophisticated applications indeed.

dBase II is the most popular micro-computer DBMS. Based on a relational model, it features a range of transaction processing and reporting capabilities, and incorporates its own, nameless, language. While dBase incorporates a number of sophisticated concepts, it falls down in its actual implementation, particularly in regard to documentation, which simply omits many of the features of the system. Indeed, for a long time, I was convinced that I must be missing something about the package. My self-confidence was recovered as people started pointing out the deficiencies of the documentation!

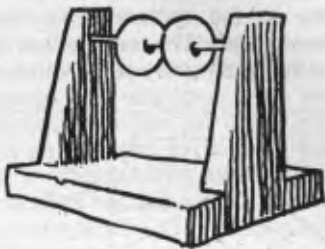
MDBS is actually a superset of the hierarchical model – termed a network database – and is primarily an access method for use from within other programs. It is possibly the most sophisticated of the packages mentioned here, and is certainly the most complex, if the documentation is any indication. It is also the most expensive DBMS package available for micros.

TIM III, from Innovative Software, runs on both the IBM PC and CP/M-based machines. It is a menu-driven system with extensive help screens, and is one of the simplest systems to use.

Many other database systems are available, both on micros and mainframes. However, the basic principles remain the same, and they all share two common concepts: the information about file structure is known to all programs that use the database, and the system provides a report generator program which can be used with virtually no programming knowledge. □

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# THE STING

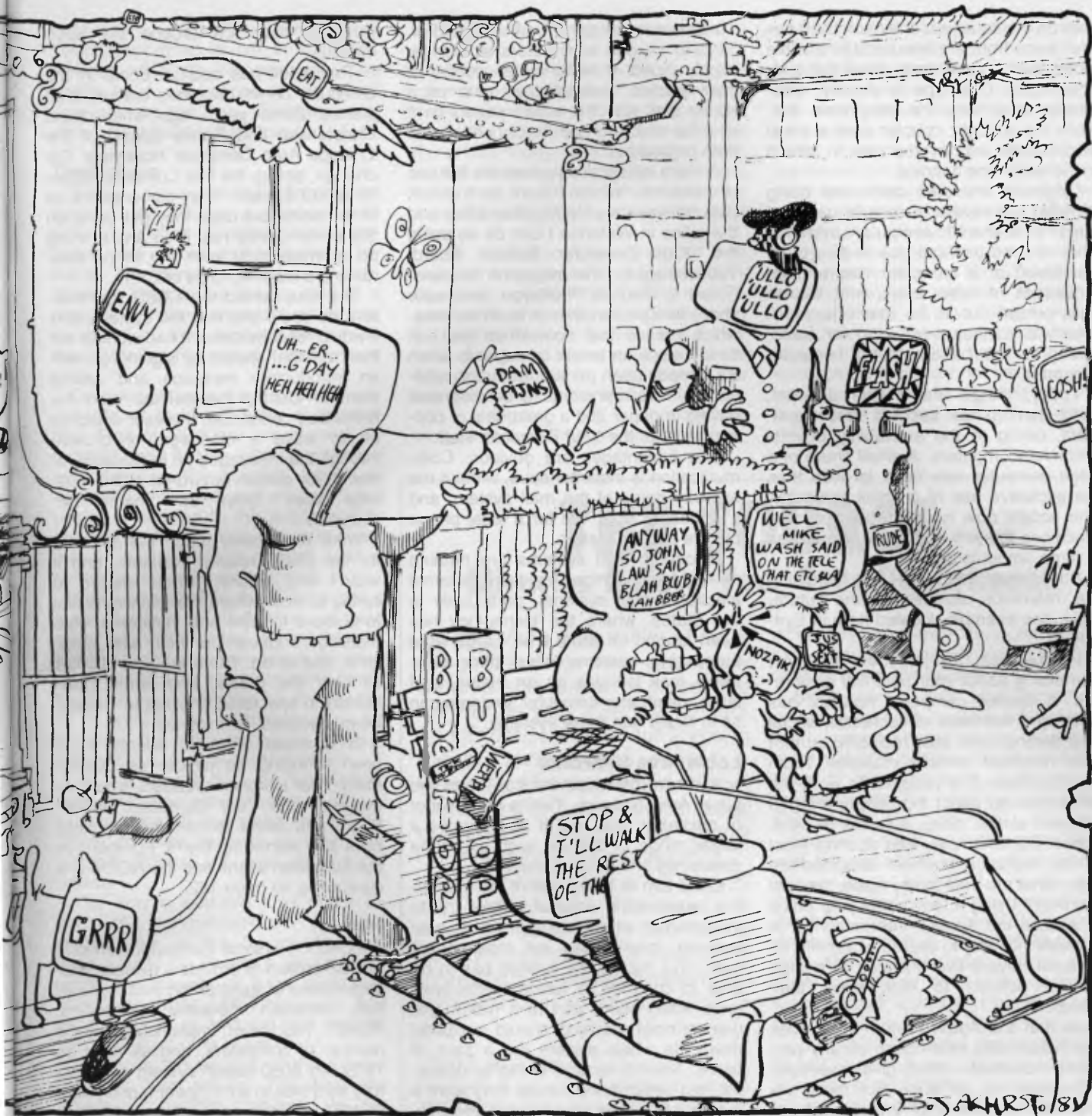


What the world has called progress in the past 50 years is almost too much to comprehend. The wireless was a remarkable invention, television the child of a genius and the two together an integral and inseparable part of life today. **Your Computer's** Les Bell looks at communications in the future. He reports that what's likely to happen will make radio and TV look like the toys of a child...

THE EARLIEST computers were designed in response to the panic of war - the problem of calculating the correct point at which to aim an anti-aircraft gun so that by the time a shell got there an enemy aircraft ran into it was one of computing's biggest catalysts.

Ever since then, computers have been wrongly named. A lot of the work done by computers is not numerical computation at all, but mainly searching through lists, or sorting lists or compiling programs and other similar jobs. Very little computer time is actually spent in solving problems of numerical computation.





As microcomputers became cheaper and cheaper, many computer manufacturers were slow to realise that the average individual does not need a horribly complex computer, or indeed the use of any computer to solve problems.

Two shocking admissions in one sentence – firstly, that you don't need a home computer anyway, and secondly, that people who should know better have managed to convince both themselves (and you) that you do.

So what is this, a gigantic con trick? Well, while it's true that you don't need a computer, that doesn't mean you couldn't benefit or profit by having one.

As I've said before, you don't need a word processing system to write 'Thank you' to Auntie Mary for the lovely socks; however, if you want to send a letter to each of the 200 members of your theatrical society, a word processor is mighty handy. At the present moment, most people deal with such a problem by avoiding it at all costs – just ask any overworked club secretary!

But the fact is, most people are not avoiding complex calculations. They just don't have any to do. What's the point of having a personal computer, then? The answer is communications.

### On The Phone

Computers can communicate with other computers, as most bank customers are finding out with the introduction of Automatic Teller Machines. Basically, a computer regards another computer just like a printer or any other device that may be attached to it. It has an input/output port which is attached to a device called a modem (modulator/demodulator), and this in turn is connected to the phone line. At the other end of the phone line is another modem, and then another computer.

Modems come in two flavours: direct coupled, and acoustically coupled. They ▶

both do the same job; they turn the ones and zeros from a computer into audible tones that can be sent down the telephone line. One type is directly, electrically wired into the telephone line, while the acoustic coupler uses a small loudspeaker and microphone to attach to the telephone handset.

Originally, modems came into being to meet the needs of remote users of large time-shared computer systems. They allowed users to type in data to be processed at a computer centre often thousands of miles away, with the results printed out at the user's terminal. That was all they were used for: transferring the input and output of computer programs.

Today, things are a little different. Time-sharing has become less significant, owing to the availability of mini and microcomputers. A small share of a large computer can be a lot less than the exclusive use of a small computer. The accent now is on the use of large machines to store and allow fast access to large amounts of data.

Such large databases are becoming the reference libraries of the future. Take one example, located here in Sydney.

In business, it's important to know something about your potential customers. A Sydney company, Apasco, has built up a database of economic, social and demographic data including current and historical census material. From that database it is possible to work out different facts about the people living in different states, cities, suburbs or post-codes. For example, who spends most on life insurance; how well educated are they, what are their family sizes, how old are they? Using a terminal in your office to access the Apasco information, it is possible not only to decide where life insurance buyers live but also to design special policies to best meet their needs.

Note that the Apasco information does not include any information on any particular individual – it only gives averaged information for an area. But there are important questions of invasion of privacy involved in the growth of databases, and computer professionals are well aware of these. The advent of the personal computer may do much to dispel people's fears – once you've used a computer you don't feel quite the same awe of it in the future, and you understand just how difficult and expensive it would be to collect a 'file' of information on an individual.

### Electronic Mail

With the advent of the ubiquitous word processor, we are now able to create letter-perfect documents and print them out for mailing. Around *Your*

*Computer* we've gone one step further. Several of our contributors no longer supply typed or hand-written copies of their articles. Instead, they give us a floppy disk with the article stored on it as a file which can be directly edited and then printed out.

A more recent development is the use of modems. When I want to transmit data between my Neutral Bay office and the office in Waterloo I can do so using the *Your Computer* Bulletin Board. Typesetting for the magazine is transmitted to Hughes Phototype (and cake shop) at Spit Junction in a similar way, which means that sometimes the first time we see an article on paper is when it's already been printed ready for publication. This represents a considerable saving in paper and a great deal of convenience for the *Your Computer* staff.

The advantages are obvious. Communication is instantaneous, without the two-day delay of the mail system, and it's cheaper, too; 13c for a local phone call, vs 30c for a letter.

Electronic mail systems are nothing new. Many companies have internal electronic mail systems, particularly in the States, where the technology has been around for some time. Large word processing systems often offer electronic mail facilities as an option, and large mainframe computer systems can tie in nicely with these systems.

### Local Area Networks

A recent development has been the Local Area Network. This is an offshoot of electronic mail, but it incorporates a larger range of utilities, such as phone directories and office diaries.

LANs aim at being part of the total office automation solution. They try to interconnect all system users in an economical, inter-related yet independent way. This means the system has to be able to continue to function effectively even when some part of it has failed; one terminal crashing should not bring down the whole system like a pack of cards. Such a system is highly desirable, but while many people may want it in principle it must also be cost effective. Currently, the best solutions are prohibitively expensive.

Nevertheless, all the major businesses recognise that the Local Area Network is the shape of things to come. IBM, DEC, Wang and many others have systems on the market and are actively developing them.

### Home Communications

In the US, communications facilities for home computers are easily and cheaply available. Modems typically cost \$150-\$200; \$400 would buy a direct-connect model with auto dialling and the ability to answer the phone. In

Australia they are around the \$200 mark.

The result has been a boom in the computer communications market. It all started some years ago when Ward Christensen and Randy Suess, of the Chicago Area Computer Hobbyists' Exchange, set up the first Computer Bulletin Board System. They scrounged a lot of the parts, but once they got going on the system, they had it up and running on an Imsai 8080, with one floppy disk, running a modified copy of CP/M.

The idea behind the CBBS was this. Anyone could dial into the system, and it would respond (once it had worked out their terminal speed) by signing on with an introductory message and asking them to identify themselves. With the formalities completed, the user could go on to leave a message, or browse through the messages on the system, or search for certain keywords in the message titles (your own name, for example).

Ward and Randy made the software for the CBBS readily available, and it wasn't long before CBBSs started to spring up everywhere. People would dial in to leave for sale ads, notices of club meetings, requests for help with problems, and so on. There are now CBBSs all over the States, and some have started to specialise; the Apple Bulletin Board Systems, for instance.

In Australia, Bulletin Boards have been springing up almost as quickly. Many *Your Computer* readers would be aware of the *Your Computer* Bulletin Board and some microcomputer clubs have also started up theirs. For more on the Australian scene see the RCPM article starting on page 122.

### PCNET

PCNET (Personal Computer Network) is a US project to provide a reliable, low-cost means of transferring messages or files between personal computers. PCNET has been implemented on a number of computers, and as early as 1978, an 8080-based system successfully sent files to a PET over a noisy line. PCNET stations can not only transmit files on command, they can be left unattended to answer the phone. This means that PCNET users have several advantages over the standard telephone:

1. It offers instant transmission of messages
2. It offers the sender an indication that the message was safely received
3. It will keep a record on disk of every file transmitted or received
4. It can be set up for unattended operation

PCNET's personal electronic mail protocol, PAN, has successfully been implemented on the PET, using a TNW-

488 modem (which, unfortunately, is not Telecom-approved for use in Australia). However, computer-computer mail has largely been overshadowed by recent developments on the timeshare networks, most notably the Source.

### The Source

Source Telecomputing Corporation operates the Source, a database and timeshare system of considerable complexity that is oriented completely towards the personal computer user. Based in Virginia, the Source runs on a network of Prime computers which can be dialled up from almost anywhere in the States for the cost of a local phone call.

Once logged onto the Source, a user has access to a vast array of information. First of all, there are several different bulletin boards with special interest categories. For example, there's an Apple Bulletin Board, and one for Pascal users. In addition to the public bulletin boards, each user has his or her own private mailbox, which can be used to send and receive electronic mail.

Also connected to the Source are a large number of information sources, such as UPI (United Press International), a wireline service which provides up-to-the minute reports on world news. Much of the information on the Source is of interest to businessmen — for example, the stock exchange information on the Source is updated hourly.

As well as the data on the system, there are also programming systems, such as a BASIC interpreter and a FORTRAN compiler, as well as other languages. There are also games, of course.

The Source indicates a lot of the future of communications. A large shareholding in the Source has just been bought by Reader's Digest, indicating the interest of large publishing companies in the new technology. And it's growing at an amazing rate, indicating the interest of its users.

An Australian version of the Source has also been set up. The American Source is, naturally, oriented to the American market and a lot of its content is just not relevant to the Australian market. The Australian version has been tailored accordingly.

The Australian Beginning is another database that promises a wide range of information.

### What Does This Mean To You

At present, probably not a lot. But it will. The expression 'the information rich' may mean nothing to you now, but it will be critical in a few years' time. We in Australia are among the information rich. We have phones, televisions, newspapers, libraries, books and other

information or information transmission media.

Whether we are aware of it or not, this information wealth enhances our lives in many different ways every day. If you don't believe me, don't talk to anyone on the phone today; only check the stock market values by going to the exchange; try to buy a stereo without checking around to see who is offering the best deal.

The communications revolution has well and truly started in many overseas countries, notably USA, Britain and France. In Australia we have already fallen far behind. Telecom (rumour has it they have discovered this wheel thing but are still discussing it in committees) has been approaching the matter with a certain degree of monopolistic megalomania. Private enterprise re-

gards the area as high risk but potentially profitable, and those who are trying to actually do something to help get the new telecommunications operative in this country could do with a lot more financial support.

The irony is that once these databases get going, the successful one (and there can really only be one) will be in control of a huge communications network that will exist for many years to come. The company that runs it will be on the gravy train for life. Everything — banking, shopping, any kind of reservations, all kinds of advertising — will be done through this system, and everybody will be connected to it. Not being connected will be like not having a television, or a phone or anything else that is evidence that we are no longer cave-

## THE SOURCE

### Miracles Before Your Eyes Department

*The Omen was a film about a nasty little boy who was really Satan's son, Jackal's blood, the lot. But he was a very smart lad. The Exorcist was about a young girl possessed by a demon — who was also very smart. Know-alls are either cast as evil or social cripples it seems. You simply don't admit to being brilliant.*

*But as KEITH STEWART points out in his story on The Source, a massive data and information network you can hook into, its no more than an endless mine of information that won't cost you your soul. . .*

USING PERSONAL computers, equipment which lets a computer use the phone and satellite links are common practises to those in the commercial field. A Sydney Engineer has a modem (acoustic coupler) near his Apple computer at home. His field workers are in mining camps in Western Australia. If they have a problem outside his normal working hours they can wake him up; if he can't provide a solution straight away, he merely links up with the parent computer in the US, works out the problem and transmits the data back to his men in Western Australia in a matter of minutes.

But what does this all mean to you?

It is possible to check on flight

schedules anywhere in the world. Book a seat. Charge it to your American Express card, all using The Source.

Stock prices, gold and commodity prices on the world markets are available from your own home at almost no cost, even when the local markets are closed, a boon to those involved in the money markets when the word spreads about The Source.

But this is not of much use to the average person. What is important is that already a user can find out literally anything from the United Press International database or from the Library of Congress database, or that of The British Museum. You can buy, sell or trade houses, cars, boats, take French or German lessons, or teach yourself almost anything using your personal computer.

I believe that personal computers in our homes and offices, linked to major sources of information such as The Source, will create greater social changes than that caused by the introduction of television.





*Computers are making their presence felt in all areas of industry, business, and the arts. In this article, John Donnan sheds light on the use of computers in music-making.*

SOME WAG or other said that if motor car technology had advanced as fast as microprocessor electronics has in the past few years, a Holden Commodore would cost about seven dollars, and get eighty thousand miles out of a tin of cat food. A comparison like this is a bit unfair to the motor industry, but it does highlight the astonishing progress being made in computers.

It's taken less than a decade, but today there are very few human activities which haven't been touched by computers in some way – music in-

use Lee de Forest's invention of the oscillator (1915).

Punched paper tape controlled the pitch, loudness, tremolo, tone and simple envelope – a bit like a pianola, in fact. The punched tape controlled various mechanical devices like rollers, springs, bellows, magnetic switches and so on. It had a simple filter, and could also produce a fairly good imitation of a mandolin, with its hard attack.

The bellows controlled the distance between two current-carrying coils. As the bellows expanded and contracted, the distance between the coils changed, different voltages were produced and, *voilà*, different pitches!

By today's slick standards, such an instrument would appear a bit comical, with its paper tape and huge wheels, air pumps and bellows, but think of the ingenuity behind it – using the best of

that – sounds like something out of Flash Gordon) which allowed its user to specify harmonic content (tone, basically) and volume envelopes by drawing the required shapes on a TV screen with a finger. This predates the Fairlight CMI capability by a good twenty years.

A computer called Illiac (University of Illinois Analogue Computer – when Sydney University acquired one it naturally became called the Silliac) was fed reams of musical and instrumental theory and, following all the right rules, it laboured mightily for a few weeks and produced a string quartet. This caused a righteous uproar amongst the more uptight members of chamber music circles, not because the composition was particularly interesting (it wasn't), but because computers were still a dark and unknown quantity (a distant cousin to the Bomb), and classical music was

# DIGITAL SYNTHESIS

cluded. Our new instruments are derived from the technology of our age. In fact, it was exactly a century ago, in 1883, that Thomas Edison accidentally discovered the operation of the diode, which later led to Lee de Forest's development of the triode. The triode is a basic component in electrical amplification, and Edison's discovery could justifiably be called the birth of electronics.

## A Bit Of History Or A History Of Bits

The first instrument ever to use electricity to produce a musical tone was called the singing arc, invented by Englishman William Duddell in 1899. He had observed that the arc lamp, a common form of lighting at the time, tended to produce a whistling sound when it was getting old. He put together a simple electrical system which allowed him to control the dc voltage in the arc with a variable ac current. This ac current was, in turn, controlled by a simple keyboard. When the singing arc was played, lamps which shared the same electrical system as the arc in other laboratories also sounded, because their voltages were being changed as well.

The first time the word 'synthesiser' was used, it described an instrument presented at the Paris Exposition of 1929 by two French inventors, Coupleux and Givelét. Their 'automatically operating musical instrument of the electrical oscillation type' was amongst the first to

available technology to make music in a new way.

By the mid 1930s most of the parts necessary for a modern-style analogue synthesiser existed – filters, oscillators, amplifiers and electrical keyboards. Each note of the keyboard would have required its own complete circuit, mainly because there was no system of assigning note priorities from the keyboard. Musicians as diverse as Leopold Stokowski and Edgar Varese were calling for musicians and technicians to work together. Great advances were being made in radio, television was just getting off the ground, and composers and artists of vision could see the possibilities in electronics.

Computers came on the scene around the Second World War, and soon reached their maximum practical size. The largest computers of the early 1950s used so many valves – tens of thousands – that their operators were spending more time finding and replacing faulty valves than in actually running programs. Bell Laboratories released the first transistors in the late 1940s, but it wasn't until the early 1960s that transistors were cheap and reliable enough to replace valves in a big way.

The period of the 1950s was a time of great research and development in computers and music, a time when technicians, academics and composers worked together in well-funded institutions. Canada produced an instrument called a Composertron (a great name,

even more of a wealthy elitist pursuit than it is today.

In 1955, RCA completed its music computer, the first computer designed and built primarily for music research. It created great interest amongst composers of the day, and great controversy in the musically aware public.

Because of wildly enthusiastic (and wildly inaccurate) claims made by the popular press on behalf of the RCA music computer's abilities and powers, the American Musicians Union, scared, attempted to have it dismantled or outlawed.

The Union banned its members from playing on RCA recordings. This ban really shook RCA, then one of the largest recording companies in America. The fuss became so great, in fact, that RCA dropped plans for commercial development of its Mark II model, cancelled its whole computer music research program, and in 1960 gave the instrument to Princeton University where the venerable old elephant is still being used.

It's interesting to daydream about the state that musical synthesis would be in now, if RCA, with all its massive financial grounding, had continued its research. Incidentally, Moog synthesisers were briefly banned in the same way in the 1960s, and only recently the British Musicians Union threatened similar action when Barry Manilow employed two synth players for his tour rather than the expected full orchestra.

Robert Moog pushed the whole syn-



thesiser field along enormously when he invented voltage control (or rather, adapted it to musical usage) in the early sixties. Prior to this, any changes in the sound or envelope had to be made by hand, or programmed by paper tape.

Up until six or seven years ago, analogue synthesisers, like the Minimoog and the ARP2600, were the only ones available commercially, mainly because digital technology was so expensive and tricky to run. But during the mid-seventies, a new breed of computer-based instruments began to appear, largely because microprocessors were becoming faster, more powerful and cheaper, and also because there was a growing market for them.

Along with Rocky Mountain Instruments in America and EMS in England, Australia's Fairlight Computer Musical Instrument was amongst the first to link

## AN INTRODUCTION

music with powerful computing. (The October 1980 *Sonics* magazine has a feature on the Fairlight, as well as an interview with composer Michael Carlos on his use of the instrument, both by George Faithfull.)

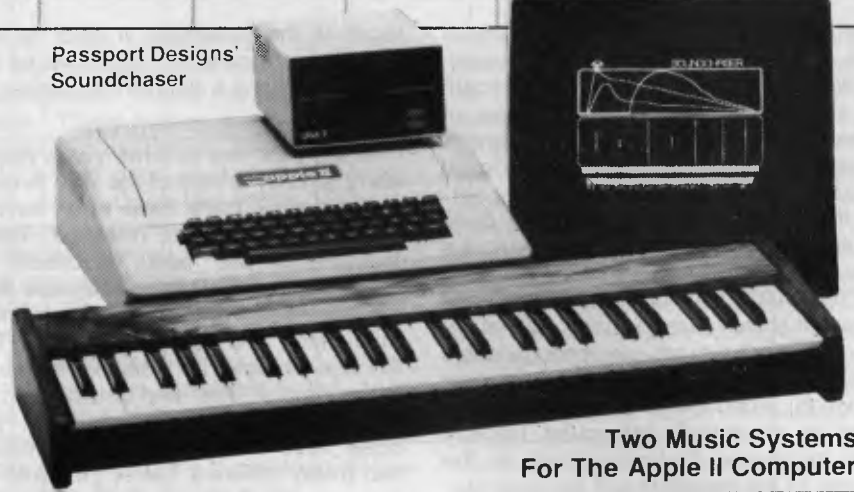
### Analogue And Digital

For many people, the difference between analogue and digital is a bit of a mystery. Simply put, analogue implies that something is continuously related to its original, and digital implies that information has been broken up into steps — sampled at regular intervals. Analogue is a reflection, if you like, while digital is a description. Consider the two types of watch in common use today. Time is obviously continuous, and no matter how humans divide it up, we experience it as such. The old-fashioned watch with its hands in continuous movement is providing a useful analogue of the passage of time. A digital watch, however, with its numerical display, splits time into steps of hours, minutes and seconds. Every time a digital watch moves a second, it holds or freezes that information until the next second, when it jumps forward.

Obviously, nature is not like that. These steps could technically be made so small as to be undetectable as steps, but the fact remains that they are still discrete points rather than a continuous flow.

So, analogue information is directly and continuously connected with the ▶

Passport Designs' Soundchaser



Two Music Systems For The Apple II Computer

### Passport Designs Soundchaser

The first stage of this package consists of a four-octave keyboard, an interface card and cable, and the Digital Performance Software diskette. Although the keyboard covers only four octaves, it can be assigned to anywhere from three octaves below to five octaves above middle C, thus giving it a range longer than a grand piano.

In synthesiser terminology, the system would be described as a six-voice polyphonic, with sound storage capabilities of ten memories or presets. Each voice has two oscillators; each oscillator has its own envelope. Each oscillator also has its own output, which is very important because the oscillator is in fact a fully variable waveshape. This means that any one preset or memory can play two completely different and separate sounds simultaneously.

There is an LFO (low frequency oscillator) which can be assigned individually to each oscillator, allowing such effects as phasing, chorus, vibrato and de-tuning.

Sounds are created by shaping the wave and its harmonics in the Create and/or Edit modes, a process designed to be quick and simple and therefore well suited to live performance. Each wave has sixteen harmonics and a different volume can be assigned to each harmonic using the method known as Fourier analysis; any wave can be drawn on the screen by controlling a moving dot (or line) with the computer's game paddle; the game paddle can also be used to edit or modify an existing wave in any way.

The Soundchaser program includes a four-voice sequencer capable of using a different preset or memory on each voice.

The second stage of the package is the Mountain Computer Music System, which consists of two double-sided diskettes, two boards, one light pen and a manual. Whereas the Passport Designs Soundchaser is a synthesiser first and a sequencer second, this system is primarily a composer's tool. Entire scores can be programmed via the Apple keyboard. The cost of this initial package is \$1695 (excluding computer!). Other programs currently available are the Notewriter (\$155) and the Music Tutor (\$255); soon to be available are a polyphonic version of the Notewriter and an eight-voice 16-track, split-keyboard

update of the Soundchaser called Turbo Tracks.

For further information or a free demonstration, contact Tony Slavich at Orbital Music (Sydney) on (02) 938-5522, or Tony Boye in Canberra on (062) 49-8561.

### alphaSyntauri

The alphaSyntauri is a good bit more expensive than the Passport Designs/Mountain Computer system, but you get a corresponding increase in the system's capabilities.

The system is eight-note polyphonic, with two independent oscillators per voice, which again means two ADSR-type envelopes per voice, one envelope per waveform.

Waveforms are player-designed by specifying harmonics, frequency modulation or by drawing on the video screen — or you can load sounds from floppy disks into the computer memory. 100-preset storage is standard and these are stored in banks (preset masters) of ten envelope/waveform pairs per bank.

The standard sequencer allows stored patches (over 2000 notes) to be auto-sequenced during playback for bass lines and rhythm tracks, and over 20,000 notes can be stored per diskette.

An optional sequencing program is also available, called Metatrack. This is basically a dedicated 16-track digital recorder, which allows the composer to build up an enormously complex piece. All the tracks can be edited, changed, given detailed expression and mixed together. Once the composition is complete, all the voices can be re-assigned, so that the line composed for horns could be played by marimbas and so on. The composition then can be stored on floppy disk. The keyboard can also be played live with any split during playback.

A supplementary program called the Composer's Assistant will, amongst other things, drive a printer to supply you with a paper copy of the composition.

Other special features include a software metronome giving 1-280 beats/minute, with a trigger output also available through the cassette port; and variable speed playback giving 1-800 per cent variation.

More information on alphaSyntauri can be obtained from Ken Guntar, Earendil, 59 Evans St, Rozelle 2039. (02) 818-2104. □

world around us, while digital is useful as an indirect description of the world. If we want to store sound, we can record it on magnetic tape as a series of changes in the strength of the magnetic field, i.e. as an analogue of the original sound.

If we want to store sound in a computer, we have to break the continuous sound into a form which the computer is designed to handle, and that means mathematically based steps (digital information). If we can use enough steps (that is, if our computer is powerful enough), when the time comes to recon-vert the steps back into sound, the way we experience that sound will be the same as the experience of the original.

### Digital Control of Analogue Synthesisers

The first microprocessors used in polyphonic analogue synthesisers found service in storing patch information (a 'patch' is a combination of settings on the synthesiser to achieve a particular sound) and keeping track of polyphonic keyboard assignments, rather than in sound generation or alteration. Instruments like the Prophets, the Oberheim four-voice, and the Roland JP8 have all used micros in similar ways - in fact, several of the famous polyphonics use the same microprocessor chip, the Z80, to do these jobs.

In order for the micro to remember the value of a particular control, the pot or slider under that control must be 'quantised'. This means, rather than being a continuous control from zero resistance (full on) to infinite resistance (full off), it must be divided into a series of steps, any one of which the micro can store as a pattern of ones and offs. There must be enough steps to make them inaudibly small, but no more than are necessary.

All the important controls on the synth should be quantised if they are to be included in the programming. You can see that with perhaps thirty or forty steps in each quantised control, forty or more controls, and dozens of patches, the patch micro has to be oriented towards memory, rather than calculation. To reverse this and retrieve the program, the micro simply sends the stored digital information to its digital-to-analogue converter output stage, which sends the appropriate voltages to the right controls. These now work in much the same way as normal voltage-controlled pots, and there you have your patch.

The keyboard-dedicated micro has a quite different task. Not many performance-oriented polyphonics allow more than six or eight notes to be played at a time. This is called Limited Polyphony. The keyboard micro must scan the keyboard constantly and, depending on the chosen mode, send the correct vol-

tages to the oscillators. It must do this very fast, otherwise the synth will be accused of having a sluggish response.

### Analogue/Digital Hybrids

In the past two or three years (gaws! we're already a third of the way through the eighties!) there have been several new-style instruments released. These instruments are best described as analogue/digital hybrids. They use their microcomputer components for more than patch and keyboard control. The Rhodes Chroma, for instance, allows all its oscillators, filters and amplifiers to be rearranged so that, for instance, you could have the sound passing through two totally different filters, then into an envelope-controlled amp, then through another filter, and so on.

Another instrument which combines the best of analogue and digital technology is the Wave 2.2 from PPG of Germany. This one uses digital waveshape generation, which allows some pretty complex and dynamic sounds, but has a more or less normal analogue filtering section.

This is good design, because filtering sound digitally takes a good deal of power, while digital waveshape generation is far superior to analogue, with its basic sinewave, sawtooth, square pulse, and triangle. For musicality and direct control over the sound being produced, these new hybrid instruments are a great direction.

### Sound Generation And Sampling

This is the area where digital synthesisers are unique. Sound is enormously complex, and there would be no way to produce and control the more complicated waveshapes without using quite powerful computers. As always when dealing with computers, we have to think of our material, in this case sound, in terms of information.

Here's a very important point: any sound can be represented by one, or at the most two, waveshapes. Any waveshape can be described mathematically, and any mathematical expression can be stored in a computer memory, if the memory is big enough. Once that sound is stored in the memory and is available to the CPU for processing, you can see that it is quite possible to play that sound, or change it in any other way, simply by doing mathematical operations on it.

The tricky part of all this, of course, is getting the sound we want into the computer memory, so that we can use it musically. There are several ways we can do this, all quite ingenious, and all requiring fairly nifty computers. They are:

- Harmonic specification
- Frequency modulation
- Sound sampling

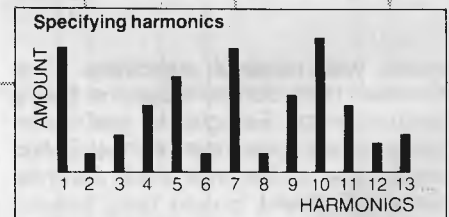
- Direct drawing of the desired waveshape.

### Specifying Harmonics

In this case, the computer will throw a display on the screen which will be a graph divided into sixteen, twenty-four or thirty-two columns. Each column will represent one harmonic, and you can specify how much you want of each by using the computer's typewriter keyboard, a games paddle, or a light pen, drawing on the screen. This method is quite straightforward, and very educational.

Real instruments have their characteristic sounds partly because of the way their harmonics are structured. A violin, for instance, contains a very strong third harmonic. The computer will calculate the waveshape from this drawn information and store it. Some of the computer-based instruments such as the alphaSyntauri will allow you to hear the sounds as you're constructing them, which is very handy.

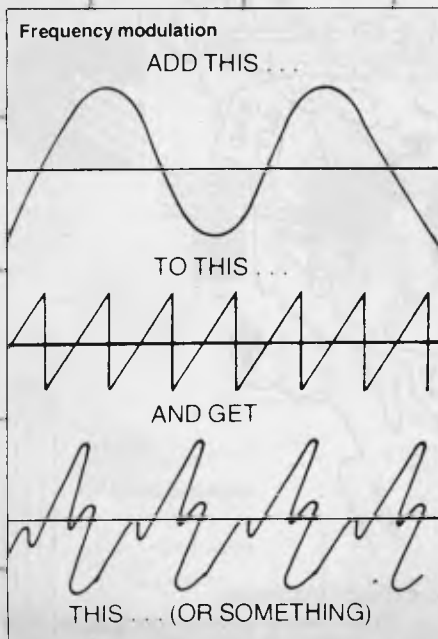
Specifying the harmonics in this fashion is probably the easiest and most useful method for constructing sound digitally.



### Frequency Modulation (FM) Synthesis

Using this method you can take any waveshape either from memory or by constructing it as above, and add it to any other. This results in a third, far more complex wave, which can then be stored or used for even more FM synthesis. The theory behind this is remarkably simple, but it's very powerful in practice. The more complex the waves being combined are the more harmonics will be contained in the result. This can end up sounding rather lifeless, metallic, clanky and unmusical, and is the kind of sound which characterised early computer music.

One limitation of the smaller computer-based systems, such as the Passport Designs system and the alphaSyntauri, is the lack of control over the harmonic envelopes. For instance, when a note is struck on a piano, the higher harmonics fade away within a few seconds, whereas the lower ones fade out much more slowly. In other words, the harmonic content changes as time passes. The larger instruments, like the Fairlight, allow the user not only to specify what harmonics he/she requires, but also how those harmonics will change in the note's duration. This re-



sults in a much more musical or natural sound, but it also demands a very powerful computer.

### Drawing The Waveshape

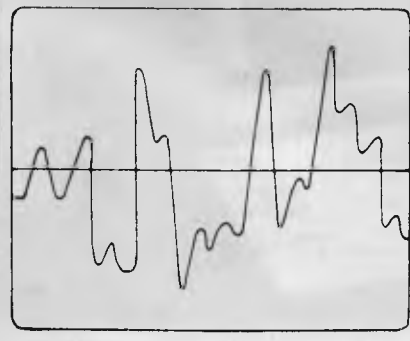
By using a light pen or a games paddle, you can actually design waves on the screen and hear them when you play. This is quite fun, but probably not as musically useful as FM or harmonic specification. The temptation is to draw very fancy rococo patterns all over the screen at first, but these usually result in dry and unanimated sounds. However, by experimenting with combinations of the simpler waveshapes like sinewave, sawtooth, square, and so on, you can produce some very lovely sounds, and learn quite a bit about musically useful sounds.

### Sound Sampling

The fourth method of getting sound information into the computer, sound sampling, doesn't require a screen at all, but it does need a very sophisticated input stage. I'd say that sound sampling is probably the most exciting and intriguing aspect of digital synthesis.

Basically, the computer will look at a

Drawing waveshapes — anything you like really; also useful for changing other waveshapes.



sound — any sound at all — up to forty or fifty thousand times per second, and will calculate values for each of these steps. These values are a digital description of the original sound, and contain all the data needed to reproduce that sound. Once this info is stored in the computer's memory as a wavetable, it can be changed and used in any way the program allows — and the programs on the big units allow a great deal indeed.

The computer will change any particular part of the wavetable — the parts which give it pitch, or tone, or envelope, or timbre. The results of these operations are sent to the digital-to-analogue converter at the output stage, which sends the resulting signal to the amp and speakers.

For example, if our digital synth has a sampling rate of, say, forty thousand samples per second, and we wish to record a pure 400 Hz tone, we can see that the computer will have taken a hundred samples, each of which is a number, or rather, a value. It stashes this string of numbers into its memory from where it can be instantly retrieved.

However, what happens if we want to change the pitch of the sampled sound? There are two ways to do it. The first

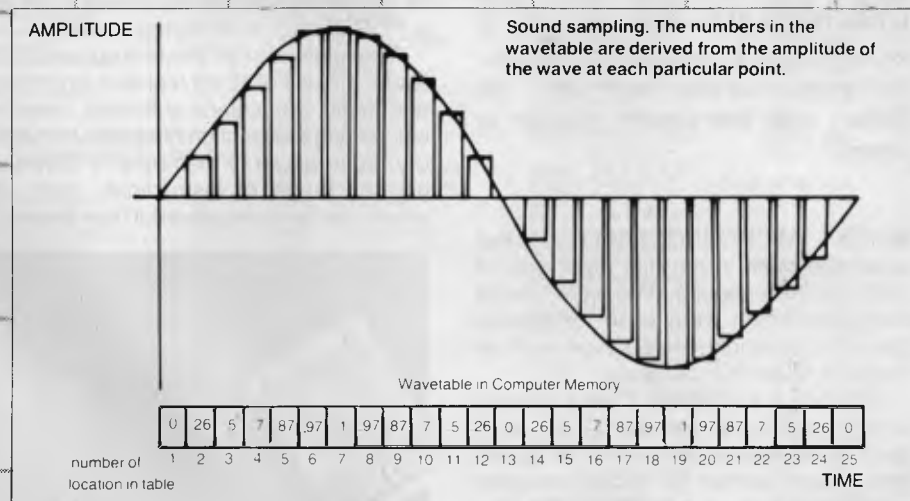
trates that they are indeed capable of a great deal. Further development is needed, however, in the interface between musician and computer. How subtle and immediately expressive can you be in your playing of a digitally based instrument? A simple bamboo flute in the right hands, for instance, can produce extremely subtle nuances of expression, the interaction between musician and instrument being continuous and immediate. A Fairlight or a Synclavier has almost unlimited ranges of timbre, pitch and melody, but in actually playing it, its responsiveness to the whims or inspirations of the player is relatively limited. This, I feel, is where all the exciting changes will occur as computers develop as music-making tools.

When the computer's power of information manipulation is coupled with a responsiveness that is as immediate and continuously interactive as that of the bamboo flute, we will be in for quite a musical feast.

I've got my place reserved at the wavetable!

### REFERENCES

- Tom Rhea and Robert Moog's columns in the *American Contemporary Keyboard* magazine gave me some ex-



way means taking the hundred samples out of the memory faster or slower. This obviously means more or less waves per second, which gives the change in pitch. The second way means keeping the speed of the process even, but not taking out all the samples for that sound. So, to double the pitch of our tone, the computer simply misses out every second sample. To halve the pitch each sample is read twice.

Similarly, mysterious calculations are required for changing all the other aspects of the sound in the computer.

### How Subtle Can You Be?

This article has hopefully introduced to you the ways in which computers can handle musical information, and it illus-

cellent background in electronic music history and how computers can be used to control analogue synths. *Contemporary Keyboard* is a consistently good magazine.

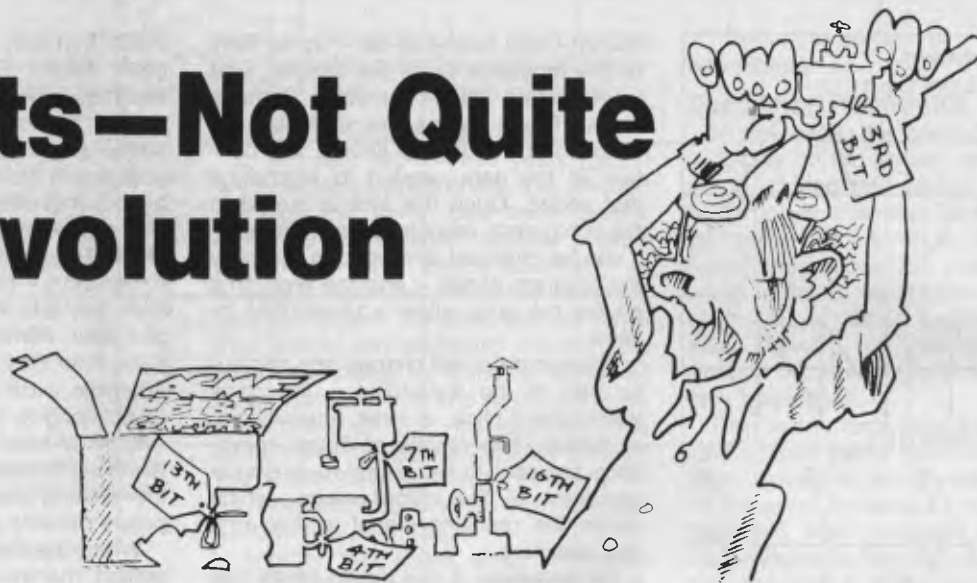
- *Personal Computer Book*, by Robin Braudbeer (Cassell) and *Silicon Chips and You*, by C.D. Renmore (Sheldon) are excellent introductions to simple computing.

- *Godel, Escher and Bach*, by Douglas Hofstadter (Penguin) is an absolutely fantastic book about Zen, computers, thought, music, artificial intelligence, humour and much, much more.

This article originally appeared in the April/June 1983 issue of *Sonics* magazine.



# 16-Bits—Not Quite A Revolution



*Since 1975, when personal computers first appeared, they have generally been based on microprocessors which operate on an eight-bit word, while large main-frame computers have had 32 or up to 60 bits per word, with mini-computers somewhere in between. Les Bell asks (and answers himself) two things: why is word length a measure of computer performance, and will 16-biters rule the world (sooner or later)?*

WHEN MICROPROCESSORS first appeared back in the dim dark ages of 1970 (or thereabouts), they were four-bit machines which were used for general control and simple computation such as might be found in a calculator.

Four bits is a convenient word length in which to store a single decimal digit and, back in those days, the kinds of programs which were written for microprocessors were small and unsophisticated. We simply hadn't built up the great body of sophisticated technique which exists today.

In 1975, hobby (or personal) computers started to appear, and in 1978-1980, they really started to become popular. The reason for this is simple: the new 8-bit microprocessors had become available, and the 8-bit word length was ideal for storing a single character (such as a letter of the alphabet) in ASCII code.

More to the point, a word of eight bits can represent one of up to 256 different instructions, and with the far greater range of instructions now available more work could be done in a given time period.

These improvements, together with advances in semiconductor technology,

enabled high level languages such as BASIC to be implemented on these processors, with a more realistic level of performance. The microprocessors from this period are the 'brains' of the most popular personal computers, such as the Apple, TRS-80, PET and VIC.

As the chip manufacturers improved their ability to cram more and more on a single square of silicon, it was only a matter of time before they could build 12-bit (a la PDP-8) and 16-bit microprocessors.

As explained in an article in our very first issue, the use of 16-bit registers simplifies arithmetic, particularly arithmetic used in calculating the location of objects in memory, such as array members. It allows a greater range of instructions, each of which can be more powerful than those of

eight-bit machines.

There were several companies manufacturing 16-bit microprocessors by 1978, notably Texas Instruments and National Semiconductor, but the first one to really attract attention from microcomputer designers was Intel's 8086.

The 8086 was designed to maintain some degree of upward compatibility from its eight-bit predecessor the 8085, and so its register and instruction sets are reminiscent of earlier microprocessors. However, a study of the details will reveal that it is really quite different.

Soon after the release of the 8086, Zilog announced its Z-8000. Now the Z-8000 looks much more like a traditional minicomputer architecture, and in fact many of its instructions are reminiscent of



The IBM Personal Computer.





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the IBM 370, although renamed. The result was to thoroughly confuse everyone who had been eyeing up the 8086, and make them wait to see the Z-8000.

Shortly before the Z-8000 was released, Motorola announced the forthcoming 68000 processor. Now here is a processor that is very mainframe-like, with special instructions which are privileged to the operating system, excellent memory management and other nice features.

This has confused everyone still further. The fence-sitters who were considering the Z-8000 now decided to wait for the 68000, while a few hardy individuals decided to get on with the job using the 8086.

Then Intel released the 8088, a version of the 8086 which works with 8-bit hardware, and that attracted more than a few designers who had existing 8-bit designs, as the pin-out of the 8088 and the 8085 are nearly identical.

The Z-8000 seems to have faded out of sight as far as the personal computer market is concerned. Only two major manufacturers adopted it, and Ithaca Intersystems has been very quiet on the subject of late, leaving Olivetti to go it alone.

Meanwhile, there are signs that the 68000 will in its turn be overtaken by the new National Semiconductor 16032, a virtual implementation of a VAX supermini on a chip. Such are the problems a micro-computer designer must contend with!

### What's Out There?

Enough of these technical discussions; what's actually happening out there in 16-bit land?

A number of 16-bit machines have hit the market recently in Australia. What should the prospective purchaser consider when evaluating one of these machines?

The basic things to bear in mind are the same for the 16-bit machines as for the 8-bit machines. Such statistics as disk capacity, speed, screen dimensions, keyboard, and so on are much the same.

The first thing to consider is the availability of suitable software. This is the major difficulty with the new machines. The 8086/8088 based machines benefit to some degree from their similarity to previous 8-bit machines, but at the same time this can count as a disadvantage.

There are two predominant operating systems available for this type of computer — CP/M-86 and MS-DOS.

CP/M-86 is fundamentally similar to CP/M-80, particularly as far as the user is concerned. Apart from the addition of a help utility and new directory facilities, it is basically indistinguishable from CP/M-80 — even utilities such as PIP and STAT work the same way. To the programmer, there are obvious differences, but the BDOS function numbers are the same, and the functions work in the same way.

MS-DOS, on the other hand, is a somewhat simpler operating system, and for that reason runs noticeably faster. It offers a couple of significant advantages over CP/M-86: it date-stamps files and offers

the ability to edit command lines — something that many a CP/M user would give an arm for!

On balance, however, my preference is for CP/M-86 as the operating system of choice for several reasons: it is compatible with MP/M-86; a multi-tasking version called Concurrent CP/M-86 (CCP/M-86) is available; and it offers much better memory and I/O management facilities, as an operating system should.

The availability of two operating systems for many machines has resulted in there being no clear standard with a majority of support from independent software vendors.

Microsoft has not made its BASIC interpreter available to run under CP/M-86, for example, obviously counting on this fact to attract users to MS-DOS (in fact, the company has stated publicly it will not support CP/M-86).

Digital Research for its part is working on a BASIC interpreter to replace Microsoft's, and my feeling is that DR will make a creditable job of it. It has acquired much more expertise in languages than Microsoft has in operating systems.

In the meantime, the would-be purchaser is missing out in the confusion.

The other major problem with software for the 8086/8088 family is that Intel very cleverly made up a program called CONV-86 which will translate 8080/8086 assembly language into 8086/8088 assembly language by rote.

This is a quick way of getting software up on the new processor, but it is definitely not a way of getting quick software up.



Digital Equipment Corp's Rainbow 100.

The translated code does not make use of the much more powerful addressing modes and instructions of the new processor, and consequently runs quite slowly. This can be seen in such programs as Microsoft BASIC for the IBM PC, which is actually slower than the equivalent 8-bit software.

Other translation programs have been released, notably Sorcim's TRANS-86 and Digital Research's XLT-86. Although these provide a way of getting programs across for development purposes, they really should not be used for production programs. The results do not flatter the machines.

### The 68000 World

In the 68000 world, the results so far are not very encouraging either. Here, the operating system action centres around variants of UNIX, from the real thing to lookalikes.

Digital Research is working on a version of MP/M for the 68000 — whatever will they think of next — but that's not expected for quite some time.

Perhaps one of the most interesting efforts is that of Cromemco which, by providing a dual processor board with a 68000 and a Z-80, has ensured its users are not totally stranded away from the software oasis that CP/M can provide.

Perhaps the most amazing thing about the software already available for the 68000 is how fast it appeared! At least some manufacturers are actually offering conventional CP/M-80 programs which are run on a 68000 emulating a Z-80. While this will work, it is also slower than a wet weekend, and misses the whole point of having a 68000.

Other manufacturers have a range of software which minicomputer manufacturers as big as DEC could not afford to produce in the timespan possible — typically hundreds of man-years of effort, from small companies little bigger than back-yard operations.

This phenomenon has mystified me more than a little; of course, the similarity between the 68000 and PDP-11 architectures goes some way to explaining how software could be transported off that minicomputer onto a micro.

So far, however, there is a selection of languages but not much apparent in the way of applications software. That situation is unlikely to change before the end of the year, at the earliest.

The machines themselves, however, are interesting. Here's a run-down on a few of them...

### Vector 4

The Vector 4 is a dual processor machine with both a Z-80 and an 8088 to run both CP/M-80 and CP/M-86 software.



The NEC Advanced Personal Computer.

Memory capacity is 128 Kbytes as standard, 256 Kbytes optional, and two types of disk drive are available — a 630 Kbyte minifloppy or a 5 Megabyte Winchester.

Graphics capability is 640 by 312 in straight black and white, and resolution can be traded off against grey scale capability or colour on an external RGB monitor.

I/O is quite extensive, with two serial ports and two parallel printer ports. Further expansion is possible through the internal S-100 interface.

### Hitachi 'Success'

Following on the heels of IBM comes Hitachi, with a new computer which not only offers software compatibility with the IBM PC, but also hardware compatibility.

Standard features of the machine include 320 Kbytes of RAM, a single 320 Kbyte disk drive, Centronics and RS-232C interfaces, ten shiftable programmable function keys, six expansion slots, colour, monochrome and lightpen interface circuitry.

The Hitachi 'Success' supports high resolution graphics in sixteen colours, and the RGB monitor can display text to a maximum of 2000 characters with an interlaced resolution of 640 by 400.

A basic set-up of system box, keyboard, single disk drive, green screen, word processing software, spreadsheet calculator and games and utilities is priced at around \$4000.

Hitachi has also announced a 16-bit upgrade for the Peach, along the lines of the Metacard for the Apple.

### Panasonic JB-3000

Panasonic's JB-3000 has been discussed in these pages before. Designed to be software compatible with the IBM PC, the Panasonic runs MS-DOS and CP/M-86.

Various peripherals are available; as the brochure says, 'I/O ports allow to ac-

cess to 5.25-inch diskette drive, 8-inch diskette drive, RS-232C and GP-IB interface by setting interface card'.

Graphics resolution is 640 by 400, and 8 colours are supported.

### DEC Rainbow

Digital Equipment Corporation's Rainbow 100 is another dual processor machine with both a Z-80 and an 8088.

Unlike the others, both processors can run at the same time, allowing much greater throughput in sections of the operating system and software that is specially written to take advantage of it.

DEC's version of CP/M for the machine will run both CP/M-80 and CP/M-86 programs providing a smooth upgrade path for the non-technical user.

By emulating the DEC VT-100 terminal in 132-column mode, the Rainbow 100 is particularly effective as a spreadsheet calculator.

Other nice facilities include optional colour graphics, asynchronous communications with other DEC machines and a very nice keyboard.

### IBM PC

We've spoken about the IBM PC before.

I guess if you want to have an IBM computer, it's going to have to say 'IBM' on the front, and this is the only micro that has that.

Also this machine is the one that will get all the direct software support: incompatibility problems may crop up with others if you buy 'IBM' software.

### Godbout 8085/88, 8086

The Godbout 8085/88 board can lay claim to being used by IBM (no less) in the development of the PC.

Also announced recently by Godbout is an 8086 CPU card, which carries the 8087 arithmetic coprocessor and the 80130 operating system kernel on a chip.

This CPU really does fly along, as it uses a true 16-bit bus — and with the 8087 installed, floating point is just obscenely fast.

### Empirical Research Group

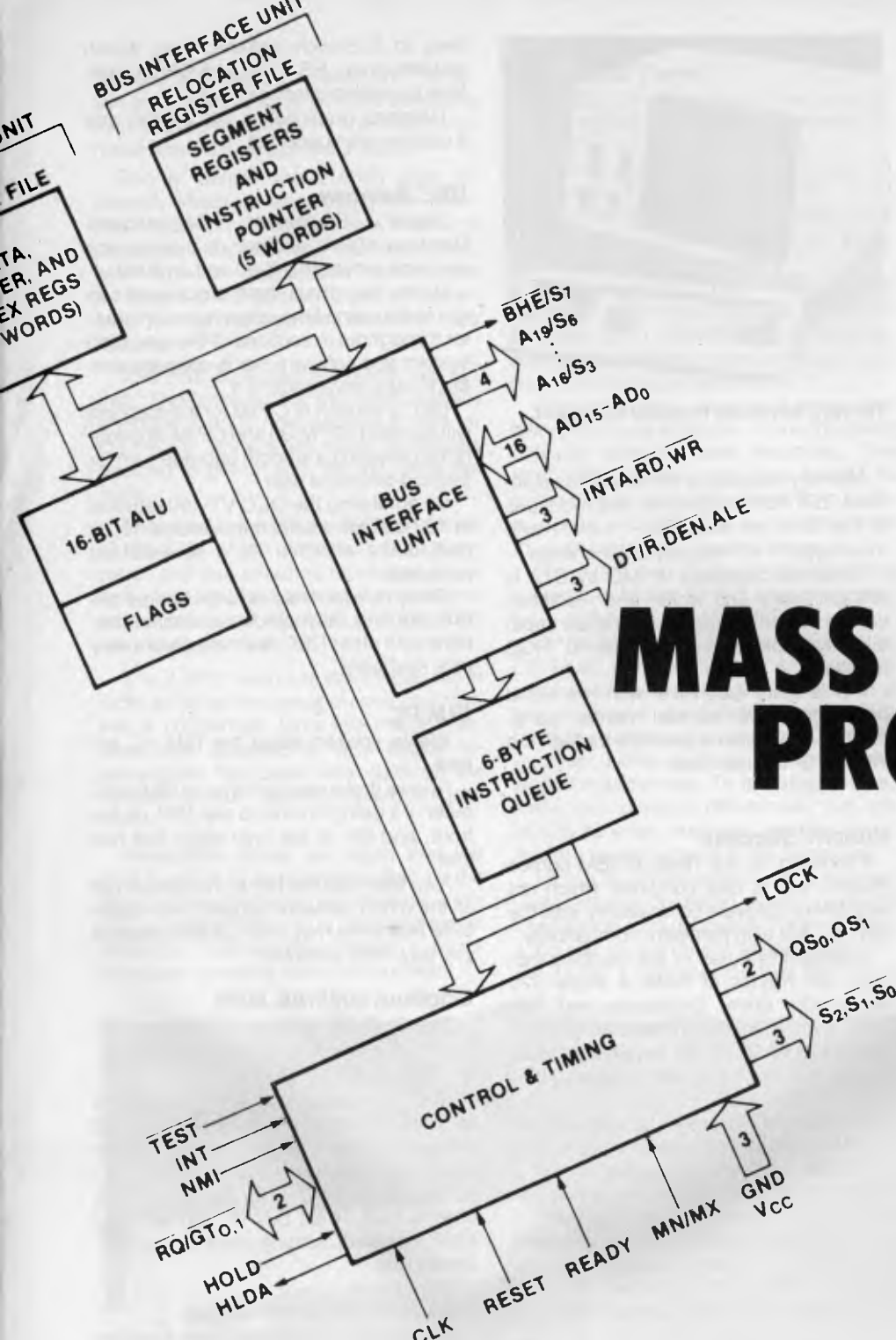
S I Microcomputers has been handling this 68000-based board for some months now.

It's intended for use on the S-100 bus, and a lot of effort has been put into making it compatible with the IEEE 696 standard. A very interesting card indeed.

### NEC 'APC'

NEC's 'Advanced Personal Computer' is another 16-bit newcomer. It was the winner of *Your Computer's* Computer of the Year Award. Turn to page 28 for more on this one. □





The world of microcomputing used to be dominated by eight-bit processors, but 16-biters are now gradually getting a bigger share of the market. What is likely to happen and what will the effects be on the microcomputer market? Les Bell reports . . .

# MASS TRANSIT PROCESSING

## Mass Transit Processing

MOST PERSONAL computers are based on one of two microprocessor chips, the Z-80 and the 6502, although you'll also come across the good old 8080, the 8085, the 6800, the 6809, the 2650 and the occasional SC/MP and 1802.

One factor links all these machines — they manipulate a byte at a time. It doesn't matter if the computer is doing double-precision floating-point arithmetic, the chip is still fetching single bytes out of memory and doing arithmetic on a byte, or at most two, at a time.

Most of these chips have instructions to add two 16-bit quantities, and they can all add two eight-bit values. And that, ladies and gentlemen, is as smart as your computer really is.

But the times are changing, and the latest chips from the semiconductor manufacturers are so much more powerful than their predecessors it's hard to know where to start in describing the differences.

The best way to view the differences is through a general examination of machine architectures, starting at the beginning:

## Single Address Machines

Most minicomputers and microcomputers are of this type. Each instruction contains, or is associated with, a single address. For example, the Motorola 6800 microprocessor has instructions such as 'Add with Carry into Accumulator A Extended' (ADCA address) in which the



first byte is the instruction itself and the following two bytes contain the address of the byte which is to be loaded into the accumulator. So, for example, the instruction ADCA \$8017 (B9 80 17) is a three byte instruction which adds the contents of location 8017 (hex) into the accumulator, along with the carry. The location \$8017 is the source of the data, and the destination, in this case the accumulator, is implicit in the instruction. Alternatively, in a sort accumulator instruction, the destination address would be given, while the source (the accumulator) is again implicit.

### Double Address Machines

Compare this with a hypothetical machine offering double addressing, the ability to specify both source and destination addresses in an instruction. This would make possible instructions like:

ADD (destination address) (source address)

One instruction covers the three required on a single address machine:

LDA (destination address)  
ADD (source address)  
STA (destination)

Those familiar with the 6800 and the 8080 and their derivatives will realise that these microprocessors do have a limited form of double addressing. For example, the 6800 has two accumulators, A and B, either of which could have been the destination in the example given above. Thus, the instruction ADCA \$8017 could have been ADCB \$8017 (F9 80 17). Notice that the opcode changes from B9 to F9 — if you write this out in binary it can be seen this is only a change of bit 6 of the opcode from 0 (referring to A) to 1 (referring to B).

Analysing other opcodes which can refer to either accumulator in this way shows this bit always indicates which accumulator is being referred to, and could be called an 'accumulator indicator bit'.

Further examination of the 6800 opcodes reveals that bits 4 and 5 often indicate the addressing mode — 00 indicates the immediate addressing mode, 01 direct, 10 indexed and 11 extended addressing.

The 8080 takes this a step further in its register-to-register move instructions. This is only obvious when the opcode is expressed in octal format. Each of the processor's internal registers is allocated a code, such as the accumulator being 7,

B 0, and C 1, and the move instructions take the format:

MOV destination, source = 1 (destination code) (source code). Thus MOV A,B becomes 170.

This is not strictly double-address architecture, as it does not address memory, but it is a powerful feature of many microprocessors.

### Three Address Architecture

Some very advanced processors offer the ability to specify two source addresses and one destination address — words can be loaded from two memory locations, added together and the result stored in a third location.

### Instruction Set Orthogonality

The scheme whereby the 6800 allows various instructions to operate with one of several addressing modes is extremely elegant; it allows the programmer to learn one basic add instruction with various options. For example, the basic add instruction ADDA will also operate on the B accumulator (ADDB) or can add in a carry bit (ADDA or ADCB). Each of these instructions can also operate in the immediate, direct, indexed or extended addressing modes, giving 16 permutations on the basic instruction. Little effort is needed to learn them. The compare, exclusive OR and other instructions also operate the same way, on either accumulator, in any addressing mode.

This feature of a computer's instruction set is called orthogonality, and it accounts for many a programmer's preference for a particular processor. Fanciers of the Motorola 6800 will point to its consistent use of addressing modes as an advantage over the 8080 and 8080 users will point to the orthogonality of its MOV instructions, and the way it can CALL, JUMP, or RETURN on any of eight conditions (again an example of orthogonality).

Orthogonality is difficult to design into an 8-bit processor. It is wasteful of opcodes and an 8-bit word only allows 256 separate opcodes — the 8080 allows redundant instructions like MOV A,A, MOV C,C, which are effectively no-ops.

The potential for instruction set orthogonality is much greater with 16-bit processors. Up to 65,536 discrete opcodes are possible. Until recently, minicomputers have used the 16 bits of an opcode as several fields, each indicating

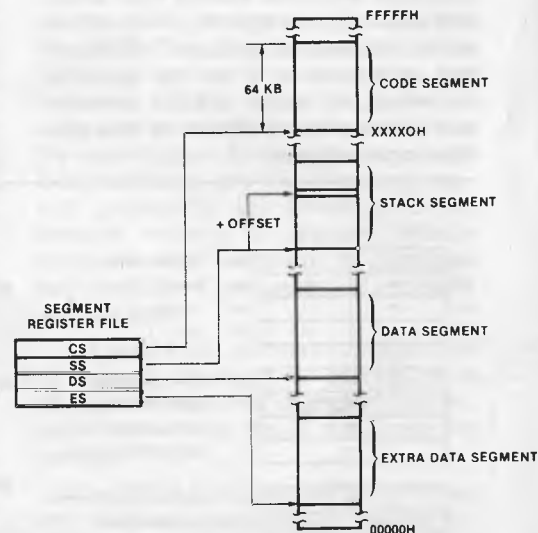


FIG 1. The 8086 uses four segment registers to point to four 64 Kbyte segments of memory.

a particular operation. This is the way the new 16-bit micros work.

### Power to the Processor

The first thing most people notice about the 16-bit processor is its new arithmetic instructions, such as multiply and divide. Previously, 8-bit processors used quite long sub-routines to perform multiplication and division. While memory is cheap, processor time isn't, and the hardware math's instructions speed the process up considerably.

The new processors sport the ability to multiply two 16-bit quantities, giving a 32-bit result, or divide 32 bits by 16 bits, giving a 16-bit result. There are also utility instructions to allow conversion to and from ASCII.

Intel's 8086 (renamed iAPX86) family takes arithmetic to the ultimate, employing a specialised co-processor, the 8087, which runs in parallel with the 8086. It performs fixed or floating-point arithmetic in a mode transparent to the user.

The big area where the new machines shine is in memory management. Intel's 8086 can address up to 1 Megabyte of memory, while the Zilog Z-8000 can address up to a theoretical maximum of 96 Mbytes. No more running out of space after 64K segments; the New Motorola 68000 can directly address up to 16 Mbytes. It does this effectively because it has a 32-bit architecture internally. But memory management goes beyond just having a large address space. The space ▶

must be managed effectively, particularly in cases where the processor is running several users independently. For this reason, the Z-8000 operates in two modes: a user mode, which is the way the user's programs usually run, and a supervisory mode, used by the operating system. The supervisory mode allows privileged operation of certain instructions. For example, the I/O instructions and memory management instructions cannot be executed by a user. This means that all I/O is done by the operating system (good design practice anyway), and reduces the likelihood of one user crashing the system.

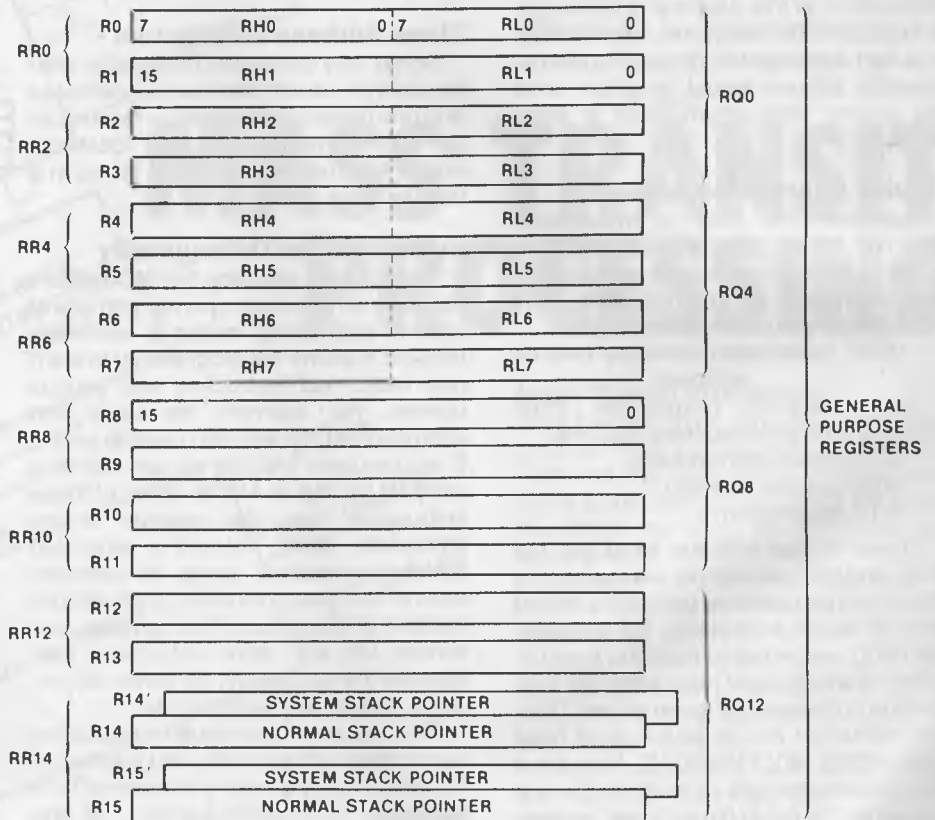
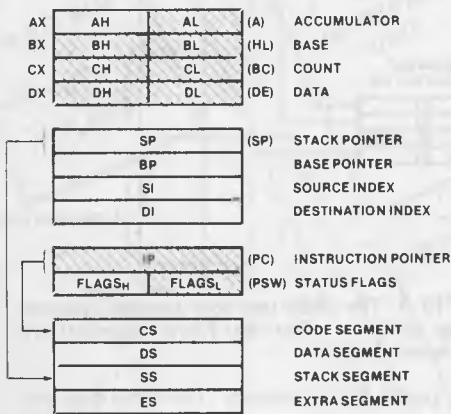
An external memory management unit breaks the Z-8000's address space into relocatable segments. It translates the logical memory addresses output by the CPU into physical addresses, so that the program the CPU is running does not have to be where the CPU actually thinks it is. Intel has taken a slightly different approach, and put its memory management unit on the CPU chip, while the Motorola chip's memory management is even more sophisticated, using traps to catch improper references to memory, and being able to nominate certain areas of memory as execute-only, read-only, and so on.

Intel is known to be working on a device which allows the use of virtual memory, though this will not be available for more than a year.

The 16-bit processors are much faster in operation than the old 8-bit types, with clock speeds up to 10MHz, and they are now on a performance par with mini-computers in many applications.

### Fly in the ointment

These chips have been available for some time now; why haven't we seen



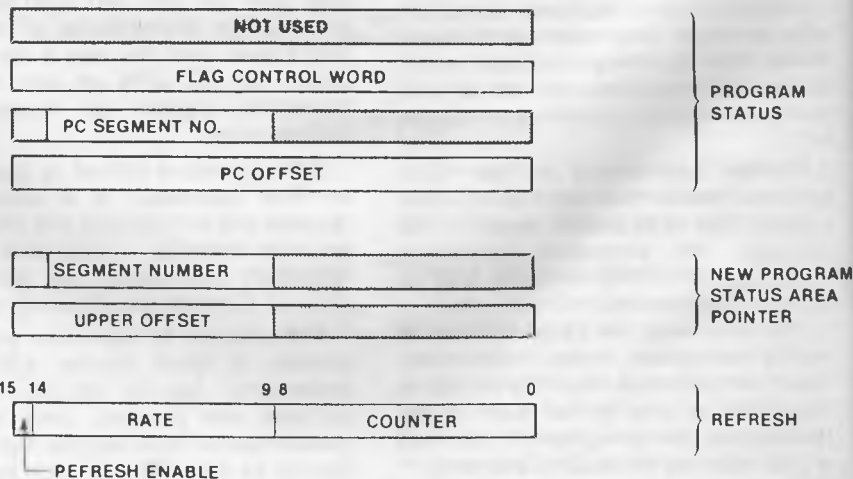
Register sets of the 8086 (iAPX86) (above) and the Z-8000 (right). Notice that the 8086 dedicates the registers to specific functions when used with certain instructions, while the Z-8000 is much more generalised.

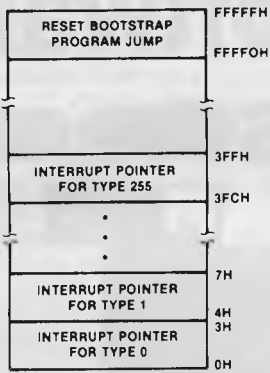
The 8086 registers include a subset (shaded) which corresponds to those of the old 8080; this makes it easy to convert programs to run on the new processor.

The Z-8000 can hold bytes (RHO-RH7, RLO-RL7), 16-bit words (RO-R15), 32 bit long words (RRO-RR14) and even 64-bit quad words (RQ0 to RQ12). Notice the stack pointers both have extra registers to allow segmentation in a similar way to the 8086.

There is considerable debate as to which arrangement is best. Intel's approach is to optimise the CPU's ability to operate on objects (data structures) in memory, while Zilog have designed a processor which has plenty of registers to minimise memory accesses.

The Intel approach uses much less micro-code and should run faster; in addition, compilers for the processor are simpler. A very sophisticated compiler would be required to take full advantage of the Z-8000 register capabilities, but an assembly language programmer with a good macro-assembler would probably find it more powerful.





**Reserved Memory Locations**

**FIG 2:** 16-bit processors are better at dealing with interrupts — the 8086, for example, reserves the bottom 1K of memory for 256 interrupt vectors.

them on the market? In particular, the 8086 has been available for almost four years — why the delay?

Initially the problem was the way Zilog and Motorola “pre-announced” their products. No-one is willing to be committed to using a particular chip if a better one is just around the corner. Even so, Intel proved to be two years ahead of its closest competitor.

All this has meant that software vendors waited and tried to hedge their bets. In the end, Microsoft released its BASIC for the 8086, but only to run on Intel systems — which are not really in the commercial league. Then Seattle Computer Products and a few other hardware manufacturers began to produce S-100 boards for the 8086, and Seattle made available

BASIC—86 for its system, in conjunction with a DOS.

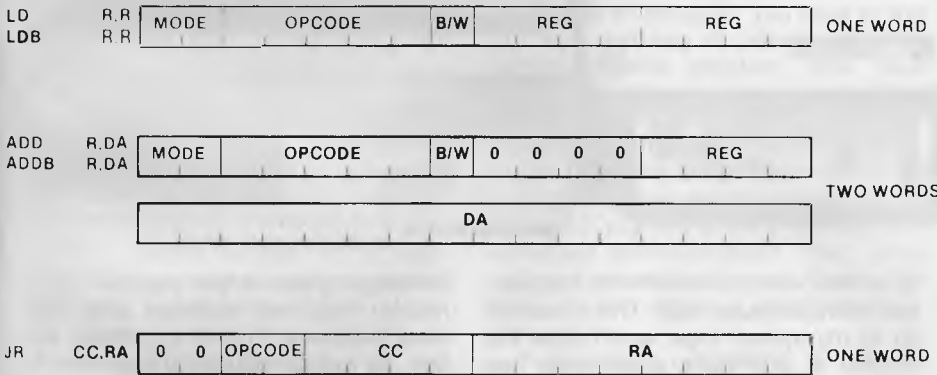
Now Digital Research has released a version of CP/M for the 8086, and Pascal/M is available. Digital Research plan to release MP/M—86, a multi-user operating system, and PL/1-86, the popular IBM programming language.

The main reason for all this activity is not the 8086, it's Intel's 8-bit equivalent, the 8088. This chip contains the same CPU, but the memory management unit translates 16-bit words into bytes to communicate with the outside world. Thus the system gives 16-bit performance with 8-bit hardware, and this is proving popular, particularly with owners of S-100 systems wishing to upgrade. What's more, the 8087 arithmetic co-processor and the 8089 I/O processor will also work with the 8088.

For the Z-8000, software has been slow in coming. Microsoft is working on a version of the Unix operating system, called Xenix, and this is due shortly for release.

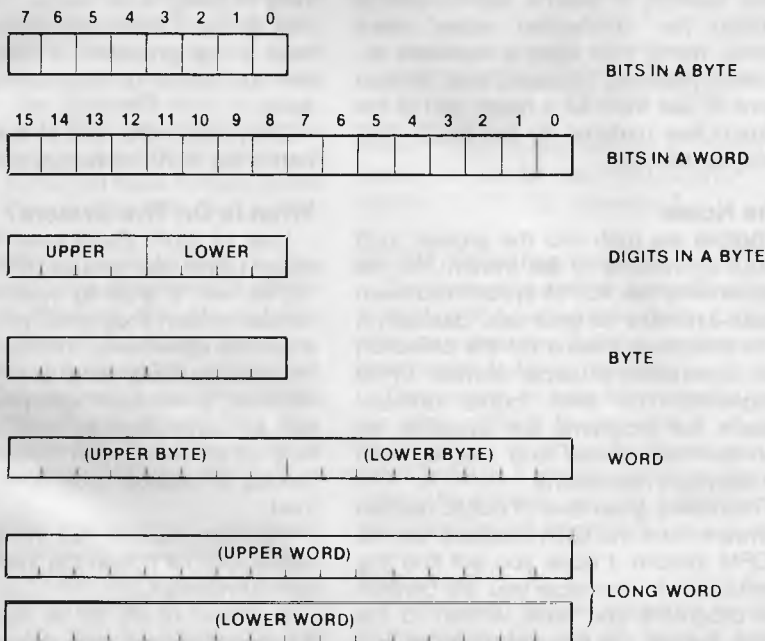
The 68000 is still too new for us to see any software released on the market, other than that from the manufacturer.

That's the current state of play on the 16-bit market. It's anyone's guess as to whether a particular processor type will dominate the market in the same way that the 8080 and its descendants led the field in 8 bits. Let's hope we get it sorted out before the 32-bit processor begins appearing. □



**FIG 3:** These Z-8000 instructions show the way an instruction word is split up into fields. The load instruction, for example,

can operate on a byte or a word (B/W) and specifies both a destination register and a source register (or memory).



**FIG 4:** The data types handled by the Z-8000 processor. Note the ability to handle two BCD digits in a byte, and two words as a 32-bit long word.

## AN INSTANT EXPLANATION

*Discussing a computer's processor is a complex technical field; for the beginner who isn't ready to delve that deeply, here's a simple summary of the story:*

A PROCESSOR controls the computer's memory. Increase the processor's power, and you've increased the computer's ability to use its memory.

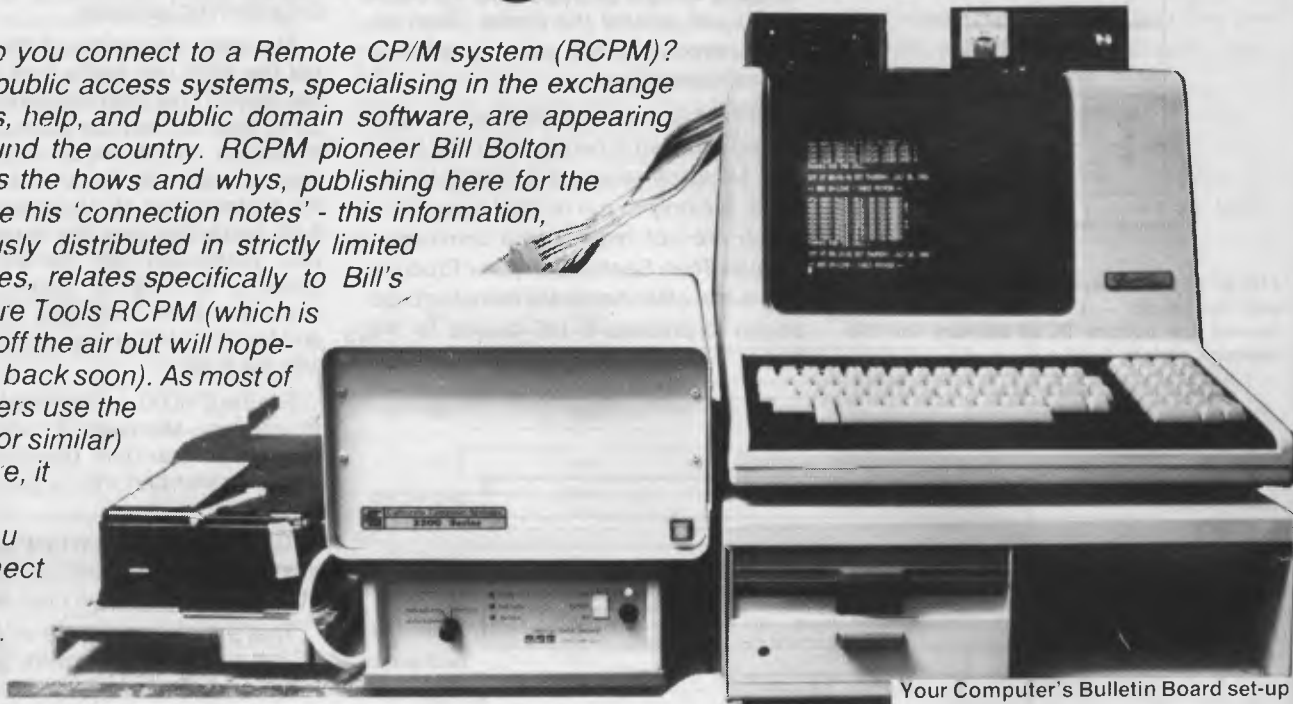
Most microcomputers have 8-bit processors, but there are some with 16-bit processors; they can handle twice as much data at the one time as their half-sized brothers.

Its impact on computer designs could be enormous, changing the face of computing as we now know it.

An 8-bit processor can handle 256 operating codes, the 16-bit processor as many as 65,536 — that's one hell of a jump in capacity. □

# RCPMs - The Free Software Smorgasbords

*How do you connect to a Remote CP/M system (RCPM)? These public access systems, specialising in the exchange of ideas, help, and public domain software, are appearing all around the country. RCPM pioneer Bill Bolton explains the hows and whys, publishing here for the first time his 'connection notes' - this information, previously distributed in strictly limited quantities, relates specifically to Bill's Software Tools RCPM (which is briefly off the air but will hopefully be back soon). As most of the others use the same (or similar) software, it should help you to connect to any system.*



Your Computer's Bulletin Board set-up in development phase.

WHEN MY RCPM system first started, microcomputer data communications was a relatively new area for Australia, and I didn't want to spend a lot of time on the phone explaining the same basic communications facts to many users about how to connect to the system (there are better things to do in life).

The idea of a set of 'connection notes' grew out of the needs of these new users. As the notes were the only way to find out the number of the system, they acted as an initial filter in that you had to be motivated enough to send me an SSAE to get them. This made sure that the initial users really wanted to use the system and weren't just idly curious.

Since those heady, early days the situation has changed. There are now several RCPM or BBS systems running on the East Coast, with more planned to come on-line before the end of the year. The very existence of the Software Tools RCPM system has encouraged over 500 microcomputer users to get actively involved in data communications, and I'm sure the MICOM CBBS has had a similar effect in Melbourne (though the number of interstate callers on both systems is considerable).

Another major change has been the introduction of affordable direct connect modems in Australia. These modems have dramatically improved the reliabil-

ity of data communications for the average microcomputer user. This is backed up by my system logs, which show the number of premature disconnects has plummeted since the introduction of cheap direct connect modems.

Now there are more systems and more opportunities to use an RCPM or BBS system, it seems appropriate to publish the 'connection notes' more widely, rather than keep a restricted circulation (besides, I suspect Matt Whelan plans to use them as a major part of the introductory material for the MiCC BBS documentation).

## The Notes

Before we rush into the prosaic stuff about connecting to the system, let me explain *why* the RCPM system has been made available for your use. Basically it is to provide a means for the collection and distribution of *public domain* CP/M programs. The term 'public domain' means the programs are available for non-commercial use and copying with no copyright restrictions.

There is a great deal of public domain software from the USA available via the RCPM system. I hope you will find this useful, but I also hope you will contribute programs you have written to the public domain, via the system, in return.

The RCPM system also supports a

message system which you can use to request help with software and hardware problems. This is a self-help system. As well as requesting help from the system you are asked to answer queries from others where you can.

I don't have much time to devote to maintaining the RCPM system, so if the thing is going to be useful you and the rest of the CP/M user community will have to be prepared to be 'givers' as well as 'takers' of information and software.

Okay, that's the end of the sermon - here's the stuff you were waiting for...

## What Is On The System?

Lots of stuff. Catalogues for all the major CP/M user groups; CP/M, SIG/M, 'C', as well a growing collection of Australian-written programs (which are not available elsewhere). Utilities to search the catalogues; extensive on-line HELP facilities; a message subsystem so you can ask other users for help (and in turn help other users), and communications utilities in source code form to download.

You can request that the software in catalogues be put on the system so you can download it.

And best of all, it's all free! (You do have to pay your own communications charges, of course!)



## What you need

You need a modem or acoustic coupler suitable for CCITT V21 'ORIGINATE' operation (such as a Dick Smith Dataphone, CI Cicada, DataSat World Modem, Modem Technology UDM 1200, Prentice STAR, Sendata 700 and so on), and you need to know how to use it.

The purpose of this article is not to tell you how to use the physical equipment you already have, though it does give a few hints if you experience problems. Your equipment supplier should have instructed you in the use of your data communications equipment; if you don't know how to use your modem/acoustic coupler find out about that *right now* before reading on.

If you intend to just plug a terminal into your modem/coupler then you need nothing else. If you want to use your whole computer as an 'intelligent' terminal you will need a program which will allow you to establish communication, using ASCII characters, with a remote computer. It is highly desirable that you have some means of saving ASCII text from the RCPM system as a file on your disk system. You will need this facility to be able to get access to better public domain communications programs which will allow secure protocol transfers of programs to and from the RCPM system. Some suitable CP/M communications programs to get you started are Telnet, Teled, Term, BSTMS, Microlink, PLink, Modem, Yam, RCPMLink and so on. Note that Telnet, Yam and Modem are public domain programs which may be available from any computer store which has disks from the various CP/M-based user groups.

If you don't already have a suitable communications program and are prepared to work a little at getting a good one, don't spend a lot of money buying one - get the cheapest one you can. Yam and Modem7 are available for downloading from the RCPM system at no charge - you just have to have some way of communicating with the system to start with.

If you already have BSTAM or Hite you can use those programs to download Yam or Modem7. BSTAM and Hite are only supported for binary file downloading and are far from satisfactory programs for use with a remote system; however, they will get you started. You will still need an ASCII communications utility if you intend to use BSTAM or Hite.

If you have an Osborne 1 computer ask your supplier about RCPMLink. It is written specifically for communicating with RCPM systems and will immediately give you full access to the program transfer facilities of the system.

It is not expensive, about \$50 to \$60, and is well worth it.

The Osborne is a difficult machine to adapt programs like Yam or Modem7 to if you don't already have access to the system (it's easier once you get on, but how do you do it without a terminal program to start with?), so you can save yourself a lot of trouble by starting with RCPMLink. (Delta Computers of Bankstown, NSW, has RCPMLink, if you can't get it from your normal Osborne dealer).

If you have a CP/M-86 or MS-DOS computer such as the NEC Advanced Personal Computer or the IBM-PC, the Modem86 program is also known to work and will allow you to get going immediately with file transfers. It is imported by Software Source, at Bondi Junction in Sydney.

Please note that the only support I am able to provide on communications programs is *solely* provided through the RCPM system itself. If you have an unusual type of computer, you have to sort out your own way of getting a suitable communications program onto your computer.

## Basic Information

The following information should be enough to allow you to connect to the system if you are already familiar with computer communications from using remote systems such as Midas, the MiCC bulletin board or other time-sharing systems.

If you don't understand it you will probably need to read the later sections for more details.

**Data format:** 8 data bits,  
1 stop bit,  
no parity,  
full duplex,  
300 bps (baud)

**Mode:** Your modem/acoustic coupler needs to be in the "ORIGINATE" mode, CCITT V21 standard.

## RCPM 'Opening Hours'

The system is on-line 24 hours a day. A brief period each day is taken for system maintenance, but this is done between calls as far as possible.

The system is now very popular and it's often difficult to get onto it. If you keep getting an engaged signal please don't give up: it means someone else is using the system, so just keep trying, you'll get through eventually.

## Password

There is no formal password system at this stage, but you will need to know the name of Digital Research's standard

debugger to gain access to the system. If you don't know the answer to this question you should find out from a CP/M user right away.

This is to satisfy a Telecom requirement that the service not be a 'general third-party message switching service' - it has been approved as a common-interest service for CP/M users, so you are expected to know a little about CP/M to get onto the system. If you are not a CP/M user it will be to your benefit to learn about CP/M to get the most out of the system in any case.

## What To Expect To See

Normally you should get an 'echo suppressor' tone from the RCPM system within a few seconds of the phone being answered. This is followed after about four seconds by ANSWER carrier. You then have 25 seconds to establish ORIGINATE carrier from your modem/coupler before the system will decide that you must have been an accidental voice caller and stop sending carrier to you and reset itself. This is normally an ample period of time to get a handset into the cups of an acoustic coupler and establish carrier.

An acoustic coupler in the ORIGINATE mode will usually not produce carrier until it is successfully receiving carrier from the answering system.

Once you have established communication with the system you should see a message:

HOW MANY NULLS (0-9) DO YOU NEED?

If you do not see the message soon after placing your handset in your acoustic coupler (or putting your modem on line), the RCPM system is probably not getting a strong enough carrier from your modem/coupler. This may be due to poor line conditions, poor coupling with your acoustic coupler, 'packing' of the transmitter in your telephone, or other technicalities. See a later section heading for what to do if you experience 'no carrier' problems.

Remember that the RCPM system will always hang up on you after 25 seconds if it has not received carrier from your modem/coupler, and if this happens you will have to hang up and dial in again.

The 'HOW MANY NULLS' message means you have established contact with the RCPM system. If you see part of the message and then transmission stops before the '?' (or for that matter if it stops in the middle of something at any other time), it means the system is having trouble getting reliable carrier from your modem/coupler. You have 25 seconds to re-establish carrier before the RCPM system will reset itself.

If you lose carrier and re-establish it ►

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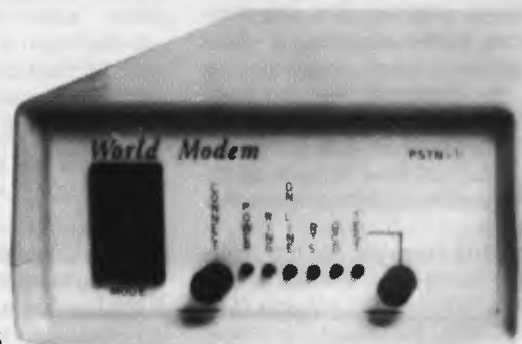
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very often (greater than 25 times) the system will conclude that the line is unreliable and will abandon the contact by hanging up and resetting itself. See the later section on changing modem modes for a possible solution to bad line performance.

If you are using a CRT terminal you should respond to the HOW MANY NULLS question with 0. If you are using an 80-column video card on an Apple you may need nulls; some of these cards are slow, so you should try three nulls for starters.

If you're using a printing terminal you'd better play safe and say nine nulls the first time. If you find you're losing characters from the start of lines when using the RCPM system, increase the number of nulls next time you log in. Once you have answered the question it is not possible to change the number of nulls during a session. You will have to put up with the results or leave the system and log in again.

If you see the message but cannot get the RCPM system to accept your response, you should make sure your modem/coupler is producing carrier. If you're sure it is, then it probably means you're not set up for the right data format as specified above. The RCPM system may respond to anything you type by repeating the 'how many nulls' prompt; if this happens it certainly means your data format is incorrect, so you'd better hang up and get your act together.

If you see a string of garbage repeated every time you hit a key, this also means your data format is incorrect. If you see random garbage characters with no repetition, the RCPM system has probably stopped sending carrier to you.

Once you have successfully answered the first question you will be asked if your terminal can display lower case characters. If you answer 'N', all output from the RCPM system will be folded to upper case for you. This may produce a few odd-looking displays, as some of the utilities use characters such as a vertical bar to delimit information, and when folded to the upper case character set this gets changed to a backslash!

### Changing The Modem Mode

After the 'lower case' question you will be asked:

DO YOU WANT TO 'FLIP' THE MODEM MODE?

Most first-time callers should answer 'N' to this one. 'Flipping' the modem mode means changing the RCPM modem to ORIGINATE mode while you simultaneously change your modem or

acoustic coupler to the ANSWER mode. Some users may find that lines which were unreliable when they were in ORIGINATE mode are quite okay when the modems are 'flipped'.

You should only answer 'Y' to this 'FLIP' question if you have not been able to successfully complete a log-in while staying in ORIGINATE mode. Once you have committed yourself to a mode change (you get one chance to change your mind if you answer 'Y') you *cannot* change back to ORIGINATE mode at your end until you successfully complete the log-in and reach CP/M command level. At CP/M command level there is a command called 'FLIP' (what else!) which will allow you to change modes as often as you like.

If the mode change is successful you will see a message advising you so. If it was not successful the system will reset for the next call after 25 seconds and you will need to call again.

If you don't understand what 'ANSWER' and 'ORIGINATE' modes are all about or don't have a switch marked 'ANSWER' or 'ORIGINATE' on your modem or acoustic coupler, then just answer 'N' to the 'FLIP' question.

After answering the 'FLIP' question you get passed from the communications supervisor to the log-in program.

### Logging In

The log-in program will ask you a question about CP/M (you get three tries to get it right) and then ask for your name and location. The first time you log in to the system you will be given some 'HELP' information and asked about the type of hardware and software you are using. Please answer the survey questions as accurately as possible, as it is important information to help me fine-tune the facilities of the system to the needs of the users (including you). You then get passed to CP/M command level.

The first-time log-in is rather lengthy, but from then on the system will only ask for your name and give you important or new information before passing you speedily to CP/M.

### System HELP Facilities

The RCPM system has extensive HELP facilities available on-line to allow you to learn about the system and to enable you to use it effectively. You will be told about the most important currently available HELP files when you log in for the first time.

Help on THIS-SYS, Messages, Software, Modem and CPM22 were the most important ones available when I wrote this. Other HELP files you may find useful are available on-line as well. New HELP files are announced in the 'Information on latest programs', which

is available during log-in or in the message subsystem.

Once you are on the system the HELP files will tell you everything else you need to know. You should read them carefully.

### Hints On Using Acoustic Couplers

Many connection problems have been traced back to users not knowing how to use their acoustic couplers correctly. The major problem is 'packing' of the transmitter in the telephone handset.

It is *absolutely vital* that you lie your telephone handset on its side when using it in an acoustic coupler. 'Packing' means that the carbon granules in the transmitter (or microphone) of the handset become packed together by gravity and do not convert sound waves to electrical signals efficiently, so your coupler does not generate enough electrical signal, through your telephone, into the line to enable reliable reception of data at the remote system.

Sometimes giving your handset a sharp tap on the edge of a table helps — but not too hard! Another cause of low carrier level is that the handset is not pressed tightly into the cups of the acoustic coupler.

You may find you can access some remote systems without difficulty but not others. Telecom line or exchange problems are likely to be a contributory cause, but often attention to the details mentioned above can turn what was thought to be a bad line into a satisfactory one. If you do suffer from 'bad line' problems you may like to try a different time of day, as line conditions do seem to vary with time.

### The End

These notes are specific to the Software Tools RCPM system but you will find most other systems have similar log-on procedures. The Software Tools RCPM system will be shutting down soon, when I move to Brisbane, but hopefully it will be back again early in 1984.

You'll find the numbers for all the free, public access systems (PAMS) in *Your Computer* magazine. Why not give one a try soon.

### A Copyright Notice

This material is copyrighted. This doesn't mean I don't want it to be freely used by anyone wanting a handout to give to people on data communications with remote systems, it just means that I'd like you to ask me before using any of it. Thanks. (*That goes for the people who have been lifting Bill's material off the Mi-Computer Club system, too — Ed*). □

# your computer glossary

**Absolute:** Located at a fixed address in memory.

**Access:** To read or write from a location in memory, or a file, or disk.

**Accumulator:** The major register of a CPU, in which arithmetic and logical functions are performed. Some computers have several registers which can function as accumulators; in others some registers can perform a subset of the full set of operations.

**Address:** A memory location which can contain data or an instruction.

**Algol:** Algorithmic Language, an early computer programming language for mathematical applications. Widely used in Europe, embodied early structured programming concepts and was a precursor of Pascal.

**Algorithm:** A set of instructions which define a method of obtaining some result (usually mathematical). A cooking recipe is an algorithm, as is a knitting pattern.

**Alphanumeric:** Composed of either letters or numbers or both.

**Analogue (Analog):** Representation of a value by a voltage or some other measurable datum, rather than a binary or other representation based on counting.

**Apple:** The Apple 11 computer is a computer based on the 6502 microprocessor with an integrated keyboard. Noted for its colour graphics capabilities, which make it popular with schools.

**Application:** What you do with your computer.

**Array:** A set of values under a common variable name, which are accessed through a subscript. For example A[1] is the first item in array A, A[2] is the second, etc. A[N] is the Nth item.

**ASM:** Assembler, also a suffix added to assembly language file names to distinguish them from other files with the same name.

**Assembler:** A program which converts assembly language into its corresponding machine (or object) code, which can be executed by the computer.

**Assembly Language:** A language in which each machine code instruction is represented by a short mnemonic which is much more comprehensible to the programmer. For example, the 8080 machine code

```
[10010110]
in binary, is
[SUB L]
```

(subtract L from accumulator) in assembly language. Each line of assembly language becomes one machine instruction.

**Assign:** To make one thing equal to another, e.g. [A = B] assigns the value of B to A.

**Atom:** An indivisible component of a data structure.

**Attribute:** A property possessed by some object, such as a file. Often attributes take the form of restrictions, such as a file being read-only.

**Backup:** An extra copy of a disk, tape or file taken as a precaution against damage of the original.

**Backus Normal form:** A special language (a metalanguage) used to describe precisely the grammatical rules of another language.

**Base:** The lowest number inexpressible in a given number system.

**BASIC:** Beginners All-purpose Symbolic Instruction Code. Invented in 1970 at Dartmouth College by Kemeny and Kurtz as a teaching language, it has since been enhanced in its more exotic forms into one of the most sophisticated yet easy-to-use languages available on personal computers. Its major rival is Pascal, which has the added virtue of stressing structured program design.

**BDOS:** Basic Disk Operating System. The major functional component of the CP/M DOS.

**Binary:** The system of counting in 1s and 0s used by all digital computers.

**Binary Search:** A method of searching for an entry in a table by successively halving the table until all that's left is the desired entry.

**Binary Tree:** A form of data structure in which entries are tagged on at the end of the appropriate branches.

**BIOS:** Basic Input/Output System. The part of the CP/M operating system which is different for each machine and provides any special I/O routines for disks, terminal, printer, etc.

**Bit:** Binary Digit. Either 1 or 0.

**Boot:** To load the operating system into the computer from a disk or tape, either initially or subsequently after running a program.

**Bootstrap:** To use one short program to load a longer loader program which then loads the operating system.

**Branch Instruction:** A program instruction which causes the computer to jump to another instruction, usually fairly close by.

**Buffer:** An area of memory used for temporary storage while transferring data to or from a peripheral such as a printer or a disk drive.

**Bug:** an error in a program. Makes programmers itch.

**Bus:** A set of wires over which, data, addresses, or control signals are transferred between the central processor and memory or I/O devices.

**Byte:** A computer word eight bits wide. A byte in memory can hold a character or a binary number between zero and 255 (or — 128 and 127), or a computer instruction.

**C:** A programming language, developed at Bell Labs, which is particularly convenient for writing system utility programs.

**Case Statement:** An instruction found in some high level languages which allows control to pass to one of several subroutines depending on the value of a variable. For example, the BASIC statement

```
ON X GOSUB 100, 200, 300
```

will jump to line 100 if X = 1, 200 if X = 2, 300 if X = 3.

**Call:** A jump to a subroutine which leaves the return address on the microprocessor stack, so that when the subroutine is finished executing, control returns to where it left off.

**CBASIC:** A commercial version of the BASIC language, running under the CP/M operating system. Doesn't use line numbers on every line, and is compiled, rather than interpreted like Microsoft BASIC.

**CCP:** Console Command Processor. The part of the CP/M operating system that reads a command line and sorts out what it means.

**Chain:** To automatically run one program after another.

**Character:** A letter or number, or in some circumstances, a control code such as "carriage return".

**Checksum:** A running total of the characters in a file, recorded or transmitted with the file so that errors can be detected.

**Code:**

**Absolute:** Machine instructions which are intended to be loaded and executed in a particular area of memory.

**Object:** Machine instructions, as distinct from the source code from which it was generated.

**Reentrant:** Code which can be used by several users at once, keeping separate variables for each.

**Relocatable:** Code which can be loaded and run anywhere in the computer's memory.

**Source code:** A program written in assembler, or a high level language such as BASIC, which must then be assembled or compiled to produce the object code which can actually be executed.

**Cold Boot:** To start up a system from scratch, loading the operating system from disk or tape.

**Cold Start:** See Cold Boot.

**COM file:** In CP/M parlance a command file, that is, a machine code program that can actually be run.

**Command:** An instruction from the console for the system to do something.

**Comment:** A note added into a program to help the reader (or programmer) to understand its operation. Does not affect the program's execution in any way.

**Compiler:** A program which accepts as input a source file written in a high level language, and produces as output an object file containing the machine instructions which are actually executed.

**Computer:** Are you serious?

**Concatenate:** To join two strings together, one after the other.

**Conditional:** A test; for example, is X greater than Y: IF X is greater than Y THEN GOSUB 500 (BASIC)



or, if the carry flag is set, jump to location NEXDIG:

JC NEXDIG (Assembler)

Conditionals are one of the most powerful features of any computer language.

**Console:** The keyboard and screen from which the operator controls the computer.

**Control characters:** Codes which perform functions like acknowledging correct receipt of a message or requesting retransmission of an erroneous message. Control characters are defined as part of the ASCII and similar codes.

**Copy:** To duplicate, usually for backup safety.

**CP/M:** A disk operating system for 8080 and Z80 based microcomputers. Allows the user to store information and programs in named files, as well as managing disk storage and input/output functions. Other disk operating systems include TRSDOS (on TRS-80) and DOS 3.3 (for Apple).

**CRT:** Cathode Ray Tube. Usually refers to the screen of a video terminal or the terminal itself.

**Data:** Information to be processed by, or output from, a program.

**DDT:** Dynamic Debug Tool. A program that assists the user to find errors in machine code programs.

**Debug:** To locate and fix errors.

**Decimal:** Based on ten.

**Delete:** To erase.

**Device:** A piece of equipment such as a printer or tape drive which the computer uses.

**Directory:** A list of the programs on a disk (or occasionally tape) together with necessary information, such as length and location.

**Disc:** A flat, circular magnetic surface on which the computer can store and retrieve data and programs. Is fast compared with tape, particularly when access is not one item after another.

**Disk drive:** The mechanical assembly which rotates the disk and positions the read/write head.

**Disk Operating System:** A program which operates one or more disk drives automatically and manages the system.

**Display:** The computer's output device at the console, usually a TV-like display of letters and numbers; sometimes the computer can draw on the display.

**Double Density:** A method of recording twice as much information on a floppy disk.

**Dump:** To list out the contents of memory or a disk.

**Echo:** When the computer inputs a character from the keyboard, it then sends it back to the display so that you can see it was received correctly.

**ED:** An editor program; part of CP/M.

**Editor:** A program which lets you alter and correct source files and other documents.

**Erase:** See delete.

**Error Message:** Tells you something went

wrong, and sometimes what.

**Execute:** To run a program; to follow its instructions.

**FIFO:** First in, first out.

**File:** A continuous collection of characters (or bytes) saved on a disk or tape for later reloading.

**Fixed Point:** Counting in integers only. Usually limited to small values, and restricted in accuracy, giving rise to ridiculous answers such as  $9/5 = 1$ .

**Flag:** A variable, sometimes a single bit, which can have only two values, used to indicate some condition.

**Floating point:** The kind of arithmetic used in scientific calculators.

**Floppy disk:** A disk, made of thin flexible mylar, and enclosed in a card jacket, which can be used for magnetic storage. There are two varieties; eight inch and 5¼ inch. These can typically store somewhere between 140,000 and 3 million bytes (characters).

**Focal:** Formula Calculator. A simple language, rather like a small BASIC, found on some mini and microcomputers.

**FORTRAN:** Formula Translation. One of the first computer languages, and beginning to show it.

**Function:** A sub-program that processes variables in some well-defined way.

**Garbage Collection:** The process of going through memory or disk space, reclaiming all the unused space.

**Global:** A variable which is known to all the parts of a program. See local.

**Grammar:** The formal rules of a language.

**Hard Disk:** A disk made of hard material, larger, faster and more fragile than a floppy disk, and capable of storing 70 million bytes or more.

**Hard Copy:** Printout.

**Hardware:** The bits of a computer you can kick, as opposed to the programs you can only swear at.

**Hashing:** A method of reducing the size of a table which otherwise would have mostly empty entries.

**Hexadecimal:** The method of counting to the base sixteen. Or the method of splitting binary digits into groups of four, which is the same thing. In hex, you count: 0 1 2 3 4 5 6 7 8 9 A B C D E F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22

**Identifier:** A label, or the name of a variable.

**Iff:** If and only if.

**Index:** A variable which usually points to an entry in a table or list.

**Index Register:** A processor register which is used to access tables and lists in memory.

**Indirect Addressing:** Referring to a variable which actually contains the address of another variable.

**Input:** To get data into the computer.

**Instruction:** A step the computer can perform.

**Integer:** A whole number.

**Intermediate Code:** A special kind of object code which cannot be run directly on the computer, but must be interpreted.

**Interpreter:** A program which examines source code a line at a time, decides what it means, and then does it. Compare with compiler.

**Interrupt:** To electronically drag the computer away from what it is doing in order to respond to some time-critical situation.

**I/O:** Input/Output.

**Jump Instruction:** Normally, control proceeds from one instruction to the next, one after the other. A jump instruction passes control, not to the following instruction, but to some other. Jumps can be conditional.

**Kilo-:** Prefix meaning one thousand.

**Kilobyte:** 1024 bytes (Kbyte).

**Kilobaud:** 1000 baud (kbaud).

**Label:** A word which identifies the destination of a call or jump instruction, or simply identifies some location in memory.

**Language:** The set of instructions, and rules for stringing them together, which you use to instruct the computer what to do.

**Library:** A set of programs, or sub-programs.

**Line Number:** A number at the beginning of a line, which identifies it in a similar way to a label.

**Line Printer:** A high-speed printer for computer output.

**Link:** Part of a data item in a list, which tells the computer the location of the next data item.

**LISP:** A list processing language, much favoured by the artificial intelligence community.

**List:** A sequence of consecutive data items.

**Load:** To transfer some data or program into the computer memory.

**Locate:** To "fix" a relocatable code so that it will only run if loaded in a particular location.

**Logical Device:** A device as the computer "sees" it: what the computer regards as the "list device" may be one of several "physical devices", such as a line printer or teletype.

**Loop:** To repeatedly execute a sequence of instructions; part of a computer program that is so executed.

**Machine Language:** The binary codes the machine actually executes.

**Macro:** A user-defined sequence of instructions which can be inserted anywhere in a program.

**Macroassembler:** An assembler which can utilise macros.

**MBASIC:** Microsoft BASIC; the BASIC used in the TRS-80, PET, Apple 11 and so on.

**Memory:** Where the computer stores data and programs internally for fast access.

**Menu:** A display which offers the operator a choice of several alternatives.

**Microcomputer:** A small computer based on a microprocessor. ▶

# glossary

- Microprocessor:** The central processing unit of a computer, built into a single silicon chip.
- Mini-diskette:** A 5¼ inch floppy disk.
- MP/M:** A multi-user version of CP/M.
- NAD:** A name and address file maintenance program.
- Numerical analysis:** The art and science of number crunching.
- Object Code:** Machine code.
- Object File:** A file containing object code.
- Object Module:** An object file containing part of a program, ready to be linked to others.
- Octal:** the system of counting to base eight, or grouping bits in threes.
- Offset:** To load an object file somewhere it will not run, in order to edit or modify it.
- Open:** To give the operating system the characteristics of a file so that it can subsequently read or write it.
- Operand:** The number an operator (+, -, etc) operates on  
all work. See Disk Operating System.
- Operator:** An arithmetic function or some other function which alters variables.
- Optimization:** Making a program work better (or faster, or using less memory).
- Output:** What the systems produces.
- Packed Data:** Data which shares the same address, and has to be unpacked before use.
- Page:** A length of memory, typically 256 bytes.
- Parameter:** A constant which sometimes has to be varied.
- Parity:** An extra bit on the end of a character or byte for error detection.
- Pascal:** A modern structured language which may eventually rival BASIC in popularity.
- Password:** A secret word the system may demand of you before allowing you access to certain (or all) programs or data.
- Patch:** A temporary (ha,ha) fix on a bug.
- Peripheral:** A piece of equipment the computer uses, like a printer, disk drive, or modem.
- Peripheral Driver:** A program which outputs data to a peripheral and controls it.
- Physical Device:** See Logical Device.
- PIP:** Peripheral Interchange Program. A CP/M utility for copying files between devices.
- PL1:** Programming Language /1. A good general purpose commercial language.
- Pointer:** A variable used for indirect addressing.
- Polish Notation:** A method of separating operators and operands; e.g. + 5 4 is Polish Notation for 4 + 5.
- Poll:** To ask a peripheral if it requires service.
- Postfix Notation:** Also known as Reverse Polish Notation, this is similar to Polish. 4 5 means 4 \* 5.
- Preprocessor:** A program which does part of a job to make life easier for the program which follows; e.g. a macro processor before an assembler.
- Printer:** Gets computer output down onto paper.
- Priority:** The resolution of which interrupt is serviced first if two should arrive at the same time.
- Process:** A program.
- Program:** A sequence of instructions which can be understood, and ultimately followed, by a computer.
- Prompt:** A message asking the operator to supply information.
- Queue:** A list in which entries are made at one end, and removed from the other.
- R/O:** Read Only; cannot be overwritten.
- RAM:** Random Access Memory.
- Random Access Memory:** The computer's internal memory which is used to hold running programs and data. The computer can both write and read RAM.
- Read Only Memory:** Memory used to store programs, which can not be erased or overwritten.
- Reader:** Paper tape input device.
- Read/Write Head:** The small coil which reads and writes on the surface of a disk.
- Reconfigure:** To reorganise the I/O or other aspects of a system.
- Record:** A set of related data items. For example, an employee's name, address, payroll number and pay rate would form a record.
- Recursion:** The ability of functions in some languages to call themselves.
- Redundant:** Not needed or taken for granted.
- Reentrant Code:** Code which can be used by several programs simultaneously, keeping separate data for each.
- Register:** A location in the processor capable of performing logical or arithmetic functions on the contents.
- Relocatable:** Capable of being moved in memory.
- Relocatable Object Module:** Part of a larger program consisting of many such modules, all linked together and located.
- Resident:** Permanently in the system.
- Reverse Polish Notation:** See Postfix.
- RPN:** See Reverse Polish Notation.
- Run:** To execute a program.
- Save:** To store a program on disk or cassette (particularly BASIC).
- Schedule:** To decide at what stage a process should run (of an operating system).
- Screen:** See CRT.
- Sector:** A section of data on a disk.
- Simulation:** Making one system behave like another.
- Software:** Programs.
- Source Code:** The original text form of a program.
- Source File:** A file of source code.
- Source Language:** The language the source code is written in, e.g. BASIC, Assembler, C.
- Sort:** To arrange items of data in order.
- Spool:** To output a file to a peripheral, usually either a printer or tape.
- Stack:** A list in which both entries and removals are made at the same end. A microprocessor usually has a hardware stack which is used to save subroutine return addresses, temporary storage of data, and to pass variables between subroutines.
- String:** A sequence of characters.
- Submit:** To put the system under control of a file of system commands.
- Subroutine:** Part of a program which can be accessed from several points within the program.
- Symbol:** The name of a variable or a location in memory.
- Symbol Table:** A table constructed by an assembler or compiler to give the addresses of all variables and labels in a program.
- Symbolic Name:** A label.
- System:** A collection of hardware and software, possessed of the property that the whole is greater than the sum of the parts.
- System disk:** A disk carrying the operating system.
- Teletype:** An electromechanical printer/-keyboard.
- Timeshare:** Running several programs on a system simultaneously.
- Track:** The area under the read/write head during one rotation of a disk.
- Transfer:** To move data.
- Transient:** A program that is only in memory for a short time before being overwritten. Often, the only program that is not a transient is the operating system.
- Tree:** A list in which each data item may refer to several others.
- TTY:** See Teletype.
- Unix:** A multi-user, multi-tasking, multi-programming operating system, expected to appear on microcomputers before long.
- User:** One of the people connected to the computer.
- Utility:** A program of use to most users.
- Variable:** Named quantity that can take on different values.
- Verify:** To check that data written on a disk or tape can be read again correctly.
- Warm boot:** To reload the operating system a second or subsequent time.
- Word:** The amount of data fetched from one memory location. Typically one byte, but can be two on recent processors.
- Word Processor:** A system for manipulating, editing, printing and formatting texts files.
- WordStar:** A proprietary word processing program.
- Write Protect:** To remove the cover from the notch in a floppy disk so that it cannot be written on.
- Zilog:** Manufacturer of the Z-80 and Z8000 microprocessors.
- Z80:** A popular 8-bit microprocessor.

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(A microcomputer has already been produced to replace the mechanical programmer on a domestic washing machine, for example.)

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usually referred to as the "hardware". This is backed up by showing how to program a microcomputer (or produce its "software") in the most fundamental form of computer language called "machine code".

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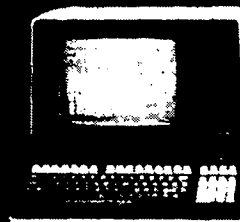
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After a more than somewhat confusing tour through the glossary of terminology in *Your Computer's* first issue, understudy office idiot FRED SYMES began to wonder what had happened to good old plain English. so, armed with his twisted mind, he set about rewriting the glossary. We really didn't want to publish the result, but he forced the issue by threatening to leave and take his dictionary with him. With apologies, then, here is. . .

# The Glossary Giggles

**Array:** The little bit of sunshine the beginner experiences when he finally comprehends the first page of an operating manual.

**Assign:** "Beware of donkeys crossing the road."

**Atom:** A male cat.

**Binary:** Modern nursery rhyme language, as in . . .

Binary, binary bed,  
The mouse ran up the LED.

**Byte:** What your friends put on you when you win the pools.

**CCP:** Comic Cut Papers; descriptive of programs produced by beginners and some experts.

**Chain:** Made obsolete by the Daisy wheel.

**Cold Boot:** What you get when you kick an Eskimo.

**Global:** The scale of domination sought by Reagan, Andropov, and to a greater degree, Robert Muldoon.

**Hard Disk:** Definitely not for beginners.

**Index:** Finger for the pulling out of.

**Interpreter:** One is desperately needed to turn computer language into plain English.

**Jump Instruction:** The act of shooting at your opponent's feet.

**Kilobaud:** A person who knows 1000 risqué stories.

**LISP:** Ita Buttrose, we love you.

**Machine Language:** HummmmmZipp-HummmmmZippHummmmm.

**Macro:** What you set a sprat to catch.

**Memory:** Umm, ah, er.

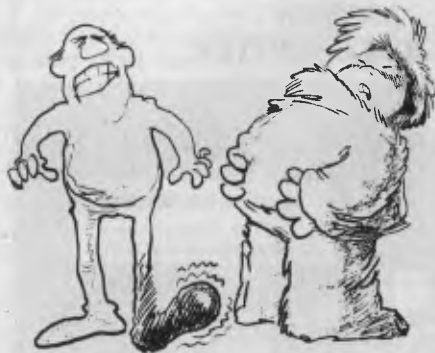
**MBASIC:** Programme language for the Mbanga tribe in deepest Africa

**Read/Write Head:** A bony structure containing a brain that can't make up its own mind.

**Redundant:** What the publisher told me I'd be if I persisted with this nonsense.

**Relocatable:** Being able to find your clean socks in the same drawer twice in succession.

**Resident:** What you call the President after he's been to the toilet.



**Control Characters:** Security guards at a punk rock concert.

**DDT:** An advanced state of alcoholism.

**Double Density:** The permanent state of mind of the office idiot.

**Execute:** Positive action required when dealing with some programmers.

**FIFO:** Abb. for a giant computer, as in . . .

Fe Fi Fo Fom,  
Oh my God — Facom



**Numerical Analysis:** Proving that  $2 + 2$  really does make 5.

**Operand:** A South African coin specially minted for Oppenheim diamond transactions.

**Operating System:** What you have after a meal of prunes.

**Peripheral Driver:** The drunk who thinks the footpath is the F1.

**PIP:** What you get when your Apple malfunctions.

**Polish Notation:** If we told you the truth Al Grassby would sue us.

**Program:** In favour of metrication.

**Read Only Memory:** The art of conversation is dead.



**Save:** Impossible on my salary.

**Source Language:** "In the beginning. . ."

**Sort:** If you get on to a good one, let me know.

**Symbolic Name:** How about "idiot"?

**Teletype:** The range of phones offered by Telecom for use between strikes.

**Timeshare:** A communal watch for poor people.

**Tree:** Talk to your dog about it.

**Unix:** Collective noun for harem guards.

**Verify:** Thick upper leg.

**Write Protect:** Instruction to write 'protect'.

**Zilog:** A new character soon to appear in the Buck Rogers series.

**Z80:** Comic speech bubble language denoting 80 winks rather than the usual 40. □



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The Archives P.C. has a clear 80 column display format. A television interface is provided. The 40 column mode displays bold characters for easy vision on most TV sets. The optional 80 column monitor provides high quality display for office or home use.

The optional low cost 80 cps matrix printer features excellent print quality, with various print styles and densities. A strong tractor feed provides excellent forms handling, with single sheet friction feed also being standard.



The Archives P.C. weighs only 12 lbs. It can easily be carried anywhere with you. A keyboard cover and carry handle are provided for convenient transportation.

The Archives P.C. provides an incredible one million characters (800 K Bytes formatted) of storage on its removable diskette drive. This is enough to handle large volumes of records, and perform a comprehensive range of tasks within most small business. A port is provided for a low cost second disk drive which doubles your available storage.

Communication via phone lines, or directly with other computers can be achieved with the optional communications board. This can also be purchased to provide communication with additional system peripherals.



What you see is not all you get with the Archives P.C. package. Each system also includes over 100 files of programs and data. Perfect Writer word processor with a spelling dictionary, are provided with Interactive diskette tutorials to teach you from a beginners level. the Perfect Filer will teach you how to design forms to computerize your index cards and other files. For example: customers, stock items, address lists or whatever, with the Perfect Calc spread sheet you can perform budgets, forecasts, costings, or many other "what if" type analysis you desire. The "P.C." also provides you CP/M, the most famous microcomputer software standard. This gives you access to thousands of available professional transfer, disk copies, printer control, etc., are standard features.

The "P.C." is distributed by one of Australia's leading microcomputer distributors. A growing network of representatives are providing nationwide support for the Archives P.C. systems. Utilising latest robotic testing technology on the Archives P.C.'s production line, maximum system reliability is achieved.

Why pay over twice the price for an equivalent capacity IBM or Apple computer system when you can purchase an Archives P.C. including \$2000 worth of software for \*\$1995?

Just another example of Archives keeping Australia's computer industry honest. Call us now!

\*Government Price - recommended retail price \$2394 Including sales tax.

archives

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