A Vision Splendid

The History of Australian Computing

Graeme Philipson

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CONTENTS

FOREWORD

By Angus Taylor

A ustralia has a long and illustrious computing history. Trevor Pearcey's Mark 1, also known as CSIRAC, was one of the first computers in the world. We haven't stopped there. From the invention of Wi-Fi to quantum computing, we have continued to show the remarkable talent we have in Australia to innovate.

Today, information technology is an important part of all our lives. We cannot imagine a world without computers and other digital devices like tablets and mobile phones. We could never have imagined in the early days of computing just how important the technology would become.

But Australia's computing history is not well-known. This book represents the first time our computing history has been documented from the beginning. There have been corporate histories, academic studies of the industry, and a great many reminiscences, but not a comprehensive history like this one.

I commend the Australian Computer Society for publishing this important volume. History is never boring, because it is the sum total of all that has gone before us.

Australians can be very proud of their computing heritage. The stories in this book show Australian science, technology and business at their best. They show a willingness to have a go, to take a risk, and to think ahead. These are key attributes of the Australian character.

Computing is an important part of Australia's history. It is also an important part of our future. Now, for the first time, we have a history of the industry and of the people who forged it.

Congratulations to all involved.

THE HON ANGUS TAYLOR MP
ASSISTANT MINISTER FOR CITIES AND DIGITAL TRANSFORMATION
OCTOBER 2017

INTRODUCTION

By Anthony Wong

Welcome to this history of technology in Australia. The Australian Computer Society has commissioned this timely book, which is more than a history of the ACS. It is a story about the evolution of our industry, and the important role of ACS within it.

Technology in Australia has many facets – academic, government, private industry, society and the many individuals within those sectors. In the 21st century, information and communications technologies are all around us. But it also has an important history, one that, until now, has never been told. Many of our early pioneers and innovators were ACS members who made important contributions to major technological advances.

The ACS began life in 1966 as an amalgamation of existing state computer societies. Since then it has grown to become one of Australia's premier professional bodies, at the forefront of issues such as accreditation and professional development. The ACS has been an integral part of Australia's growth as a digital economy, and will continue to play a major role as the industry and technology evolve.

Life in Australia is very different now than it was when Trevor Pearcey first turned on his CSIR Mark 1 in 1947. It is impossible to catalogue how much it has changed and the huge role information technology has played, but this book goes a long way towards explaining it. *A Vision Splendid: The History of Australian Computing* is a book that needed to be written.

It was researched and written by Graeme Philipson, a leading Australian computer journalist and computer historian. Graeme has brought to life many of the people and events that have shaped computing in Australia. We thank him for his efforts and we thank those who have assisted him.

In particular, I'd like to acknowledge the work of the ACS Heritage Committee, which includes Michael Hawkins (Chair), Graeme Philipson, Dr Peter Thorne FACS, Nick Tate FACS and Dr Arthur Tatnall FACS. They were ably supported by ACS Heritage agents: Peter Outtridge; Helen McHugh; Jacky Hartnett; Peter Griffith; Martin Lack; and SUSn Bandias, along with many other ACS members who shared stories, pictures and other information.

The ACS is proud to have commissioned this book. But it is a story that will never end, and in a sense the project will never be finished. We invite anybody with the knowledge of historical events in the industry to share their recollections and insights. We intend this book to be a living document; it will grow and evolve as more people add to it.

The book itself is only one part of the ACS's ongoing Heritage project. We are collecting textual and audio reminiscences, important historical documents, images and any other material relevant to Australia's computing history. It is important that future generations have access to this material and understand the beginnings and subsequent development of technology in Australia.

As this book shows, Australia has a proud technology heritage. As the ACS enters its second half-century, "A Vision Splendid" is an opportunity to reflect on our many achievements to date and to look forward to what we will achieve together in the future.

ANTHONY WONG
ACS PRESIDENT
OCTOBER 2017
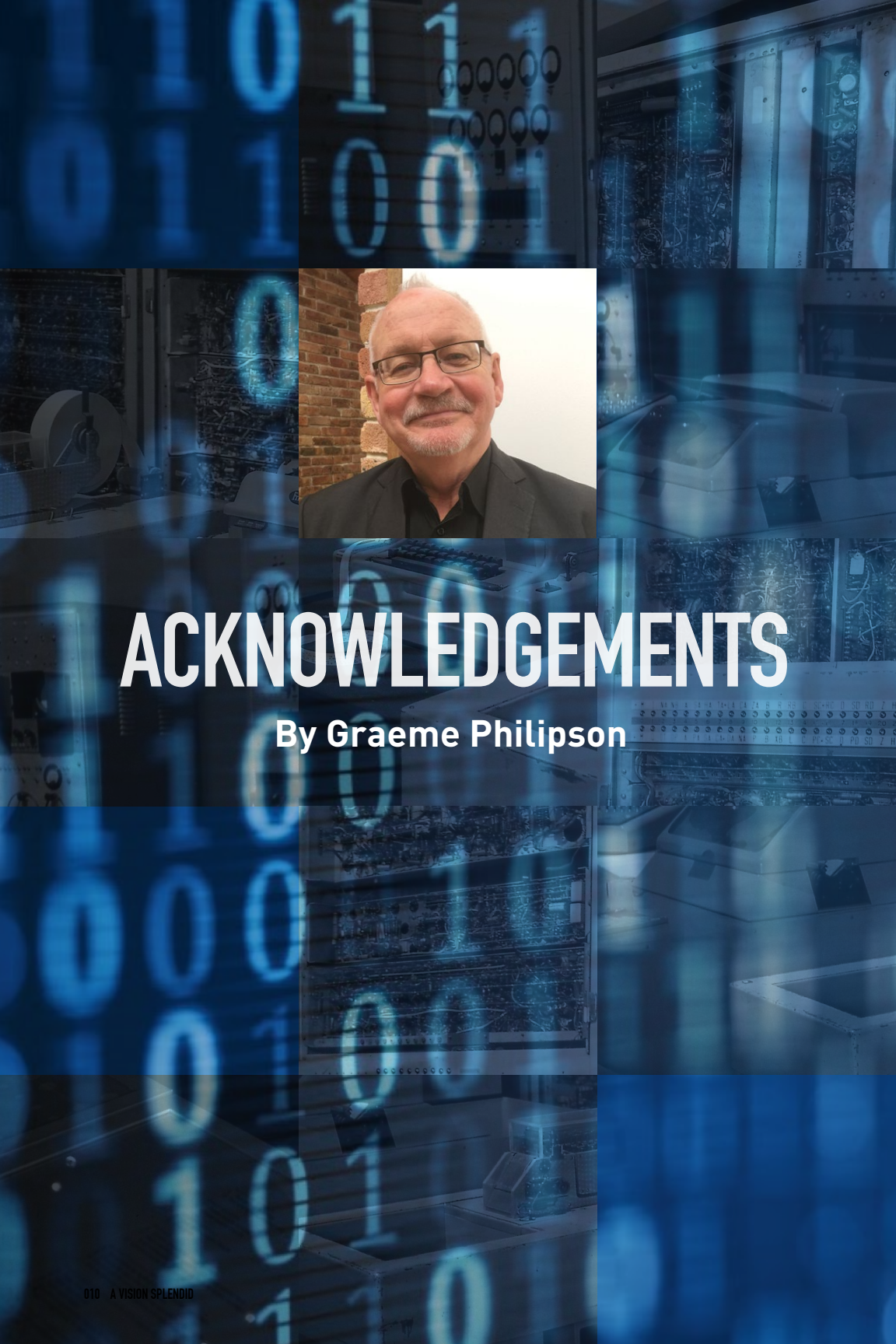
ACKNOWLEDGEMENTS

By Graeme Philipson

MANY PEOPLE HELPED IN THE
RESEARCH FOR THIS BOOK.
THE ACS HERITAGE COMMITTEE
WOULD LIKE TO THANK THEM
ALL. INDIVIDUALS WHO GAVE
OF THEIR TIME AND THEIR
KNOWLEDGE INCLUDE:

ABOUT GRAEME

Graeme Philipson is a writer,
communicator and researcher into high
technology and its effects on business
and society. He is a journalist, market
researcher, public speaker, poet and
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He was founding editor of *MIS Magazine*
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The Sydney Morning Herald and *The Age*,
Research Director for Gartner Asia
Pacific, and Editor of Computerworld
Australia.

His book of original poems, *Social
Cricket, the Universe and Everything*, was
published in 2017.

THE ANALOG WORLD
AUSTRALIAN COMPUTING BEFORE THE DIGITAL ERA.

01

Computing in Australia has a long and distinguished history. When we think of computers today, we normally think of electronic digital devices. But the word 'computer' derives from 'compute', a word that entered the English language in the 17th century from the Latin *computare* – to come together, or to settle an account.[1]

Before modern electronic machines, computers were people – mostly young women – hired to perform repetitive mathematical tasks by hand or with the aid of a mechanical calculator. When these functions started to be performed automatically by what we know as computer technology, the new field appropriated this term and human 'computers' became a thing of the past.

Most histories of computing begin with pre-digital and pre-electronic devices and techniques. This chapter briefly explores two important strands: George Julius's automatic totalisator, and analog computers in Australia in the pre-digital era.

GEORGE JULIUS AND THE AUTOMATIC TOTALISATOR

By far the most important early development in the history of Australian computing was George Julius's invention of the automatic totalisator. This device used many of the concepts later found in electronic computers and deserves much recognition in modern Australia.

Totalisation is a method of calculating returns on wagering based on the amount wagered on each option and the amount to be returned to the operator. Its earliest application was in betting on horse races, using the parimutuel system invented by Spanish immigrant Joseph Oller in France in 1867 – although Oller is perhaps better known as the founder of the famous Moulin Rouge cabaret.[2]

Determining returns in a parimutuel betting system involves complex calculations. In 1913 Julius, an Australian engineer, invented an automatic totalisator to quickly and accurately calculate parimutuel returns. He originally conceived of the machine as a mechanical vote counter, but when the Western Australian Government rejected this idea he modified the design and built a totalisator machine. That same year, his first totalisator was installed at Ellerslie Racecourse in Auckland, New Zealand.

Julius was born in Norwich, England, in 1873. His father, Churchill Julius, was an Anglican minister who had brought the family to Australia in 1884 to take up the position of

"TIME WAS WHEN COMMERCIAL MEN THOUGHT OF THE SCIENTIST WITH THE FAINT CONTEMPT NATURAL IN THE PRACTICAL MAN FOR THE IMPRACTICAL VISIONARY – AND THE SCIENTIST WORKED AT HIS PROBLEM, CARING NOTHING FOR THE APPLICATION OF HIS DISCOVERIES TO COMMERCE. BUT THIS HAS ALL CHANGED WITH THE ENLISTMENT OF SCIENCE AS AN AID TO THE PROPER GOVERNANCE OF A COUNTRY."

GEORGE JULIUS, 1926
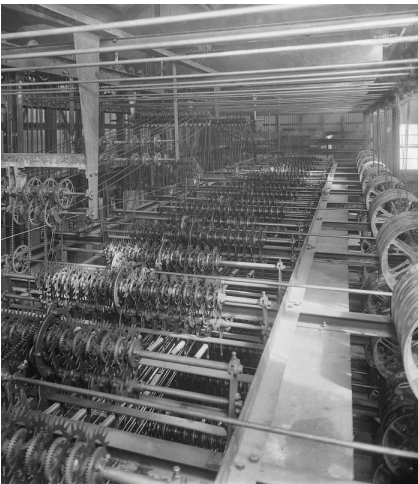
Archdeacon of Ballarat. In 1890, Churchill was promoted to Bishop of Christchurch in New Zealand, and eventually became the first Anglican Archbishop of New Zealand in 1922.

Julius studied engineering at the University of New Zealand's Canterbury College in Christchurch, graduating in 1896 and moving to Western Australia, where he took a position with the Western Australian Government Railways. His engineering genius was apparent, but his undemanding work on the railways meant he had ample time to develop his totalisator machine. After the success of his first device, he formed Automatic Totalisator Limited (ATL) to commercialise the technology. Improved versions were installed at racetracks all around Australia and New Zealand. The Julius Tote, as it became known, was an enormous commercial success worldwide.

The totalisator was an electromechanical device that enabled multiple terminals where punters could place their bets. All bets on each horse were automatically added together, and returns were calculated at the end of the race from the total pool and the number of bets on each horse.

ATL had a virtual global monopoly on tote machines. They were one of Australia's first successful manufacturing exports. [3]

In an email to the Museum of Victoria, Brian Conlon discusses the invention:

■ "One of the largest of these systems was installed in Longchamps France in 1928 with 273 terminals. This was a large scale multi user real time system with no sign of the world's first so-called computer in sight. I wondered for some time about the nickname a Paris newspaper attributed to the Longchamps Julius tote 'The Insatiable Moloch'.

■ "Moloch was the god of the Canaanites who demanded extreme sacrifice. I concluded that unlike today the populace had never seen machines that extract money from people so quickly and relentlessly and that this nickname resulted from an observation of a system with an appetite for money which could not

be satisfied.

"One of these electromechanical totalisator systems built and tested in Sydney in 1920 was capable of supporting 1,000 terminals and a sell rate of 250,000 per minute, which is good by today's standards! The system in White City in London ended up with 320 terminals."[4]

The automatic totalisator made Julius both rich and famous. In 1926, Prime Minister Stanley Melbourne Bruce invited him to become the Foundation Chairman of the new Council for Scientific and Industrial Research (CSIR), which was later to become the Commonwealth Scientific and Industrial Research Organisation, better known as the CSIRO. Julius was knighted in 1929 and died in 1946.

Julius's automatic totalisator was an important mechanical computer in its day. It was a remarkable device, of great complexity:

■ "The ATL totalisator had four essential components: the ticket machine, the adder, the odds calculator and the indicator. The ticket machines were placed at the windows of the tote house and other sundry buildings at the racecourse. When punters placed a bet at any ticket machine it provided a ticket (this being a secure receipt for the bet) while simultaneously registering the bet on the adder, thereby incrementing the total for the particular horse, as well as the grand total for the race.

■ "The odds calculators determined the ratio of the bets on each horse to the grand total (the likely dividend), and that information was transmitted to the odds indicator, usually mounted on the front of the tote house.

■ "The odds calculator was a later invention than the other three, but all components, indeed all aspects of the tote mechanism, were subject to ongoing refinement. The rarely glimpsed calculating mechanism of the machine consisted of vertically delineated banks of adders, each with a dedicated odds

calculator and odds transfer box, with all adders connected to the drive shaft. Usually there were two such banks back to back.

■ "These were in effect two separate totes: a win tote and a place tote. At the end of the row was the grand total adder and the grand total gearbox which incorporated a mechanism for subtracting the owner's and the government's fractions of the pool before the odds were calculated and displayed."[5]

The Julius Totes were multi-user machines, enabling dozens or even hundreds of simultaneous users. They were also marvels of engineering, performing many of the functions of modern computers. They did not have memory, as such, and were not programmable, but their sheer size and sophistication were not matched by electronic computers until well into the 1950s.

By the end of the roaring 1920s, Julius's company was selling totalisators around the world. The devices were initially manufactured in a small workshop in the Sydney suburb of Newtown.

In 1930, ATL moved to much larger premises at the southern end of Sydney's CBD. During World War II, the company also manufactured gun sights and other military equipment, and in 1945 moved to new premises by the Parramatta River in Meadowbank.[6]

At its peak, ATL supplied totalisators to hundreds of racetracks worldwide. But the company began to decline in the 1960s and 1970s and, after many changes of ownership, ended up as part of the New South Wales Government Totalizator Agency Board (TAB), set up in 1964 to help stamp out illegal starting-price bookmakers. The TAB moved straight to electronic computers and had no interest in the mechanical technology. The machines were trashed and the ATL company records largely destroyed.

In 1994, Sydney's Powerhouse Museum received a call from electronics company AWA, which had acquired many of ATL's

"MY INTEREST IN COMPUTING WAS AROUSED IN THE 1920s WHEN I HEARD JULIUS DESCRIBE HIS INVENTION AND DEMONSTRATE IN A SPECTACULAR WAY OTHER PROBLEM OF HOW THE PROCESSING OF LARGE MASSES OF DATA ARRIVING IN AN UNPREDICTABLE SEQUENCE COULD BE HANDLED QUICKLY, CONTINUOUSLY AND ACCURATELY BY MACHINE."

DAVID MYERS

MORE INFORMATION

George Julius and his totalisator are well documented, but deserve greater recognition. A very good overview is the article by Lindsay Barrett and Matthew Connell in New Zealand's *The Rutherford Journal*, 'An Unlikely History of Australian Computing: The Reign of the Totalisator'.

Brian Conlon's website devoted to the same subject has a wealth of information: **http://members.ozemail.com.au/~bconlon/**.

Trevor Pearcey's 1988 *History of Australian Computing* covers David Myers reasonably well. Myers himself wrote a chapter on his early career in the 1994 ACS book *Computing in Australia*.

assets from the TAB in the 1980s. There was an "untidy collection of ticket dispensing machines, deconstructed mechanical and electronic components, slide rules, odds indicators, boxes full of papers and lists of figures, and a filing cabinet, all of it covered in a thick layer of dust."[7]

The collection included photographs from the development of ATL and part of a demonstrator totalisator that Julius had used as a sales model. That machine is now in the Powerhouse Museum, one of the few reminders of a remarkable era when Australia led the world in mechanical computing.

DAVID MYERS AND EARLY ANALOG CALCULATING DEVICES IN AUSTRALIA

George Julius was an inspiration to many. In 1925 he gave a talk on the totalisator and its workings to students at Sydney Boys High School. In the audience was 14-year-old David Myers, who found in Julius's talk "a lifetime of encouragement."[8]

■ "My interest in computing was aroused in the 1920s when I heard Julius describe his invention and demonstrate in a spectacular way other problem of how the processing of large masses of data arriving in an unpredictable sequence could be handled quickly, continuously and accurately by machine."[9]

Myers was academically brilliant and after completing a degree in electrical engineering at the University of Sydney, wrote his PhD at Oxford from 1933 to 1935. While in England, he worked briefly with Douglas Hartree (see Chapter 3) at the University of Manchester on an analog differential analyser. He then returned to Sydney in 1936 to become chief of the CSIR's Division of Electrotechnology, where he presented a paper to the Institute of Engineers entitled 'Some Mechanical Aids to Calculation'. Myers hoped to interest CSIR in the possibility of using physical devices to solve mathematical problems.[10]

Myers' work in England led him to develop an improved version of the planimeter, a mechanical device that was able to measure

the area of any two-dimensional shape. Named the Integraph, it was able to solve second-order differential equations.

Remarkably, video footage exists of Myers and his Integraph.[11] But in Myers's own words, "its intended application was overtaken by world events in the development of electronic computers [which] soon rendered it obsolete".[12]

During World War II, Myers became involved in the design of firing-control devices placed along the coast to defend Sydney.

■ "The system was dependent upon telephone transmission of triangulation data from varying measurements, and predicted target positions using specially devised error minimisation methods. The six of these systems known as the '103 Converter' were built in the early stages of World War II.

■ "Australia's need for involvement in the development and manufacture of radar systems during World War II led the CSIR to establish its Division of Radiophysics in the grounds of the University of Sydney, in what was to become the University's Madsen Building. To support the operations a valve laboratory was established for the development and manufacture the special new 'strapped magnetron' vacuum tube that make microwave radar possible.

■ "By the end of World War II the division was, with the knowledge it had gained of electronic pulse techniques and radio and television, in a position to develop new, fast electronic methods of computation."[13]

These new methods led directly to the development of Trevor Pearcey's CSIR Mark 1, Australia's first true electronic computer, in the late 1940s (see Chapter 2). In 1948, Myers became Professor of Electrical Engineering at the University of Sydney and visited England on behalf of the CSIR to inspect developments in computing technology. Upon his return, he advised that work on the development of electronic computers in Australia should be confined to

components, at least until a cheap, reliable, directly accessible storage medium became available.

Myer's belief that electronic computing had a limited future in Australia turned out to be incorrect, but it did mean his interest in analog computing continued. In 1951, he built a complex electromechanical differential analyser for the CSIR that was employed in many government agencies, including at the Snowy Mountains Hydro-electric Authority. Myers was also instrumental in establishing the CSIR's Section of Mathematical Instruments (SMI) within the Division of Radiophysics[14], which existed until 1959.

Myers, along with Pearcey, was on the organising committee for Australia's first computer conference in Sydney in August 1951 (see Chapter 3), where the guest of honour was his mentor, Douglas Hartree. True to form, Myers delivered a paper at the conference on analog computing.

Myers was to have a very distinguished academic career. He was elected President of the Institution of Engineers Australia, and in 1960 took up the position of Dean of Applied Science at the University of British Columbia in Vancouver, Canada. He returned to Australia in 1965 and became the first Vice-Chancellor of the newly established La Trobe University in Melbourne, a position he held until his retirement in 1976. David Myers died in 1999.

TREVOR PEARCEY AND THE CSIR MARK 1
AUSTRALIA WAS A WORLD LEADER — THANKS TO ONE MAN.

02

Trevor Pearcey is the father of Australian computing. He designed Australia's first computer, the Mark 1 (better known as CSIRAC), largely independently of advances occurring in other countries. It was only the third or fourth true computer in the world and is the oldest still in existence — it now lives in the Melbourne Museum, although not in working order.

Pearcey's achievement was so significant he can be regarded as one of the seminal figures in the birth of electronic computers not just in Australia, but globally. His efforts put Australia at the centre of the burgeoning global computer industry, and it was to Pearcey's eternal regret that Australia's early prominence declined – that his adopted country ended up a technological colony of the two other computing pioneers, the US and UK (see Chapter 7).

Pearcey was born in the London suburb of Woolwich on 5 March 1919. Tall, dark and bookish, he graduated from Imperial College in 1940 with First-Class Honours in theoretical physics and mathematics. He intended to complete a doctorate, but because of World War II he joined the UK's Air Defence Research and Development Establishment (ADRDE), based at Christchurch in the marshy Fenlands north of Cambridge.

The British Government, worried that the coastal regions were vulnerable to German commando raids, moved the ADRDE to Malvern in Worcestershire in 1942. It combined ADRDE with the Telecommunications Research Establishment to form the Radar Research Establishment, developing aerial and naval radar for Britain's armed forces.

After the war Pearcey, just 26 years old, answered an advertisement for a mathematical physicist with the Radiophysics Division of the Australian Government's Council for Scientific and Industrial Research (CSIR). He arrived in a US Air Force Douglas C-54 Skymaster, "sitting on top of a load of mail bags"[15] on Boxing Day, 1945. Pearcey had crossed the Atlantic by boat, the US by train and the Pacific by air.

While in the US, he visited Boston, where he saw the Bush differential analyser being built at the Massachusetts Institute of Technology (MIT) and the massive Mark 1 electromechanical calculator that IBM had installed at Cruft Laboratory at Harvard University.

IT IS NOT INCONCEIVABLE THAT AN AUTOMATIC ENCYCLOPEDIC SERVICE, OPERATED THROUGH THE NATIONAL TELEPRINTER OR TELEPHONE SYSTEM, WILL ONE DAY EXIST.

TREVOR PEARCEY, 1948
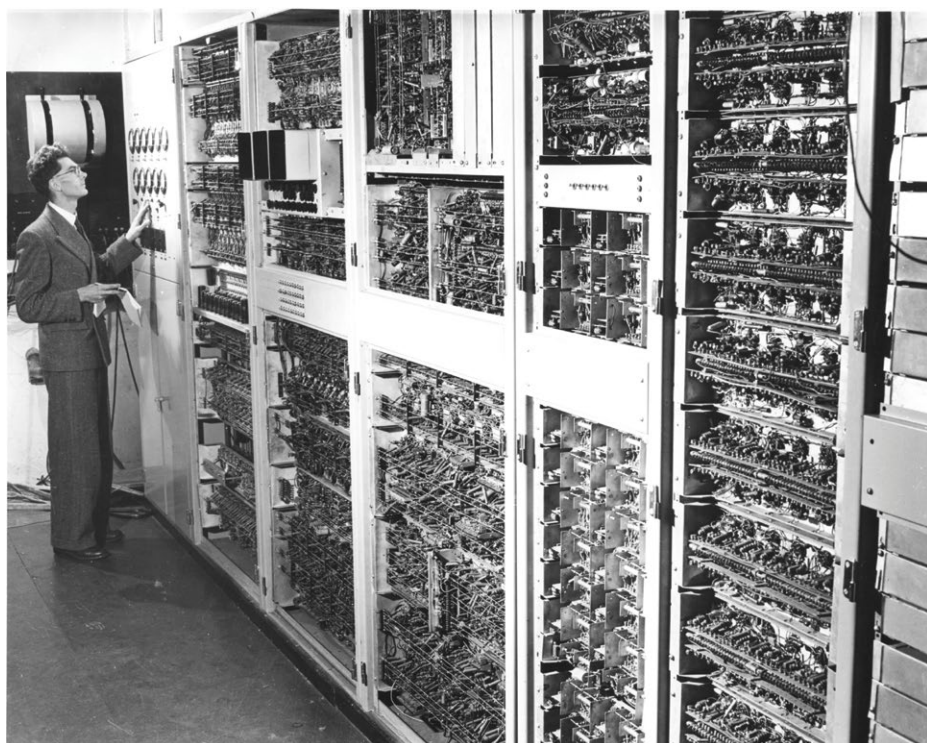
IBM called it the Automatic Sequence Controlled Calculator (ASCC), and it was the largest electromechanical calculator ever built. It was also the first automatic digital calculator in the US, and was used on the Manhattan Project, helping with calculations for the first atomic bomb.

IBM's archives describe this monster.

■ "The Mark 1 was a parallel synchronous calculator that could perform table lookup and the four fundamental arithmetic operations, in any specified sequence, on numbers up to 23 decimal digits in length. It had 60 switch registers for constants, 72 storage counters for intermediate results, a central multiplying-dividing unit, functional counters for computing transcendental functions, and three interpolators for reading functions punched into perforated tape.

■ "Numerical input was in the form of

punched cards, paper tape or manually set switches. The output was printed by electric typewriters or punched into cards. Sequencing of operations was accomplished by a perforated tape[16].

The Mark 1 was a marvellous machine for its day, but with 765,000 separate components, 3,300 mechanical relays and over 80 kilometres of wiring, it showed Pearcey that mechanical computation was too slow. On the long journey to Australia he considered what he had seen.

"It showed me some very important facts," he recalled later.[17] "It only operated at about two operations per second. This was obviously not going to be adequate for the future. We would have to go electronic."

Pearcey's experience with radar during the war had familiarised him with using vacuum tubes as switches instead of mechanical relays. "We had all that was necessary to go electronic and gain a factor of speed of about 1,000,"[18] he realised. He had no doubt he could achieve such speeds for computation, but was uncertain how to develop storage that could match these speeds. That was to come later.

THE BIRTH OF THE CSIR MARK 1

When Pearcey arrived in Australia, he established a Mathematical Section within CSIRO's Division of Radiophysics.[19] He was determined to design and build an electronic computer, and assembled some small-scale binary calculators using telephone relays.[20] Barely a year later, working largely in his spare time, he had designed the machine on paper using a notational style developed by US logicians Walter Pitts and Warren McCulloch, the pioneers of neural networking.

In early 1947, Pearcey approached the head of the Radiophysics Division, Dr Edward 'Taffy' Bowen, to ask for the resources he would need to build an electronic computer. Bowen, a Welsh radar specialist with whom Pearcey had worked in England, agreed.

The development of what was eventually called the CSIR Mark 1 was a slow process – it did not run its first program until November 1949.[21] In the meantime, Pearcey was influenced by the ENIAC program in the US, the details of which became known in 1947.[22]

ENIAC (**E**lectronic **N**umerical **I**ntegrator **A**nd **C**omputer) is widely regarded as the first true computer. It was developed by US engineers John Mauchly and J.Presper Eckert – and funded by the US Army – to calculate ballistics tables, although it was not finished before the war ended. Its initial use was in the development of the hydrogen bomb.[23]

ENIAC confirmed what Pearcey already knew – that an electronic computer was not only feasible, it was the only way to achieve the speeds necessary for large-scale computation. ENIAC used 17,468 vacuum tubes; had 500,000 soldered joints, 70,000 resistors and 10,000 capacitors; and weighed 30 tonnes.[24]

In developing the CSIR Mark 1, Pearcey enlisted the aid of fellow CSIR researcher Maston Beard. Born and educated in Australia and four years older than Pearcey, Beard was a brilliant electrical and mechanical engineer. He had been seconded by the US to Washington DC during the war as a scientific liaison officer, and was a specialist in electronic circuit design.

Pearcey was responsible for the conceptual design, but it fell to Beard to translate those designs into componentry. The two papers they published on their process[25] are among the earliest reports ever written on the mechanics of digital computer design.

Electronic computers were simultaneously being developed in the UK. Pearcey returned to England briefly in November and December 1948[26], where he visited three electronic computer development sites: EDSAC, MADM and ACE.

EDSAC (Electronic Delay Storage Automatic Calculator) was built at the University of Cambridge and was the

AS SOON AS IT WAS COMPLETED, THE MARK 1 WAS HARD AT WORK. IT WAS TEMPERAMENTAL, AND ITS OPERATORS OFTEN HAD TO HIT FAULTY CIRCUITRY WITH A RUBBER MALLET TO OVERCOME INTERMITTENT FAULTS. PEARCEY DEVELOPED A RUDIMENTARY BUT VERSATILE PROGRAMMING LANGUAGE. THE MACHINE DID NOT HAVE AN OPERATING SYSTEM, SO EACH PROGRAM – FED INTO THE MACHINE ON PAPER TAPE – INCLUDED ALL HARDWARE INSTRUCTIONS.

world's first stored-program computer. When Pearcey visited, EDSAC was still under construction and the Australian John Bennett – who would later become the Foundation President of the Australian Computer Society – was on the development team (see Chapter 4). The MADM (Manchester Automatic Digital Machine) at the Victoria University of Manchester and ACE (Automatic Computing Engine) at the UK's National Physical Laboratory were also under development when Pearcey visited.

Inspired by what he had seen, Pearcey and Beard pushed on with the development of the CSIR Mark 1. The visit was particularly useful in revealing to Pearcey the detailed design of some of the electronics, particularly arithmetic circuits and logic gates.[27]

But there were major problems getting the components they needed, thanks to shortages of equipment. According to Pearcey, "industrial anarchy was rampant in Australia towards the end of the 1940s." In 1949, the Chifley Labor Government had called in troops to break a strike by the Communist-dominated miner's union. Prolonged strikes led to power blackouts, which further hampered development. The Cold War had started and times were still tough after the depredations of war.

"Australia was absolutely strapped for US dollars, so we couldn't get US communications equipment for input and output," said Pearcey. "Delivery times for paper tape gear and punch card machines ran into the order of two to three years. So we had to design our own input and output."

Frustrated by the unreliability of the available Hollerith punched card equipment, Pearcey and Beard designed and built entirely original 12-hole paper-tape readers and punch equipment. The paper tapes were like 12-hole punched cards of indefinite length. They used a second-hand post office teletype machine as the output device.

All programs and instruction were fed into the machine on paper tape. The Mark

1 used approximately 2,000 vacuum tubes, mostly 6SN7 twin triodes, which were comparatively easy to source because they were widely used in World War II radar systems. CSIR already had its own vacuum tube manufacturing facility, a legacy of radar work during the war.

The delay line storage used 32 metal tubes filled with mercury, each of which was able to hold 16 words.[28] Engineer Reg Ryan found a way to double the capacity by interleaving the two streams, which meant a memory capacity of 1,024 20-bit words, or about 2.5 KB of RAM in today's terminology.

Beard and his colleague Brian Cooper developed a range of magnetic storage devices for the CSIR Mark 1. First, a cylindrical drum with words read in parallel from a line of heads,[29] then a single platter disk. The Mark 1 used a 415-volt three-phase power supply and consumed 30 kW. It had a loudspeaker that was activated when programs were running and gave early warning of errors by clicking madly. The speaker was later used to play the world's first computer music.

THE MARK 1 IN OPERATION

The CSIR Mark 1 ran its first test program in November 1949 – the exact date is unfortunately not recorded. This was well after the UK success in running the first stored-program, in mid-1948, on the SSEM or 'Baby' (which was developed into the Manchester Mark 1 'MADM' in 1949). The EDSAC at Cambridge also commenced operation during 1949.

In the US, the BINAC was running test programs in early 1949 but was subsequently deemed unreliable. There is no evidence of any other electronic computer running a stored program before CSIR Mark 1, meaning it was just the fourth functional electronic digital computer in the world.

It did not run perfectly, but as Pearcey said, "in view of the effort that had to be expended over all aspects of design and construction by a staff of not more than six people … it is surprising that the computer attained a satisfactory operating state and provided computing assistance to many users."[30]

As soon as it was completed, the Mark 1 was hard at work. It was temperamental, and its operators often had to hit faulty circuitry with a rubber mallet to overcome intermittent faults.[31] Pearcey developed a rudimentary but versatile programming language. The machine did not have an operating system, so each program – fed into the machine on paper tape –included all hardware instructions.

Trevor Pearcey describes its work in its early years.

- ■ "From 1950 to 1955, the machine was in continuing, somewhat irregular, service, and performed really massive computations. For instance, weather analysis, analysis of flood data for the design of dams for assembling the Snowy Mountains Hydro-electric Authority (SMHA) at that time, for big problems in physical optics, and in the solution of problems in hydraulics and hydrodynamics."[32]

After a few years of operation, the Mark 1 became a victim of its own success. The University of Sydney, where it was housed, decided to install its own computer, as did the new University of Technology, which was to become the NSW University of New South Wales in 1958. The new computers were called SILLIAC and UTECOM (see Chapters 4 and 5).

Sydney University's SILLIAC would be much more powerful than the CSIR Mark 1, which was offered to the University of Melbourne and gratefully accepted in 1954. Beard made a number of improvements to its central processing unit (or 'sequencer'), which, along with other modifications, were sufficient to warrant changing its name to the Mark II.[33] In July 1955 it was dismantled and shipped down the Hume Highway to begin its new life in Melbourne.
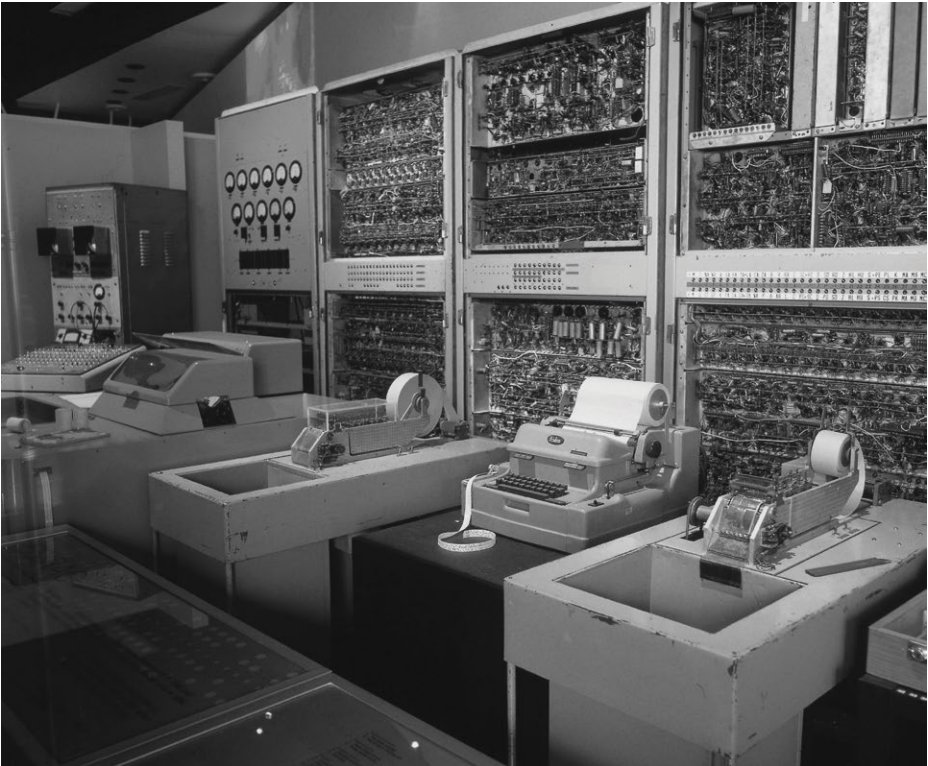
A SECOND LIFE – CSIRAC

In Melbourne the computer was given the new name CSIRAC (CSIR **A**utomatic **C**omputer), On 14 June 1956[34] it was formally relaunched when Sir Ian Clunies Ross, Chairman of the newly renamed Commonwealth Scientific and Industrial Research Organisation (CSIRO), certified its indefinite loan to the university.[35] CSIRAC remained in operation for a further eight years. It was used by many university departments and CSIRO divisions, and by the Commonwealth Aeronautical Research Laboratories, the Australian National University's School of Physics, and by private industry. It was also extensively used to teach computer programming practice and theory.

CSIRAC gave the University of Melbourne a head start in academic computing in Australia. The university even built a new laboratory to house it. The laboratory, in the

School of Natural Philosophy Building, was a joint venture by the university's Department of Mathematics (under Tom Cherry, who was later knighted for services to academia) and the Department of Physics (under Leslie Martin, also later knighted). For the first year, CSIRAC was partially funded by CSIRO, which continued to use it.[36]

As part of the commissioning ceremony, the computer executed a simple program that had been pre-loaded by engineer Ron Bowles and output this message, at five characters a second:

> MR VICE CHANCELLOR, THANK YOU FOR DECLARING ME OPEN. I CAN ADD, SUBTRACT, AND MULTIPLY; SOLVE LINEAR AND DIFFERENTIAL EQUATIONS; PLAY A MEDIOCRE GAME OF CHESS AND ALSO SOME MUSIC.[37]

The new laboratory and CSIRAC's operations were under the management of Frank Hirst, a PhD in Physics who had spent Word War II as a navigator in the Royal Australian Air Force.[38] A course in programming began in early 1956, even before the newly arrived computer was recommissioned. By the late 1950s, such courses were offered as part of the Bachelor of Science degree.[39]

In 1959, Trevor Pearcey, the man who had designed CSIRAC, joined the university's Computation Laboratory.

When Pearcey arrived, he began courses in numerical methods and computing as part of the Bachelor of Arts in Pure Mathematics. The first undergraduate courses in computer science (called The Theory of Computation) began in the 1960s, initially as part of the Bachelor of Science degree. These subjects were not offered to first-year students until 1970.

As well as providing a computing service to the university, CSIRO staff and the wider community, the Computation Laboratory provided its own academic courses and undertook research.

One CSIRO staff member, Geoff Hill, who transferred down from Sydney with the computer, wrote and implemented an early high-level language (Interprogram). Hill's 1961 PhD thesis 'Advanced Programming of Digital Computers' was the basis of what was probably the first 'computer science' doctorate awarded in Australia.[40]

AFTER CSIRAC — COMPUTING AT THE UNIVERSITY OF MELBOURNE

In 1964, CSIRAC was 15 years old and showing its age. That year the University of Melbourne purchased an IBM 7044 and on 24 November 1964, CSIRAC was turned off for the last time and donated to the Melbourne Museum. It was kept in storage until 1980, when it was briefly put on display at the Pearcey Centre at the Chisholm Institute. It went back into storage until June 1996, when it was once again exhibited at a 40-year commemoration at the University of Melbourne.

Several years later still, CSIRAC was prepared for permanent display at Melbourne Museum, where it has had its own special display since 2004. It is not in working order, but all its components have been refurbished and are on display in one of the museum's premier exhibits. CSIRAC is the oldest complete computer in existence anywhere in the world – the three that preceded it were all scrapped long ago.

The University of Melbourne was to remain at the forefront of Australian computing. The IBM 7044 was a transistorised machine released in 1963 and provided by IBM 'under generous terms',[41] but it was quickly rendered obsolete by the IBM System/360 released the following year (see Chapter 12). In 1966-67, the university's Chemistry, Physiology and Computation departments all installed DEC PDP-8s.

The Computation Department at the university provided both academic teaching and research. Besides Hirst and Pearcey, early academic staff in the Computation Laboratory included Bill Flower (joined

MORE INFORMATION

Fortunately, there is a wealth of information on CSIRAC. Its story is becoming better known, and more and more people are becoming aware of its special place in Australia's computing history and in the context of the evolution of digital computing globally. And, of course, the machine itself still exists. There are two good books on CSIRAC:

- ■ *The Last of the First. CSIRAC: Australia's First Computer* by Doug McCann and Peter Thorne, which includes a detailed technical description of CSIRAC and all the papers presented at a 1996 conference celebrating the 40th anniversary of CSIRAC's move to Melbourne, including one by Trevor Pearcey.
- ■ *CSIRAC, Australia's First Computer* by John Deane, a monograph published by the Australian Computer Museum Society with a technical description of the machine and an overview of its development.

There is also Trevor Pearcey's own *History of Australian Computing* published in 1988, in which he wrote about himself in the third person – and which contains a number of inaccuracies. This valuable book is unfortunately difficult to find, but is in many libraries. There are other Pearcey recollections in the Australian Computer Society's 1994 publication *Computing in Australia,* Chapters 1–3. The Museum of Victoria's website has a thorough section on CSIRAC with short videos about the machine, many of them narrated by people who actually worked on it.

September 1961, Rex Harris (February 1962), and Alfs Berztiss (January 1964). Engineers were Ron Bowles and Jurij Semkiw, assisted by undergraduate student Peter Thorne.

In 1969 the university decided to split the Computation Department into two – the Department of Information Science, in the Faculty of Science and a Computer Centre. The Computer Centre was established in 1970 under Alan Bell (who had been with the Department of Defence and was later to become Treasurer of the Australian Computer Society).

In 1971 Frank Hirst was invited to take up the Chair in Computing at the University of Adelaide (see Chapter 10). Bill Flower was appointed as Acting Head of Information Science, the other academic staff being Rex Harris, and Peter Thorne (who, after his undergraduate Physics degree, had worked with Hirst to complete another of the first computing PhDs in Australia, in 1967).[42]

PEARCEY'S LEGACY

Pearcey went on to have a long career in academic and commercial computing in Australia. After a stint back in England, he was the driving force behind the CSIRO's move into computing, which led to the establishment of the CSIRO Division of Computing Research and CSIRONET, established in 1963 as Australia's first computer network.

In 1972, Pearcey received the doctorate World War II had denied him. It was awarded by the University of Melbourne on the strength of his prodigious output – thoUSnds of pages of scholarly papers on subjects as varied as radio propagation, physical optics, air traffic control, crystallography, viscous flow and what is now called chaos theory.[43]

In 1980 Pearcey became the first Dean of Computing and Information Systems at Caulfield Institute of Technology, later renamed the Chisholm Institute of Technology and now a campus of Monash University (see Chapter 10). He retired shortly

afterwards to the Mornington Peninsula near Melbourne, and died on 27 January 1998, just a month short of his 90th birthday.

Trevor Pearcey's name is honoured today in the Pearcey Awards, which recognise the pioneering achievements of Australians in the information and communications technology (ICT) industry. The awards are bestowed by the Pearcey Foundation, a non-profit organisation set up shortly after his death. The Foundation operates broadly across the Australian ICT sector and is involved in debate and public policy on critical national issues such as productivity, the digital economy and national infrastructure.

There is a wonderful video clip, available on YouTube[44], of Pearcey being interviewed just two years before his death. The interview discusses CSIRAC's special place in history as the first computer ever to play music.

"CSIRAC was able to provide tones through a loud speaker," says Pearcey in the interview conducted by his former student and colleague Peter Thorne.

■ "The loud speaker was initially installed so a particular instruction could be coded into a program to send a pulse to the speaker when that instruction was executed. That could provide the user with an indication of where the program was at any particular moment, by providing the appropriate click.

■ "When the program went wild because of a spurious electronic fault, the user would be warned by a change in the rhythm of the noise. From there it was not a great extension to program regular tones. We managed to develop a program which would pass impulses to the speaker in a diatonic tone, and extend it to the controlled execution of tones and the playing of what might be called music.

■ "This was of course purely experimental, to see if it could be done. It was done successfully over a small range of a couple of octaves of the diatomic scale. After a few false passes and mistakes, we played 'The Girl with the Flaxen Hair', 'Colonel Bogey', and one or two other things like that.

"I remember calling the chief of the division at that stage to come and listen to it. I suggested we record the tones – the tunes – and to play it over the radio. But Dr Bowen, who was then chief, didn't think this was good enough.

■ "I don't think he realised the intellectual skill and effort that had gone into actually getting the machine to play specific musical sequences.

■ "It would have been 1950 or 1951. I cannot give you the precise date. It was certainly a very early programming exercise."

There is little doubt this was the first music ever to be played on a computer.

Pearcey was a true visionary. He wrote a 20-page article about electronic computing for the February 1948 edition of the *Australian Journal of Science*. In closing, he said:

■ "In the non-mathematical field there is wide scope for the use of the techniques [of computing] in such things as filing systems. It is not inconceivable that an automatic encyclopaedic service operated through the national teleprinter or telephone system will one day exist."[45]

This was written when Pearcey was still developing the CSIR Mark 1. Most of the article is devoted to a detailed technical description of the theory and practice of electronic computing, but his mention of "filing systems" predicts the development of databases, and his "automatic encyclopaedic service operated through the national teleprinter or telephone system" predicts the Internet – more than 20 years before it came into being, and 50 years before the emergence of Google.

His comments are remarkable and his prescience astonishing. Trevor Pearcey was a giant of the early years of computing.

THE FIRST AUSTRALIAN COMPUTER CONFERENCE
THE COMPUTER CONFERENCE IN SYDNEY IN 1951 WAS ONE OF THE FIRST HELD ANYWHERE IN THE WORLD.

03

In August 1951, a conference was held at Sydney University's Department of Electrical Engineering – the first computer conference ever held in Australia. Indeed, only a few such conferences had been held in other countries. The first in the world was at Harvard University in December 1947, with 40 papers presented, followed by another in 1949. A close runner-up was the Association for Computing Machinery (ACM) in the United States, which began holding annual conferences after its formation in 1947.[46]

In the UK, the first computer conference was held at the University of Cambridge in 1949, followed by one at the University of Manchester in July 1951. This made the Australian conference the ninth computer conference ever held.

The three-day symposium opened on Tuesday 7 August, a cold and windy winter's day. The newspapers were full of news of the Korean War and of the previous day's arrival of Australia's first jet bomber, the appropriately named *Canberra*. The bomber had been made in the UK by English Electric, an influential early computer manufacturer.

The event was organised by Trevor Pearcey of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Radiophysics and David Myers, Professor of Electrical Engineering at the University of Sydney. Myers had been head of the CSIRO Section for Mathematical Instruments (SMI), which was established in 1948 to provide advice on mechanical solutions to mathematical problems.[47]

Myers had developed a mechanical analog differential analyser called the Integraph as part of his doctoral thesis at the University of Sydney in 1939 (see Chapter 1). His machine was an improvement on the planimeter – a device for calculating irregular areas on a plane.

Neither Pearcey nor Myers gave the other much credit in their subsequent recollections about the conference,[48] a symptom of the digital–analog divide that was one of the key aspects of the event. The conference attracted 186 registrations and included demonstrations of a range of computing equipment including Pearcey's Mark 1, which at that stage was the only digital computer in Australia (see Chapter 2).

IT MAY WELL BE THAT THE HIGH-SPEED DIGITAL COMPUTER WILL HAVE AS GREAT AN INFLUENCE ON CIVILISATION AS THE ADVENT OF NUCLEAR POWER.

DOUGLAS HARTREE, 1946

ATTENDEES BY ORGANISATION TYPE

TYPE OF ORGANISATION	NUMBER	NOTES
CSIRO Division of Radiophysics	12	
CSIRO – other	43	Total CSIRO = 55
University of Sydney	33	
NSW University of Technology	10	Renamed University of NSW in 1958
University of Melbourne	7	
Other academic institutions	10	Total academia = 60
Snowy Mountains Hydro-electric Authority	12	
Long Range Weapons Research Establishment	5	Renamed the Weapons Research Establishment (WRE) in 1955 after being amalgamated with other agencies
Other Defence agencies	2	
Postmaster-General's Department	2	Split into Australia Post and Telecom Australia in 1975
Astronomy and astronomical research	4	
Other Federal Government agencies	7	
NSW Government agencies	16	
Commercial organisations	23	IBM, Burroughs, Kalamazoo, Skillman, STC, MacDougalls, British Tabulating Machines

A number of commercial attendees displayed a range of accounting machines and scientific calculators. A star attraction was Professor Douglas Hartree, an early British computer pioneer who was the first civilian to program the American ENIAC (**E**lectronic **N**umerical **I**ntegrator **A**nd **C**omputer), generally acknowledged to be the world's first true computer, when he visited the US in 1946. It was Myers who invited Hartree to Australia, having met Hartree when he spent three years in England before World War II.

Hartree was an important figure in the early years of computing. In 1933, he had visited the Massachusetts Institute of Technology (MIT) and seen the Differential

Analyzer, an early mechanical device developed by US pioneer Vannevar Bush.

Hartree was given a copy of the Differential Analyzer's design, and built his own out of Meccano parts for a total cost of £20 on his return to England.[49] His subsequent work with ENIAC was a direct inspiration for the development of EDSAC at the University of Cambridge, which would become the second electronic computer in existence (see Chapter 4).

The list of attendees and the organisations they represented at the Sydney Computer Conference shows where interest in 'automatic computing' lay at the time. There were universities, the CSIRO, and other government research establishments, but there was also a smattering of government departments and calculating machine manufacturers and suppliers who were interested in the practical uses and financial potential of the new technology.

A full list of attendees and their organisations is in the table at left. It is a who's who of the Australian computer industry at its inception – many of those named went on to significant careers in the field. It is also a reflection of the 'boy's club' era – just 16 of the attendees were women and all of them were unmarried.

 The welcoming address was delivered by Sir John Madsen, Emeritus Professor of the University of Sydney, and Myers's predecessor. Madsen was largely responsible for obtaining funding for the CSIR Radiophysics Laboratory where Trevor Pearcey had developed the Mark 1.

■ "Computing has traditionally occupied an intermediate position between theory and practice, and being neither fish nor fowl, has been looked at rather askance in the past by both species. But modern science and technology, with their rapid expansion accelerated by the demands of two world wars, have placed a correspondingly increasing requirement on the computer.

■ "Consequently, both the producer and user of mathematical theory have closed their ranks in stimulating the progress of computing methods and techniques. The resulting progress can only be described as spectacular, so much so that its protagonists are at considerable pains to keep abreast of it."[50]

Madsen said that until that time, computing had been viewed as a sub-discipline within mathematics, but was now emerging as a discipline and profession in its own right.[51]

Hartree presented four papers at the conference, as did Trevor Pearcey (one of them with Marston Beard). All the presentations were focused on technical detail and theory, rather than the practical application of computing. The conference attracted little interest outside the mathematics and engineering community, but it was seminal to many attendees.

In his keynote address, 'Introduction to Automatic Calculating Machines',[52] Hartree made a distinction between 'instruments' (analog devices) and 'calculating machines' (digital devices), and outlined the strengths and weaknesses of the two approaches. He described the analog differential analyser he had worked on, as well as recent advances in digital computing, including storage hardware.

Hartree also raised the key debate between building a simple, faster computer that would need more processing steps, or a more complicated, slower computer with fewer processing steps.[53]

■ "There seems to be a difference of policy between the group at the Mathematical Laboratory at Cambridge and the group at CSIRO Radiophysics in Sydney. The policy at Cambridge is to simplify the engineering at the cost of lengthening the programming … The policy at Sydney is to shorten the program by incorporating more components in the machine."[54]

INDEX TO THE CONFERENCE PROCEEDINGS

ABOVE: Conference Proceedings - CREDIT UNIVERSITY OF SYDNEY

MORE INFORMATION

The best source of information about the conference is the proceedings, which run to over 200 pages. There are copies remain in the National Library of Australia and many university libraries.

Museum Victoria's website also has a good summary of the event: **http://collections.museumvictoria.com.au/articles/2718**.

This debate remained a significant question in computing for some time. The second path eventually won out, largely because of rapid advances in computing power.

Three of Pearcey's papers at the conference were about the Mark 1, which was to remain the only digital computer in Australia for four more years. His fourth paper was on programming punch-card machines. Other papers presented covered various digital and analog devices. As Pearcey described them:

■ "The published proceedings of the 1951 conference show research and development going on in a number of areas related to the design of computing devices. These included the design of magnetic switches, special binary gating vacuum-tube counting and shifting devices which were for functions necessary in digital computing (CB Speedy), and the design of vacuum-tube beam counters (DL Hollway).

■ "Working models of these had been built at the CSIRO Valve Laboratory under RE Atchison and digital-analogue converters were being designed by W.R. Blunden. The first magnetic drum system in the country was designed by B.F.C Cooper and was installed on the Mark 1. At the University of Adelaide an analogue device for solving polynomial equations up to the fourth degree, using commercially available 'magslip' resolvers and 'variac' autotransformers, was being built."[55]

The 1951 Sydney conference was, in many ways, the beginning of computing in Australia as an industry and a profession. It was the first significant gathering of people interested in the subject, and no similar conference was held for another six years – in June 1957 at the Weapons Research Establishment in the northern Adelaide suburb of Salisbury (see Chapter 6).

David Myers wrote many years later that the conference "was a turning point in Australia and that since that time computing became increasingly a study in its own right rather than a plaything of specialists. Anyone wishing to consider the state of the art at the end of the first half of this century would be well advised to read the report of that conference."[56]

AIRPORT INTERCEPTION CHANGES THE FACE OF AUSTRALIAN COMPUTING
HARRY MESSEL, JOHN BENNETT AND SILLIAC.

04

Founded in 1850, the University of Sydney is Australia's oldest university. It was also home to Australia's first computer. Trevor Pearcey's famous Mark 1 was switched on at the university in 1949 (see Chapter 2). The machine, though physically located at the university, was owned and operated by the CSIR Radiophysics Laboratory, then located on the university campus.

In 1952, a dynamic 29-year-old physicist named Harry Messel was appointed as Head of the Department of Physics at the University of Sydney. He held the position until 1987, and he was to play a seminal role in Australian computing.

But Messel was almost lost to Australia. The son of Ukrainian immigrants to Canada, he had been a paratrooper in the Canadian Army during World War II. He then had a whirlwind academic career, gaining honours degrees in both mathematics and physics at Queens University in Kingston, Ontario, and a doctorate in physics in Dublin, Ireland studying under famous Nobel Laureate Erwin Schrödinger. Messel had come to Australia in 1951 to teach at the University of Adelaide.

He was invited there by Professor Herbert Green, who had met him in Dublin. Messel quickly established a reputation as a brilliant theoretician, and a tireless and outspoken advocate for science and technology. But he resigned after almost coming to blows with Vice-Chancellor Albert Rowe, culminating with Rowe mounting Messel's desk and grabbing him by the lapels in a disagreement over the role of physics at the university.[57]

The University of Sydney's Vice-Chancellor, Sir Stephen Roberts, saw an opportunity to resuscitate his university's moribund Department of Physics. He was well aware of Messel's strong personality and said to the university's Senate that "while the tribulations of the administration will probably be added to by this dynamic personality, the Department of Physics will gain increasing international reputation." [58]

Roberts arranged for Messel to be intercepted at Sydney Airport while he was flying back to Canada and offered him the job. Messel set out a range of conditions that he didn't believe would be accepted, including an increase in staff from seven to 21 and funding for cosmic ray research as a path into nuclear physics. His conditions were met and he was appointed.[59]

"I WAS RESPONSIBLE FOR DESIGNING, CONSTRUCTING AND TESTING THE MAIN CONTROL UNIT AND DECODING INSTRUCTIONS EXTRACTING OPERANDS, INITIATING INDIVIDUAL ARITHMETICAL AND LOGICAL PROCESSES."
JOHN BENNETT, REMEMBERING EDSAC, 1994
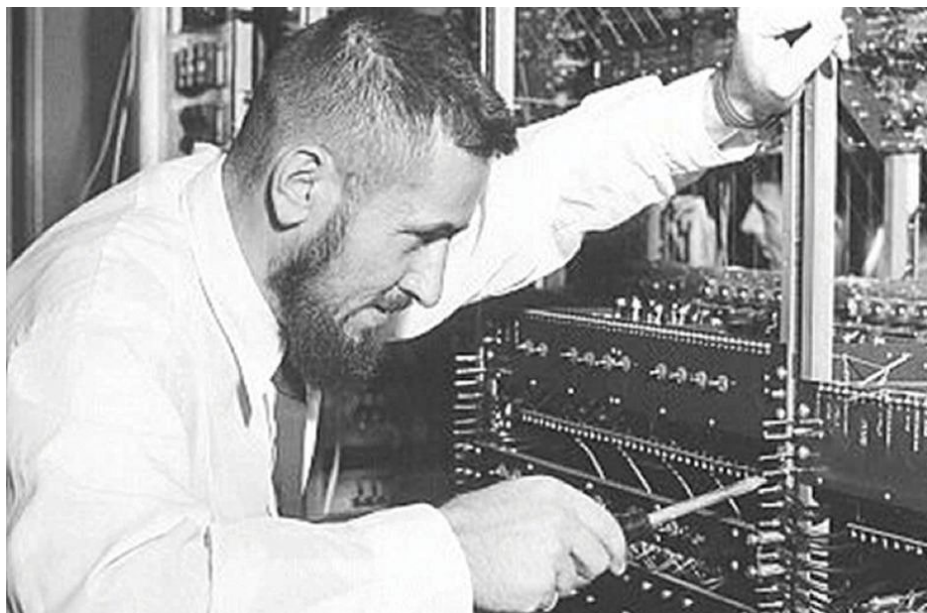
ABOVE: Harry Messel tweaks SILLIAC - CREDIT UNIVERSITY OF SYDNEY

His first act was to recruit prominent physicists from around the world, including John Blatt from the University of Illinois in the United States.[60] It was to be an important decision for the future of Australian computing.

In 1954 Messel established the Nuclear Research Foundation within the School of Physics. The foundation was later renamed the Science Foundation for Physics, and he eventually raised more than $130 million to help run it (Australia moved from pounds to dollars in 1966). The first donation came from press baron Sir Frank Packer. Messel had asked him for £2,000 a year. "What do I get for it?" Sir Frank asked. "Absolutely nothing," said Messel. The cheque was in the mail the next day.[61]

Messel knew he would need a computer to do the sorts of calculations he was planning.

■ "We are planning to perform a large-scale experiment to investigate the structure and origin of the large air-showers in the cosmic radiation ... This experiment would be completely useless without an electronic computing machine

to analyse the data, since analysis by human beings using desk calculators would take 2,000 man-years … The electronic computer will be able to do the job in 800 hours."[62]

Messel soon realised he had limited access to Trevor Pearcey's Mark 1 and would in any case need substantially more computing power than it could offer. John Blatt, who found Pearcey and the Mark 1 staff difficult to deal with,[63] persuaded Messel to build a copy of the much more powerful ILLIAC (Illinois Automatic Computer), which Blatt had worked on in the US, rather than design and build a machine from scratch.

THE BIRTH OF SILLIAC

ILLIAC was as advanced as any of the dozen or so computers that existed in the world at the time. Like many of the other early machines it grew out of work conducted at the Institute for Advanced Study (IAS) in New Jersey by John von Neumann, an extremely influential US computer pioneer.

A child prodigy with a photographic memory, Budapest-born von Neumann moved to the IAS, where Albert Einstein was also a professor, in 1933. Von Neumann was an important figure in the Manhattan Project that developed the atomic bomb, and his famous 'First Draft of a Report on EDVAC' described for the first time the design of the modern stored-program computer, now known as the von Neumann architecture.

Under von Neumann's leadership, a computer based on this design was built at IAS. The Cold War was heating up and a number of other computers using similar designs were being built, including ORDVAC for the Army Ordnance Department, ORACLE (**O**ak **R**idge **A**utomatic **C**omputer and **L**ogic **E**ngine) for the Atomic Energy Commission, and the wonderfully named MANIAC at the Los Alamos atomic weapons site. MANIAC was an acronym for **M**athematical **A**nalyser, **N**umerical **I**ntegrator and **C**omputer, contrived in a vain attempt to stop the rash of silly names for computers.[64] These machines were intended for military use, but one was for education – the ILLIAC at the University of Illinois in Urbana, 100 kilometres south of Chicago.

The first step for Messel's team was to get hold of the design for ILLIAC, which Blatt was able to secure from his former colleagues. The second was to develop a budget. Blatt did not get along with most of Pearcey's team but had established a friendship with the Mark 1's maintenance engineer, John Algie, who was able to calculate the cost of building the machine from the detailed drawings supplied by Blatt's connections.

Algie calculated that an Australian version of ILLIAC, which was to be named SILLIAC (**S**ydney ILLIAC), could be built for £35,000 – about ten times the cost of a Sydney suburban house at the time. SILLIAC eventually cost £75,000.

With typical enthusiasm, Messel went about raising funds. He wrote to the British Dominions and Colonies Fund, and the Nuffield Foundation. He suggested that the Commonwealth Government's Long Range Weapons Research Establishment, soon to buy its own computer (see Chapter 6), should fund SILLIAC. He addressed meetings of the business community and academia.

Nobody was willing to put up the money, which is hardly surprising since most of them had no idea what a computer was.[65] Messel was finally introduced to philanthropist Adolph Basser, a Polish Jew who had emigrated to Australia in 1908 and made a fortune in the jewellery business. Basser had a strong interest in science and technology and on 12 February 1954 donated £50,000 to Messel's foundation, specifically to build SILLIAC.

Basser's great love was horse racing. His horse Delta won the Melbourne Cup in 1951, ridden by the greatest jockey of the era,
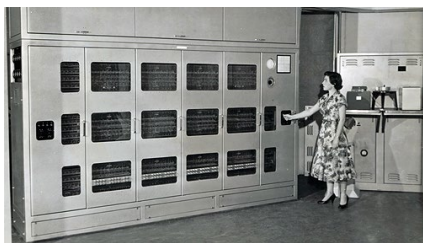
"I WAS RESPONSIBLE FOR DESIGNING, CONSTRUCTING AND TESTING THE MAIN CONTROL UNIT AND DECODING INSTRUCTIONS EXTRACTING OPERANDS, INITIATING INDIVIDUAL ARITHMETICAL AND LOGICAL PROCESSES, AND PROCEEDING TO THE NEXT INSTRUCTION. I ALSO DESIGNED, CONSTRUCTED AND TESTED THE BOOTSTRAP FACILITY."

JOHN BENNETT

Neville Sellwood. Basser said in later years that the money he donated for SILLIAC came from his race winnings.[66] That makes for a good story, except the two events were more than two years apart and he had made many other donations in the intervening period.

Basser was to be knighted for his contributions to Australian medicine and science. He later doubled his donation to Messel's endeavours, and the Computing Laboratory at the University of Sydney still bears his name.

The next step was finding someone to build SILLIAC. The Australian subsidiary of British company Standard Telephones and Cables (STC) was contracted to do the chassis and wiring, but would not be responsible for the project as a whole. The senior engineer was Brian Swire, hired out of the Government Aeronautical Research Labs in Melbourne. His deputy was John Algie, the man who had costed the project. Swire spent six months in Urbana getting to know the intricacies of ILLIAC, returning to Australia in March 1955. Construction of the two-tonne machine was completed in January 1956.

While Swire was in the US, he also visited a number of other early computer installations and companies, including Remington Rand in Philadelphia, which built the UNIVAC computers based on ENIAC; the IAS in Princeton, New Jersey; and the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, which had built a computer called Whirlwind for the US Navy. Whirlwind was a very important machine, as it was the first real-time computer and the first to use the magnetic core memory that became the standard for most early mainframe computers. Swire also visited IBM in New York, which was developing its 700 series machines.

Swire was tragically killed in a high-voltage accident in the University of Sydney's School of Physics Plasma Lab in 1964, one week before Adolph Basser died.

JOHN BENNETT

Messel needed someone to develop software and manage SILLIAC day to day. He found the right person in the form of John Makepeace Bennett, an Australian living in England at the time. Bennett's appointment was to prove another momentous decision.

Bennett was one of the major figures of the early Australian computer industry and the first President of the Australian Computer Society. He was a major contributor to EDSAC, one of the world's first stored-program computers, and Australia's first Professor of Computer Science.

Born in the southern Queensland town of Warwick on 31 July 1921, he was educated at The Southport School – a prestigious Anglican boarding school – and the University of Queensland, where he studied civil engineering. He later said, perhaps only half in jest, that the main reason he decided on civil engineering was that his older brother Ron had done the course and he could use his lecture notes.[67]

Bennett joined the Royal Australian Air Force in 1942, working in a radar unit in the Wessel Islands off Arnhem Land, which sparked a lifelong interest in Aboriginal culture.[68] After the war he returned to the University of Queensland as part of the Commonwealth Reconstruction Training Scheme, a program that provided further education to returned servicemen.

Bennett studied mathematics and electrical and mechanical engineering at the university, including a work experience stint at the Electrotechnology Section of the Council for Scientific and Industrial Research, which was to become the Commonwealth Scientific and Industrial Research Organisation, better known as the CSIRO. There he met Trevor Pearcey.

Bennett's interest in computing was aroused in 1947 when he was forced to carry out a large number of repetitive calculations for Brisbane's post-war electricity network.[69]

He heard about the work on automatic computing being conducted in the UK and applied to join the National Physical Laboratory, which was developing the ACE (**A**utomatic **C**omputing **E**ngine) in London.

He was accepted, and by chance his application was passed through to Douglas Hartree, Chairman of Cambridge University's Mathematical Laboratory (see Chapter 3). When he arrived in England in late 1947, Bennett became the first research student assigned to the Laboratory's head, Maurice Wilkes.[70]

Bennett became a member of the team developing the EDSAC (**E**lectronic **D**elay **S**torage **A**utomatic **C**alculator). He played a major role in developing this seminal machine, which was the most advanced computer in the world at that time and the first stored-program computer in regular operational use. He later wrote:

- ■ "I was responsible for designing, constructing and testing the main control unit and decoding instructions extracting operands, initiating individual arithmetical and logical processes, and proceeding to the next instruction. I also designed, constructed and tested the bootstrap facility."[71]

Bennett programmed the world's first structural engineering calculations on EDSAC, using the work as part of the PhD the University of Cambridge awarded him in 1952.[72] He stayed in England for nearly ten years, from his mid-20s to mid-30s, holding senior design positions with Ferranti – which built the world's first commercially available computer – and designing the instruction set for the Ferranti Mark 1.

While at Ferranti, Bennett met Mary Elkington, a graduate of the London School of Economics. They married in 1952 and had four children. In November 1955, Messel approached Bennett and invited him to take charge of SILLIAC in the newly created position of Numerical Analyst in the University of Sydney's School of Physics.

SILLIAC RAN ITS FIRST SUCCESSFUL 'LEAPFROG' TESTING PROGRAM ON 4 JULY 1956. LEAPFROG FEATURED AT THE UNIVERSITY OF SYDNEY'S OPEN DAY ON 22 JULY AND SILLIAC WAS FORMALLY INAUGURATED ON 12 SEPTEMBER. JUST ONE DAY EARLIER, THE NSW UNIVERSITY OF TECHNOLOGY UNVEILED ITS FIRST COMPUTER, CALLED UTECOM (**U**NIVERSITY OF **TE**CHNOLOGY **COM**PUTER. BUT SILLIAC WAS THE FIRST TO BE OPERATIONAL.

Bennett saw the opportunity and gave up the offer of a high-paying job with IBM in England to return to Australia in February 1956.

SILLIAC IN OPERATION

One of the most advanced computers in the world, SILLIAC was one of the first computers to be dubbed a 'supercomputer', and was much more powerful than Pearcey's CSIR Mark 1. It was a parallel machine, which greatly increased its computational speed. It was also comparatively compact – 3 metres wide, 2.5 metres high and just 0.6 metres deep, containing 2,768 vacuum tubes (expanded to 2,911 after a 1957 upgrade).

Most of the valves were high-quality 2C51 twin triodes, about the size of a large human thumb. They were much more reliable than the tubes used in ILLIAC, which gave SILLIAC a Mean Time Between Failures (MTBF) of 11 hours – extraordinary for its era. Modified versions of these valves are still in production today, mostly to provide the mellow sound of high-end audio amplifiers.

The 2C51 vacuum tubes and its solid construction meant SILLIAC developed a reputation as the most reliable computer in the world. It had a 1,024-word RAM (random access memory) provided by 40 Williams-Kilburn tubes, a type of cathode ray tube used as memory in many early computers. Each tube held one bit of each 40-bit word, meaning a total memory capacity of 1,024 x 40 bits, or about 5 KB in modern parlance. It used paper tape for input/output, and there was no external storage until the addition in 1958 of four magnetic tape units. It took 20 kilometres of wiring to connect all the components.

SILLIAC was first switched on in March 1956, a few weeks after Bennett had arrived from London (though the exact date is not recorded). The first few months were devoted to testing its various components – it could do nothing useful until its memory was installed in May.

By June 1956, Bennett had written a

programming manual that incorporated much of the work done at ILLIAC. He also found time to develop and deliver Australia's first university course in computer programming, which ran over two evenings a week from June to August and attracted 50 students.[73]

SILLIAC was in demand before it was switched on. The Snowy Mountains Hydro-electric Authority (SMHA) was the largest external user of the CSIR Mark 1 and was keen to get time on a more powerful computer. Formed in 1949 to construct and manage the massive civil engineering program that was the Snowy Mountains Scheme, the SMHA needed large amounts of computation for modelling such things as optimised tunnel diameters, dam walls, and water and electricity flows.

In March 1956, shortly after Bennett had arrived in Australia, the SMHA invited him to its Cooma headquarters to discuss its computing requirements and the extent to which SILLIAC might be able to meet them.

Following four days of intensive meetings, the SMHA decided to try to hire Bennett as a consultant, train one of their engineers to operate SILLIAC, prepare a trial problem, investigate options for the SMHA's own computing equipment, and as soon as possible use SILLIAC to process survey data. The anticipated quantity of this data focused attention on the idea of a high-capacity storage device for SILLIAC. Bennett recommended that this should be magnetic tape and that that it should be provided at high priority.[74] The problem was there was no such storage commercially available and the construction of SILLIAC had already gone significantly over budget.

SILLIAC ran its first successful 'Leapfrog' testing program on 4 July 1956. Leapfrog featured at the University of Sydney's open day on 22 July and SILLIAC was formally inaugurated on 12 September.[75] Just one day earlier, the NSW University of Technology unveiled its first computer, called UTECOM (University of TEchnology COMputer – see Chapter 5). But SILLIAC was the first to be operational.

SILLIAC's launch was a significant event, attended by the Administrator of Australia (acting Governor-General) Sir John Northcott; the University's Chancellor and Vice-Chancellor; and the man who had made it all happen with his donation of £50,000, Adolph Basser, who spoke at the launch.

"I helped bring SILLIAC into the world," Basser said.[76] "I have every intention of seeing that it is well reared." With that, he announced a donation of an extra £50,000, half to cover the budgetary overspend and half to cover the cost of developing and installing magnetic tape storage for the machine. Messel and Bennett had not dared ask Basser for more money and had been desperately seeking funding from other sources to improve SILLIAC's data storage capabilities to meet the SMHA's requirements.

When Sir John Northcott flicked the white switch that officially turned SILLIAC on, it replied with a printout:

THANK YOU, YOUR EXCELLENCY FOR DEDICATING ME TODAY.
AND THANK YOU, DR. BASSER, FOR MAKING ME POSSIBLE – SILLIAC.[77]

The opening ceremony handouts included a list of the sorts of tasks SILLIAC was capable of: nuclear physics, low-temperature analysis, cosmic ray shower analysis (its original justification), aeronautics, telephone routing, road traffic control, retail store planning – even diet and nutrition optimisation.[78]

That list shows that the SILLIAC team realised the wide range of applications for computers, many of which were soon translated into practice. Charging out time on SILLIAC became a major source of revenue for the School of Physics, which received requests from Qantas, Woolworths, STC, the Australian Gas Light Company (AGL) and the Postmaster-General's

Department (which used it for Australia's first computerised payroll system).

IMPROVING SILLIAC

The biggest potential user after the School of Physics itself was the SMHA. This made the search for suitable magnetic tape storage of critical importance. Some computers of that era – like SILLIAC's progenitor ILLIAC, and UTECOM – used magnetic drum storage, which was much faster and useful for compute-intensive applications. But the great advantage of magnetic tape was that it could store much more data, limited only by the length and number of tapes, which could be stored offline and loaded as needed. Tape storage was much slower to access, as each tape needed to be read sequentially, but that was not an important issue in the sorts of applications the SMHA was pursuing.

SILLIAC Chief Engineer Brian Swire made another long trip to the US in late 1956, visiting all the sites where magnetic tape drives were in operation. The SILLIAC team eventually settled on a tape drive from US company ElectroData, which was then in the process of being acquired by Burroughs Corporation, greatly accelerating that company's move into electronic computing (see Chapter 8).

The ElectroData 544 was the first commercially available magnetic tape drive for computers. It used six tracks on ¾-inch (2 cm) wide tapes, each 2,500 feet (750 metres) long.

■ "Data was recorded on the tape in fixed, 20-word blocks. Each word in a block consisted of 11 data digits ... plus a spacer digit. The tape moved at 60 inches/second, recording at 100 bits/inch. In addition to data words, each block had a header that contained the address of that block, numbered 0-9999.

■ "A block on tape required 2.4 inches for data, 0.08 inch for the header, and 0.3 inch for an inter-block gap, for a total of 2.78 inches. Read time was 46 ms per block,

> DATA WAS RECORDED ON THE TAPE IN FIXED, 20-WORD BLOCKS. EACH WORD IN A BLOCK CONSISTED OF 11 DATA DIGITS ... PLUS A SPACER DIGIT. THE TAPE MOVED AT 60 INCHES/SECOND, RECORDING AT 100 BITS/INCH. IN ADDITION TO DATA WORDS, EACH BLOCK HAD A HEADER THAT CONTAINED THE ADDRESS OF THAT BLOCK, NUMBERED 0-9999.

plus 6 ms start time to bring the tape up to speed at the start of an operation." [79]

That meant each tape could store around 300 KB, a massive amount for the time. But because of delays in the ordering process – including getting an import licence – and supply problems in the US because of massive demand driven by the computing boom, the ElectroData tape drive did not arrive in Australia until November 1957.

Coupling the tape drive with SILLIAC meant adding 143 vacuum tubes to the machine, increasing the total to 2,911. The tape drive was installed over Christmas 1957, but operational difficulties resulted in another extended trip to the US, this time by John Bennett, to examine best practice in using magnetic tape storage.

The tape system did not work properly until the end of 1958, more than two years after Basser had funded its purchase and installation. Even then, there were continuing problems. Ultimately, SILLIAC would have four tape drives attached.

It was worth the wait. The revamped SILLIAC was a vast improvement on the original machine, and during the intervening three years there had been significant advances in its USbility and reliability. The knowledge of operators had also greatly improved, not least because of the computer courses Bennett had designed. SILLIAC was now in use virtually around the clock.

As had been anticipated, the SMHA became a major user, but by this time it had decided to build its own machine. It was to be called SNOCOM (**SNO**wy **COM**puter) and would be one of the first transistorised computers in the world (see Chapter 8).

SILLIAC remained in operation until May 1964, long after newer computers made it obsolete. It was replaced by an off-the-shelf English Electric KDF9, a much more powerful transistorised machine that ran 20 times faster. One of the KDF9's most important pieces of software was a SILLIAC emulator, which allowed all of the older machine's programs to be gradually moved over onto the newer computer.

The KDF9 was one of the first British solid-state computers. Only 29 of these advanced machines were ever built, and the University of Sydney received one of the early models. Its purchase was made possible by a gift of £250,000 from noted philanthropist Dr Cecil Green, a Vice President and early investor in the US semiconductor company Texas Instruments.

SILLIAC ended its life as a peripheral device to the KDF9. Despite being a much newer machine, the KDF's tape drives were temperamental and SILLIAC had four reliable tape drives, although they could not be adapted for the KDF9 in any way other than building a data communications link between the two. This link became one of the world's first local area networks.

In 1968, SILLIAC was given to School of Physics honours students as a plaything. But it was too old and too difficult to maintain, and was turned off for the last time on 17 May 1968. Its final act was to play Chopin's funeral march on its loudspeakers, programmed onto paper tape for the occasion.[80]

John Bennett is regarded as the most important figure in the early history of computing at the University of Sydney. But the first computer-related courses in any university in Australia were those taught by Trevor Pearcey in the university's Department of Mathematics from 1947 to 1952, in the early years of the Mark 1 computer. These were extracurricular courses in the theory of computation, computing practices and the principles of programming.[81]

Pearcey's courses were very early and very basic. It was not until the installation of SILLIAC in 1956 that further courses were introduced. These courses, run by Bennett, were also extracurricular and designed to introduce staff and students to the practicalities of computing.

■ "Courses of a few weeks' duration in the techniques of programming in the mode appropriate to each machine included some practical experience in running an actual computational task, so practical experience in the handling and operation of at least one computer was provided."[82]

Bennett said that because his courses were not part of any degree, attendance dropped off during exams.[83] In 1959, the University of Sydney introduced Australia's first academic course in computing, a Diploma in Numerical Analysis and Automatic Computing. The name was later changed to the Diploma in Computer Science, because it was thought 'numerical analysis' dissuaded potential students. [84]

Bennett became the university's Professor of Physics (Computing) in 1961, the first such position in Australia. The Basser Computing Department within the university's School of Physics was named after Adolph Basser, and in 1971 was split in two to form the Basser Computing Centre (which moved to its own building in 1972) and the Basser Department of Computer Science.

The department has now been expanded into the School of Information Technologies, though Basser's name lives on in the Basser Seminar Series, which specialises in innovative information technologies. Bennett was appointed Chair of Computer Science in 1982.

■ "Many people cut their computing teeth on the SILLIAC. The Laboratory became an important source for the distribution of computing expertise throughout the country during the next years. Many of the students who graduated under Bennett were appointed to chairs in computer science as other universities throughout the country set up their own academic departments of computer science and computing centres or their equivalents."[85]

MORE INFORMATION

The best source on SILLIAC is John Deane's excellent book *SILLIAC: Vacuum Tube Supercomputer*, which goes into great detail about the machine's planning, construction and operations, and its technical specifications.

There are many sources on Harry Messel's long life. One of the most interesting is an interview on ABC TV's *Talking Heads* program, which aired on 9 March 2009. A transcript is available at **http://www.abc.net.au/tv/talkingheads/txt/s2505093.htm**. There is also a long audio interview in the National Library of Australia as part of the ACS's oral history project.

John Bennett was one of the editors of the ACS's 1994 book *Computing in Australia*, which contains an eight-page autobiographical snippet.

ILLUSTRIOUS CAREERS

In 1959, Bennett became the first Chairman of the Australian National Committee on Computation and Automatic Control (ANCCAC), an organisation he founded to promote computing around Australia (see Chapter 9). In 1965, he was named the first President of the NSW Computer Society, and when the state computer societies merged to become the Australian Computer Society (ACS) on 1 January 1966, he became first President of the national organisation.

After his retirement from the University of Sydney in 1987, Bennett remained an active member of the Australian and international computing community, serving on various boards of the ACS, International Federation for Information Processing (IFIP) and International Conference on Computational Creativity (ICCC). But he believed his greatest achievement was educating two generations of young Australian computer professionals.[86]

John Bennett was a true pioneer of Australian computing. He was made an Officer of the Order of Australia (AO) in 1983, and was awarded the Centenary Medal for services to Australian technology in 2001 and the Pearcey Medal in 2004. He died in Sydney, aged 89, on 9 December 2010.

Harry Messel also had an illustrious career, becoming perhaps Australia's best known scientist. He was a vocal advocate for higher-quality science education in Australian schools, especially for girls, whom he felt were often ignored. He was responsible for two major initiatives funded largely through his foundation – the International Science School, and an integrated science syllabus in Australian high schools.[87] He personally wrote the textbooks used in the syllabus – the 'blue books' – which are remembered by a generation of Australian school students.

Messel was also Chancellor and CEO of Bond University from 1990 to 1997. When he assumed the position the university was struggling, but by the time he left it was thriving. He was named a Companion of the British Empire (CBE) in 1979 and a Companion to the Order of Australia in 2006. He died in Sydney on 8 July 2015, at the age of 93.

UTECOM
SYDNEY'S SECOND UNIVERSITY JOINS THE COMPUTER ERA.

05

In addition to SILLIAC, two other computers were commissioned in Australia in 1956 – UTECOM at the NSW University of Technology, and WREDAC at the Weapons Research Establishment (WRE) in South Australia. Both were commercial models (highly modified in the case of WREDAC), built in England and shipped to Australia by the manufacturers.

The fact that it took almost seven years after the birth of the Mark 1 for another computer to appear in Australia demonstrates just how far head of his time Trevor Pearcey was. And the fact that three more appeared almost simultaneously indicates the speed of progress in the intervening period, marking the beginning of the computer age in Australia.

Then, in June 1957, Australia's second computer conference was held, six years after the first (see Chapter 3). It was held at the WRE, and attracted over 200 attendees, including many from the UK, the US and New Zealand (for WREDAC and this conference, see Chapter 6). This second conference showed that Australia now had a significant and vibrant computer scene.

In the years between CSIR Mark 1 in 1949 and the spate of new Australian machines in 1956, the theory and practice of electronic computing had grown substantially. Computers were still being designed and built from scratch, and they were still being given individual names, but the growing demand for 'electronic brains' was increasingly being met by companies producing standardised general-purpose computers for academia, government and commercial use.

This activity was largely confined to the US and the UK. Electronic computing had begun largely independently in both countries during World War II, but subsequently there was a great deal of cross-fertilisation, from which Australia benefitted. SILLIAC had US roots and UTECOM and WREDAC were both made in England.

ALAN TURING AND THE ACE

Just one day before the SILLIAC opening ceremony, a similar, if less dramatic, event was held five kilometres away in Kensington, at the new campus of the NSW University of Technology. SILLIAC's rival UTECOM was officially launched on 11 September 1956.

"TWO HIGH-SPEED AUTOMATIC ELECTRONIC COMPUTERS NOW IN SERVICE IN SYDNEY HAVE GIVEN AUSTRALIA COMPUTING FACILITIES COMPARABLE WITH THOSE OVERSEAS. BOTH ARE GENERAL PURPOSE COMPUTERS, BUT THEY DIFFER IN DESIGN AND OPERATING METHODS. THEY MAKE CALCULATIONS IN A FEW MILLIONTHS OF A SECOND, SOLVING IN SECONDS OR HOURS PROBLEMS THAT WOULD REQUIRE DAYS, OR EVEN MONTHS, BY OTHER METHODS."

THE SYDNEY MORNING HERALD, 12 SEPTEMBER 1956

UTECOM was the fifth of 33 DEUCE computers manufactured by British computer company English Electric. DEUCE was a contrived acronym for **D**igital **E**lectronic **U**niversal **C**omputing **E**ngine. It was an improved version of the ACE (Automatic Computing Engine) designed by British computer pioneer Alan Turing, who had also designed and built the Colossus electronic code-breaking machines used at Bletchley Park in England in World War II.

Turing was an enigmatic figure, one of the most influential in the early history of computing. The Turing machine, a theoretical model of how computers work, is named after him, as is the Turing test, regarded as the criterion for true artificial intelligence.

He was born in London on 23 June 1912 and died two weeks short of his 42nd birthday at his home in Wilmslow in Cheshire. The coroner believed his death was almost certainly at his own hand, from cyanide poisoning.[88]

Turing was a gay and had been charged with 12 counts of 'gross indecency' in 1952. He lucidly defended his actions, which he did not deny, and was placed on probation provided he submit to 'organo-therapy', or chemical castration.[89] He was granted a posthumous pardon in 2013.

Turing's wartime work remained secret for many years, though he was awarded an OBE in 1945. His work on cryptanalysis and the deciphering of German codes may have shortened the war by months or even years.

After the war, he moved to the National Physical Laboratory (NPL) in the London suburb of Teddington, where in early 1946 he submitted a detailed design for a stored program computer, which he called the ACE (Automatic Computing Engine).

Turing's plans for the ACE were quite ambitious, but because his work during the war could not be disclosed for security reasons, his colleagues at the NPL doubted whether it could be built. There were long delays as Turing worked to convince others of the value of his design. Meanwhile other computers were being designed and built in England, most notably the Baby and the Manchester Mark 1 at the University of Manchester by a team headed by Max Newman, who had been a colleague of Turing's at Bletchley Park, and the EDSAC at Cambridge.

Finally, the NPL decided to build a smaller version of Turing's machine called the Pilot Model ACE. It first ran on 10 May 1950. Its design was adopted and commercialised by English Electric, which called it the DEUCE. It remained in production until 1964.

A DEUCE FOR AUSTRALIA

The fifth customer for the DEUCE was the NSW University of Technology. The university, renamed the University of UNSW in 1957, was established in 1949 by the New South Wales Government in response to a shortage of scientists and engineers highlighted during World War II.[90] The university established an Institute of Nuclear Engineering in 1954 with a grant of £125,000 from the state government, intended to examine the use of nuclear power.[91]

An electronic computer was regarded as essential to the task, with the advantage that it could be used by other areas of the university. The Head of the School of Electrical Engineering, Professor Rex Vowels, planned to build a large computing department, and the University Council decided in late 1954 to use some of the grant money to purchase a computer.[92]

The university decided on the Turing machine, for reasons that were explained in the Graduate's Handbook of that year:

■ "The University has placed an order … for a digital computer known as the DEUCE (in the University this computer will be known as UTECOM). The DEUCE is based on the ACE Pilot Model and the National Physical Laboratory, which was built be a combined team of mathematicians and engineers.

■ "This Pilot model was intended as a forerunner to a much larger computer but since its inception in 1952 it has proved itself to be a very powerful computer in its own right. The DEUCE incorporates a number of improvements and additions to facilities, whilst a thorough overhaul of circuit design, a completely new physical layout and additional equipment for checking circuit operations have led to an extremely high reliability in DEUCE production models.

■ "The achievements of these computers are unique in the field of automatic computation. The considerable programming experience which led to these achievements is made available to all users in the form of a library of subroutines and programmes."[93]

The university set up an area to house UTECOM. It appointed Department of Electrical Engineering lecturer Ron Smart to manage it, and sent him to England for six months to study the design and maintenance

of the machine. Smart ran the machine until 1961, when he left to join Remington Rand. He was later to head up the Digital Equipment Corporation (DEC) in Australia (see Chapter 13).

UTECOM was installed in September 1956, just as SILLIAC was being installed at the University of Sydney (see Chapter 4). It was built at the English Electric manufacturing and research facility at Kidsgrove in Staffordshire, then tested, disassembled and shipped to Australia, arriving on 1 August 1956. Smart's experience and the machine's solid design meant it was fully operational just a month later.

Its mercury delay line memory provided about 1.6 KB of memory. It had 1,450 valves, with online memory provide by a magnetic drum of 32 KB. The computer itself came by sea, but this fragile device came by air, in its own seat.[94]

On its opening day, one of the most inquisitive attendees was cross-town rival John Bennett, eager to see how this

off-the-shelf English machine compared to SILLIAC (see Chapter 4). The two machines had very different design philosophies. SILLIAC, based on the von Neumann architecture, was a parallel machine suited to data-intensive applications. UTECOM, based on the Turing architecture, was a serial machine that required detailed programming knowledge. It was more suited to what have come to be called compute-intensive applications.

While WREDAC (see Chapter 6) was isolated in South Australia in a secure government research laboratory, SILLIAC and UTECOM were both in universities in Sydney. They attracted significant attention from the public and the press. In a very real sense, they were rivals.

Both machines were reliable by the standards of their day and, as general-purpose machines, adaptable to most of the jobs they were asked to do. *The Sydney Morning Herald* ran a three-page supplement on the two machines on 12 September 1956, describing them in considerable detail. It was the first in-depth computer feature in any Australian newspaper.

The supplement makes fascinating reading, with articles on both the CSIR Mark 1 and WREDAC (though it incorrectly dates the Mark 1 from 1951 rather than 1949). It discusses the technology, applications, and people involved. Equally interesting are the advertisements, from STC, NCR, English Electric, British Tabulating Machine, Kalamazoo, IBM and Burroughs.

A Layman's Guide described the machines' operations, and their uses in industry and commerce were outlined. 'Welcome News – Drudgery Ended in Many Business Systems', one headline optimistically predicted. The three pages are reproduced at the end of this chapter.

A major upgrade in 1958 saw automatic indexing and 64-column input-output, which doubled I/O speed. Another in 1963 installed a Siemens teleprinter and enhancements were made to the magnetic drum storage.[95] The ACE and DEUCE machines had the only movable head magnetic drums ever built.[96]

UTECOM had a major influence on the subsequent development of computer hardware in the United Kingdom. Professor Charles Hamblin, a logician in the NSW University of Technology's Philosophy Department, developed a new way of programming UTECOM based on the use of Reverse Polish Notation, a way of writing mathematical equations that put numbers before operational symbols.

Hamblin called the technique 'interpretive programming', and named it GEORGE, for **GE**neral **O**rder **GE**nerator. It was essentially what we would call today a compiler. He presented the idea at the WRE computer conference in 1957 (see Chapter 6), which was attended by representatives of the English Electric company, at that stage one of the leading computer manufacturers and later to become part of International Computers Limited (ICL – see Chapter 27). They took the idea back to England, where it was incorporated into the hardware of the company's next generation machine, the transistorised and widely used KDF9.

UTECOM was as popular with outside users as SILLIAC, but because it was shared across departments it had a higher proportion of university work. In an address to the Conference on Data Processing and Automatic Computing Machines held at the WRE in June 1957 (see Chapter 6), Ron Smart described some of UTECOM's applications:

■ "The type of work carried out in the Laboratory covers a wide range. A considerable amount of statistical calculations have been done and many of these were programmed using the matrix algebra interpretive system. Only 18 percent of the total computing done to date has been for outside organisations (though) the proportion of work for outside organisations is steadily growing."[98]

BELOW: An early DEUCE ad -
CREDIT ENGLISH ELECTRIC

Smart listed some of the projects conducted on UTECOM:

- Payroll, in conjunction with the NSW Public Service Board
- Electrical Network Synthesis
- Induction Motor Design
- Hydrology, in connection with flood control and the design of dams
- Linear Programming
- Market Analysis
- Program Library. (The English Electric Company operated a scheme for the interchange of programming information between DEUCE users).

UTECOM remained the main workhorse when the School of Electrical Engineering was reorganised into four departments, including a Department of Electronic Computation, in 1962.

Like SILLIAC, UTECOM had a long life, extended by the 1963 upgrade. But valve computers were on the way out as transistors became popular, and magnetic core memory was superseding the slower delay tubes and CRTs. UTECOM was replaced by an IBM 360/50, installed at the university in October 1966. This machine was 50 times faster than UTECOM, which was decommissioned in December 1966 and broken up for scrap. Only the drum (now in the Computer Museum in Silicon Valley), some memory tubes and a few racks of electronics were saved.

In 1961, the UNSW bought an IBM 1620, named DUCHESS, for £500,000. It was primarily used by the Traffic and Highway Engineering School and by the university administration for payroll. Another IBM 1620 was soon bought by the School of Chemical Engineering.[99] In 1967, the Chemistry Department and Electrical Engineering Department each installed a DEC PDP-8. In 1974 a Control Data Corporation CCDC Cyber 74 was installed, with a dozen DEC PDP-11s, in what was one of Australia's largest local area networks.

Academic teaching in computer science

BELOW: An early DEUCE ad -
CREDIT ENGLISH ELECTRIC

at the UNSW was slow to get started,[100] but accelerated with the appointment of Murray Allen as foundation professor of Electronic Computation and director of the Digital Computing Laboratory in 1965.

As a PhD student at the University of Sydney, Allen had been the chief designer of SNOCOM (see Chapter 7) for the Snowy Mountains Hydro-electric Authority. He subsequently went to the University of Adelaide, where he was part of the Cirrus design team (see Chapter 8), then worked briefly with Control Data Corporation in the US.

■ "In the Department of Electronic Computation, the main research activity continued to concentrate on the development of a graphics data system. This consisted of a special purpose computer, Intergraphic [see Chapter 7], coupled to a communications network and terminal sets based on television techniques.

■ "The system was designed to produce an order of magnitude reduction on the cost of general purpose graphic terminals and the project was supported by the Australian Research Grants Committee. Software projects were also conducted in related fields including operating systems, graphical languages, information retrieval and console mathematics. Other project areas included speech recognition, optimum job scheduling and digital instrumentation."[101]

In 1972, the department was renamed the Department of Computer Science. By 1978, one-third of electrical engineering students were doing a component of computer science in their degrees.[102]

MORE INFORMATION

Historian John Deane wrote a short history and technical overview of UTECOM, *A Turing Machine for the University of NSW*, published by the Australian Computer Museum Society.

Alan Turing's fame continues to grow as the extent of his contributions to computer science become more apparent. An excellent and detailed biography is *Alan Turing, The Enigma of Intelligence* by Andrew Hodges.

The Sydney Morning Herald supplement of 12 September 1956 is a fascinating glimpse into the extent of public knowledge of computers at that time. The reproduction in this book is of low resolution and impossible to read, but the original can be found in the Fairfax archives and in many libraries.

ABOVE: An early DEUCE ad – CREDIT ENGLISH ELECTRIC

FIRE ACROSS THE DESERT
WREDAC AT THE WEAPONS RESEARCH ESTABLISHMENT.

06

In 1946, the UK and Australia established the Anglo-Australian Joint Project to test rockets, atomic bombs and other weaponry. Australia had the large areas of virtually uninhabited land needed to test such devices, and in return was given access to the technology the project developed.

The initial impetus for the program came from the UK's desire to develop a long-range rocket similar to Germany's V-2, the world's first ballistic missile.[103] (The 'V' stood for the German word *vergeltung*, meaning 'revenge' or 'retribution'.) The UK wanted a test site at least 800 kilometres long, but Europe was too densely populated and firing over water would limit the ability to recover missiles.[104]

The decision was spurred by the Cold War and the desire to develop atomic weapons and the means to deliver them. A purpose-built town – Woomera – was established in central South Australia, 450 kilometres north of Adelaide. At its peak in 1960, Woomera had a population of 7,000, and at one stage the Woomera Test Range covered a quarter of the entire state.

Under the Joint Project, Australia was the site of the UK's first atomic weapons testing. These tests were not conducted at Woomera, but at the Montebello Islands off the northern coast of Western Australia in 1952 and 1956, and at Maralinga in the desolate west of South Australia in 1956 and 1957.

Tests were conducted above ground; radiation from Montebello radiation was detected as far east as Mount Isa, and the Maralinga blasts caused massive contamination and the radiation deaths of many of the native Tjarutja inhabitants of the region, and some Aboriginal women miscarried.[105]

In 1947, to support the Joint Project, the Australian Government initiated the Long Range Weapons Establishment (LRWE) in an old munitions factory at Salisbury, just north of Adelaide. Populated largely by British scientists, it was renamed the Weapons Research Establishment (WRE) in 1955 with the incorporation of other Australian Department of Defence research laboratories.

One of the best-known pieces of technology to come out of the WRE was David Warren's invention the 'black box' flight recorder – still used by commercial aircraft worldwide – in 1957. In 1974, WRE and all other Australian Defence

"OTHER APPLICATIONS OF THE WREDAC COMPUTER HAVE BEEN EXPLOITED OUTSIDE THE FIELD OF GUIDED MISSILES. FOR EXAMPLE, IT HAS ALREADY BEEN APPLIED TO A VARIETY OF CALCULATIONS ARISING IN AERODYNAMICS AND AIRCRAFT STRUCTURES, AND NOW THE POSSIBILITY OF ITS USE FOR BUSINESS CALCULATIONS IS UNDER CONSIDERATION. AN OFFICER OF THE PUBLIC SERVICE BOARD HAS SPENT SOME TIME HERE STUDYING THE WREDAC IN ORDER TO REPORT TO THE BOARD ON THE POSSIBLE APPLICATIONS OF HIGH-SPEED DIGITAL COMPUTERS IN GOVERNMENT DEPARTMENTS."

JOHN OVENSTONE, OPENING ADDRESS TO THE WRE COMPUTER CONFERENCE, 1957

research facilities were incorporated into the new Defence Science and Technology Organisation (DSTO).

A COMPUTER FOR THE WRE

The weapons testing activities at Woomera involved detailed mathematical calculations, and by the early 1950s the WRE became interested in the new electronic computers. The decision to purchase one came about largely as a result of the efforts of John Allen-Ovenstone, who had worked on the CSIR Mark 1 in Sydney and EDSAC in Cambridge. He was later instrumental in introducing computers into the Australian Public Service (see Chapter 14), and would later become the first Professor of Computing Science at the University of Adelaide. (He dropped the hyphenated surname and started calling himself John Ovenstone in 1958.)

Ovenstone joined the LRWE in 1950, immediately travelling to the UK to complete a doctorate in mathematical science at the University of Cambridge. When he returned to Australia in 1953 he developed a specification for a computer for the LRWE, which favoured calculating power over input/output (I/O) requirements.[106] The LRWE had previously considered a Ferranti Mark 1 but withdrew from the deal when the price quadrupled.[107]

The LRWE sent its requirements to a number of British computer manufacturers and despatched Ovenstone back to the UK, along with engineer George Barlow, to look at the various options. They visited English Electric and Ferranti, but could not find what they were looking for.

Still looking for an appropriate machine, Ovenstone and Barlow were back in England barely a year later. This time they also visited Elliott Brothers, a century-old instrumentation company that had moved into electronic computers after World War II. The new Elliott 402 seemed to satisfy the LRWE's requirements. Elliott's engineers

BELOW: WREDAC - CREDIT OUR COMPUTER HERITAGE

were working on various add-in modules to increase the 402's power and functionality. The called the enhanced computer the 403 Project, and it seemed to fit the LRWE's requirements.[108] The LRWE placed an order in early 1955, about the same time it was renamed the WRE.

The modified machine was officially an Elliott Model 403, though the WRE would always to call it WREDAC (**WRE D**igital **A**utomatic **C**omputer). In tribute to Aussie slang, Elliott's engineers called it 'Cobber' while it was being built and tested at the company's manufacturing facility at Borehamwood in Hertfordshire.[109]

WREDAC was a big computer – no more powerful than its Australian contemporaries (see the table at the end of this chapter), but physically much larger due to its modular design. Sixteen large cabinets nearly 2 metres tall formed a U shape about 6 metres wide with 3-metre arms. WREDAC also needed substantial power supplies and a separate air-conditioning plant.

The system comprised a processor cabinet – where the operator stood to program the machine by flicking switches – and seven cabinets housing the 1,600 12AT7 twin triode valves that formed the machine's logic circuitry. The remaining eight cabinets housed the circuitry that controlled the I/O devices.

The WRE's requirements for specialised peripherals made WREDAC unique and set it apart from the Elliott Model 402 on which it was based. It was to be the only Model 403 that Elliott ever made.

It had the equivalent of 2 MB of nickel delay-line memory, and a 68 KB magnetic disk drive. Unlike other rotating magnetic disk memories, the WREDAC disk had fixed heads, which had to be adjusted to something like one or two thoUSndths of an inch off the disk surface. This was impossible to maintain and led to many head crashes, rendering those tracks forever useless. "It was a proper beast," said

engineer Peter Main, who was charged with its maintenance.[110]

Because of its primary role in tracking rocket trajectories, WREDAC had four plotters attached – quite an innovation at the time – and specialised input convertors for rocket telemetry tapes. The plotters were early Mufax facsimile machines, modified by Elliott, which printed four lines of dots per second.

WREDAC arrived in Adelaide by sea in September 1955, accompanied by three Elliott engineers, who reassembled and tested it at the WRE facility in Salisbury. The output subsystem (called WREDOC) did not arrive until May 1956, and WREDAC did not start performing useful work until July 1956.

WREDAC IN OPERATION

While WREDAC was being assembled and tested in Salisbury, Ovenstone wrote *An Introduction to Programming for Automatic Digital Computers*, which included detailed explanations on how to program it. He also wrote the basic system software, a compact symbolic program loader on the same principles used by EDSAC.[111]

WREDAC's primary task was tracking missiles. WRE's operators received films from pairs of kinetheodolites – devices containing movie cameras that could track a moving target through the air. These films were manually processed to convert the frame-by-frame output of the missile's azimuth and elevation onto paper tape. This output had to be combined with telemetry data – radio transmissions from the rockets themselves – which arrived on magnetic tape.

- "The received data is recorded directly on magnetic tape. The data is played back at a slower speed into a fully automatic measuring device which measures the data as it comes along, sample by sample, and codes those measurements in binary-digital code.

- "The machine will work for hours, even

days, at a time. These measurements, which are now recorded on magnetic tape in binary-digital code, are played into a high-speed electronic digital computer [WREDAC].

■ "The output of the computer is then recorded again on a third magnetic tape, and also, as willed, can be tabulated very rapidly using a fast printer ... or, by using another type of decoder, caused to plot graphs at very high speed on anything up to 12 simultaneous channels.

■ "The pay-off of this system can be expressed very simply and briefly. To process completely 10,000 data by relatively up-to-date manual methods required a total of 20 working hours. The automatic system does the entire job in a total time of fifteen minutes."[112]

Ovenstone made a major improvement to WREDAC in 1957 by building a proper operator's console. The original console was an array of switches and two modest display tubes built into a processor cabinet, which had to be operated standing up. The replacement was an impressive looking desk with switches, dials and two cathode ray tube (CRT) screens.[113]

Then in October 1957, the USSR put Sputnik I into orbit and the space race began. Ovenstone remembers the urgency this instilled into WRE's operations:

■ "We at WRE were asked if we could track it, using our kinetheodolites and associated programs. Established to track objects at about 10 km altitude, the instruments were sited about that far apart. For an object in orbit at over 150 km altitude the pairs of sight lines were nearly parallel, but we did our best.

■ "With ICBMs in our impending future, two widely spaced telescopes were already being installed (at Woomera and near Perth). Called Baker-Nunn cameras, these were motorised and could be programmed to stay on a fixed sky object as Earth moved or even to track a moving object. With

THE TRUE SIGNIFICANCE OF WREDAC AND THE WRE'S WORK BECAME APPARENT TO THE WIDENING COMPUTER COMMUNITY WHEN OVENSTONE ORGANISED A MAJOR COMPUTER CONFERENCE IN SALISBURY ON 3-8 JUNE 1957.

precisely timed shutter closures allowing precise measurement of position via known stars, these gave us much better data for tracking Sputnik."[114]

THE 1957 WRE COMPUTER CONFERENCE

The true significance of WREDAC and the WRE's work became apparent to the widening computer community when Ovenstone organised a major computer conference in Salisbury on 3-8 June 1957. The Data Processing and Automatic Computing Machines event was Australia's second computer conference since the pioneering event organised by Trevor Pearcey and David Myers in Sydney in August 1951 (see Chapter 3).

WRE gave three objectives for the event in the introduction to the published conference proceedings:

- ■ "To tell the many interested people and organisations of our experiences and to show them our system and equipment and demonstrate our operations.
- ■ "To get intelligent and constructive criticism of our methods from those versed in the art with a view to improving our techniques and operations.
- ■ "To provide sound advice from our own staff, and the many renowned visiting delegates and lecturers, to those business and technical delegates interested in the use of such machines in their own spheres of activity."[115]

The conference was a great success, attracting over 150 delegates from Australia, the UK, the US and New Zealand. It was split into three sections: Programming and Mathematics, Engineering, and Business Applications.

Sixty-eight papers were presented over the six days of the conference, from:

- ■ Australia: CSIRO, Kalamazoo, NSW University of Technology, Snowy Mountains Hydro-electric Authority, University of Adelaide, University

of Melbourne, University of Sydney, University of Tasmania and WRE.
- ■ UK: British Tabulating Machines, University of Cambridge, EMI Electronics, English Electric, Ferranti, National Physical Laboratory, NCR, Royal Aircraft Establishment, Royal Radar Establishment, of Leeds, University of London and University of Manchester.
- ■ US: Burroughs, IBM, Patrick Air Force Base, RCA and University of Michigan.

There were eight presentations about WREDAC and its work, 14 relating to the other three Australian computers (CSIRAC, UTECOM and SILLIAC); eight on computing in the UK; eight from commercial suppliers; and others on analog computing techniques and a range of technical issues. WREDAC was also on display, demonstrating its capabilities to the attendees.

The conference proceedings provide a remarkable description of the early days of digital computing in Australia and the UK. Many of the papers were subsequently very influential in further developments in the field.[116]

THE END OF WREDAC

WREDAC was performing well, but like all computers of that – and any other – era, it was quickly being made obsolete by newer machines. In particular, the first generation of valve-based machines were being challenged by much faster and more reliable machines using solid-state transistors for their logic circuitry.

At the end of the 1950s, only four years after WREDAC began operations, the WRE began evaluating its replacement.[117] At the same time, the UK was considering the Blue Streak, a new long-range intercontinental ballistic missile. It was intended that the WRE would have had a major role in its development.

The search for a replacement computer settled on IBM's new 7090, which was nearly

By far the best source of information on WRE is Peter Morton's magisterial *Fire Across the Desert: Woomera and the Anglo-Australian Joint Project*, which is still in print. It in an official history sanctioned and published by the Australian Government, but Morton is adamant that he was not censored, and its official status ensures he had access to a trove of government documents.

The best source on WREDAC itself comes from the indefatigable John Deane, who also documented CSIRAC, SILLIAC and UTECOM – in great detail and largely at his own expense. His contributions to chronicling the early days of computing in Australia are invaluable. His chapter on WREDAC in *Reflections on the History of Computing*, amusingly named 'WREDAC – It *Was* Rocket Science', is the best source available. That book was edited by Australian Arthur Tatnall and is still in print.

The proceedings of the 1957 WRE computer conference offer a valuable insight into the early days of digital computing, especially in Australia and the UK. The complete two-volume document is available in the National Library of Australia and in many Australian university and state libraries.

100 times faster and could perform trajectory calculations at one-fifth the cost of WREDAC, even at its rental cost of US$330,000 a year. (IBM's business model meant that it initially only rented out its computers. It did not sell them outright until many years later.)

During this time the UK was slowly beginning to recognise that it was no longer a global superpower, the Blue Streak project was cancelled, with the focus turning to the delivery of nuclear weapons from submarines. But the arguments in favour of the IBM 7090 remained compelling. The new machine was ordered in March 1960 and installed at the WRE in February 1961. As well as its superior performance, two great advantages of the 7090 were its large library of available software and its use of the recently standardised Fortran programming language.

WREDAC and the 7090 ran in parallel while the WRE's programs were rewritten in Fortran. Telemetry processing and missile range data conversion were updated, and the 7090 soon took over the day-to-day missile trials analysis. WREDAC still did some work – such as analysing missile wind tunnel tests and completing some statistical and mathematical tasks – but high maintenance costs meant its days were numbered.

At the end of 1962, after seven years in service, WREDAC was retired. Most of it ended up as scrap, though some components remained valuable enough to be returned to Elliott in the UK as spare parts.[118]

AUSTRALIA'S FIRST FOUR COMPUTERS

NAME	CSIR MARK 1	SILLIAC	WREDAC	UTECOM
Provenance	Designed by Trevor Pearcey and Maston Beard, built by the Council for Scientific and Industrial Research (CSIR) in Sydney. Only the fourth stored-program computer in the world.	Built in Sydney to the plans of ILLIAC, University of Chicago, Urbana, US. One of 18 in the IAS family, designed at the US Institute for Advanced Studies.	Modified Elliott 402. Designed and built in England for WRE and shipped to Australia. Designated the Model 403, the only one ever made.	English Electric DEUCE. Production machine built in England and shipped to Australia. Number 5 of 33 built.
First operation	November 1949	July 1956	July 1956	September 1956
Location	CSIR Radiophysics Laboratory, University of Sydney. Shipped to University of Melbourne and renamed CSIRAC, 1956.	Department of Physics, University of Sydney.	WRE, Salisbury, South Australia.	NSW University of Technology (renamed University of NSW in 1958). Shared between departments.
Number of valves	c. 2,000	2,768 (2,911 after 1958)	c. 1,600	1,450
Main memory	Mercury delay line (1.9 KB)	Williams–Kilburn CRTs (5 KB)	Nickel delay line (2 KB)	Mercury delay line (1.6 KB)
External storage	Magnetic disk (10 KB)	Magnetic tape (after 1958)	Magnetic disk (68 KB)	Magnetic drum (32 KB)
I/O	Paper tape	Paper tape	Paper tape and magnetic tape	Punched cards
H × W × D	2.4 m × 4 m × 2 m	2.5 m × 3 m × 0.6 m	2 m × 6 m × 2 m	1.5 m × 4 m × 2 m
Weight	c. 2,000 kg	c. 2,000 kg	n/a	1,194 kg
Decommissioned	November 1964	May 1964	December 1962	December 1966

The table above compares the specifications of Australia's first four computers. They had very different histories and design philosophies, but were similar in many ways. The specifications of SILLIAC, UTECOM and WREDAC show just how remarkable Trevor Pearcey's CSIR Mark 1 was, predating them by seven years.

There is debate over which one of these later three computers was first operational, and thus the second computer in Australia. UTECOM and WREDAC were built in England and tested and disassembled before being shipped to Australia, so technically they were first switched on by their manufacturers some time in 1955. SILLIAC was built in Australia and tested before the two imports had been reassembled after their arrival. UTECOM's official launch was the day before SILLIAC's. WREDAC most likely ran its first program before the other two.

It is not a debate we need enter. The three later machines and the teams using them operated independently of each other, and the actual dates each machine began operating, depending on how that is defined, were so close as to be essentially simultaneous. The number of computers in Australia had quadrupled overnight and Australia had truly entered the computer age.

AUSTRALIA'S LAST DESIGNS
DID AUSTRALIA MISS THE OPPORTUNITY TO BE A MAJOR PLAYER IN THE GLOBAL COMPUTER INDUSTRY?

07

Australia was a world leader in the early days of computing, third after only the US and the UK. This was largely due to Trevor Pearcey's pioneering work on the CSIR Mark 1 (see Chapter 2), one of the first stored-program computers in the world.

But comparatively little happened after the Mark 1 – Australia didn't produce any more computers for another seven years. Three more machines – SILLIAC, UTECOM and WREDAC – entered service almost simultaneously around the middle of 1956 (see Chapters 4, 5 and 6). But none of these were actually designed in Australia. SILLIAC was built locally using a US design, and UTECOM and WREDAC were made in the UK.

More computers – including SNOCOM and Cirrus – were later designed and built in Australia. But the nation's early computing prominence soon faded, and Australian computer suppliers were just branch offices of US, British and – later on – Japanese companies.

When Australia's government departments and financial institutions started using computers, they had to purchase machines from these multinational vendors (see Chapter 8) – there were no Australian-made computers to buy.

Then, as now, many in Australia rued what they believed to be a lost opportunity. Australia, they said, could have had a vibrant computer industry, and become known for designing, manufacturing and selling machines locally, and exporting them globally.

It was not to be. There were a few attempts at local manufacturing during the minicomputer and microcomputer eras, but Australia never built the homegrown hardware industry that so many thought was possible. (Software and computer services have their own story, which we examine in Chapters 19 and 26.)

The myth of the lost opportunity persists to this day. Many believe that Australia had the expertise to build a viable industry, but lacked the political and commercial will to make it happen.

It is one thing to say Australia could or should have had a local industry. It is another to identify how this might have happened, whether it should have and the reasons why it did not. Many factors stood in the way of a potentially successful local industry, such as the small size of the

"FAILURE TO FOLLOW UP THE CIRRUS DESIGN WAS PROBABLY ONE OF THE GREATEST MISTAKES OF AUSTRALIAN COMPUTING."
TREVOR PEARCEY, 1988

domestic market, and Australia's relative isolation from the export markets it would need to serve to make local manufacturing commercially viable.

Like many such debates, it is impossible to say who is right. Hypotheticals – what might have been – are notoriously difficult to resolve. We examine some of the arguments later in this chapter, but first we look at the last of the Australian-designed and -made computers.

ADA, SNOCOM AND ARCTURUS

The Snowy Mountains Hydro-electric Authority (SMHA) was established in 1949 to oversee the Snowy Mountains Scheme – a massive hydroelectricity and irrigation project still considered a feat of engineering even by today's standards. The SMHA was an early and major user of both the CSIR Mark 1 and SILLIAC computers, and as early as 1956 was considering a computer of its own (see Chapter 3).

The SMHA approached David Myers, head of the Section for Mathematical Instruments (SMI) at the Commonwealth Scientific and Industrial Research Organisation (CSIRO – see Chapter 1) for advice on what sort of computer it should build or buy.[119] Myers told the Authority that an SMI graduate, Murray Allen, was building a machine as part of his PhD thesis that would probably be suitable.

Allen had been working on a transistorised version of the Bendix D-12 Digital Differential Analyser, which was a not a true programmable computer[120] as it could only solve differential equations. He called his new device an ADA, or Automatic Differential Analyser.

Allen started building ADA in 1956 and finished in early 1958. On 11 March, the famous philanthropist Sir Adolph Basser formally named the machine, having partially funded its creation and donated the money for the University of Sydney's SILLIAC machine (**S**ydney version of the **ILLI**nois **A**utomatic **C**omputer – see Chapter 4).[121]

BELOW: SNOCOM - CREDIT SNOWY HYDO
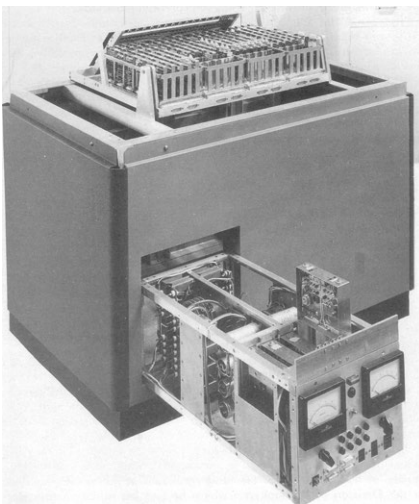
Unfortunately ADA relied on a CSIRO-built magnetic drum for memory, and when this crashed in early 1961, ADA's days were over.[122]

The SMHA decided to build a replacement and call it ADA-2, but eventually settled on the name SNOCOM (**SNO**wy **COM**puter). SNOCOM's specifications were determined by University of Sydney graduate student David Wong, who determined that since the SMHA's computational needs involved much than differential analysis, it was going to need a general-purpose computer.[123]

The SMHA commissioned Allen and Wong to design and build SNOCOM. The two based their design on a small American computer, the LGP (Librascope General Purpose) Model 30[124], using the design its inventor Stanley Frankel had published in early 1956. Frankel had worked on the Manhattan Project and been a programmer for the ENIAC (**E**lectronic **N**umerical **I**ntegrator **A**nd **C**alculator), the world's first computer.

The LGP-30 was a valve machine, but Murray and Wong found that many of its design features were similar to ADA, and they were able to adapt many of the latter's transistorised modules to their new design. Meanwhile the University of Sydney's John Bennett (see Chapter 4) and SMHA engineer Michael Chapple developed the instruction set and much of the programming library using an emulator on SILLIAC.[125]

Allen and Wong delivered SNOCOM to the SMHA's headquarters in the cold town of Cooma in southern New South Wales, in August 1960. Its magnetic drum memory gave it the equivalent of 8 KB of RAM in today's terminology. It remained in heavy use, running two shifts a day, until 1967. It then returned to the University of Sydney as a student teaching machine, and is now in Sydney's Powerhouse Museum.

After SNOCOM, Wong built a large digital trainer called NIMBUS – a device that incorporated many of the components of SNOCOM and was used as an instructional device in solid-state digital electronic and digital logic.[126] He then went on to build another computer for the University of Sydney Electrical Engineering Department on a very low budget of £5,000, largely by scrounging parts.

The financial constraints meant that this machine took five years to build. When it was finally finished in 1966, it was given the name ARCTURUS, after the guardian of the bear from Greek mythology and one of the brightest stars in the northern sky. ARCTURUS was small but fast and convenient,[127] and remained in operation at the University of Sydney until 1975, when it was replaced by a DEC PDP-11/45. In 1971 Arcturus was coupled to a large IBM RAMAC (**R**andom **A**ccess **M**emory **AC**counting) disk drive through an interface designed by university engineer Kevin Rosolen, and operated like this for the rest of its days.[128]

CIRRUS

CSIRO's SMI was disbanded in 1959, when head David Myers moved to the University of British Columbia in Vancouver, Canada.[129] SNOCOM co-designer Murray Allen had graduated, and with the demise of the SMI moved to the Department of Electrical Engineering at the University of Adelaide, where he became a Senior Lecturer. In 1965, Allen became Foundation Professor of Electronic Computation and Director of the Digital Computing Laboratory at the University of New South Wales (UNSW – see Chapter 5).

After his CSIR Mark 1 was dismantled and shipped to Melbourne in 1956 to become CSIRAC, a disappointed[130] Trevor Pearcey returned to the UK to program the advanced TREAC (Telecommunications Research Establishment Automatic Computer) at the Radar Research Establishment, where he had worked during the war. He also saw the new EDSAC-II at the University of Cambridge – the first computer to have a microprogrammed control unit[131], and one
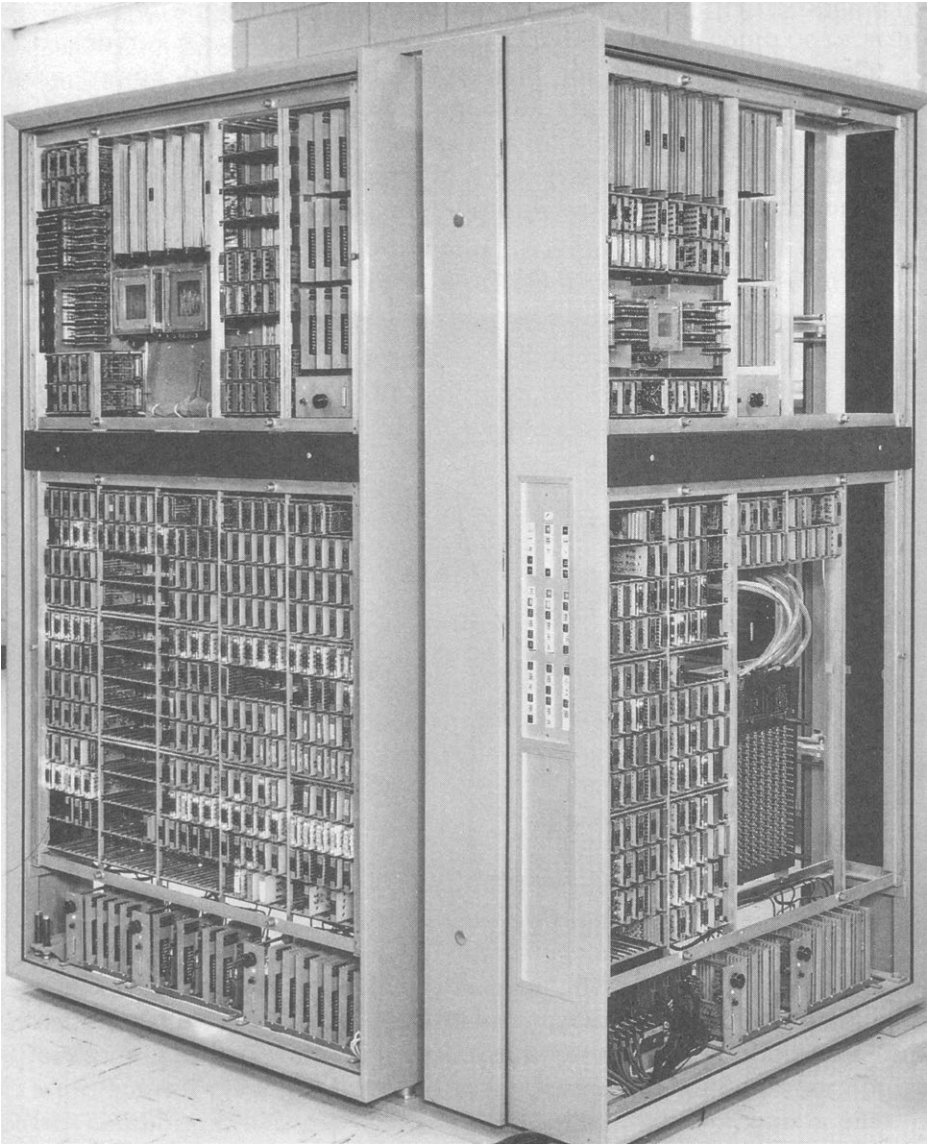
of the last to use vacuum tubes instead of transistors.

In 1959, recharged by his time in England, Pearcey returned to Australia and joined CSIRO's Division of Mathematical Statistics in Melbourne[132], where he was reunited with a version of the Mark 1, called CSIRAC (see Chapter 2).

Allen visited Pearcey there, and they

discussed how to structure a computer's architecture so that it would use more of the expensive hardware for a greater proportion of the time.[133]

The pair took Australia's third computer conference, held jointly at the University of Sydney and UNSW in May 1960, as an opportunity to share some of their ideas for achieving this. This conference called itself the "First Conference", as it was the first to be held under the auspices of Australian National Committee on Computation and Automatic Control (ANCCAC – see Chapter 9).

The result was the Cirrus project, initially conceived by Murray Allen as a cheap, open-ended architecture based around ferrite-core memory. The University of Adelaide supported the idea, and the Postmaster-General's Department (PMG, the precursor to Telstra) and the Weapons Research Establishment (WRE) provided funding.[134]

Using some of the basic hardware elements Murray had employed in SNOCOM, PMG engineers began construction. But as development progressed, it became apparent that Cirrus's operations would be so fast that keeping the processor busy – one of the design aims – would require a new form of microprogramming.[135] John Penney, a member of the design team, wrote a simulator on the WRE's IBM 7090 that would help the team develop the Cirrus operating system.

The Cirrus was a very advanced machine for its day, and far ahead of its commercial contemporaries. In Trevor Pearcey's words:

■ "Its architecture, engineering and software, all developed specifically were entirely homegrown and based upon the aims of economy of cost and ease of use to be gained from the applications of read-only storage at many levels within the system. It recognised the basic principle that the nesting of systems one within the other by a hierarchy of interpretation could simplify design and achieve real

economies, while maintaining high execution speed at the user's level."[136]

Cirrus had a magnetic ferrite-core memory and was totally transistorised. As a true multi-user system, it could run up to seven programs and support up to four users simultaneously. Trevor Pearcey estimated the total cost of the hardware at A£20,000 and total development cost at A£70,000.[137]

Cirrus was commissioned in late 1963 and was a great success, used for teaching and research programming. Custom-built online control and digital signal processing workstations were subsequently added on,[138] and the system ran until 1969 when it suffered a major hardware failure that was never fully overcome. Cirrus was replaced by a Data General Nova minicomputer in 1971.

ATROPOS

At the same time Cirrus was being built, scientists at the WRE designed and built another digital computer, which was to be installed at the WRE's rocket testing facility at Woomera, in central South Australia. Its job was to track rocket trajectories in real time and predict where they would fall.[139] Because many of these rockets self-destructed, the computer was named Atropos, after the Greek goddess of death.

Three WRE engineers – Ian Hinckfuss, Ron Keith and Ian Macaulay – had visited the UK in 1957, when Trevor Pearcey was at the Radar Research Establishment working on TREAC. While there, they designed an improved transistorised machine based on the TREAC design, optimised for the precise arithmetical calculations they needed for the planned work at WRE.[140]

Atropos was built at WRE's Salisbury, South Australia headquarters by the organisation's own engineers, and its software was written in a simulator on WRE's IBM 7090 computer, which by this time had replaced WREDAC (see Chapter 6).

Atropos was a very large machine,

BUT NOT ONE OF THESE EARLY AUSTRALIAN COMPUTERS WAS EVER COMMERCIALISED. NONE EVEN CAME CLOSE. PROBABLY THE MACHINE WITH THE MOST POTENTIAL WAS CIRRUS, WHICH HAD THE RIGHT COMBINATION OF ECONOMY, INNOVATIVE DESIGN AND A MODULARITY THAT COULD WELL HAVE MADE IT A COMMERCIAL SUCCESS.

6 metres wide and 2 metres high. It entered service at the end of 1963, after being transported to Woomera on an air-cushioned truck at the very cautious speed of 15 kilometres per hour.[141] The new computer's major input was tracking data from WRE radar stations 200 kilometres from Woomera, which meant WRE also had to invent a suitable data transmission system. As a result, Atropos was incredibly reliable, and at the time was also the largest real-time computer in Australia. It remained in service until 1974.

INTERGRAPHIC

The Intergraphic was an advanced graphics display processor designed and built in 1966 at UNSW's Department of Electrical Engineering by a team that was led by Gordon Rose and included Murray Allen, who had worked on Cirrus (see above). Rose would go on to become the Foundation Professor of Computing Science at the University of Queensland (see Chapter 10).

Intergraphic was not a complete computer; rather, it translated signals from a mainframe computer – in this case UNSW's IBM 360/50 – and distributed them to graphics terminals. The display transmitted this data from the mainframe to a fast ferrite-core read/write store, allowing a data point to be positioned and graphically displayed within 150 nanoseconds.[142]

It was the first computing device built in Australia to use the new integrated circuit technology from Texas Instruments.

■ "Use of these standard packages of electronic logic allowed an even further reduction in size, price and power requirements and the heavy environmental costs of the earlier big systems.

■ "It also meant that, whereas previously the designer had to deal with each discrete component, the integrated circuit packages represented standardised sets of complex logic functions which could be incorporated into the design en bloc,

so relieving him [sic] of much detailed attention at the discrete component level."[143]

THE 'BEAST'

There was at least one other computer built from the ground up in Australia in this period. But little is known of it, because it was a top-secret device built in Melbourne for the Department of Defence, to enable research into high-speed secure communications.

This mysterious machine was never given a name, but one of the men who worked on it, Phil Grouse, called it the 'Beast'.[144] The valve-based device was built in the late 1950s, mostly using components made in the UK and shipped to Australia in 'multitudinous crates'[145] before being assembled by imported technicians. **Also involved was Trevor Robinson, who would later became head of Control Data Corporation in Australia (see Chapter 11). The Beast was located in a basement below the Albert Park Barracks off St Kilda Road, and was under the control of the Defence Signals Board – now the Australian Signals Directorate. As Robinson remembers:**

■ "The Beast was a collection of compatible digital devices which could be assembled [into] a special purpose machine to tackle a special purpose job. In today's terms it was a bit like a box of miscellaneous integrated circuits, socketed breadboards, miles of hookup wire, clock pulse generators, various display devices, memory chips, large scale magnetic memory, and a high-speed paper tape reader."[146]

It was all designed to test mathematical hypotheses ... and all operated using valves. The Beast's logic boxes were half a metre wide and 14 centimetres deep. There were around a hundred of them, each with just six binary 'OR' logic gates. Long-term memory was courtesy of a magnetic drum.[147]

The fate of the Beast, like most details about it, is unknown. It was superseded in 1965 by a CDC 3400, installed in Canberra (see Chapter 12). This computer too was intended to remain secret, but its presence and activities were widely known, if seldom discussed.

A LOST OPPORTUNITY?

SNOCOM, ARCTURUS, Cirrus, Atropos and Intergraphic – and presumably the Beast – represent the pinnacle of Australian computer design. They were as technologically sophisticated as any computers in the world, at a time when a large commercial industry was just getting started. In both the US and the UK, entrepreneurs were starting small operations, and many larger companies were entering the field, often commercialising designs developed by the same sorts of research teams that existed in Australia.

But not one of these early Australian computers was ever commercialised. None even came close. Probably the machine with the most potential was Cirrus, which had the right combination of economy, innovative design and a modularity that could well have made it a commercial success.

Trevor Pearcey, the father of Australian computing, later became very vocal in his belief that the failure to turn Cirrus into a commercially available product represented a massive lost opportunity for Australia, which he believed could have been a player in the burgeoning global computer industry. The idea that Australia blew its chances has persisted to this day.

In his 1988 book *A History of Australian Computing*, written long after the events, Pearcey says that CSIRO's turn away from computing after the closure of its SMI in 1959 was the first indication that Australia was not serious about computers:

■ "The SMI ceased as a section of CSIRO in 1959 when David Myers left for Canada. This terminated any official involvement

by the CSIRO with computer design and effectively discouraged any further effective work in, and recognition by, CSIRO on computer architecture. The importance gained by Murray Allen and David Wong and others of the section and the succeeding department of the University of Sydney was to be of importance later, during the early 1960s.

■ "It is to be noted that the fund of experience in transistor digital electronics ... that had been built up could then have led to establishing a successful, and profitable, small special-purpose machine industry if the opportunity it presented had been taken. Better opportunities were to be offered later that also were not pursued."[148]

The most important of these later opportunities, according to Pearcey, was the possibility of turning the Cirrus project into a commercially viable exercise:

■ "That the opportunities [Cirrus] offered were not followed up, and no economic value gained by Australia, was due to a number of circumstances. The main factor was probably that the University [of Adelaide] was not sufficiently interested to pursue digital technology further; the Department and Professor ... were mainly from the analogue era. Consequently the design team broke up. The University thus lost its expertise and, although it sought outside advice, that advice was to concentrate upon software instead of rebuilding its engineering and design group.

■ "Some of the responsibility for the failure to recognise, or accept, the opportunity offered may lie with the CSIRO in its discouraging attitude to computer design work. If their history had been otherwise it may well have taken up and continued the Cirrus to the eventual outgrowth of a local industry. Failure to follow up the Cirrus design was probably one of the greatest mistakes of Australian computing."[149]

MORE INFORMATION

Most of the information about the early Australian computers mentioned in this chapter comes from two sources:

■ John Deane's chapter 'Connections in the History of Australian Computing' in Springer's *Reflections on the History of Computing*, which was part of the proceedings of an IFIP International Conference held in Brisbane in September 2010. The publication is still in print.

■ Trevor Pearcey's *A History of Australian Computing*, published in 1988. It is long out of print, but available in many libraries.

David Wong's thesis, 'The design and construction of the digital computers SNOCOM, NIMBUS and ARCTURUS', is available in the University of Sydney Library.

The best source of information on the Beast is a short piece by Phil Grouse, 'The drum principle: a few Beastly recollections' in the 1994 ACS book *Computing in Australia*.

Miriam Goodwin's thesis has not been published and is difficult to find. The ACS retains a hard copy.

This theme of Pearcey's has been repeated often in subsequent years, and it is today almost an article of faith in the Australian industry. But is it true? Could Australia have fostered a strong local industry, or were there too many reasons why this could never have happened?

In 1992, Miriam Goodwin, a UNSW graduate student, wrote a substantial thesis on the subject: 'The early Australian computer industry: the myth of the lost opportunity'. In that work, she outlined a number of reasons why it is unreasonable to have expected Australia to have built a local hardware industry. Her arguments are summed up in the closing words of her thesis:

■ "Emphasising hardware research and development achievements represents a longing for an opportunity that never was. Australia lacked the industrial research and development tradition; the domestic market size and an export orientation; the management expertise to compete against substantial transnational companies; and, most importantly, the need to make it all happen. Its need was for computing tools. That was why Australia has developed its first computer systems.

■ "However the measures necessary to continue to develop and manufacture computers in Australia would have worked against this goal. Had the Australian Government pursued the development of an Australian computer manufacturing industry with greater vigour, the nation may well, as a whole, have become technologically poorer."[150]

The debate has continued for decades, during which time Australia has had a massive trade deficit in information technology. During that time, many countries that have attempted to foster their local computer industries have failed to do so, despite massive government intervention.

In many cases governments have attempted to build a strong local competitor through subsidies, tax breaks and purchasing preferences. It has never worked. Notable failures include the UK (ICL), France (Groupe Bull) and Italy (Olivetti). Throughout this time, the most successful computer companies have come out of the US – and, to a much lesser extent, Japan. These are two of the biggest economies in the world, and they have massive home markets.

Could Australia have done more? Of course. Would it have made much difference? Probably not. Whatever the case, it is not an argument that anybody can ever win or lose. It is, however, a theme we will return to often in this book.

THE BIRTH OF AN INDUSTRY
GOVERNMENT DEPARTMENTS AND COMMERCIAL
ORGANISATIONS MOVE INTO COMPUTING.

08

Australia's first few computers attracted substantial interest from organisations in the public and private sectors, which saw the opportunities offered by the new technology. SILLIAC and UTECOM, in particular, were widely used by organisations outside of the universities that housed them (see Chapters 4 and 5). This USge was on a contract basis, and became an important source of income, especially for the University of Sydney's SILLIAC.

As more computers became commercially available, it became increasingly cost-effective for commercial organisations and government departments to buy or lease their own machines. In 1956 there were just four computers in Australia; by 1958 there were 12 and by 1960, 34. The number grew exponentially, until it was impossible to count them all.

"THE 1960s BEGAN A GREAT EXPANSION IN THE APPLICATION OF COMPUTER SYSTEMS IN MANY AREAS, PARTICULARLY IN LARGE ENTERPRISES THAT HAD MASSIVE AMOUNTS OF ADMINISTRATIVE, FINANCIAL AND SUPPLY PROBLEMS TO KEEP UNDER CONTROL."

TREVOR PEARCEY, 1988

COMPUTER SYSTEMS INSTALLED IN AUSTRALIA 1955–1968

Year	Computer Systems
1956	3
1958	12
1960	34
1962	170
1964	300
1966	487
1968	714
1970	1121
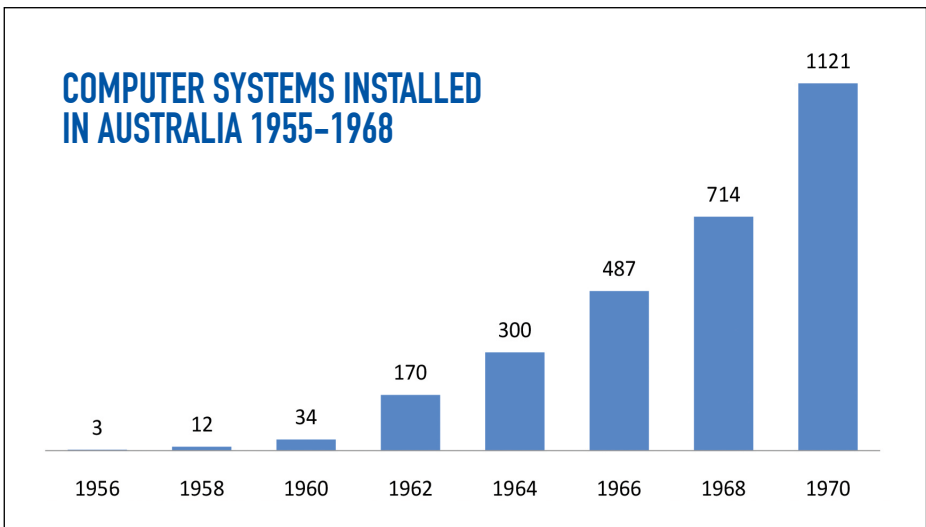
(SOURCE: TREVOR PEARCEY, 1988, *A HISTORY OF AUSTRALIAN COMPUTING*)

LIST OF COMPUTERS IN AUSTRALIA AS AT DECEMBER 1962

RIGHT IS A LIST OF COMPUTERS INSTALLED IN AUSTRALIA AS OF DECEMBER 1962.[151] THERE ARE 74 MACHINES IN TOTAL, AND THOUGH INCOMPLETE, IT GIVES A GOOD IDEA OF THE SORTS OF MACHINES INSTALLED AND ORGANISATIONS RUNNING THEM.

VENDORS AND SERVICE BUREAUX

SYDNEY

AWA	Bendix G-15
Burroughs	Burroughs E101
General Electric	GE 225
IBM	IBM 650s, IBM 1401s
ICT	ICT 1500
National Cash Register	NCR (NE) 405, NCR 390
Remington Rand	Sperry Univac SS80

MELBOURNE

EDP Pty Ltd	Bendix G-15
Ferranti	Ferranti Sirius
EL Heymanson & Co	CDC 160A
IBM	IBM 1620, IBM 1401
ICT	ICT 1202
National Cash Register	NCR 390, NCR 315
Remington Rand	Sperry Univac SS80

COMMERCIAL ORGANISATIONS

NSW

AC Nielsen	IBM 650, IBM 1620
AGL	IBM 650
AMP	IBM 650, IBM 1401
BHP	IBM 1620, IBM 1401
CSR	ICT 1301
Drug Houses Australia	IBM 1401
MacPhersons	IBM 305
Merchants	IBM 305
MLC	IBM 650
Parke-Davis	IBM 305
Paul's	ICT 1301
Phillips	IBM 1401
Qantas	IBM 1401
Rothmans	ICT 1301
WD & HO Wills	ICT 1301
Woolworths	IBM 305

VICTORIA

Dowds	IBM 1401
Ford	IBM 1401
GMH	IBM 305
National Mutual Life	IBM 1401

Nettlefolds	IBM 1401
Sigma Drug Company	IBM 1401
Vacuum Oil Company	IBM 1401

QUEENSLAND

Queensland United Foods	ICT 1301
Woolworths	IBM 305

TASMANIA

Cadbury-Fry-Pascall	IBM 1301

UNIVERSITIES

Australian National University	IBM 1620
Monash University	Ferranti Sirius
University of Adelaide	IBM 1620
University of Melbourne	CSIRAC
University of Queensland	GE 225
University of Sydney	SILLIAC, IBM 1620
University of Western Australia	IBM 1620
University of New South Wales	UTECOM, IBM 1620

STATE GOVERNMENT

NSW

Northern Rivers CC	NCR 390
Sydney Water Board	IBM 1401

VICTORIA

SECV	IBM 1620
State Savings Bank	IBM 1401

SOUTH AUSTRALIA

Electricity Trust of South Australia	IBM 1401

WESTERN AUSTRALIA

Department of Main Roads	Bendix G-15

AUSTRALIAN GOVERNMENT

Atomic Energy Commission, Sydney	IBM 1620
Australian National Line, Melbourne	Burroughs E101
Bureau of Census and Statistics, Canberra	ICT 1201
Commonwealth Actuary, Canberra	Burroughs E103
CSIRO, Melbourne	CSIRAC
Department of Defence, Canberra	Honeywell 800
Department of Interior, Canberra	IBM 1620
Snowy Mountains Hydro-electric Authority, Cooma	SNOCOM, NCR (NE) 405
Weapons Research Establishment, Salisbury	WREDAC, IBM 7090

TOP: Bendix G15 - CREDIT
WIKIMEDIA COMMONS
ABOVE: IBM 1401 - CREDIT IBM

IBM AND THE BUNCH

The ten vendors in the list on the previous two pages were very much the dominant players in the early years of the Australian computer industry. That remained the case until the late 1960s, when minicomputers from companies like Digital Equipment Corporation (DEC) and Data General began to displace and supplement mainframes (see Chapter 13).

These suppliers were often referred to as IBM and the BUNCH – an acronym for Burroughs, UNIVAC, NCR, Control Data Corporation and Honeywell. Given its US origins, this nickname did not include the other major player in Australia, ICL, which came into existence in 1968 when all the British suppliers merged, at the UK Government's insistence (see Chapter 18). So in Australia, it was really IBM and the BUNCHI (though that term was never used).

The other players on the list above were all absorbed by BUNCHI suppliers during the 1960s. IBM remained the biggest player

in the industry until the 1990s, and was as dominant in Australia as it was globally (see Chapter 12).

IBM

IBM (International Business Machines) dominates the list of Australian computer sites in 1962, with around half of all installations and over 75 percent of the commercial sites. IBM, often known as 'Big Blue', had been a major force in the global electromechanical tabulating market since its foundation as the Computing-Tabulating-Recording Company (CTR) in 1911. The legendary company was headed by the equally legendary Thomas J Watson from 1914 onwards (until his retirement in 1956) and changed its name to IBM in 1924, establishing an Australian office in 1932.

The 1401 used magnetic core memory and high speed input/output devices. The machine was wildly successful; at one stage in the mid-1960s, nearly half of all the computers in the world were from the IBM 1401 family.[152] This was also the case in Australia; a very high proportion of Australia's first generation of computing professionals learnt their trade on the IBM 1401.

Production of the 1401 did not stop until 1971. Its printer, the 1403, was also introduced in 1959 (it is in the foreground of the photo above). The noisy 1403 was the workhorse in many IBM mainframe installations, including the important System/360 models introduced in 1964 (see Chapter 12). IBM also continued the 1403 until 1971, alongside the 1401, although the printers remained in use at many Australian IBM sites until well into the 1980s.[153]

In the early 1960s, IBM also marketed the Model 1620 in Australia, a lower-cost machine optimised for scientific analysis and mainly used by universities. There was also the 7090 model, which the Weapons Research Establishment (WRE) installed in 1961, making it the first site to do so outside of the US.[154]

NCR

National Cash Register was founded in Ohio in 1884 by the famed John H Patterson, who is widely regarded as the father of modern sales techniques. NCR first came to Australia in 1907, but didn't enter the computer market until 1952, when it acquired the small Californian company, Computer Research Corporation. The NCR 304, released in 1957, was the world's first transistorised business computer (see Chapter 16).

In Australia and the UK, NCR rebranded the Elliott 405 computer as the 'National Elliott', a large computer similar to the 403 'WREDAC' being used at Australia's Weapons Research Establishment in Salisbury (see Chapter 6).

ICT

International Computers and Tabulators was formed in 1959 after a merger between British computer companies British Tabulating Machine Company (BTM) and Powers-Samas. ICT sold the 1200 series (which still used vacuum tubes), the 1300 series (a transistor-based computer) and the 1500 series (designed by RCA in the US). It also offered the larger 1900 series, which in a modified version formed the basis of the ICL product range after ICT itself merged into International Computers Limited in 1968.

The 1300 series was the most popular ICT model in Australia. First available in 1962, it was an unusual machine that used decimal rather than binary logic, enabling it to perform financial calculations in pounds, shillings and pence,[155] making it especially popular with financial institutions – at least until Australia moved to decimal currency in 1966 (see Chapter 17).

BURROUGHS

Burroughs started its life as the American Arithmometer Company in St Louis, Missouri in 1886. In 1904, it moved to Detroit, Michigan and became Burroughs, named

for the man who invented its main product: a mechanical adding machine.

The E101 and E103 models that appear in the listing above were barely computers. They were essentially large accounting machines, which could be programmed to some extent by inserting pins into a removable board.

They were not a great success, but Burroughs later became a major computer vendor with its advanced B5500 machines, the first commercial computers to use virtual memory. These more advanced machines were first released in the US in 1961 but were not initially available in Australia. Burroughs merged with Sperry Univac in 1986 to form Unisys (see Chapter 16).

BENDIX

Bendix, a Californian engineering company founded in 1924, was known for making a range of electrical and mechanical equipment. Its G-15 computer, introduced in 1956, was inspired by the Alan Turing– designed Automatic Computing Engine (ACE – see Chapter 5).

It used both valves and solid-state diodes, and its main memory was a magnetic drum. The G-15 was intended primarily for scientific and engineering applications, and Bendix had produced more than 400 units by the time Control Data Corporation acquired the Bendix computer division in 1963.

FERRANTI

In 1951, British engineering company Ferranti produced the Ferranti Mark 1, the first commercially available computer in the world. Ten years later, it released the Sirius, a smaller machine with delay-line memory, designed to sit in an office with no special power or cooling requirements. Ferranti sold its computer division to ICT in 1963, and became part of ICL in 1968 (see Chapter 17).

GENERAL ELECTRIC

US manufacturing giant General Electric (GE) was briefly a power in the computer industry,

but sold its computer division to Honeywell in 1970. Its GE-200 series, of which the GE-225 was the most popular, was transistor-based system and only used in Australia by GE's computer bureau.

SPERRY

The Sperry Gyroscope Company was founded in New York in 1910 as a manufacturer of navigational instruments. In 1955 it first acquired the Rand Corporation and became Sperry Rand, then acquired the Eckert-Mauchly Computer Corporation. The latter had been founded by the two men who designed the ENIAC, the world's first electronic computer.

That technology was the basis for the UNIVAC (**UNIV**ersal **A**utomatic **C**omputer), one of the most successful early computers. The company initially introduced the UNIVAC model SS80 in Australia. The 'SS' stood for solid state, but they used magnetic amplifiers rather than transistors for their logic circuitry.

These early UNIVAC machines were not very popular in Australia; Sperry did not achieve commercial success in the Australian market until it introduced the more advanced 1100 series computers in 1963. In 1986, Sperry Univac (its corporate branding at the time) merged with Burroughs to form Unisys (see Chapter 16).

HONEYWELL

Honeywell was founded in 1906 in Wabash, Indiana, as a heater manufacturer. It eventually grew into a multi-industry conglomerate and released its first computer in 1955, the Datamatic 1000, in partnership with Raytheon. In 1960, Honeywell bought out Raytheon and formed its own computer division, based in Minneapolis, Minnesota.

The 800 model that Honeywell sold to Australia's Department of Defence was a descendant of the Datamatic 1000. Although Honeywell promoted this machine as ideal

for scientific purposes[156], it also sold them to business and government customers, and the Government of New South Wales was an early user (see Chapter 16).

CONTROL DATA CORPORATION

Control Data Corporation CDC was founded in Minneapolis, Minnesota in 1957 by a number of disgruntled Sperry Rand employees, including the legendary supercomputer designer Seymour Cray. CDC would become major player in Australia in the 1960s (see Chapter 11), but in 1962 its only installed machine was in Melbourne at EL Heymanson & Co, its local agent's bureau.

Control Data Australia was established in 1963. Its first machine installed in Australia, a 160A, is sometimes regarded as the first minicomputer[157] and was built into a standard office desk.

AUSTRALIA GETS A COMPUTER SOCIETY
STATE-BASED COMPUTER SOCIETIES AMALGAMATE TO FORM THE AUSTRALIAN COMPUTER SOCIETY IN 1966.

09

Australia's first computer association was the Australian National Committee on Computation and Automatic Control (ANCCAC). It came into being in the late 1950s, answering the perceived need for an umbrella organisation to run computer conferences.[158]

At this point there had been two major computer conferences in Australia, at the University of Sydney in 1951 (one of the first in the world – see Chapter 3) and at the Weapons Research Establishment (WRE) in South Australia in 1957 (see Chapter 6).

It was obvious there would be more to come, and at a meeting between computer groups at the University of Sydney and the University of New South Wales (UNSW) in late 1957, a working party led by John Bennett was formed to discuss the possibility of forming some sort of Australian body that could organise future conferences.[159] They concluded that it was too early to think about a formal computer society. But they also agreed that the best way forward was to approach a number of Australia's existing professional societies, seeking participants in a committee on computers and automatic controllers.

At Bennett's instigation, there was a meeting in Sydney on 15 July 1958, attended by leading figures from the Institution of Engineers Australia, the Australian Institute of Managers, the Actuarial Society of Australasia, the Royal Australian Chemical Institute, the Australasian Institute of Cost Accountants, the Australian Institute of Physics and the NSW Branch of the Statistical Society ofAustralia. The attendees recommended that their organisations form a national committee on computing, in cooperation with the Australian Society of Accountants and the Institute of Chartered Accountants in Australia.[160]

The committee adopted its ANCCAC name at a second meeting on 24 October 1958, and was formally inaugurated on 10 April 1959, with Bennett as Chairman-Convenor and Max Dillon as his deputy. (Dillon, representing the Australian Institute of Managers, would later be knighted for his services to industry, and became the head of the Confederation of Australian Industry.)

Together, the member societies hoped to "advance the design, development, construction, and application of automatic computing machinery and associated techniques;

"WE REPRESENT A VOICE, UNBIASED BY A COMMERCIAL OR POLITICAL AGENDA, FOR THE ICT INDUSTRY IN AUSTRALIA."

NICK TATE, ACS PRESIDENT, 2013

facilitate exchange of information and views in the best scientific tradition and foster the spread of knowledge; gather films and literature on the subject; and arrange conferences and symposia from time to time".[161]

ANCCAC's first computer conference, the third ever in Australia, was held jointly at the University of Sydney and UNSW on 24–27 May 1960. The growth in interest since the 1957 conference at the WRE was apparent; only three years later, 150 papers were presented and the more than 650 delegates attended. In an indication of computing's expansion into private industry, most delegates expressed an interest in the commercial aspects of computing.[162]

Another important early role for ANCCAC was its membership of the new International Federation for Information Processing (IFIP), established in in 1960 under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO) following the first World Computer Congress in Paris in 1959.[163]

IFIP was established as a non-governmental, non-profit umbrella organisation for national societies working in the field of information processing. ANCCAC was the only such body in Australia and joined IFIP on 1 January 1962 (later transferring its membership to the ACS). John Bennett was appointed ANCCAC representative to the IFIP Standards Committee and was very prominent in its activities.

ANCCAC organised its second conference in Melbourne in February 1963, attracting more than 900 delegates, and its third in Canberra in May 1966, with a similar turnout (see Chapter 15).

By this time some states had formed their own computer societies (see below), and there were renewed discussions about forming a national body. On 26 July 1962, the Victorian Computer Society and ANCCAC called an informal meeting to discuss moving

ANCCAC'S FIRST COMPUTER CONFERENCE, THE THIRD EVER IN AUSTRALIA, WAS HELD JOINTLY AT THE UNIVERSITY OF SYDNEY AND UNSW ON 24–27 MAY 1960. THE GROWTH IN INTEREST SINCE THE 1957 CONFERENCE AT THE WRE WAS APPARENT; ONLY THREE YEARS LATER, 150 PAPERS WERE PRESENTED AND THE MORE THAN 650 DELEGATES ATTENDED. IN AN INDICATION OF COMPUTING'S EXPANSION INTO PRIVATE INDUSTRY, MOST DELEGATES EXPRESSED AN INTEREST IN THE COMMERCIAL ASPECTS OF COMPUTING.

the small ANCCAC secretariat into the Victorian Computer Society's larger offices.

Although talk soon turned to the possibility of forming a true national computer society[164], that did not happen for another three-and-a-half years.

THE STATE COMPUTER SOCIETIES
SOUTH AUSTRALIA

The first state computer society in Australia was the Computer Society of South Australia (CSSA). Its genesis was in a meeting called by Professor Renfrey 'Ren' Potts of the University of Adelaide on 24 October 1960, to hear an address by Dr Paul Gygax from IBM Research Laboratories about one of the first computer translation programs. The event attracted an audience of 160.

The CSSA was formed just four days later, with Potts as President and Donald Overheu as Vice President. Potts had recently been appointed to the new Chair of Applied Mathematics at the University of Adelaide in 1959, where he remained until his retirement in 1990. He was also the inaugural recipient of the Australian and New Zealand Association for the Advancement of Science (ANZAAS) Medal in 1995. He died in 2005.[165]

VICTORIA

The Victorian Computer Society (VCS) held its first meeting on 15 February 1961, in the physics lecture theatre at the University of Melbourne. The gathering was convened by Dr Frank Hirst and attended by around 200 people. The initial membership count was 186 'ordinary members' and 13 institutional members, growing to 303 individuals and 37 institutions by March 1965.

The Executive Committee comprised Professor Tom Cherry (President), Trevor Pearcey (Vice President), Dr Frank Hirst (Honorary Secretary) and Brian Stonier (Honorary Treasurer).

The VCS immediately applied to become a sponsoring society of ANCCAC, and

was elected on 30 June 1961. At the first annual VCS general meeting on 28 March 1962, entrance fees were set at one guinea ($2.10 in today's currency) and annual subscriptions at two guineas for individuals or 10 guineas for institutions.

In 1962, the VCS established a number of special interest groups focusing on systems analysis; personnel and training; internal and external audit; input and output systems; systems programming; mathematical models; and computer mathematics. The first *VCS Bulletin* was produced in September 1962, followed by a *Thesaurus of Terms and Definitions used in Automatic Data Processing* in 1963.

The *VCS Bulletin* featured coverage of early computer installations in Victoria. The first five to be covered were:
- the University of Melbourne's IBM 7044
- Shell's LEO III
- Colonial Mutual's LEO III
- the Local Authorities Superannuation Board's ICT 1300
- National Mutual's IBM 1410.

Cherry was knighted in 1965 for his services to education and the sciences, and became the first Honorary Member of the Australian Computer Society (ACS) at its formation in 1966. In 1929, at the age of 31, he had become Professor of Mathematics at the University of Melbourne, a position he held until he retired in 1963. He was elected a Fellow of the Royal Society in 1954 and President of the Australian Academy of Science in 1961. He died in November 1966.[166]

QUEENSLAND

The Queensland Computer Society (QCS) was formed in1962, largely at the instigation of Ken Pope, who had come to Brisbane from England to head up a new computing division within the Queensland Government. Before taking on this role, he had been a founding member of the London Computer Society.

ALL THE STATE GROUPS SAW THE MERIT IN HAVING A NATIONAL BODY, BUT THEY COULD NOT AGREE ON THE BEST WAY TO ACHIEVING THIS. AUSTRALIA IS A BIG COUNTRY, AND COMMUNICATION WAS NOT AS EASY THEN AS IT IS NOW. EVEN INTERSTATE PHONE CALLS WERE EXPENSIVE, SO MOST NEGOTIATIONS HAD TO BE CARRIED OUT BY POST OR OCCASIONAL INTERSTATE TRAVEL, WHICH WAS ALSO EXPENSIVE AND USUALLY ONLY HAPPENED AS AN ADJUNCT TO OTHER BUSINESS.

QCS's first meeting, held in a Department of Electrical Engineering lecture room at the University of Queensland, attracted 120 people. The first Chairman was Professor Hugh Webster, Ken Pope was Secretary and Dick Kelly was Treasurer. Donald Overheu, who had moved from South Australia to become the inaugural Director of the Computer Centre at the University of Queensland, was Deputy Chair.[167]

NEW SOUTH WALES

The NSW Computer Society (NSWCS) was founded largely through the efforts of Cecil Potter, who pioneered commercial computing in Australia as part of his work at AMP. He was elected President at the first NSWCS meeting on 9 August 1963, with John Bennett as Vice President, Jan Marr as Honorary Secretary and Denis Macourt as Treasurer.

Following in the footsteps of the VCS, in 1964 the NSWCS become a sponsoring society of ANCCAC. Its first annual general meeting was held on 23 March 1964, with 97 people in attendance. In September 1964, a threeday residential conference at the Carrington Hotel in Katoomba focused on 'New horizons in electronic data processing' and dew in more than 100 patrons. Another conference was held at the Hotel Florida in Terrigal, in October 1965.[168]

THE AUSTRALIAN CAPITAL TERRITORY

The only other independent computer society to be formed before the emergence of the ACS was the Canberra Computer Society (CCS), formed in 1965. Donald Overheu, who had been a founding member of the South Australian and Queensland societies, came to Canberra in 1965 to become First Assistant Secretary (Electronic Data Processing) for the Department of Defence.

Trevor Pearcey, who was nearing retirement, was also in Canberra at the time, working with the Commonwealth Scientific and Industrial Research Organisation

(CSIRO). He became Chairman of the new CCS, with Overheu as Vice Chairman. The Public Service Board's John 'Jack' Shaw was Treasurer (though he would later head computer education at the Caulfield Institute of Technology – see Chapter 10), and the CSIRO's Paul Frost was Secretary.

THE FORMATION OF THE AUSTRALIAN COMPUTER SOCIETY

All the state groups saw the merit in having a national body, but they could not agree on the best way to achieving this. Australia is a big country, and communication was not as easy then as it is now. Even interstate phone calls were expensive, so most negotiations had to be carried out by post or occasional interstate travel, which was also expensive and usually only happened as an adjunct to other business.

Negotiations began in earnest at the February 1963 ANCCAC Conference in Melbourne. By this time there were already computer societies in South Australia, Victoria and Queensland (see page 085). In August 1963, the VCS proposed a draft national constitution, just as the NSWCS was being formed. Thus began "a debate reminiscent of that which attended the formation of the Australian Commonwealth" in the 1890s.[169]

Victoria argued for a strong national body – largely based on an extension of its own role. NSW, on the other hand, argued for strong state branches and a less powerful federal body, with powers confined solely to national matters and national assets, only binding together the state associations to the extent necessary to provide national representation.

There were arguments about fees. What proportion of membership dues would be payable to the state and what proportion to the national body? There were arguments about voting rights. Would each state have an equal vote, or would they be in proportion to membership? There were arguments

about the ownership of assets. Would these be owned by the state bodies, or the national association?

In many ways, it was a classic Sydney-versus-Melbourne confrontation. In October 1963, the NSWCS sent a revised draft constitution to the VCS for comment. This updated proposal was largely written by ANCCAC committee member Bob Rutledge, who was later to be President of both the ACS and its NSW branch.

In May 1964, the VCS produced another draft. This of course was countered with yet another draft from the NSWCS, which was then sent to the smaller societies in South Australia and Queensland for comment.[170]

And so it went, backwards and forwards, draft after draft. Then on 25 February 1965, a meeting at the University of Melbourne's computer department brought together senior office bearers of the NSW and Victorian societies, to nut out the differences between the two largest states. Debated raged on until after midnight, but they eventually reached a general agreement on proportional representation.[171]

Two more drafts of a national constitution followed, but the disagreements were essentially minor and all were resolved over the next few months. Eventually, representatives from all the states except South Australia (which had agreed to abide by all decisions made) agreed to meet – rather appropriately – in Canberra. On 20 October 1965, they adopted the ninth draft of the prolonged negotiations as the constitution of the new Australian Computer Society (ACS).

■ "Having ratified the constitution, the existing societies then dissolved themselves and reconstituted as branches of the Australian Computer Society. Victoria had been the initiator but the successful formation of an Australia-wide computer society was the culmination of long and patient work from all concerned."[172]

Six weeks before Australia moved to decimal currency and two-thirds of a century after Australia became a country, the ACS came into existence. On 1 January 1966, the individual state societies became branches of the national body, though with a large degree of autonomy. Australia had a national computer society.

WESTERN AUSTRALIA, TASMANIA AND THE NORTHERN TERRITORY

The ACS was not formally incorporated in the ACT until 3 October 1967. ANCCAC turned over its conference to the ACS after its successful 1966 event, then handed all its assets to the ACS (to be used for purposes that ANCCAC had pursued) and dissolved itself.

Additional branches came into existence after the national body was formed: Western Australia in March 1967, Tasmania in July 1975 and the Northern Territory in November 1983.

WESTERN AUSTRALIA

Before the formation of the ACS in 1966 a few people in the small WA computing community had been in touch with the various societies in the eastern states. Then on 6 October 1966 a meeting was held in Perth to establish a Western Australian Computer Society. It had 61 founding members.

Dennis Moore from the University of Western Australia (see Chapter 10) was elected president, and the new body immediately applied to become the WA branch of the ACS. This was successful, and the first meeting of the WA branch was held on 2 March 1967, attended by 58 people.

TASMANIA

Many Tasmanian computer professionals were members of mainland computer societies until Tony Haigh formed an interim committee in March 1975 to work to form a Tasmanian branch of the ACS. In May Haigh

MORE INFORMATION

The information in this chapter is largely taken from the 1994 ACS publication *Computing in Australia*, which contains extensive personal recollections from many of the people involved in the formation of the ACS and the various state societies.

and the University of Tasmania's Arthur Sale attended the National ACS Council meeting as observers, and pressed for the incorporation of a new Tasmanian branch.

Council unanimously agreed, and donated $1,000 to establish a working cash reserve. The branch was formally inaugurated, with 17 members, on 5 July 1975.

NORTHERN TERRITORY

Ken Pope, NT Public Service Commissioner, called a meeting in Darwin in August 1983 for all ACS members resident in the Territory to work to establish a local branch, with 26 people attending. Another meeting was held in September, with Pope elected Chair. The ACS Council formally accepted the NT's application for membership in November 1983, and the first meeting was held on 6 December.

IT'S ALL ACADEMIC
AUSTRALIA'S FIRST COMPUTER USERS — UNIVERSITIES — STILL LED THE WAY IN THE 1960S AND EARLY 1970s.

10

A ustralia's universities have been major users of computers since the technology first emerged. There are over 40 universities in Australia today, but in 1960 there were just ten, and until World War II there were only six – one in each state capital. Even in 1963, there were just 18 full-time computer staff members across all of Australia's universities.[173]

Early computing efforts at the University of Melbourne are examined in Chapter 2. The University of Sydney and University of New South Wales (UNSW) are examined in Chapters 4 and 5. This chapter looks at the beginnings of computing in other Australian universities, and in colleges of advanced education (Australia had a two-tier tertiary system until the Dawkins reforms on the 1990s).

Four of these universities were founded in the 1960s – Macquarie University, La Trobe University, the University of Newcastle and Flinders University – and they were slow to adopt computing. The 1970s saw many more universities established in Australia, and by the mid-1970s computing became a mainstream academic discipline.

MONASH UNIVERSITY

Monash University, founded in 1958, was Melbourne's second university after the University of Melbourne (founded in 1853), and today is Australia's largest. It grew very quickly in the 1960s and opened its computer centre in 1962, when it purchased a Ferranti Sirius computer.

Monash added a Burroughs B500 in 1963 to handle administrative work, and a second Sirius, donated from the chemical company ICI, in 1964. The university then leapt to the forefront of Australian academic computing in 1964 when it installed a CDC 3200 (see Chapter 11), which remained in operation until 1979. In the meantime, it installed a DEC PDP-8 in 1967.

At one stage, there was a proposal to install a network of CDC 3200s throughout Australia's universities, and to integrate them with Commonwealth Scientific and Industrial Research Organisation (CSIRO) network. Unfortunately the cost was prohibitive[174] and only Monash University installed a CDC machine at the time, though they later became more popular in academia.

These machines supplied computing services to various

"THE DEEPENING PENETRATION OF COMPUTER DATA PROCESSING AND ALL THE INCREASINGLY VARIED APPLICATIONS TO WHICH COMPUTERS WERE FOUND TO BE SUITED CREATED A PRESSING NEED FOR MORE AND MORE KNOWLEDGEABLE PEOPLE."

TREVOR PEARCEY, 1988

ABOVE: The Ferranti Sirius at Monash, 1962 - CREDIT MONASH UNIVERSITY

Monash University departments; the university did not begin offering academic computing courses until 1969, when it established a separate Department of Information Science within the Faculty of Science.[175] The first professor there was Chris Wallace, a brilliant 34-year-old PhD graduate from the University of Sydney, where he had studied under John Bennett.

While at the University of Sydney, Wallace had worked with Bennett on one of the world's first local area networks (LANs), which connected SILLIAC, the university's new KDF9 and a CDC 1700 to provide online access to a dozen workstations.[176] A PDP-8, used as a graphics teaching tool, was later added to the network.

Wallace became a renowned computer scientist around the world, having devised a number of theorems and practical systems. After his death in 2004, an entire issue of University of Oxford's *The Computer Journal* was devoted to examining his work.[177]

At first, Monash University's computer courses were only offered in the third year of an undergraduate degree, but were extended to the second year in 1972 and the first year in 1976.[178]

Monash Computer Centre successfully cooperated with industry representatives, largely through the efforts of Cliff Bellamy, an entrepreneurial New Zealander who had been a programmer on SILLIAC (also under John Bennett) and who became the Centre's Director in 1964.[179]

After his time in Sydney, Bellamy worked for Ferranti in London, and was instrumental in the company's success in Australia after he returned in 1962. He became Dean of Monash's Faculty of Computing and Information Technology in 1990, the year Monash University absorbed the Chisholm Institute of Technology.

UNIVERSITY OF ADELAIDE

In 1959, the recently appointed Professor of Applied Mathematics Renfrey 'Ren'

Potts became aware that the university administration was about to upgrade the punch-card equipment it used to keep track of student records.

He knew that digital computing was about to revolutionise business processes, and took the opportunity to identify the university's computing needs.[180] Potts was also influential in the founding of the Computer Society of South Australia – Australia's first – and was founding President of the Australian Computer Society (ACS – see Chapter 9).

The university's proximity to the Weapons Research Establishment (WRE) at Salisbury in Adelaide's northern suburbs meant there was significant local expertise on hand. The university formed a Punch Card Equipment Users Committee, which recommended it establish a 'computation centre'. The university's Computing Centre began operation in 1961, using Powers-Samas punch-card equipment and a share of time on WRE's IBM 7090.

Meanwhile, the university's Department of Electrical Engineering had embarked on its own computer project, developing a computer it called Cirrus, which first ran in 1963 (see Chapter 7). Cirrus was an advanced transistorised machine partially designed by Trevor Pearcey. It was an important machine in the history of Australian computing, but as an experimental machine it was not suited to the university's teaching needs[181] and was replaced by a Data General Nova in 1971.

The university's first academic appointment in computing was Nick Capon, a recent PhD from the University of Cambridge. He was appointed as a lecturer in late 1961 and put in charge of the Computer Centre. Capon ran crash courses in the Fortran programming language and lectured in numerical analysis in the Mathematics department, but the emphasis of his work was the provision of computer services, rather than the academic side.[182]

By May 1962, the university's first central computer, an IBM 1620, had begun operating in the new Computer Centre.[183]

Use of the WRE's 7090 increased to the extent that it was difficult to maintain, but this issue was overcome in 1964 when the university gained access to the CSIRO's CDC 3200, installed on-campus in the university's Computing Centre.

That same year, John Ovenstone (see Chapter 14) was appointed to the new Chair of Computing Science, with a department outside of the traditional faculty structure. Ovenstone had no academic experience, but threw himself into the work with his customary enthusiasm, immediately introducing Honours and Diploma courses.

The university formed a new Computing Science Committee in early 1965 to coordinate the activities of the Computer Centre and the new Department of Computing Science.[184]

The committee decided to buy a more powerful machine, and settled on Honeywell, perhaps because Ovenstone was familiar with the equipment from his time at the Department of Defence.

At the same time Capon, on a trip to the US, became aware of the new CDC 6400. The university went with Capon's idea, and ordered the CDC machine at a cost of £480,000, and installed in August 1966. This was only the fifth CDC 6400 to be built, and was so expensive that the university had to sell use time to other universities and commercial organisations.[185]

The 6400 ran until 1977[186] when it was replaced by a Control Data Cyber. The old IBM 1620 central computer was moved to Angle Park High School in 1968, making it one of the first computers to be installed in Australian secondary institution (see Chapter 23). The university's Institute of Medical and Veterinary Sciences also installed its own small CDC 1700 in 1965.

The Department of Computing Science and the Computing Centre separated

ABOVE: The new GE225 at the University of Queensland, 1962 - CREDIT UNIVERSITY OF QUEENSLAND

in 1969. Capon stayed on as head of the Computing Centre and became acting head of the Department of Computing Science after Ovenstone left the following year to join a private firm, International Business Consultants. From there, Ovenstone moved to Darwin and took various positions in the Northern Territory and Commonwealth governments.[187]

The University of Melbourne's Frank Hirst (see Chapter 2) was appointed to head the Department of Computing Science in 1972. He further developed the range of courses, and added the first postgraduate courses. He retired in 1984.

UNIVERSITY OF QUEENSLAND

The story of computing at the University of Queensland begins in 1958, when Sydney Prentice, Professor of Electrical Engineering, headed a committee to consider installing a machine on the main campus.[188] Prentice had previously been a consultant to the CSIRO and had become interested in the organisation's computing activities.[189]

But it was not until 1961 that the university placed an order was placed with Australian General Electric for a GE225 computer. The

machine was delivered in March 1962, and was officially inaugurated a few months later, on 1 August.[190] Donald Overheu – who had worked at the WRE in South Australia, where he was responsible for installing the IBM 7030 that replaced WREDAC in 1961 (see Chapter 6) – was appointed Computer Centre Manager. He stayed in this role until 1965, when he joined the Department of Defence's data processing project, before becoming Head of the School of Computing Studies at the new Canberra College of Advanced Education in 1971.[191]

The university began offering a Postgraduate Diploma in Computing Technology in 1965, and in 1970 established a Department of Computer Science. Gordon Rose – who had been acting head of the Computing Centre since Overheu's departure – became Foundation Chair, where he remained until his retirement in 1995. Rose had already worked on many of Australia's early computers, including SNOCOM, SILLIAC, Cirrus and Intergraphic (see Chapter 7).

The department installed a DEC PDP-8 in 1967, and a dual processor DEC PDP-KA10 in 1968, which enabled time-sharing. In 1973, the university began offering computer services to the newly established Griffith University.[192]

UNIVERSITY OF WESTERN AUSTRALIA

In September 1962, the University of Western Australia (UWA) installed a small IBM 1620 'scientific computer', at a cost of £44,000. It was placed in the charge of Dennis Moore, who had previous experience running the same type of machine at CSIRO in NSW. Moore, just 24 at the time, was also appointed as Director of a new UWA Computer Centre.[193] He was instrumental in the establishment of the Western Australian branch of the Australian Computer Society (see Chapter 9).

The 1620 and the UCC were the first occupants of the newly constructed Physics building. The computer had to be kept in a large, temperature controlled room, which at the time was the only air-conditioned room on campus. The machine was used by external organisations such as CSIRO and the WA State Government, along with UWA academics. It was kept running 24 hours a day, seven days a week.[194]

In 1963 UWA offered its first computing course, a one-year postgraduate diploma in 'Numerical Analysis and Automatic Computation'. In May 1965, it installed a DEC PDP-6, though the IBM 1620 remained in use elsewhere in the university until 1970.[195]

That PDP-6 was sold to the university by Ron Smart, who had been head of the Computing Centre at UNSW before joining Remington Rand and then DEC. The university was the first Australian user of DEC's PDP-6 machine (see Chapter 13), which it claimed to be the world's first commercially delivered time-share computer.[196] Many other university departments and government agencies used it remotely during its time at UWA.

In 1967 the university installed two PDP-10s, and in 1972, in conjunction with the Western Australia Institute of Technology (now Curtin University) it established the Western Australian Regional Computing Centre (WARCC), installing one of the world's first CDC Cyber 72 computers.

- ■ "WARCC was a unique venture, set up by the University but operated as an autonomous unit, responsible to its Board representing a range of universities, CSIRO and government departments.
- ■ "This sharing enabled a much larger computer to be bought than would otherwise have been possible – the Cyber 72 was one of the biggest computers in Australia at the time.
- ■ "The Commonwealth Government, which at the time funded large computer purchases by universities on a three year programme, was eager to induce such sharing, but WA was the only State to do

this, and thus was the only State to receive funding in that three year period."[197]

In 1977 UWA established a Department of Computer Science, with Professor Jeff Rohl as Head of the Department. It took over all computing teaching, including the Diploma in Computation previously taught by members of WARCC. In 1992 WARCC was spun off from the university and renamed Winthrop Technology, with the exception of its network group which formed the nucleus of a continuing University Computing Centre.

UNIVERSITY OF TASMANIA

The University of Tasmania started its computing journey in 1963 with an Elliott

503, which it shared with the state's Hydro-Electric Commission in the Hydro-University Computing Centre (HUCC).[198]

The shared operation continued until 1976, when the university installed its own Burroughs B6700. (The university also had a Burroughs 1900 for administrative work.) The Director of HUCC was John Boothroyd, who came from England to take up the position. He had previously worked for British computer company English Electric as a senior programmer on the DEUCE.[199]

Arthur Sale, a South African who had come to Australia in 1969 to work at the Basser Laboratory at the University of Sydney, was invited to take up the university's Foundation Chair of Information Science in 1974. He was largely responsible for the university being the first in Australia, along with the University of Melbourne, to offer a full three-year degree in computer science.[200]

OTHER UNIVERSITIES
AUSTRALIAN NATIONAL UNIVERSITY
Australia's national university was established in Canberra in 1946, initially as a research institution. It started accepting undergraduate students in 1960 when it amalgamated with Canberra University College, part of the University of Melbourne. It then established a Computer Centre in 1968, and a College of Engineering and Computer Science in 1971.

THE UNIVERSITY OF NEWCASTLE
The University of Newcastle was formed in 1965, having previously operated as the Newcastle University College, part of the Uinversity of NSW. Its first computer was a rented IBM 1620 1130 that began operating in 1965. It was replaced by an IBM 1130 in 1966.

In 1970 the university bought an ICL 1904A using a special NSW Government grant of $450,000. It shared the use of this machine with Shortland County Council,

which used it to compute electricity load flow calculations.[201] For the university, the ICL 1904A served an administrative function as well as being used for tuition, and was supplemented by a DEC PDP11/45 in 1973.[202]

THE UNIVERSITY OF NEW ENGLAND
For many years Armidale's University of New England in northern NSW was Australia's only non-metropolitan university. It came to computing in 1972, when it installed an ICL 1904A in a new custom-built computing centre. The centre cost $340,000 to build and the machine $500,000 to buy – at the time it was claimed to be "the first sophisticated computer complex outside a major Australian city".[203]

The computing centre operated as a bureau for the university, which also rented out time for commercial use. Then as now, the university had a large rural science department, and much of the computer's work involved agricultural research.

OTHER EDUCATIONAL INSTITUTIONS
CAULFIELD TECHNICAL SCHOOL/CHISHOLM INSTITUTE OF TECHNOLOGY
Chisholm Institute of Technology began operations in 1022 as Caulfield Technical School, becoming Caulfield Technical College in 1958 to reflect its increasingly post-secondary nature. Like Monash University 10 kilometres down Dandenong Road, it also acquired a Ferranti Sirius – in 1963.

The institution changed its name again in 1968, becoming Caulfield Institute of Technology, and then again in 1982 when it merged with the State College of Victoria at Frankston to become the Chisholm Institute of Technology.

Computing at Caulfield began early, when Austin Lambert was appointed Principal at the beginning of 1959. He proposed that the institution develop a speciality area of 'machine computation', as had Swinburne University (for production engineering) and

Footscray City College (for building and construction).[204]

- "In July 1960, Lambert prepared a small brochure that advertised a course called 'Computers in Engineering'. The course, which was scheduled to run from 3 August to 15 November 1960, aimed to give 'engineers some understanding of the characteristics of analogue and digital computers and how they may be used for typical engineering problems'.

- "The course cost each participant £6 and involved six three-hour and nine two-hour sessions. In a move that would be repeated in the decades to come, Lambert recruited two computing practitioners to teach the evening course, one from the Postmaster-General's Research Laboratories and the other from IBM."[205]

The course received seven applications, and was run without any computers on which to do practical work. Lambert lobbied hard for funding, and in 1963 the Victorian Education Department gave the college a special equipment grant of A£57,850, which it used to lease, then buy, a Ferranti Sirius computer.[206]

Lambert expanded the number of courses and hired John 'Jack' Shaw, who had been working with the Public Service Board to introduce computers in Canberra (see Chapter 14).

In May 1964, White became Senior Technical Instructor of Data Processing at Caulfield Technical College. He immediately set about restructuring the courses and hiring more staff for the new Electronic Data Processing (EDP) Department.

Most were from industry rather than academia, which gave the institution a solid reputation for graduating students strong in the practicalities of computing.[207] The EDP Department added a CDC 160A in 1965, and in 1969 the Computer Centre separated from the EDP Department, which filled the void with a new ICL 1903A.

Computer pioneer Trevor Pearcey

became head of the EDP Department in 1972, and ended his career there in 1984, as Foundation Dean of the Faculty of Technology. Chisholm Institute of Technology became a campus of Monash University (see above) in 1990 as part of the Dawkins tertiary education reforms.

CANBERRA COLLEGE OF ADVANCED EDUCATION

The Canberra College of Advanced Education was established in 1967, mainly to provide technical training to members of the Australian Public Service. Donald Overheu, who had previously been with the WRE, the University of Queensland and the Department of Defence (see above), became Head of the School of Computing Studies in 1971. He was an important figure in the computing industry in that era, and was instrumental in helping establish computer societies in South Australia, Queensland and the Australian Capital Territory.

The early 1970s revealed a great need for computer programmers, especially in the Department of Defence. Overheu established a Computer Centre in the college, based around Burroughs equipment. The college became a major source of computer training for the Australian Public Service, and Overheu developed a major new program to teach degree-level courses in computing. These courses specialised in designing, installing, operating and managing the large and complex computer systems[208] that were already being operated in various Commonwealth Government departments.

In 1990 the college became the University of Canberra, as part of the Dawkins reforms.

ROYAL MELBOURNE INSTITUTE OF TECHNOLOGY

The Royal Melbourne Institute of Technology (RMIT) began life in 1887 as the Working Men's College of Melbourne. It became the Melbourne Technical College in 1934, the Royal Melbourne Technical College

during Queen Elizabeth's visit to Australia in 1954, and the Royal Melbourne Institute of Technology in 1960.

Computing at RMIT began in 1962, with the installation of a leased Elliott 803B in the Department of Mathematics. It was a transistorised machine with ferrite-core memory, selected mainly for its ability to run the new ALGOL 60 programming, which had already made it the most popular computer among British universities.[209]

ALGOL (**ALGO**rithmic **L**anguage) was introduced in 1960 to reduce the gap between algorithms (which describe computer procedures at a high level) and the more low-level instructions executed by the computer's hardware. It became very influential in the development of programming languages, and was widely used to teach programming, although it was never used widely in the commercial context.

Starting in 1964, RMIT offered one of the first computer science courses in Australia, and many students transferred from the University of Melbourne to learn ALGOL 60.[210] The School of Computer Science and Information Technology became a separate academic department in 1980.

In 1992 RMIT merged with the Phillip Institute of Technology to become RMIT University, as part of the Dawkins reforms.

CONTROL DATA AUSTRALIA

CDC WAS A MAJOR PLAYER IN THE EARLY YEARS OF COMPUTING. IT WAS ESPECIALLY IMPORTANT IN AUSTRALIA.

11

C ontrol Data Corporation (CDC) was founded in the US mid-west city of Minneapolis, Minnesota in July 1957. Its CEO was William Norris, and an early employee was Seymour Cray, one of the most influential and best known early computer designers.

The company grew out of Engineering Research Associates (ERA), a company formed after World War II to keep together the team that had worked on the US Navy's code-breaking machines during the war.[211] ERA was sold to Rand in 1952, which was then acquired by Sperry in 1955. Norris (one of ERA's founders) and some of his associates decided to go out on their own, starting a company called Control Data Corporation (CDC) to build small computers and peripherals.

The company's first computer was the Model 1604, released in 1959. It was a transistorised redesign of the ERA 1103 that ERA had built for the US Navy – a valve-based machine and the first ever designed by Seymour Cray.[212] (The ERA 1103 subsequently became the basis of the UNIVAC 1103A after Sperry acquired Rand.[213])

The Model 160A was a smaller version of the 1604. It was sometimes regarded as one of the first minicomputers, because it was built in the shape of a standard office desk. Three of these ended up in Australia, but the mainstay of CDC's product line during the 1960s was the 3000 series.

The 3000 series machines were divided into upper- and lower-class machines. The larger 3400, 3600 and 3800 models used 48-bit words, and the smaller 3100, 3200 and 3300 models used 24-bit words. The instruction sets were identical, so the same programs could run on all machines. And they all used magnetic core memory.[214]

The lower-end models were introduced specifically to meet the Australian market, after CDC's local representative Trevor Robinson persuaded the company that he could sell at least a dozen in Australia – which he indeed managed to do.

The 3000s were the most advanced commercially available computers of their era, and were particularly suited to scientific work. Cray initiated the original designs, but in 1962 moved into a purpose-built laboratory in his home town of Chippewa Falls, Wisconsin, a hundred miles from Minneapolis. There he worked on the 6000 series,

"CONTROL DATA AUSTRALIA BECAME A LEADING SUPPLIER OF COMPUTING SYSTEMS AND SERVICES, AGGRESSIVELY SEEKING TO ADD LOCAL CONTENT. IT GREW TO INCLUDE A MANUFACTURING PLANT, A SYSTEMS DIVISION, A MAJOR DATA SERVICES OPERATION AND AN EDUCATIONAL INSTITUTE."

JOHN O'NEIL, 2007 (IN TREVOR ROBINSON'S EULOGY)

ABOVE: CDC 160A - CREDIT WIKIMEDIA COMMONS

widely regarded as the first supercomputer. Cray liked to work in isolation, and even the CEO Norris could only visit his lab by invitation.[215]

The 3000 and 6000 series machines were extremely popular, and cemented CDC's reputation as a technology leader in the early days of commercial computing. They also established Cray's position as the world's

leading computer designer – the 'father of supercomputing'. Cray left CDC in 1972 to form Cray Research Inc and successfully built his own supercomputers from that point onwards. He died a month after being badly injured in a car accident in 1996, aged 71.[216]

By the late 1960s, CDC had run into trouble. Developing the 6000 series turned out to be hugely expensive, and even after the model was released IBM slowed its sales by announcing a competitor, called the 360/92, as part of its System/360 series.

The IBM machine did not exist except on paper, but the promise of it affected CDC so much that in 1968 it sued IBM, claiming IBM had announced the machine before it was anywhere near being released, specifically to stop people ordering CDC's machines.[217]

CDC won the case in an out-of-court settlement, but not until 1973. In the meantime, IBM's System/360 and System/370 had become the de facto standard for corporate computing. CDC had lost momentum.

■ "In return for dropping its suit, Control Data won a good deal. For about $16 million, it will acquire IBM's Service Bureau Corp., a subsidiary that processes customers' data and sells time on its own computers.

■ "Wall Street analysts reckon that the Service Bureau's real market value is closer to $60 million. In addition, IBM will buy services from the bureau for five years, stay out of the services business itself in the USA for six years and reimburse Control Data for $15 million in legal fees spent on the case.

■ "Total cost of the package to IBM: at least $80 million. William C. Norris, Control Data's one-man-gang chairman, said that the daring suit had turned out to be 'one of the best management decisions in our history'."[218]

Norris may have won the battle but he lost the war. CDC announced the 6600's

successor, the 7600, in January 1973, which led to the Cyber series of machines in the 1970s and 1980s. But it was rushed to market and unreliable.[219] CDC was living off its reputation, and that reputation suffered. Losses mounted as it was unable to compete against Cray's own supercomputers, IBM in the commercial world, and the new breed of minicomputers from the likes of Digital Equipment Corporation and Data General.

CDC exited the hardware industry in 1989 to concentrate on services. But its various divisions were ultimately acquired by other companies and in 1992 it ceased to exist entirely (see Chapter 16).

HEYMANSON AND THE FOUNDING OF CONTROL DATA AUSTRALIA

The rise and fall of Control Data Australia (CDA) in many ways mirrors that of the parent corporation. CDA was a very influential vendor in Australia in the 1960s, second only to IBM. In government, research and education it was number one.

The CDA story starts on 1 January 1962 when EL Heymanson & Co became the Australian distributor for CDC. The company had been founded in 1938 by Ernest Heymanson, who came from a family of prominent Melbourne businessmen. During World War II the company became involved in aviation and had extensive facilities at Moorabbin Airport. By the 1950s its main business in Australia involved representing the US aeronautical company Lockheed Corporation.

Heymanson believed that Lockheed would have trouble competing in the commercial space after Boeing and Douglas introduced the first jet airliners in the late 1950s.[220] So he decided to diversify into computers, and became Australian distributor for Ramo-Wooldridge Corporation (which became TRW), and car radio and computer company Philco (later acquired by Ford).[221]

In 1961 Heymanson hired Trevor Robinson to manage the company's computer

marketing activities. This decision would have a significant effect on the course of the Australian computer industry.

Robinson was born in Perth in 1922 and grew up on a remote farming property in the north of Western Australia. He attended Wesley School in Perth, and was studying science at the University of Western Australia when World War II began.

He joined the Royal Australian Air Force in 1942, and studied radar at the University of Sydney (with John Bennett), before becoming Commanding Officer of two radar stations, one in Geraldton and one in New Guinea.

After the war, he completed his degree and was awarded First-Class Honours in Physics. He then joined the Weapons Research Establishment (WRE) and was sent to England to work on designing and developing new computer systems – including the top-secret 'Beast', which he helped install in Melbourne for the Department of Defence in 1959 (see Chapter 7).

Robinson believed that the TRW and Philco machines were unsuitable for the Australian

market.[222] He had heard good reports of CDC and recommended that Heymanson seek the Australian distributorship. He then visited the CDC head office in Minneapolis to convince Norris that operating in Australia was a viable business opportunity. He was helped by the fact that a CDC Vice President, John Lacey, had been a colleague of his when they worked together in England.[223]

Heymanson installed a CDC 160A in Bank House in central Melbourne, and in 1962 sold its first machine, another 160A, to the Postmaster-General (PMG) Research Laboratories in Lonsdale Street, Melbourne. (The PMG was split into Australia Post and Telecom Australia, later Telstra, in 1975.) in 1963 Heymanson also sold another 160A to the Bureau of Census and Statistics, the forerunner to the Australian Bureau of Statistics.

The PMG's 160A was installed in early 1963:

■ "The system components were lifted in during a weekend by a crane in a rear lane through a temporarily removed large window frame. Power poles in Lonsdale St impeded lifting from the front of the building.

■ "Fortran was the main language used, and CDC supplied a 2 pass compiler that had many limitations (and bugs) that it was re-written by Arthur Thiess within the Laboratories, and a copy was given to CDC for the benefit of other 160A users.

■ "One of the early tasks for the 160A computer was the design of special filters to enhance the group delay transmission characteristics of data lines used in the NASA space program. The Laboratories later received NASA recognition for their efforts."[224]

On 17 May 1963, Robinson established CDA as a wholly owned subsidiary of the US corporation. The first office was at 474 St Kilda Road in Melbourne, in two converted apartments of a residential block built in the early 1930s.

THE CENSUS AND CSIRO DEALS

While Heymanson was still the distributor for CDC, Robinson worked hard on two big deals. One was the sale of a CDC 3600, a 3300 and six 3200s to the Commonwealth Bureau of Census and Statistics (CBCS). The other was the sale of a 3600 and three 3200s to the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

The CBCS deal was worth A£2,097,000 and the CSIRO deal A£1,500,000,[225] at a time when the average weekly wage in Australia was just A£20 ($40). The sales were announced on 19 June 1963, barely a month after the formation of CDC's Australian subsidiary. In fact, CDA was incorporated at the insistence of CSIRO, which wanted a direct corporate link to CDC rather than having to deal with the distributor.[226]

At the time, these were by far the largest computer sales ever made in Australia. The deals were announced simultaneously by both the Federal Treasurer, Harold Holt, and the Minister for Education and Science, Senator John Gorton – both of whom would later become Prime Minister (in 1966 and 1968, respectively).

The sales marked CDC's arrival in Australia, and were not without controversy. An article in *The Australian Financial Review* about the Government's 'surprise choice' two days after the sale is worth quoting in full (see a full reproduction of the article on page108).

The sale was notable for a number of reasons. Its sheer size was one thing, but the fact that the contracts had been awarded to a company that was barely known in Australia – and had previously sold only two small computers – was quite remarkable.

Even more noteworthy is the fact that CDC had only been persuaded to make the smaller 24-bit models in the 3000 series (the 3100, the 3200 and the 3300) at Robinson's insistence, after he said he could sell at least 15 of them in Australia. His powers of persuasion were remarkable.

Robinson himself said that he sold the smaller 3000s to the Bureau of Census and Statistics and CSIRO on the basis of rumours within CDC that a lower-end machine, codenamed the 160Z, would be produced – and that after he made the sales the company had no option but to announce and produce them.

He also had allies on the staff at CDC, but said he received a 'drubbing' over going out on a limb and selling the 3200s when they did not yet exist.[227] Nevertheless CDC swung into action, and the low-end 3000 series machines ended up becoming very successful worldwide.

But the 3200s were not available, even in the US, until May 1964 – they began shipping in June 1963, around the time the Australian deals were announced. The Bureau of Census and Statistics and CSIRO 3600s arrived in Australia in early 1964, and the CSIRO's machine was installed at the agency's new purpose-built Computer Research Section laboratory in the Canberra suburb of Black Mountain.

Shortly after the Bureau of Census and Statistics and CSIRO orders were announced, Robinson recommended to Norris that Heymanson be paid the commission on the deal, since much of the early negotiations had been done under the EL Heymanson & Co umbrella. CDC was under no legal obligation, but at Robinson's insistence Norris immediately agreed, showing the respect he had for Heymanson's (and Robinson's) efforts.[228]

After CDA made the sales to the Bureau of Census and Statistics and CSIRO, it became one the first computer companies to open an office in Canberra. Most computer companies that came to the national capital settled in the suburb of Civic or along Northbourne Avenue, but CDA chose a two-storey red-brick house at 122 Empire Circuit, Yarralumla, in the diplomatic district. It became known as 'The Embassy'.

CDA purchased the building, which was

MORE INFORMATION

Fortunately, the histories of CDC and of CDA are well documented. Australia is particularly well served by the archives of the Ex Control Data Australia Employees, whose website **(http://excda.webport.com.au)** is an absolute goldmine containing many firsthand recollections. Many thanks to Brian Membrey of Ex Control Data Australia Employees for his help in compiling this chapter.

See also transcriptions of interviews with former employees of CDA conducted in 2013 by Tom Misa of the Charles Babbage Institute (CBI) at the University of Minnesota – see **http://conservancy.umn.edu/ handle/11299/59493** with a search on 'Control Data Australia'. The CBI also has an extensive collection of documentary material on CDC and CDA. The author visited the facility in 2008.

There are some references to the online encyclopedia Wikipedia in the endnotes to this section. This history has tried to rely on original sources wherever possible, but in some cases those cited were the best references available.

next door to the Dutch embassy and within two blocks of the US, West German and Israeli missions. CDC had a policy of leasing floor space where possible, but suitable office space in Canberra was scarce at the time and the Yarralumla building was available at a reasonable price.

CDA's Canberra office remained in The Embassy until 1971,[229] when the National Capital Development Commission demanded that CDA cease running a business in a residential area.

Many large deals followed for CDA. Monash University ordered a 3200 not long after the Bureau of Census and Statistics and CSIRO deals were announced, and the Victorian Totalisator Agency Bureau (TAB) ordered twin 3100s and twin 3200s, which it named after the racehorse Carbine.

In 1968 the TAB ordered five 1700s for a major project to connect all agencies around the state, a project it named after another famous racehorse, Rimfire. The Rimfire contract saw CDA develop a significant manufacturing facility in the Melbourne suburb of Cheltenham so it could produce the branch office Remote Input Output Terminals (RIOTs).[230]

By 1969, CDA had sold dozens of machines in Australia. (See the table at end of this chapter for a listing of all CDC machines sold in Australia in the 1960s.) The company notched up impressive achievements in Australia and internationally in the 1960s, but they were not to last. By 1970 IBM's System/360 had become the dominant computer architecture in Australia, and in that year Robinson left CDA, correctly assessing that its long-term outlook was "not good".[231] Like its US parent, CDA survived into the 1980s, but its best days were behind it (see Chapter 16).

GOVERNMENT'S SURPRISE CHOICE

£4M COMPUTER ORDERS WON BY "OUTSIDER"

(*THE AUSTRALIAN FINANCIAL REVIEW*, 20 JUNE 1963)

Computing orders amounting to about £4 million have gone to Condata – a fully owned subsidiary of the American computer company, Control Data Corporation.

News of the orders – collectively the biggest ever granted in Australia and large by world standards – has shocked the market leaders in Australia. The orders comprise a computer network of £1.5 million for the CSIRO and a network of £2.3 million for the Bureau of Census and Statistics.

The Treasurer, Mr HE Holt and the Minister in-charge of the CSIRO Senator JG Gorton announced the letting of the contracts last night. Mr Holt said a Control Data 3600 computer would be installed in the Bureau in Canberra.

Senator Gorton said the contract for the CSIRO contract provided for the installation of a 3600 computer in the new CSIRO scientific computing laboratory being built in Canberra. "Four subsidiary computers would be installed in CSIRO research laboratories in Melbourne, Adelaide, Canberra and Melbourne."

Senator Gorton said the chairman of the Australian Universities Commission, Sir Leslie Martin, had also announced the commission would consider that satellite computers for this system be acquired by certain Australian universities during the period 1964-66.

NOW IN THE TOP THREE

Control Data is a small but profitable company by world standards – it is one of two companies successfully making a profit out of computers, though it only has one other order in Australia. The PMG's department has ordered a small computer to be installed in Melbourne next month.

Most computer companies conceded Control Data a good chance of getting the order for CSIRO network, but it was not generally thought the company was in the running for the richer Census order. From

being a comparatively small computer company, Control Data has now probably joined the American giant IBM and the English company ICT in the top three of the Australian market.

It is understood that delivery of all the computers has been promised in 12 months' time. The hitch here is that the CSIRO and the Bureau will not be ready for the machines as the present dearth of trained computer personnel is certain to become more acute. Both have attempted to train electronic data processing staff for their installations, but with virtually only one university (Sydney) turning out trained computer staff, there is a good chance that there will be shortages of staff.

In fact, the inadequate provision of Commonwealth money for university training is fast emerging as the greatest drawback to industry growth in this country. It appears Control Data, with a staff of about eight, will have to recruit the majority of EDP personnel from the US because of the shortage here. Big teams of systems men will be needed to service and supervise the installation of the computers in Australia.

Intense lobbying preceded the granting of the orders to Control Data, and it is no surprise that there is much bitterness among many of the manufacturers about losing both orders. Some manufacturers have alleged that Control Data submitted a joint proposal at a price that would not return a profit but would give the company a foothold in the fast-developing Australian market.

MUMBLINGS OF DISSENSION

There are also mumblings of dissension about the manner in which it has been learnt that both orders were going to the same company. Other computer manufacturers point out that tenders were called at different dates and they should have been in no way connected. It is felt, they say, that the CSIRO has brought pressure to bear upon the Bureau of Census to order the same equipment in order to get a better deal from the company.

A spokesman for Control Data in Melbourne told the Review "It is not the practice of our company to sell computers at a price not expected to show a profit, as shown by our successful overseas business. We did not submit a joint tender on the orders." The spokesman said that apart from military orders in the United States, it would be one of the biggest ever gained by the company.

Losing manufacturers have further criticised the successful company on the grounds that, although possessing fine "hardware" (i.e. the computer), the company lacks software (the programming and support which follows machine installation).

Whatever the truth, it seems that there will be much shouting about the manner in which the orders have gone to one small company. Several companies which had been depending on the orders for survival will probably now withdraw from the Australian market.

CDC INSTALLED IN AUSTRALIA, 1962–69

MODEL	ORGANISATION	LOCATION	YEAR INSTALLED
160A	EL Heymanson & Co (relocated to the Bureau of Census and Statistics in 1963)	Melbourne	1962
160A	PMG	Melbourne	1963
3600	Bureau of Census and Statistics	Canberra	1964
3300	Bureau of Census and Statistics	Canberra	"
3200	Bureau of Census and Statistics	Sydney	"
3200	Bureau of Census and Statistics	Melbourne	"
3600	CSIRO	Canberra	"
3200	CSIRO	Sydney	"
3200	CSIRO	Melbourne	"
3200	CSIRO	Adelaide	"
3200	Monash University	Melbourne	"
160A	Aeronautical Research Laboratories	Melbourne	"
3200	Bureau of Census and Statistics	Adelaide	1965
3200	Bureau of Census and Statistics	Brisbane	"
3400	Defence Signals Directorate	Melbourne	"
1700	Institute of Medical and Veterinary Sciences	Adelaide	"
160A	Caulfield Institute of Technology	Melbourne	"
2 x 3100	Victorian TAB	Melbourne	1966
2 x 3300	Victorian TAB	Melbourne	"

MODEL	ORGANISATION	LOCATION	YEAR INSTALLED
6600	Royal Melbourne Institute of Technology	Melbourne	1966
6400	University of Adelaide	Adelaide	"
1700	University of Sydney	Sydney	1968
3200	Control Data Australia	Melbourne	"
1700	Qantas	Sydney	"
3200	Bureau of Census and Statistics	Hobart	"
3300	Bureau of Census and Statistics	Sydney	"
3300	Bureau of Census and Statistics	Melbourne	"
3300	South Australian Public Service Board	Adelaide	"
5 x 1700	Victorian TAB (Rimfire project)	Melbourne	"
3200	Bureau of Census and Statistics	Perth	1969
3200	Control Data Institute	Sydney	"
2 x 3300	BHP (Australian Iron and Steel)	Port Kembla	"
2 x 3300	BHP	Newcastle	"
160A	Cybernet	Sydney	"
6600	Cybernet	Sydney	"

COMPILED FROM VARIOUS SOURCES, INCLUDING THE ARCHIVE SITE INFORMATION (CONTROL DATA AUSTRALIA) AND CDA HISTORICAL TIMELINE (FORMER CONTROL DATA AUSTRALIA EMPLOYEES)

IBM REDEFINES THE COMPUTER INDUSTRY
THE IBM SYSTEM/360, RELEASED IN 1964, WAS THE MOST IMPORTANT MACHINE IN THE EARLY YEARS OF COMPUTING.

12

I n 1964 IBM released the System/360 – the computer that defined the modern computer industry. IBM was once by far the world's largest computer company. The early history of commercial computing is, to a large extent, the history of IBM and its competitors' responses to its dominance.

International Business Machines – the company's longer and rarely used name – is a direct descendant of the company founded by Herman Hollerith to make tabulating machines for the 1890 US census. Hollerith merged with two other companies in 1911 to form the Computer-Tabulating-Recording Corporation (CTR), which was renamed IBM in 1924.[232]

IBM was shaped by two men, father and son. Thomas J Watson Sr led the company before World War l until after World War II, and his son Thomas J Watson Jr from the 1950s to the 1970s. Watson Sr is famous for his remark in the late 1940s that he estimated the total world market for computers at only six or seven machines.

Fortunately for IBM, he was soon convinced otherwise, and the company released its first electronic computer, the Model 701, in 1953. IBM soon overtook its early rivals – conglomerates such as Sperry Rand – and by the early 1960s was selling twice as many computers as all its rivals combined, in Australia as well as globally (see Chapter 8).

The modern mainframe era began when IBM announced the System/360 range on 7 April 1964.[233] It was announced simultaneously around the world, and Australia would receive some of the first machines. The System/360 forever changed the way people thought about computers. It was the first ever family of computers – the first example of a consistent architecture across computers of a different size.

This consistent architecture meant that the different machines could use the same peripherals and software, making it very easy to move to a larger computer within the range, and then move on to new models as they were released. ('360' referred to the degrees of a full circle.)

Previous IBM machines like the 1401 were incompatible with other machines in IBM's range. Every time IBM or any other manufacturer brought out a new computer, users had to rewrite their entire application suites and replace most of their peripherals.

"THE SUCCESS OF THE SYSTEM/360 IS HARD TO OVERESTIMATE. IT SUCCESSORS – VASTLY MORE POWERFUL – STILL FORM THE BACKBONES OF THE MAJOR NETWORKS THAT POWER AUSTRALIAN ORGANISATIONS TODAY."

IBM AUSTRALIA, 2002

In the early 1960s IBM was under threat from many competitors, particularly CDC and Honeywell, and the lack of a consistent architecture did nothing to engender customer loyalty. IBM conceived the System/360 as a way of protecting its diminishing, if still dominant, market share.

A team of engineers, led by the legendary Gene Amdahl (see Chapter 18), designed a modular computer system that could be upgraded by adding more memory or bigger disks, and which ran the same operating system from the bottom to the top of the range.

This 'product family' approach seems normal now, but at the time it was revolutionary. It also represented a massive investment for IBM – one so large that IBM's senior management later admitted it was a 'bet the company' proposition. And it very nearly didn't come off – the sheer size of the project meant severe time and cost overruns.

The System/360 was the biggest gamble in IBM's history, before or since. Watson Jr estimated that the costs involved came to more than US$6 billion, a figure that exceeded IBM's annual revenues at the time.

■ "Although they were expected at the April 1964 introduction to bring in revenues of $7 billion, the 360s actually gave IBM close to $16 billion in revenues and more than $6 billion in profits. Within six years of their introduction, more than 18,000 of the systems had been installed in the United States.

■ "As a result of that enormous success, the 360 line radically reshaped the burgeoning computer industry. The machine's popularity created de facto technical standards that became the basis of federal laws and of the business plans of dozens of new companies."[234]

■ The System/360 was not without its problems. It was late to market – some models up to two years behind schedule. Many of its models performed more poorly than IBM had hoped. Its systems software was initially of very poor quality, and was delivered long after the hardware. But it was an unqualified success, primarily because of the upgrade path it offered, but also because of IBM's brilliant marketing, which was at times less than ethical (see below).

IBM IN AUSTRALIA

IBM started in Australia in 1932, when it formed a local subsidiary to sell the company's time-recording and tabulating equipment. In 1948 the company established a punch-card manufacturing plant in Sydney to serve its growing number of tabulating machine users. IBM also introduced the 604 Tabulating Punch that year, its first large-scale electronic device, which was used by many Australian companies and government agencies.[235]

In 1949 IBM Australia had 60 staff members and was assembling some of its time-recording machines locally. In 1952, it announced the IBM 701, also known as the Defence Calculator, its first commercial computer.

It released a version designed for commercial use the following year. The 650 was the first IBM computer to be installed in Australia, at market research company AC Nielsen. The insurance company AMP and the Commonwealth Department of Social Services soon joined the club, installing 650s of their own.[236]

In 1958, Allan Moyes became General Manager of IBM Australia. He had joined IBM in 1953, one of only five employees in the Australian subsidiary's data processing division (there were over a hundred in the time-recording division). That same year IBM opened its Sydney Data Processing Centre, housing 650 RAMAC processors. The RAMAC was an improved version of the 650 with up to four disk drives.

In 1961, an IBM 7090 was installed the Weapons Research Establishment (WRE) near Adelaide (see Chapter 6), making it the first to be installed outside of the US. In the early 1960s many IBM 1401 computers were installed in Australia; it was IBM's most successful computer before the System/360. Many 1620s were also installed, especially in universities (see Chapter 8 for a list of all computers installed in Australia in 1962).

The System/360 was as successful in Australia as it was elsewhere in the world. Early Australian users of included chemical company ICI, real estate agent LJ Hooker, pharmaceutical distributor Drug Houses of Australia, and car companies General Motors Holden and Ford.[237] Oil company Shell used a Model 65 linked to terminals at refineries in NSW and Victoria, which transmitted data on the performance of refinery equipment, highlighting areas where engineers should take corrective action.[238]

Qantas, Australia's national airline, ordered three of the machines: a Model 40

and two Model 30s. The Model 40 was used for payroll and other corporate systems, while one of the Model 30s was used for airline reservations.[239] The other was used for message switching.

The Qantas reservation system was not the first in the world to be computerised. That distinction belongs to American Airlines' SABRE (Semi-Automated Business Research Environment) system, jointly developed by the airline and IBM in the late 1950s, using IBM 7090 computers. But the Qantas reservation system was the first developed for the System/360.The previous Qantas booking system was largely manual and very labour-intensive, supplemented by teletype machines that operated over dozens of phone lines, while clerks seated on stools entered details into a ledger.

■ "When a booking came in via tape from the travel agent, the reservation clerks

would enter the details for each flight in each ledger. When the flight was full, a line would be drawn and a message sent to all offices informing them that no more bookings could be taken. Cancellations created another manual process of contacting each sales office in turn.

■ "Over the course of about 18 months IBM and Qantas programmers designed the reservations application and wrote an operating system. The System/360s had just 64 KB of memory stored on a costly ferrite core, yet [were] powerful enough to support Qantas's large throughput of messages and reservations. Data was stored on Model 3211 disk drives with removable disk packs.

■ "The system created computer records available from a single centralised source, creating enormous benefits for the airline."[240]

The Qantas reservation system was so successful that IBM Australia took its systems engineer, Ron Carr, to England to show the world's-first system to BOAC (now British Airways). In 1966, Carr transferred to IBM in the UK to work on the company's new International Passenger Airline Reservation System (IPARS), which incorporated elements of the Qantas reservation system.

SABRE and other one-off systems that IBM had developed for other airlines were all to be incorporated into IPARS, parts of which evolved into the Transaction Processing System (TPF) software, the real-time operating system still used by the System/360's descendants today.

After its introduction, the System/360 quickly became the standard operating environment for most large corporations and government agencies in Australia. But IBM did not get it all its own way – a group of other US mainframe vendors collectively known as the BUNCH (Burroughs, UNIVAC, NCR, CDC and Honeywell) were very strong competitors in the 1970s and into the 1980s (see Chapters 8 and 16). But they were all

much smaller and eventually faded away.

The release of the improved System/370 in 1970 further accelerated IBM's success in Australia, though the first was not installed until 1972. Although it lost a number of significant deals to competitors, the System/370 was the mainframe of choice for most large Australian banks and government agencies. The only sector IBM did not dominate in the 1970s was academia, where CDC continued to do well (see Chapter 11).

LEGAL ACTION, UNBUNDLING AND THE BIRTH OF THE SOFTWARE INDUSTRY

In 1970 the System/360 evolved into the System/370 with most of its features intact. Since then it has grown further, going through a number of models and name changes. The architecture still exists today as the zSeries, and is still used by most of the world's major financial institutions, including all of Australia's big four banks.

Even when the System/360 was introduced, it was no technical miracle. Its memory management was primitive, its peripherals performed poorly, its processors were slow and it had poor communications capabilities. But it was an architecture. It was all things to all people. It excelled nowhere, except as a concept, but it could fit just about everywhere. For the first time, upward compatibility was possible. The phrase 'upgrade path' entered the language. With the System/360, IBM also promised compatibility into the future, protecting customers' investment in their applications and peripherals.

It also locked the users into IBM, which of course was IBM's aim. The System/360's enormous success, and the sharp commercial strategies that IBM used to achieve that success, would become the basis for the US Department of Justice's long-running lawsuit against IBM.

The US Department of Justice's suit, filed in January 1969, claimed that IBM's

System/360 marketing tactics were in violation of the country's antitrust law, known as the Sherman Act. These relied to a large extent on sowing fear, uncertainty and doubt (three words that have now entered the computer industry's lexicon, often acronymised as 'FUD') in the minds of users and potential users of competitors' equipment.

The suit was one of many antitrust suits filed against IBM in the late 1960s[241], and they all had the same theme: that IBM was "monopolising and intending to monopolise the computer industry". The central idea underlying these suits was that IBM's size, structure, experience and salesmanship made competition difficult, and that its tactics were therefore unfair and in violation of the law.[242] Two other important suits were filed by:

- Control Data Corporation (CDC), which also made mainframe computers. CDC filed a suit in December 1968 alleging that IBM had announced a scientific version of the System/360 (the Model 90) with the sole aim of affecting sales of CDC's Model 6600 (see Chapter 11). The 360/90 had outstanding specifications, but was not actually shipped three for years after its announcement, during which time CDC claimed its sales suffered. Indeed, it was unable to sell a single 6600 in the 18 months after the 360/90 was announced.[243]

- Applied Data Research (ADR), an early software company. ADR filed a suit in May 1969, claiming that IBM had exaggerated the capabilities of its Flowcharter product (which competed against ADR's Autoflow) and that by bundling its software with its hardware, IBM was stifling the development of an independent software industry.[244]

The suits put IBM on the defensive. Hoping to pre-empt the US Department of Justice, IBM made the decision in December 1968 to 'unbundle' software from hardware – to sell

MORE INFORMATION

There is extensive documentation on System/360 and its importance to the computer industry. The massive 1991 volume from MIT Press, *IBM's 360 and Early 370 Systems*, is the most comprehensive. IBM Australia's 2002 publication, *IBM@70: Big Blue Beneath the Southern Cross*, has the most information about the early years of IBM in Australia and the first System/360s.

Richard DeLamarter's comprehensive 1986 work, *Big Blue: IBM's Use and Abuse of Power*, remains the definitive work on how IBM used every trick in the book, ethical and unethical, legal and illegal, to maintain its market dominance in the 1960s and 1970s. DeLamarter was a leading lawyer on the antitrust case for the US Department of Justice. It is not a pleasant story.

software separately, rather than include it as part of the total system.

In the early days of computing, hardware was the expensive part. Software, most of which had to be written from scratch, was comparatively inexpensive. As software became more sophisticated with introduction of operating systems and programming languages, this remained the case. In 1969, there was virtually no applications software market – everybody wrote their own applications. Some companies like ADR had entered the packaged software market, but the business was in its infancy.

IBM's decision to unbundle software from hardware – a direct consequence of the various antitrust suits brought against it – had vast and unforeseen circumstances. It essentially kick-started the software industry. For the first time, people could write software for IBM computers and compete against IBM. Most major software companies of the 1970s and 1980s – just about all of them now gone as the industry has rationalised – began in this manner, and they showed the way for many others who followed.

From June 1969 onwards, IBM charged separately for 17 system and application programs, and for programming and educational services. Its unbundling has been widely described as "the crucial inflection point"[245] in the development of an independent software industry. There was an immediate boom in the availability of applications and systems software from independent software vendors.

In 1969, the total global revenues of software product companies was estimated at somewhere between US$20 million and US$50 million, growing to US$400 million by 1975. Computer Sciences Corporation (CSC), the largest independent computer services firm at the time, immediately announced 12 new software packages, including Cogent II (for file management), Compuflight II (for

US regional airlines) and Exodus (a 1401 to System/360 migration tool).[246]

Other services companies, such as TRW and Westinghouse, also entered the software market. The few existing vendors – including ADR and Informatics – experienced unprecedented growth. New suppliers like Management Sciences of America (MSA) and Cullinane built financial applications, and Cincom, a small company from Cincinnati, released TOTAL, an early database management system. In 1971, Germany's Software AG entered the market with ADABAS (**A DA**ta**BA**se **S**ystem). All were early entrants, in the 1970s, in Australia's growing computer industry (see Chapters 19 and 27).

In 1982 a pro-IBM Reagan administration threw out the US Department of Justice's case, by which time it had generated more than 100,000 pages of evidence. Whatever the merits of the case, by this time the arguments had become academic, and the industry was very different to what it had been in the late 1960s.

IBM had achieved its immediate aim of continued hardware dominance, but only at the expense of its stranglehold on the software industry, which was to become much more important in the years ahead.

DEC AND DATA GENERAL — ENTER THE MINICOMPUTER
LOW-COST MINICOMPUTERS VASTLY INCREASED THE NUMBER OF PEOPLE AND ORGANISATIONS USING COMPUTERS.

13

Until the mid-1960s only large organisations could afford computers. They were very expensive, and only big companies, government agencies and universities had the means to buy or lease them.

That changed with the introduction of minicomputers – smaller and less-expensive devices that were practical (and affordable) for smaller organisations and departments within larger organisations. That said, they were still not suitable (or affordable) for individuals, who had to wait for the microcomputer revolution of the late 1970s and 1980s (see Chapter 22).

One of the earliest suppliers of minicomputers – and certainly the most important for Australia – was Massachusetts-based Digital Equipment Corporation, usually referred to as DEC or Digital. DEC was to become the second-largest computer company in the world, after IBM.

There is no standard definition of what constitutes a minicomputer. As the name suggests, they are smaller than the earlier mainframe computers. But because processing power was constantly increasing, and because the technology was constantly improving (a phenomenon later to become known as Moore's Law), minicomputers still had substantial capabilities.

DEC was founded in 1957 by Kenneth Olsen, the grandson of Scandinavian immigrants to the US. Olsen, born in Connecticut in 1926, had graduated from Massachusetts Institute of Technology (MIT) with a degree in electrical engineering, and then worked on Project Whirlwind in the late 1940s. Whirlwind was an ambitious attempt to build the world's first real-time computer system, and became the basis for the Semi-Automatic Ground Environment (SAGE) air defence system, implemented by IBM for the US military in the late 1950s.[247]

Olsen worked for MIT Lincoln Laboratory, a commercial offshoot with a Digital Computing Laboratory tasked with designing the SAGE project and working with IBM as the primary contractor. He worked on the SAGE core memory system, where he gained a deep appreciation of what real-time computers could do, and also of what he regarded as IBM's unsophisticated engineering and bureaucratic nature.[248]

"THE DEVELOPMENT OF THE COMPUTER FOR ORDINARY PEOPLE TO HAVE ACCESS TO, WITH MORE AND MORE SPEED AND MORE AND MORE MODES OF INTERACTION, WAS THE STORY OF DIGITAL."

KEN OLSEN, 2000
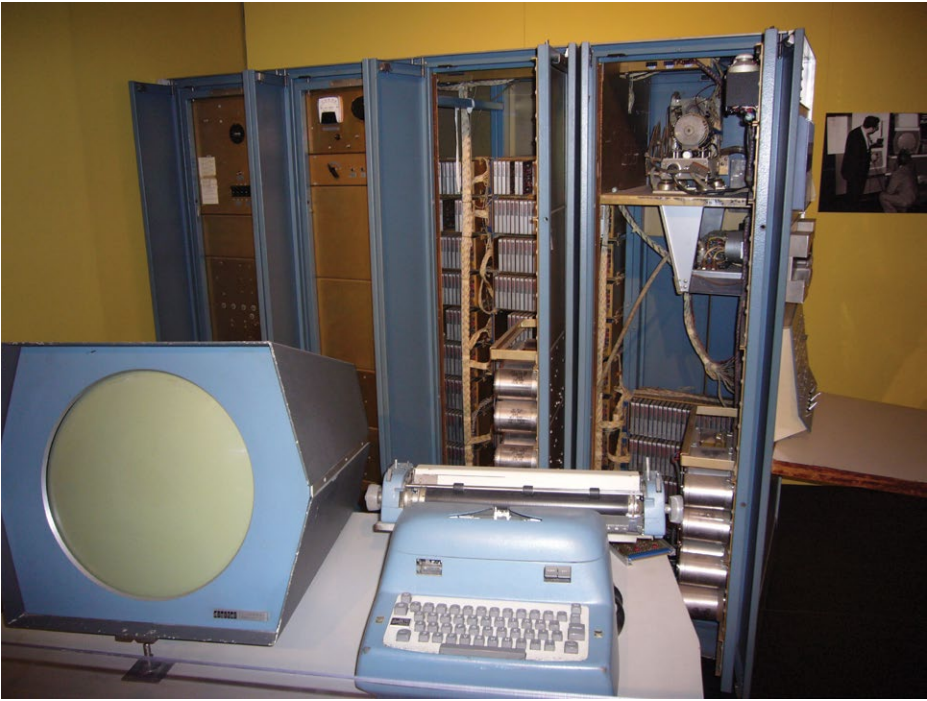
In 1957, Olsen sought and received a US$70,000 investment from American Research and Development, an early Boston-based venture capital firm, to start a new computer company: Digital Equipment Corporation (DEC).[249] With his brother Stanley and MIT Lincoln Laboratory colleague Harlan Anderson, he set up shop in a corner of Assabet Mills, a century-old disused woollen mill in Maynard, Massachusetts, 40 kilometres west of Boston.

The company's first products were logic modules for memory testing, which is what he had been working on at MIT Lincoln Laboratory. Its first computer was the PDP-1, released in 1959 ('PDP' stood for Programmable Data Processor). The machine was the size of a fridge and sold for US$120,000. Designed by Ben Gurley, who Olsen had worked with on the SAGE project, it contained 2,700 transistors and 3,000 diodes. It was largely based on the IBM TX-0, a transistorised machine that used the new

surface-barrier transistor technology and had been designed specifically for SAGE.[250]

The PDP-1 used a new architecture, pioneered in the TX-0, called direct memory access (DMA), which became a hallmark of all DEC's products and most later minicomputers.[251] DMA allowed faster input/output (I/O) operations than larger mainframe computers, and meant significantly less hardware, which reduced prices.

The machine was a success. One of its first customers was consulting firm Bolt Beranek and Newman (BBN), located next to MIT in Cambridge, which later became famous for helping design the Internet (see Chapter 24).

PDP-1s also ended up in Lawrence Livermore Laboratories at the University of California, Berkeley, and Atomic Energy of Canada. Telecommunications giant ITT purchased 15 of the machines in 1962.[252]

About 50 PDP-1s were eventually sold. It was not an outstanding commercial success, but it made money and established DEC's reputation for technical innovation.

Later models of the PDP were designed and produced in the following years. The most successful, and the machine often credited with starting the minicomputer revolution, was the PDP-8, released in 1965, and which sold more than 50,000 units.[253]

A key factor in DEC's success was its practice of publishing its designs and making them accessible to customers and prospects. The company also encouraged people to tinker with its designs and build their own subsystems.

■ "This policy of encouraging its customers to learn about and modify its products was new and born of necessity. The tiny company could not afford to develop the specialised interfaces, installation hardware, and software that were needed to turn a general-purpose computer into a useful product.

■ "IBM could afford to do that, but DEC had no choice but to let its customers in on what, for other companies, were jealously guarded secrets of the inner workings of its products. DEC found, to the surprise of many, that not only did the customers not mind the work but they welcomed the opportunity."[254]

GORDON BELL AND DIGITAL EQUIPMENT AUSTRALIA

In 1960, DEC hired Gordon Bell, a brilliant computer engineer who was born in Missouri in 1934 and went on to design most of DEC's first generation of computers. Bell, like Olsen, obtained bachelor and master degrees in electrical engineering at MIT, graduating in 1957 with a Fulbright scholarship. This took him to the University of New South Wales (UNSW) in Sydney.

While in Sydney, Bell worked on the university's UTECOM computer (see Chapter 5), and he taught some of the first courses in Australia on computer design. Returning to the US, he worked in speech synthesis at MIT before being hired by DEC. His first job was to work on the PDP-1's innovative I/O system, and he subsequently became chief designer of the PDP-4, PDP-5, PDP-6 and famous PDP-11.

During his time in Sydney, Bell also met Ron Smart, a lecturer at UNSW who managed the Computer Centre. The connection led to Smart being hired as the first General Manager (and only employee) of Digital Equipment Corporation Australia in February 1964, operating out of his home in the northern Sydney suburb of Turramurra.[255] It was one of DEC's first international subsidiaries. (DEC had previously been represented in Australia by the Melbourne company JJ Masur[256], but no machines had been sold.)

DEC Australia's first sale was of an analog-to-digital converter to the University of Queensland. Its first computer installation was a 'demonstration' PDP-5 at UNSW, and the first actual sale was of a PDP-6 to the

University of Western Australia in May 1964, though it was not delivered until 1965 (see Chapter 10). The third machine was a PDP-7, installed at the Australian Atomic Energy Commission at Lucas Heights in Sydney, in January 1966.[257]

The 12-bit PDP-8 was based on Gordon Bell's PDP-5 design. That machine set new standards in design, performance and value for money. Its runaway success also encouraged DEC to become a public company in 1966.[258]

In May of that year the first PDP-8 arrived in Australia, to be installed in the University of Melbourne's physiology department. But first, straight off the plane, it was rushed by car from Sydney to Canberra to star at the Australian Computer Conference being held on the day of its arrival, overseen by DEC's new local General Manager Robin Frith (Smart had relocated to the DEC head office in the US).[259]

Frith had been a logic designer at the Commonwealth Department of Aviation, and was so impressed with DEC's equipment that he immediately wanted to join the company. He was hired when Vice President and co-founder Harland Anderson visited Australia in January 1964, but was sent to Maynard for training before taking on the job.[260]

The PDP-8 was massive success in Australia, as it was throughout the world. By the end of 1967, more 30 of the machines had been installed in Australia (see the list at right).

In August 1966, *The Australian Financial Review* reported on Australia's first "long-distance man-computer conversations" – the University of Western Australia's PDP-6 was communicating across telephone lines with teleprinters stationed in DEC's Sydney and Maynard offices.

■ "'Although the economics of inter-continental man-computer inter-action are doubtful, this time-sharing demonstration established a distance record which will be hard to beat unless either the man

DEC PDP COMPUTERS INSTALLED IN AUSTRALIA AS AT DECEMBER 1967

MODEL	ORGANISATION
PDP-5	BHP Research Labs (after UNSW)
PDP-6	University of Western Australia
PDP-7	Australian Atomic Energy Commission
PDP-8 x 2	Australian Atomic Energy Commission
PDP-8 x 2	WRE Salisbury
PDP-8	Aeronautical Research Laboratories
PDP-8	Computer Sciences Australia
PDP-8	Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra
PDP-8/S	CSIRO, Mechanical Engineering
PDP-8	CSIRO, Tribophysics
PDP-8	Monash University Computing Centre
PDP-8	University of Sydney
PDP-8	University of Melbourne, chemistry department
PDP-8	University of Melbourne, computation department
PDP-8	University of Melbourne, physiology department
PDP-8	UNSW, chemistry department
PDP-8	UNSW, electrical engineering department
PDP-8	University of Western Australia
PDP-8/S	University of Western Australia
PDP-8	University of Queensland
PDP-8	STC Transistor Testing
PDP-8 x 3	John Fairfax (The Sydney Morning Herald)
PDP-8	Cumberland Newspapers
PDP-8 x 2	Queensland Newspapers
PDP-8 x 2	Totalisator Agency Board of NSW (TAB)
PDP-8/S	Wessex Engineering

MORE INFORMATION

The history of DEC in Australia is better documented than that of any other computer company, thanks the remarkable efforts of former General Manager and long-time employee, Max Burnet. Burnet has written a detailed history of the company in Australia, unpublished but widely distributed, and also has one the world's largest collection of historical DEC equipment, much of it in working order.

Edgar Schein's 2003 book, *DEC is Dead, Long Live DEC: The Lasting Legacy of Digital Equipment Corporation*, is a masterful examination of DEC's rise and fall, and its corporate ethos.

Tracy Kidder's Pulitzer Prize–winning story of Data General, *The Soul of a New Machine*, is essential reading to anyone interested in this period of computing history. Sadly, the early days of Data General in Australia are largely undocumented.

or the computer leaves the surface of the earth,' the newspaper quoted an unnamed DEC spokesman as saying. This early demonstration of computer communications enabled remote users to obtain printouts from the computer's tape files, edit data and programs in the computer's memory, and compile and debug programs under remote control, the article reported." [261]

DEC grew quickly in Australia. A Melbourne office opened in November 1967. By mid-1969 the company had 31 local staff members, and offices in Sydney, Melbourne, Perth and Brisbane. But it was soon joined by an aggressive competitor, Data General.

DATA GENERAL MAKES A PLAY

One of the key designers of DEC's PDP-8 was Edson de Castro, who was responsible for the logic circuitry. Born in New Jersey in 1938, de Castro joined DEC in 1961 as an engineer. When the IBM System/360 was released in 1964 (see Chapter 12) he was immediately impressed with the concept[262] and proposed to DEC senior management an architecture that could compete with it.

He liked the idea of a family of computers,

and he also thought that some of System/360's technical aspects showed promise, particularly the idea of building data architectures in multiples of 8 bits.

"DEC was sitting there with 12- and 18-bit machines, which really didn't play in any of these new standards. Being out in the field I began to hear from customers that they were concerned as the product they were buying was going to be adaptable out in the future. I began to talk to a number of people about the feasibility of building a new line of computers, which would incorporate some of these new standards.

"The new line really had to be a clean sheet of paper. There were also some things going on in the underlying technology at that time. Monolithic integrated circuits, which to that time had been quite expensive, had become economical for commercial applications and offered the opportunity for a much lower cost way to design these things.

"That in turn had some packaging implications. DEC, believing they were in the module business, took single chips or a couple of chips and plugged them into a back plane, which in my mind resulted in a lot of redundant interconnects that didn't add much value but added a bunch of cost and unreliability."[263]

He proposed a new machine codenamed the PDP-X, a 16-bit computer. When Ken Olsen rejected the idea, de Castro left DEC with two other engineers, in early 1968 and started a company called Data General in a former beauty parlour[264] in the small town of Hudson, Massachusetts, just a few kilometres southwest of DEC's Maynard headquarters. By the end of the year the new company had announced its Nova computer, which started shipping in 1969.

The Nova was revolutionary, and immediately established Data General's credentials. Even today it is regarded as an exemplar of elegant design.[265] It incorporated advances in circuitry and packaging never before seen, including the large-scale use of integrated circuits, still a comparatively new technology, as well as large-printed circuit boards. Its successor, the 1971 Super Nova, introduced integrated circuits as RAM, replacing magnetic cores.

The Data General Nova was a great success. More than 200 over shipped in the first year, and upwards of 50,000 over its lifetime. Like DEC, Data General was to enter the Fortune 500 and provided an example to many other minicomputer companies that sprouted in the 1970s. It went public just a year after its founding.

For many years afterwards, Olsen said that de Castro had developed the Nova while still at DEC. This became an article of faith for many DEC employees, though nothing was ever proven and DEC never sued de Castro or Data General for any theft of intellectual property or copyright infringement. There was certainly bad blood between the two companies, particularly because of what DEC saw as Data General's overly aggressive sales and marketing tactics.

(For more on Data General in Australia, see Chapter 20.)

THE GOVERNMENT TAKES NOTICE
COMMERCIAL COMPUTING TAKES OFF IN THE 1960s,
AND THE AUSTRALIAN GOVERNMENT JOINS IN.

14

I n 1960 there were just a few dozen computers in Australia, and no more than a hundred people held a job involving some facet of computing – like programming, managing, operating or teaching. Outside academic and research institutions, computer professionals were few and far between.

Just a decade later, working with computers had become a notable competence. With more than a thoUSnd machines installed around the country, computing was becoming an industry in Australia. Computer skills were widely taught in public and private tertiary institutions; programming and systems analysis were clearly defined disciplines; and computer vendors employed armies of salespeople and maintenance staff.

Many people in business, government and academia started learning about computers, becoming proficient in their use and discovering new applications. What began as ad hoc training and a few limited academic courses by the end of the decade had become a major industry.

Australia's first wave of computing in the 1950s was dominated by universities and research establishments, many of which had built their own computers. In the 1960s, computing was transformed by the arrival of many new suppliers in the market, and by interest from large commercial organisations – such as banks and manufacturing companies – attracted by the new field's potential benefits.

But the public sector remained the biggest customer. Universities and government-owned research bodies dominated the base of installed computing systems in Australia well into the 1960s. They were joined by other government agencies, mostly at the federal level, though state governments and even some larger local government authorities moved into computing during this period (see Chapter 10 for computing in Australian universities in the 1960s). Even today, government agencies at all levels represent the largest segment of the computing industry, and these contracts are keenly contested by hardware, software and services vendors alike.

Computing in Australia in the 1960s is essentially the story of government and academic computing. Some of the most important innovations took place in one of the country's

"THE STAGE HAS BEEN REACHED WHERE COMPUTER USE BY THE AUSTRALIAN PUBLIC SERVICE HAS AN IMPACT, ON MOST ORGANISATIONS AND ON EVERY MEMBER OF THE COMMUNITY."

JOHN SHAW, 1994

most renowned government-owned research organisations, the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

TREVOR PEARCEY AND THE RISE — AND DECLINE — OF COMPUTING AT CSIRO

Australian computing started at the CSIRO with the Mark I computer (see Chapter 2). The subsequent growth of computing is closely linked to the career of the man who developed that first computer back in the late 1940s, Trevor Pearcey.

For many years, Pearcey's Mark I was the only computer in Australia. Then in 1956, three more computers appeared almost simultaneously – the SILLIAC at the University of Sydney, the UTECOM at the NSW University of Technology (today's University of NSW) and the WREDAC at the Weapons Research Establishment (WRE) in Salisbury, South Australia (see Chapters 3 to 6).

In the mid-1950s, the CSIRO decided not to further pursue the development of electronic computing. Pearcey's recommendation for the establishment of a computing division was rejected[266], and computing in CSIRO remained a minor department within the Division of Mathematical Statistics. With the arrival of SILLIAC and UTECOM in 1955, the Mark I was dismantled and moved to the University of Melbourne, where it was renamed CSIRAC.

Disappointed, Pearcey returned to his native England in 1957 to resume work at the Telecommunications Research Establishment (today's Royal Radar Establishment) in Great Malvern, Worcestershire[267], halfway between Bristol and Birmingham.

Back in England, Pearcey worked on improving computer programming techniques. He also gained exposure to the advanced EDSAC II computer at the University of Cambridge, which was pioneering a programming technique later

known as microprogramming.[268]

Pearcey remained in England for nearly two years. In early 1959 he returned to Australia as part of CSIRO's Division of Mathematical Statistics. A key factor in his return was a chance meeting in London with Edmund Cornish, head of the Division. They discussed their desire to propose a "new, well-supported approach for the establishment of a laboratory where [computing] research could be pursued and computing services provided."[269]

After his return to Australia, Pearcey was instrumental in designing the Cirrus computer[270] (see Chapter 7). With the support of Cornish, he successfully persuaded the CSIRO to take electronic computing more seriously and by 1956 it had established a Computing Research Section in Canberra – albeit one that was underfunded and understaffed. This changed in 1962, when the CSIRO approved Pearcey's proposal to vastly increase the organisation's computing capabilities and build a network connecting its various research facilities around Australia. It was a momentous decision, reversing a decade of neglect.

- ■ "In view of the wide geographical distribution of CSIRO's Divisions, other likely users of a scientific computing service and the high capital and running costs of the large number of separate equipments [sic] that would have to be situated in readily accessible locations, Pearcey proposed a network of computing facilities of various levels of computing capability.
- ■ "In 1962, the proposal was approved by the CSIRO Executive and a £3 million grant was provided by the Commonwealth Government for the establishment of a Section of Computing Research within CSIRO."[271]

The CSIRO immediately started working on a purpose-built computing facility at its Black Mountain headquarters in Canberra. CDC's newly established Australian subsidiary won the tender that had been put to find suitable computers for the project. The deal was announced on 19 June 1963, the same day CDC won the computing business of the Commonwealth Bureau of Census and Statistics (CBCS – see Chapter 11). The computer network that Pearcey envisioned later became the CSIRONET system (see Chapter 24).

JOHN OVENSTONE AND THE DEPARTMENT OF DEFENCE

The first non-academic use of computing in the Australian Government took place in the Army, Navy and Air Force, which were all separate departments until 1973. John Ovenstone, a key player in the WREDAC operations (see Chapter 6), was the driving force behind this development.

In 1958, Ovenstone convinced the Department of Defence to conduct a feasibility study on using computers to automate the administrative functions of the four defence departments.[272] In May 1958, he gave a presentation at an Australian Institute of Management meeting in Mittagong, NSW, attended by William Gleason, a senior officer on the Public Service Board. The meeting demonstrated the potential opportunities computing (then called 'automatic data processing') could offer the Commonwealth Government.[273]

The first step was to introduce computers to the Department of Defence. Ovenstone was named Controller of Automatic Data Processing, and he built a team to conduct a detailed study on the potential ways computers could work for the different defence departments.

The study took 14 months, from 1960 to 1961, and culminated in a 12-volume report[274] recommending the establishment of a dedicated building within the Department of Defence headquarters at Russell Hill in Canberra, with a dedicated network connecting defence facilities around Australia.

■ "The objective was to apply automatic computing methods to all aspects of the administration of four complex and largely technical departments, and create reliable and timely support mechanisms for high-level decision-makers within the departments.

■ "The plan centred on the use of standard, commercially available equipment, as well as software that could handle the required applications thanks to a high-level language that deconstructed the system's processes.

■ "Today, such methods are well established, but they were novel at the time. Ovenstone's approach paved the way for the future development of automatic data processing methods in Commonwealth Government Departments."[275]

The Government sat on the proposal for about a year. In August 1962, it committed the first Australian troops to the war effort in Vietnam, bringing more attention to the Department of Defence. Later that year, Ovenstone's plan was implemented using two Honeywell H800 computers running FACT (Fully Automated Compiling Technique), Honeywell's high-level programming language. (FACT would go on to become a major influence on the development of the widely used COBOL protocol.)[276]

The implementation was slow, mainly hampered by a lack of skilled and specialised individuals. But by the time Ovenstone left the Department in 1964 to take up the inaugural Professor of Computing Sciences position at the University of Adelaide (see Chapter 10), the program had progressed well. The H800s were upgraded to H1800s, and would later be replaced by Sperry Univac machines.[277]

THE INTER-DEPARTMENTAL COMMITTEE

Other parts of the Commonwealth Government were equally active at the time. On 2 March 1962, Gleason's activities

within the Public Service Board led to the creation of two standing committees: the Inter-Departmental Committee on Automatic Data Processing (IDC) and the Policy Committee on Electronic Data Processing.[278]

The Policy Committee met only a few times, mainly to endorse the CSIRO's computing activities. The IDC, meanwhile, was extremely influential in bringing the Government into the computing age. Comprising representatives from the Public Service Board (Gleason himself was Chairman), Treasury, Defence, the Postmaster-General's Department (PMG) and other departments on an ad hoc basis, the IDC had no legislative power but its recommendations carried much weight.[279] It was not disbanded until 1981.

■ "One of the first actions of the IDC in 1960 was to conduct an extensive survey of the prospective use of computers for administrative work in the Australian Public Service.

■ "The survey teams identified departments with functions suited to computer processing; estimated the order of use and the extent of data flow between such departments; produced projections of the classes of computers required and the possible costs, the likely geographical spread, time scales and priorities; assessed specialist and data collection staff requirements; and commented on training."[280]

The IDC was instrumental in the CBCS's May 1963 decision to acquire CDC (see Chapter 11), making it the biggest user of computers in the entire public service. Other early adopters included the Australian Atomic Energy Commission, the Department of the Interior's Survey Branch, the PMG, the Commonwealth Actuary and the Reserve Bank of Australia.[281] Qantas and the Commonwealth Bank, both government-owned at that time, also adopted some form of computing.

COMMONWEALTH BUREAU OF CENSUS AND STATISTICS

The CBCS was established in 1905 to replace the a multitude of individual state statistical departments, though it did not achieve full integration for another 50 years. The CBCS became the Australian Bureau of Statistics in 1974.

1901 marked the year of Australia's first national census. The third census of 1921 used Hollerith punch-card machines from the British Tabulating Machine (BTM) company, which built them under licence from the US Computing-Tabulating-Recording Company, renamed International Business Machines (IBM) in 1924.

Much like the CSIRO, the CBCS developed its own homegrown network to connect remote offices in state capitals to its headquarters in Canberra. The CBCS shared its computing facilities with many other departments before they acquired their own machines, notably the departments of Health, Social Security, Taxation and Treasury, and the Superannuation and Public Service boards.[282]

The CBCS also developed many of its own data analysis tools, mostly out of necessity. Its most significant achievement was an application called Table Generator, developed to handle the enormous workload of the 1966 census. Table Generator was a great success; the US Bureau of Labor Statistics adopted it as the basis for its Tabulation Programming Language, which became widely used by census bureaus around the world.[283]

THE PIT PROGRAM

Computers quickly spread throughout the public service. By 1966, nine departments and nine statutory authorities had computing equipment installed, and they employed a total of around a thoUSnd specialised people to operate it.[284]

The expansion of computing within government created a demand for trained

computing staff. There were no suitable external courses, so in 1960 the Public Service Board initiated a series of three-month courses for interested participants.[285] This was extended in 1963 and formalised as the Programmer in Training (PIT) program, which at first drew upon the expertise of Ovenstone's group in the Department of Defence.[286]

The PIT program trained a generation of public servants how to use specialist computing technologies, and provided by far the most important and influential non-academic training in the country. The PIT courses ran for 12 months and were open only to graduates. They were very demanding, requiring 20 hours a week of class time and substantial study.[287]

The main PIT training centres were located in Canberra and Melbourne, where many Federal Government agencies were still based. In Canberra, the Department of Defence ran the PIT course internally for its own staff, while the CBCS ran courses for its own staff and for those of other agencies.[288] The PMG ran courses in Melbourne, and the Public Service Board coordinated regional efforts.

- ■ "The CBCS/ABS variant was what would later be called a 'sandwich course', including two ten-week stints of on-the-job training. The content was about 50 percent programming and 50 percent systems analysis and design.
- ■ The CBCS 1965 syllabus included two languages, Fortran and Compass (CDC's assembler). Evaluations at the end of the year included a seven-hour systems analysis and design exam."[289]

The PIT program ran until the end of the 1960s, by which time sufficient academic and commercial courses existed within academia to supply the country with well-trained computer specialists. When the program disappeared, many participants moved to the large number of new tertiary institutions that had begun to teach computing (see Chapter10).

MORE INFORMATION

Trevor Pearcey's 1988 book *A History of Australia Computing*, unfortunately out of print, is the main source for this chapter. The 1994 Australian Computer Society book *Computing in Australia* also provides very useful insights into this period in Australia's computing history.

The 85th report of the Australian Parliament's Joint Committee on Public Accounts offers an interesting insight into 'automatic data processing' in the Australian Government in the early 1960s. Published in 1966 and running to 142 pages, and it is now available online.

UNITED WE STAND
IN ITS FORMATIVE YEARS, THE AUSTRALIAN COMPUTER SOCIETY
FOUGHT TO MAKE COMPUTING A PROFESSION.

15

The Australian Computer Society came into existence on 1 January 1966, formed from the amalgamation of existing state societies. From the start, it was very much a federated body; the individual state and territory branches retained considerable autonomy.

At the time, this was the only way the formerly independent organisations could be brought together. There had been much debate over the relative merits of a loose confederation of state branches versus a strong national body, and this was the model that won out (see Chapter 9).

An ACS Council under the ACS Constitution officially helped coordinate the branches, although the Council and the branches were specifically empowered to handle their own financial and other affairs. The inaugural meeting of the Council was held in Canberra on 2 February 1966, with John Bennett as President, Trevor Pearcey as Vice President and Robert (Bob) Rutledge as Honorary Secretary.

The ACS Council was given powers relating to member registration (to ensure consistency across all branches), international matters, affiliation with other bodies, the establishment of new branches and the suspension of any branch that failed to pay its fees to the Council[290] (a scenario that has never yet happened).

This first Council was ostensibly set up as an interim body to establish the Society. In May 1966, a new Council took office following the branch elections two months prior. Its first meeting was in Canberra on 16 May, attended by the following branch delegates:

- Trevor Pearcey and Donald Overheu (Canberra)
- John Bennett and Bob Rutledge (New South Wales)
- L Olsen and Ken Pope (for Merv Fagg) (Queensland)
- Peter Benyon and Ted Norman (South Australia)
- Peter Murton (Victoria).

The three inaugural office bearers – Bennett, Pearcey and Rutledge – were all re-elected. Branches were subsequently formed in Western Australia (October 1966 – admitted January 1967), Tasmania (March 1975) and the Northern Territory (January 1983).

Over time, the role of the Council evolved into a strong national secretariat, and it remained in existence until 2008 when it was replaced by a national Management Committee. The individual state branches have always retained a strong

"THE ACS WILL NEED TO BE PROACTIVE IN DEMONSTRATING THAT COMPUTING IS A PROFESSION REQUIRING PRACTISING PROFESSIONALS WHO SUBSCRIBE FULLY TO THE TENETS OF ANY PROFESSION, NAMELY QUALIFICATIONS AND EXPERIENCE, ESTABLISHED ETHICS, RESPONSIBILITY AND COMMITMENT TO CONTINUING PROFESSIONAL DEVELOPMENT."

ALAN UNDERWOOD, PRESIDENT OF THE AUSTRALIAN COMPUTER SOCIETY, 1994

local identity, and conduct many activities under their own banners.

The following aims of the ACS were spelt out in May 1968, in resolution of the Council:

- **On membership qualifications and standards:** To raise the membership to the standard where corporate membership is accepted as evidence of professional competence.
- **On public relations:** To have the Society accepted as an authority and in a position to advise on computer matters as they relate to the public interest.
- **On the activities of the Society and its branches:** To promote the Society as the proper forum for the discussion of computer matters; to ensure that no opportunity for attracting new members or publicising the activities of the Society in a dignified and professional way are overlooked; to encourage all persons qualified to be members to join the Society; if it appears appropriate with the Society's objectives, to engage in or promote activities directed at non-members.
- **On international activities:** To work towards the Society representing the Australian computing profession internationally in computer and information processing matters.[291]

THE ACS IN ACTION — THE EARLY YEARS

The ACS was not formally incorporated until 3 October 1967. That year, the objectives were changed slightly, making member benefits a consequence of pursuing scientific and educational activities, rather than the primary objective.

A key focus of the ACS since its inception has been the development, maintenance and promotion of professional standards. The standardisation of qualifications is a constant theme throughout the history of the Society, as it aims to increase the consistency with which different tertiary institutions and commercial training organisations award

qualifications.

One of the very first committees the ACS Council formed back in February 1966 was the Qualifications Committee. Its mission was to "investigate the objective standards of professional competence for persons seeking membership of the Society, and to apply them uniformly across branches."[292]

Headed by John Blatt, the committee developed a standardised entry requirement for the Society: an internal examination organised by the Examination Committee, to be completed following completion of an accredited training course. The examination system was an outstanding success, and achieved international recognition. Stuart Summersbee later led the Qualifications Committee, followed by John Hughes.

Just after the ACS was formed, the Careers and Training Committee came into being under the guidance of Barry de Ferranti as convenor. This committee became the Careers and Education Committee under Peter Farrell in 1969, and in 1970 prepared the ACS's first guidelines for commercial training schools. In the same year, it initiated professional development seminars in parallel with similar activities in many of the state and territory branches.

The ACS Constitution was revised on three separate occasions between 1967 and 1969, as the Society and its members adjusted to the transition from independent state-based societies to branches of a national body. In May 1969, the Council adopted a Code of Ethics as a guide to proper behaviour and a professional conduct instrument to "give the Codes some teeth".[293]

The Social Implications Committee was founded in 1971. Its activities included promoting an information technology week with Federal Government support, and publishing a series of position papers on the impact of computing and information technologies on society.

Many of the papers this committee produced were written by people who would become very well known in the computer industry, including committee head Ashley Goldsworthy, Alan Coulter, Karl Reed, Kate Behan and Roger Clarke.[294]

In 1972, a Memberships Standards Committee was set up under convenor Geoff Hill to work on a proprietary system of course accreditation. Bob Northcote took over as convenor in 1974, and his committee finally developed the ACS system of course accreditation, insuring standardisation across tertiary institutions.

The ACS at that time also had three very active technical committees: the Data Communication Committee under Alan Coulter, the Software Committee headed by Karl Reed, and the Hardware Technology committee led by Bill Caelli.[295]

THE ANCCAC AND ACS CONFERENCES IN THE 1960s AND 1970s

After the success of Australia's first two computer conferences (see Chapters 3 and 6) and long before the ACS was formed, a special body was formed to run computer conferences in Australia.

The Australian National Committee on Computation and Automatic Control (ANCCAC) came into being in 1958, mainly thanks to John Bennett. The ANCCAC was the first Australian national body to join the International Federation for Information Processing (IFIP), in the absence of a national computer association (see below).

The first ANCACC conference was held jointly at the University of Sydney and the University of NSW from 24 to 27 May 1960. The organisers only expected 50 papers, but more than 150 were delivered to the 650 attending delegates.[296]

The conference delegates completed a survey, 400 of them saying they were interested in the commercial aspects of computing. A hundred said they were interested in papers analysing some of the technical applications of computing, while another hundred cited design and

programming techniques as key areas for development. The remaining 50 people said they were interested in all three categories.[297]

The second ANCCAC conference was held in Melbourne from 26 February to 1 March 1963, bringing together 68 papers and over 600 delegates. A third conference was held in Canberra from 16 to 20 May 1966 – the year the ACS was founded – attracting more than 860 participants.[298]

ANCCAC then handed over its conference responsibilities to the ACS, which held its first conference in 1969, in Adelaide, where 1,470 delegates took part. During the 1970s, ACS conferences were held biennially: in 1972 in Brisbane, in 1974 in Sydney, in 1976 in Perth and in 1978 in Canberra.[299] Once the ACS took over, the ANCCAC had no reason to exist, and it was disbanded on 20 March 1969, handing over its assets to the ACS.

THE ACS AND INTERNATIONAL RELATIONS

From the beginning, the ACS was very active on the international stage. One of the driving forces behind the creation of a national society was the ability to present a single, unified face of Australian computing to the rest of the world.

THE INTERNATIONAL FEDERATION FOR INFORMATION PROCESSING

Australia's involvement with IFIP began long before the ACS existed. IFIP was established in 1960 under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO), following the first World Computer Congress held in Paris in June 1959.[300] The first IFIP Council meeting, with 15 member countries represented, was held in Rome in June 1960. The second was held in Darmstadt, Germany, in February 1961 – when Australia was admitted.

IFIP was established as a non-governmental, non-profit umbrella organisation for national societies working in the field of information processing. At the time it was formed, the

ANCCAC was the only such body in Australia, so it was this body that brought Australia into IFIP on 1 January 1962. Bennett was appointed ANCCAC representative to the IFIP Standards Committee and was elected a Trustee in 1974, as well as Vice President from 1975 to 1978. He served on the IFIP Council in both positions.

Ashley Goldsworthy replaced Bennett as Australia's representative to IFIP in 1980. Goldwsorthy held a multitude of roles during his career, including ACS President (1974–75 and 1982–83), CEO (1990–94) and President of IFIP in 1986–89. In 1999 he was elected one of the few honorary members in IFIP's history.

Australia's profile within IFIP picked up some more clout in 1980, when IFIP jointly held its triennial global conference in Melbourne and Tokyo. Planning had begun in 1969 with an unsuccessful bid for the IFIP 1977 Congress, which Bennett had led.

The decision to hold IFIP's 1980 conference in Melbourne and Tokyo was made in August 1975, after both cities had bid for it. Peter Murton and Goldsworthy were the main orchestrators[301], having put in their bids at the 1974 IFIP convention in Stockholm, Sweden.[302] The Tokyo leg of the 1980 conference was held from 6 to 9 October and the Melbourne leg from 14 to 17 October. Overall 3,665 delegates attended the entire conference, 1,782 of whom visited the conference's Sydney events.[303]

SEARCC

The South East Asian Regional Computer Confederation (SEARCC) originated during an informal lunch in 1974 at IFIP's Stockholm conference. Bennett and R Narasimham, the Indian representative, agreed that regular South East Asian conferences should be arranged, and that membership rules should be changed to allow smaller local societies to enjoy regional IFIP membership.

On his way back to Australia, Bennett contacted Robert Iau, President of the Singapore Computer Society who went on to organise the first SEARCC conference in Singapore in September 1976. The six founding computer societies represented Singapore, Hong Kong, the Philippines, Indonesia, Malaysia and Thailand, later joined by India (1978), Pakistan (1984) and Sri Lanka (1986). Australia became a full member, represented by the ACS, in 1989.[304]

ASCOCIO

In 1984, the Japan Information Technology Service Industry Association approached the ACS seeking to form an association with other Asian nations and represent the entire computer industry in each country. The result was the Asian-Oceanian Computing Industry Organization (ASOCIO), formed later that year by founding members Australia, Japan, Korea, New Zealand, Singapore and Taiwan.[305]

ASOCIO was an association of all IT organisations from around the region, including those that represented vendors. Other Australian members were the Australian Information Industry Association (AIIA), the Australian Computer Equipment Manufacturers Association (ACEMA) and the Australian Software Houses Association (ASHA). (The latter two groups were subsequently absorbed into the AIIA.)[306]

ACS members served with distinction in the ASOCIO over many years. John Shaw, who had chaired the ACS's early Committee on Developing Countries, and John Goddard, also involved with SEARCC, were two notable members.

RECIPROCAL MEMBERSHIP AGREEMENTS

Over the years the ACS arranged a number of reciprocal membership agreements computer societies in other countries. The first of these was in 1974, negotiated by Ann Moffat.[307]

THE ACS AND THE BEGINNINGS OF COMPUTER EDUCATION

Since its inception in 1966, the ACS has devoted much energy to education. The rapid growth of computing in the 1960s and 1970s made it urgent for the education system to change if it wanted to meet technology-related demands and seize computing-based opportunities.

Tertiary institutions created courses in computer science, but the new discipline had little to no established traditions. When computers were introduced into schools in the 1970s and 1980s, one of the ACS's first educational initiatives was to establish standards for computing and academic institutions. This entailed identifying courses that met ACS standards and maintaining registries of accredited computing courses offered by recognised Australian academic institutions. These standards were widely recognised, and tertiary institutions began to take ACS accreditation criteria into account when developing new courses.

The first Commonwealth Government initiative investigating computers' role in education was a 1973 research project that defined Australia's tertiary computer education needs for the next ten years. Conducted by the ACS's Barry Smith and Barry de Ferranti, the project also considered the social, economic, educational and technological impact of the relatively new technology.

In the 1970s, the ACS also became involved in educational radio and television programs, and in creating course content for schools. An important ACS initiative at this time involved establishing the National Information Technology Council, founded by Ashley Goldsworthy in 1979, and sponsored by the ACS and the Department of Science and Technology. The Council aimed to increase community awareness of information technology and associated issues, and to emphasise the benefits for businesses and individuals.

MORE INFORMATION
Most information in this chapter is taken from the 1994 ACS book *Computing in Australia*.

During this period the ACS facilitated training for computer teachers' associations in many states around Australia, often providing financial and human resources to help establish new groups until they were solid enough to sustain themselves. In 1984, it was instrumental in establishing the Australian Council for Computers in Education – a national professional body to which all state computing teachers' associations now belong (see Chapter 23).[308]

THE MAINFRAME ERA: THE BUNCH
AS THE COMPUTER INDUSTRY MATURED, THE 1970s
SAW INCREASED COMPETITION BETWEEN HARDWARE VENDORS.

16

Australia entered the 1970s with a vibrant, flourishing computer industry. Dreams of local manufacturing were kept alive by a few intrepid companies and individuals (see Chapter 21), but the fiercest competition was between major multinational hardware suppliers.

These foreign vendors – and a host of software suppliers – were fighting hard for supremacy as virtually all large companies and major government departments computerised their operations. Many were now onto their second generation of machines. The highest stakes – and the largest orders – involved mainframe computers, the battleships of the computer industry. Minicomputers were becoming a major market (see Chapters 13 and 20), but mainframes were where most of the action was happening.

IBM remained by far the largest vendor, but its dominance was being challenged on many fronts. By the 1960s there were already many other mainframe suppliers in the US, namely RCA and General Electric (GE).

But as the industry matured and consolidated, only five non-IBM US mainframe makers remained. They were often called the BUNCH – an acronym for Burroughs, UNIVAC (Sperry's mainframe brand), NCR, CDC and Honeywell. CDC had made a major play in Australia in the 1960s (see Chapter 11), but its dominance faded in the 1970s and 1980s. The rest of the BUNCH had sporadic success in Australia, but they too declined over time.

The BUNCH era didn't last long. As early as the mid-1980s, it was no longer a meaningful term. Two of the BUNCH merged in the 1980s (Sperry and Burroughs) and one of them (CDC) disappeared completely in the early 1990s. Not one survived the century as a serious mainframe manufacturer.

With the BUNCH's decline, IBM's biggest challenge came from two non-US mainframe companies: Japan's Fujitsu and the UK's International Computers Limited (ICL). Fujitsu aggressively entered the Australian market in 1973, and soon beat IBM in some major local deals. Fujitsu subsequently diversified into computer-related services and became one of Australia's largest computer companies.

ICL was formed in 1968 when all the UK's computer suppliers, at the insistence of the UK Government, merged to form a single company. The move did not have the

"DESPITE MANY RUMOURS TO THE CONTRARY, THE MAINFRAME IS ALIVE AND WELL. MAINFRAMES WILL ALWAYS BE NEEDED TO HANDLE THE MASSIVE DATA STORAGE AND MANIPULATION NEEDS OF MODERN ORGANISATIONS."

GRAEME PHILIPSON, 1994

anticipated effect. ICL was a major player on the Australian scene in the 1970s and 1980s – especially in Queensland, with key users in most other states – but was progressively acquired by Fujitsu throughout the 1980 and 1990s.

Other threats to IBM came from the so-called plug-compatible manufacturers (PCMs), which copied IBM's hardware designs and were able to offer similar equipment at a much lower price.

This chapter examines IBM and the BUNCH in Australia in the 1970s and 1980s. Chapter 17 looks at ICL and Fujitsu, and Chapter 18 looks at the PCMs.

THE AUSTRALIAN COMPUTER MARKET IN 1970

In its January 1970 edition, Australian business magazine *Rydge's* (which would later become *Business Review Weekly*) published a special feature on computers. It was based on a major survey the magazine had conducted of the 813 computers installed in Australia. The survey divided them up into four price ranges: under $100,000; $100,000 to $250,000; $250,000 to $500,000; and over $500,000. It also broke them down into industry segments.

"After logging a solid 40 percent increase in the last 12 months, the Australian computer market has risen to become one of the major capital goods market in the country. The estimated total value of the 813 computers currently in use in Australia is $187 million.

"This is also one of the most open computer markets in the world. The industry Goliath IBM, which in the US and some other countries has up to 70 percent of the market, has managed to gain only 40.1 percent here. Some of the bigger chunks of the remaining sales belong to ICL (13.1 percent), Control Data (CDC) (10.9 percent), Honeywell (8.3 percent) and General Electric (6.3 percent).

"The reason for the relative openness of the Australian market lies in the fact

COMPUTERS INSTALLED IN AUSTRALIA IN 1970

INDUSTRY	UNDER $100,000	$100,000 TO $250,000	$250,000 TO $500,000	OVER $500,000	TOTAL
Mining and base metal production	14	4	5	5	28
Metal manufacturing	30	34	18	5	87
Clothing and textiles	14	10	1	2	27
Food drink and tobacco	15	7	4	0	26
Pharmaceuticals, soap and toiletries	7	13	3	0	23
Other chemicals, including oil	9	9	11	8	37
Other manufacturing	32	16	6	6	60
Electricity, gas and water	7	4	9	3	25
Transport	7	10	10	4	31
Finance	17	15	22	11	65
Commerce	21	27	6	0	54
Other services, including building and construction	24	9	6	4	43
TOTAL COMMERCIAL	**197**	**158**	**101**	**50**	**506**
Commonwealth Government	41	28	16	32	117
State governments	6	5	7	4	22
Local governments	14	4	1	1	20
TOTAL GOVERNMENT	**61**	**37**	**24**	**37**	**159**
Education	42	13	8	11	74
Data processing bureaus	17	18	25	14	74
TOTAL	**317**	**226**	**158**	**117**	**813**

RYDGE'S, JANUARY 1970

that the Australian government is such a heavy spender when it comes to computers. About 25 percent of the money spent on computers belongs to either Commonwealth, state or local governments."[309]

The article paints a fascinating picture of the Australian computer industry at the beginning of the 1970s. It also published an extremely illuminating breakdown by vendor.

COMPUTERS INSTALLED IN AUSTRALIA IN 1970, BY VENDOR AND VALUE

VENDOR	VALUE OF INSTALLED BASE (A$M)	NUMBER OF MACHINES	MARKET SHARE (% BY VALUE)	AVERAGE COST PER MACHINE (A$000)
IBM	74.9	272	40.1	275
ICL	24.6	151	13.1	163
CDC	20.3	36	10.9	564
Honeywell	16.6	45	8.3	369
GE	12.5	41	6.3	305
DEC	9.4	97	4.7	97
NCR	8.9	75	4.8	119
Sperry Univac	8.6	14	4.6	614
Burroughs	5.3	25	2.8	212
Other	5.9	56	4.4	105
TOTAL	187	812	100	230

RYDGE'S, JANUARY 1970

As this table shows, IBM was bigger than its next four rivals combined, a position it was able to maintain until the end of the 1980s. Its number one spot in Australia – and its dominance – was similar to the position it enjoyed on a global scale at the time.

Although it trailed way behind IBM and ICL, CDC achieved its result with only 36 computers installed, compared to IBM's 272. This was because its machines were on average much larger and more expensive than its competitors', and because it had a strong presence in universities and large organisations such as the Commonwealth Bureau of Census and Statistics (CBCS) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). (See Chapter 11 for a full list of all CDC machines installed in Australia at the end of 1969.)

In 1970, Honeywell (in fourth place) acquired GE's global computer business (in fifth place). The combined value of the two vendors' installed base would briefly move Honeywell into second place in Australia, ahead of ICL.

DEC led the minicomputer charge in the late 1960s (see Chapter 13) and had 97 computers installed by 1970. But the average value was only $97,000, which only gave it a 4.7% market share by installed value. NCR's machines were also comparatively small on average.

Sperry Univac had the largest average cost per computer of any vendor established in Australia – larger even than CDC – and was especially popular for time-sharing its machines. Burroughs' biggest strength was also in data processing bureaus.

Of the total number of installed machines in 1970, 56 were from an assortment of smaller vendors, most of them small computers with average values similar to that of DEC's.

HONEYWELL IN AUSTRALIA

Honeywell was known as the Minneapolis-Honeywell Regulator Company until 1965.

Its origins were in heating equipment, but by 1955 it was a pioneer of commercial computing, entering the market through Datamatic, a joint venture with Raytheon. Its first computer was the D-1000, which shipped in 1957.

In 1960, Honeywell bought out Raytheon and formed its Electronic Data Processing Division, which it later renamed Honeywell Information Systems (HIS). In 1966 it acquired another computer pioneer, Computer Control Corporation, and in 1970 acquired GE's computer division. These acquisitions greatly increased Honeywell's product range as well as its technological capabilities.[310]

Honeywell set up in Australia in 1961 under Phil Dobbs, who had started with computers in the US Navy and subsequently worked in the US Treasury Department.[311] He had led the team in Honeywell's successful bid to install the first computers – two H800s – in Australia's Department of Defence (see Chapter 14).

The order confirmed, Dobbs was sent to Australia to set up the local operation and oversee the delivery of the machines, initially setting up operations in two rooms of Sydney's Chevron Hotel.[312] The original 18-month assignment turned into a lifetime career, and he remained head of HIS Australia until his retirement in 1975.

The H800 units acquired by the Department of Defence were later upgraded to the H1800, and in 1969, the Department installed the first Honeywell multiprocessor in the world, an H8200.[313] Honeywell remained the Department's main computer supplier until the late 1970s, when Sperry took over that honour.

In 1964 Honeywell sold its first two commercial machines in Melbourne: one H200 to Gordon and Gotch, a newspaper and magazine distributor; and another one to Bonds, the clothing company. The H200 was compatible with IBM's 1401, which was then the world's most popular computer.
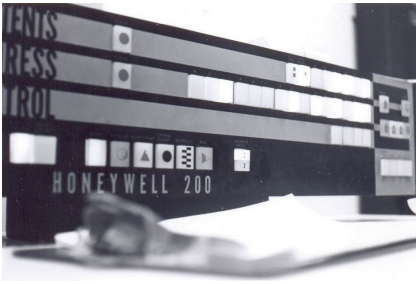
Honeywell continued its successes in Australia and by 1970 it had a branch in every Australian state capital. It was a position further solidified by the inheritance of GE's large Australian user base.

Honeywell's machines were very popular in the government sector. Apart from the Department of Defence, prominent customers included the Postmaster-General's Department (PMG), the Treasury and the NSW Government. Honeywell also placed many of its H6000 machines in Australian banks, and in 1973 installed the first Australian H2000 series machine, an update to the H200, at Reckitt and Coleman, a consumer goods company.

In Australia and globally, Honeywell enjoyed a relatively prosperous decade or two as an independent mainframe supplier, supported by a larger instrumentation and process control parent. But as the technology became more sophisticated, the economies of scale failed to follow. Honeywell began to look for international alliances, which led it to enter a technology-sharing agreement with Japan's NEC as early as 1962.

NEC was unknown outside of Japan at that time, and it seemed ready to gain much more from the relationship than Honeywell. That's exactly what happened; NEC released its successful NEAC Series 2200 computer in 1965, a single-architecture range that by the 1970s had propelled it to a market-leading position in Japan.

When Honeywell bought GE's computer business in 1970, the latter had been losing large amounts of money in computers. But Honeywell saw value in accessing GE's more advanced technology. The purchase included a two-thirds interest in French computer company Compagnie des Machines Bull, which was renamed Compagnie Honeywell Bull.

In 1973, Honeywell agreed to supply NEC with the source and object code of its GCOS 64 operating system, which then became the basis of NEC's ACOS-4 operating system. By

1976, NEC had begun producing copies of the Honeywell Series 60 mainframes under its own name.[314]

Honeywell remained moderately successful as a mainframe supplier, but it was unable to substantially increase its user base in the face of IBM's popularity and the growing number of minicomputer suppliers. It began to rely more and more on its technological agreement with NEC and its marketing agreement with Bull.

In 1976, Compagnie Honeywell Bull merged with French company Compagnie Internationale pour l'Informatique (CII), and in 1982 with other French computer companies Sems, Transac and R2E to form Groupe Bull. Honeywell's stake was 20 percent, and most of the remainder went to NEC and the French Government, which had nationalised Bull's largest shareholder.

In 1984, Honeywell and Bull signed 10-year cross-licensing deals with NEC, under which NEC would supply DPS90 mainframes to both companies. Honeywell continued to make its own DPS8 range of mainframes, but these were old technology compared to the DPS90, and HIS began to lose its footing.

In 1986, Honeywell finally sold its majority shareholding in HIS to NEC (15 percent) and Groupe Bull (42.5 percent) for a total of US$527 million. The new company was called Honeywell Bull. Bull itself remained healthy, largely because of the partisan support of the French Government, which purchased products and delivered capital injections. In 1988 Bull increased its share in Honeywell Bull to 65 percent, ending Honeywell's days as a computer supplier.[315]

BURROUGHS AND SPERRY IN AUSTRALIA

Burroughs and Sperry (which produced UNIVAC mainframes) put the 'B' and 'U' in BUNCH, before merging in 1986 to form Unisys. Both these companies – at one stage the second and third largest in the global computer industry – had a long and illustrious history as mainframe suppliers, and were responsible for many installations in Australia in the 1970s and 1980s.

Burroughs was founded by William S. Burroughs in 1887, in the US city of St Louis, Missouri, with the aim of marketing the adding machines Burroughs had devised. (He was also the grandfather of the Beat-Generation author of the same name.) The company became very successful over the years, and was an early entry into the computer industry in the 1950s.

Its major strength, however, remained in smaller machines, until it failed to foresee the microcomputer boom of the 1980s. It had some success with its A series mainframes, which attracted a comparatively small but loyal user base. But in the 1960s and 1970s, the next generation of B series mainframes were widely recognised as technological leaders.

Burroughs set up in Australia in the 1920s to sell adding machines. It moved into computers in the 1950s, and in the early 1960s started selling computers to the local market. It had some early success with its B500 computers – including a significant sale of a B500 to Monash University (see Chapter 10) – and smaller machines designed for accountants, but its biggest successes came with its B6500 and B6700 machines, introduced in Australia in the early 1970s.

By 1978, Burroughs had gained 8.8 percent of the Australian computer market, based on the value of installed machines.[316] Some of its larger users included the Ford Motor Company and Citibank.

Burroughs had a major breakthrough in Australia in 1971, when it won a large order from Victoria's Gas & Fuel Corporation for dual B6700s, replacing two IBM 360/40s that were less than five years old. It also sold a B6700 to insurance company CML.

Sperry was the descendant of the Sperry Rand Corporation, which had released the world's first commercial mainframe, the
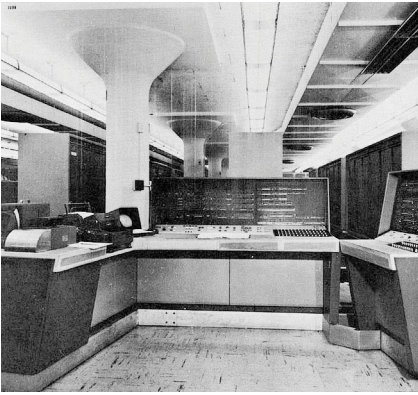
UNIVAC (**UNIV**ersal **A**utomatic **C**omputer). UNIVAC was the brainchild of computing pioneers John Presper Eckert and John Mauchly, based on their work with the first computers during World War II.

Remington Rand delivered the first UNIVAC machine to the US Census Bureau in March 1951. It was a remarkable machine, with a memory bank of 24 KB at a minimum, expandable 'at the discretion of the user' to 120 KB. A tape drive called a UNISERVO could read and write at 20 KB per second. Each tape could store nearly 3 MB of data, and up to 10 tape drives could be attached.

Sperry was successful with the UNIVAC, but it was soon overshadowed when IBM decided to enter the mainframe market. Its greatest successes were in the enormous US government and defence markets.

The Australian office of Sperry Rand attempted to sell UNIVAC computers in Australia in the early 1960s, but was unsuccessful. In 1967, it established a specialised UNIVAC division with an office in Sydney, which was able to capitalise on the growing computer market in Australia at the time. Sperry Australia scored a major win when insurance company AMP defected from the IBM camp and ordered a $4 million UNIVAC 1110 in 1973.[317]

In 1972, AMP had established a computer services company, Computer Sciences Australia (CSA), as a joint venture with US services company Computer Sciences Corporation (CSC – see Chapter 27). In a move that is common nowadays but was innovative back then, AMP then outsourced all its internal computing services to CSA. CSC used UNIVAC 1100 machines for its worldwide time-sharing bureaus and had advised AMP to make the move from IBM to Sperry.

Sperry's reputation in Australia suffered severely with its failure to implement the Government's Common User Data Network, a grand plan for a national computer network, in the early 1970s (see Chapter 24), and by the early 1980s Burroughs and

Sperry were both struggling on many fronts. They completely missed the microcomputer boom, and their minicomputer entries were not doing well. Their mainframe lines – the Burroughs B series and the Sperry 1100 series – represented between them the largest installed base of non-IBM and PCM mainframes, but their market shares were declining.

Burroughs's Michael Blumenthal initiated a merger between the two companies, which Sperry accepted after a long courtship, and Unisys was born. The combined company was for a short time the second largest in the industry, but problems in bringing the two organisations together – which included selling off some divisions to finance the merger – soon saw it drop back in Australia and be overtaken by DEC and Fujitsu.

Unisys's financial problems persisted. It was saddled with an enormous debt, a legacy of the merger. It maintained a sizeable user base, but this declined as the company increasingly moved into computing services. The two disparate mainframe lines were slowly merged over the next two decades, but Unisys declined and is today a midrange services company.

NCR IN AUSTRALIA

NCR – the 'N' in BUNCH – was one of the major non-IBM-compatible mainframes of the 1970s and 1980s. NCR originally stood for National Cash Register, a company founded in Dayton, Ohio in 1884. John Patterson, its founder, is also credited with creating modern salesmanship, and was mentor to Thomas J Watson, who went on to establish IBM.

NCR moved into mechanical accounting machines in 1921, and electronic computers in 1952, when it acquired the Computer Research Corporation (CRC). In 1957, to broaden its product range, it entered into an agreement with the UK's Elliott Automation to jointly develop and market computers worldwide under the National Elliott brand.

NCR also pursued its own technology development and released its first transistorised computer, the NCR 304, in 1958. The arrangement with Elliott ended in 1967 when that company merged with English Electric.

NCR began selling computers in Australia in 1959 under the National Elliott brand, and in 1960 established an Electronic Data Processing Centre in York Street in Sydney, which it claimed to be the first computer bureau in Australia.[318]

The bureau used a National Elliott 405 computer, a valve computer first released in 1956. That computer later went to the CSIRO and is now displayed in Sydney's Powerhouse Museum.

In 1967 NCR introduced its first integrated circuit machine, the Century 100. The Century 200 and Century 300 followed, and were the mainstay of NCR's product line into the 1970s, operating like the IBM System/360 as a family of compatible computers.

NCR was quite successful in Australia, and in 1971 it held 11 percent of the Australian computer market by installed base. It had increased the share to 13.2 percent by 1976[319], and won a number of major orders, including a $4.75 million deal in 1973 for a nationwide network of data terminals in 67 Department of Social Security offices.

Another major sale during this period was to insurance company T&G, which in 1974 ordered Century 151 mainframes for each of its Sydney, Brisbane, Adelaide and Perth offices, all connected to a Century 300 machine in Melbourne. The $3 million deal also included a large number of terminals and other peripherals.[320]

NCR announced a product cooperation deal with CDC in 1973, but little came of it. It changed its name from National Cash Register to NCR Corporation in 1974, which was about the time its market position started faltering. NCR had always

stayed close to its roots, and despite fading out of the mainframe race, retained a strong presence in financial computing and transaction processing. Even today, it remains a major supplier of automatic teller machines (ATMs).

NCR had a brief resurgence after it released its Tower series in 1982, a minicomputer that was one of the first specifically designed to run the Unix operating system. In 1983 it released the NCR 9300 mainframe, followed by the 9500 and 9800 in 1986. They were technically advanced machines that used large-scale integration (LSI) technology, but by this time NCR had lost critical mass as a mainframe supplier.

In 1991, NCR was acquired by telecommunications giant AT&T. In 1994 it briefly became AT&T Global Information Solutions, but was spun off in the late 1990s and reverted to the name NCR. By that time it had ceased to be a major computer supplier.[321]

CDC FADES

In the 1960s and 1970s, the CDC Corporation experienced fantastic growth, becoming a world leader in large-scale supercomputer technology (see Chapter 12). But its descent was as quick as its rise; it declined in the 1980s and ceased to exist in 1992.

The company was founded in 1957 by William Noyce, who dreamt of creating a successful computer company with a social conscience. CDC quickly made a name for itself in the large-scale scientific mainframe market, and it soon diversified into peripherals and the emerging services market. Its 6600 series mainframes were enormously successful in the 1960s, winning most of the business for scientific and engineering applications. IBM regarded CDC as such a threat that it announced a new high-end mainframe, the System 360/90, to counter the 6600.

The problem was that the 360/90 did not exist. IBM's tactics in discouraging sales of

MORE INFORMATION

There is little published information on computer suppliers in Australia in the 1960s and 1970s. The exceptions are DEC and CDC, which have good corporate historians. Some information in this chapter is taken from Australia's first computer newspaper *Computer Weekly*, later renamed *Pacific Computer Weekly*. Copies can be found in most state libraries, and it is reasonably well indexed.

A good overview of the history of mainframe suppliers can be found in Graeme Philipson's 1991 book *Mainframe Wars*.

CDC's 6600 series while it developed the 360/90 – and the low cost of the 360/90 when it was finally delivered – caused CDC to file an antitrust suit against IBM in 1968. The case was settled out of court in 1973, but not before it had done great damage to CDC's mainframe business.

The settlement was generally favourable to CDC. It gained, at negligible cost, IBM's Service Bureau Corporation, a large time-sharing division. That acquisition, combined with CDC's increasing activities in other areas, made it one of the most diversified companies in the computer industry in 1980.[322]

CDC was very successful in Australia in the 1960s. This success continued into the 1970s thanks to a strong relationship with the CBCS and CSIRO (see Chapter 11). It also sold a lot of equipment to the Australian Taxation Office, BHP, the NSW Department of Main Roads, and many other government departments and universities.

Some of its biggest customers were the Totalizator Agency Boards (TABs) in various Australian states. But in the late 1970s, CDC Australia became involved in legal action in the Victorian Supreme Court, marking the beginning of a long downward spiral in Australia.

This situation mirrored the misfortunes of the parent company in the US. CDC began to lose serious market share in the 1980s, and its time-sharing activities started to lose money as personal computers (PCs) emerged onto the market.

CDC blew hundreds of millions of dollars on Plato, an educational software system, and lost more than US$500 million on its various activities in 1985 alone. That year, Norris announced his retirement, in a further blow to the company's already shattered morale.[323]

Throughout the late 1980s CDC ruthlessly shed parts of its diverse activities in an effort to retain a profitable core. Through all these problems CDC kept its Cyber range of mainframes barely alive, maintaining a loyal, if dwindling, band of customers. Then in 1990

CDC announced the 4000 series, a computer based on a RISC (reduced instruction set computer) architecture and a Unix processor that was the outcome of a technology-sharing deal with emerging RISC supplier MIPS Computer Systems. But it was too little too late, and CDC closed its doors in 1992.

Trevor Robinson, the driving force behind CDC's initial success in Australia (see Chapter 11), had left the company in 1970. He returned as Managing Director of CDC Australia in 1986 but was unable to turn the company around in the face of what he saw as massive financial problems.

"In spite of freshened mainframe hardware, an excellent new operating system, and the possible miracle in the shape of new supercomputers, it was too late."[324]

As far as Robinson could see, the mainframe era was coming to an end. He left Control Data Australia again in 1989 to become a special advisor to Senator John Button in the Hawke Government's Department of Industry, Technology and Commerce. He became a Member of the Order of Australia in 1994, and in 1999 was awarded the Pearcey Medal for services to the Australian computer industry. He died in 2007.

One of CDC's legacies in Australia was the Control Data Institute, which trained an entire generation of programmers before being sold to Computer Power in 1989 (see Chapter 20). After Robinson left the company, new Managing Director Philip Michod organised a management buyout with Douglas Dent, Director of Operations, and called the new company Miden Corporation, a combination of their two surnames. The venture was unsuccessful and went bankrupt in 1994. After more than 30 years, CDC was all but erased from the Australian computing industry.

THE MAINFRAME ERA: ICL AND FUJITSU
AS THE BUNCH DECLINED, OTHER MAINFRAME SUPPLIERS KEPT UP THE COMPETITION WITH IBM.

17

T he Australian computer industry has always been a uniquely competitive environment. As an advanced English-speaking economy, Australia has always attracted suppliers from all over the world. The market is large enough to make the effort worthwhile, but small enough to make establishment costs feasible. And Australia's relative isolation from the rest of the world means that if something goes wrong, the effects are relatively insulated.

IBM and the BUNCH, examined in Chapter 16, were all US–based suppliers. Also active in Australia were a number of other mainframe players that made the country the most competitive market in the world for these large computers in their heyday – from the release of the IBM System/360 in 1964 to the end of the 1980s.

This chapter examines the two major non-US mainframe suppliers – Britain's ICL and Japan's Fujitsu, both of which were very important in Australia. The following chapter examines the so-called plug-compatible manufacturers (PCMs).

ICL

The BUNCH acronym was coined in the US, and referred only to US computer companies: Burroughs, UNIVAC, NCR, Control Data Corporation and Honeywell. Had it encompassed other players, it would have had to squeeze in an 'I', because British mainframe supplier ICL shared many of the group's common characteristics.

ICL (International Computers Limited) was formed in 1968 with the merger of British computer companies ICT (International Computers and Tabulators) and English Electric Computers (EEC). EEC had been formed from a merger of Elliott Automation and EELM in 1967. Elliott had supplied the WREDAC computer to the Weapons Research Establishment (WRE) in Salisbury, South Australia, in 1956 (see Chapter 6). EELM was itself the result of a 1963 merger between English Electric, LEO and Marconi.

ICL was created at the urging of British Prime Minister Harold Wilson's Labour Government, elected in 1964 after 13 years of Conservative rule. In 1968 the government passed the *Industrial Expansion Act* as a means of rationalising and strengthening Britain's industrial sector. Technology

"IT WAS IN THE BRITISH NATIONAL INTEREST TO DEVELOP AS MUCH INDEPENDENCE AS WE COULD FROM THE UNITED STATES IN THE TECHNICAL FIELD. THIS WAS WHY WE WERE TRYING TO BUILD A STRONG COMPUTER INDUSTRY."

TONY BENN, 1968

THE ICL FAMILY TREE


```
British Tabulating
Machine Company     1959
(BTM)                        →
                                  International
Powers-Samas        1959          Computers &          1968              International
                             →    Tabulators                   →         Computers
                                  (ICT)                                  Limited (ICL)
Ferranti (business  1963
computer division)           →                                          1990 − 80%
                                                                         acquired by
                                                                         Fujitsu
English Electric    1963
(computer division)          →    English                                1998 − 100%
                                  Electric Leo         1967              acquired by
LEO                 1963          Marconi                       →        Fujitsu
                             →    (EELM)                     English
                                                             Electric          1968
Marconi             1963                                     Computers                → 2002 − ICL
(computer division)          →                               (EEC)                      brand name
                                                                                        dropped
Elliott Automation              1967                              →
                                          →
```

Minister Tony Benn, a noted left-wing firebrand who had renounced a peerage (he had been a viscount) so he could sit in the House of Commons, used the Act to force the merger, which was intended to form a British ICT vendor capable of succeeding globally.[325]

The government took a 10.5 percent stake in the company, in return for which it provided £10 million in funding for research and development. The rest was held by English Electric Computers and the electronics company Plessey (18 percent each), and the former shareholders of ICT, who held the majority (53.5 percent).[326]

THE ICL FAMILY TREE

ICL was initially successful, but only because British Government agencies were essentially forced to buy its products. In its first year of operation it gained 97.6 percent

(by value) of the government's computer orders. That dropped to virtually zero after Edward (Ted) Heath's Conservative Government, elected in 1970, opened the government market to competitive tendering.[327]

The Tories repealed the *Industrial Expansion Act*, but in 1971 were forced to lend ICL £40 million to keep it going during that year's recession.[328] It used the money to develop a new range of computers called the 2900 series (see below). These were very successful and the company's problems appeared to be over – but not for long.

Outside of the UK, ICL was mostly successful in Commonwealth countries such as Australia, New Zealand and South Africa. Its Australian business, the most successful international subsidiary, were formed in 1968 with the merger of Australian Computers (the local distributor of EEC) and ICT's Australian operations.

Australian Computers, usually called AusComp, was owned 60 percent by EEC and 40 percent by Australian electrical and electronics company AWA. AusComp had planned to produce the EEC System/4 computer in Australia, but nothing came of the idea until ICL was formed in 1968.[329]

The various companies that formed ICL had all sold machines in Australia, so when ICL came into existence it already had a large local user base. Two of Australia's first four computers were from companies that came to be part of ICL – the University of New South Wales' UTECOM was from English Electric (see Chapter 5) and WREDAC at the Weapons Research Establishment in South Australia was an Elliott machine (see Chapter 6).

The Australian operation of ICT had been very successful, selling hundreds of computers in the 1960s. Before the introduction of the ICT 1900 in the mid-1960s, most of these machines were rebadged Sperry Univac 1004s, a comparatively inexpensive machine

introduced in 1962 and programmed by a plug board.[330]

They were replaced by the much more advanced Model 1900, which were based on the Ferranti Packard FP6000, developed in 1963 by the Canadian subsidiary of Ferranti before the formation of ICT.[331]

Released in 1964, the 1900 series was similar to the IBM System/360 – a family of computers with a consistent architecture, from the smallest to the largest machine.

The 1900 was announced six months after IBM's architecture appeared, but deliveries to Australia started before any System/360s had arrived.

From the English Electric side of ICL came the System/4, an IBM System/360–compatible machine. The System/4 was licensed from US mainframe company RCA, which called it the Spectra 70. (RCA left the IT industry in 1971 and Sperry acquired its user base.)

Both architectures were successful in Australia. A 1900 replaced an IBM System/360 at Woolworths, and the Customs Department installed a high-end Model 4/72 in 1972. Another System/4 replaced an IBM System/360 at pharmaceuticals distributor DHA.

ICL was remarkably successful in Queensland, largely through the efforts of one man: sales manager John Marshall. He had worked for Powers-Samas in the 1950s, and stayed with the company as it morphed into ICT and then ICL.[332]

Marshall had been very successful selling Powers-Samas punch card machines around Queensland. As the organisations transitioned into electronic computers, he was able to keep all these customers in the ICT/ICL camp. When the ICL 1900 was released, he sold dozens of machines to virtually every major computer user in the state, in both the private and public sector. The only exception was Queensland Railways, which went with IBM.[333]

ICL sold a 1903A to the South Australian
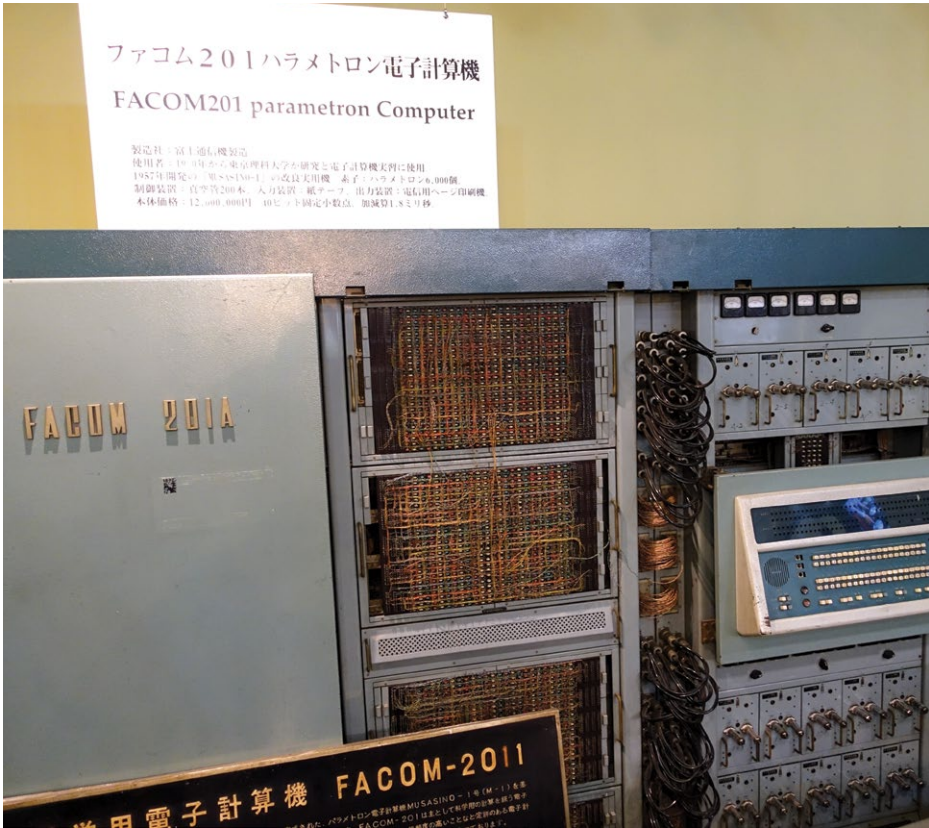
Institute of Technology in 1970, and was persuaded by the South Australian Government to establish a software development centre in Adelaide. It became the largest software laboratory in Australia, employing 60 people, but closed in 1974 due to 'communication problems' with head office in London.[334] Staff members were offered fully paid transfers to ICL in the UK, but many stayed in Australia, their expertise forming the genesis of the Adelaide Technology Park.[335]

The 2900 series mainframes were announced in 1974 and became available in Australia the following year. These advanced machines were able to emulate software from both architectures inherited in the ICL 1968 merger, running the VME (Virtual Machine Environment) operating system.

The low-end 2903 model was a particular success in Australia.

In 1976, ICL acquired Singer Business Machines (see Chapter 20), and inherited Singer's large Australian user base. The Singer System Ten, which had nearly 100 Australian users, became the ICL System 25 minicomputer, and formed the basis of ICL Australia's move into the retail vertical market in the 1980s.

In the 1960s and 1970s Australia was economically in many ways still a British colony. A 'Commonwealth Preference' law stated that imported goods from countries other than Britain and other Commonwealth countries would be charged a tariff if they competed against 'equivalent' imports from the Commonwealth. ICL always said this offered the company no advantage in Australia.[336]

ICL's Content Addressable File Storage (CAFS) system, a hardware database engine, was the first device of its kind commercially available from any ICT supplier in the world. It formed the basis for ICL's Indepol software, a free-form database for the intelligence, defence and police markets (hence the name). The development of Indepol was partially financed by the UK Ministry of Defence, which wanted a way to record and access the massive amounts of real-time data gathered by modern military intelligence, especially in battle.

CAFS's speed and flexibility made it a favourite with police forces and other investigative bodies, which could use it to conduct unstructured searches of disparate data in a way and at a speed that had been impossible with conventional databases.[337] Queensland Police was one of the system's major users in Australia.

ICL started to struggle in the late 1970s. In 1981 US mainframe company Univac attempted to buy it, and there had also been discussions with Burroughs back in 1973. A loan guarantee from the British Government saw off the 1981 challenge, but ICL started

looking for global partnerships that would enable it to stay in the race technologically and financially. After the Univac scare, ICL cancelled its expensive LSI (Large Scale Integration) chip development program and bought the technology from Japanese company Fujitsu.

In 1984, ICL was acquired by major British telecommunications company STC (Standard Telephones and Cables). Things did not go well, and ICL ended up having to bail STC out of financial problems. Within a few years, ICL was contributing 60 percent of STC's total revenues.[338] ICL's combative new CEO Peter Bonfield managed to turn around the combined operation, but the competitive pressures continued to mount.

Despite many acquisitions, further investment from the British Government and substantial product development, ICL was increasingly unable to compete against IBM and the other mainframe players. The Series 39, the first mainframe computer to use internal optical fibres (five years before IBM), was released in 1985. It was an impressive machine, but the end was near.

Fujitsu ended up making more and more of the internal componentry of ICL's mainframes, and in 1990 it acquired 80 percent of the company from STC, for US$1.3 billion. Two years later, it acquired the remaining 20 percent, and over the next few years the ICL brand was quietly dropped as it merged into Fujitsu. The dream of a British computer giant was over. ICL Australia, like the parent company, had been consumed by Fujitsu.[339]

FUJITSU: THE NEW KID ON THE BLOCK

In the early 1920s, Japan's powerful Furukawa industrial family established a relationship with Siemens, the German electrical and industrial conglomerate, and in 1923 they branched out into electrical generator manufacturing. The new company was named Fuji Electric Company Limited – named not after Japan's famous

FUJITSU'S ENTRY STRATEGY WAS UNIQUE FOR AN OVERSEAS COMPANY – ESPECIALLY A JAPANESE ONE – AS IT INVOLVED HAVING LOCAL MANAGEMENT, STAFF AND SKILLS TO RUN THE BUSINESS, AS OPPOSED TO THE TRADITIONAL APPROACH OF RUNNING EVERYTHING FROM JAPAN AND SOURCING THE MOST SENIOR PEOPLE FOR THE FOREIGN OPERATION FROM THE JAPANESE HEAD OFFICE. THIS APPROACH ENABLED THE AUSTRALIAN BUSINESS TO RESPOND TO LOCAL SITUATIONS WITH ALMOST COMPLETE AUTONOMY, BUT WITH THE FULL SUPPORT AND BACKING OF THE HEAD OFFICE.

mountain, but from the first syllables of the two companies' names: 'Fu' from Furukawa, and 'Ji' from Siemens, which was known as Jimens in Japan. The young company grew by supplying Japan's growing East Asian empire with specialised electrical equipment.[340]

The Great Kanto earthquake virtually destroyed Tokyo in 1923, creating the impetus to rebuild the entire Japanese telecommunications system. The Japanese Government took the opportunity to replace all manual telephone exchanges with automatic switching systems, so Fuji Electric imported Siemens H-type exchanges and telephones to meet the demand, then started manufacturing them itself. In 1935 it formed a telecommunications subsidiary, Fuji Tsushinki ('Fuji Telecommunications'), condensing the name to Fujitsu in 1967.

The company moved into computer systems in the 1950s and quickly became a major innovator. It developed its first computer – the FACOM (**F**uji **A**utomatic **COM**puter) 100 – in 1954. It started mass producing transistors in 1960, and by 1961 had released the transistorised FACOM 222. The 1965 FACOM 230-10 is credited with starting the computer boom in Japan, selling more than 1,000 units.

In 1968, Fujitsu released the world's first entirely integrated circuit computer, the FACOM 230-60, and in the same year overtook NEC and Hitachi to become Japan's leading computer company.[341] In the same year, it opened its first international subsidiary, in the US.

In 1971 Fujitsu made a strategic investment in IBM mainframe-compatible vendor Amdahl (see Chapter 18), which helped it design and build its own FACOM M series mainframes, first released in 1974. These machines competed against IBM's largest mainframes, leading to a protracted legal battle between the two companies that was not finally resolved until 1997. In 1981 Fujitsu formed an alliance with British computer manufacturer ICL (see above),

buying 80 percent of that company in 1990 and all of it in 1992.

Fujitsu's entry into Australia remains one of the best examples of a computer supplier using Australia as a testbed for the rest of the world. Fujitsu initially entered the Australian market in 1973 by establishing a partnership with the Bank of Tokyo, the Bank of New South Wales (now Westpac) and Nissho Iwai, a Japanese trading house that provided shipping and mercantile experience. A key member of the consortium was Computer Manufacturers (Australia), an Australian data entry equipment company that provided local marketing expertise.

The operation was initially called FACOM Australia Limited (FAL). Fujitsu soon acquired the shareholding of the other partners, making FACOM a fully owned subsidiary. Mike Rydon, formerly of IBM South Africa, who had been head of Computer Manufacturers (Australia), was invited to take the position of Managing Director.[342]

Fujitsu's entry strategy was unique for an overseas company – especially a Japanese one – as it involved having local management, staff and skills to run the business, as opposed to the traditional approach of running everything from Japan and sourcing the most senior people for the foreign operation from the Japanese head office. This approach enabled the Australian business to respond to local situations with almost complete autonomy, but with the full support and backing of the head office.

When it started in the early 1970s, FACOM Australia had no reseller agreements and was completely on its own. But it did have a growing base of loyal customers, and a slowly increasing market share. It relied on finance from Fujitsu Japan (in the form of a loan that had to be paid back on commercial terms) until 1983–84, when it announced its first profit of a little over $1 million.

Things were not easy for the newcomer. Existing Australian computer suppliers were actively hostile towards the company, taking every opportunity to aggressively attack its small base and discredit it in the computer community.

All of these companies were affiliates or subsidiaries of large US firms – they had quickly recognised that this Japanese upstart was potentially a major threat, and not just in the Australian market. They knew that if Fujitsu could be successful in the Western test tube of Australia, it could leverage this success and experience and start attacking their home markets. These fears were justified, because that is exactly what happened.

In February 1977, the Australian Bureau of Statistics (ABS) went to tender for new computer equipment, having moved into the computer age in 1961 when it installed CDC mainframes around Australia (see Chapter 11). The 1977 tender would replace its core computer equipment for analysing census data and processing trade and financial statistics, completely renovating the existing national network. The deal was worth more than $17 million, which at the time made it one of Australia's largest ever computer projects.

The ABS received responses from Control Data Australia, IBM, Sperry and Fujitsu, and in May 1977 shortlisted IBM and Fujitsu. The ABS contract was a large deal on a global scale, and Fujitsu viewed it as crucial to the company establishing itself in a Western market.[343]

In late 1977 the industry rumour mill began to suggest that Fujitsu was favoured over IBM to win the deal. But it also emerged that the Australian Government had recommended that IBM be awarded the contract, despite its bid being more expensive.

This caused some controversy. Questions were asked in Parliament. Some people were even calling it 'Computergate', and Prime Minister Malcolm Fraser's Coalition Government was forced to call new tenders,

with an independent arbitrator to oversee the selection process. Finally, in November 1979, Fujitsu was awarded the contract.

This was a major victory for FACOM Australia and Fujitsu worldwide. Not only had Fujitsu overcome the technical challenges of competing against IBM, it had also overcome the language barrier, which had previously prevented Japanese computer manufacturers from being accepted in projects of this size. Fujitsu was now recognised in the Australian computer market. Significant purchases from other major government departments and commercial organisations followed.[344]

George Ranucci, an urbane Italian who joined FACOM Australia in 1981 as a sales manager, in 1985 succeeded Mike Rydon as Managing Director – the same year the company changed its name from FACOM Australia to Fujitsu Australia.

During Ranucci's time in the role, Fujitsu Australia became the most successful of all Fujitsu's international subsidiaries. Revenues trebled – from $80 million to $210 million – and headcount doubled from 450 to 900. In Ranucci's first year, big-name organisations like AAMI *The Canberra Times*, CSIRONET, Fairfax, Hindmarsh Building Society, P&O Cruises, SA Gas, and SEQEB all became Fujitsu customers.

The acquisition of ICL in the 1990s (see above) greatly accelerated Fujitsu's move into services, and a year after the merger services already formed half of the company's Australian revenues. Important service areas included third-party hardware maintenance (where ICL had been particularly strong), systems integration, and English-language technical support for Fujitsu's other overseas subsidiaries.[345]

THE FUJITSU–IBM ARBITRATION

Mainframe computers are complex beasts, and the operating system is key to the issue of compatibility. If different computers from different manufacturers can run the same

operating system, they can run the same application.

In 1974, IBM released an operating system called MVS (Multiple Virtual Storage), which ran on its higher-end mainframes into the 21st century. In its attempts to compete against IBM, Fujitsu developed a similar and compatible operating system called MSP (Multiple Storage Partition), which used some of the same source code. IBM immediately cried foul and claimed that Fujitsu had violated its intellectual property rights.

There was no doubt that much of Fujitsu's operating system software had come from IBM. Even mistakes and comments embedded in the code had been copied verbatim. IBM claimed that Fujitsu had stolen the code, while Fujitsu claimed it was in the public domain. *The New York Times* gave some background to the dispute in 1987:

■ "Fujitsu argued that it had done most of its operating system work by itself and that it drew only on developed technology that was already in the public domain. In fact, throughout the 1970s little of IBM's operating system work was copyrighted, chiefly because copyright protection was not believed at the time to extend to operating systems.

■ "In recent years, however, the courts have greatly expanded intellectual property rights to include such programs, making the IBM-Fujitsu dispute even more complicated.

■ "Fujitsu further argued that some of IBM's operating system software had become 'industry standards' and that, by overzealously guarding it, IBM was trying to lock out competitors."[346]

Both parties agreed to submit the dispute to an independent arbitrator. In 1985 the dispute went to arbitration in the US, under the auspices of the American Arbitration Association. The arbitrators, agreed to by both parties, were Robert Mnookin (a professor of law at Stanford University) and John L Jones (a retired railway executive and computer systems manager).

The arbitrators handed down their first decision in September 1987. The weighty document – about an inch thick – set the framework for the agreement. A second judgement, handed down in November 1988, spelt out the details.[347]

Mnookin and Jones resolved the extent to which and how Fujitsu and IBM could access each other's systems software secrets, and established the payments Fujitsu would make to IBM for that use. Under the arbitrated agreement, IBM and Fujitsu were permitted to derive specific interface information from new operating systems the other released before 1997. In return, Fujitsu agreed to pay an annual access fee. The first fee, for the year 1989, was set at a minimum of US$25.7 million.

Fujitsu was also directed to pay a licence fee of US$396 million for IBM-based operating system software it had already released. The payments assured Fujitsu of immunity from any claims of infringing intellectual property and absolved it from the threat of any further litigation by IBM. The sharing of operating system secrets was to take place in a so-called 'secured facility', opened in Japan in 1989.

It was generally agreed that the arbitration agreement was better for Fujitsu than it was for IBM. Fujitsu, despite the limitations placed on its ability to publicly comment on the agreement, was clearly the more satisfied of the two participants. It had to pay IBM a vast amount of money, but it was money the company could well afford, and it was allowed to continue competing in the mainframe market, which over the period of the agreement was to decline.[348]

The arbitration agreement came after Fujitsu executives in Japan had expressed their concern at Fujitsu's ability to keep its applications compatible with those of IBM, despite IBM's threat to sue over operating

system infringements. In one decisive stroke the agreement cleared away that concern. It also gave Fujitsu a powerful marketing argument: the company could use the agreement as proof that it would indeed be able to keep a parallel path with IBM, and provide truly compatible applications. Under the terms of the agreement, neither party could comment publicly on the terms, but Fujitsu could refer people to it whenever the question of continued IBM compatibility came up.

Fujitsu Australia, operating in Fujitsu's largest mainframe market in the English-speaking world, was intimately involved in the proceedings, providing many expert witnesses when the dispute went to arbitration. Ranucci, who was Managing Director at the time, recalls the effect the arbitration ruling had on Fujitsu Australia's operation:

■ "For a time it made it a lot more difficult to win new business. We did well but we could have done a lot better had we been able to offer an operating system which was totally compatible with MVS. We couldn't – it was pretty close but not quite there. We could never get the big banks, for example, because they were using third-party software packages which had been developed specifically for MVS, which we couldn't access.

■ "We were limited to a market that was reduced in size. We could only address those companies where we could offer something compatible with what they had. But most of our customers were very supportive and they were seeing us as finally offering an alternative."[349]

THE MAINFRAME ERA:
PLUG-COMPATIBLE MANUFACTURERS
WITH IBM SO DOMINANT, MANY OTHER SUPPLIERS TRIED TO RIDE ON ITS COATTAILS.

18

In the mainframe's glory years, many companies copied IBM's hardware. Some were successful for a time, but none lasted beyond the 1990s. With the massive success of IBM's System/360 (see Chapter 12), there was an increasing demand for more affordable processors and peripherals compatible with IBM's mainframe range. The companies that supplied these products went under the collective name of 'plug-compatible manufacturers', usually abbreviated to PCMs.

After the release of the System/360, a number of companies attempted to copy components of its architecture, mostly tape and disk drives. Companies such as Ampex and Memorex were very successful in the IBM-compatible peripherals market.

Because IBM's pricing was 'functional' rather than cost-related – which essentially meant that IBM charged as much as it thought it could get away with – many of these suppliers were able to supply peripherals and add-on memory at a much lower cost, despite having nothing like IBM's economies of scale. The System/360 PCM industry was born.

The most successful of all the PCMs was Amdahl. Its machines consistently offered superior price performance to IBM, and even beat Big Blue to the punch with many innovations, particularly in storage and memory management. The other major PCM, at least in Australia, was Hitachi Data Systems (HDS) – first known as Itel and then as National Advanced Systems (NAS) before Hitachi and Electronic Data Systems (EDS) bought it from National Semiconductor in 1989.

Many other companies attempted to play the PCM game over the years, but all eventually failed. IBM had a very uneasy relationship with the PCMs, greatly complicated and made more personal by the fact that most of them had senior staff made up of ex-IBMers.

IBM had great difficulty throwing the PCMs off its trail. After its antitrust suits (see Chapter 12) it was wary of indulging in business practices that might be seen as monopolistic. But elements kept emerging in IBM's marketing strategies that aimed to maintain an edge over its most bothersome of competitors. IBM was playing on the old themes of fear, uncertainty and doubt (FUD).

"EVEN BACK IN THE DAYS WHEN IBM WAS THE SINGLE MOST IMPORTANT COMPUTER COMPANY, IT WAS POSSIBLE FOR ONE OF ITS ENGINEERS TO ESCAPE AND MAKE AN IMPACT THAT DISTURBED EVEN BIG BLUE."

GENE AMDAHL, 2010
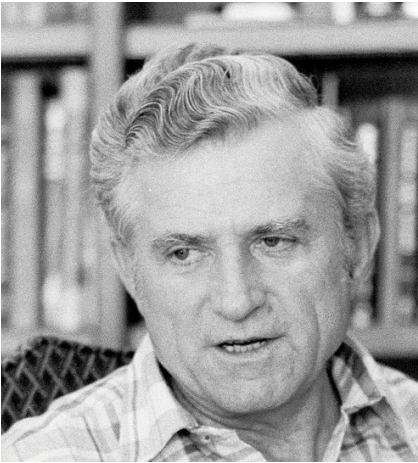
The concept of FUD came into existence in the 1970s to describe IBM's practice of sowing doubt in its users' minds over its competitors' continued ability to remain compatible with IBM 'standards'. The strategy, which IBM still denies ever happened, was well documented in evidence presented in the US Justice Department's antitrust suit that ran throughout the 1970s.

IBM always said its competitors had the same advantages and disadvantages as it did, and that it never indulged in unfair marketing practices. But a dispassionate reading of its position in regard to its competitors – and anecdotal information from its competitors and customers, not to mention from IBM itself – indicates that it played the game very hard, though with increasing degrees of subtlety after its experiences in the antitrust suit.[350]

THE FOUNDATION OF AMDAHL

Amdahl Corporation was founded by legendary computer designer Dr Gene Amdahl, the man who had led the team designing the IBM System/360 (see Chapter 12). Frustrated with IBM's unwillingness to back his design for a more technologically advanced mainframe, he struck out on his own and formed Amdahl Corporation in October 1970.

The System/360 had been very successful for IBM, more because it introduced the concept of a consistent computer architecture, rather than for its inherent performance advantages. Almost before it had been released, Gene Amdahl realised it could be made to operate much more efficiently by using new technology, particularly more efficient chip packaging.

But when he went to his marketing masters and explained how he could design and IBM could manufacture a better System/360 – one that used fewer chips, consumed less power and took up less space on the computer-room floor – he was politely but firmly turned down.

The System/360, he was told, was doing

okay. There was no need to rush into new technology when people were still quite prepared to pay for the old. The longer the old technology could be sold, the more profitable it would become.

Amdahl knew that there was a lot of sense in this argument – after all, variations on it had made IBM the world's most successful computer company. But the engineer in him rebelled against such reasoning. He tried every way he could to get IBM to adopt his new ideas.

Finally, unable to persuade IBM's product planners of the commercial merit of his case, he reluctantly decided to leave and seek finance to establish his own company, so he could realise his dream of a more efficient computer. That would mean competing against IBM, but he saw no alternative.

Amdahl took with him a team of engineers who shared this vision. But his biggest problem was attracting finance. Many large companies like RCA and General Electric had already tried to take on the might of IBM and failed.

Amdahl's background – and his obvious dedication and sincerity – convinced the Japanese computer giant Fujitsu to back him. Fujitsu took a 47 percent stake in the fledgling company; the rest of the money came from a variety of US institutional investors. In 1984 Fujitsu increased its holding in Amdahl to 49 percent. The investment gave Fujitsu access to IBM-compatible technology, at the same time enabling it to establish a position and experience dealing in the US and other Western markets. Fujitsu manufactured Amdahl mainframes at its plant in Numazu in Japan, near the base of Mount Fuji.

Amdahl Corporation delivered its first computer, a model 470V/6, to NASA's Goddard Space Flight Center in Maryland in the US on 22 July 1975. It ran IBM software, and was around 40 percent more powerful and 20 percent less expensive than the IBM alternative. Amdahl's reputation for price performance was established.

The 470V/6 broke new ground in a number of fields. It was the first large mainframe to be air-cooled, and the first to be upgradeable in the field. It was built using the new technology of large-scale emitter-coupled logic (ECL) chips, which substantially reduced the physical size of the computer and its power consumption. Other advances pioneered by the 470V/6 included inboard channels, which further reduced the machine's size, and remote diagnostics.

The Amdahl Corporation had arrived. By 1977 it had installed 40 computers, and annual revenues had reached US$200 million. The company went public in 1976 and paid its first dividend in 1977, the year it was listed on the New York Stock Exchange.

In 1979 Amdahl left the company he had founded a decade earlier and moved to Trilogy Systems, where he made an ill-fated attempt to design and build a new supercomputer from scratch. He tried again with a company called Andor Systems, with the idea of designing a miniaturised IBM-compatible mainframe (see below), but he could never get anyone to manufacture the large chips he designed. He died in 2015 at the age of 93.[351]

After its initial successes, Amdahl Corporation ran into trouble in the early 1980s. The root of the problem was its difficulty bringing the 5860 processor, the last designed by Gene Amdahl, to market. Its profits plummeted, reaching a mere $7 million in 1982. The 5860 was designed to compete against IBM's 3080 – the new high-end model in IBM's revamped System/370 range – but the re-engineering job was much more substantial than Amdahl thought.

IBM was able to cut its prices towards those Amdahl was asking, and for a while also offered newer technology. It seemed that Amdahl Corporation might fail, and it twice sought a merger – deals thwarted by the

OTHER MAJOR USERS IN AUSTRALIA INCLUDED COMALCO, NISSAN, REPCO, SHELL AND THE STATE ELECTRICITY COMMISSION OF VICTORIA. BY THE END OF THE 1980s, AMDAHL AUSTRALIA ESTIMATED THAT IT HAD EQUIPMENT IN HALF OF AUSTRALIA'S LARGER MAINFRAME SITES. IT MOVED STRONGLY INTO PROFESSIONAL SERVICES, AND BEGAN SPONSORING SEMINARS AND RETREATS ON TOPICAL ISSUES FOR SENIOR MANAGERS.

extent of Fujitsu's holding in the company.

But Amdahl weathered the storm. Once it had delivered a machine capable of running IBM's MVS/XA operating system (the 5880) it was once again able to compete technologically, and the problem it had endured resulted in tighter management and production processes.

Amdahl did not use the term 'IBM-compatible', preferring the phrase 'industry-compatible'. Its philosophy was that while IBM defined many of the parameters, within those parameters there was great scope for innovation. Many Amdahl products over the years offered features that IBM lacked or only implemented years later. Amdahl was also a pioneer in the use of the Unix operating system on mainframes.

AMDAHL IN AUSTRALIA

When Fujitsu set up in Australia as FACOM in 1973 (see Chapter 17) it had difficulty competing against the IBM mainframe. Its M series machines were completely proprietary, and software had to be developed specifically for that environment. IBM systems, on the other hand, had a large and growing variety of packaged software, and experts skilled in operating IBM systems were readily available.

FACOM needed a product with which to compete in this market, so in 1975 Managing Director Mike Rydon visited Amdahl's headquarters in Silicon Valley and arranged for FACOM to distribute its systems in Australia, where Amdahl was not represented. This enabled FACOM Australia to enter the IBM-compatible market. Amdahl Corporation Australia was established as a FACOM subsidiary with Jim McDonald, a New Zealand–based ex-IBMer, as its first Managing Director.

The company's first sale in Australia – a 470 V/6 in 1976 – went to Qantas. The airline bought a second machine the next year, and many other large private and public sector organisations followed. But IBM was not

completely frozen out of Qantas, which in 1978 ordered two IBM 3032 machines for its worldwide reservations and departure control systems, beating Amdahl in a closely contested tender. Gene Amdahl visited Australia for the first time in 1977, as keynote speaker at the New South Wales Branch conference of the Australian Computer Society.

In 1978, FACOM released the IBM-compatible M100 series in Australia. These systems ran a Fujitsu proprietary operating system (OSIV/F4, which later evolved to become MSP), which could run IBM's MVS applications. This meant that FACOM now had two sales teams -the Amdahl and FACOM sales representatives often competed against each other, even though they were divisions of the same company. But they also often worked together to defeat the common enemy: IBM. A prime example was FACOM's sale of Amdahl processors to Telecom Australia in 1980, beating an IBM bid.

In 1982 Amdahl set up its own operation in Australia, still headed by Jim McDonald, and for the next decade it did very well. It made two very large sales, to the Department of Social Security in 1983 and the Australian Tax Office in 1989. Both were for massive re-equipment programs that involved multiple mainframes spread across the country. Computer Power (see Chapter 19) was systems integrator for both deals.

Other major users in Australia included Comalco, Nissan, Repco, Shell and the State Electricity Commission of Victoria. By the end of the 1980s, Amdahl Australia estimated that it had equipment in half of Australia's larger mainframe sites. It moved strongly into professional services, and began sponsoring seminars and retreats on topical issues for senior managers.

In 1990 Amdahl formed the Amdahl Executive Institute to encourage the discussion of information technology issues at a strategic level, and in the same year

hosted the seventh Australian Business Congress, an invitation-only seminar for 150 of Australia's leading business executives and public sector managers.

But by the 1990s the mainframe market had started to decline. While Fujitsu was making the successful transition from hardware manufacturer to services company, Amdahl saw its market share shrink. It attempted to diversify, buying French-Canadian services company DMR in 1995, but it was too late.

In 1997 Fujitsu acquired the 53 percent of Amdahl it did not already own, and in 1999 Amdahl once again became a division of Fujitsu in Australia and New Zealand. The Amdahl name exited the global computing market and became part of computer history in 2002, when Fujitsu made the decision to no longer compete directly against IBM's new generation of mainframes.[352]

ITEL BECOMES NAS BECOMES HDS

After Amdahl, HDS was the largest and most successful PCM, with origins in Itel, a US computer leasing company that decided in 1976 to make IBM-compatible mainframes (see above). It contracted the work to NAS, a joint venture between US chip company National Semiconductor (NatSemi) and Japanese conglomerate Hitachi.

But NatSemi had serious financial problems. Its business started to go bad in the mid-1980s and it began to rely heavily on NAS, which remained profitable, to prop it up. But Hitachi and NAS had many legal problems in the early 1980s. In 1982 Hitachi was charged with stealing IBM's trade secrets, including information about IBM's mainframe architecture. That dispute was resolved, with an agreement that IBM would share technical information about its MVS/XA operating system for a fee, and Hitachi would share its secrets with IBM. The deal was similar to the later IBM–Fujitsu arbitration (see above).

National Semiconductor sold out in May

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1988, when NAS was acquired by Hitachi (80 percent) and EDS (20 percent) for US$398 million, and renamed Hitachi Data Systems. (Along with Fujitsu and NEC, Hitachi is one of the three giants of the Japanese computer industry. EDS was a large software and services company founded by the legendary Ross Perot in 1962. It was acquired by General Motors in 1984 and then Hewlett-Packard in 2008.)

HDS was also very successful with its range of mainframe disk drives, building up a strong reputation for reliability and price performance. Much of its mainframe business came from accounts that initially installed only its peripherals, enabling it to establish a relationship with the user that eventually translated into a system sale.[353]

Hitachi sold the NAS mainframes in Japan. In Germany they were sold by Comparex (a joint venture between Siemens and BASF), and in Italy by Olivetti.

EDS took a largely hands-off role in HDS, supplying some management expertise but not favouring the company in its many systems integration bids. At the time, Hitachi was also a leading supplier of IBM-compatible disk and tape drives. The

technical excellence of these products allowed it to compete strongly against IBM throughout the 1980s, and enabled HDS to win substantial mainframe business.

The company entered the Australian market as Itel in 1977 when the local leasing company Datronics signed a deal to distribute its products in Australia. Datronics had recently purchased Dier Computer Corporation, which had been a leading computer financing company in Australia in the 1960s and 1970s. But before Datronics could sell any machines, Itel decided to set up a subsidiary, which began operations in Melbourne at the beginning of 1978 under General Manager Curtis Reid.

In 1979 Reid was promoted to run Itel's Asia-Pacific operations out of Hong Kong, and was replaced in Australia by Bruce Eggington, formerly the company's Marketing Director. At the end of that year, the Australian operations were transferred to the local subsidiary of National Semiconductor, and renamed NatSemi Advanced Systems. It operated under that name until the formation of HDS Australia in 1988.

HDS supplied a wider range of machines than did Amdahl, closely mirroring IBM's entire range. Unlike Amdahl, it did not have a history of being a 'value-added PCM' – it was content to offer total compatibility with IBM. That was both a weakness and a strength, and meant that HDS had to compete, essentially, on price alone.

OTHER PCM ATTEMPTS

Many other PCMs tried and failed, though some had short-term success. Ever since IBM overtook Sperry Rand in the 1950s to became the world's major computer supplier, other companies have seen IBM use plug-compatibility as a shortcut to success. Those companies generally regarded IBM as fair game, and IBM generally regarded them as parasites.

The battlefields of the computer industry are littered with the bodies of companies that tried to play the plug-compatible game and failed. IBM was already dominant in the industry before the release of the System/360 in April 1964, and many companies had got an early start making machines and peripherals compatible with earlier IBM machines.

Most notable of these was Honeywell, which had great success in the early 1960s with its H-200, which, when equipped with software called Liberator, allowed it to run software for IBM's 1401 – its most successful pre-System/360 machine. IBM's concern with the H-200's success was one of the reasons it did not at first make the System/360 capable of running 1401 software.

The release of System/360 saw the emergence of many suppliers that gained success selling tape and disk drives for the range. The System/360's consistent architecture – which ensured that the same peripherals could be used on all machines – was designed to make things easy for IBM and its customers, but it also made things easy for an emerging band of PCMs.

Many of these suppliers were successful for a while. IBM viewed their emergence with horror and undisguised disdain and began a FUD campaign against them. The aim was to convince customers that the PCM's devices were less reliable than IBM's, that they would lead to increased maintenance charges, or that they might not be compatible with later releases of IBM's processors or software.

The problem from IBM's viewpoint became more severe when some of these upstart PCMs began to make processors that were compatible with the IBM mainframe range. Over the years most of these manufacturers withered and died, but some of them enjoyed enough success in the short term to make IBM legitimately worried. They included names that have since disappeared, such as Cambridge Memories, IPL, Magnuson Computer Systems (which hired Gene Amdahl's son

Carl) and Two Pi. Two Pi, backed by Dutch giant Philips, released a PCM machine called the V32 to compete against IBM's low-end 4300 in 1979. These machines were briefly distributed in Australia by Sydney-based Semiconductor Systems.

A newspaper article at that time reported that IBM had bumped four potential Australian IBM 4300 customers to the top of its queue after they considered buying a Two Pi machine.[354]

The IBM 4300, released in 1979, was the cheapest System/370 machine released and became incredibly popular. IBM Australia already had 50 orders placed by the time the machine became available – hence the waiting list.

But Two Pi died like all the others, disappearing after being acquired by Four-Phase Systems, a company that didn't last long itself. These suppliers may have had no great difficulty copying the early IBM System/360s, but IBM made it increasingly difficult for them as newer models were released.

A notable PCM failure was Storage Technology (StorageTek), which for many years was one of the more successful of the plug-compatible peripheral suppliers. But StorageTek's attempt to make its own processor and become another Amdahl or HDS almost drove it out of business. It took years to recover, doing so largely because of the remarkable success of its ACS 4400 robot tape library for IBM mainframes, and vowed to never again get involved in the processor market.

The most spectacular of all the failed PCMs was Trilogy Systems, an ambitious attempt to build an IBM-compatible mainframe from the ground up, headed by none other than Gene Amdahl. It attracted more than US$300 million from private investors and in 1983 launched a public stock offering.

Trilogy gambled on an untried technology that would have seen massive four-inch square chips, each containing around 40,000 high-speed circuit gates, with 100 such

MORE INFORMATION

Most of the information in this chapter comes from Graeme Philipson's two books: *Mainframe Wars*, an early 1990s overview of the mainframe industry; and *Fujitsu in Australia and New Zealand*, written in 2013 to mark the local company's 40th anniversary.

wafers layered together into giant modules. Major vendors – including Digital Equipment Corporation (DEC), Unisys and Bull – purchased rights to the technology.

The gamble failed. Trilogy tried to break new technological ground on too many fronts at once. It was far too ambitious. The size of the engineering task became too large, and impossible to control in a new organisation. In one of the most expensive failures in computing history, Trilogy went broke in 1986, losing its investors hundreds of millions of dollars.

Trilogy's failure was well publicised. Less well known were the failed operations of Synthesized Computer Systems (SCS) and Andor Systems – Gene Amdahl's next venture after Trilogy's failure. SCS, which began operations in May 1984, was headed by Jacques Losq, formerly of IBM and StorageTek.

SCS designed an IBM-compatible processor called the FT3790, which would have competed against the lower end of IBM's System/370 range. The machine attracted some publicity when it was announced in 1987 – mostly because of its extremely small physical size – but it soon sank without trace.

Andor Systems, headed by the indefatigable Gene Amdahl, made an ambitious attempt to design, develop and market a 'mainframe in a shoebox'. It would use new chip technology and miniaturised components to supply a machine compatible with the largest IBM mainframes, in a small cabinet not much bigger than a personal computer. It too failed; the chips that Amdahl had designed were simply too complex to be manufactured.[355]

THE DECLINE OF THE PCMs

IBM's System/360 evolved into the System/370 in the 1970s and then, in 1990, to the System/390. At that time the PCMs were still able to match IBM technologically. But mid-range computers (the term 'minicomputer' was falling out of use) became more powerful.

Companies like DEC, Hewlett-Packard and Tandem Computers (see Chapter 20) were selling machines as powerful as the low end of the IBM mainframe range, but with much better price performance and significantly lower operational overheads. The number of organisations running IBM and IBM-compatible mainframes declined significantly.

Meanwhile, IBM Australia powered ahead. In 1980 Brian Finn – a native of Newcastle, England – replaced long-serving Managing Director Allan Moyes, who became Chairman. In 1986 IBM was the first computer company in Australia to exceed $1 billion in revenues.

In 2000, IBM revamped its entire mainframe range, renaming it the zSeries, and then later the System z (the 'z' stands for 'zero downtime'). The new machines were still compatible with IBM's earlier mainframes, but they used a new 64-bit instruction set and IBM-designed complex instruction set computing (CISC) microprocessors that were very cost-effective and difficult to copy.

The cost of competing technologically in a declining market led Fujitsu (which by this time had absorbed Amdahl) and HDS to withdraw from the mainframe market, leaving IBM as the sole supplier.

The PCM era ran from 1964 – when IBM's System/360 was released – to 2000, when Big Blue's last competitors exited the market. It was a very important era in the history of computing, and particularly significant for the Australian industry.

Throughout this period, most of Australia's large government departments and agencies, all of its major banks and financial institutions, and most large commercial organisations ran their businesses on IBM or PCM mainframes. The software and services industries that supported these massive operations formed the heart of the Australian computer industry for decades. Only with the growth of PCs in the 1980s (see Chapter 22) and the Internet in the 1990s (see Chapter 28) did things change.

AUSTRALIA GETS A
SOFTWARE AND SERVICES INDUSTRY

THE 1960s AND 1970s SAW THE BIRTH AND GROWTH OF LOCAL AND INTERNATIONAL COMPANIES SUPPLYING SOFTWARE AND SERVICES TO AUSTRALIA'S GROWING COMPUTER INDUSTRY.

19

The two main parts of a computer system are hardware and software. Over the history of the industry, the emphasis has moved from hardware to software. In the early days of commercial computing, hardware comprised such a large proportion of the total information systems budget that vendors could afford to throw in the software for free. Today hardware is a much lower proportion of the total cost.

The use of computers for business began in the 1950s, but the commercial software industry did not really take off until the 1970s. The key event was IBM's unbundling of software from hardware in 1969 (see Chapter 12). After that time, the number of software companies proliferated, and the packaged software industry began.

The growth in computer services is somewhat related to that of software. Computer services include training, contract programming, project management, and executing the many processes that go along with implementing complex computer systems. Australia has long had a vibrant computer services industry, often with the same organisations delivering both software and services. This chapter examines the early years of software and services in the Australian computer industry, in the 1970s and 1980s. The 1990s and beyond are covered in Chapter 27.

THE BIRTH OF AUSTRALIA'S IT SERVICES INDUSTRY

As more and more Australian companies began to computerise, there emerged a need for expertise in helping them install, implement and manage their expensive new devices. It did not take long for enterprising individuals to identify opportunities and form businesses to meet this growing need. Three of the earliest and most successful were Adaps, Datec and Computer Power.

ADAPS

Adaps, which stands for '**A**ustralian **da**ta **p**roce**s**sing' was formed in 1964 by John Thompson and Peter Monahan. It began in Melbourne as a computer bureau, processing information for *The Age* and the Australia and New Zealand Banking Group (ANZ). It soon started providing programming services, and within a few years had a staff of 200, all aged under 30. The company listed on the Australian

Stock Exchange in 1969 – making it the first Australian computer services company to go public.[356]

But Adaps overextended and it lost money in the first few years after going public, blaming these problems on poor financial control. In 1972 control of the company changed hands, with Melbourne's Jelbart family gaining a majority shareholdings as John Thompson sold out his portion. The Jelbarts reorganised the company but did not return it to profitability until 1974. It began by moving the company into packaged software development in areas such as motor vehicle registration and library software systems. It also continued as a batch processing bureau and programming services provider.[357]

In 1984, Adaps was sold to Idaps, another Australian-owned software and services company, which specialised in the insurance industry. Idaps changed its name to Paxus in 1988 (see Chapter 27) and evolved into an IT recruitment company. It was subsequently acquired by giant US–based IT services company Computer Sciences Corporation (CSC) which, in 2013, sold it to South African IT recruitment company Adcorp.

The Adaps name did not disappear. In 1996, former Marketing Director Paul Halstead and founder John Thompson started a new company, also called Adaps and specialising in IT contract services.[358] It still exists today as an IT recruitment company, though under completely different ownership.

DATEC

Another major force in the early years of Australia's IT services industry was Datec, founded in Melbourne in 1965 by a group of computer consultants. In 1966, they employed Harry Douglas to open a branch in Sydney. Within 12 months Douglas had bought the NSW branch himself, and after the parent company went broke through mismanagement he re-established the Datec brand in Sydney, Melbourne and Canberra.[359]
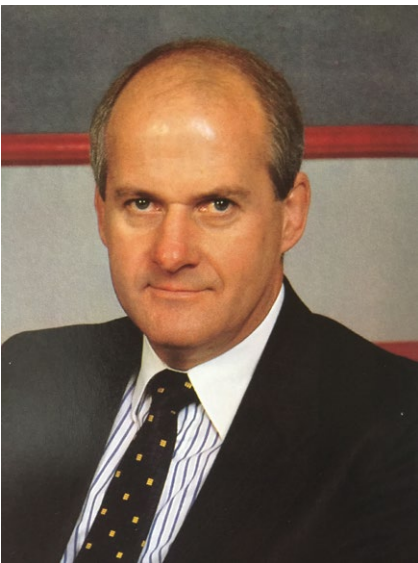
TOP: Harry Douglas in 1974
- CREDIT *PACIFIC COMPUTER WEEKLY*
ABOVE: Roger Allen in 1990
- CREDIT COMPUTER POWER

Douglas became one of the best known figures in the Australian computer industry in the 1970s and early 1980s. He had spent ten years with the Royal Australian Navy – where he qualified as an electrical engineer – and was the first IT specialist at management consultancy WDScott.[360]

Datec became Australia's largest privately owned software and services company. It had 60 staff members by 1975 and 200 by 1983. French-Canadian software and services company DMR acquired Datec in 1984, and was itself acquired by Amdahl in 1995 as part of that company's attempt to diversify beyond mainframe hardware (see Chapter 19).

In the mid-1970s Datec's revenue came from contract programming (30 percent), turnkey software development (25 percent), consulting and advisory activities (20 percent), systems analysis (20 percent) and education (5 percent).[361] It had a large profit margin, and established a reputation for lavish parties and generous corporate entertainment.

In 1983, Datec conducted an extensive survey of Australia's computer market, covering all major installations. The survey found that 69 percent of organisations using IT in Australia were running commercially available applications packages, and that the availability of such packages was rapidly increasing. Packaged software – from international and Australian suppliers – would eventually lead to the demise of software and services companies like Adaps and Datec.

COMPUTER POWER

One of the largest Australian software and services companies of the 1970s and 1980s was Computer Power. It was founded in 1968 by Jack Vale, a US computer entrepreneur who was something of a technical guru and had attracted finance to build a software development company in Melbourne.

In 1973, the company ran into financial difficulties and Vale hired 28-year-old Roger Allen as Managing Director to sort things out. Allen had applied for the job after seeing an advertisement for the position in *The Age* newspaper.

Allen had started his career as a programmer with insurance company National Mutual — a major user of IBM mainframe computers — ten years earlier. He then joined Datec in 1966. When Datec got into trouble (see above) he joined the oil company Mobil, which at that time was one of Datec's clients. Within seven years he rose to become head of software development at Mobil before moving into marketing and management.

When Allen joined Computer Power the company was facing major problems. Vale's business strategy was to develop and market complex software, but the lead times were too long. It did have one success – developing a COBOL compiler for the new DEC minicomputers (see Chapter 20) – but this went largely unrecognised. The company was also developing a pre-press system for newspapers and printers, but Allen assessed that it was unviable and Vale left the company he had founded.

The COBOL compiler eventually caught the eye of US computer giant McDonnell Douglas, which invited Allen to St Louis, Missouri in 1974 to discuss the software and related projects.

McDonnell Douglas ended up giving Computer Power US$100,000 to develop software using POGO, a programming language that was another of Vale's ideas. Computer Power was soon a major contractor to McDonnell Douglas and even had a steady income stream. The company's peak years were underway.

In 1978, Roger Allen chaired an Australian Computer Society committee set up to advise the Federal Government on the future of the software industry in Australia.

The company grew quickly, and in the 1970s set up separate divisions for services,

training, and hardware and software sales. It acted as prime contractor for a number of major computer deals, bringing together the appropriate hardware and software vendors, and acting as the systems integrator and implementer.

In 1983, Computer Power entered its biggest deal to date, for the Australian Department of Social Security's massive Stratplan project. But even larger was a billion-dollar systems implementation deal with the Australian Taxation Office, in 1989. Both deals involved multiple Amdahl mainframes (see Chapter 18).

In 1984, Rupert Murdoch's News Limited bought a one-third shareholding in Computer Power. Shortly afterwards, Vale sold out, and Allen and News Limited each held half the shares. In 1985 Computer Power started a venture capital arm, CP Ventures, headed by Roger Buckeridge – a former public servant and McKinsey consultant. CP Ventures eventually became a separate public company and was sold in 1990.

Computer Power listed on the Australian Stock Exchange in 1987 and sold its US operation to Florida-based training and employment company Interim Services in 1995, at which time Allen left the company. Interim Services acquired the whole company in 1999 for US$200 million.

In 1989, Computer Power restructured and closed its software products and hardware product divisions, on the basis that they had begun to compete with many of its important clients.

A group of former Computer Power employees formed a company called EXECP (**EX-E**mployees of **C**omputer **P**ower) to take over distribution of the software products. That company was sold to South African software and services company AST Group in 2000.

Back in 1996, Allen had started a venture capital firm, Allen & Buckeridge. (The latter half of the name came from Roger Buckeridge, who had worked with Allen at CP

Ventures.) From 1990 to 1997 he was Deputy Chairman of Austrade, and in 2007 was awarded the Pearcey Medal for significant contributions to the Australian computer industry.

Computer Power had acquired the Control Data Institute in 1989 at a time when Control Data Corporation was in decline (see Chapter 16) and renamed it the Computer Power Institute. In 1988, Computer Power also acquired Management Technology Education (MTE), a major Sydney-based computer training and seminar company.

After Interim Services acquired Computer Power, it retained the Computer Power Institute name for the company's training arm, which remained an independent operation. It is still in existence today, albeit after many changes of ownership.

OTHER PLAYERS

In an era when the computer industry was growing quickly and expertise was at a premium, many software development and computer services companies sprang up around Australia. Adaps, Datec and Computer Power had many smaller peers, including:

- **Datronics**, which acquired Dier Computer Corporation (see below) in 1977 and later became a public company, but ceased operations in the 1990s.
- **Dier Computer Corporation**, founded by Ian Dier, which became a major computer leasing and services company with offices in New Zealand, Singapore and Hong Kong.
- **Joint Services**, a services company that ran IT for the St George Building Society and the United Permanent Building Society. St George was the first building society to go online, when it installed an IBM mainframe connected to 30 terminals in 1972.

Other major services companies like Aspect and KAZ Technology Services grew up in Australia in the 1980s and flourished in the 1990s (see Chapter 27).

THE MULTINATIONAL SOFTWARE COMPANIES MOVE IN

After IBM's momentous decision in 1969 to unbundle its software and hardware, the software industry in the US and the rest of the world expanded rapidly (see Chapter 13). This happened for two main reasons for this. The first was that people now had a choice; they could buy software from other sources rather than being tied to the hardware vendor.

The second and equally important reason was that IBM's operating systems and other aspects of the system software were limited in their functionality. Smart developers could create products that made the IBM mainframes run more efficiently than IBM's own software, saving their users money.

Most of the new system software companies that grew up during this time were founded on a single product that made IBM mainframes faster, easier or less expensive to use.

Australia was a major player in this market; some of the most successful independent software products selling into the IBM systems software space were designed in Australia.

Over time, IBM incorporated most of these functional enhancements into its own operating systems or developed equivalent add-on products. This meant that most of the system software companies that grew up in the 1970s and 1980s eventually disappeared, mostly through acquisition – and most of them acquired by one company: Computer Associates (see below).

Most of these companies established offices in Australia in the 1970s. Their products were initially handled by distributors, but most had set up direct subsidiaries by the end of the 1980s. This was a booming decade for software, during which the global market grew exponentially (see the chart over page).[362]

WORLDWIDE SALES OF US SOFTWARE PRODUCT FIRMS 1967–1990
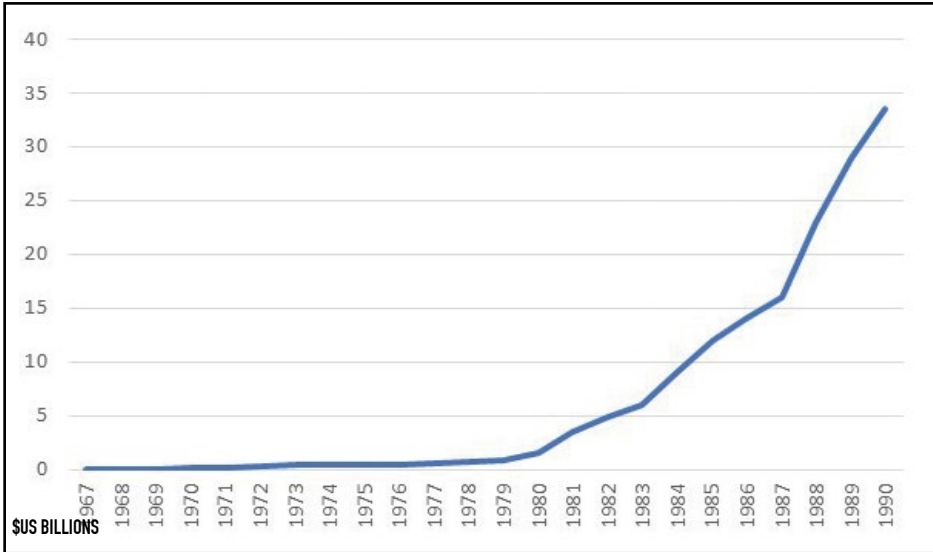
This section looks only at early systems software companies and pre-relational database companies. For relational database companies (such as Oracle) and application software companies (such as SAP), see Chapter 26.

The following are some examples of international software companies that set up in Australia during the 1970s and 1980s, either directly or through distributors.

ADR

Founded in Princeton, New Jersey in 1959 as a contract programming company, ADR (Applied Data Research) was the first independent software company. Its Autoflow flowchart package made it one of the few software companies to be successful with packaged software before IBM's unbundling decision in 1969.[363]

ADR was best known for its Datacom/DB database management system, one of the first database products. It had been introduced by a small company called

Computer Information Management, founded in Dallas, Texas by three former IBM employees, in 1971. Computer Information Management was then acquired by another small software company called Insyte shortly afterwards, and in 1978 Insyte sold Datacom/DB to ADR.[364]

ADR set up an Australian subsidiary in 1984 under Kevin Nuttall, but it was short-lived and ADR was acquired by Computer Associates (see below) in 1986.[365] Datacom/DB, now called CA Datacom, is still widely used today, in Australia and overseas. (Datacom is not to be confused with the large New Zealand–based software and services company of the same name, which also operates in Australia).

BMC

BMC was founded in Houston, Texas in 1980 by three former Shell Oil employees. Its IBM mainframe utilities became very popular, and the company went public in 1988, the year it opened a subsidiary in Australia.

BMC grew strongly through acquisition and organic growth in the 1990s, and was one of the few companies in the IBM mainframe utilities market not to be acquired by Computer Associates.

CINCOM

Like ADR, Cincom (a contraction of **Cin**cinnati **Com**puter) was also founded before IBM's software unbundling decision. It was started in 1968 in Cincinnati, Ohio by Thomas Nies – a former IBM salesperson – and two associates. Nies is still CEO today, making him the longest serving CEO in the global computer industry.[366]

Cincom's first product and its mainstay ever since is its TOTAL database management system. It expanded into application software in the manufacturing industry, and built 4GLs (fourth-generation programming languages) such as MANTIS and SUPRA. It has always been privately owned.

Cincom entered the Australian market in 1974, with direct representation at an office in Sydney under the leadership of Ian MacLachlan. Early users of TOTAL were Caltex, T&G Insurance and Aftek, a service company for building societies.

TOTAL was very successful across many hardware platforms, making Cincom one of the leading multinational software companies in Australia in the 1980s and 1990s. MacLachlan left soon after it started and was replaced by Barry Sargeant, who was in turn succeeded by John Debrincat in 1979.

COMPUTER ASSOCIATES

Computer Associates – widely known as CA and today called CA Technologies – was one of the world's most important independent software vendors.

In 1976, Charles 'Charlie' Wang (pronounced 'Wong'), a Taiwanese immigrant to the US, was working in a Manhattan computer services bureau that marketed software from a small Swiss company called Computer Associates. Its main product was a sorting and data management utility for IBM mainframes called CA-Sort.[367]

Wang saw an opportunity to start a new business selling the product in the US in a joint venture with the Swiss company[368], forming an American operation initially called Trans-American Computer Associates. Wang could not afford a conventional marketing campaign and decided to sell CA-Sort by telephone and through mail order on a 'try before you buy' basis, for US$3,000.[369]

It was a sales technique and a pricing level unheard of in the industry at the time, and made CA-Sort so successful that Wang was able to buy the Swiss company in 1980 and take Computer Associates public in 1981.

Wang became one of the leading figures in the global computer industry in the 1970s

and 1980s, well known for his aggressive and innovative marketing practices. In 1989, Computer Associates became the first software company to reach US$1 billion in revenues, and in the late 1980s and 1990s gained a reputation for hostile and opportunistic acquisitions, which led to extremely adverse press coverage[370].

CA-Sort was initially distributed in Australia by Carus Pacific, which also distributed software from Pansophic Systems (see below) and Software International. A direct subsidiary of Computer Associates was set up in Australia in 1977 after the Swiss arm of Computer Associates bought Carus Pacific. Alan Gallagher, who had worked for Carus Pacific, was the first Managing Director, later replaced by Swiss Jorg Illi in 1979 when there were still only three staff. David Wardle replaced Illi in 1987.

After the local company consolidated around Wang's US operation in 1980, Computer Associates Australia grew quickly and became one of the largest software companies in the country, mirroring the growth of the organisation in the US and the rest of the world.

COMPUTER CORPORATION OF AMERICA

Computer Corporation of America (CCA) was founded in Boston, Massachusetts, in 1965 to develop a high-performance database management system for the US National Security Agency (NSA). The software became Model 204, a 'multivalue' database with a built-in programming and application development environment.

The multivalue data model, which allows for multidimensional tables, was first developed in the early 1960s by Don Nelson and Richard Pick, programmers at the giant US defence contractor TRW. Pick subsequently used the concept for his Pick operating environment, which became very popular in Australia (see Chapter 26).

Model 204 stored vast amounts of data and handled very high transaction loads – and

still does to this day (see below). It was very popular in the US Department of Defense, and became particularly important in Australia when Computer Power's product division sold it to the Department of Social Security in 1983 as part of the Stratplan re-equipment project (see Chapter 25). Computer Power also made other Model 204 sales in Australia, most notably to Telecom and the Department of Defence.

All those systems were subsequently replaced by relational databases, except for the Department of Social Security, which still uses Model 204 to run Centrelink's payments system, in one of the largest Model 204 implementations in the world. Even after Computer Power stopped distributing the software in Australia CCA never set up a local office, instead flying in staff members from Massachusetts as required.

For more than a decade there have been suggestions of replacing Centrelink's Model 204 system, but the size and the cost of the systems redevelopment project has seen the idea repeatedly postponed.

Boston-based Rocket Software – an IBM strategic partner – acquired CCA in 2010. Model 204 is now called Rocket M204.

COMPUWARE

Peter Karmanos and two associates founded Compuware as a services company in Detroit, Michigan, in 1973. It became a major software company with the success of its first product, Abend-AID, released in 1977. The software detected bugs and suggested corrective actions in IBM and other compatible mainframe systems, and was very widely used. It subsequently introduced a number of other products, including File-AID.[371]

Executive Computing distributed Compuware's products in Australia from 1989 onwards. The company had been established by Peter McCallum, who had previously distributed Pansophic Systems

products through his earlier company Carus Pacific (see below).

In 1994 Compuware set up a direct operation in Australia under the leadership of John DeBrincat, who had previously run Cincom in Australia (see above), and who by that time was headed the Compuware distribution business within Executive Computing.

CULLINET SOFTWARE

Cullinet Software began life in Westwood, Massachusetts, in 1968, as Cullinane Corporation – named after founder John Cullinane. Its initial business plan was to identify software written by major computer users that it thought could be turned into products. This strategy brought some success but the company's big breakthrough came in 1973 when it developed its own database management system, IDMS.[372] The name soon changed to Cullinane Database Systems, and then in 1983 to Cullinet Software.

IDMS was a great success and led to Cullinane going public in 1978 – the first time a software company had been floated. It attempted to diversify into application software with moderate success, and was acquired by Computer Associates in 1989.

In Australia, the company's products were distributed by the local subsidiary of US software house Infotrol until 1979 when Cullinane Australia was set up under Kim Newby, to market IDMS locally. Infotrol continued to distribute Cullinane's other products.[373]

GOAL SYSTEMS

Goal Systems was started in Columbus, Ohio in 1975 by Steve O'Donnell, initially as a developer of IBM data management software. Its products were distributed in Australia by Peter Stewart's Stewart Systems, but in 1981 Greg Klein set up Goal Systems Australia.

In 1987, the company became a fully

owned subsidiary of the US company, managed by Brenda Hunter (née Wilson), formerly of IBM Australia. Legent acquired Goal Systems in 1992, and was itself acquired by Computer Associates in 1995 (see below).

LEGENT, DUQUESNE SYSTEMS AND MORINO ASSOCIATES

Legent was formed in 1989 by the merger of Duquesne Systems and Morino Associates, two early systems software vendors. It acquired Goal Systems in 1992, making it one of the largest vendors in the mainframe market. All three companies sold systems software and utilities into the IBM mainframe market.

Duquesne Systems was founded in 1970 in Pittsburgh, Pennsylvania, by Glen Chatfield. Morino Associates was founded in 1973 in Vienna, Virginia – just outside Washington DC – by Mario Morino. Both companies were represented in Australia by subsidiaries.

Legent had a strong presence in Australia under Managing Director Rob Luscombe, who had previously run the local subsidiary of Morino Associates. Computer Associates acquired Legent in 1995 for US$1.74 billion. At the time, it was the largest software acquisition in industry's short history.[374]

PANSOPHIC SYSTEMS

Joe Piscopo founded Pansophic Systems in Chicago in 1969. Piscopo described his entry into the industry as being like the 'plastics' incident in the movie *The Graduate*: he was attending a family gathering when a wealthy relative said he should 'get into computers' – so he did. More specifically, he wrote a program called Panvalet, a library system for IBM mainframes that would allow programs previously resident on stacks of punched cards to be stored on tape.[375]

It was a great success, and Pansophic Systems went on to be one of the major software companies of the 1970s. Its big break came in 1972 when General Motors bought an unlimited licence to use it

Panvalet in its 33 data centres worldwide. Pansophic's next product was Easytrieve®, a report writer for IBM mainframes that was also very successful.

Pansophic Systems came to Australia in 1973 when Carus Pacific started selling its products. The company set up its own subsidiary in Australia in 1975 under Jonathan Farrell, and was acquired by Computer Associates in 1991.

SAS INSTITUTE

SAS Institute came into being in 1976 in Cary, North Carolina, after James (Jim) Goodnight and three colleagues from North Carolina State University created a statistical analysis system (hence 'SAS'). At the time of writing in 2017, Goodnight is still CEO and SAS is the largest privately held software company in the world, not to mention a major player in Australia.

The company originally specialised in statistical software, and in later years has diversified into business intelligence and vertical market applications. It grew quickly, with its unique software licensing model ensuring a continuous revenue stream.

SAS Australia began in 1982 under the leadership of Richard Lindsay. Lindsay stayed on until 1995, when he was replaced by Brian Wood, who had been a marketing manager with the company since it first began operating in Australia.

SOFTWARE AG

Where all the other companies on this list were (or are) originally American, Software AG was and is German. ('AG' stands for Aktiengesellschaft, which is simply the German equivalent of our 'propriety limited'). It was founded by Dr Peter Schnell and some associates in Darmstadt in Germany in 1969.

Its main product is Adabas (**A Da**ta**ba**se **S**ystem), an inverted list database optimised for high levels of transactional processing and first released in 1971. Other inverted list databases of that period were ADR's

Datacom and Cincom's TOTAL (see above).

Adabas was the most successful of them all, especially after the introduction in 1979 of Natural, a 4GL that made it comparatively easy to write programs for Adabas-based systems. Software AG set up a major subsidiary in North America as early as 1971, largely at the initiative of US entrepreneur John Maguire, who became a legend in the software industry for his extraordinary efforts in establishing the company internationally.

For many years Software AG's products were distributed in Australia by SPL Worldgroup, a South African/Israeli company that had a major presence locally. Adabas became one of the most popular database products in Australia, and is still widely used today.

In 2006, Software AG acquired the software division of SPL WorldGroup and is now directly represented in Australia. The same year SPL WorldGroup was acquired by Oracle.

AUSTRALIA'S ROLE IN THE IBM SYSTEMS SOFTWARE MARKET

The industry was not all multinationals during this time. Australia spawned a number of software entrepreneurs, many of whom were very successful internationally, and the local industry had a justified reputation for software innovation in the 1960s and 1970s.

In the early days of computing there was very little software and users had to write their own, even at the system software level. Australia's relative isolation meant that local organisations were even more reliant on their own resources than those in the US or the UK, where virtually all computers originated.

There were many early examples of local innovation, such as the development of ICL's GEORGE operating system at the University of New South Wales (see Chapter 5). Once commercial computing became

more widespread after the release of IBM's System/360 in 1964, many local software developers started writing software for resale rather than only for their own use. Australian innovators were among the most successful of the early software vendors who provided added functionality to IBM mainframes. Three outstanding examples were Boyd Munro, John Robinson and Ian Cairns.

BOYD MUNRO AND GRASP

Boyd Munro was Australia's first successful software entrepreneur. In the late 1960s he was working for IBM Australia, having studied mathematics at the University of Melbourne. He believed that the IBM System/360 operating system (initially called DOS/360) could be greatly improved by the addition of spooling – the ability to queue input and output so that the computer didn't depend on the speed of its peripherals.

He wrote the software in his own time and offered it to IBM – which turned it down. Convinced he was onto something, in 1969 he went to London where some friends at aircraft company Hawker Siddeley gave him machine time on their IBM mainframe so he could improve the software enough to make it a saleable product. The only condition was that Hawker Siddeley would be able to use the program for free.[376]

The software, which he called GRASP, became the most successful independent IBM systems software product of its era. Within five years he had sold more than 1,000 copies worldwide and created a company called Software Design Inc (SDI), incorporated in the US, to market it. In Australia, it was marketed by Adaps (see above). The software was rented rather than sold – as most of IBM's products were at that time – which ensured a steady revenue stream.

GRASP was updated as new versions of IBM's operating system were released – DOS/VS and DOS/VSE. With the System/360's great success and the release of the

System/370 in 1970, SDI became the first significant independent systems software company. It diversified into other systems software tools, notably EPAT for tape management and FMAINT for library management.

Munro was a colourful figure. He set up SDI's research and development centre in Bermuda, where it was easy to service both his US and European customers. Bermuda was also, conveniently, a tax haven. He installed the island's first IBM mainframe in his development centre. (Each copy of GRASP had to be tailored for the individual installation.)[377]

The use of GRASP and other SDI products gradually declined in the 1980s as IBM's operating systems achieved more functionality – a common fate of this type of software.

Munro's great passion was – and is – flying. He subsequently became active in promoting Australian aviation and aviators, setting up Air Safety Australia in 2000 to lobby against what he believed to be inadequacies in the government's aviation policy.

JOHN ROBINSON AND NET/MASTER

In the late 1970s John Robinson was a systems programmer working at the Bank of NSW (now Westpac), where he developed some software to improve the management of the bank's IBM Systems Network Architecture (SNA). IBM had developed SNA in 1974 as a way to connect mainframes, terminals and remote devices.

Robinson saw the potential of the software he had built and left the bank to develop it into a product, which he named Net/Master. He and two associates, Steve Dawson and Michael Gill, formed Software Developments International to develop and market the product, which competed against IBM's own NetView.

Robinson was Managing Director and handled sales and business development. Dawson, who had previously worked at the bank with Robinson before moving to Alcoa

was Technical Director and also did much of the selling. Gill managed the architecture and technical development.

Much of the development for Net/Master was completed using Qantas's mainframes in the airline's Sydney data centre. In an arrangement not unusual in the software industry, Qantas was then able to use the software at a substantial discount.

Net/Master was extremely successful in Australia, and was eventually in use at more than three-quarters of Australia's large IBM mainframe sites. Some sales occurred when senior systems programmers moved from one company to another and demanded that Net/Master be installed as a condition of their employment.

Net/Master was also quite successful internationally. In 1984, Software Developments International licensed the international marketing rights to Cincom, which then distributed Net/Master outside of Australia. In 1988 that agreement ended in a lawsuit over different interpretations of the terms of Cincom's distributorship.

Those problems were solved when Software Developments International sold Net/Master to US software company Systems Center in 1990, at a time when the IBM system software market was consolidating. As part of the deal, Systems Center also acquired the global marketing rights from Cincom, and Robinson, Dawson and Gill continued to work with Systems Center on product development for the next few years.

Net/Master was never as successful outside Australia as it was at home, though in some markets – including the UK, Germany and Japan – it did outsell IBM's NetView. Systems Center continued to develop the product but, in a familiar tale, that company was acquired by Sterling Software in 1993. Sterling Software was in turn acquired by Computer Associates in 2000. The software, much altered with time, is now called CA NetMaster.

Software Developments International

had another product called IMS/Access, designed to improve the management of IBM's IMS (Information Management System) database (see Chapter 26). That was not part of the Systems Center deal, so Robinson subsequently started another company – Locksley Software – to sell and support it. The company and the product are still in existence.[378]

IAN CAIRNS AND PDSMAN

In the early 1970s, Ian Cairns was working as a systems programmer for Qantas, and in 1976 developed software on Qantas's IBM mainframe to simplify partitioned data set management under IBM's MVS (Multiple Virtual Storage) operating system. He called the software, rather prosaically, PDSMAN (**P**artitioned **D**ata **S**et **MAN**agement).

He built the software into a product in his spare time and sold it to finance company AGC and the Bank of New South Wales. In 1981, he arranged for US software vendor Goal Systems – which had just set up in Australia (see above) – to sell the software globally, and he left Qantas to join the Australian operation, where he continued to develop the software.

PDSMAN became very successful internationally, and was used at hundreds of IBM MVS sites worldwide. After Goal Systems took direct control of the Australian operation in 1987, Cairns left and formed a new company called Software Design Associates to continue developing the software, with partly at the Goal Systems head office in Columbus, Ohio.

Goal Systems was subsequently sold to Legent and then Legent was sold to Computer Associates, where the software still exists today as CA PDSMAN. SDA still distributes the product in Australia and New Zealand, but all development now takes place in the US.[379]

MORE INFORMATION

Martin Campbell-Kelly's 2003 book *From Airline Reservations to Sonic the Hedgehog* provides a good overview of the history of the software industry, mostly from the US perspective. There is unfortunately very little available information on the early days of the software industry in Australia. Much of the information in this chapter is taken from interviews and email exchanges with the people involved.

THE MINICOMPUTER REVOLUTION
MINICOMPUTERS WERE THE WORKHORSES OF THE 1970s AND 1980s, AND THE AUSTRALIAN MARKET WAS VERY COMPETITIVE.

20

DEC first introduced minicomputers to the Australian market in the 1960s (see Chapter 13), but it wasn't until the 1970s that they really started to make an impact. The major minicomputer specialists in Australia were DEC, Data General, Datapoint, Hewlett-Packard, Prime and Wang.

Many of the mainframe suppliers also supplied minicomputers. The most notable of these was IBM, which significantly expanded its product range during this time. The proliferation of minicomputers in Australia in the 1970s was phenomenal. The lower prices – which kept dropping, even as performance greatly improved – meant that many organisations that had not come close to considering a computer in the 1960s were installing machines in the 1970s.

In 1970 it was still possible to count all the computers in Australia (see Chapter 16). By 1980 this was impossible. Computers were everywhere, even before the introduction of the microcomputer (see Chapter 22).

"FOR OVER 30 YEARS DEC AUSTRALIA WAS PERCEIVED AS A GLAMOROUS COMPANY, A LEADER IN HIGH TECHNOLOGY, AN EXCITING PLACE TO WORK AND THE PROVIDER OF A DISTRIBUTED STYLE OF COMPUTING THAT OFFERED AN ALTERNATIVE TO THE MONOLITHIC IBM APPROACH."

MAX BURNET, 2010

MAJOR MINICOMPUTER SUPPLIERS IN AUSTRALIA, 1983

COMPANY	AUSTRALIAN REVENUES IN 1983 (A$M)	GLOBAL REVENUES IN 1983 (US$M)	AUSTRALIAN % OF GLOBAL REVENUES	NUMBER OF AUSTRALIAN EMPLOYEES (1984)
DEC	116	4,827	2.4	858
Wang	92	1,793	5.1	824
Hewlett-Packard	89	4,710	1.9	600
Prime	48	517	9.3	380
Data General	30	867	3.5	260
Datapoint	22	548	4.0	300

SOURCE: YANKEE GROUP AUSTRALIA, 1984
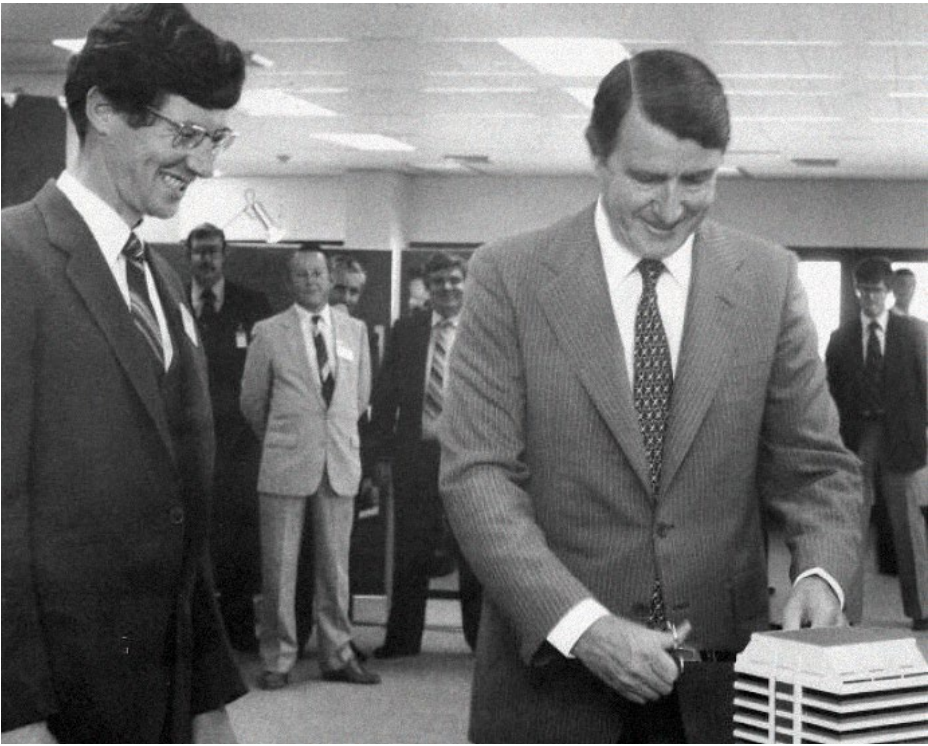
The table on the previous page shows the six largest minicomputer suppliers in Australia in 1983. Note that IBM is excluded because its minicomputer revenues were never separately reported, and that Wang's numbers were unusually high because of its very large Stratplan order from the Department of Social Security in 1983. The percentages of global revenues for Australia are in most cases much higher than the average figures for other types of computer supplier, indicating the great strength of the minicomputer market in Australia.

This chapter looks at the major minicomputer vendors in Australia in the 1970s and 1980s – when they were at their peak – and at the market's decline and rationalisation in the 1990s.

DEC

Digital Equipment Corporation (DEC) was the first and always the largest of

the minicomputer vendors. It came to Australia early, in 1964 (see Chapter 13), and remained the dominant minicomputer supplier locally until it was acquired by Compaq in 1998.

DEC's success in Australia in the 1960s was almost solely due to its customers in academia and government. By the 1970s, the market started to notice the new breed of small computers available, and DEC began selling to a number of commercial organisations in Australia, including Australian Paper Mills, Servex, Kodak and others.[380] By this stage DEC had offices in Sydney, Melbourne, Brisbane and Perth, and a man in Townsville to service the DEC PDP-10 sold to James Cook University. DEC employees became known as 'Digits'.

The company's growth in Australia in the 1970s was driven by its continued ability to release new and more powerful machines, and to support them effectively. The PDP-8, introduced in 1965 (see Chapter 13), was the basis of DEC's initial success in Australia. The PDP-10 followed in 1967 but was never very popular, and the PDP-11 arrived in 1970.

The 16-bit PDP-11 was DEC's most successful product to date, developed quickly as a response to Data General and other emerging minicomputer suppliers. The team that developed it was mostly brought into DEC especially for the project, after many of the company's senior engineers defected to Data General. DEC founder Ken Olsen hired Andrew Knowles, a seasoned and hard-nosed manager from RCA, to head the development team. The design was overseen by DEC veteran Gordon Bell, who had designed PDP-5 and was at that time on sabbatical from DEC at the Massachusetts Institute of Technology (MIT) in the US.

■ "What Bell orchestrated was a family of minicomputers with larger memories and more processing power than any small machine DEC built. Unlike the other systems, the PDP-11 was designed to

span a range of computing performance. Most of all, the PDP-11 offered such ease of use that novice users could embrace a computer as never before.

■ "It was a breakthrough machine built on a technology that would far outlive and outperform any expectations. The PDP-11's simplicity and elegance quickly made it an industry standard, a model for a generation of computer designers. These engineers felt that DEC taught the world how to build small computers."[381]

The PDP-11 was a revolutionary machine. It stayed in production into the 1990s and eventually sold 600,000 units worldwide, making it probably the most popular minicomputer in history.

At first it had very little software. Australia made an important contribution in 1973 when local software company Computer Power developed a COBOL compiler for the PDP-11, which it sold to DEC in Massachusetts. It was the first ANSI (American National Standards Institute) 1968 standard COBOL compiler to fit into a 64KB minicomputer[382], and was instrumental in Computer Power's international success (see Chapter 19).

The PDP-11 was very successful in Australia and cemented DEC's position as the leading minicomputer supplier. In 1972, DEC supplied seven PDP-11/20s to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to act as nodes on the CSIRONET network (see Chapter 24), connecting all mainland capitals and Rockhampton.[383] Max Burnet, who had been with DEC Australia since 1967 when he started the Melbourne office, was appointed General Manager at the end of 1975. By 1978 DEC had opened additional offices in Adelaide, Canberra and Hobart, with field service offices in Darwin, Mackay, Newcastle and Wollongong.

The PDP-11's enormous success was repeated with the VAX range of computers, introduced by DEC in 1977. VAX was a 32-bit

extension of the PDP-11's 16-bit architecture (hence the name, short for **V**irtual **A**ddress E**X**tension). It used a technique known as virtual memory to manage the increased addressable space, and an operating system called VMS (Virtual Memory System).

The first Australian sale was to Mount Stromlo Observatory near Canberra. Most of the early sales were to universities, but the machine soon became very popular in the commercial world. In 1980 alone, DEC sold 70 VAX machines in Australia[384], and by 1983 was selling so much equipment locally that it had to charter an air freighter to bring over equipment from the US every three weeks.[385] By 1984, it had sold 500 VAX machines to Australian customers.

The VAX range remained DEC's main product line for more than 20 years; production did not cease until 2000. The first VAX was the 11/780, followed in 1984 by the high-end VAX 8600 and low-end MicroVAX – available in Australia the following year. DEC sold more than 20 VAX 8600s in Australia – at around $1 million each – within just a few months.[386]

There followed a succession of models, including the VAXstation workstations. In 1992, DEC released the Alpha range of machines with new 64-bit processors, but they never equalled the VAX in popularity.

The Alpha used a DEC-designed RISC (reduced instruction set computing) chip, at a time when fierce rivals Hewlett-Packard, Sun Microsystems (see below) and IBM had all released similar microprocessors, and DEC's computers were no longer seen to have a technological advantage.

At the end of 1980 DEC Australia moved into new headquarters in a tower building above Chatswood train station in Sydney's northern suburbs. American Frank Wroe arrived from head office in Massachusetts in 1982 to become General Manager, and Max Burnet moved into a kind of elder statesman role with responsibility for a number of special projects. He later became DEC

Australia's corporate historian, and today owns one of the world's largest private collections of DEC equipment.

DEC maintained its market leadership role in Australia through the 1980s, and the Australian office became one of the company's most successful international operations. Founder Ken Olsen, made his first trip to Australia in 1989, and in 1990 the first DECWorld event in Australia was held, with a turnout of more than 4,000 attendees. In the same year DEC Australia moved to a new headquarters in the Sydney suburb of Rhodes.

The company was at its peak. Max Burnet explains what happened next:

■ "DECWorld and the new Rhodes building represented the zenith of DEC in Australia. The company could do no wrong. VAX computers were selling like hot cakes, Networking with Ethernet was a great success, order books were full, marketing meetings were held to plan when DEC would be bigger than IBM (2007 was predicted), the fast elegant Alpha chip was winning all the benchmarks, etc. etc.

■ "But dark clouds were gathering both overseas and in Australia. No one saw the tidal wave of PCs coming (driven by Intel chips, Moore's Law, IBM dominance and Microsoft marketing). No Digits acknowledged that the world wanted open systems. No Digits acknowledged the world wanted Unix (even though it was invented on a DEC machine).

■ "Even our fearless leader Ken Olsen declared Unix to be snake oil, thereby blowing a billion dollar campaign! No Digits acknowledged workstations might be engulfed by commodity PCs and Moore's Law. Thirty years of rampant success had generated too many product lines, too many products and too many factories.

■ "So the bottom line was impacted by the cost of bureaucracy, and the word went out that head count had to

be reduced. There was little attempt to keep the profitable bits. Just world wide edicts to cut staff by 7 per cent. The initial retrenchment packages were generous and Digits put their hands up for them.

■ "But no one bothered about the health of those that remained! They had to do the work of those that had left, as well as their own. They were left wondering if they would be next. A vicious cycle of resentment and negativity set in. So the next few years became death by a thoUSnd cuts."[387]

In 1998, DEC was acquired by Compaq – a major US microcomputer supplier, but a much smaller company in Australia. Compaq's Australian headquarters moved to the DEC building in Rhodes, and Burnet and many others left the company, refusing to be 'Compaqed'.

Then, in 2001, Hewlett-Packard acquired Compaq (see below), and would soon surpass IBM to become the largest computer company in the world (before Apple's renaissance). Hewlett-Packard was itself smaller than the combined DEC/Compaq operation in Australia, and it too used the Rhodes building as its new Australian headquarters, relocating from Melbourne.

DATA GENERAL

Data General was DEC's greatest minicomputer rival in the 1970s and into the 1980s. The 1969 Data General Nova was revolutionary computer that in many ways sparked the minicomputer revolution of the 1970s (see Chapter 13).

Data General came to Australia when semiconductor company Fairchild, which had provided many of the Nova's integrated circuits, started distributing its products in 1969. Data General set up an Australian subsidiary in Melbourne at the beginning of 1973.

The local company was headed by Wayne Fitzsimmons, who had been distributor

DATAPOINT WAS FOUNDED IN 1968 IN SAN ANTONIO, TEXAS, AS COMPUTER TERMINAL CORPORATION (CTC). AS THE NAME SUGGESTS, ITS FIRST PRODUCTS WERE TERMINALS, INTENDED TO REPLACE TELETYPE MACHINES. TELETYPES, OR TELEPRINTERS, WERE CUMBERSOME ELECTROMECHANICAL TYPEWRITERS USED TO SEND AND RECEIVE MESSAGES ON TELEX AND OTHER ELECTRICAL COMMUNICATIONS SYSTEMS.

Fairchild's Marketing Manager in Australia. Fitzsimmons became known for his aggressive marketing, and Data General Australia grew quickly, selling $1 million worth of equipment in its first year.[388] The big break, recalls Fitzsimmons, was a large sale to BHP towards the end of 1983.

■ "I remember it very well. I made a sales call to the head of their data processing department and he asked me if we could put computers into all their facilities around Australia. Some of them were quite remote, like Whyalla and Koolan Island off the Western Australian coast.

■ "He told me if we could put computers in those places, and support them, we would get the business. I asked him why. He said that when Hewlett-Packard and Honeywell had come to see him he asked them that, and they said they would get back to him. They never did.

■ "He asked me how I was able to say we could install and support the computers. I told him I could because that was my job. We got the business, which was a big deal, because they were Australia's largest company and they had only Control Data and DEC at that stage. The initial order was for a few million dollars, but BHP just kept buying more and more off us, and we were on our way."[389]

In 1974, Data General released the Eclipse range of 16-bit machines, intended to compete against the DEC PDP-11. The Eclipse was late to market and unsuccessful, and was left behind by DEC's VAX 11/780. Data General stumbled badly, but things picked up with the release of the 32-bit MV series in 1980.

The frantic development of the MV was the subject of Tracy Kidder's 1982 Pulitzer Prize–winning bestseller *The Soul of a New Machine*, which examined in detail the internal workings of Data General at the time.[390]

Fitzsimmons left Australia in 1979 to head up Data General in the UK. He was replaced by John Dougall, who also succeeded him

in the UK in 1983, when Fitzsimmons became Vice President for Asia and the Americas at Data General's head office in Massachusetts.

Data General Australia was then run by John Filmer, who had worked for Fitzsimmons in the UK and would go on to run Idaps – one of Australia's largest computer services companies (see Chapter 27). In later years, Fitzsimmons was a well-known figure in the Australian computer industry and chair of the Pearcey Foundation, which honours Australia's computing pioneer Trevor Pearcey.

The MV series machines were successful in Australia and Data General won many significant orders. The company then released an office automation package called CEO (Comprehensive Electronic Office). But like many other minicomputer suppliers, Data General missed the microcomputer boom and went into decline in the 1980s and 1990s.

Although Data General did release an advanced microcomputer called the DG-1 in 1984, it did not gain ground in the competitive IBM-compatible market. It also failed to compete with computers that were increasingly adopting the Unix open operating system.

In 1989 Data General released the AViiON range of Unix servers, which used off-the-shelf Motorola 88000 microprocessors, and chips from Intel. The name was a play on 'NOVA ii', an homage to the company's first successful computer. Data General also released the CLARiiON storage system, which became so successful that when the company was acquired by EMC Corporation in 2002, that technology drove the deal.

DATAPOINT AND SIGMA DATA

Datapoint was founded in 1968 in San Antonio, Texas, as Computer Terminal Corporation (CTC). As the name suggests, its first products were terminals, intended to replace teletype machines. Teletypes,

or teleprinters, were cumbersome electromechanical typewriters used to send and receive messages on telex and other electrical communications systems. They were often adapted for use on early computers. Datapoint's terminals used the same interface, and had a keyboard and small screen that made them much more suitable for use with computers.

CTC's terminals were very successful and Datapoint went public a year after it was founded. Its 2200 programmable terminal, released in 1971, was so successful that the company changed its name to Datapoint, which had better brand recognition than the original CTC. Datapoint, needing money for product development, sold its international manufacturing and distribution rights to aerospace giant TRW.

The 2200's small size and programmability led some to suggest that it was the first personal computer. Its original design included an 8-bit microprocessor, a device that did not exist when the computer was being designed. Datapoint asked two microprocessor companies, Texas Instruments and Intel, to design a suitable chip. Neither was able to do so, and Datapoint went with a multi-chip solution.

Even though it missed the Datapoint contract, Intel persisted with the design. In what has been described as 'the worst decision in business history' [391], Datapoint let Intel keep the intellectual property of the chip that Datapoint had asked it to build. Intel then used the design the following year to develop its 8008 microprocessor. IBM eventually chose that chip's successor, the 8086, for its first personal computer, and it was the basis for Intel's x86 architecture, the most dominant in computing history. [392]

Sigma Data Corporation distributed Datapoint computers in Australia, under the leadership of founder and Managing Director Mike Faktor, who had distributed Datapoint systems in his native South Africa – where he had previously become the youngest IBM

national manager in the world at the age of 26.[393]

The urbane Faktor saw more opportunities in Australia than in apartheid South Africa, and together with two partners moved to Sydney in 1974. They set up Sigma Data to distribute products for Datapoint and British word processor vendor Wordplex.

Sigma Data sold Datapoint products in Australia until 1982 when Datapoint set up its own local subsidiary (TRW also took a share). By that time Datapoint had become a Fortune 500 company and was regarded as a major minicomputer supplier.

Datapoint's fall from grace was very rapid. Datapoint got into severe financial problems by inflating its revenues, and fell afoul of the US Securities and Exchange Commission. Its stock price plummeted and corporate raider Asher Edelman acquired it in 1985, selling it off for the sum of its parts. The Datapoint story ended as quickly as it had begun.

The loss of the Datapoint distributorship just before the company's demise was a blessing in disguise for Sigma Data, which re-emerged in 1984 after a two-year non-compete period, distributing products for US vendors Convergent Technologies and Sequent.[394]

Both these product lines were successful in Australia, and Sigma Data was a major player on the local scene in the late 1980s. Convergent Technologies had been founded in 1979 by ex-employees of Intel and Xerox's Palo Alto Research Centre (PARC), who wanted to build workstations based on Intel's 8086 chip. Over the next few years it produced a range of advanced terminals and workstations that were rebadged and sold by a number of leading computer vendors including Bull, Burroughs, NCR, Prime and Unisys.

The Convergent Technologies CTOS operating system was initially popular, but its most popular products were based on Unix platforms. The company was acquired by Unisys in 1988 and became the Unisys

HEWLETT-PACKARD OPENED OFFICES THROUGHOUT AUSTRALIA SOON AFTER ACQUIRING SAMPLE – IN ADELAIDE IN 1967, IN PERTH AND CANBERRA IN 1969, AND IN BRISBANE IN 1972. IN 1974, IT MOVED INTO A NEW CUSTOM-BUILT FACILITY IN THE MELBOURNE SUBURB OF BLACKBURN, AND IN 1980 THE SYDNEY OFFICE MOVED INTO A CUSTOM-BUILT BUILDING IN THE SUBURB OF NORTH RYDE.

Network Systems Division, after which time it declined along with the rest of the company.

Sequent (see below) was a high-performance minicomputer that was briefly successful in the 1990s. Sigma Data lost the Sequent distributorship in 1990 when the company established a local subsidiary. Michael Faktor attempted to plug the gap with new distributorship arrangements – including products from AT&T and NetFrame – but they were not enough. Sigma Data went into voluntary receivership in 1991[395], and disappeared shortly afterwards.

HEWLETT–PACKARD

Hewlett-Packard was founded in Palo Alto in in 1939 in Silicon Valley, California, by William Hewitt and David Packard – in the proverbial garage (decades before Apple's Steve Jobs and Steve Wozniak would do the same). Hewlett and Packard both had electrical engineering degrees from nearby Stanford University, and saw an opportunity to form a company that would build electrical and electronic equipment.

During World War II they designed counter-radar technology and fuses for artillery shells. The two partners incorporated the company in 1947 and went public in 1957. Their first commercially successful product was an audio oscillator, but they entered the computer market properly in 1966 with the HP 1000 and HP 2100 machines.

Hewlett-Packard became well known for its scientific calculators. The HP 9100A, introduced in 1968, is sometimes considered the first personal computer, though Hewlett-Packard called it a calculator. Its handheld calculators were legendary – no self-respecting engineer would be seen without one. They were slide rule of the 1970s.

Hewlett-Packard did not initially have a dedicated sales force, instead relying on resellers. But in 1962 it began developing its own US sales force and started setting up international subsidiaries. In most cases, Hewlett-Packard bought the Hewlett-Packard distribution business (including employees and offices) from the local distributor, which is exactly what happened in Australia.

Hewlett-Packard products had been distributed in Australia by Melbourne-based Sample Electronics since the 1940s, right up until Hewlett-Packard bought the business in July 1967. All 29 employees made the transition from Sample Electronics to Hewlett-Packard, including General Manager John Warmington, who became Hewlett-Packard Australia's first Managing Director.

The first office was in the Melbourne suburb of Glen Iris, with a few staff members based in a Sydney office. In 1981, Hewlett-Packard Australia became a public company and the name changed to Hewlett-Packard Australia Limited. The company had sales of $2 million in its first year of operation (1967–68), and by 1977 had grown to $25 million, with a staff of 240. In 1986, annual sales reached $163 million and the company had 650 employees.

Hewlett-Packard opened offices throughout Australia soon after acquiring Sample – in Adelaide in 1967, in Perth and Canberra in 1969, and in Brisbane in 1972. In 1974, it moved into a new custom-built facility in the Melbourne suburb of Blackburn, and in 1980 the Sydney office moved into a custom-built building in the suburb of North Ryde.

The HP 3000 range of minicomputers, introduced in 1972, was extremely successful and remained in production until 2003. That machine ensured Hewlett-Packard was one of the world's major minicomputer suppliers, rivalling DEC and outselling most other vendors globally.

In 2002, Hewlett-Packard acquired Compaq, which had itself acquired DEC in 1998 (see above). In Australia DEC had

THE EVOLUTION OF THE IBM MIDRANGE 1969–1994 (IBM)

System /32

System/38

Advance System/400

Application System/400

System/3

System/36

System/34

1965   1970   1975   1980   1985   1990   1994
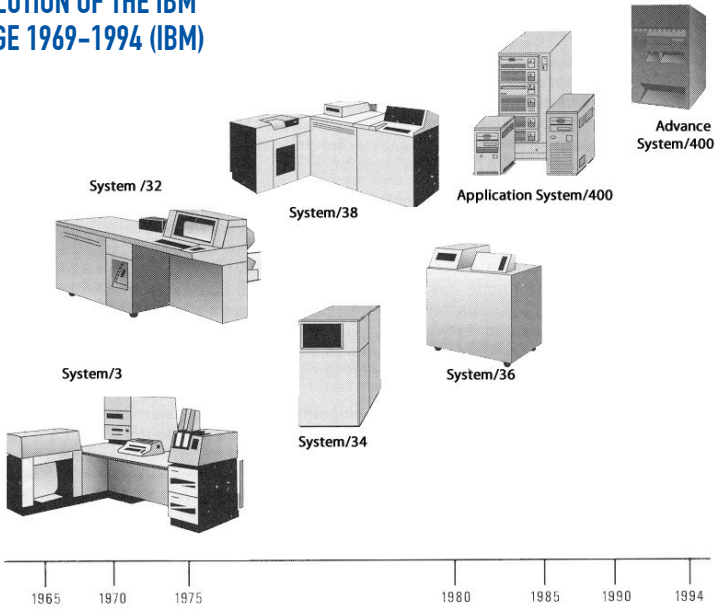
SOURCE: IBM

been much bigger than Compaq, so when Hewlett-Packard acquired Compaq the Australian operation more than doubled in size, inheriting the DEC user base and product line.

With the change in the balance of power, Hewlett-Packard Australia moved its headquarters in Sydney into the same building in Rhodes that DEC Australia had built for its Australian home in the early 1990s (see above).[396]

IBM

IBM, for a long time the largest vendor in the computer industry, keenly felt the challenge from minicomputer suppliers in the 1960s and 1970s and responded with its own smaller machines. It released a range of very successful minicomputers which, if they had formed a computer company in their own right, would have been one of the largest in

the industry.[397]

IBM dabbled with small computers in the 1960s, but its first real entry into the minicomputer market was the System/3, released in 1969. It was an impressive machine that evolved into the 16-bit System/32 (otherwise known as the 5320), released in 1975. That was later replaced by the System/34 in 1977 and the System/36 in 1983.

Those machines were logical progressions, but IBM also released the System/38 in 1979, confusingly, before the System/36. The System/38 was a more advanced machine with a different heritage. It was very successful and evolved into the AS/400 range in 1988, a widely anticipated machine that had been codenamed 'Silverlake' during its development. The 'AS' stood for application system, although IBM changed this to 'advanced system' later in the product lifecycle.

The AS/400 was a coming together of the System/36 and System/38 product lines, though mostly based on the System/38. IBM also had a separate and incompatible minicomputer range called the Series/1, released in 1976 and discontinued in 1988. IBM called these computers its 'midrange', a term that came to be used generically and eventually replaced the term 'minicomputer'.

THE EVOLUTION OF THE IBM MIDRANGE 1969–1994 (IBM)

IBM Australia created a General Business Group in 1975 to sell midrange computers.[398] It was very successful – the System/36, System/38 and AS/400 machines were extremely popular in Australia. In the early 1990s Australian market research company Strategic Research conducted an analysis of the AS/400 market share in Australasia.

■ "On a per capita basis, the AS/400 is even more popular in Australia and New Zealand than it is in the rest of the Western world. There is at least one installed in nearly a quarter of all significant computer-using organisations.

■ "The AS/400 is particularly widely used in the wholesale/retail and manufacturing sectors, which are largely made up of the medium-sized businesses that are the backbone of Australasian industry. The AS/400 suits these users admirably, because of its integrated design. It is a solidly performing computer that is reliable and does not need a large IT staff. Its built-in database makes programming for the sorts of applications used by these organisations very easy.

■ "But it is fashionable in some quarters to disparage the AS/400 and its success. Many in the industry don't regard it as a 'real' computer, because of its many idiosyncrasies. Its operating system, called OS/400, contains a built-in database (now called DB2/400), which is contained largely within microcode.

■ "It uses an unusual method of memory management, known as single level storage, which treats all memory – disk and RAM – as one, distributing data over a number of disks rather than storing files on individual drives. It makes heavy use of a language, RPG, which is not used at all outside the AS/400 environment."[399]

The AS/400 was one of the most popular minicomputers ever released; around 500,000 were shipped before the iSeries replaced it in 2000.[400] An entire software ecosystem grew up around the architecture, for which many development environments and software packages were specifically developed. Many were written in Australia by independent software companies such as Aspect (see Chapter 27) and Generator Systems. KAZ Computers (see Chapter 27), which
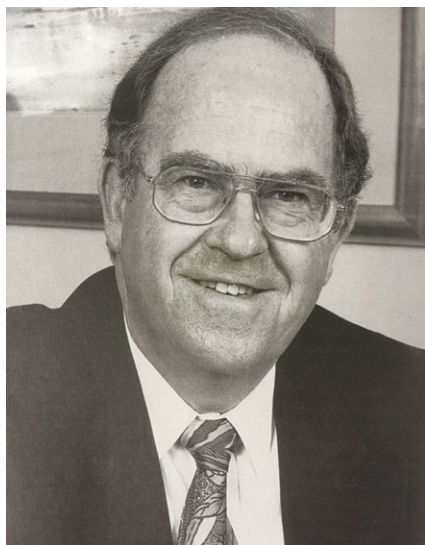
would become one of Australia's largest computer services companies in the 1990s, initially focused on servicing Australia's large IBM midrange user base.

PRIME AND THE LIONEL SINGER STORY

Prime Computer, founded in Natick, Massachusetts, in 1972, was only briefly a major global minicomputer supplier, but it was remarkably successful in Australia due to the marketing prowess of its local distributor.

Prime's first computer, the Prime 200, was a Honeywell 516 clone. It went on to develop a range of minicomputers in the 1970s and 1980s that were notable for their excellent price and performance.

Prime's machines used a proprietary operating system called PRIMOS, but Prime's key differentiator was Prime Information, an operating and development environment based on the Pick operating system, developed by Richard Pick for the US Department of Defense (see Chapter 19). Most importantly, Prime Information enabled fast application development and high performance.

In Australia, Prime's products were initially distributed by electronics company Warburton Franki which started selling the machines locally in 1974.

In 1977, the distributorship passed to entrepreneur Lionel Singer, who had been looking for suitable hardware and software to distribute in Australia. Singer made a great success of Prime, and in doing so became a legend in the Australian computer industry.

Prime Computer became known for its innovative advertising and aggressive marketing. The 1980 TV advertisements featuring *Doctor Who* actor Tom Baker are still remembered today, as are the ads featuring a C-3PO–type robot called Albert EinPrime.

The Prime 750, released in 1979, was an enormous success – in Australia and internationally. In the early 1980s Prime

reached the number four position in the US minicomputer market, behind DEC, Data General and Hewlett-Packard. In 1980, it was the fastest moving stock on the New York Stock Exchange – its share price grew by 272 percent in the year.

Prime was even more successful in Australia, under Lionel Singer becoming one of the largest minicomputer suppliers in the local market. At a time when most US computer suppliers collected around 2 percent of their annual global revenues in Australia, Prime regularly reached 10 percent. It was the company's largest international operation, and so successful that Prime established a direct subsidiary in 1981, with Singer continuing as Managing Director for another year.

Prime continued to be a very successful vendor in Australia in the 1980s, but the US parent company did not mirror this local success. In 1988 it purchased Computervision, an early computer-aided design (CAD) company, which produced software Prime had used to develop its own CAD systems. But Prime was unable to integrate the two companies successfully, and was also suffering from declining sales brought about by the growth of the Unix operating system and the emergence of more powerful hardware from its rivals.

In 1992, Prime sold its Prime Information software to emerging software company VMark, exited the hardware business and took on the name of the company it had acquired a few years prior, Computervision. Prime Computer was no more.

Meanwhile back in Australia, Lionel Singer was going from strength to strength. After he lost the Prime distributorship, he formed the not-so-modestly named Lionel Singer Corporation to distribute hardware and software for other US computer vendors. Lionel Singer had become a brand.

In a conversation with the author in the early 1990s, he said he used to drive around Silicon Valley, look at the signage of new computer companies that sprang up, then ring them immediately for an interview, seeking to distribute their products. He eventually distributed goods from dozens of companies, such that UK magazine *Computer Business Review* referred to his business as "the octopus-like Lionel Singer Corporation".[401]

Major distributorships that Singer signed during this period included Sun Microsystems (see below), Pyramid and Convex. All were successful under Singer and later set up direct operations in Australia. He also briefly distributed computers from a small Utah-based company called Wicat (World Institute for Computer Assisted Teaching), which he was attracted to for its early use of Motorola's powerful 68000 processor.

Wicat was a Mormon-run educational software company, which developed the hardware as a platform for its products. Singer ported the Pick operating environment onto Wicat's machines and sold them in Australia as commercial computers. His success in Australia proved something of embarrassment back in Utah – the company did not want to be in that business, and Singer was forced to end the distributorship.

By the mid-1990s most of the companies that Singer had bought Australia had set up their own subsidiaries, and the rise of the Internet (see Chapter 24) was a sign the world was changing. Seeking a new challenge, Singer left Australia in the late 1990s to live and work in New York, where he started a small software development company with big ambitions, on Wall Street. He died unexpectedly in New York from a heart attack in 2000.

WANG

Wang Laboratories was another Massachusetts-based microcomputer company. It had its origins in 1951, when Chinese immigrant and Harvard graduate An Wang started a company to develop a

A SECOND WAVE OF MINICOMPUTER SUPPLIERS CAME TO PROMINENCE IN THE 1980s WITH HIGH-PERFORMANCE COMPUTERS THAT WERE OFTEN CALLED 'SUPERMINIS'. MANY OF THESE MACHINES OFFERED BETTER PERFORMANCE THAN OLDER-STYLE MAINFRAMES, AND WERE USUALLY SOLD AT A PREMIUM. FIVE THAT WERE PARTICULARLY IMPORTANT IN AUSTRALIA WERE CONVEX, PYRAMID, SEQUENT, SUN MICROSYSTEMS AND TANDEM.

technology he had been working on at the university, that would become known as core memory.

Wang sold a patent for the technology to IBM for US$500,000 in 1955, enabling him to build a larger business, but problems with the deal gave him a lifelong animosity towards IBM. Wang Laboratories moved into calculators and then word processers, where it became a market leader, before entering the minicomputer market in the 1970s. The Wang VS system, introduced in 1977, had a very similar instruction set to the IBM System/360 – an attribute that would be instrumental to Wang's success in Australia.

The Wang Laboratories Australian subsidiary was established in 1973 under Marvin Cook, who was replaced by Tom Lambert in 1975, and then in 1978 by Richard Connaughton. All were Americans.

Connaughton's brief was to hire a local replacement, and although he didn't find an Aussie, he got the next best thing. In 1979, Mike Clarkin became Managing Director, having already successfully established Wang in his native New Zealand. He ran Wang during its most successful years in Australia, and was instrumental in landing Wang's biggest ever global order, the $63 million Stratplan deal (that amount was Wang's component only) with the Australian Department of Social Security in 1983.

Stratplan was enormous. Coordinated by Computer Power (see Chapter 19), it involved Amdahl mainframes in Canberra and every state capital, and 275 Wang VS minicomputers, at least one in every Department of Social Security office around the country. The Wang machines were connected to the mainframes by 9.6 Kbps data lines supplied by Telecom Australia (later to be renamed Telstra).

All these computers communicated using IBM's Systems Network Architecture (SNA) protocol. It was the largest SNA network in the world – and the only IBM product involved was the mainframe operating system.[402]

As part of the deal, Wang set up a manufacturing facility in Canberra to make thoUSnds of colour terminals that would sit in the Department of Social Security offices. Stratplan meant that Wang had to substantially ramp up its operations in Australia, in every department. That deal alone ensured that Wang Laboratories became a major vendor on the local scene. It was successful in many other areas, and within five years was in the list of top 10 computer supplier in Australia.[403]

Like Prime, Wang was much more successful in Australia than it was globally. In the year Stratplan was implemented, more than a quarter of Wang's worldwide revenues came from Australia – a remarkable figure when Australia comprised only around 3 percent of the global computer market.

Under Mike Clarkin, Wang Laboratories became one of the largest corporate donors in Australia, sponsoring organisations such as the Sydney Dance Company, the Queensland Ballet, the Sydney Marathon and the Australian men's basketball team (the Boomers).

But the success was not to last. Like the other minicomputer suppliers of the time, Wang Laboratories was unable to compete against more powerful personal computers at the low end, and the new breed of Unix superminis at the high end. An Wang died in 1990 – he did not live to see his company's demise.

In 1991, Wang Laboratories exited the hardware market to concentrate on imaging software and office productivity. It signed a deal with IBM under which IBM would invest US$100 million in the company and Wang would resell IBM AS/400 and RS/6000 machines, converting its existing user base to them.[404] (An Wang must have turned in his grave.)

Mike Clarkin did not agree with the new direction and left the company. By this time, he was a leading figure in the Australian

computer industry, and after his departure sat on the boards of many local technology companies. He made the right decision to leave; Wang entered Chapter 11 bankruptcy in 1992. It emerged a year later and reinvented itself as a services company with some success, but the boom years were well behind it.

The Wang name disappeared in 1999 when it was acquired by Dutch services company Getronics. Clarkin died in 2008.

THE SUPERMINI SUPPLIERS

A second wave of minicomputer suppliers came to prominence in the 1980s with high-performance computers that were often called 'superminis'. Many of these machines offered better performance than older-style mainframes, and were usually sold at a premium. Five that were particularly important in Australia were Convex, Pyramid, Sequent, Sun Microsystems and Tandem.

CONVEX

Convex was formed in 1982 in Richardson, Texas, and released its first machine in 1985. It used similar architecture to Cray supercomputers, but used off-the-shelf components to minimise the cost. Sigma Data distributed Convex's products in Australia without a great deal success, before it set up its own operation in Australia in 1992. Hewlett-Packard acquired Convex in 1995.

PYRAMID

Pyramid, like many other companies of the era, initially distributed its products in Australia via the Lionel Singer Corporation. It eventually set up its own local operation in 1989, under the leadership of former senior employee Gary Jackson. Pyramid was very successful in Australia, and at one stage brought in 10 percent of its global revenues from the local operation. The extroverted Jackson became one of the highest-profile

figures in the Australian computer industry, later running the local operations of Microsoft, then Cisco. (His tenure at Microsoft was cut short after an unfortunate misunderstanding over a golf sponsorship.)

Pyramid was particularly strong in supporting Unix, and was a popular platform for the emerging relational database management systems in that era. Telecom was a very large customer. The company was acquired by German company Siemens in 1995.

SEQUENT

Sequent Computer Systems began life as Sequel in 1983, founded by a group of ex-Intel employees who wanted to build a symmetric multiprocessing (SMP) computer based on technology from a project that Intel had cancelled. The SMP computer architecture involves multiple processers connected to a single, shared memory, which enables increased throughput.

Sequent was based in Portland, Oregon. It used off-the-shelf Intel chips to build Unix-based superminis that were initially very successful. Sequent's products were first distributed in Australia by Sigma Data (see above), although it set up its own local subsidiary in 1990. The local company did well at first but declined through the 1990s, lacking the critical mass to keep up with machines from the likes of Sun Microsystems and Hewlett-Packard. Sequent was acquired by IBM in 1999, which shortly afterwards stopped developing its architecture.

SUN MICROSYSTEMS

Sun Microsystems was a comparatively late entry into the minicomputer market. Founded in 1982 in Santa Clara, in California's Silicon Valley, it grew very quickly and was a major player in the Australian market in the late 1980s and 1990s.

Sun Microsystems began as a workstation vendor. Workstations, conceived as powerful single-user machines, were eventually superseded by powerful microcomputers.

TANDEM COMPUTERS WERE ORIGINALLY DISTRIBUTED IN AUSTRALIA BY AN ALREADY WELL ESTABLISHED MELBOURNE COMPANY, HARRY FOSTER'S MIS, WHICH HAD THE ANZ BANKING GROUP AT ITS LARGEST CUSTOMER. TANDEM BOUGHT OUT MIS IN 1984 AND SET UP AN AUSTRALIAN SUBSIDIARY UNDER GRAHAM BENNETT. IT WAS BASED IN MELBOURNE AND WAS INITIALLY STAFFED BY PEOPLE WHO HAD COME ACROSS FROM MIS.

At this point most workstation vendors (such as Apollo) disappeared, but Sun grew into a significant hardware vendor by concentrating on open systems – in particular the Unix operating system. When Unix became very popular at the end of the 1980s, Sun Microsystems was in the right place at the right time. Its workstations grew into powerful servers, and Sun Microsystems became a major industry player.

'Sun' stood for Stanford University Network, named after the famous Silicon Valley university where it was conceived. One of the founders, Scott McNealy, remained its CEO until 2002.

The company's computers were initially distributed in Australia by Lionel Singer (see above), but it set up a local subsidiary in 1986 under Val Mickan, who had previously run ICL Australia. Subsequent managing directors were Shaun McConnon (1990), Les Hayman (1992) and Russell Bate (1994).

In the 1990s, Sun Microsystems in Australia grew as many other minicomputer suppliers declined. It strongly emphasised its support for the Internet; McNealy pioneered the phrase "the network is the computer".

Many of its sales were to companies riding Internet boom. Duncan Bennet became Managing Director in 1999, at the height of the company's success. He held that position for ten years, only to see the company decline.

Sun Microsystems was hit hard by the tech crash of the 2000s (see Chapter 28). The fact that it had tied its fortunes so closely to the Internet was ultimately the cause of its demise. Its revenues and share price plummeted. It made many vain attempts to strike out in a new direction, even acquiring former storage leader StorageTek in 2005. Sun Microsystems was eventually acquired by software company Oracle in 2009, mostly for its software assets including Java and MySQL.

TANDEM

Tandem Computers was founded in Silicon Valley in 1974, by James 'Jimmy' Treybig. Most of its employees came from Hewlett-Packard, where Treybig had been a marketing manager. Its machines were based around a fault-tolerant architecture, which ensured high reliability.

The company was successful, and its 'NonStop' computers were popular in online transaction processing (OLTP) environments. But like many other minicomputer suppliers in the 1990s, it had trouble competing against commoditised machines, and was acquired by Compaq in 1997.

Tandem computers were originally distributed in Australia by an already well established Melbourne company, Harry Foster's MIS (Management Information Systems), which had the ANZ Banking Group at its largest customer. Tandem bought out MIS in 1984 and set up an Australian subsidiary under Graham Bennett. It was based in Melbourne and was initially staffed by people who had come across from MIS.

Under the second Managing Director Ray Whiteside, Tandem opened a Sydney office and became a major supplier to Australian banks and financial institutions. Its fortunes in Australia followed those of its parent company and it folded into Compaq in 1997.

OTHER MINICOMPUTER SUPPLIERS

The vendors mentioned above were not the only minicomputer suppliers in Australia. There were dozens of them in a very competitive market, including attempts by most of the mainframe vendors. Some of these other suppliers are described below.

BURROUGHS

Better known as the mainframe supplier that put the 'B' in BUNCH (see Chapter 16), Burroughs supplied a range of minicomputers to the Australian market. Its smaller B700 and B1700 computers were

particularly popular accounting applications, but after the 1984 merger with Sperry to form Unisys, the company declined quickly as a hardware supplier.

ICL AND SINGER

ICL (see Chapter 17) was a major supplier of mainframes in Australia. It diversified into minicomputers in 1976, when it acquired Singer's Business Machines division. US company Singer (not to be confused with Lionel Singer) – best known as a manufacturer of sewing machines – had decided in the 1960s to get into computers.

It entered the market with the Singer System Ten, released in 1970. The machine had a very unusual architecture that made it extremely suitable for retailers: its memory was partitioned to interface with electronic cash registers. The System Ten was a success in Australia, with more than 100 installations.

When ICL acquired Singer, it inherited this customer base. It renamed the Singer System Ten the ICL System 10, which later evolved into the ICL Model 25.

NCR

Mainframe supplier NCR (see Chapter 16) had some success as a minicomputer supplier with its Tower series, launched in 1982. The Tower series used the Unix operating system, which became very popular during the 1980s. NCR sold more than 100,000 units worldwide.

NCR also made the 5000 series minicomputers, which used the powerful Motorola 68000 chip. The 5000 series was mostly sold into NCR's existing financial industry base, along with a range of other minicomputers that used proprietary an open source operating systems. But like the other companies with roots in the mainframe industry, NCR never really adapted to the new world of minicomputers – or the even newer world of microcomputers (see Chapter 22) – and faded as a supplier in the 1990s.

MORE INFORMATION

Apart from Max Burnet's excellent and privately published history of DEC in Australia, there is very little documentation on this period of Australia's computing history. This chapter has largely been put together from conversations with people involved in the companies involved, and from various US corporate histories.

NIXDORF

Nixdorf was a German computer supplier that did very well in Australia in the 1970s and 1980s. It was founded by Heinz Nixdorf in Paderborn, Germany, in 1952 using seed funding from an electrical utilities company, and originally produced calculators. It moved into computers in 1968, and opened an Australian office shortly afterwards to sell its 820 machines.

Mixdorf's most successful machine in Australia was its 8870 minicomputer, released in 1976. It also manufactured and sold point-of-sale terminals, automatic teller machines (ATMs) and digital telephone equipment. Telecom became a major customer, and under Managing Director Dieter Moench, a dynamic German, Nixdorf became a major supplier to the Australian retail market.

In the first half of the 1980s, Nixdorf marketed a small IBM-compatible mainframe, the 8890, which competed against the very low end of IBM's 4300 series. It was much cheaper than IBM's machines, and at one stage Nixdorf sold a dozen 8890s to Australia's Department of Finance. The division was managed by the effervescent Richard Buckle, who later went to Tandem (see above).

The company declined quickly after Heinz Nixdorf died in 1986. It was taken over by Siemens in 1990 and renamed Siemens Nixdorf Informationssysteme (SNI). It had had a continued but declining presence in Australia for a few more years, and lives on today as Diebold Nixdorf, an ATM manufacturer.

LOCAL MANUFACTURING
DESPITE THE MANY ATTEMPTS, AN AUSTRALIAN HARDWARE MANUFACTURING INDUSTRY NEVER TOOK OFF.

21

T he Australian Government strongly enabled the rise of computing in the 1960s (see Chapter 14). Because of this, discussions arose around the extent to which the Government should help foster a homegrown computer industry. Over the years, governments made various attempts to facilitate the emergence of an Australian computer hardware manufacturing industry, but none succeeded (see Chapter 7). Many computer pioneers such as Trevor Pearcey believed that Australia missed an opportunity to become a significant computer supplier. Others believe that Australia never truly had a chance, largely because of its geographical isolation and relatively small local market.

The argument is now largely academic. Virtually all computer hardware is manufactured in Asia, with multiple levels of outsourcing in every step of the process. Australia can hardly compete in this regard, but it can develop solid software and services industries that themselves become major sources of income (see Chapter 27).

This chapter examines some of the most notable private and public sector attempts to manufacture computers in Australia.

THE OFFSETS PROGRAM

In 1968 at the height of the Vietnam War, an Australian Government mission visited the US to examine potential ways for Australia's industry to work with the US defence program. The visit led to the establishment of the Australian Industry Participation (AIP) program, an 'offsets' agreement under which Australia's purchases of US defence material would be reciprocated – or offset – by US purchases of Australian material.[405]

The program was initially limited to defence purposes, but it soon included other areas such as aviation and computing. Unfortunately, the arrangement did not specify if the offsets were mandatory, nor did it set the amount of material to be offset. Contractors were expected to 'do their best' – an ambiguity that jeopardised the program's longevity.[406]

"The Government decided to introduce a program to encourage the Australian industry to explore offset opportunities with potential defence suppliers, as well as increase its participation in the US defence procurement market.

"AUSTRALIAN COMPANIES FACED DIFFICULTIES IN BEING PRICE COMPETITIVE AND PROFITABLE COMPARED TO THEIR COUNTERPARTS IN JAPAN, THE UNITED KINGDOM AND THE US. ECONOMIES OF SCALE WILL ONLY REDUCE COSTS OF THE FINAL PRODUCT, NOT STIMULATE INVESTMENT."

MIRIAM GOODWIN, 1992

IN 1989 FUJITSU
ESTABLISHED FUJITSU
AUSTRALIA SOFTWARE
TECHNOLOGY
(FAST), ITS FIRST
MAJOR SOFTWARE
DEVELOPMENT
FACILITY OUTSIDE
OF JAPAN. IT WAS A
MAJOR INVESTMENT
FOR FUJITSU, WITH
INITIAL CAPITAL OF $10
MILLION AND TENS OF
MILLIONS MORE OVER
THE SUBSEQUENT
YEARS.

■ "Purchases employing significant Government funds outside the defence sector – purchases of computers and civil aircraft, for instance – could be included in the offsets policy. The principal objective of the offsets policy – to upgrade Australia's industrial technology and efficiency – was reaffirmed in 1976 and in 1979, when the Government decided to continue to seek offsets of technological significance as a means of enhancing Australia's industrial base."

Two major projects that benefited from the AIP program were the Aussat satellite (which would later be privatised and form the foundation of Optus) and the trans-Pacific ANZCAN communication cable. At this time, the Australian Government was spending around $40 million a year on computers, almost all of which were imported.[407] Many major projects, such as Stratplan, involved substantial local manufacturing, including the construction of a terminal manufacturing facility by Wang in Canberra, and thoUSnds of terminals and networks (see Chapter 20).

Other technological benefits to flow from the program included software; computer components such as multi-layer circuit boards; re-flow soldering; metal glare resistor production; and micro welding of integrated-circuit flat packs.[408]

The offsets program encouraged many international computer suppliers to undertake software development in Australia instead of overseas. This included software development undertaken locally by multinational suppliers while contracting out software development to local software companies. IBM, Hewlett-Packard and Fujitsu were predominant in this approach, but smaller vendors also had their own operations.

More broadly, the AIP program indirectly increased the funding of computer science and technology in Australian universities and colleges. For instance, the Systems Research Institute of Australia in Western Australia

received support from Unisys, and carried out research to determine how computers could help improve efficiencies in Australian industry end-production.[409]

IBM

In 1976, IBM began assembling its Selectric electric typewriters in a plant in Wangaratta, Victoria. The first production line employed 13 people and produced 30 electronic typewriters per day. A new plant, built in 1979, produced 100,000 electric typewriters by 1981.

In 1984, IBM also began assembling personal computers (PCs) in Wangaratta. One of only three IBM PC production facilities in the world, the plant expanded to produce PC planar boards, Japanese-character Kanji display cards and entire PC motherboards. By the 1990s, IBM's RS/6000 RISC workstations were also being assembled in Wangaratta.

Despite these encouraging initiatives, IBM was unable to justify continued local manufacturing in such a high-cost economy. It sold the Wangaratta plant to Australian company Bluegum in 1998, which was in turn acquired by US company Solectron in 2000. Solectron ended its Australian manufacturing operations shortly afterwards.

IBM, meanwhile, redirected its efforts towards computing services, eventually becoming a major exporter of software and services to the Asia-Pacific region and beyond.

HEWLETT–PACKARD

After Hewlett-Packard entered the Australian market (see Chapter 20), it quickly realised it would have much better odds of winning government contracts if it possessed local research and development (R&D) and manufacturing capabilities. By the 1970s, it was assembling oscillators for local and foreign markets, and in 1984 had established its Australian Software

Operation (ASO) in the Melbourne suburb of Ringwood.

Hewlett-Packard's most significant manufacturing initiative in Australia was its Australian Telecom Operation (ATO), established in 1989 after the company won a number of large orders from Telecom, the government-owned telecommunications monopoly and precursor to Telstra. From this point onwards, all of Hewlett-Packard's global design and manufacturing of high-end telecommunications test equipment took place in Melbourne, and by the end of the 1990s the business was exporting more than $100 million worth of equipment annually.

FUJITSU

In 1989 Fujitsu established Fujitsu Australia Software Technology (FAST), its first major software development facility outside of Japan. The main FAST operations were based in the Sydney suburb of Frenchs Forest, with a smaller facility in the Brisbane suburb of Taringa, near the University of Queensland. It was a major investment for Fujitsu, with initial capital of $10 million and tens of millions more over the subsequent years. The first computer to be installed at FAST was a Fujitsu M-780, the company's largest commercial mainframe at the time. It required a staff of 45 software developers, almost all Australian.

Fujitsu had opened FAST in response to the arbitration settlement that granted it and IBM access to each other's mainframe system software. Many of FAST's early projects involved developing software to bridge the gap between IBM and Fujitsu software. The first project undertaken was called CICS/AIM/BRIDGE, which allowed third-party applications to run on IBM's CICS mainframe transaction processing system as well as on Fujitsu mainframes under the AIM/DB database.

FROM OFFSETS TO PARTNERSHIPS FOR DEVELOPMENT

The Hawke Labor Government, elected in 1983, set out to reform the Australian economy. It formed a Department of Industry, Technology and Commerce (DITAC) under Senator John Button, to undertake a complete overhaul of industry assistance in Australia.

The Government's Inglis Review in 1984 found that it was difficult to precisely qualify the costs and benefits of the AIP program, although it was able to identify transaction costs to the Government and noted that price premiums may have been factored into purchases. The review concluded that there were net benefits from the program, including enhanced access to international markets and technologies.[410]

But the offsets program still received much criticism. In March 1987, the Parliamentary Joint Committee of Public Accounts and Audit found that the offsets program was poorly administered and "open to abuse, lacked accountability and, worst of all, failed to achieve its primary purpose, the transfer of technology".[411]

After the Inglis Review the Government introduced two new initiatives: a Defence Offsets Program and a Civil Offsets Program. In September 1987, after 18 months of consultation with businesses and unions, Senator Button also announced an Information Industries Strategy (IIS).

■ "The IIS is designed to rectify Australia's growing trade deficit in the information industry sector by encouraging firms to link into world markets through alliances with foreign companies and to develop specialised products which are internationally competitive in terms of quality, design, delivery and price.

■ "Like other industry plans, the IIS has specific initiatives aimed at product R&D, increased exports, and skills formation and development. An Information Industries Board has been established to advise

MOST OF THE MICROCOMPUTERS BUILT IN AUSTRALIA IN THE 1990s AND 2000s WERE MERELY ASSEMBLED FROM IMPORTED COMPONENTS. THIS WAS FAIRLY EASY ONCE THE PC-COMPATIBLE STANDARD HAD SETTLED IN FOR THE LONG HAUL AND INDIVIDUAL COMPONENTS HAD BEEN COMMODITISED. ANY PC ENTHUSIAST OR BACKYARD RESELLER COULD BOLT TOGETHER A MACHINE, OFTEN AT A LOWER PRICE THAN A FULLY ASSEMBLED PRODUCT BEARING A MAJOR BRAND NAME.

the industry Minister and monitor the effectiveness of the strategy."[412]

A significant result of the IIS was a new Partnership for Development Agreements scheme, aimed primarily at information technology industries.[413] It was introduced in September 1988, and had the effect of replacing the Civil Offsets Program that was abolished in 1991. It was hoped that the new scheme would boost Australian manufacturing by waiving offsets requirements for transnational companies that entered into joint ventures with Australian companies. Businesses that signed Partnership for Development Agreements committed to investing 5 percent of their total annual turnover in Australia towards developing export-oriented products.

A number of major international computer suppliers signed Partnership for Development Agreements. The first was Honeywell Bull, in November 1987, closely followed by eight more – Apollo, Apple, Cincom, DEC, Hewlett-Packard, IBM, Unisys and Wang – in the first 18 months alone.

The Federal Opposition criticised the interventionist program, which was allowed to quietly die after the election of a Coalition Government in 1996.

AUSTRALIAN MANUFACTURING

While the Government fostered the Australian computer industry through policies designed to help multinationals work with local industries, several Australian hardware companies were going it alone, attempting to establish their own homegrown computer manufacturing industry.

There were many brave attempts, but all eventually failed. Some achieved initial success but ended up succumbing to the commoditisation of hardware, which made it difficult to compete against the low costs of mass-produced microcomputers coming out of Asia. Additionally, very few electronic

components were easy to manufacture in Australia, and Australian labour costs could not compete against those of its neighbours in Asia.

Most of the microcomputers built in Australia in the 1990s and 2000s were merely assembled from imported components. This was fairly easy once the PC-compatible standard had settled in for the long haul and individual components had been commoditised. Any PC enthusiast or backyard reseller could bolt together a machine, often at a lower price than a fully assembled product bearing a major brand name.

Despite decades of government support, the best efforts from some remarkable entrepreneurs were not enough to build an enduring computer hardware manufacturing industry in Australia. Ambitious individuals such as David Hartley, David Webster, Damien Dunlop and Owen Hill tried their best and there was some success with machines like the Dulmont Magnum, but none were able to truly get a homegrown industry off the ground.

DAVID HARTLEY, BILL GATES AND THE ONE THAT GOT AWAY

David Hartley (not to be confused with the British computer scientist of the same name) was a civil engineer employed by the Brisbane City Council in the early 1970s. His work later took him to Namibia in southern Africa, where he was introduced to computing through the mathematical modelling of rainfall in the vast Okavango river basin – using Fortran programming on an ICT 1500 machine.

When he returned to Australia in 1974 he decided that computing was more interesting than civil engineering. In that year he established his own business in Brisbane, Hartley Computer, to develop accounting software. He worked on the assumption that accounting could be easily computerised but that many in the

ELECTRICAL ENGINEER DAVID WEBSTER STARTED WEBSTER ELECTRONICS IN MELBOURNE IN 1970, AT FIRST PRODUCING CUSTOM-BUILT COMPUTER INTERFACES FOR DEC AND DATA GENERAL COMPUTERS. THANKS TO HIS PRIOR EXPERIENCE WORKING WITH AUTOMOTIVE CONTROL SYSTEMS FOR GENERAL MOTORS HOLDEN, THE COMPANY WAS A SUCCESS AND IN JULY 1977 RELEASED ITS FIRST COMPUTER SYSTEM, THE SPECTRUM II.

profession did not realise the immense possibilities this represented.

Hartley's first project was to write the AANCS (Australian Accountants Number Crunching System) program, using BASIC on a Hewlett-Packard cassette-based desktop calculator. But the Hewlett-Packard machine only had a one-line display, and in 1975, Wang approached Hartley to rewrite the program so it would run on a Wang 2200.

The company's newly popular minicomputer had a full display screen and ran off floppy disks, two new features that allowed the HAPAS program (**HA**rtley **P**rofessional **A**ccountants' **S**ystem) to see the light of day. The new software was the only program in Australia designed specifically for small accounting practices, making it very successful. Hartley also designed SHEILA (**S**ystem by **H**artley for **E**ntirely **I**ntegrated **L**edger **A**ccounting) for larger organisations.

Hartley also ventured in hardware with the Hartley 3900 and even created his own operating system, RT86. In Hartley's words:

■ "The operating system was a true pre-emptive, multi-user, multi-tasking operating system for the 8086 chip. It was launched in 1980, 15 years before Windows PCs had that capability.

■ "Hartley Computer was one of the first mini/PC computer vertical market successes in the world, with ultimately 250 staff and 3,000 sites in seven countries. In the process, I became known as 'the father of computer client accounting', and we won several awards. The success was killed by hubris and a messy divorce. Big lessons, only partly learned at the time."

The company sold thoUSnds of copies of HAPAS in Australia throughout the 1970s and early 1980s, but as imported minicomputers rapidly became more affordable, Hartley moved out of hardware manufacturing and concentrated on software. At one stage he was the largest global customer for Wang minicomputers.

In 1979, Hartley expanded the business to

the US, setting up in Denver, Colorado. The US business was run by Roger Brownlee, who grew the US operations to more than 100 customers.

But financial problems developed as Hartley diverted more and more funding into the development of his hardware platform.

In 1984 the US business closed, much to Hartley's regret. He believes the entire history of the microcomputer industry could have been very different had it continued.

■ "When IBM launched the IBM PC, it decided to use the Intel 8088 (an 8-bit external bus sister chip of the full 16 bit 8086 we had chosen). IBM asked Intel for an introduction to someone who could supply an operating system. Intel knew of our work in Australia, but did not make the introduction because we were not in the US.

■ "Instead, they introduced IBM to Bill Gates, who did not even have an Intel chip-based software at the time. Bill was smart enough to rush out and buy what became MS-DOS for US$50,000 [see Chapter 24]. Thus, MS-DOS and Microsoft were born – who know what could have been with our far superior RT86."

In 1982, the Queensland Government put Hartley Computer into receivership. According to Hartley, this was due to a technicality with a loan guarantee, "even though there was no commercial reason or need, as business was booming with just some cash flow issues during the financial year-end, exacerbated by a cargo handlers strike in Sydney, which the bank understood."

David Hartley believed he was being punished for not having donated to the Bjelke-Petersen Foundation, a kickback vehicle for the corrupt Queensland Government. Embittered by the experience, Hartley moved to Hong Kong in 1985 and founded Banksia Information Technology (BIT), which designed and manufactured IT gear – including PCs, modems, and an early

voice-activated fax/phone switch, called the PHAXswitch.

He later returned to Australia and developed the HAPAS Mark II, and in 1993 went to the UK with some colleagues to set up Hartley Computer UK, which gained more than 1,000 accounting practice clients, ranging from sole practitioners to PricewaterhouseCoopers. In 1999, Hartley sold the company to British accounting software vendor Sage, and moved to the Caribbean. He still lives there today, where he is a self-described 'Caribbean blockchain evangelist', pursuing initiatives that use blockchain technology – including accounting systems, which he believes to be the next era of blockchain business.

Hartley was admitted to the Pearcey Hall of Fame in 2003 for "distinguished lifetime achievements and contributions to the development and growth of the information technology profession, research and industry".[414]

DAVID WEBSTER AND WEBSTER COMPUTER CORPORATION

Electrical engineer David Webster started Webster Electronics in Melbourne in 1970, at first producing custom-built computer interfaces for DEC and Data General computers. Thanks to his prior experience working with automotive control systems for General Motors Holden, the company was a success and in July 1977 released its first computer system, the Spectrum II.

The machine used an LSI-II microprocessor, the same employed by the DEC PDP-11. In its base form, it had 32 KB of RAM and a floppy disk drive, and sold for $6,500. An extra floppy drive cost an additional $1,000, as did a memory increase to 64 KB. By contrast, DEC's RT-11 operating system sold at $1,500, and a further $1,500 would buy a visual display screen and printer.[415]

Webster initially geared up to manufacture 20 systems a month, a target he managed

ABOVE: Microbee Computer-in-a book -
CREDIT WIKIMEDIA COMMONS

to achieve. In August 1983, he consolidated his businesses under the Webster Computer Corporation, expanding his product range to include DEC-compatible storage and communications controllers. The company's Computer Systems Division, established in 1988, continued to develop more and more sophisticated products. By the end of the 1980s, it was making $10 million in annual sales and had 65 employees located all around Australia.[416]

But Webster's success was short-lived. The price performance of DEC's computers continued to improve, and he was unable to compete against the DEC VAX, which by 1980 was selling in large volumes all over the country. Webster Computer Corporation struggled through the 1980s, a hardship that culminated in Webster moving his company

to Los Gatos, in California's Silicon Valley, in 1992. He subsequently acquired the design for a Macintosh computer network router from the University of Melbourne and developed it into the Multiport/LT, which sold successfully around the world with total sales exceeding US$10 million.

By January 1995 Webster had sold his shares in the company's Australian operations and completed his divestment. Shortly afterwards, he closed his US operations and moved into capital and business development with various organisations around North America.[417] The local company struggled after Webster left Australia, unable to compete in the booming microcomputer market. It continued as a systems integrator and was finally dismantled in 2015.

DAMIEN DUNLOP, TSS AND CMAD

In 1973 Damien Dunlop, who had previously worked at Honeywell Australia, started a company in Melbourne called Time Share Systems (TSS) to sell data-entry equipment based around the Honeywell 316 minicomputer. The company was successful, with its biggest customer the Australian Taxation Office (ATO). In 1975 TSS was acquired by Datronics, an Australian company specialising in computer maintenance.

Dunlop then started Computer Manufacturer and Design (CMAD) to build a minicomputer. Some of the funding was from Computer Manufacturers (Australia), which also sold data-entry equipment, and which was part of the consortium that first brought Fujitsu computers to Australia in 1973 (see Chapter 17). The deal was that CMAD would develop the machines and Computer Manufacturers (Australia) would sell them.

Its CM20 was billed as Australia's 'first locally built and designed minicomputer'. The CPU was built from a number of off-the-shelf integrated circuits already available in

Australia. Dunlop described the benefits of CM202 as a combination of hardware and software.

■ "These days, the CPU itself and the device controllers are often found integrated on a single chip. In 1975, they had to be fabricated from tens or hundreds, if relatively simple, integrated circuits. The CM202 CPU required about 750 separate integrated circuits. As can be imagined, the design effort by the electronics engineers involved, particularly Charles Amy and Greg Hotchin, was a powerful tribute to their skill and dedication.

■ "But the CM202 design effort consisted of more than hardware. An equal if not greater effort was applied to software, with the primary contributors to the multi-user, multi-tasking operating system CMDOS (CMAD's version of Unix), created by software engineers Lionel Parker and David Nolan.

■ "The range of software ultimately available on the CM202 was remarkable and included Basic, Fortran, Ratfor, the ML1 macroprocessor, Cobol, a database enquiry language called ELF, Plancalc (a spreadsheet) and a word processor. Much of this software was developed in Melbourne specifically for the CM202."[418]

A front-page article in the *Pacific Computer Weekly* of 12 September 1975 described the new Australian minicomputer at length, and included an interview with Computer Manufacturers (Australia)'s managing director Mike Rydon, who predicted a manufacturing capacity of 20 to 30 machines a year.[419]

Computer Manufacturers (Australia) reached this target, selling machines into its existing accounts around Australia, primarily as a total system including application software. According to Rydon, the CM202 had taken four years and A$2.9 million to develop.[420]

In 1983 CMAD released a much more

substantial machine that used the Motorola 68000 microprocessor, the CM2. But the costs involved in its development sent the company into receivership the following year.[421]

OWEN HILL AND THE MICROBEE

In 1975, electrical engineer Owen Hill, based in Gosford on the NSW Central Coast, founded Applied Technology, a company that sold electronic components by mail order. It sold 2,000 kits for a video card designed by hobbyists Stephen Dennis and David Griffiths, suitable for microcomputers that used the S-100 peripherals bus.[422]

Dennis and Griffiths followed this with a

microprocessor card that used the Zilog Z80 microprocessor, which was very popular at that time. These also sold well, and Hill suggested they use the expertise they had gained to build the MicroBee, a complete computer specially designed for the education market.

In April 1982, Applied Technology and Apple were awarded substantial contracts to supply computers to NSW schools. Hills describes how it happened.

- ¨Key teachers in NSW Education already used Applied Technology computers and suggested we tender. It was not really a hard fight. I am sure we would have produced the MicroBee anyway, but it would not have been nearly as successful.
- ¨The first 1,000 MicroBees were sold as kits with a A$100 service and support option, but many customers bought the kit and left A$100 to have it built. It didn't take long to understand what the market required.¨[423]

Fully assembled MicroBees soon followed, for $399. By August 1982, Applied Technology was making almost 1,000 of the machines a month.

Other states followed the example of NSW, and within a few years more than 3,000 Australian schools were using MicroBees. Many were also exported – they become a standard microcomputer in Swedish schools.

Over the next five years, the company more than doubled each year, listing on the Australian Stock Exchange in 1985. During this period it also developed new models for the business market: the Telecomputer and the Gamma (a Motorola 68000–based graphics workstation).

But it was not to last. Competition from cheap IBM PC clones meant that the Microbee was no longer competitive, and the company went into receivership in 1990. The MicroBee remains one of Australia's most successful computers, selling more than 70,000 units worldwide.[424] Even today, there is an active Microbee Software Preservation Project (www.microbee-mspp.org.au).

THE DULMONT MAGNUM AND TIME OFFICE COMPUTERS

Australia was home to the first laptop computer, the Dulmont Magnum, released in 1983 and later known as internationally as the Kookaburra. It was designed and built by Dulmison, an electrical equipment manufacturing company based in Wyong, NSW.

The Magnum was conceived by three Dulmison executives – including Alex Paine, an international development manager – during a 1979 trip to the US.

- ¨I was travelling in a car across Alabama with Dulmison's MD Clive Mackness and the newly appointed US General Manager Colin Morriss. We were discussing how to store the data on the business cards that we had collected and decided it would be possible to produce business cards with a magnetic strip and wipe the card through a calculator similar to the scientific calculator produced by Texas Instruments. It was Thursday, 24 May 1979.¨[425]

What was conceived as a 'storage calculator' grew into a portable microcomputer. Dulmison first approached Hewlett-Packard and Texas Instruments with the idea, but was turned down and decided to build a machine on its own, forming a subsidiary called Dulmont Electronic Systems for this express purpose.

Much of the push to design a very compact computer came from Graham Hellestrand, one of Australia's first microchip designers, who ran the VLSI (very large-scale integration) research facility at the University of NSW. In 1980 Dulmison hired him as head of research and development.[426]

Hellestrand brought to the project a very important design philosophy: the idea of designing the exterior casing first. That

meant that the engineering team, led by John Blair, had to design the circuitry to fit the box, at a time when designing the exterior of the computer was always an afterthought.[427] The end result was a portable computer that weighed 4.8 kilograms and could be carried in briefcase. It was the world's first truly portable computer.

The original machine used a 16-bit Intel 80186 microprocessor, the first microcomputer to do so. It had a sophisticated power management system and a small screen that folded back over the full-sized keyboard. Applications such as a word processor (Magwriter) and spreadsheet (Magcalc) were installed on removable EPROM (electrically erasable programmable read-only memory) modules, with external floppy drives available as an option. It also plugged into an external video monitor. The base model cost $2,995.[428]

The Magnum was a sensation, especially in Europe. But it suffered from being incompatible with the IBM PC, and from Hewlett-Packard and Sharp releasing similar machines shortly afterwards (the HP110 and PC-5000, respectively).

Like many Australian computer companies, Dulmont was undercapitalised and unable to invest sufficient funds into marketing or further product development. In 1984, Time Office Computers acquired the company for $1 million, using funds lent to it by the NSW Government for that purpose.[429]

Michael Roberts had founded Sydney-based Time Office Computers, originally called Electronic Control Systems, in the 1970s, intending to develop and market small computer terminals.

In 1983, Time Office Computers developed a new terminal called the 5600 – which had extensive networking capabilities – and made a large sale to the ATO, which was just implementing a major new project, the Prescribed Payments System. The 5600, marketed as the Emu, was an ergonomic terminal, supposedly designed by Ferdinand

MORE INFORMATION

Unfortunately, much of the subject matter in this chapter is not well documented. There is quite a bit about Microbee available from various sources – the Microbee Software Preservation Project (**www.microbee-mspp.org.au**) is a good starting point.

Porsche. Apart from its sculpted keyboard it took up no desk space, as the screen was mounted on a retractable arm. Meanwhile, Time Office Computers continued to develop the Magnum, now renamed the Kookaburra for the international market.

The Emu terminal was a big hit, but Time Office Computers ran into trouble with its next-generation 6000 series terminal. In 1985, the ATO refused to pay the agreed $2 million because of what it considered the 6000 series' 'unsatisfactory design'. In litigation with its largest customer and beset by financial difficulties, the company closed in 1987. The Dulmont Magnum (Kookaburra) died with it.

PERSONAL COMPUTING —
THIS CHANGES EVERYTHING

THE MICROCOMPUTER REVOLUTION THAT BEGAN IN THE 1970s COMPLETELY CHANGED THE FACE OF THE MODERN COMPUTER INDUSTRY.

22

In the late 1970s and into the 1980s, the balance of power in the computer industry changed forever. Computing moved from the organisation to the individual, with the arrival of the appropriately named personal computer – often abbreviated to PC and sometimes called the microcomputer. The revolution began in the 1970s with the technology that made it all possible: the microprocessor, conceived by Intel at the very beginning of the decade.

Intel was founded in 1968 by pioneers Robert Noyce and Gordon Moore, two engineers who had left Fairchild Semiconductor to start their own semiconductor-based computer memory business. Semiconducting materials have the ability to switch electric currents, and as such are the basis of all transistors – a technology that was invented at Bell Labs in 1947 and by the late 1950s was used to replace vacuum tube valves in computers.

In the 1960s, Fairchild Semiconductor was one of the major transistor manufacturers in the US. It developed the first commercially available integrated circuit in 1959, combining multiple transistors onto a single chip. The concept was pioneered by Texas Instruments's Jack Kilby, but it was Robert Noyce at Fairchild Semiconductor who made it a commercial success by developing a new production process.

Fairchild Semiconductor's integrated circuits were a great success, but increased competition and management differences saw sales decline. Noyce and Moore decided to leave and start the company that became Intel. They were joined by Andrew 'Andy' Grove, who would go on to become Intel CEO and one of the leading figures in the industry throughout the 1970s and the 1980s.

The new company was an immediate success. Its memory chips sold well, but the real breakthrough came in1971, when Intel engineers Marcian Hoff and Federico Faggin developed the first microprocessor, the 4004.

Computers are essentially a series of switches. The very first switches were mechanical; valves made electronic computing possible in the 1940s. The next step was transistors – so-called solid-state switches. Then followed integrated circuits, which combined a number of transistors onto a single silicon chip.

In 1970, Hoff and Faggin took this idea a step further. By

"NOT ONLY IS THE COMPUTER FUN, IT ALSO PROVIDES A WIDE VARIETY OF USEFUL TASKS. SOMEHOW, THE IDEA ABROAD IS THAT COMPUTER ACTIVITIES ARE UNCREATIVE AS COMPARED TO SAY, ROTATING CLAY AGAINST YOUR FINGERS UNTIL IT BECOMES A POT – THIS IS CATEGORICALLY FALSE. COMPUTERS INVOLVE IMAGINATION AND CREATION OF THE HIGHEST LEVEL."

RUDI HOESS, 1978

putting multiple solid-state logic circuits onto a single chip, they could program it to perform multiple different tasks. If they could combine enough of them, the chip could act as a general-purpose computer processor.

The 4004, which contained 2,300 transistors, was developed as a cheap way to build handheld calculators. It was a not an immediate success, mainly because nobody really knew what to do with it. But sales picked up as its flexibility became apparent. In 1972 Intel released a successor, the 8008, which was used in the design of the Datapoint 2200 programmable terminal in 1972 (see Chapter 20). Then came the 8080, released in 1974. The 8008 and the 8080 would start a revolution.

THE BIRTH OF THE MICROCOMPUTER

In July 1974, US magazine *Radio-Electronics* announced the Mark 8, 'Your Personal Minicomputer'. It was designed by Jonathan Titus – a postgraduate student at the University of Virginia – around Intel's 8008 microprocessor. Undeterred by the fact that instructions were required to set it up,

thoUSnds of enthusiasts placed their orders.

Its success inspired rival magazine *Popular Electronics* to announce the 'World's First Minicomputer Kit to Rival Commercial Models' in its January 1975 issue. The device, the Altair 8800, was designed by Ed Roberts, who ran Micro Instrumentation and Telemetry Systems (MITS), a small electronics company in Albuquerque, New Mexico.

MITS sold Altair kits for less than US$400, at a time when the cheapest DEC PDP-8 minicomputer cost more than 10 times as much. Roberts was swamped with orders, and the microcomputer revolution began.

One of the Altair's great strengths was its open architecture. Roberts deliberately designed it so that others could add to it by developing plug-in cards. As sold by MITS, the device was very limited, but hobbyists and small companies all over the country soon began developing their own hardware and software.

Among these enthusiasts were Paul Allen and Bill Gates, two Harvard undergraduates who had been playing with computers since their high school days in Seattle, Washington. Allen noticed the Altair story in the magazine and suggested writing a BASIC interpreter for it. (BASIC was a simple language that simplified computer programming.)

Allen rang Roberts in Albuquerque offering him the BASIC compiler, which they had not actually written yet. Gates wrote the compiler in six weeks, and the duo drove to New Mexico, Gates finishing the software in the parking lot before their meeting with Roberts.

The compiler worked, and Gates and Allen dropped out of Harvard to start a company they called Micro-Soft, around the corner from MITS in Albuquerque. Soon after, they dropped the hyphen from the company name and moved their small company back to their hometown of Seattle. Microsoft would become the largest microcomputer software

company in the world.

The Altair spawned a host of imitators. Computer clubs sprang up across the world. The most famous, located in the area south of San Francisco that had already become known as Silicon Valley, was the Homebrew Computer Club. Two of the club's most active members – Steve Wozniak and Steve Jobs – had teamed up in 1975 to build a little computer called the Apple I, powered by the 6502 microprocessor from a small Silicon Valley semiconductor company called MOS.

The Apple I was moderately successful, so the two Steves decided to go into business. Jobs sold his VW microbus and Wozniak his Hewlett-Packard calculator, and once they had borrowed another US$5,000 from a friend, they were in business. They soon attracted the attention of venture capitalist Mike Markkula, who believed that microcomputers were the next big thing. He was right.

Apple released the Apple II in the middle of 1977, about the same time as commercial designs were being released by Tandy (the TRS-80) and Commodore (the PET). But the Apple II outsold them both thanks to its aesthetic design and simpler user interface. Apple went public in 1980 in the most successful float in Wall Street history. That was the year *Time Magazine* named the microcomputer 'Man of the Year'.

Yet the revolution had hardly begun.

THE IMPORTANCE OF MOORE'S LAW

Intel's Gordon Moore is famous for the eponymous Moore's Law, which states that the increasing number of transistors that could be squeezed onto an integrated circuit would ensure a doubling of performance every 18 months or so.

He first set out this thesis on the 25th anniversary edition of *Electronics Magazine*, published in April 1965, well before he and Bill Noyce had started Intel.

- ■ "The complexity for minimum component costs has increased at a

MOORE'S LAW: THE NUMBER OF TRANSISTORS ON INTEGRATED CIRCUIT CHIPS, 1971–2016

Transistor count

Year of introduction
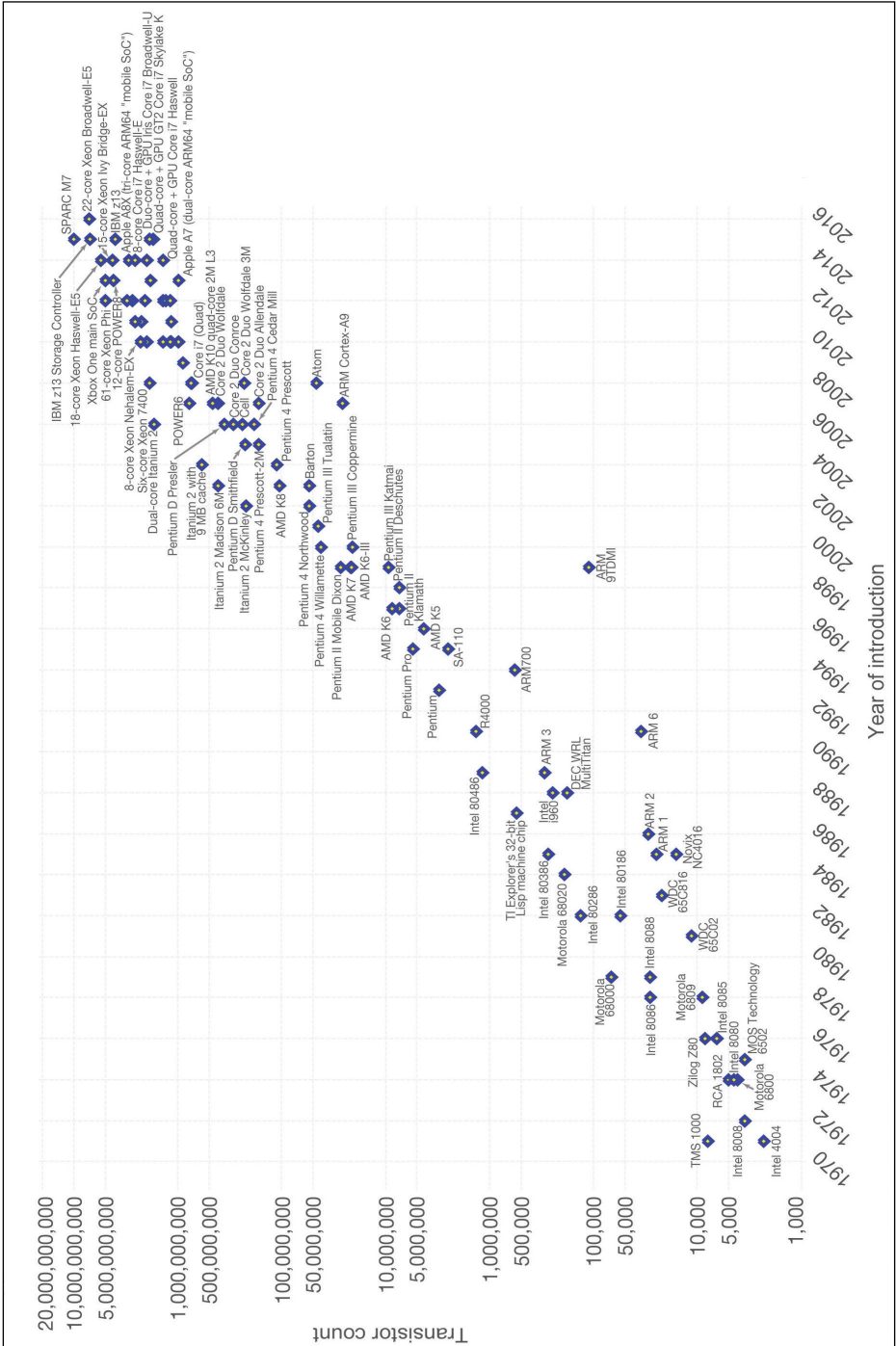
SOURCE: WIKIMEDIA COMMONS AND OUR WORLD IN DATA

rate of roughly a factor of two per year. Certainly, over the short term this rate can be expected to continue, if not to increase. Over the longer term, the rate of increase is a bit more uncertain, although there is no reason to believe it will not remain nearly constant for at least ten years."[430]

Moore's Law became famous in the computer industry – and a target for microprocessor designers and manufacturers. The chart at left shows how remarkably accurate it has been over the course of four decades.

Many commentators have remarked that Moore' Law must eventually be repealed, but new manufacturing technologies have always ensured it remains relevant. The exponential growth in performance that it predicts has ensured that even the smallest computers today rival the power of 1960s mainframes.

Moore' Law is relevant to all classes of computer, and from the 1970s helped microcomputers become increasingly more powerful, even as their cost plummeted. Intel remained the major supplier of microprocessors to the industry, its original 8080 architecture evolving into the 8086 and then the x86 architecture – still in common use today in vastly more powerful forms.

RUDI HOESS BRINGS THE APPLE II TO AUSTRALIA

The burgeoning microcomputer market in the US caught the attention of Australian entrepreneur Rudi Hoess. In 1976 he started Electronic Concepts, a company that imported and sold calculators and microcomputer boards.[431] He soon raised his sights higher.

Hoess was a German electrical engineer who had come to Australia in 1961 with Italian computer company Olivetti. He subsequently worked in a number of computer companies in Australia and around Asia, and through his company Datanamics was one of the pioneers of key-to-disk technology in Australia.

During a visit to the US in March 1977, Hoess bought four Apple II computers and imported them into Australia. They were the country's first microcomputers, not counting a few kits imported by individual enthusiasts. In November of that year, Electronic Concepts opened the first Australian ComputerLand franchise in Sydney, on the corner of Margaret and Clarence Streets near Wynyard in the central business district.

ComputerLand was a major success story in the early years of microcomputing. The first few microcomputers had done well and had attracted the interest of US retailers. The most successful were Byte Shop and ComputerLand (originally Computer Shack), both of which began in California in 1976.

ComputerLand founder William Millard developed a successful franchise model, and had 200 stores across the US by mid-1977.[432] By the time Millard retired in 1985 as one of the first computer industry billionaires, there were more than 800 stores around the world.

On his seminal March 1977 trip to the US, Hoess, a self-confessed workaholic and a consummate salesperson, managed to acquire the exclusive Australian distributorship rights to Apple computers and the ComputerLand franchise.

He had to pay a substantial deposit to ComputerLand, which he later said "paid everybody's salary in the US operation for a few months".[433] At that time both ComputerLand and Apple were very small operations in the US, and had little interest in the international market. But Hoess had big plans.

He was the right person at the right time. Other microcomputers also came onto the Australian market – Tandy's TRS 80, sold through Tandy RadioShack stores; the Exidy Sorcerer, sold by Dick Smith Electronics; and Commodore's PET 2001. Hoess also imported a range of other

The home computer that's ready to work, play and grow with you.

Clear the kitchen table. Bring in the color T.V. Plug in your new Apple II,* and connect any standard cassette recorder/player. Now you're ready for an evening of discovery in the new world of personal computers.

Only Apple II makes it that easy. It's a complete, ready to use computer—not a kit. At $1298, it includes features you won't find on other personal computers costing twice as much.

Features such as video graphics in 15 colors. And a built-in memory capacity of 8K bytes ROM and 4K bytes RAM—with room for lots more. But you don't even need to know a RAM from a ROM to use and enjoy Apple II. It's the first personal computer with a fast version of BASIC—the English-like programming language—permanently built in. That means you can begin running your Apple II the first evening, entering your own instructions and watching them work, even if you've had no previous computer experience.

The familiar typewriter-style keyboard makes communication easy. And your programs and data can be stored on (and retrieved from) audio cassettes, using the built-in cassette interface, so you can swap with other Apple II users. This and other peripherals—optional equipment on most personal computers, at hundreds of dollars extra cost—are *built into* Apple II. And it's designed to keep up with changing technology, to expand easily whenever you need it to.

As an educational tool, Apple II is a sound investment. You can program it to tutor your children in most any subject, such as spelling,
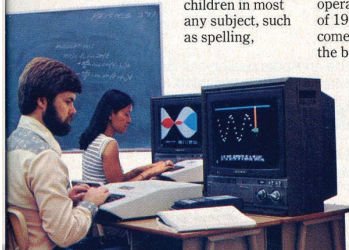
history or math. But the biggest benefit—no matter *how* you use Apple II—is that you and your family increase your familiarity with the computer itself. The more you experiment with it, the more you discover about its potential.

Start by playing PONG. Then invent your own games using the input keyboard, game paddles and built-in speaker. As you experiment you'll acquire new programming skills which will open up new ways to use your Apple II. You'll learn to "paint" dazzling color displays using the unique color graphics commands in Apple BASIC, and write programs to create beautiful kaleidoscopic designs.

As you master Apple BASIC, you'll be able to organize, index and store data on household finances, income tax, recipes, and record collections. You can learn to chart your biorhythms, balance your checking account, even control your home environment. Apple II will go as far as your imagination can take it.

Best of all, Apple II is designed to grow with you. As your skill and experience with computing increase, you may want to add new Apple peripherals. For example, a refined, more sophisticated BASIC language is being developed for advanced scientific and mathematical applications. And in addition to the built-in audio, video and game interfaces, there's room for eight plug-in options such as a prototyping board for experimenting with interfaces to other equipment; a serial board for connecting teletype, printer and other terminals; a parallel interface for communicating with a printer or another computer; an EPROM board for storing programs permanently; and a modem board communications interface. A floppy disk interface with software and complete operating systems will be available at the end of 1977. And there are many more options to come, because Apple II was designed from the beginning to accommodate increased power and capability as your requirements change.

If you'd like to see for yourself how easy it is to use and enjoy Apple II, visit your local dealer for a demonstration and a copy of our

Apple II™ is a completely self-contained computer system with BASIC in ROM, color graphics, ASCII keyboard, lightweight, efficient switching power supply and molded case. It is supplied with BASIC in ROM, up to 48K bytes of RAM, and with cassette tape, video and game I/O interfaces built-in. Also included are two game paddles and a demonstration cassette.

SPECIFICATIONS
- **Microprocessor:** 6502 (1 MHz).
- **Video Display:** Memory mapped, 5 modes—all Software-selectable:
  · Text—40 characters/line, 24 lines upper case.
  · Color graphics—40h x 48v, 15 colors
  · High-resolution graphics—280h x 192v; black, white, violet, green (16K RAM minimum required)
  · Both graphics modes can be selected to include 4 lines of text at the bottom of the display area.
  · Completely transparent memory access. All color generation done digitally.
- **Memory:** up to 48K bytes on-board RAM (4K supplied)
  · Uses either 4K or new 16K dynamic memory chips
  · Up to 12K ROM (8K supplied)
- **Software**
  · Fast extended Integer BASIC in ROM with color graphics commands
  · Extensive monitor in ROM
- **I/O**
  · 1500 bps cassette interface
  · 8-slot motherboard
  · Apple game I/O connector
  · ASCII keyboard port
  · Speaker
  · Composite video output

Apple II is also available in board-only form for the do-it-yourself hobbyist. Has all of the features of the Apple II system, but does not include case, keyboard, power supply or game paddles. $798.

PONG is a trademark of Atari Inc.
*Apple II plugs into any standard TV using an inexpensive modulator (not supplied).

detailed brochure. Or write Apple Computer Inc., 20863 Stevens Creek Blvd., Cupertino, California 95014.

Circle 4 on inquiry card.

apple computer inc.

ABOVE: Early Apple II ad, 1977 - CREDIT APPLE

early microcomputers, but these were not successful and became less important as the Apple II rose to popularity.

All the early microcomputers use standard cassette tapes for data storage. They were cheap, but slow and unreliable. In 1978, Apple's Wozniak designed an innovative interface for the Apple II that would allow it to connect to an inexpensive disk drive.

With a capacity of 113 KB, the Apple disk drives were the first random-access mass storage devices for any microcomputer, transforming the Apple II from hobbyist gadget to viable business device. Another major factor in the Apple II's success was the release of VisiCalc in late 1979, the first spreadsheet program (see below).

Apple II sales boomed in Australia and worldwide. In 1978, Electronic Concepts sold a hundred Apple IIs in Australia; and in 1979, 1,000.[434] By early 1981, there were six ComputerLand stores in Australia and 33 other Apple dealerships.[435]

Hoess's Electronic Concepts kept its monopoly on Apple sales in Australia for some time. It acted as a wholesaler to a growing group of microcomputer retailers, using its privileged position to demand upfront payments. 1981 in 1982 were boom years for the Apple II in Australia, before the IBM PC entered the market (see below). In late 1982, Apple set up a direct subsidiary in Australia and paid Hoess a considerable sum to buy back its distribution rights.

Electronic Concepts closed in 1984; Hoess's arrangement with Apple Australia had prevented him from marketing or retailing computers in Australia. After a short stint back in Asia, he started a company called Megavision, selling printers and monitors into the Australian market[436], but with nowhere near the success he had had with Electronic Concepts. Under Managing Director David Strong, Apple Australia became one of the company's most successful international subsidiaries.

VISICALC AND THE BIRTH OF MICROCOMPUTER SOFTWARE

Like larger computers, microcomputers need software to make them useful. The first microcomputers had very little of it, and computer hobbyists had to write their own. Gradually, software packages came into existence, but most were very limited in their functionality.

The big breakthrough came in November 1979, when Dan Bricklin invented VisiCalc. Initially written for the Apple II, VisiCalc and its many imitators revolutionised accounting and financial management to the extent that today it is impossible to imagine a world without spreadsheets.

Bricklin had the idea for VisiCalc while studying for an MBA at Harvard University.[437] His professors had described large blackboards divided into rows and columns that were used for production planning in large companies[438], a task that he felt should be automated.

Bricklin shared his idea with Daniel Fysltra, a Harvard graduate who had recently started Personal Software, a microcomputer software company. Together, they wrote VisiCalc on an Apple II and released it in October 1979. It was an immediate sensation, shipping 500 copies a month at first but quickly rising to 12,000 a month in 1981.

Although rudimentary by the standards of today's spreadsheets, VisiCalc completely changed the way people did financial analysis. Soon, large companies were buying Apple IIs by the dozen just to run VisiCalc. With the release of Mitchell 'Mitch' Kapor's Lotus 1-2-3 for the IBM PC (see below), the spreadsheet became a standard microcomputer application.

VisiCalc came to Australia in November 1979 in Rudi Hoess's hand luggage after one of his frequent trips to the US. He assembled his sales team at ComputerLand in Sydney and told them it would change the world.[439] It certainly improved the fortunes of the

THE SUCCESS OF THE APPLE II AND OTHER EARLY MICROCOMPUTERS PERSUADED IBM TO ENTER THE MARKET. IN JULY 1980, WILLIAM 'BILL' LOWE, HEAD OF IBM'S ENTRY-LEVEL SYSTEMS DIVISION IN THE US, MADE A PRESENTATION TO IBM SENIOR MANAGEMENT ABOUT WHY THE COMPANY SHOULD MAKE A MOVE INTO MICROCOMPUTERS.

Apple II in Australia; word of its capabilities spread quickly and in early 1980 Hoess and Australia's Apple II network of dealers were selling hundreds of the machines on the back of VisiCalc.

The other key microcomputing application was the word processor. Word processors evolved from typewriters rather than computers, but with the advent of the microcomputer the two technologies merged. The first word processor was IBM's MT/ST (Magnetic Tape/Selectric Typewriter) released in 1964[440], which fitted a magnetic tape drive to an IBM Selectric electric typewriter.

In 1972, word processing companies Lexitron and Linolex introduced machines with video displays that allowed text to be composed and edited on screen. The following year, Vydec introduced the first word processor with floppy disk storage. All these early machines and the many that came afterwards from companies like Lanier and NBI (which stood for Nothing But Initials), were dedicated word processors – the instructions were hardwired into the machines.

The first word processing program for microcomputers was Electric Pencil, developed by Michael Shrayer for the MITS Altair in 1976. It was very rudimentary. The first to be commercially successful was WordStar, developed in 1979 by Seymour Rubinstein and Rob Barnaby.[441] WordStar used a number of cryptic commands, but it had all the power of a dedicated word processor.

The Apple II was initially unsuited to word processing because its display only accepted up to 40 uppercase characters. A market developed for add-in cards that would enable the Apple II to display upper and lowercase characters across 80 columns. The most successful of these in Australia was designed and sold by suburban Sydney Apple dealership Zofarry Enterprises. An Australian-designed word processing

ABOVE: The IBM PC - CREDIT IBM

program called Zardax was the market-leading word processor on the Apple II.

By the time the IBM PC was released in 1981, PCs and word processing machines had all but converged in technology and appearance. It took some time before word processing software caught up with dedicated machines in functionality, but they won the battle on price performance immediately. All the dedicated word processing companies were out of business by 1990.

Spreadsheets and word processors led the way, but there were many other types of PC applications. PC databases became popular; dBase II and its successors dBase III and dBase IV were the leading product for most of the 1980s. The growth of the microcomputer software industry during the decade mirrored the growth of mainframe and minicomputer software in the 1970s (see Chapter 20). Leading companies of the era included WordPerfect, Lotus (acquired by IBM in 1995), Ashton-Tate, Borland and, of course, Microsoft.

ENTER IBM

The success of the Apple II and other early microcomputers persuaded IBM to enter the market. In July 1980, William 'Bill' Lowe, head of IBM's entry-level systems division in the US, made a presentation to IBM senior management about why the company should make a move into microcomputers. More importantly, he suggested how this could be done.

The key to moving quickly, said Lowe, was to use standard components. This was a major departure for IBM, which normally designed and built everything itself. There was no time for that, argued Lowe. Management agreed, and he was told to make it happen.

The IBM PC was given the name Project Chess, and the machine itself was internally called the Acorn.[442] A triumph of outsourcing, the machine was ready in less than a year. The microprocessor was an Intel 8088; Microsoft supplied the operating system and a version of the BASIC programming language; disk drives (just two low-capacity floppy drives) came from Tandon; printers from Epson; power supplies from Zenith; and there were third-party applications including a word processor and spreadsheet program.

Many in IBM were uncomfortable with the idea of getting involved in the personal computer market. One famous internal memo warned that it would be 'an embarrassment' to IBM.[443] The doubters were quickly proved wrong; within days of the machine's launch on 12 August 1981, IBM was forced to quadruple its production, struggling to keep up with demand. Businesses and consumers, previously wary of microcomputers, were both reassured by the IBM logo on their machines.

The IBM PC did not make it to Australia until 1992. Such was its success in the US that IBM simply had none to spare for international markets. As soon as it was introduced to Australia, it was as big a success as it was elsewhere in the world, and the microcomputer market changed irreversibly.

A brilliant advertising campaign featuring a Charlie Chaplin look-alike made the brand recognisable, enough for people to overlook the machine's lack of technological innovation. It worked and it was from IBM; that is all customers wanted to know.

IBM's decision to source the components from other manufacturers had far-reaching, if unintended, consequences. For one, it meant that anybody could copy the design and hundreds of companies did, making the IBM PC the industry standard. A huge industry of 'IBM clones' emerged, and for the first few years the big battle in the computer industry was over 'degrees of compatibility' with IBM peripherals.

Some companies, it seemed, were even more IBM-compatible than IBM, extending

WITHIN 18 MONTHS OR SO, THE PUBLISHING INDUSTRY WORLDWIDE WAS ALSO REVOLUTIONISED. TYPESETTERS AND PRINTERS WENT OUT OF BUSINESS BY THE THOUSNDS. PUBLISHING PROFESSIONAL-QUALITY NEWSLETTERS, POSTERS AND MAGAZINES WAS AT ANYONE'S FINGERTIPS AND FOR A FRACTION OF THE COST OF A FEW YEARS EARLIER.

the architecture even further. One such company, Compaq, grew out of a 1982 meeting in a Houston pie shop during which Rod Canion, a senior manager with Texas Instruments, sketched a picture of a portable IBM-like computer on a serviette.

The first Compaq computer, designed to be as portable as a sewing machine, hit the market just a few months later. By 1985 the company was in the Fortune 500, the fastest any company had ever gotten there.

But the most far-reaching consequences came from IBM's decision to license the PC's operating system, rather than buying or developing one itself. It initially called on a company called Digital Research, developers of the CP/M operating system used on many early microcomputers.

Gary Kildall, Digital Research's idiosyncratic founder, broke the appointment because he was out flying his plane.[444]. Irritated, IBM turned to Microsoft, another small company in Seattle it had heard might have a suitable operating system.

The problem was that Microsoft did not have an operating system – a fact Bill Gates hid from IBM. He quickly bought an operating system called QDOS (Quick and Dirty Operating System) from another small company, Seattle-based Computer Products, for US$50,000. Then he renamed it MS-DOS and licensed it to IBM.

The licensing deal was important. For every IBM PC sold, Microsoft received US$40. Microsoft, previously just another minor software company, was on its way up – and fast.

Realising his mistake, Kildall developed a rival to MS-DOS called DR-DOS. At the end of the 1980s it was far from certain which computer operating system – and which hardware architecture – would win out. Apple was still strong and the IBM PC was still dominant. But Apple faced challenges from Digital Research's DR-DOS and – more significantly – from IBM's OS/2.

THE APPLE MAC AND THE PC OPERATING SYSTEM WARS

IBM renamed the licensed version of MS-DOS it used, calling it PC-DOS.[445] After the astounding success of the PC, IBM realised it had made a mistake licensing Microsoft's operating system as this was where the battle for the hearts and minds of users was being fought. IBM decided to build its own PC operating system, which it called OS/2. It was a vastly superior operating system to MS-DOS, with a 'microkernel' that made it better at multitasking. It was built for the new era of microprocessors that were emerging.

It could also operate across architectures and across platforms. In its early days, Microsoft and IBM cooperated in developing OS/2, but Microsoft later withdrew to concentrate on Windows NT (New Technology). Microsoft out-marketed IBM, OS/2 subsequently died, and Microsoft started bundling its applications. The battle for the desktop became a one-horse race. IBM PC and its clones running Microsoft operating systems had 90 percent of the market; others – including Apple – lagged way behind.

During most of the 1980s, it seemed like Apple would fulfil its early promise, and perhaps become the dominant force in the PC industry. It answered the challenge from IBM's PC with the Macintosh, an innovative machine that brought the graphical user interface (GUI) to the people. The GUI had been invented at Xerox PARC (Palo Alto Research Center) years earlier, and Apple had already used it on its earlier ill-fated Lisa computer. But the Mac made it work.

Xerox – a photocopier company – had established PARC in 1970 as a centre for pure research. Its scientists were free to develop whatever they wanted. And develop they did.

Other significant inventions to come out of PARC include Ethernet (which remains the standard computer networking technology),

the computer mouse, the laser printer, object-oriented programming and the scientific workstation.

Xerox itself never commercialised any of these products. PARC has acted as a kind of giant research lab for the rest of the industry, training a generation of scientists to innovate and execute.

The GUI-based Macintosh was announced with a single advertisement during the 1984 Super Bowl TV broadcast.

The ad pictured a woman running at a screen with a sledgehammer, mounting the stage, and shattering the image of a Big Brother–type figure who had been indoctrinating the faceless masses. It was a sensation.

And so was the Macintosh. It was underpowered and lacked software, but these shortcomings were soon addressed and the Mac looked like it would live up to its early slogan: "The computer for the rest of us". Apple developed a low-cost laser printer – also invented at Xerox PARC – and the first piece of publishing software, and overnight the desktop publishing revolution was born.

Within 18 months or so, the publishing industry worldwide was also revolutionised. Typesetters and printers went out of business by the thoUSnds. Publishing professional-quality newsletters, posters and magazines was at anyone's fingertips and for a fraction of the cost of a few years earlier.

But Apple struggled to follow up. Unlike the IBM PC, the Macintosh had a closed architecture, which Apple protected closely. It refused to license its technology, which meant there were no direct competitors. Most importantly, its prices remained high. That did not matter at first because the technology was so superior, but gradually the PC caught up when Microsoft released a USble version of Windows in 1992, version 3.11.[446]

Apple came within an inch of merging with

AUSTRALIAN PC MARKET SHARE, 1985 (UNIT SHIPMENTS)

IBM PC
11%

IBM PC XT/AT
6%

APPLE II
13%

APPLE MACINTOSH
7%

APRICOT
8%

HP
6%

NEC
6%

SANYO
5%

OTHERS
38%
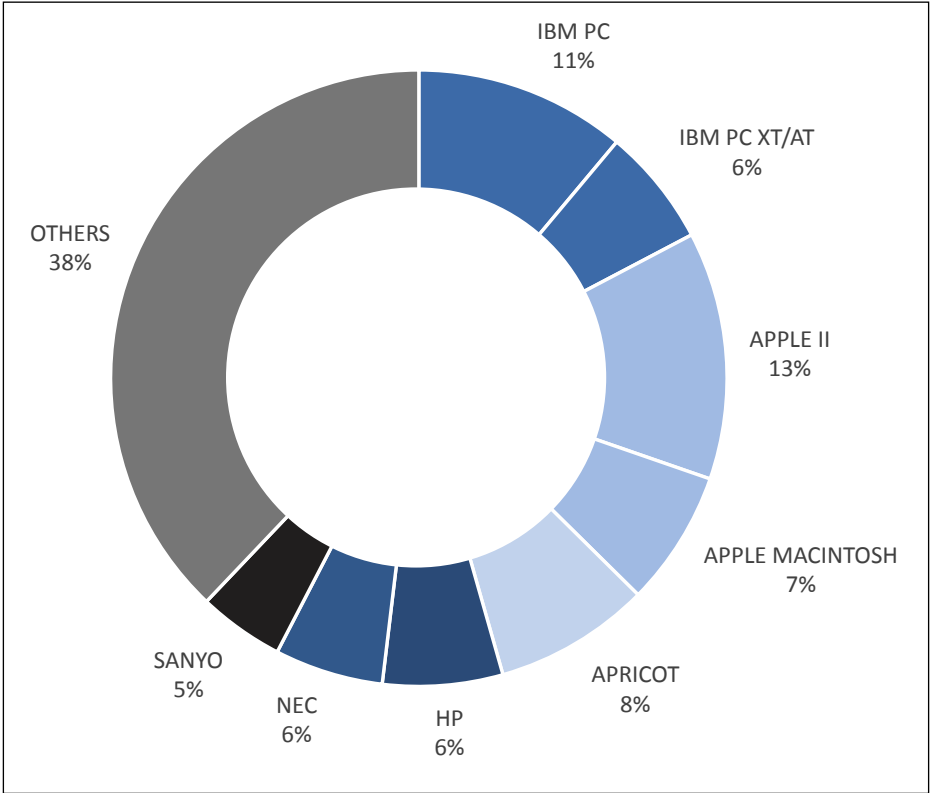
IBM in 1994, but when that fell through Apple was left with few friends beyond its declining band of loyal users. Apple would not rebound until the 2000s with the iPod and the iPhone (see Chapter 28).

At the beginning of the 1980s virtually no-one used microcomputers. By the end of the decade they were on almost every desk and in every office across the US. The growth of the PC industry during those ten years remains one of the most remarkable tales in both the history of business and the history of technology. Windows had won out over other desktop environments; Microsoft had out-marketed IBM and Apple had imploded. The scene was set for the industry's next big shake-up, the rise of the Internet (see Chapter 24).

THE STATE OF PLAY
IN AUSTRALIA IN 1985

A number of market research companies measured PC shipment figures in Australia in the 1980s, including Arthur Hoby and Associates, Focus, IDC and the Yankee Group. Their numbers differed because of their varying collection methods and the difficulty of obtaining exact data. But they all agreed that by 1985 IBM was leading the Australian market by value – and Apple by units, with about 100,000 units shipped that year. (IBM PCs were generally more expensive than Apple IIs.) Arthur Hoby published market share shipments for the year ended March 1985, by vendor, units shipped and dollar value. Another research firm, Focus, differed a little from these numbers, but broke down the IBM and Apple numbers by model type. Combining the two sets of data gives us the pie chart below.

Apple's Macintosh had a 7 percent market share in 1985, and the Apple II a 13 percent share – comprising mainly the newer II C and II E models, which were rarely used in business.

IBM PC–compatibles from Apricot Computers, HP NEC and Sanyo each had at least 5 percent market share, with the remainder taken up by a range of machines, virtually all of them IBM PC-compatible.

Major vendors such as DEC, Wang and Sperry had also entered the PC market, though none of them made much of an impression.

And two vendors that would become major PC players in the 1990s, Compaq and Dell, had only just been formed and had not yet entered the Australian market.

The PC software market in Australia was dominated by a few locally owned companies that distributed software from mostly US vendors. With the exception of Microsoft – which set up an Australian subsidiary in 1985 under Linda Graham – PC software companies were not normally large enough to have an Australian branch.

The largest Australian distributor of microcomputer software was Imagineering, founded by Jodee Rich. The company was the Australian distributor for leading software products from Lotus (the Lotus 1-2-3 spreadsheet product, a market leader on the IBM PC) and WordStar.

Imagineering floated on the stock market in 1987, but after the market crashed in November its market capitalisation virtually disappeared and it was sold to Hong Kong company First Pacific in 1990. (Rich later formed telecommunications company One. Tel, which failed spectacularly in the tech crash of the early 2000s.)

Other important distributors were Arcom Pacific, Sourceware and the Software Corporation of Australia (SCA). An important player in the late 1980s was Tech Pacific, at first half-owned by Imagineering.

The hardware and software markets were very competitive. Vendors and products came and went much more quickly than they had in the mainframe and minicomputer days. At the same time, the market was expanding quickly, mainly because of falling hardware prices. It was volatile.

THE VICTORY OF THE
WINTEL ARCHITECTURE

As the chart at left shows, Apple was selling more microcomputers in Australia than any other vendor as late as 1985. These sales were split between Apple II and the Macintosh – two very different architectures with very different markets.

Jobs was totally dedicated to the Macintosh and had no time for the Apple II, despite it being the cash cow that funded the Macintosh's development. The Apple II was essentially allowed to die despite the Macintosh never achieving the functionality, the range of software, nor the critical mass to compete against the juggernaut of the IBM PC–compatible architecture.

The Macintosh was popular in certain quarters – such as graphic design and

desktop publishing – but by the 1990s it had become a niche product. Intel-based IBM PC–compatibles running Windows – the so-called 'Wintel' architecture – were the standard machines in business throughout the 1990s.

The debates over standards of IBM compatibility faded as this architecture became the new standard. Two aggressive new suppliers out of Texas – Compaq and Dell – became dominant vendors using this architecture.

Compaq made its name with portable PCs, and Dell with cheap mail-order machines. The only major hardware vendor of the pre-PC period that succeeded in the microcomputer market was Hewlett-Packard, which would eventually acquire Compaq in 2001.

Microsoft supplied the operating system for the Wintel architecture, and it also became the dominant supplier of application software. In the 1980s, the leading spreadsheet software on IBM-compatible computers was 0Lotus 1-2-3, with Microsoft's Excel trailing just behind. Similarly with word processing, Microsoft's Word was well behind WordPerfect, the market leader at that time.

In 1988, Microsoft announced that all its desktop applications would be bundled together as Microsoft Office. This had little effect at first, but with the release of Windows 3.11 in 1993 and highly functional GUI versions of all Microsoft desktop applications, Microsoft gradually supplanted its rivals and the Microsoft Office applications rose to become market leaders.

Following Moore's Law, the continued commoditisation of PC hardware led to lower prices and smaller sizes – key factors that made the advent of the portable laptop computer possible. PCs were much more powerful and affordable, so much so that specialised workstations – powerful and expensive single-user machines – disappeared.

Intel microprocessors were increasingly used to power minicomputers, and many specialised processor architectures also ceased to exist.

MORE INFORMATION

The early history of the microcomputer revolution in the US is very well documented. Two excellent books are *Fire in the Valley* by Paul Freiberger and Michael Swaine, and *Accidental Empires*, by Robert X Cringely.

The story of the origins of microcomputing in Australia is unfortunately not nearly as well recorded. It deserves more attention than we have been able to give it in this book.

COMPUTERS AND SCHOOL EDUCATION

COMPUTING MOVED INTO SECONDARY AND PRIMARY SCHOOLS IN THE 1970s, AND EDUCATION BECAME ONE OF AUSTRALIAN COMPUTING'S MOST IMPORTANT SECTORS.

23

It was not until the early 1970s that computers started to appear in Australian schools, after teachers had a chance to become exposed to computing at university.[447] Trinity Grammar School in the Melbourne suburb of Kew was the first Australian school to own a computer when it purchased a DEC PDP-8/S in February 1970.[448]

That machine and other early school computers were mostly used by mathematics departments to teach programming and mathematical algorithm design. At this time programming classes were seen as the only worthwhile use of computers in schools, and they had very little impact on other subject areas.

In 1974, the Monash Educational Computer System (MONECS) was introduced, developed by a group of computer scientists at Monash University. MONECS was designed to teach Fortran in programming classes or BASIC in maths classes. It typically ran on a DEC PDP-11 minicomputer and used mark-sense cards for program and data entry.[449] Students used pencils to fill in the cards at school, and teachers delivered the completed cards to a local university for execution. The results were frequently disappointing, returning nothing more than a print-out listing a number of syntax errors. It often took students several attempts to get a program working properly.

Some TAFE colleges and centres for adult education made some use of computer-assisted instruction (CAI), as did a small number of technical secondary schools, but this did not continue for long.

THE ADVENT OF THE MICROCOMPUTER

The arrival of the Apple II and other microcomputers in 1977 (see Chapter 22) saw the beginning of real advances in the use of computers in schools. At around $2,000 in Australia, a 16 KB Apple II was almost affordable for most schools.[450] It used a cassette tape recorder as storage and a television set as a monitor – neither of which was supplied with the machine.

In the late 1970s and early 1980s, computer awareness courses began to appear in Australian schools, to help students learn how to talk sensibly about computers. In 1977, Watsonia High School in the northern suburbs of Melbourne obtained an Apple II microcomputer with 16 KB

THE WIDESPREAD AVAILABILITY OF A VARIETY OF HARDWARE HAS OPENED UP OPPORTUNITIES FOR SCHOOL[S'] USE OF COMPUTING THAT HAVE NOT PREVIOUSLY EXISTED, BUT AT THE SAME TIME HAS CAUSED A NUMBER OF PROBLEMS.

COMMONWEALTH SCHOOLS COMMISSION, 1983

ABOVE: Schools' Congress at the First Pan Pacific Computer Conference in 1985 CREDIT ARTHUR TATNALL

of RAM, a television monitor and a cassette tape deck as the result of a curriculum innovations grant submission to the Federal Government.

In 1979, Watsonia introduced a computer awareness subject into the core curriculum for Year 10. It ran for the full year and consisted of three parts, each entailing three periods per week over one term, delivered by the relevant teacher.

The course covered:

- How a computer works, computer programming, history of computer technology – taught by the science and maths teacher
- Business and commercial uses of information technology – taught by the commerce teacher
- The social implications of increased use of computers – taught by the social sciences teacher.

The subject was immediately popular with the students, most of whom were intrigued by the new technology. Parents also saw it as worthwhile, acknowledging the possibility of better jobs for their children if they learned how to use these new machines.

Watsonia's subject remained in place at the school until the late 1980s. Many other schools soon offered similar subjects as the personal computer (PC) revolution gathered pace.

COMMONWEALTH SCHOOLS COMMISSION'S COMPUTER EDUCATION PROGRAM

In 1983, the Australian Government's Commonwealth Schools Commission established the National Advisory Committee on Computers in Schools (NACCS) to provide leadership and funding for computer education across all Australian states and territories.[451]

In the 1984–1986 triennium, the Federal Budget allocated $18.7 million to the Commonwealth Schools Commission's Computer Education Program.

One goal of the program was to coordinate computer education facilities and offerings in each of the states and territories. In 1983, NACCS published its first blueprint for computer education in schools.[452] The *Teaching, Learning and Computers* report listed a number of possible uses for computers in schools, including:

- Computer awareness or computer literacy courses for upper primary and lower secondary levels, aimed at teaching students about computers, how they are used and the social effects of their use.
- Computer science, computer studies or information processing courses, for general computer knowledge.
- Broad curriculum inclusion in areas such as word processing, problem solving, information handling, simulation and modelling, educational games, spreadsheets, graphics, drill and practice, tutorials and electronic blackboards
- Curriculum support, including information retrieval, preparation of teaching materials and maintenance of student records
- Communication with other teachers and students, and interrogation of remote databases
- Administrative applications performed by ancillary staff members and teachers, for the normal business applications of database management, financial management and word processing.

STATE COMPUTER EDUCATION CENTRES

Secondary education in Australia is state- and territory-specific, so each government at that level adopted a different policy on computing in schools. Some states introduced computing early by installing a central minicomputer that could provide a computing service to multiple schools.

South Australia, Tasmania and Western Australia (the so-called TASAWA states) initially adopted this approach, which entailed establishing a computing centre with a staff that would operate the machine and provide support to teachers.

SOUTH AUSTRALIA

South Australia first became involved in computer education in 1968, when it established the Angle Park Computing Centre (APCC) in the northern suburbs of Adelaide. The APCC provided schools with a batch-card input system for teaching computer programming, and access to two extensive microcomputer networks.

It also loaned computer equipment to schools and produced curriculum materials and educational software. The APCC had an important role in recommending, ordering and installing computer hardware, and helping schools use computers for administrative tasks.

The South Australian Education Department had a School Computing Activities policy, which in part stated that:

- "Computing is an object of study in its own right. Computing provides the means of enhancing and extending traditional components of the school curriculum and computing and related technology have the potential to change the curriculum, the manner in which that curriculum is implemented and to improve the general organisational procedures used by schools."[453]

To implement this policy, the South Australian Education Department established a Schools Computing Section, which comprised professional staff, support staff and regional advisers, and maintained the APCC.

TASMANIA

Tasmania was also involved in educational computing early on, beginning with the introduction of a Year 12 Computer Studies course in 1972. It developed a statewide

time-sharing network for educational purposes (TASNET) and in the mid-1970s, set up the Elizabeth Computer Centre (ECC).

The ECC was involved in developing educational and administrative software for TASNET and microcomputers; providing expert computing advice to the Department of Education; and advising and training Tasmanian teachers.

In 1982, the ECC achieved national prominence with its First Fleet database, which contained personal details of all the convicts who came to Australia with the First Fleet. This software package was produced in conjunction with the Commonwealth Department of Science and Technology and was made available on CD – a very new technology at the time – to all Australian schools.

WESTERN AUSTRALIA

Western Australia also offered computer education before microcomputers were common. Policy on the educational use of computers in Western Australia was developed by the Department of Education Schools Computing Branch, which comprised six full-time professional staff members and five technical personnel.

The associated Schools Computing Centre advised schools about hardware, software and teaching matters; prepared and distributed computer software, teaching materials and curriculum guidelines; and ran a wide range of educational activities.

TASAWA

In 1981, South Australia, Tasmania and Western Australia began to formally cooperate in computer education, enabled by their common use of Acorn BBC Micro computers. Frustrated by a perceived lack of interest from the other states, they set up TASAWA to facilitate the sharing of software development and curriculum materials relating to computer education.

The states' frustration grew as it became

apparent the others were much less interested in adopting the Acorn BBC Micro as a standard, and were more inclined to support a disparate range of hardware including the Apple II. In 1983 the Commonwealth Schools Commission intervened and strongly discouraged the 'exclusive' TASAWA grouping.

NEW SOUTH WALES

As in Victoria, the New South Wales Department of Education was a little slow to formally sponsor the use of computers in schools. In 1983 it created a Computer Education Unit, based in Erskineville, to "provide a critical mass of expertise, combining complementary skills, and a visible focus for computer education activities and innovation to support work in schools and regions".[454]

The unit aimed to bring together curriculum development, consultancy support and in-service teacher education; advice on the selection of computer equipment for schools; and the evaluation, development and distribution of software and other resource materials.

NSW schools made early extensive use of the locally built, cassette-operated Microbee computer, a low-cost Australian designed and built CP/M machine.

The Apple II was also popular in NSW, while Acorn BBC Micros were not. This preference, along with the lack of any central operation before 1983, made cooperation with the TASAWA states unproductive.

Later, Computer Education Unit staff members expressed regret that in the 'early days', schools had been encouraged to purchase low-end microcomputers such as the cassette-operated Microbee and the Commodore C64.

The ideology of the time was that computer awareness was of primary importance, and purchasing as many low-cost machines as possible would at least give more students some access to computers. However, these large numbers of low-end machines quickly became a burden, hampering their effectiveness.[455]

VICTORIA

In Victoria, early developments in computer education began in the late 1970s, thanks to the efforts of a small number of maths, science and commerce teachers, and forward-thinking curriculum consultants. But it was some time before the Department of Education became interested. When computing in schools became popular in the early 1980s, the Department recognised that a central focus and control over computer education in the state were required. The result was the formation of the State Computer Education Centre (SCEC) of Victoria in 1984.[456]

The SCEC began life in temporary premises with 10 seconded staff members and in 1985 moved to a permanent location with six new senior roles: a Senior Computer Education Officer, a Software Coordinator, an In-service Education Coordinator, a Curriculum Coordinator, an Educational Computer Systems Analyst and an Equal Opportunity Officer, along with nine other positions.

Simultaneously, a Regional Computer Education Resource Centre (RCERC) was set up in each of the 12 regions covered by the Department of Education. A full-time teacher was seconded to act as Computer Resource Centre Manager, and each RCERC received four Apple IIe computer systems and a four-user Commodore 64 network.

The SCEC was set up to support computer systems beyond purely hardware, so software development was also an important component. Programming was no longer considered the only possible use of a computer and educational software began to grow in significance. The SCEC was also tasked with producing curriculum materials.

Moreover, the SCEC and RCERCs

were logically the best placed to provide professional development for Victoria's teachers. Professional development was especially important in the early days of the new curriculum, as few teachers knew much about using a computer or any of its educational possibilities. The development of SCEC and RCERCs resulted in a considerable centralisation and rationalisation of computer education resources in Victoria.

QUEENSLAND

Queensland's schools showed a preference for the Apple II, and the state government made no move to set up a computer education centre or to produce curriculum software. The state's most significant contribution to the field arguably came in during the mid-1980s, with the development of a new Year 12 information processing syllabus that used fourth-generation database query languages and conceptual schema. Most other computer science courses during this era were concerned with studying computer architecture, algorithms and programming in third-generation languages like Pascal or BASIC.

THE TERRITORIES

The Computing Services Section of the ACT Schools Authority was responsible for introducing and maintaining administrative and educational computer systems in ACT schools. It also managed the Deakin Computer Centre, which secondary colleges used for administrative purposes.

In a much later development, the Northern Territory in the mid-1980s set up its own Computer Education Unit to promote the use of computers in school administrative and educational applications. The unit had a stated policy encouraging the use of computers in education. These computer education centres in the Northern Territory and the ACT were both fairly low key.

RECOMMENDED COMPUTER SYSTEMS

The late 1970s and early 1980s saw a huge increase in the number of low-cost microcomputers on the market and available to schools (see Chapter 22). These included the Apple II, the Tandy TRS-80, the Commodore VIC-20, the Commodore 64, the Acorn BBC Micro, the Microbee, the Atari 400/800, the Sinclair ZX80 (and XZ81 and Spectrum), the Exidy Sorcerer, the DEC Rainbow 100 and the Hitachi Peach, as well as computers from Altos, Franklin ACE, Cromemco, Osborne, SEGA, Amstrad, Spectravideo, Apricot, Micromation, Pulsar and Olivetti.

The IBM PC and Apple Macintosh did not appear in Australian schools until the mid-1980s. The sheer volume of PCs available increased the need for coordination within and between states, to generate at least some sense of compatibility.[457]

All state and territory education authorities regularly went through a process of evaluating computer systems for educational use, and they each established a recommended list of computers. Government schools using Department of Education funds were required to purchase recommended systems in order to comply with government tender, offset and preferred supplier requirements.

In 1985 in NSW, the recommended computer systems were the Microbee, the Apple IIe, the Apple Macintosh, the Acorn BBC Micro Model B, the IBM JX, Tandy 1000 and the Sperry PC. In Victoria at the same time, the preferred machines were the Apple IIe and Macintosh; the Acorn BBC Master 128 and Model B; the Microbee; and the IBM JX. In other states and territories common recommendations were the Apple IIe, the Acorn BBC Model B, the Microbee and the Commodore 64.

THE AUSTRALIAN EDUCATIONAL COMPUTER

Australian schools initially used software from organisations like the Minnesota Educational Computing Consortium, but it typically had a US outlook and created cultural issues. One example was the Apple II simulation game 'Lemonade', based on making and selling lemonade from a street-side stall. While the game had some merit in terms of teaching students about mathematics and one aspect of doing business, lemonade stands are an almost unknown concept in Australia.

Likewise, a number of programs for the Acorn BBC computers were very British. Education authorities saw a need to develop Australian educational software – and a microcomputer on which it could run.[458] Along with reinforcing Australian culture, this project would bring the added advantage of having the new computer built in Australia, by an Australian company. Microbee was considered most likely to build this new machine.

Canada, New Zealand, Sweden and the UK had all designed and produced computers specifically for educational purposes, so a similar approach was considered worthwhile in Australia. In the UK and New Zealand, private industry developments had produced the Acorn BBC and the Poly respectively.

In Sweden, the government drove production of the Compis educational microcomputer, with the primary goal of assisting the local computer industry. In Canada, a similar process resulted in the development and production of the Unisys ICON, designed especially for use in schools.

The ICON was a sophisticated computer with high-resolution colour graphics, sound synthesis capabilities, 64 KB of RAM and a local area network form of architecture. A significant problem was lack of suitable educational software, as ICON was not compatible with either the Apple II or the Commodore PET (or later MS-DOS or Macintosh machines).

In Australia, the Commonwealth Schools Commission was made responsible for producing a set of educational user requirements and educational technical

requirements, while the Department of Science and Technology (DST) took charge of the systems concept study.[459] If no existing computers satisfied the educational technical requirements, the DST would draw up Australian design specifications and arrange for pilot and prototype systems to be manufactured.

The relevant committees each produced a report – *Australian School Computer Systems: Educational User Requirements*[460] and *Australian School Computer Systems: Technical Requirements*[461] – but the three years of funding for the National Computer Education Project was at an end and work on creating a truly Australian educational computer ground to a halt. Within a few years, the dominance of Apple Macintosh and MS-DOS (later Windows) PC meant it was probably fortunate that Australia did not create a white elephant like Canada's ICON.[462]

COMPUTING IN SCHOOLS IN THE 1980s AND 1990s

By the mid-1980s, it was widely acknowledged that school computers could be used for more than teaching computer programming. The disparity in microcomputer architectures was fast disappearing towards the end of the decade, and rationalisation around the IBM PC and the Macintosh continued into the 1990s.

By this time there were two major strands of computer use in Australian schools: the specific subject of computer science (typically offered in the last two years of secondary school), and the broader use of computers across other subject areas.

Computer science courses usually involved studying algorithms, learning to program in a language like Pascal and developing a general understanding of the machines themselves. There was often some discussion of computer use and the social implications of computing. The first subjects to use computers more broadly were

BELOW: A Tasman Turtle - CREDIT DENNING INTERNATIONAL
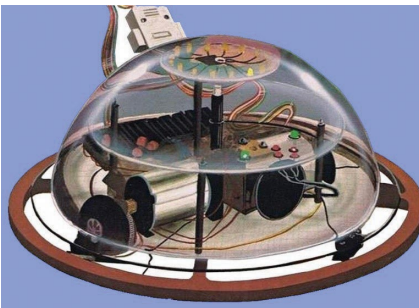
mathematics and commerce.

There was some use of computer-based simulations in general science and of databases in other subjects including social science (such as the First Fleet database, for example).

One important application, especially in some primary schools, was the programming language Logo, which involved using commands like FORWARD 10 and RIGHT 90 to move a the cursor around the screen. Logo could be used for other programming tasks and was related to the Lisp programming language, but few schools used it for this.

This was made more interesting to students by using a 'turtle', a hemispherical robot that could be made to move around the floor of the classroom. This was before the days of Wi-Fi, so the 'turtle' was connected by a cable to the computer.

The robot turtles were available from a number of overseas companies but the one most used in Australia was the locally built Tasman Turtle. In the late 1980s and 1990s, Lego produced Lego Technic Control, a robotics kit that made use of a programming language rather like Logo.

The use of computers in educational administration began to grow from the mid-1980s onwards. This involved programs written by local school teachers for tasks like managing school sports, producing student reports and recording attendance. State education authorities soon produced their own administrative packages to manage school finances and school reporting.

In the late 1980s, teachers of secretarial studies came to the significant realisation that the typewriter was now a thing of the past and they should move to word processors.

The computer also became popular with commerce teachers who increasingly used spreadsheets, but despite being involved at the beginning, fewer maths teachers were using computers.

Towards the end of the 1980s, a conflict arose between those who thought that teaching about computing was important and those who thought that only using computers in school subject areas was worthwhile. Much of this conflict was due to disagreements on how best to use the relatively small number of computers in each school. Email use began in the second half of the 1980s and grew rapidly. At this stage the Internet was still text-based, making it quite difficult to use in an education setting, but the arrival of the Web in the 1990s saw computer use in schools skyrocket (see Chapter 28).

COMPUTER EDUCATION GROUPS AND THE ACS SCHOOLS CONGRESS

In the late 1970s, a group of teachers, academics and teacher educators formed the Computer Education Group of Victoria (CEGV). It was not long before other states set up their own similar computer education groups and eventually the Australian Council for Computers in Education (ACCE) was established as a national coordinating group. These groups all ran conferences, held meetings and provided professional development opportunities for teachers. ACCE ran regular national conferences in different state capitals.

The Australian Computer Society (ACS) supported school-based computing from the outset. It was especially interested in computer science and associated aspects that might potentially lead to careers in computing, but also advocated for the use of computers in other subject areas. In the 1980s, the ACS ran several schools' congresses, with the aim of giving student participants a broader view of the role of computers in the business community and industry. Topics at these congresses included careers in computing, computers in the business world, desktop publishing, artificial intelligence, expert systems, computers in the sciences, computers

and music, and robots. The speakers were computer industry practitioners. Schools' congresses were run in conjunction with the First Pan Pacific Computer Conference (PPCC-1)[463] and the Australian Computer Conference (ACC-87)[464] in Melbourne.

Perhaps the biggest change to school-based computing has been the availability of mobile computing through the use of mobile phones and tablet computers such as the iPad. Some primary schools now require parents to purchase iPads for students to use both at school and at home.

One of the latest developments is the teaching of coding, which claims to assist with 'computational thinking', seen as a fundamental set of skills that all students need to be prepared for the future real-world challenges A Lego kit encourages coding using building bricks, aiming to "encourage students to explore, build, code, test and refine solutions to engaging STEM challenges".[465] Some schools use MIT Media Lab's Scratch programming language in a similar way.

Far from the novelty experiment it was in the 1970s, computer use is now commonplace – even omnipresent – in all types of schools, for all types of applications.

FROM DATA COMMUNICATIONS
TO THE INTERNET

IN THE 1960s, COMPUTERS STARTED TO TALK TO EACH OTHER. IN A COUNTRY AS LARGE AS AUSTRALIA, DATA COMMUNICATIONS WERE ALWAYS GOING TO BE IMPORTANT.

24

Data communications, a very important technology today, had their origins in the 1950s with the US Military's Semi-Automatic Ground Environment (SAGE), based on large, purpose-built IBM mainframes. The first commercial computer network was the Semi-Automated Business Research Environment (SABRE), a reservation system built by IBM for American Airlines in 1960. Both systems were closed and proprietary.

In the 1960s, numerous researchers at US universities experimented with computer networks. There was also substantial activity in academia and in the commercial world in Australia. Connecting computers was initially very difficult because there was no standardisation and each network developed its own methodologies and protocols. Standards were gradually developed, but took many years for computer networking to mature.

CSIRONET

When Australian computer pioneer Trevor Pearcey returned to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in 1959 (see Chapter 15), he dreamt of a network connecting all CSIRO computers across all states.

In 1963 the CSIRO signed a large contract with Control Data (see Chapter 11) for a CDC 3600 to be installed in Canberra, with smaller 3200s in Sydney, Melbourne, Adelaide and Brisbane. Initial networking occurred by physically transferring tapes; conversion to 'electrical transmission' did not begin until 1966.[466]

The technology of the time made it difficult to make the CSIRO machines communicate directly with each other. The Postmaster-General's Department (PMG), precursor to Telecom and Telstra, had been experimenting with computer communications for some time and announced successful tests using DEC computers in 1966 (see Chapter 14).

Pearcey had to work almost from scratch to develop the computer network that was to become known as CSIRONET. His initial efforts focused on ensuring total compatibility between all CSIRO machines, by establishing uniform programming languages, file structures and peripherals.[467] When the machines were connected by low-speed data lines, they could share data by seeing each other's peripherals

ONE OF THE REALLY SPECTACULAR SUBCULTURES OF THE COMPUTER WORLD OF THE 1970s WILL BE THAT OF DATA TRANSMISSION. ALREADY IN AUSTRALIA MANY COMPUTER MAKERS, GOVERNMENT BODIES AND DEPARTMENTS, BUREAUS AND PRIVATE INDUSTRIES ARE POURING VAST AMOUNTS OF DATA BACKWARDS AND FORWARDS AROUND THE CONTINENT.

THE SYDNEY MORNING HERALD,
18 DECEMBER 1970

as their own, though all processing was still in batch mode. This compatibility made 'networking' possible, with each machine sharing the others' peripherals over slow leased lines.

True data communications capabilities came slowly, and involved substantially tweaking operating systems and replacing teletypes with CRT terminals.[468] In his 1988 book *A History of Australian Computing*, Pearcey describes in detail the intricacies of developing real-time networking for CSIRONET.

Pearcey and his team had developed a new operating system called DAD (Drums and Displays), which enabled the CSIRO machines to operate together as a single network. It was the first large-scale computer network in Australia, and one of the first in the world.

■ "The DAD operating system was the first direct access, time-sharing and multi-programmed system in large scale service in Australia. The knowledge gained from its operation was valuable in later development of the online communications based extension of the network which was to become CSIRONET.

■ "The first moves toward that facility were taken in 1966 by incorporating a DEC PDP-8 as a communications controller, connecting the CDC 3600 to other terminals and remote sites by telephone lines."[469]

There were other rudimentary computer networks in Australia at this time. The University of Sydney and University of NSW had both connected the various computers on their campuses, but CSIRONET was the first attempt to implement what is now called a wide area network (WAN) in Australia.

By 1976, CSIRONET connected more than 50 computers and 150 terminals around Australia, with the primary role of serving CSIRO and other research institutions. In the 1980s, CSIRO's networking and processing capabilities were commercialised

under the CSIRONET brand and it began to offer a range of data communications and information services to academic and industry users.

The first generation of CSIRONET was a hierarchical network that relied strongly on the computing power of its central Canberra data centre. It did not adopt standardised peer-to-peer networking protocols until these become the norm in the 1980s.[470] CSIRONET remained in use until 1989, when it was supplanted by AARNet.

THE COMMON USER DATA NETWORK

As early as 1964, the PMG began experimenting with digital data transmissions over the telephone network, between Australia's six stock exchanges, the banks and some large companies.[471] (The state-based exchanges were not amalgamated into the Australian Stock Exchange until 1987.)

In 1969, the PMG announced Datel, a data transmission service run by the Australian Post Office, using the public telephone system for lower speeds and leased lines for higher speeds. The network was capable of 1,200 bps (bits per second) over the switched telephone network and 9,600 bps over the leased lines. The PMG granted Australia Post a monopoly on the supply of modems, and by the mid-1970s over 2,500 were in use.[472]

Datel was popular with government and the business community, but the Australian Post Office was already planning something much bigger. In February 1970, it called for tenders for an Australia-wide Common User Data Network (CUDN), a message-switching system based around mainframe computers in each of the five mainland state capitals. A contract was signed with the Univac Division of Sperry Rand Australia in September 1970.

The CUDN was estimated to cost $7 million, with $4.4 million designated for two Univac 418/3 mainframes and one Univac 9200 controller in each location. The plan was to begin in Brisbane (November 1971), and expand to Melbourne (March 1972), Sydney (September 1972), Perth (November 1972) and Adelaide (January 1973). Canberra and Hobart were to be 'promotional centres', which could be switched in to the larger network. The entire network would have a standard data rate of 4,800 bps.[473]

The CUDN was extremely ambitious – too ambitious, as it turned out. Soon after the project was announced, a long article published in *The Sydney Morning Herald* outlined how it would work. The most important feature was its store-and-forward capability:

■ "Organisations which belong to the CUDN will be able to send data to their regional centre. It will be analysed for relevant data (address or addresses, priority, etc.) and then pushed onto disk storage. When transmission filleted facilities are available and the receiving equipment is ready, the information will be retrieved and pushed out at speeds up to 2400 bps – and later 4800 bps.

■ "This means the sending and receiving devices can operate at different speeds and codes. Compatibility is required only between the CUDN interface and the terminals. Data transmission can begin without establishing a data patch from the sending terminal to the destination. There is no time taken to establish a connection as there is with circuit switched networks. Terminals can be operated at a high utilisation rate.

■ "The CUDN can provide communications between a customer's central computing unit and remote computer terminals. With a single link to the CUDN, the customer's computer can interface with a variety of terminals in different places."[474]

There was strong demand for such a system, predominantly from governments. The Department of Health, Bureau of
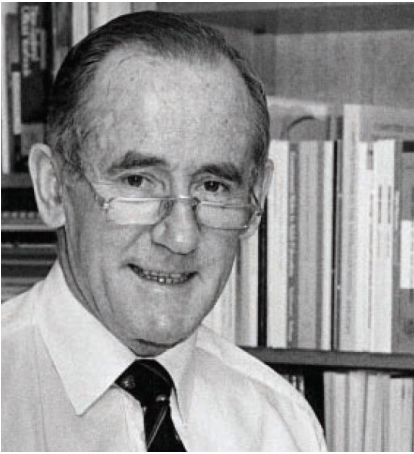
Meteorology and government-owned domestic air carrier Trans Australia Airlines (TAA) all lined up to use the CUDN. But it was too optimistic; it relied on untried technology, and neither the PMG nor Univac Australia had ever achieved a similar undertaking.

The CUDN was a disaster. It immediately fell behind schedule and the PMG withheld payments to Univac when the vendor failed to deliver. According to one report at the time, "the Australian Post Office underestimated the size of the task and Univac oversimplified it".[475]

The CUDN turned into a major political issue and led to a government Commission of Inquiry into the Australian Post Office, which recommended separating Australia's postal and telecommunications services. The PMG was dissolved and the Australian Postal Commission (trading as Australia Post) and Telecom Australia came into being on 1 July 1975.

The CUDN eventually worked, though never to its intended specification. After Telecom Australia was formed, many large data communications users developed their own internal data networks. When the CUDN's largest user TAA decided to build its own network on Telecom-leased lines, the CUDN was shut down and the Univac data centres closed in late 1976.[476]

The project was ultimately three years late and cost three times the initial budget.[477] Largely forgotten now, the CUDN was at the time regarded an enormous step forward – a project intended to propel Australia to the forefront of data communications globally. Its failure led directly to the formation of Telecom Australia (now Telstra) and greatly raised the Australian industry's understanding of how important effective data communications can be.

But even as the CUDN saga unfolded, major developments in data communications were happening in the US that would change the world forever.

THE BIRTH OF THE INTERNET

In the late 1960s, the world's biggest computer user was the US Department of Defense. It owned many machines and used many more at universities and research institutions. Robert 'Bob' Taylor – a manager at the Department's Advanced Research Projects Agency (ARPA) and a former NASA manager of technology research – proposed that the agency's computers should be connected in some way. He eventually persuaded ARPA to call for tenders using the untried technology of packet switching.[478]

The tender went out to 140 companies, asking for a network connecting four computers. Mainframe market leaders IBM and Control Data Corporation did not respond, saying the network could not be built.[479] A small company in Boston called BBN (Bolt, Beranek and Newman) wrote a proposal for "interface message processors for the ARPA network". The company – already known to and respected by ARPA – got the job, and BBN's Frank Heart and his team started work.

Packet switching involved sending data in discrete packets, rather than all at once. BBN was the first company to implement the technology, but the concept was picked up by a young man in Heart's group called Bob Metcalfe. Four years later, Metcalfe used the concept to devise Ethernet, the most commonly used networking technology of the next 30 years. Metcalfe is famous for Metcalfe's law – that "the utility of a network expands by the square of the number of users".[480]

Telephone giant AT&T ridiculed the idea of packet switching[481], but BBN was able to turn the theory into practice. It built the rudimentary network and on 29 October 1969 the first Internet message was sent from the University of California, Los Angeles, to Stanford Research Institute. This first missive was supposed to say 'logon', but the system crashed after the first two letters. Lo, the Internet was born.

Before the end of the year, the University of California at Santa Barbara and the University of Utah were connected, in a network called ARPANET. Growth was slow; a year later, the network had expanded to just 15 nodes and it took a further seven years to reach 100.

Initially, use of ARPANET was restricted to academia and the military. The Internet remained very difficult to use until ARPA developed a networking standard called TCP/IP (Transmission Control Protocol/Internet Protocol) in 1982.[482] Email became its most widespread application, which improved substantially in 1983 with the introduction of domain names like .com and .org. Gradually, people began calling the new network the Internet.

The Internet went international in 1973 when ARPANET made its first international links via satellite with University College of London and the Royal Radar Establishment in Norway.[483] It was very slow to reach Australia.

ACSNET AND AUSTPAC

During the 1970s, many Australian academics became aware of developments in the US and debated their relevance to Australia. In the late 1970s, Kevin 'Robert' Elz at the University of Melbourne – along with Robert 'Bob' Kummerfeld and Piers Lauder at the University of Sydney – developed the Australian Computer Science Network (ACSnet), which was the primary academic computer network in Australia until the late 1980s.

In December 1982, Telecom Australia announced Austpac, a public packet-switched network using the new X.25 protocol. X.25 had been developed in the early 1970s as an international standard and was widely used by telecommunications companies around the world to meet the increasing demand for data communications. Austpac was a dial-up system widely used by Australia's banks and

organisations such as the Australian Taxation Office and TABs. It lasted a quarter of a century and was not decommissioned until 2008, by which time the TCP/IP protocol had supplanted X.25.

■ "Capabilities of Austpac are handling of corporate data messages, electronic payments, monitoring systems, other communications and Teletex. Terminals operating a different data transmission rates can also be linked through Austpac because packets are conveyed through the network at high speed that transmitted to the destination terminal at the speed which suits best. Austpac is considered by Telecom to be particularly useful where a large number of users transmit small volumes of data over long distances."[484]

While Austpac was a publicly available packet-switched service sold by Telecom, ACSnet was a proprietary store-and-forward network, like the CUDN (see above), which used modems and Telecom's switched telephone network. It was widely used by computer scientists at Australian universities, and at its peak it had more than 300 nodes.

■ "ACSnet is a loosely coupled network of machines throughout Australia that use a particular set of networking facilities known as SUNIII (Sydney University Network Version 3). All true ACSnet hosts run the Unix operating system. Some non-Unix machines able to attach as foreign nodes with limited functionality. Hosts exist in universities, CSIRO divisions, institutes of technology, and a number of private research and development organisations.

■ "ACSnet is a store and forward message handling network and should not in any way be confused with networks like Austpac or CSIRONET, which provide network connection between nodes which can then use the connection for various purposes including a remote login or file transfer. ACSnet relies on the provision

of a network service between certain machines, although the store and forward capability means that a message can be sent between nodes which are not directly connected.

■ "It does provide multiplexing facilities across network connections which may themselves be simple synchronous lines, local area networks, Austpac or CSIRONET. The consequences of this style of networking are that an extensive network can be easily and cheaply established without the need for expensive interfaces or software. Great advantage can be taken of the cheap bandwidth available in local areas using dial-up modems over Cybernet in the wider area or over CSIRONET in the wider area."[485]

ACSnet used the Unix-to-Unix Copy Protocol (UUCP), and was so successful it was blamed for the slow uptake of the Internet in Australia.[486] It did a good job at delivering email, and file transfers and the real-time capabilities of a network like the Internet were not a major issue.

Other computer networks were being established in Australia during this time, mostly at universities and research establishments. The South Australian Institute of Technology connected its two Adelaide campuses and its campus in Whyalla using a network based on DEC's proprietary DECnet protocol. VICNET was a terminal network connecting Victorian Colleges of Advanced Education and Institutes of Technology, based upon intelligent switches and with little host-to-host communication capability.[487]

A key development was SPEARnet (South Pacific Educational and Research Network), launched in 1986 using Telecom's Austpac X.25 network as the carrier. SPEARnet was the brainchild of the University of Queensland's Alan Coulter and played a key role in accelerating the progression for a true national network.

The first SPEARnet workshop was held at the University of Queensland in February 1987. Representatives from 19 of Australia's 21 universities were in attendance, as were delegates from New Zealand, the CSIRO, DEC and IBM.[488] By the end of the year there were 22 nodes on the network.

Momentum was building for a single national computer network. In early 1987, the Australian Vice-Chancellors Committee (AVCC) commissioned a report on the possibility of building a single computer network for universities and other tertiary institutions. The AVCC was concerned about the cost and approached the Australian Committee of Directors and Principals in Advanced Education (ACDP) about establishing a joint network.

The ACDP represented the heads of colleges of advanced education (CAEs) and institutes of technology, which would become universities under the Dawkins tertiary education reforms announced the following year. The AVCC and ACDP merged in 1991.

The AVCC and the ACDP established a joint working party to look at the idea of a single network, chaired by Professor Ken McKinnon, Vice-Chancellor of the University of Wollongong. McKinnon was not a computer expert but had spent a lot of time in the US and had witnessed developments in the Internet and academic computer networking there. He was also an experienced administrator and knew how steer things through academic and government bureaucracy.[489]

The committee commissioned a report from Dr Brian Carss of the University of Queensland on the networking needs of Australia's academic sector. Carss recommended a national circuit-switched network with a bandwidth of 2 Mbps, which would allow existing networks such as ACSnet and SPEARnet to operate on top of it. In July 1988, the AVCC and the ACDP agreed to provide $247,000 to fund the initial development of a network.[490]

AARNET IN LATE 1991
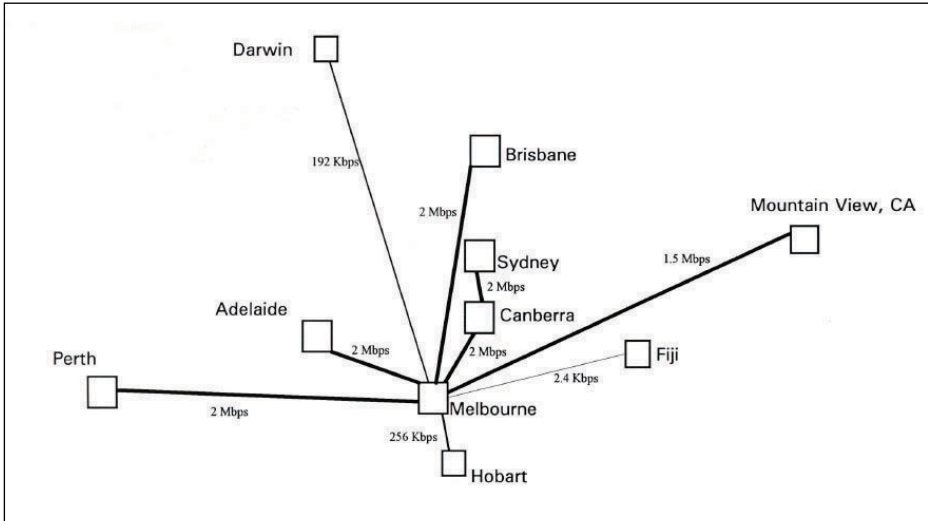
Darwin
192 Kbps
Brisbane
2 Mbps
Mountain View, CA
1.5 Mbps
Sydney
2 Mbps
Canberra
Adelaide
2 Mbps
2 Mbps
Fiji
Perth
2.4 Kbps
2 Mbps
Melbourne
256 Kbps
Hobart

ABOVE: Early AARNet Connections across Australia - an early network map, 1991 - CREDIT AARNET

After much debate about protocols and standards, in September 1989 McKinnon's working party submitted a funding proposal to the Australian Research Council (ARC) for a new network – the Australian Academic and Research Network (AARNet). By this time, the CSIRO had been convinced to come on board. In November 1989, the ARC agreed to provide $1.77 million to establish the network and cover its first two years of operation.[491] Ken McKinnon was the inaugural chair of the AARNet advisory board.

THE INTERNET COMES TO AUSTRALIA

While the details of AARNet were still being hammered out, a very important event had occurred in Melbourne. Almost exactly 20 years after its inception in the US, the Internet had come to Australia. On the evening of 23 June (AEST), Elz (who had been one of the drivers of ACSnet) and Torben Nielsen of the University of Hawaii completed the connection that brought the Internet to Australia – a 56 Kbps satellite circuit.[492]

The link came about after Nielsen had proposed a research infrastructure program

to NASA, which included extending the Internet to Australia and other countries in the Pacific. NASA offered to fund half the cost of the link, Elz leased a 56 Kbps bitstream service to the University of Hawaii and the connection to ACSnet was made. For the first time, Australia had a permanent live link to the Internet. The University of Melbourne initially supervised the connection before AARNet took it over in 1990.

Work on AARNet began immediately after the ARC grant was announced, with a 'Networkshop' held at the University of Adelaide in December 1989 to discuss its implementation. One of the hosts of the event was Simon Hackett, who would later become an important figure in the development of the Internet in Australia.

In attendance were Geoff Huston, who had been hired as Network Technical Manager when the AVCC was developing its plans; Peter Elford, hired to help Huston roll out the network; and the ubiquitous Elz.[493]

■ "The plan was for a star of stars network with AARNet organising a connection to a host university in each state. This host university would be contracted by AARNet to provide the operational services for the regional hubs.

■ "The backbone of the national network was constructed using the digital service equivalent of a single voice circuit, which in Australia at the time, was a 48Kbps circuit. There was no particular ulterior motive behind the topology other than simply one of working within a very constrained budget.

■ "The initial regional hub sites were to be located at the Australian National University, the University of Melbourne, the University of Sydney, the University of Queensland, the University of Adelaide and the University of Western Australia. The University of Tasmania and Northern Territory University (now Charles Darwin University) – where there were no hubs

– linked directly to Melbourne. The decision to locate the backbone hub at the University of Melbourne was made because of its existing connection into the US, operated by Robert Elz for ACSnet."[494]

The use of AARNet grew very quickly, doubling every eight months. By 1992, AARNet's users included all 37 universities in Australia; 30 out of the CSIRO's 36 departments; and another 42 affiliates, including bodies such as the Anglo-Australian Observatory, the Australian Nuclear Science and Technology Organisation (ANSTO), BHP Research Labs, the National Library of Australia and Technology Park Adelaide.

There were also 141 mail affiliates, ranging from one-person systems to entire government departments. The charging model changed from a levy to a volume-based tariff in 1992. Most institutions absorbed the cost rather than passing it on to individual faculties or departments.[495]

In late 1990, a 128 Kbps link to San Francisco replaced the link to Hawaii. The growth in traffic meant it needed to be frequently upgraded and by the end of 1991, a 1.5 Mbps trans-Pacific link was connected to a NASA facility at Mountain View, in California's Silicon Valley. The bandwidth of links within Australia was also constantly being enhanced to handle the increased traffic.

In the early 1990s, Australia's first Internet service providers (ISPs) – connect.com, Pegasus and Internode – connected to AARNet. AARNet was not supposed to be for commercial use, but the affiliate program was very flexible. Snowballing demand for access kept pushing up the running costs, creating an unsustainable revenue model.

In September 1993, the Clinton administration in the US launched its National Information Infrastructure (NII) initiative, which recast the Internet as a commercial and publicly available network.

TWO KEY DEVELOPMENTS VASTLY IMPROVED THE INTERNET'S EASE OF USE AND DROVE ITS WIDESPREAD ACCEPTANCE IN THE EARLY 1990s. THE FIRST WAS THE WORLD WIDE WEB; THE SECOND WAS THE WEB BROWSER.

Pressure was building in Australia to follow suit. In May 1994, AARNet was opened up to value-added resellers (VARs) – today known as ISPs – which were charged for access for permanent links on a fixed-cost basis. In turn, they typically charged retail customers for timed dial-up access.[496]

Some of AARNet's initial email-only affiliates – such as Simon Hackett's Internode in Adelaide – upgraded themselves to become ISPs. Many other ISPs were formed, including Michael Malone's iiNet in Perth, and OzEmail. By the end of 1994, these new ISPs accounted for nearly one-quarter of AARNet's total traffic.

Internode was to be acquired by iiNet in 2011, and the combined operation by TPG in 2015. Hackett and Malone became well-known and influential figures in the Australian communications industry, especially in their home states of South Australia and Western Australia.

OzEmail began life as Microtex, founded in the 1980s by Sean Howard, a former computer magazine publisher, as an attempt to build a proprietary email system. When the opportunities offered by the Internet became apparent, he secured the financial backing of publishing executive Trevor Kennedy and investment banker Malcolm Turnbull to relaunch the company as an ISP. (Turnbull later went into politics and became Prime Minister of Australia.)

OzEmail became one of the largest ISPs in Australia and in 1996, the first Australian company to list on the US NASDAQ exchange. US company WorldCom (later called MCI) acquired the company in 1999; Howard, Kennedy and Turnbull made millions. In Turnbull's case, his initial investment of $500,000 in 1994 became $57 million when OzEmail sold to WorldCom five years later.[497]

Meanwhile, AARNet's commercial success led to major changes in its operations. In early 1993, Peter Saalmans was appointed to the new position of General Manager, and Brenda Aynsley was appointed Customer

Service Manager. (Aynsley later became the first female President of the Australian Computer Society, in 2014.)

Increased use of AARNet was leading to severe congestion on the network. In January 1995, a new volume-based charging system was introduced. The AVCC was concerned that AARNet was becoming more than it could handle, and initiated discussions with Telstra – the company created by the merger of Telecom and OTC (the Overseas Telecommunications Commission) – for Telstra to take over the network.

The massive growth in Internet traffic meant that AARNet had become one of Telstra's largest customers, and Telstra could see potential commercial advantages in owning Australia's Internet backbone.[498]

In June 1995, Telstra acquired the network and AARNet's commercial customer list for $3.8 million. It reduced AARNet's tariffs and increase the transmission speed of the network from 4.5 Mbps to 6 Mbps. The deal also included a one-off payment to the AVCC for the goodwill of the AARNet commercial customer base.[499]

This was variously regarded as the salvation of the Internet in Australia, a commercially realistic negotiation, a necessary transition, a giveaway by the AVCC, a sellout by the AVCC, or a naked grab by Telstra for commercial control of the Internet in Australia.

The passions it aroused reflected the importance that many people attached to Internet services. The AVCC's own (very brief) court history describes it as follows:

- ◼ "[The transfer] stimulated further growth of the commercial and private use of the Internet in Australia. The intellectual property and expertise transfer to industry resulted in development of the Internet in Australia that would not have otherwise occurred at such a rapid rate."
- ◼ "The lack of clarity about the

administration of the core functions involved in running the Internet resulted in ill feeling from time to time. Telstra was perceived by many observers to have pillaged a national resource."[500]

AARNet pioneer Geoff Huston, regarded by many as the father of the Internet in Australia, became Telstra's Head of Internet Services, and in 2012 was the first Australian to be inducted into the Internet Hall of Fame. AARNet continues today as a very successful service. Telstra's acquisition of the network was the beginning of a major new phase in the history of the Internet in Australia.

THE WORLD WIDE WEB AND THE INVENTION OF THE WEB BROWSER

Two key developments vastly improved the Internet's ease of use and drove its widespread acceptance in the early 1990s. The first was the World Wide Web; the second was the web browser.

The Web was the brainchild of Tim Berners-Lee, an English scientist working at European nuclear research organisation CERN (from the French *Conseil Européen pour la Recherche Nucléaire*) in Switzerland. In 1989, he came up with some simple specifications that made it easier to navigate around the Internet, devising a language called HTML (Hypertext Markup Language), and a communications protocol called HTTP (Hypertext Transfer Protocol). HTML and HTTP used the concept of 'hypertext' to allow people to jump easily between locations on the Internet.

But the Internet was not a place for beginners. Addresses and locations were standardised, but users still had to know where they were going and needed a range of different software tools to get there. Enter the web browser.

The browser was invented by Marc Andreessen, a 21-year-old student at the University of Illinois National Center for Supercomputing Applications. Frustrated with how difficult it was to use the Internet,

he enlisted the aid of a colleague, Eric Bina, to make it easier.[501]

Over three months in the northern winter of 1992–93, Andreessen and Bina developed a piece of software that could navigate through hypertext links with the click of a mouse and display graphics as well as text. It also had an attractive and easy-to-use interface. They called it Mosaic.

The first version was ready in February 1993 and in April of that year they released it publicly. By the end of 1993 it had more than a million users. The next year, Andreessen and Jim Clark started a company called Netscape, to commercialise a browser of the same name. Then Microsoft entered the browser market with Internet Explorer, and started the acrimonious 'browser wars' of the 1990s.

The advent of the browser led to a vast increase in Internet USge. In January 1993, there were just 50 commercial websites on the Internet. One year later, there were more than 10,000, and a year after that, more than 100,000. Amazon.com, started by Jeff Bezos in 1994, became the archetype of a new e-business model and once Pizza Hut let people order over the Internet in 1994, things started to happen very quickly.[502]

The introduction of the Web and the web browser – along with massive improvements in the 'backbone' infrastructure by Telstra and its new competitor Optus – vastly accelerated the growth of the Internet in Australia.

■ "By the end of 1997, there were estimated to be 1.6 million Internet users in Australia, of whom 1 million were relatively frequent users. These included 500,000 users in educational institutions, 650,000 dial-up consumers, academic and SOHO (Small Office Home Office) users, and 450,000 Business & Government users.

■ "The heavy majority were using dial-up access, with modems capable of up to 33.6Kbps, with 56Kbps modems newly

MORE INFORMATION

The best two sources on the early years of the Internet in Australia are Glenda Korporaal's 2009 book *AARNet: 20 Years of the internet in Australia*, commissioned by AARNet, and Roger Clarke's 2004 online history *Origins and Nature of the Internet in Australia*.

available. Only tiny numbers were using 64/128 Kbps ISDN. Broadband services such as cable and ADSL were not yet available."[503]

Australia may have started late, but thanks to visionaries like Elz, McKinnon and Huston, it arrived just in time to take advantage of the Internet boom years of the 1990s (see Chapter 27).

THE FOURTH ESTATE
THE COMPUTER PRESS, INDUSTRY ANALYSTS AND PUBLIC RELATIONS PRACTITIONERS ARE IMPORTANT PARTS OF AUSTRALIA'S COMPUTING HISTORY.

25

Almost since the industry began, Australia has known vibrant press coverage of the computing world. The mainstream press was interested in computers from the start, and specialist computer industry publishing houses appeared very quickly. The major international computer publishers came to Australia and many small local publications competed against them. It was, and is, a very competitive market.

Alongside the press there evolved a small army of public relations consultants and publicists, within the computer vendors and in a range of independent and multinational PR firms. There have also been many computer industry analysts and market researchers. The lines between all these groups blurred at times, as many individuals moving effortlessly from one group to another.

THE EARLY DAYS

The first major article about computers in the Australian press was published by *The Sydney Morning Herald* on 12 September 1956. A three-page spread mostly written by Ray Lenning discussed the commissioning of SILLIAC and UTECOM (reproduced at the end of Chapter 5).

In 1959, a small magazine called *Data Trends* appeared, published by Management Enterprises in Sydney. Keith Windschuttle was founding editor and Frank Linton-Simpkins the only reporter. Linton-Simpkins achieved minor notoriety in 1963 when he reported on the sale of a CDC 3400 to the Defence Signals Branch (to be renamed the Defence Signals Directorate in 1978) for cryptanalysis and cryptography (see Chapter 11).

There was much speculation over who had leaked. The deal was supposed to be top-secret, with all involved sworn to secrecy. But the sale was common knowledge in the industry and Linton-Simpkins read the Commonwealth Gazette, where all requests for tender and successful bidders were listed. Nobody had thought to exclude the details of this particular deal from such a public document. Linton-Simpkins had seen that the Government Communications Headquarters (GCHQ) in the UK had bought a similar machine a few months earlier, so easily guessed its purpose.

Data Trends was best known for its annual *EDP Manual* and

"ELECTRONIC COMPUTERS ARE EXCITING AS MUCH INTEREST AS AUTOMATION IN INDUSTRY AND COMMERCE. A FEATURE IN *THE HERALD* TODAY REVIEWS THE CAPABILITIES OF THE TWO UNITS, COSTING ABOUT £75,000 EACH, WHICH ARE AT THE UNIVERSITY OF SYDNEY AND THE NSW UNIVERSITY OF TECHNOLOGY, AND OF OTHER UNITS WHICH SEVERAL COMPANIES ARE MARKETING".

THE SYDNEY MORNING HERALD,
12 SEPTEMBER 1956

was acquired by business magazine *Rydge's* in the 1970s. *Rydge's* ran many articles on computing before being acquired by Fairfax and folded into *Business Review Weekly* (now *BRW*) in 1987 (see below).

The Australian Computer Society began its quarterly publication the *Australian Computer Journal* in November 1967. As a scholarly publication, it later became a monthly and was renamed the *Journal of Research and Practice in Information Technology*. It did not cease publication until 2015.

THE MAINSTREAM MEDIA

In 1960, Henry Strasburger became the science writer for *The Australian Financial Review* and wrote all the newspaper's computer-related stories before leaving in 1962 to become IBM Australia's first public relations specialist. Fairfax's *The Canberra Times* began running irregular features on computing in the early 1960s and other newspapers ran many articles about computers over the next few years.

Then, on 21 July 1964, the first Tuesday after Rupert Murdoch's new national daily *The Australian* commenced publication, it began running a weekly computer section. It was the first regular computer supplement in any newspaper in the world and would also become the largest.

The founding editor of the section was Michael Daly, who died later that year and was replaced by Noel Bennett. The idiosyncratic and eccentric Linton-Simpkins took over the role 1971, leaving in 1979 to join *The Sydney Morning Herald.* He died in 2003.

Soon *The Australian*'s weekly computer supplement was booming, driven by job advertisements for programmers, analysts and salespeople. In fact, it was often larger than the rest of the newspaper. Helen Meredith became computer editor in 1983, a position she held until 1989.

Editorship of the supplement was one of the most prestigious jobs in Australian IT journalism. Subsequent section editors

included Jeremy Horey (1989-92), Mark Hollands (1996-99), Ian Grayson (1999-2002) and Stuart Kennedy (2003-14). *The Australian's* Tuesday computer pages continue to this day, though are decreasingly substantial as employment advertising moves elsewhere on the Internet.

Soon enough, other major Australian newspapers started weekly computer supplements. Melbourne's *The Age* began its regular weekly coverage in 1970, under the editorship of Roland Perry, who would later become a well-known and successful historian and biographer. He was succeeded by Jay Spencer.

Charles Wright, formerly a leading tabloid journalist, was an important writer for *The Age* in the 1980s and 1990s. The weekly supplement, known as the *Green Guide*, covered hi-fi and television developments and had a very strong following in Victoria. *The Age* was acquired by Sydney-based Fairfax in 1983.

Fairfax dailies *The Sydney Morning Herald* and *The Australian Financial Review* both started computer sections that remained small because they failed to attract job advertisements. This was most likely because *The Sydney Morning Herald* was aimed at the general reader and *The Australian Financial Review* only covered the computer industry for business readers.

Editors for *The Australian Financial Review* computer pages were John Costello (1981-82), David Noble (1983-84) and Beverley Head (1984-95). Head, who also worked for the International Data Group (see below), remains one of Australia's most prolific freelance computer journalists.

Gareth Powell was an influential and dynamic editor of *The Sydney Morning Herald's* computer pages, who held the position from 1987 to 1994 before being dismissed over a plagiarism scandal which he always claimed was a set-up. Powell, a dynamic and larger-than-life Welshman, started a number of early microcomputer

magazines (see below) and was one of Australia's best-known travel writers. Other important editors were Stephen Hutcheon and Nathan Cochrane.

In 1987, Fairfax's *Business Review Weekly* hired Sandy Plunkett to write regularly about the business aspects of the computer industry. It became an important part of the publication, and Plunkett became associate editor in 1994, only leaving at the beginning of 1997 to join venture capital firm Allen & Buckeridge in the US (see Chapter 19). Plunkett is now an independent consultant and commentator on innovation and entrepreneurship.

The Canberra Times ran a regular computer section that concentrated on computing in the Federal Government. From 1987 to 1997 it was edited by the fearless Englishman David Ives, who became well known for his penetrating stories on government computing. He died in 2008.

In 1987, Fairfax launched a PC magazine called *Today's Computers*, edited by Ken McGregor. It lasted only four years in what was then a very competitive market for computer magazine publishers.

PACIFIC COMPUTER WEEKLY AND IDG

In March 1971, Melbourne-based trade publisher Peter Isaacson, a decorated World War II bomber pilot, started Australia's first specialist computer newspaper, *Computer Weekly* – which despite its title, was first published fortnightly.

The title was changed to *Pacific Computer Weekly* in 1981, reflecting its international ambitions. Alan Power was founding editor, supported by reporters Mike Vanderkelen in Melbourne and Paul Rigby in Sydney.

Rigby left to form Paul Rigby Public Relations and was replaced by Graham Howard, who had been with *The Australian Financial Review*. Vanderkelen relocated to Sydney to set up a bureau in February 1974, after Howard went to Melbourne to become news editor. Vanderkelen effectively became
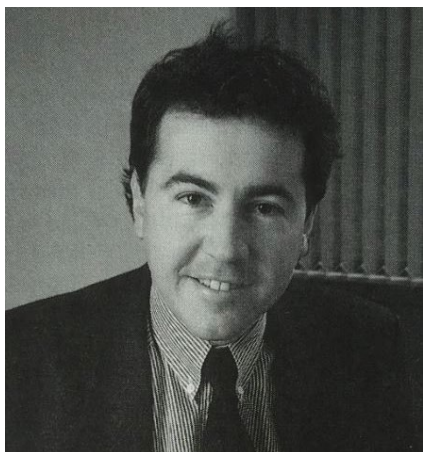
IN JANUARY
1988, COMPUTER
PUBLICATIONS
LAUNCHED *PC WEEK
AUSTRALIA* THROUGH A
CONTENT LICENSING
DEAL WITH ZIFF
DAVIS, PUBLISHER OF
PC WEEK IN THE US.
PC WEEK AUSTRALIA
QUICKLY BECAME
VERY SUCCESSFUL.
IN 1990, COMPUTER
PUBLICATIONS
LAUNCHED *PC USER*,
WHICH WAS SIMILARLY
POPULAR.

editor in 1975 when Alan Power assumed publishing responsibilities for other titles in the Peter Isaacson stable. In Sydney, Vanderkelen hired John 'Jack' Costello as news editor. Costello moved to Melbourne in 1975.

The publication grew steadily during the 1970s and went weekly in 1978. In July that year, competition arrived in the form of *Computerworld Australia*, published by International Data Group (IDG), the largest computer publishing house in the world. Founded by Patrick McGovern in Boston in 1964, IDG operated in 97 countries at its peak and was the parent company of market research group International Data Corporation (see below).

Power had tried to persuade Vanderkelen to return to Melbourne to edit *Pacific Computer Weekly,* but he himself then switched from Isaacson to IDG and moved to Sydney to become founding publisher of *Computerworld Australia*. Power took Costello with him as founding editor and Mike Vanderkelen left to go into public relations (see below). Largely because it was Sydney-based, where the computer industry was focused, *Computerworld* quickly became Australia's largest specialist computer weekly, eclipsing *Pacific Computer Weekly.*

Costello left *Computerworld* in 1983 to become computer editor for the *Australian Financial Review*. He was replaced by Peter Scott, who in 1986 hired Beverley Head from the UK as news editor. She subsequently became computer editor at *The Australian Financial Review*. After Scott resigned from *Computerworld* in 1987, Graeme Philipson became editor, followed by American Don Kennedy in 1988. In 1990, Kennedy replaced Power as publisher of IDG Australia, a position he held until 2000.

Linton-Simpkins became news editor of *Pacific Computer Weekly* in 1983. SUSn Coleman, who had been head of IDG's Melbourne bureau, moved across to Peter Isaacson Publications in 1987 and became editor and Publisher. Known for her

flamboyant hats, Coleman held that position until the publication closed in 1995. She died in 2015.

In 1994 Isaacson sold his company to Australian Pacific Newspapers (APN), and the ubiquitous Power appeared as publisher of its technology titles, including the successful *Windows Sources,* launched in May 1994, which later became *PC Magazine*. APN closed *Pacific Computer Weekly* in 1995 and relaunched it as *Computer Week*, later to become *PC Week*, edited by Bill Dawes from 1995 to 1999.

Pacific Computer Weekly's quarter-century history was significant, not only because of its early appearance, but because it was one of the few computer industry publications based in Melbourne.

IDG quickly became Australia's largest computer industry publishing house, launching *Australian Microcomputer World* in 1982. It was renamed *PCWorld* in 1984 with Ian Webster as editor, though he was replaced by Paul Zucker the following year. Other IDG publications included *Macworld*, *CIO, Techworld*, *Good Gear Guide* and *Australia Reseller News (ARN)*.

IDG still exists, in Australia and internationally. When founder Patrick McGovern died in 2014, after personally owning the company for 50 years, it was sold to Chinese venture capital group China Nationwide Holdings.

SEAN HOWARD, APC AND COMPUTING AUSTRALIA

In 1980, Sydney entrepreneur Sean Howard started the *Australian Personal Computer* magazine, based on the successful *Personal Computer World* magazine published in the UK by Dutch-owned *Verenigde Nederlandse Uitgeverijen* (VNU, or United Dutch Publishers). Howard cut a licensing deal with VNU for content from the UK publication. He called his company Computer Publications.

It was tough going at first, but by 1983 the PC boom was in full swing and *Australian Personal Computer* became very successful. In 1986, Howard rejected a takeover offer from Fairfax and sold 60 percent of Computer Publications to major Australian publishing house Australian Consolidated Press (later ACP Magazines), owned by Kerry Packer. Howard started looking for new titles to publish.

The most significant project to come from this deal was *Computing Australia*, a weekly competitor to *Computerworld*, *The Australian*'s computer section and *Pacific Computer Weekly.* It was launched in 1985 as a 50:50 joint venture between ACP and VNU.

Computing Australia was an immediate success, with its mix of hard news stories and sensationalist content. Founding editor John Sterlicchi was an acerbic Englishman imported to Australia specifically for the role. With him came a sales team including Alistair Gordon, who became publisher by 1987.

Computing Australia was a hit with readers but failed to attract job ads away from *The Australian*, which by then had something of a monopoly. VNU lost interest and sold its half of the venture to ACP, which continued to struggle financially with the title. Sterlicchi left to start a successful computer news service called Edittech in Silicon Valley.

The new editor was Kester Cranswick, a prolific writer who had been *Computing Australia*'s Melbourne correspondent. He subsequently had a successful freelance career and became a government advisor on information technology, working for Senator John Button. He died young in 1996, from cancer. Australia's most prestigious computer industry journalism award, the Kester, is named after him.

In January 1988, Computer Publications launched *PC Week Australia* through a content licensing deal with Ziff Davis, publisher of *PC Week* in the US. *PC Week Australia* quickly became very successful. In 1990 Computer Publications launched *PC User*, which was similarly popular.

ACP decided to close *Computing Australia*, in 1988 but Howard persuaded ACP publisher Richard Walsh to sell it to him for a nominal $1. Sterlicchi returned from the US to resume the editorship, and with Alistair Gordon, Howard revived the title. Barely a year later, in mid-1990, the trio sold *Computing Australia* to IDG for $1 million. IDG immediately closed it down to get rid of a competitor to *Computerworld.* ACP was not amused.

Howard used the money from the sale to help fund the development of the company that was to become OzEmail (see Chapter 24). Sterlicchi went back to the US and built Edittech into a major source of US computer industry news for Australian, European and Latin American publications. And Gordon set up a new company called Strategic Publishing (see below) to publish some one-off titles that had been planned but were not part of the deal with IDG.

In 1994 ACP underwent a corporate reorganisation that involved a merger with the Nine Television network, and was renamed ACP Magazines. It continued to publish *Australian Personal Computer* until 2012, when the company was acquired by Bauer Media. *Australian Personal Computer* is still published today and bills itself as the longest running PC magazine in the world.

ACP was also publisher of *The Bulletin*, a weekly dating back to 1880. It ran many technology articles, many of them written by Collyn Rivers in this period. *The Bulletin* closed in 2008.

STRATEGIC PUBLISHING GROUP

In 1991, Alistair Gordon, former publisher of *Computing Australia*, asked Graeme Philipson, former editor of *Computerworld Australia*, to join him at Strategic Publishing as joint owner and editorial director. Philipson, who had worked in market analysis with the Yankee Group and Focus suggested they build a business that covered publishing and market research. Strategic

Publishing Group (SPG) was born.

They opened discussions with the Australian Computer Society to take over publication of its monthly magazine, but nothing came of it. In February 1992, SPG launched its own title, *Managing Information Systems* (*MIS*). They also researched and built a database of Australia's 1,000 largest IT departments, with details of their equipment and key contacts, which they called the *MIS 1000.*

Both products were very successful. *MIS* magazine, which styled itself as a business magazine for computer professionals, was soon being published in Singapore and New Zealand. The database, which increased in size every year until it became the *MIS 4000*, became an indispensable tool for computer marketers and sold thousands of copies. SPG launched other titles, including *CFO* magazine and *Information Age*, the latter published for the Australian Computer Society.

The company conducted surveys of IT managers and chief financial officers about their architectural strategies and buying intentions. The surveys were so successful that in 1997, leading analyst group Gartner acquired SPG's research division (see below). As part of the deal, Philipson went to Gartner as Research Director. SPG bought the division back in 1999 for less than a third of the original sale price when new management at Gartner decided it did not want to be in the survey business.

SPG opened an office in Mumbai in 1996 with an Indian edition of *MIS,* and moved its head office to Singapore in 1997 to take advantage of expanded business opportunities in Asia. It opened a sales office in Hong Kong in 1998 and another in London in 1999, planning to launch *MIS* magazine in the UK in 2000.

Under Gartner, the MIS database, which had grown to include CFOs, was expanded throughout Asia. SPG remains the only example of an Australian computer industry publishing company successfully expanding internationally.

But it all came to an end in December 1999, when SPG was acquired by Fairfax. The merger with that company's *Business Review Weekly* title formed Fairfax Business Media under Michael Gill. Gordon became publisher, but had a falling out with Gill over strategy, exacerbated by financial problems largely caused by a tech crash in March 2000 (see Chapter 28).

The MIS and CFO databases and surrounding research formed the basis of a new Fairfax Business Research division. Many of the former SPG titles were closed in 2000 and 2001, though *MIS* magazine in Australia continued publication until 2012.

DWR BECOMES PENTON BECOMES HAYMARKET BECOMES NEXTMEDIA

David Richards was a Fleet Street journalist who founded Weston Communications, then sold it to Ogilvy PR in Australia, a business he ran from 1983 to 1995. In 1997, Richards started DWR Media, which published *iTNews*, *Windows 2000*, *ITgraphics Magazine*, *Computer Reseller News* and *Information Week*, the last two under licence from CMP Media in New York.

By the end of the 1990s DWR had become the largest independent Australian-owned publishing house (though Strategic Publishing Group's international operations made that company larger overall). Under editor Stuart Kennedy, its flagship publication *iTNews* was one of the first Australian computer publications to have its own website. Other senior writers included Ben Woodhead and Michael Sainsbury.

Richards sold DWR Media to US company Penton Media in 2001. He then started 4Square Media, which publishes a number of online titles including *Channel News*, *SmartHouse, CliK, Plug* and *SoundMag.* 4Square Media also publishes commercial titles for companies like JB Hi-Fi and Ted's Cameras. It remains in operation today.

Richards remains a dynamic and

controversial figure, noted for his unorthodox news-gathering techniques and dogged by accUStions of plagiarism.

Unable to maintain DWR's momentum during the tech slump of the early 2000s, Penton sold the Australian operation to British publishing company Haymarket, owned by former British politician Michael Heseltine. Its Australian operation, which published *iTNews*, *Computer Reseller News (CRN)* and *PC & Tech Authority*, was acquired by nextmedia — owned by German publishing company Forum Media Group — in 2013.

ZIFF DAVIS TO CBSI

Many international publishing houses with Australian subsidiaries publish IT titles. As is the case in the wider computer industry, there is a continuing round of mergers and acquisitions.

Ziff Davis was founded in Chicago in 1927 to publish hobbyist magazines, including *Popular Electronics*. This magazine ushered in the microcomputer boom in its January 1975 issue when it announced the MITS Altair on its cover (see Chapter 22). Ziff Davis moved into computer publishing when it acquired *PC Magazine* in the US in 1982.

The company had a very early presence on the Internet, initiating ZiffNet in 1991 for users of the early CompuServe network. Its name was changed to ZDNet in 1995, by which time it was the world's largest

information technology website. ZDNet was spun out from Ziff Davis as a separate company in 1999 and acquired by rival CNET in 2000. CNET was acquired by broadcasting network CBS in 2008 and renamed CBS Interactive (CBSi).

ZDNet was active in Australia from the mid-1990s onwards. CNET – and then CBSi – became major players in the Australian computer publishing scene with a range of online titles including *TechRepublic*. The flagship online news resource continues the ZDNet name.

INDEPENDENT PUBLISHERS

The Australian computer industry has seen many independent newsletters and magazines published by individuals and small companies. Some of the most significant are listed below.

LES BELL, MATT WHELAN AND YOUR COMPUTER

Your Computer magazine was started in 1982 by publisher Matt Whelan and editor Les Bell, who called themselves the White House Publishing Group. Bell and Whelan had a substantial business as microcomputer consultants, offering seminars and training on technical matters. Whelan was also a leading automotive journalist.

Jake Kennedy joined as a journalist in 1984 and was editor from 1987. *Your Computer* was acquired by Eastern Suburbs Newspapers in 1986 and then by Federal Publishing. It closed in 1997.

DAVID FRITH AND COMPUTER DAILY NEWS

David Frith was a journalist on the Fairfax weekly the *National Times* and a well-known hi-fi columnist. In the early 1980s, editor Brian Toohey asked him to write a few stories about PCs. Frith was one of only three Australian journalists invited to the launch of the Apple Macintosh in San Francisco, California in 1984.

When the *National Times* folded in 1988, Frith went freelance. In 1992, he started the

Computer Daily News as a four-page faxed newsletter published five days a week. It is still published today and edited by Frith with his daughter Kate Castellari. It has never missed a daily issue. It is not available online, and now exists as a PDF distributed by email.

STUART CORNER AND *EXCHANGE*

Stuart Corner, a former electronic engineering educator, founded a daily telecommunications newsletter called *Exchange* in 1987. In 2005, he sold it to *iTWire* (see below) in exchange for equity. *Exchange* was published by *iTWire* and edited by Corner until 2008, when he resigned over a strategy disagreement.

Corner became a successful freelance writer and consultant, and now publishes a website on the Internet of Things.

STAN BEER AND ITWIRE

Stan Beer, former Melbourne IT reporter for *The Australian Financial Review,* and Peter Dinham, former tabloid journalist, started newsletter *The Beer Files* in 2003 and expanded it to an online computer news source called *iTWire* as in 2005 *iTWire* also publishes *CommsWire*, a telecommunications daily that incorporates Corner's previous *Exchange* communications newsletter (see above).

iTWire employs a number of specialist contract and part-time writers who generate sizeable volumes of content for its website and daily newsletter.

GARETH POWELL

Gareth Powell was a Welsh immigrant who started *POL* magazine in Australia in 1968, with Richard Walsh as editor. Walsh had been one of the founders of the infamous *Oz* magazine and was to become the head of Kerry Packer's ACP.

Powell had been something of an *enfant terrible* in British publishing in the 1960s, when he published the erotic novel *Fanny Hill*. Powell later moved into travel

magazines and in 1983 to computers, with the *Australian Apple Review* – edited by Graeme Philipson.

He subsequently launched the *Australian Commodore Review* with Andrew Farrell as editor and the *Australian PC Review*. These publications lasted only a few years and Powell became computer and travel editor of *The Sydney Morning Herald* in 1987 (see above). Gareth Powell died in 2016.

PETER KARR AND ON DECK, TRUE BLUE AND AUSTRALIAN UNIX REVIEW

In 1988, former IBM and DEC salesperson Peter Karr and his partner Rayma Creswell saw an opportunity to create a magazine specifically for users of DEC computers in Australia, which he called *On Deck*. In 1989, he released *True Blue* for IBM mainframe and midrange users, and in 1991 added *Australian UNIX Review* for the growing Unix market.

True Blue was edited by Graeme Philipson, former editor of *Computerworld* and subsequently co-founder of Strategic Publishing Group (see above). *Australian Unix Review* was edited by David Crow, who would later become editor of *The Australian Financial Review*'s computer pages and then a leading political journalist for News Limited.

Karr ran into financial difficulties in the mid-1990s as the market commoditised. He unsuccessfully attempted to sell his company and closed it down in 1996.

PETER BLASINA, THE GADGET GUY

Former schoolteacher Peter Blasina established a persona as The Gadget Guy, appearing frequently on radio and television as a commentator on technology. He carried his profile across into a popular and successful website and newsletter publishing business.

THE PUBLIC RELATIONS SCENE

Australia's computer companies, especially the subsidiaries of multinationals, have

employed specialist public relations to help promote their message to the media from the 1980s. At first, these were mostly internal employees. As the computer press became more important, independent public relations companies were founded specifically to service this growing part of the industry.

By the early 1990s, there were a number of small Australian-owned companies servicing the computer industry. A partial list follows.

COOPER ASSOCIATES AND WATTERSON MARKETING COMMUNICATIONS

Australia's first computer industry public relations specialist was journalist Ray Cooper, who founded Cooper Associates in 1970. Cooper had been a journalist at *The Australian Financial Review*. In 1988, Hannah Watterson joined him and was manager of Cooper Associates until she left in 2004. Cooper retired in 2005.

Watterson then started her own public relations company, Watterson Marketing Communications, which continues today as one of Australia's leading independent IT public relations companies. Ray Cooper died in 2011.

CREATIVE MARKETING AND INFOTECH

After Mike Vanderkelen left *Pacific Computer Weekly* in 1975 (see above), he joined Sydney computer bureau Datacard in the newly created position of marketing and communications manager. Vanderkelen was to oversee Datacard's transition to the more substantial Computer Resources Company.

In 1978, Vanderkelen started a public relations company with Ian Pearson called Creative Marketing, which styled itself as a full-service computer industry marketing consultancy, offering advertising, graphic design, production and marketing collateral and event management.

Pearson left in 1984 and Vanderkelen renamed the company Infotech Marketing

and Communications, hiring Kate Smith as a PR consultant the following year. In the late 1990s, Vanderkelen relocated to the Sunshine Coast hinterland in Queensland and operated a joint venture with Blackie McDonald (see below) called Blackie McDonald Infotech.

Pearson continues to operate as an independent media consultant in Adelaide. Vanderkelen is still active as an independent consultant operating from Geelong, Victoria.

TALKING POINT

In 1984, SUSn Hitchener founded SUSn Hitchener & Associates, changing the name to Talking Point shortly afterwards. She was joined by Shuna Boyd in 1985 and the company grew quickly as the computer industry expanded. Talking Point became one of the major PR companies in the Australian computer industry in the late 1980s.

Hitchener saw opportunities in the UK and opened an office in London in 1989. The company became very successful there, but the Australian operation suffered in the face of increasing competition. Hitchener decided to concentrate on the London office and sold the local operation to Marketing Directions (see below) in 1992.

MARKETING DIRECTIONS

Marketing Directions was founded by Jolyon Bone and Barry Vaux in 1985, offering high-tech marketing training and consulting as well as public relations, although the latter came to dominate its business. In 1986, Marketing Directions became the Australian distributor for Dataquest, a market research company acquired by Gartner in 1994.

In 1986, Marketing Directions became affiliated with Regis McKenna, a high-profile Silicon Valley marketing and consulting company. Vaux left in 1988 and Marketing Directions became the pre-eminent PR company in the industry. Shuna Boyd came across from Talking Point (see above) in 1990.

THE AUSTRALIAN COMPUTER INDUSTRY HAS SEEN MANY MARKET RESEARCH AND ANALYST GROUPS. THE FIRST WAS THE INTERNATIONAL DATA CORPORATION (IDC) AUSTRALIA, PART OF THE INTERNATIONAL DATA GROUP FOUNDED IN THE US BY PAT MCGOVERN IN 1964. IDC AUSTRALIA LAUNCHED IN 1978 UNDER DAVID MCNABB BUT SOON AFTERWARDS LEN RUST BECAME MANAGING DIRECTOR, A POSITION HE HELD UNTIL 1998.

Bone expanded Marketing Directions into Asia, opening offices in Hong Kong in 1993, Singapore in 1994 and Kuala Lumpur, Malaysia in 1995. After the Asian financial crisis in 1997, he sold the Singapore and Hong Kong operations, closed Kuala Lumpur and withdrew to Australia, which had suffered during his absence.

He downsized Marketing Directions Australia and operated as a consultant before becoming part of Macquarie University's Institute for Innovation in 2005 and subsequently lecturing on entrepreneurship at Macquarie University and the University of Sydney.

RECOGNITION PR

Recognition PR was founded in 1985 by Steve Townsend, the look-alike younger brother of eminent children's TV host Simon Townsend. Recognition PR became one of the major computer industry PR companies of the early 1990s and was well known for its annual quiz night for the computer press.

In 2000, Townsend stepped down and sold part of the business to staff members, including Adam Benson, who became managing director. Townsend sold the remainder to staff members in 2012. Recognition PR remains a successful company today, operating out of Ballina in northern NSW.

Other PR firms included Blackie McDonald, Macro Communications and Professional Public Relations (PPR). There was a significant exchange of individuals between these companies and many journalists relocated into public relations. Some moved in the opposite direction but over time the number of people in PR exceeded those in journalism. Most publications came to rely very heavily on content produced by PR companies, particularly after the tech crash in 2000 and cutbacks in media budgets as advertising started to move online (see Chapter 28).

Another trend in recent years was the

growth of multinationals and the relative decline of specialist Australian-owned PR companies. In the 1990s, Australian computer PR was dominated by the independent Australia-owned companies mentioned above.

Many of these still exist and some new ones such as Espresso Communications have come into existence, but the scene is dominated by large multinational firms that have an Australian presence and an IT division.

These include Burson-Marsteller, Edelman, and Howorth (part of Ogilvy and Mather). This is partly a function of the increased size of the industry and partly the desire of many multinational vendors to use the same PR firm worldwide.

THE ANALYSTS

The Australian computer industry has seen many market research and analyst groups. The first was the International Data Corporation (IDC) Australia, part of the International Data Group founded in the US by Pat McGovern in 1964. IDC Australia launched in 1978 under David McNabb but soon afterwards Len Rust became Managing Director, a position he held until 1998.

Rust, an Englishman who had served in the Royal Navy in electronics and communications, had previously worked for General Electric's computer time-sharing operation. He grew IDC Australia substantially during his 20 years there, which included managing the Asia-Pacific operations.

Rust left after refusing to relocate to the new Asia-Pacific headquarters in Singapore. He then set up Dialog Marketing Services and started the *Rust Report*, a weekly newsletter.

Rust remains one of the best known and best connected people in the IT industry.

The Yankee Group was significant in the 1980s, founded in Boston in 1970 by Howard Anderson. Adrian Wood and Jennifer

Adelstein set it up in Australia in 1982, though both left soon afterwards to found their own market research company, Focus.

Focus had some success in the 1980s, as did Arthur Hobey and Associates from New Zealand, which entered the Australian market in 1986 and merged with Focus in 1989 to become Compass. It briefly represented Gartner (see below) before it set up its own operation in Australia, but Compass faded soon after.

The Yankee Group became very successful under former salesperson Joe Chadwick, who hired Graeme Philipson as the first Research Manager in 1984. Yankee was the dominant market analysis company in Australia in the mid-1980s, but declined during the 1990s due to competition from newer rivals the Gartner Group and the Meta Group.

The Gartner Group was founded in New York in 1979 by Gideon Gartner, a former market researcher at IBM and Wall Street computer industry analyst. During the 1980s, the Gartner Group became a public company before being acquired by UK advertising giant Saatchi & Saatchi. A management buyout funded by Bain Capital and Dun & Bradstreet floated the company again in 1993. The name was changed to Gartner in 2000.

Gartner was first represented in Australia by Compass in Sydney and then, from 1988, by Andrew and Irene Brooks out of Melbourne. They hired their first analyst, Chris Morris, in 1992, and in 1995 Gartner set up an Australian subsidiary based in Brisbane to take advantage of Queensland Government tax incentives. Head of research was Bob Hayward, an Englishman who had originally come to Australia in 1987 to run software company Candle. Sales was run by Jim Watson, who had been sent from the US to do the job.

Gartner made a number of important international acquisitions during this period: benchmarking company Real Decisions in 1994 and computer industry

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MORE INFORMATION

Paradoxically, very little has been
written about Australia's computer
press. This chapter is largely
based on conversations with the
people involved, particularly Steve
Townsend, Mike Vanderkelen,
Shuna Boyd and Len Rust.

market researcher Dataquest in 1995.
Gartner invested heavily in Australia and
had employed dozens of analysts by 2000.
It also acquired three significant Australian
computer industry market research
companies.

In 1997, Gartner acquired the market
research division of Strategic Publishing
Group (see above), and Graeme Philipson
moved to Gartner to become Research
Director. At Gartner, Philipson managed
the former SPG products, including the MIS
database and research products from East.
East was a Gold Coast–based company
Gartner had acquired in 1987, which
researched the global telecommunications
market.

In 2012, Gartner acquired Australian
analyst company Ideas International, which
specialised in publishing performance
and pricing data on computer equipment.
Established in Sydney in 1981 by John
Tulloch, Ideas International listed on the
Australian Stock Exchange in 2001 and
in 2004 acquired US-based analyst group
DH Brown Associates. By the time of its
acquisition by Gartner, Ideas International
had offices in Asia, Europe and North
America, and had become Australia's most
successful market analyst group on a global
scale.

Another important player in the 1990s was
the Meta Group, founded in Connecticut in
the US in 1990, by Dale Kutnick – formerly
head of research at the Yankee Group – and
a number of ex-Yankee and Gartner analysts.
An Australian operation was established
under William Ehmcke in 1994 under a
franchise model. Ehmcke had been European
manager for the Yankee Group in 1992–93
and had subsequently worked with Meta
Group in London.

Ehmcke's Meta Group ran successfully
until Meta bought him out in 2001, and
Meta itself was acquired by Gartner in 2005.
Another leading US analyst group, Forrester
Research, made a number of attempts to

enter the Australian market in the 1990s, but was unsuccessful, primarily because it hired salespeople rather than analysts. Gartner made many other acquisitions around the world. At the time of writing, it is larger than all of its competitors combined and its annual symposium is the largest event in the IT industry calendar.

THE 21ST CENTURY AND THE DEATH OF PRINT

The growth of the Internet and the changing dynamics of the advertising market revolutionised the structure of the computer press in the 21st century. The publishing industry was affected internationally, but the shock was particularly stark in an industry with so many low-circulation specialist titles. Already in the 1990s many computer publications were only available online and in the 2000s, those that had print editions mostly discontinued them. The mainstream media continued to cover IT-related issues, but in the absence of significant advertising revenues from computer companies – and with many other cost pressures – the significance of the coverage declined.

Like many other parts of the media, Australia's computer publications fragmented. They were generally unable to operate under a subscription model and most titles are funded through online advertising. At the same time, the number of PR consultants both inside computer vendors and working for them through agencies has grown immensely. This inevitably led to a massive increase in the proportion of content created by vendors and a decline in that generated by old-school journalists.

In Australia today, computer-related titles are predominantly opinion columns and product reviews or news generated from vendor press releases. There is no shortage of content, but the quality suffers badly.

THE APPLICATIONS SOFTWARE REVOLUTION
MANY AUSTRALIAN SOFTWARE COMPANIES RODE THE APPLICATIONS BOOM OF THE 1980s AND 1990s.

26

I n the 1970s and 1980s, changes began that would completely transform the software industry in the decades that followed. New software technologies emerged and took advantage of more powerful hardware technology, a function of Moore's Law. Hardware and software moved in lock step: more powerful processors enabled software to do more, more sophisticated software in turn drove the demand for greater processing capacity.

This chapter discusses at the emergence of the relational database model and how it affected the emerging applications development market in Australia and internationally. It looks at developments in enterprise software in the 1980s and 1990s and how they affected the Australian computer industry. Other software developments, such as the evolution of applications development tools and operating systems, are examined in the following chapter.

THE RELATIONAL DATABASE PHENOMENON

In 1969, the same year IBM unbundled software (see Chapter 12), one of its developers invented a new database structure. Edgar F 'Ted' Codd was an Englishman who had worked for IBM since 1948. In 1970, he published an influential paper *A Relational Model of Data for Large Shared Data Banks*, which outlined his ideas on what would become known as a relational database management system (RDBMS).

The relational model differed from earlier hierarchical databases in that it stored data as a series of tables that were related to each other through a shared field. For example, a database system might have separate tables for customer address details and customer transactions, both of which would have a common customer number field that related them to each other.

Codd initially had difficulty convincing IBM of the merits of the new concept, but gradually his ideas took hold. In 1974, IBM initiated its System R project to develop an RDBMS based on Codd's ideas using the new structured query language (SQL) that another team at IBM had developed. The first product sold in 1977 and IBM changed the name to DB2 in 1983.

Meanwhile, others outside IBM began to notice the new concept, most significantly a small company founded

"AUSTRALIA HAS THE CHANCE TO BE MADE TO GLOBAL PLAYER IN SOFTWARE, AND WE HAVE COMPANIES HERE WITH THE POTENTIAL. ONE OF THE PROBLEMS IS THAT THE GOVERNMENT DOES NOT SEEM TO DIFFERENTIATE BETWEEN THE HOME-GROWN SOFTWARE INDUSTRY AND THE INTERNATIONAL PLAYERS. THE KEY FACTOR IS LOOKING AT WHETHER PROFITS WILL GO."

ADRIAN DI MARCO, 2000

in Silicon Valley in 1977 called Software Development Laboratories – renamed Relational Software Inc in 1979, and Oracle Systems Corporation in 1982. Founded by Larry Ellison, Oracle soon became one of the largest software companies in the world.

The company released its first commercially available RDBMS, called Oracle, in 1979. For the next ten years, this new and emerging technology was problematic. It had considerable performance, stability and reliability issues compared to the established database technologies of that era.

But by the late 1980s, RDBMSes started to gain ground against other types of databases. Other early RDBMSes were Ingres, Informix

and Sybase, all in Northern California; Progress from Massachusetts; and software giant Microsoft in Washington, which entered the market with its SQL Server in 1989. All of these databases used SQL to access and manage data.

During the 1990s, the RDBMS model came to dominate the software industry. Its many advantages – flexibility, USbility, logical structure – became more apparent as products based on the paradigm became more efficient and computer hardware became more powerful.

THE DATABASE WARS COME TO AUSTRALIA

Before the emergence of RDBMS technology, the Australian database market was dominated by IBM's IMS and products from companies like Cincom, Cullinet and Software AG (see Chapter 19). Australia's large banks and financial institutions in particular were very advanced in their use of database and online transaction processing (OLTP) technology, but their systems were based on an ageing model.

This model was superseded when the major RDBMS vendors arrived in Australia in the second half of the 1980s. First came Oracle, initially distributed by Peter Jones's Techway (see Chapter 27) before commencing its own Australian operation in 1985 under Englishman Steve Clarke. Clarke left Oracle Australia in 1990 to set up a local Sybase subsidiary. Informix and Ingres also established Australian operations.

One of the first major users of Oracle in Australia was new software company TechnologyOne, founded by Adrian Di Marco in Brisbane in 1987 (see below). Di Marco decided to base his company's software on the RDBMS model and chose Oracle as its development platform. He explained:

■ "Oracle's marketing was good, though the technology we believed was inferior at the start. Very early on, I realised that marketing is a very important part of being successful. We needed to go with the company that had the strongest market presence.

■ "Oracle technology was always a couple of years behind the others, but it's not better technology that always wins. We were one of the first companies in the world to build products on the platform. It was pretty basic at first, with quite a few performance issues, but we made it work."[504]

Unfortunately for TechnologyOne, in 1987 Oracle made the decision to start its own applications software division, which would directly compete with TechnologyOne's products. Oracle revoked all TechnologyOne's licences and would not even let it attend that year's inaugural Australian Oracle user conference.

TechnologyOne was still able to obtain licences for Prime Computer, which had a master distributorship agreement with Oracle. But instead, it quickly decided to make its products' database independent, porting first to Ingres and then to the other RDBMS products.

Oracle became very big very quickly. In 1990, it made US$1 billion in revenues globally and $30 million in Australia. But it suffered from expanding too quickly and faltered when it rushed Version 7.0 to market still full of bugs. Australian revenues declined by one-quarter between 1990 and 1991, until the new Australian Managing Director John Thompson put a successful turnaround strategy in place.[505]

Ingres, Informix and Progress were also doing well in Australia and after Sybase was set up locally, it too became a contender. Ingres Australia was headed by Alan Jarvis and was particularly popular in universities. Informix, led by Howard Haythornthwaite, was more successful in the commercial world. Progress, headed by Steve Brady, concentrated on the applications developed with its software.

The database wars of the early 1990s

TO MANY PEOPLE'S
SURPRISE,
MICROSOFT BECAME
ORACLE'S MAIN
RDBMS COMPETITOR,
RELEASING THE FIRST
VERSION OF ITS SQL
SERVER RDBMS IN
1989. THE PRODUCT
WAS TECHNICALLY
INFERIOR AND
UNCOMPETITIVE
AT FIRST, BUT
MICROSOFT
CONTINUED TO
IMPROVE IT AND
THE COMPANY'S
INCREASING
DOMINANCE IN THE
SOFTWARE INDUSTRY
ENSURED ITS
SUCCESS.

were fiercely contested globally and in Australia. Oracle was particularly famed for its aggressive style, reflecting the personality of founder Larry Ellison.

Ellison, a keen sailor, skippered his maxi yacht *Sayonara* to secure line honours in the 1995 and 1998 Sydney to Hobart Yacht Race. The 1998 race was infamous for disastrous weather; six sailors died and most of the fleet failed to finish. Ellison famously returned home to California within 30 minutes of the race finishing, vowing never to return. He said it was a "life-changing experience".

Oracle's technology improved and its growing application software division helped drive its market presence to an eventual victory in the database wars. In 1997, Informix suffered a major reverse because of accounting irregularities so severe they sent CEO Phillip White to jail. It was acquired by IBM in 2001. Ingres was acquired by ASK Computer Systems in 1990 and ASK itself was then acquired by CA Inc in 1994, which spun it out again as a separate company in 2005. Sybase was acquired by German company SAP (see below) in 2010.

To many people's surprise, Microsoft became Oracle's main RDBMS competitor, releasing the first version of its SQL Server RDBMS in 1989. The product was technically inferior and uncompetitive at first, but Microsoft continued to improve it and the company's increasing dominance in the software industry ensured its success.

Meanwhile, IBM's mainframe DB2 became increasingly popular and it released a version for its AIX version of Unix. During the 1990s, the RDBMS model continued to supplant earlier database paradigms. At the time of writing the relational model is dominant; Oracle, Microsoft and IBM are the three biggest players.

WHAT MAKES DICK PICK TICK?

Pick was another very important database environment in Australia, named after Dick Pick, a programmer at giant US defence

contractor TRW. Pick and Don Nelson, who also worked at TRW, developed a software system called the Generalized Information Retrieval Language System (GIRLS) on an IBM System/360 in 1965. GIRLS was based on a multi-value data model, which allowed for multidimensional tables and great programming flexibility. Model 204, which still runs Australia's social security system (see Chapter 19), was based on the same model.

In 1973 US software company Microdata Corporation released an operating system based on the same concept. Pick left TRW and formed Pick Systems to popularise Reality, which became known as Pick. By 1980, it had been ported to many hardware platforms and was widely used.[506]

The new operating system was particularly suited to many business applications, and would form the basis of Prime Computer's Prime Information and of IBM's UniVerse environment. Prime was a very popular vendor in Australia during the minicomputer boom of the 1980s (see Chapter 20), and many Australian software houses – such as Fenwick Software and Clegg Driscoll Consultants – adopted the Pick environment.

The International Pick Users Association (IPUA) was very influential in Australia, and from 1988 to 1994 the annual Australian PickLab conferences were well attended. But despite its many advantages as a programming environment, Pick's popularity waned, for two key reasons.

One was the growth of the Unix operating system, but equally important was the fragmentation of the Pick market. Pick himself was a poor promoter of the operating system that bore his name and his efforts to maintain control were counterproductive. He often seemed more interested in litigation than improving the software.

■ "The Pick community was certainly not united. Even the local Victorian IPUA attempted to assuage their vendors' sensibilities by renaming themselves to the Multi Dimensional Database Forum to remove the word 'Pick' from the association name. Few licensees embraced TCP/IP and fewer still acknowledged SQL and interoperability, and those that did make such an investment ensured that it remained proprietary and certainly not portable to other Pick vendors.

■ "The Pick community's inability to work together on keeping up with technology will be one of the reasons that many organisations will be electing to drop Pick as their preferred business platform and select more expensive mainstream solutions. There were some efforts to create a Windows-based front end but it came to nothing as funding was limited to one vendor.

■ "It is also my own opinion that industry was so used to the two-dimensional database model that interfaces tended to mirror the spreadsheet in concept. Pick's data model being inherently three (or even four) dimensional was difficult to effectively represent with the tools of the day. It is of passing interest that today's advanced HTML is now capable of such a representation without too much difficulty."[507]

By the time Dick Pick died in 1994, his operating system was in severe decline. It no longer exists.

THE EMERGENCE OF FINANCIAL SOFTWARE

One of the first things organisations computerised was their financial systems. Every organisation kept both a general ledger and a record of accounts payable and receivable, and computers are ideal for the routine nature of these processing functions.

But in the early days there were no off-the-shelf financial software packages; people had to write their own software. It

BUT IN THE EARLY DAYS THERE WERE NO OFF-THE-SHELF FINANCIAL SOFTWARE PACKAGES; PEOPLE HAD TO WRITE THEIR OWN SOFTWARE. IT WAS ONLY AFTER IBM'S DECISION TO UNBUNDLE SOFTWARE IN 1969 THAT AN INDEPENDENT SOFTWARE INDUSTRY CAME INTO EXISTENCE AND THE FIRST FINANCIAL SOFTWARE PACKAGES WERE RELEASED.

was only after IBM's decision to unbundle software in 1969 (see Chapters 12 and 19) that an independent software industry came into existence and the first financial software packages were released.

A forerunner in the field was Management Science America (MSA). Founded in 1963 in Atlanta, Georgia as a custom programming company, MSA grew quickly during the 1960s. When it ran into financial difficulties in 1970, John Imlay, a prominent local businessperson and computer consultant, was brought in to rescue it.

Imlay, a colourful individual and a dynamic salesperson, concentrated on products and cutting costs. By 1980, MSA was one of the most successful companies in the software industry and the leading supplier of financial software for America's large enterprises. Imlay visited Australia in 1984 to give the keynote address at the 11th Australian computer conference.[508]

Another pioneering financial software company was McCormack & Dodge, founded in Massachusetts in 1969. It also began as a services company and moved into application software with a low-cost fixed-assets system in the 1970s, becoming MSA's largest rival in the US.

McCormack & Dodge was acquired by business services firm Dun & Bradstreet in 1983. After the acquisition, it operated as an independent division, keeping the McCormack & Dodge name. In 1989, Dun & Bradstreet acquired MSA and merged it with McCormack & Dodge to form an independent subsidiary called Dun & Bradstreet Software. The merger was not a success; there were major cultural clashes between MSA's aggressiveness and McCormack & Dodge's more reserved style.[509] There were also problems merging the two product lines.

Dun & Bradstreet Software briefly became a major player, but problems persisted and it was acquired by Geac Computer Corporation in 1996. Geac was then acquired by Infor in 2006.

The other major financial software vendor

of this period was Software International, with a financial suite called Masterpiece. Founded in Massachusetts in 1974, Software International was acquired by General Electric in 1981, which subsequently sold it to Computer Associates in 1986.

MSA and McCormack & Dodge were both active in Australia. MSA entered the Australian market directly in 1979 with an office in Sydney. It opened a second office in Melbourne in 1983. Managing Director Kerry Frederick was replaced in 1984 by George Koukis and later by Gary Corcoran, who had previously worked with Prime Computer. Its first Marketing Manager was Bill Dunn, who later ran Computer Associates in Australia. MSA secured most of Australia's big banks and insurance companies as users, and was the largest financial software vendor of that era.

McCormack & Dodge was first distributed in Australia in 1979, by Adaps (see Chapter 19). It set up a subsidiary in Sydney in 1986 under Barrie Williams, who later took Australian company Mincom into Asia .

AUSTRALIAN FINANCIAL SOFTWARE VENDORS

Many Australian companies developed financial software during this period. A short and non-inclusive list follows.

WACHER PARTNERS AND STOWE

Wacher Partners was established as a software development company in the Sydney suburb of Hurstville in 1968, by Bill Wacher. The fifth employee was Colin 'Col' Hoschke, a former AMP actuary and operations manager at the Sydney Stock Exchange. Hoschke became CEO in 1974 when Wacher moved to Coffs Harbour for family reasons, returning in 1983 as Marketing Manager.

After Wacher left, Hoschke was joined by merchant banker David Thorpe as a partner in the business. They opened a Melbourne office in 1977 and became one of Australia's largest software houses, specialising in

software for the medical, transport, health insurance and manufacturing industries.

In 1984, Wacher acquired Harry Douglas's Datec (see Chapter 19) and called the combined company Datec, recognising the better brand recognition. In 1987, Datec merged with Stowe Computing Australia and changed its name to Stowe Computing International, before selling the professional services business to Canadian consulting group DMR in 1987. When Canadian software company Geac acquired most of Stowe Computing International in 2006, what was left of the business changed its name back to Wacher Partners, with Hoschke still in charge.

In 1991, Wacher established a subsidiary called SoftGen to distribute software built on the Informix relational database and its allied FourGen fourth-generation programming language (4GL). Wacher was acquired by British IT services company Sanderson in 1996 and became part of its Civica software subsidiary. Hoschke became Chairman of the company's Australian operations and was Executive Chairman of Australian software vendor Mainpac from 2001 to 2010. SoftGen was not part of the acquisition deal and remains in existence as an independent software company.

NELLER

John Neller founded John Neller & Associates in Adelaide in 1976. The company name was changed to Neller Software in 1984 and then to simply Neller in 2005, prior to its sale to English HR vendor Northgate Arinso in 2010 and subsequently to the Australian Company Ascender early in 2017.

The popular original HR product was PAYMAS, the name of which was changed to the extremely successful Preceda in the mid-1990s. The two original fixed assets systems MAFAS and COFAS were developed in the late 1970s but discontinued in 1999.

MOST LARGE
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APPLICATIONS
SOFTWARE UNTIL
THE RISE OF
ERP AND THE
EVOLUTION OF
A PACKAGED
SOFTWARE
MARKET. GERMAN
COMPANY SAP
BECAME THE
MARKET LEADER.

IBM AUSTRALIA

IBM Australia produced local software packages including the manufacturing application IMP/3 in 1976 and the accounting application IMAS in 1977. It subsequently redeveloped IMP/3 as MAPICS (Manufacturing, Accounting and Production Information Control System) in the US and sold it to US software company Marecam in 1993. In 2005, IBM Australia was acquired by Infor.

PROPHECY

Prophecy began life as Computer Software Packages in Adelaide in 1979, and changed its name to Prophecy International in 1992. Its first products were accounting packages Basis and Midas, and it listed on the Australian Stock Exchange in 1997.

SYBIZ SOFTWARE

Sybiz Software was established in Adelaide in 1983 as accounting software that ran on Hewlett-Packard–programmable calculators but was later developed for the PC platform. Sybiz was acquired by Softline in 1998, which was acquired by the UK company Sage in 2003 before re-emerging through a management buyout in 2005.

PRONTO

Prometheus Software was founded in Melbourne in 1984 and acquired by SaUSge Software in 1999. After a management buyout in 2002, it changed its name to Pronto – the name of its primary product – and is today a strong contender in the midrange enterprise resource planning (ERP) market.

BCM SYSTEMS

Sydney-based BCM Systems released its first software package in 1987. Founder Steve Ironside sold half the company to Swedish financial software vendor Intentia in 1996 and the remainder in 2002. Intentia merged with Lawson in 2005 and the combined company was acquired by Infor in 2011.

MYOB

MYOB (Mind Your Own Business) was founded in Melbourne in 1991 by Christopher Lee and Brad Shofer to develop accounting software for the PC market. It has had a convoluted history and many changes of ownership, and is now a public company traded on the Australian Securities Exchange.

FROM FINANCIAL SOFTWARE TO ERP

In 1964, US electric tool manufacturer Black & Decker became the first company to implement a computer-based material requirements planning (MRP) system, using an IBM 1401. MRP was a system invented by Joseph Orlicky, a US production engineer, to manage the material used in any production process. Oliver White released an improved system called MRP II in 1983. The second MRP stood for 'manufacturing resource planning'.

- "MRP II featured modules as a key software architectural component and integrated core manufacturing components including purchasing, bill of materials, scheduling, and contract management. For the first time, different manufacturing tasks were integrated into a common system.
- "MRP II also provided a compelling vision of how organisations could leverage software to share and integrate enterprise data and boost operational efficiency with better production planning, reduced inventory, and less waste."[510]

In the late 1980s, MRP II evolved into enterprise resource planning (ERP) and could integrate all of an organisation's high-end applications, not only those used for manufacturing. The development of ERP was directly driven by the need for commercial computing applications to talk to each other.

Most large organisations wrote their own applications software until the rise of ERP and the evolution of a packaged software market. German company SAP (*Systeme, Anwendungen und Produkte*, or Systems, Applications and Products) became the market leader.

SAP was founded in 1972, based in the small town of Walldorf just south of Heidelberg. Five software engineers from IBM Germany had been told to stop working on a new enterprise software development project because IBM had acquired some off-the-shelf software. So they left and set up SAP, releasing their first product in 1973. The real breakthrough came in 1979 when they launched R/2, a product that incorporated payroll, accounting and MRP II. They followed up with a greatly improved R/3 product in 1992.

ERP changed the game. Before SAP, it was common for users of large computer systems to apply different software from different companies for different purposes – an approach often known as 'best of breed'. But the idea of a single integrated system across all applications was extremely attractive and most major financial software companies began redeveloping to ERP systems.

SAP came to Australia in 1989, with Managing Director Graham Young. He was followed by Les Hayman, later head of Sun in Australia (see Chapter 20). Early adopters included Australian branches of German firms like BASF, and Shell. After R/3 was released in 1992, SAP became the fastest growing multinational software company in Australia.

SAP was the market leader but there were many other ERP companies, including Australia's Mincom and TechnologyOne (see below). The ERP boom completely altered the enterprise software market. Many of the major players in the 1980s merged or folded, which led to massive consolidation in the global financial software and ERP markets in the 1990s.

Other ERP companies like PeopleSoft and Baan did well for a while, though both were eventually acquired (PeopleSoft by Oracle

and Baan by SSA). Many older manufacturing software companies like JD Edwards successfully moved into ERP, though others had less success.

Infor, which moved its offices from Atlanta, Georgia, to New York City in 2012, acquired many major financial software and ERP players, including Lilly Software Associates; MAPICS; Geac, which had itself acquired many financial software companies including Dun & Bradstreet Software, JBA and Australia's Stowe; SSA, which had acquired Baan; Lawson, which was the eventual owner of Australia's BCM; and GT Nexus.

Today there are just three major ERP players – SAP (which remains the market leader), Oracle and Infor – with many minor players. In Australia, TechnologyOne (see below) is also a major player.

QUEENSLAND ERP SUCCESS STORIES: MINCOM AND TECHNOLOGYONE

Mincom (Mining Computing) was an early ERP success story in Australia. The company

– founded in Brisbane in 1979 by David Merson and three partners – became the world leader in software for mining industry in the 1980s and 1990s. Mincom entered the US market in 1984 and was very successful in South America, with a regional office in Santiago, Chile.

In 1986, Barrie Williams, previously head of the Australian subsidiary of McCormack & Dodge, joined Mincom with a brief to grow the company's business in Asia. The Australian Government's Austrade seeded the company $1 million and Williams open an office in Singapore in 1990.

The Asian business was successful, securing resellers and customers in Indonesia, Malaysia, Thailand, the Philippines, Korea and Hong Kong. Williams was instrumental in developing a major initiative to make the product double-byte, so it could handle multiple language and character sets.

In the 1990s, Mincom became a global software giant, dominating its sector. It expanded beyond mining into other asset-intensive industries such as transport and defence. In 1992, Mincom scored a major contract with US railway Union Pacific and also became the prime contractor to the Australian Department of Defence's enormous Supply System Redevelopment program. In 1997, US equipment giant Caterpillar bought a 10 percent stake in the company.

Mincom's most successful product was MIMS (Mincom Information Management System), later renamed Ellipse. By the mid-1990s, Mincom was a global leader this type of software. It had customers in 40 countries, employed 1,300 people and brought in revenues of $200 million per year. At one stage, eight of the world's top 10 mining companies were using its software.

Revenues began to decline after Mincom's founder David Merson retired in 2000. In 2005, the Board hired Richard Mathews as Managing Director to turn the company around. He replaced most of the management and sales staff, and returned the company to profitability. [511]

In 2007, Mincom was bought by US private equity firm Francisco Partners, which sold it to Swedish–Swiss engineering giant ABB Group in 2011. ABB merged Mincom with its Ventyx ERP software subsidiary, and the Mincom name disappeared. Ventyx still maintains a large software development centre in Brisbane.

TechnologyOne was even more successful than Mincom. Programmer Adrian Di Marco started the company in Brisbane in 1987, and focused on developing financial software. TechnologyOne's first office was in a demountable building in front of a tannery owned by JL McTaggart Industries, an agricultural company that was a seed investor and the software developer's first customer.

TechnologyOne started slowly, working on custom-designed software projects, but Di Marco's intention was always to build packaged software. It released its first product, FinanceOne, in 1991. In 1992, it finished two large contracts, the College Administration System for Queensland TAFE and the Automated Titling System for the Queensland Department of Natural Resources and Mines. These substantial projects funded further growth.

Di Marco made an early decision to base the company's software on relational database technology (see above), which proved prescient as the industry moved definitively in that direction in the 1990s. TechnologyOne attracted national recognition in 1995 when it came out on top in *CFO* magazine's customer satisfaction survey. TechnologyOne used the results extensively in its advertising and the company grew quickly, attracting international orders and opening offices around Australia. In 1999, it sold to its hundredth customer and listed on the Australian Stock Exchange.

TechnologyOne invested heavily in research and development. It released a range of other products in the 1990s targeting the tertiary education and local government sectors, became and remains a market leader. TechnologyOne redeveloped FinanceOne to become a multifunctional ERP package. In 2000, it opened offices in Malaysia and New Zealand.

TechnologyOne also grew through acquisition, buying local government software company Proclaim in 2000, and enterprise content management company Avand in 2007. In 2015, it acquired Icon, Digital Mapping Solutions and Jeff Roorda & Associates.

TechnologyOne opened an office near London in 2006 and is now a major supplier in the tertiary education, local government and emergency services markets in the UK. It is Australia's largest software company, with more than 1,000 employees and 1,000 customers worldwide. Its market capitalisation exceeds $2 billion and it runs the largest software development centre in Australia, employing more than 400 developers. It also has development centres in Bali, Indonesia, and Ho Chi Minh City, Vietnam.

A key aspect of TechnologyOne's success has been its Power of One philosophy. Unlike most software vendors, it has no external sales channel or implementation partners. TechnologyOne handles everything itself, enabling it to maintain complete control of the customer relationship. It established the TechnologyOne Foundation in 2015, becoming one of the largest corporate donors in the Australian computer industry.

Adrian Di Marco was CEO until 2017, when he stepped down and was replaced by Edward Chung, but stayed on as Executive Chairman. At the time of writing TechnologyOne was moving predominantly into the cloud (see Chapter 28), totally redeveloping its software for that environment.[512]

MORE INFORMATION

Except for Graeme Philipson's corporate history of TechnologyOne, information to date on the Australian application software industry is patchy; to address that gap John Neller is writing a book on the first 50 years of the Australian software industry, with publication anticipated in late 2017 or early 2018.

COMMODITISATION, SERVICES AND APPLICATIONS DEVELOPMENT

THE 1990s SAW A BOOM IN MANY PARTS OF THE INDUSTRY, BUT AUSTRALIA REMAINED A TECHNOLOGICAL COLONY.

27

During the 1990s, the Australian computer industry, already mature, continued to grow strongly. The key technology of the 1990s was the increasing ubiquity of the Internet (see Chapter 28), but there were many other important trends. Moore's Law ensured that computers, from desktop to mainframe, became much more powerful, even as their prices plummeted. PC USge became commonplace with the commoditisation of hardware.

An important consequence of this was the decline of proprietary operating environments. The growing power of Intel's x86 chip family made it increasingly unviable for other companies to continue developing their own microprocessor architectures. At the software level, the popularity of Microsoft Windows on the desktop and Unix on larger computers hastened the decline of other operating systems.

That led to the downfall and eventual death of many of the major computer companies that defined the industry in the 1970s and 1980s. Companies as large and as important as Control Data, Amdahl, Wang and Digital Equipment Corporation (DEC) did not make it into the 21st century. Honeywell, Unisys, NCR and a host of others either got out of computers altogether or became bit players. The enterprise resource planning (ERP) boom of the early 1990s (see Chapter 26) turned into a bloodbath by the end of the decade.

No one, it seemed, was immune. Even IBM, once as large as its dozen closest rivals combined, faltered in the early 1990s and never regained its dominance. It remains an important vendor in the 21st century, but it is now just another player in a transformed world.

While many companies failed, others took their place. One PC maker, Dell, pulled away from the pack and became one of the industry's largest hardware suppliers by the end of the decade, and the Internet spawned a host of new players.

The services sector also grew strongly. At the beginning of the 1990s, Australian-owned services companies dominated, but by the turn of the century virtually all of them had been taken over by multinationals, which had an even stronger grip on the local industry than they had previously.

This chapter looks at a number of the key trends in the 1990s, and how they affected the Australian computer industry. The chapter that follows examines the Internet

"CHANGES IN SOFTWARE AND SERVICES THAT ARE AS DRAMATIC AS THE HARDWARE CHANGES WE'VE SEEN OVER THE PAST TEN YEARS ARE ALREADY STARTING TO TAKE EFFECT. RELATIONAL DATABASES, AI, OBJECT-ORIENTED PROGRAMMING, CASE TOOLS, EXECUTIVE INFORMATION SYSTEMS, CUSTOMER INFORMATION SYSTEMS WILL BECOME A MAJOR FACTOR IN THE AUSTRALIAN MARKETPLACE."

LEN RUST, IDC, 1992

boom of the 1990s and how it led to the information millennium.

THE EVOLUTION OF APPLICATIONS DEVELOPMENT

When computers were first developed in the 1940s, programming them was very difficult. There were no computer languages, and each individual computer had to be programmed using the instruction set of the computer, known as machine code. This was often as basic as the zeros and ones used by the computer, and was sometimes achieved with switches or cables and plugs.

The next generation of programming was assembly language. The raw machine code was replaced by simple instructions that aggregated common functions such as adding or subtracting. Assembly language programming was a vast improvement on machine language, but it was still specific to the individual computer being programmed. Next came high-level languages, the first of which was Fortran (**FOR**mula **TRAN**slation), developed by John Backus at IBM in the mid-1950s.

Fortran and other high-level languages, such as the popular COBOL (**CO**mmon **B**usiness-**O**riented **L**anguage), developed in 1959, replaced assembly programming with a portable programming language that could be used on different computers through a utility called a compiler, which translated the high-level language to assembly language.

By the time computers became widespread in business, applications development was a comparatively simple, if cumbersome, exercise. Many other languages came into existence, and as computer performance increased, software developers looked for better and easier ways to program.

In the 1970s, a new applications development technique came into existence, as demand for increased computer performance began to far outstrip the capabilities of the limited number of programmers to write and maintain what

was wanted. These new tools were called 4GLs (fourth-generation programming languages), machine language being the first generation, assembly language the second and high-level languages the third.

4GLs, such as RAMIS and FOCUS, were reporting and query tools that allowed end users to make their own enquiries of corporate information, usually in the IBM mainframe environment. They worked well, but only when coupled with a good database. They were useful in this role, freeing up programmers to develop applications. 4GLs produced USble computer code, and were widely used by end users to create applications without going through the IT department.

At the same time, PCs were becoming widespread in many corporations, further enhancing the idea of end-user computing. 4GLs spread from the mainframe to PCs. Many of the most popular PC applications, such as the Lotus 1-2-3 spreadsheet and the dBase database products, were in effect 4GLs optimised for particular applications.

But most of them produced code that needed to be interpreted each time they ran, which made them a drain on computing resources. Programs written in these early 4GLs typically ran much more slowly than programs written in 3GLs, just as 3GL programs ran slower than assembly language programs, which in turn ran slower than those written in machine language.

This drain on resources led many companies to re-evaluate their use of 4GLs, and also caused the 4GL suppliers to create more efficient versions of their products, usually through the use of compilers. 4GLs are more accurately called non-procedural languages; they are used to explain what needs to be done, not how it should be done.

For all the advantages offered by 4GLs, there remained a need for query languages, which was what 4GLs were originally designed for. The increasing use of relational databases in the 1990s saw SQL (Structured Query Language) evolve to perform many of the query functions of the early 4GLs.

From 4GLs, it was a short step to what came to be called applications generators. Whereas 4GLs produced code in their own specialised languages, applications generators produced standard 3GL code through a user-friendly 4GLtype front end. Thus, the use of a 4GL was similar to that of an applications generator, and the two product types competed against each other. But the end result was different. Applications generators had the advantage of producing code that could then be maintained or modified by 3GL programmers unfamiliar with the way in which it was produced.[513]

THE RISE AND FALL OF CASE

Applications generators merged with another new technology in the 1980s – CASE (computer-aided software engineering), which referred to the use of software to write software.

CASE originated from the 1960s Apollo space program, the most complex computer-based project of that era, when two computer scientists – Margaret Hamilton and Saydean Zeldin – developed a set of mathematical rules for implementing and testing complex computer systems.

They later formed a company called Higher Order Software, and their methodology evolved into a product called USE.IT, which was not a commercial success, despite being promoted by software guru James Martin in his influential book *Systems Development Using Provably Correct Constructs*, published in 1979. At the time, Martin was one of the industry's leading and most successful theorists, and an important figure in the development of CASE.

Building applications from scratch is never an easy job. CASE promised to simplify this task: instead of a programmer cutting

code, they would tell a smart computer program what was required, and it would do the work. In its broadest sense, CASE referred to any computer-based product, tool or application that assisted in the software development process.

With the realisation that software design could be systematised came the inevitable development of standard methodologies – procedures to guide systems analysts through the various stages of software design.

Many such systems were designed, such as SSADM (Structured Systems Analysis and Design Methodology), which was mandated by the British Government and became very popular in the UK. These design methodologies were the precursors of CASE, and a precondition to its effective use, guiding analysts and end users through the design process.

The promise of CASE was virtually irresistible. Applications development had long been beset by two major difficulties: getting the developments finished on time; and ensuring the finished software was robust, meaning it was properly documented, internally consistent and easy to maintain.

IBM released a strategy called AD/Cycle, which was like a unified field theory of applications development, an umbrella under which various CASE tools addressing different stages of the applications development life cycle fitted together, allowing developers to mix and match various products to suit their purposes. CASE boomed because it would (so the theory went) allow a developer to outline the specifications, from which point the CASE software would automatically generate the code, which would be well documented, modular and consistent.

But in practice CASE products demanded a level of discipline that did not come naturally to many developers. The products were a great aid to program design, but the real creative work was still left to people, not

CHAPTER 27 – COMMODITISATION, SERVICES AND APPLICATIONS DEVELOPMENT

machines.

Many CASE tools were quite advanced, but none of them ever reached the stage where a developer could simply tell them to develop a retail banking system, for example, and wait for all the code to be written.

Developers found that the bigger the system being developed, the more that could go wrong. Often the complexities existed not so much in the computer system as in the organisational structure it was trying to service. CASE did not address those problems, so most large and small organisations stopped developing their own applications, and most of the CASE vendors withered and died. Some stayed in existence, but they changed their focus and moved into other areas.[514]

AUSTRALIA'S MOST SUCCESSFUL 4GL – ASPECT AND LANSA (AND KAZ)

There were many attempts to develop 4GLs and CASE tools in Australia, but the most successful by far was a product called LANSA. The story begins in the early 1970s, when two young Australian computer programmers worked for a mainframe software company called Alterego in London.

In 1974, one of them – Lyndsey Cattermole – returned to Melbourne, where she set up an Australian office for Alterego. The other, Peter Draney, returned to his home town of Sydney at the end of 1975 to open another Alterego office.

Alterego developed a mainframe product called Shadow, which competed against IBM's CICS (Customer Information Control System), and another called Roscoe (Remote Operating System Conversational Operating Environment), which competed against IBM's TSO (Time Sharing Option). Cattermole and Draney's Alterego Australia sold those products, and also saw an opportunity to move into training for IBM mainframes. They specialised in the PL/1

programming language. They encountered little opposition and soon had many customers, including National Mutual, Westpac, Comalco and Grace Bros.

In January 1978, Cattermole and Draney flew back to London and negotiated a management buyout of Alterego's Australian operations. They renamed the company Aspect.

The IBM mainframe market in Australia was growing strongly, and Aspect grew with it. It expanded into training and software development for Fujitsu mainframes, and by 1980 had offices in Canberra and Adelaide. Its next big break was being awarded a major contract supplying training and services to the Department of Defence's DESINE project, in 1984. Michael Blake, a senior public servant, joined Aspect as its Canberra manager, with a brief to grow the company's business with the Commonwealth Government.

It worked. Aspect won a contract to manage the Department of Defence's entire desktop environment. By the beginning of the 1990s, it was one of Australia's largest software and services companies, with annual revenues approaching $100 million. Its success continued throughout the decade. It rode the outsourcing boom, and was successful in government, both state and federal. By 2000, revenues were more than $200 million.

But there was to be another string to Aspect's bow. In 1983, at the urging of former employee Trevor Campbell, Aspect started a division to provide services to users of IBM's midrange equipment, the System/36 and System/38 (see Chapter 20). Campbell, who had left Aspect to join IBM Australia as a senior systems engineer on the System/38, persuaded Draney and Cattermole of the size of the market, and they hired Peter Kazacos to run the division.

One of the contracts they won was with Colgate, a heavy System/38 user, which

ASPECT AND KAZ WERE TWO OF AUSTRALIA'S MOST SUCCESSFUL COMPUTER SERVICES COMPANIES IN THE 1990s. THE TERM 'COMPUTER SERVICES' IS A BROAD ONE, COVERING AREAS AS DIVERSE AS CONTRACT PROGRAMMING AND SOFTWARE DEVELOPMENT, PROJECT MANAGEMENT, AND RECRUITMENT AND HUMAN RESOURCES, THROUGH TO PROVIDING AN ORGANISATION'S ENTIRE COMPUTING NEEDS – A PRACTICE KNOWN AS OUTSOURCING.

asked them if there was a better way to develop software for the machine than using IBM's RPG programming language. A programmer at Aspect, Mark Duignan, developed a 4GL for the System/38, which he called LAMDA (Language to Automate the Management Development of Applications).

The new 4GL was highly successful. The name was changed to LANSA when Aspect started selling the product internationally, as LAMDA had already been trademarked in some countries. It became one of Australia's most successful software exports and is used by thoUSnds of IBM midrange users worldwide. In 2000, LANSA was spun out of the parent company.

Peter Kazacos left Aspect in 1988 to start his own company, KAZ Computer Services, which owed its initial success to LANSA.

He left after insurance company AMP asked if he could write a superannuation system for IBM's new AS/400, the successor to the System/38. While AMP's internal development staff had said it would take three years to write the system, Kazacos knew he could do it a lot quicker with LANSA, so he left Aspect, bought a LANSA licence and successfully bid for the AMP job.

The new company grew quickly when Kazacos found out that many companies wanted to use AS/400 machines but didn't want to run them. KAZ landed large contracts with Computer Sciences of Australia (CSA) and Nestlé, and soon diversified beyond the IBM midrange to become a major services company across all computer environments, competing against Kazacos's former employer Aspect and many other players in the industry.[515]

KAZ went public in early 2000, by which time the company had 200 staff members. It continued to grow strongly, buying AMP's superannuation administration business, which catapulted the company into the business process outsourcing market. It acquired Aspect in 2002, which gave it a strong presence in Canberra and made it

the third-largest IT services company in Australia behind IBM and Electronic Data Systems (EDS).

Around this time, Australia's biggest telco, Telstra, made the decision to expand into IT services. It acquired KAZ in 2004, and expanded the business further before selling it to Fujitsu in 2009. All of this started with LANSA, which continues today as a successful independent company, with Peter Draney still at the helm. Its software is available in 15 languages, and the company has offices in Asia, Europe and North America. Cattermole is no longer with the company, and has become a well-known figure in the Australian corporate scene, serving on many boards.[516]

OUTSOURCING AND THE GROWTH OF THE COMPUTER SERVICES INDUSTRY

Aspect and KAZ were two of Australia's most successful computer services companies in the 1990s. The term 'computer services' is a broad one, covering areas as diverse as contract programming and software development, project management, and recruitment and human resources, through to providing an organisation's entire computing needs – a practice known as outsourcing.

Now as then, many computer services companies also develop software packages and resell hardware and software from other companies. A common activity is systems integration, the building of new systems from diverse hardware and software.

But outsourcing, in its various forms, was the key driver of the services industry in the 1990s. The term came to mean the contracting out of all or part of the IT function. The arguments around outsourcing were essentially those of 'make versus buy', familiar to any manufacturing concern. The movement from in-house development to packaged software, described in Chapter 26, was part of this trend.

Towards the end of the 1990s and into the new millennium, outsourcing took on a whole new dimension, known as 'offshoring', whereby various business functions – including software development – were outsourced to other countries. Very often, 'other countries' meant India, whose software industry grew enormously in the 1990s.

The removal of import restrictions, improved data communications, and the sheer number and quality of Indian software professionals, combined with their very low cost compared to their Western equivalents, made India an attractive software development centre for many Western vendors and users.

There was also substantial immigration of Indian programmers to Western countries, particularly the UK, the US and Australia, which caused something of a backlash. Even as Western governments and industry spokespeople were proclaiming an IT skills shortage, employment figures and salaries in the IT industry fell, a development blamed mainly on offshoring and the immigration of IT workers.

What most observers missed was the fundamental structural change occurring in the industry – the shift of IT jobs from inside user organisations to outside. Outsourcing was an attempt to lower the costs of IT, particularly in areas such as applications development, hardware maintenance, and network and data centre management.

Increasing amounts of activity moved from internal (do-it-yourself) to external (product): buying packages rather than writing applications; plugging into the Internet rather than building networks; and outsourcing training, programming and help desks.

Outsourcing became particularly popular in Australia in the 1990s. Aspect and KAZ were key players, but there were also many others, both homegrown and multinational. Computer Power's success in the 1980s was described in Chapter 19. Other companies are discussed below.

PAXUS

Paxus was a major player in the Australian computer scene in the 1980s and 1990s. It was formed in 1987 by the merger of Idaps Computer Science and New Zealand–based Paxus information Services. The name Paxus was retained because it was believed to have better brand recognition (it stood for **P**acific **A**ustralia e**X**port **US**).

Founded in Sydney in 1966 by John Bagshaw, Idaps became a major computer bureau, listing on the Sydney Stock Exchange in 1970. It continued to grow throughout the 1970s and 1980s, acquiring Melbourne-based recruitment agency Adaps in 1981 (see Chapter 19). In 1986, it bought a 60 percent share in CSIRONET (see Chapter 24), turning it into a joint venture.

Paxus was originally the IT services arm of New Zealand Insurance. It entered the Australian market in the early 1980s, largely through acquisition, buying 75 percent of David Hartley's Hartley Computer Group (see Chapter 21) in 1982.

In 1985 it acquired Casac, a Sydney-based consulting group whose acquisition greatly increased Paxus's consulting capabilities and presence in Australia. Other acquisitions included Systems Control Programming (SCP) and Australian Commercial Computing, both also in 1985.

The 1987 merger of Paxus and Idaps created a trans-Tasman software and services giant. Paxus Corporation, as the combined entity was called, immediately listed on the Australian Securities Exchange (ASX). It soon bought the remainder of CSIRONET, which it renamed Paxus ComNet. CSIRO was initially ComNet's biggest customer, but in 1990 it moved its business to the new AARNet (see Chapter 24).

One quarter of Paxus's revenues were from New Zealand, one quarter from Europe and half from Australia. Idaps managing director John Dougall, formerly with Data General, became head of the Paxus information services subsidiary and the

consulting, SCP and recruitment divisions. The former head of Paxus, Neil Cullimore, became CEO of the whole group. Dougall left in 1989.

Paxus specialised in insurance software, its Polisy package being widely used in Australasia and Europe. It ran an electronic document interchange (EDI) network called Tradegate, and was active in the healthcare and government sectors.

Revenues in 1992 reached $250 million. Then, in 1993, Paxus was acquired by US insurance software giant Continuum, which was in turn acquired by CSC in 1996.

CO-CAM

Co-Cam was founded in Melbourne in 1984 by Ken Dodson, as a software development offshoot of actuarial firm Campbell & Cook (hence 'Co' and 'Cam'). It soon became a separate company and by 1987 employed 50 people. It concentrated on software development and systems integration, and became Hewlett-Packard's largest reseller in Australia.

Dodson became executive chair soon after the company was spun out from Campbell & Cook, when Michael Lappen was appointed managing director. In Lappen's nearly ten years as head of CoCam, the company grew to $110 million in annual revenues, with 19 international offices – in Asia, Europe and North America.

In the late 1980s, Co-Cam developed an integrated human resources management system called WorkForce, which was highly successful, and it also became Australia's largest provider of superannuation software.[517] In 1991, insurance company Colonial Mutual acquired 60 percent of the company, mainly for its software products.

Lappen left to become managing director of Wang Australia in 1993, and the following year Colonial Mutual sold the hardware distribution business to Fujitsu. It sold the software business to CSC in 1997, and Co-Cam disappeared.

FERNTREE COMPUTER CORPORATION

Ferntree began life as ACI Computer Services, a subsidiary of Australian manufacturing conglomerate BTR Nylex. ACI spun out from the parent company to supply computer services across the group. In 1989, BTR Nylex renamed it Ferntree Computer Corporation (it was based in Ferntree Gully Road in Melbourne) and sold it to a consortium comprising Citicorp Capital Investors, HG Ventures and Fulcrum Two Trust. Fulcrum was 60 percent owned by the New South Wales Superannuation Board and 40 percent by Westpac.

The aim was to build a large Australian-owned software and services company. It operated a number of divisions:

- Ferntree Financial Systems, servicing the banking and insurance industries
- Ferntree Personnel, a large payroll processor (acquired from Brambles in 1988)
- Sourceware, a PC hardware and software distributor
- Ferntree Computer Systems, a major reseller of PCs and peripherals.

Under managing director Norman McCann, Ferntree grew substantially, reaching nearly $200 million in revenues in the early 1990s. It became a major outsourcer and systems integrator. Ferntree was acquired by US company Technical Management Services (TMS), a subsidiary of GE, in 1996 and renamed GE ICTS. GE then sold it to CSC in 1999.

BHP IT

In 1989, Australian mining giant BHP established BHP Information Technology as a separate company, also incorporating the BHP Aerospace and Electronics division into the new business. Initially its job was solely to service BHP's many operating divisions, but it soon attracted other business, and within two years its annual revenues exceeded $100 million.

BHP IT developed into a major services

player in Australia in the 1990s. In 1991, it became prime contractor for a massive re-equipment program for the Department of Foreign Affairs and Trade, and was particularly active as a major implementer of the SAP ERP system. But, in a familiar story, BHP sold it to CSC in 2000.

DATA#3

One Australian services company not acquired by CSC or any other multinational is Data#3, which remains an important IT services company in Australia today. The company had its origins in Brisbane in 1977, when Terry Powell and Graham Clark founded a computer consultancy, Powell, Clark and Associates (PCA).

PCA merged with Albrand Typewriters & Office Machines in 1984 to become Data#3. It grew to be the biggest PC dealer in Queensland, and also became a distributor of IBM's midrange computers in the late 1980s.

Data#3 expanded quickly in the 1990s and listed on the ASX in 1997. John Grant, who had joined PCA in 1982, became managing director in 1996, a position he held until 2014, when he was replaced by Laurence Baynham.

A former rugby league player for Australia, Grant became the inaugural chair of the Australian Rugby League Commission in 2011.

In recent years, Data#3 has expanded its range of services, partly through acquisition. In 2008, it acquired recruitment agency Fingerprint Consulting Services.

In 2014, Data#3 acquired Brisbane-based Business Aspect, an IT consultancy group, and Discovery Technology, a Wi-Fi analytics firm. Data#3 is now Australia's largest Australian-owned IT services companies, breaking through $1 billion in annual revenues in 2016.

THE COMPUTER SERVICES INDUSTRY – THE MULTINATIONALS

With a few exceptions, most notably Data#3, the Australian computer services market came to be dominated by large multinational companies by the early 21st century. As with much of the industry, the history of these firms is marked by a confusing array of mergers and acquisitions.

CSA AND CSC

The AMP Society, Australia's largest insurer, was an early user of computers, commencing in the 1950s. It was also a pioneer in setting up a separate division, and then company, for its computer operations. In 1970, AMP formed a joint venture, Computer Sciences of Australia (CSA), with US computer services giant CSC.

AMP owned 51 percent. Its first managing director was Ian Esplin, a World War II fighter pilot who had risen to the rank of air vice-marshal in the Royal Air Force before moving into business life. AMP then outsourced all of its IT to CSA, which also began to sign up other clients.

In 1979, CSC increased its stake to 75 percent. In 1982, AMP bought out CSC, and by 1990, CSA's annual revenues were approaching $100 million, making it one of Australia's biggest IT services companies. AMP remained its largest client, but CSA also won substantial business in government, and particularly in defence.

In 1993, AMP sold all of CSA back to CSC. Further acquisitions of major Australian IT services companies followed, most notably Ferntree in 1999, and BHP IT in 2000 (see above).

 CSC acquired another major Australian IT services company, UXC, in 2015, and then merged with Hewlett-Packard's services division to form DXC in 2017.

EDS, HEWLETT–PACKARD AND DXC

EDS was founded by Ross Perot in Texas in 1962. One of the pioneers of outsourcing,

EDS made Perot a billionaire and one of the best-known figures in the US computer industry. He ran for US president as an independent in 1992 and 1996. EDS was acquired by General Motors in 1984 and became the largest IT services company in the world. In 2008, it was acquired by Hewlett-Packard, instantly making that company an IT services giant. HP's EDS division merged with CSC in 2017 to form DXC.

IBM AND PWC

IBM's sheer size, and its full-service ethos, has meant that it has always been a major IT services supplier. It organised its services operations into a separate division called IBM Consulting Group in 1992. This division was rebranded IBM Business Consulting Services in 2001, and then became IBM Global Services when it acquired the IT services arm of PricewaterhouseCoopers (PwC). This deal doubled the size of IBM's services division, which is now one of the largest in the industry.

FUJITSU

Japanese giant Fujitsu (see Chapter 17) developed into one of Australia's largest IT services companies, largely as a result of its acquisition of KAZ in 2009 (see above).

DIMENSION DATA AND COM TECH

Founded in Johannesburg–––, South Africa, in 1983, Dimension Data came to Australia in 1996 when it purchased 45 percent of Com Tech. Another company with African roots, Com Tech had been set up in Australia by South African immigrant David Shein in 1987. Dimension Data purchased the remainder in 2001.

Dimension Data became a major IT services company in Australia, and it still operates under the Dimension Data brand despite being acquired by Japanese telecommunications giant NTT in 2010.

PETER JONES AND TECHWAY

Peter Jones, an Australian academic and entrepreneur. Born in Sydney in 1933, Jones was introduced to computing on the CSIR Mark 1 in the early 1950s while studying maths and engineering at the University of Sydney.

After completing his PhD in Sydney, he worked at the University of Manchester in the UK before returning to Australia in 1964, where he helped install the first CDC computers at the CSIRO and what was to become the Australian Bureau of Statistics (see Chapter 11). He also then worked at CDC's headquarters in Minneapolis.[518]

He then returned to Australia and founded Techway in 1979. It was for many years one of the great success stories of the Australian computer industry. Techway Initially represented a number of US hardware and software companies in Australia, including the first representation of database company Oracle, and formed a number of joint ventures.

Techway shifted focus in 1988 to concentrate on developing Australian hardware and software products, based around three divisions: high-performance networking, manufacturing and software services. It became a networking specialist, developing advanced packet-switching products using IBM channel extension technology and the emerging Internet standard TCP/IP.

In 1988, it also opened a manufacturing facility in the Western Sydney suburb of Penrith to build PCs and other equipment. Investment paid off immediately when, in 1989, Techway was appointed the primary PC supplier for the Department of Defence's giant DESINE contract, at the time the largest PC contract awarded in Australia. Then, in 1990, Techway signed an alliance with NCR, under which it had the rights to manufacture and supply NCR workstations.

Back in 1986, Techway had invested in a new company, Softway, started by programmer Greg Rose as a Unix

development house. Rose had worked on Unix device drivers and utilities at the University of New South Wales School of Electrical Engineering and Computer Science, and co-founded the Fawnray company in 1980 to commercialise these skills.[519]

The idea behind Softway was to provide software and services around the Unix operating system. It developed a system called Share II, a Unix resource management software utility, and developed a multiprocessor Unix system for CSIRONET (see Chapter 24). Rose went to IBM's Thomas J Watson Research Center in 1991 as a visiting scientist, working on software for IBM's RS/6000 Unix-based workstation.[520]

Sadly, Techway's success was not to last. It listed on the ASX in 1993, with Jones stepping down from day-to-day management but remaining as chair, with Dick Webb as CEO. But it overextended and lost its focus. It acquired professional services company Tangent in August 1994 and expanded into web development.

A new board dominated by private equity investors ousted Jones and Webb, and sold off Techway's hardware manufacturing facilities. They set up a division called Web Australia, which developed one of Australia's first Internet banking systems, bought by the Commonwealth Bank. But the board kept divesting Techway of its assets until there was nothing left apart from its banking software. What was left of Techway was sold to Perth-based Intellect in 1997, which delisted the company and wound it up.

After Jones was forced out of Techway, he was instrumental in raising $20 million to set up the Australian Centre for Advanced Computing and Communications (AC3), a supercomputer facility at the Australian Technology Park in Sydney. He also started Cirrus, a broadband wireless company. In 1998, Jones was awarded the inaugural Pearcey Medal for services to the Australian IT industry. He died in 2016.[521]

AN AUSTRALIAN SOFTWARE SUCCESS STORY — INTEGRATED RESEARCH

Integrated Research (IR) was started by Steve Killelea in 1988 to provide systems and performance management tools for Tandem Computers. Tandem (see Chapter 20) was a major manufacturer of fault-tolerant computers widely used in financial applications such as stock exchanges and ATMs. Tandem was acquired by Compaq in 1997, and its hardware architecture is now owned by Hewlett-Packard.

In 1983, Killelea and some colleagues started a systems management company called Software Products, which was successfully floated on NASDAQ and bankrolled IR. While he started IR in Sydney, from the beginning most of its revenues came from outside of Australia. IR expanded beyond the Tandem platform into other architectures in the financial space, building similar applications on top of Windows and Unix. Its software now manages most of the world's ATMs.

In the late 1990s, IR expanded into unified communications, and it is now a major supplier of management tools for Microsoft's Skype for Business. Its software is widely used in call centres, and the US Department of Defense is a major customer.

The company listed on the ASX in 2000, with Killelea retaining a majority shareholding. IR's market capitalisation now exceeds $500 million, on annual revenues of around $100 million. With offices in Asia, North America and Europe, it has more than 1,000 customers in 75 countries, mostly banks, airlines and telecommunications companies. All product development still takes place in Sydney, where the company employs more than 50 software developers.

Killelea stepped down as CEO in 2004 to focus on The Charitable Foundation (TCF), which he started in 2000 as a vehicle to provide donations to worthy causes in developing countries. In 2007, he launched the Institute for Economics and Peace,

which publishes the Global Peace Index, a ranking of the world's regions and countries by their peacefulness.

He is one of Australia's biggest philanthropists and still chairs IR. He was appointed a Member of the Order of Australia in 2010 and has been nominated for the Nobel Peace Prize.[522]

UNIX AND THE DEATH OF PROPRIETARY OPERATING SYSTEMS

Most early mainframes and minicomputers used proprietary operating systems designed just for that computer. IBM had OS/360 and its many derivatives; DEC had VMS; Data General had AOS; Honeywell had GCOS; Wang had VS; Hewlett-Packard had MPE – and there were dozens more.

But an operating system called Unix, developed in 1969 on a DEC PDP-8 by Ken Thompson and Dennis Ritchie at AT&T's Bell Labs, gradually supplanted them. Thompson and Ritchie's aim was to build a small and elegant general-purpose operating system that would be independent of the hardware platform on which it ran. They succeeded, and Unix filled a gap at a time when most manufacturers were developing their own proprietary operating systems. Unix prospered, largely because AT&T adopted a policy of giving it away to universities.

That meant a generation of programmers learnt about the basics of computing on Unix, taking their expertise with them into the workforce. While Unix was difficult to learn and a nightmare for end users, it prospered as the only alternative to the maze of proprietary systems – even if vendors built their own small proprietary extensions to differentiate themselves from their competitors. Inevitably, different versions of Unix began to appear, but there remained an identifiable core Unix.

In the 1980s, many new minicomputer suppliers entered the industry (see Chapter 20), lured by the massive growth

in commercial computing and the lower cost of entry afforded by the new breed of microprocessors and cheap off-the-shelf peripherals. The leading vendors stayed with their proprietary operating systems but most of the newcomers could not afford to develop their own, so they used Unix, which was cheap, functional and readily available.

Each tweaked Unix to its own specifications, and at one stage there were dozens of different varieties. The momentum grew – and, in 1984, Hewlett-Packard legitimised Unix. The others followed, including IBM with its RS/6000 Unix computer in 1990.

The first ever port of Unix to a non-DEC hardware platform happened in Australia, at the University of Wollongong in 1977. Juris Reinfelds recalls:

■ "Although it is perhaps difficult to imagine in this day and age (given the Open Source Linux project, for example), there was a time when the porting of operating systems from one hardware platform to another was viewed as a radical undertaking. Back in the late 1970s, the University of Wollongong established an international reputation for the porting of the [DEC PDP-11] AT&T Unix OS to a Perkin Elmer platform.

■ "Subsequently, a company was set up in California to commercialise these efforts. The original Wollongong Unix port was only the second successful one in the world (the first being undertaken within AT&T Bell Laboratories, and on another DEC minicomputer).

■ "The Chief Architect (e.g. OS kernel) of the 1977 Wollongong Unix port was Richard Miller, project officer in the Department of Computing Science from 1976 to 1982. Richard was ably assisted (e.g. line editor) by the Department's first Honours Student, Ross Nealon."[523]

During the early 1990s, there were attempts to unify the various strands of Unix. Two major consortiums emerged,

Unix International (essentially, the AT&T camp); and the so-called Open Software Foundation, which was neither open nor a foundation, its name having more to do with politics and marketing than software.

These groups and other splinter bodies conducted an unedifying fight over standards and directions now loosely referred to as the 'Unix wars'. Eventually, standards emerged through market forces rather than industry agreement, as the user community coalesced around three major varieties of Unix: from Sun Microsystems, Hewlett-Packard and IBM.

Other varieties faltered, including DEC's Ultrix, which should have been most successful. DEC, which led the minicomputer revolution and on one of whose machines Unix was originally developed, could never make up its mind about Unix. Its ambivalence became doctrine when founder and CEO Ken Olsen referred to Unix as 'snake oil'. DEC was acquired by Compaq in 1998, and the combined company was acquired by Hewlett-Packard in 2001 (see Chapter 20).

Another pretender was Novell's NetWare networking operating system, which enjoyed a great boom in the early to mid-1990s as people started to network PCs together in great numbers. But NetWare turned out to be a flash in the pan, and is now relegated to the dustbin of history along with the other proprietary systems.

NetWare's demise occurred largely when Microsoft decided to move into operating systems for larger computers with the 1993 release of Windows NT ('new technology'). Windows NT had just one version across all architectures, and had similar functionality to Unix and NetWare. While Windows NT started out slow and underpowered, it gradually improved and was able to compete at the technical level. Users migrated to Windows NT, and it looked at one stage as if Windows would sweep all before it.[524]

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LINUX AND THE OPEN–SOURCE MOVEMENT

In 1992 a Finnish university student named Linus Torvalds developed a version of Unix called Linux, which used the 'open-source' model. Any developer could improve the software and submit those improvements to a committee for acceptance.

Linux is available for free, despite an army of developers improving it all the time. It represents the antithesis of the proprietary Microsoft development method as well as the Microsoft marketing model. The battle between the two became almost a religious war.

The Linux development process of continuous improvement saw it move up the ladder of scalability and respectability, to the point where it entered the data centre, even getting IBM's endorsement. IBM picked up on the move to Linux in the late 1990s, and was soon spending more than $US1 billion a year on Linux development, mainly in what used to be called in the mainframe world 'RAS' (reliability, availability, scalability) – the very things that make an operating system suitable for enterprise computing.

Microsoft and many others saw a threat to capitalism in the open-source movement. There is little doubt that the open-source software movement has anti-capitalist elements. 'Linux is subversive' are the first three words of the Linux manifesto, *The Cathedral and the Bazaar*, written by Eric Raymond, the movement's Karl Marx.[525]

The title reflects Raymond's idea of open-source software development as a medieval bazaar: an untidy agglomeration of merchants and stalls and thronging people, rather than the standard method of building software, which is like a stately cathedral – planned in advance and built over time to exacting specifications.

Open source was a major worry to the software establishment. In October 2003, Microsoft president Steve Ballmer cut short a holiday in Europe to try to convince the Munich city council to rescind a decision to

move to open source. In early 2004, software company SCO, which claimed ownership of Unix after a convoluted series of deals in the late 1990s, sued IBM for US$3 million over allegations that IBM had stolen Unix code and put it into Linux. It lost.

But there is much more to open source than Linux; a huge variety of software is available in open source. Open-source databases like MySQL and PostgreSQL are widely used around the world, often in production applications, and the Apache web server is more widely used than its commercial competitors. There are even open-source ERP packages.

The software itself may be free, but many suppliers make money from delivering services to the open-source world. Open source is now mainstream, and attracts little of the furore that surrounded it in its early years.[526]

BUSINESS INTELLIGENCE – PUTTING USERS IN TOUCH WITH DATA

Throughout the 1980s and 1990s, there was a shift towards packaged software. Packaged applications became much more flexible, and it no longer made sense for users to write their own software when something bought off the shelf could do it as well, for a fraction of the price.

The focus for application development moved to the desktop, where people used products such as Microsoft's Visual Basic and Access to build quick and dirty systems that allowed them to download corporate data, often out of these packaged software systems, into desktop systems like Excel where they could be easily manipulated.

End-user access to corporate data drove the applications software industry and a class of software developed in the 1980s called the decision support system (DSS), which quickly evolved into the executive information system (EIS). These systems took operational and transactional data from corporate databases and reformatted it in

such a way that it could be easily understood by end users – for example, graphs comparing sales data by region over time.

This new category of software became necessary because traditional computer systems were operational systems – their purpose was to record transactions and store financial data. Extraction of that data was through predetermined reports that were part of the application. No thought was given to the ability of end users to make ad hoc enquiries.

The first EISes were cumbersome and required vast processing power. As an example, in the late 1980s, the Australian multinational Wormald had an entire IBM mainframe devoted to running the Comshare System W EIS to provide reports to senior management.

In the 1990s, EISs evolved into a whole new class of PC software, generically called business intelligence (BI), that displayed information in attractive graphical formats, and allowed information from different sources to be easily juxtaposed. Displaying data in multiple dimensions, multidimensionality or online analytical processing (OLAP) underpins this type of software. OLAP tools are often used as the front end to data warehouses – systems in which operational data has been downloaded and optimised for such retrieval.

The structure of relational databases, together with vastly increased processing power, enabled the development of specialist BI tools optimised for the creation of ad hoc end-user queries. The term 'data warehousing' came into vogue, describing the way corporate data could be downloaded into a software warehouse optimised for this purpose.[527]

A number of specialist BI vendors did well in the 1990s, including the likes of Brio, Business Objects, Cognos, Crystal Reports, Hyperion and MicroStrategy. One came from Australia – CorVu, founded by Justin Macintosh, an Adelaide entrepreneur, in 1990. CorVu's first

product was released in 1993.

Key designer Troy Rollo incorporated a number of unique design features in CorVu, which ensured its initial success. One of these was a data dictionary that separated the text from the program code, which made it easy to translate the software into other languages. A prime prospect in Japan was amazed when the entire software package was translated into Japanese in less than a week, leading to major success in that country.[528] CorVu was also a pioneer in automating the balanced scorecard, a performance metrics tool popularised in the early 1990s by US management consultancy Nolan-Norton & Co.

CorVu opened a UK office in 1994 and a US office in 1995. At its peak, it had more than 1,000 customers worldwide. But it faltered when Macintosh took it public in the US through a reverse takeover – he bought a small underperforming public company, renamed it CorVu, and transferred his assets into it. The company he chose was a Minneapolis-based company called Minnesota American, which, among other things, made school lockers.[529]

At the time, MacIntosh had high hopes for CorVu. He was looking at listing on the NASDAQ exchange, home of most US glamour tech stock, but investors were wary after the tech crash of the early 2000s and CorVu struggled. It closed its European offices and reduced staff numbers, and was eventually acquired by US company Rocket Software in 2007.

THE INTERNET BOOM AND THE
INFORMATION MILLENNIUM
HOW THE COMPUTER INDUSTRY HAS TRANSFORMED THE WORLD.

28

W e live in the information era. In the space of 70 years, digital computers have come into existence and changed the world. They may have had a minimal effect on most peoples' lives for the first half of this period, but today is hard to imagine a world without them.

Most people carry with them a small computer and communications device – a smartphone – that connects them with the digital universe and billions of their fellow humans. Virtually all information can be stored digitally, which means it can be easily and infinitely archived, transmitted and copied without degradation. This capability has totally transformed all activities that involve information – in other words, virtually everything we do.

Australia is and has often been at the forefront of this digital revolution. The rate at which Australians have adopted computers and other digital communications devices has always been among the highest in the world. Australians have always been very quick to recognise the benefits of computer technology – in government, in business and in our personal lives.

Today it is virtually impossible to do business without the Internet. Email is the standard method of commercial communication, all media channels are digital and most travel is booked online. Smartphones and other wireless devices are commonplace, removing physical location as a constraint on communication. There is more processing power in a smartphone than in the largest data centres of the 1970s.

Data communication and voice telephony costs are now so low, bandwidth so broad and the Internet so ubiquitous that applications development centres can be run offshore. An increasing number of the world's call centres are now in India, the Philippines or southern Africa.

We are now witnessing, on a global scale, the kind of disruption that occurred in the English countryside in the industrial revolution 200 years ago. We have long witnessed the movement of blue-collar jobs to low-cost countries; now we are seeing white-collar jobs move offshore at an even faster rate.

Continuing this parallel with the industrial revolution, the dark satanic mills of the information millennium are in the suburbs of Bangalore (India), Shenzhen (China) and

"THE NUMBER OF HOUSEHOLDS CONNECTED TO THE INTERNET GREW RAPIDLY BETWEEN 1996 AND 2000. .IN FEBRUARY 1996, ABOUT 260,000 HOUSEHOLDS (FEWER THAN 4 PERCENT) HAD ACCESS TO THE INTERNET. BY NOVEMBER 2000 THIS FIGURE HAD RISEN TO 2.7 MILLION (37 PERCENT OF HOUSEHOLDS)."

AUSTRALIAN BUREAU OF STATISTICS, 2002

St Petersburg (Russia). And the workers in these 'mills' are not just doing IT-specific jobs; they're also architects, accountants, engineers – indeed, any type of knowledge worker. If the work can be digitised, it can be exported. Microsoft's second-largest development centre is in Beijing, and most of Oracle's software designers are in India. Large and small IT shops are moving software development and other functions to India and elsewhere at an ever increasing rate.

CRASH, BOOM, CRASH

On Monday 19 October 1987, the world's stock markets crashed – a rapid domino-effect collapse that spread from Hong Kong to Europe and beyond at a rate only possible in the digital era. By the end of the month the Australian market had lost more than 40 percent of its value. There was talk of another Great Depression. But it didn't happen. Stocks rebounded quickly.

The previous year, Commonwealth Treasurer Paul Keating had warned that Australia risked becoming a 'banana republic' if it could not reform its economy. Australia did go through a recession in the early 1990s ("the recession we had to have" was one of Paul Keating's many famous quotes), but after that entered a long period of economic prosperity. A booming information technology industry was one of the drivers.

The good times were unevenly shared. Many major companies and products disappeared (see Chapter 27), but they were replaced by new companies and new technologies, most of them based around the Internet. The 1990s were written up in Australian history as the decade of the tech boom, ushering in the information era – a period of rapid change brought about by continued technological innovation.

The advent of the World Wide Web in the early 1990s (see Chapter 24) led to an incredibly rapid rise in Internet use. Communications are the lifeblood of

commerce, and the business world – always an early adopter of any new communications medium – adopted the Internet immediately. The first online stores appeared in the US in 1993, and by 1994 you could order pizzas from Pizza Hut via the Internet. Online retailers Amazon.com and eBay were both formed in 1995, and one of the most astonishing booms in history was underway. By 1999 the worldwide ebusiness market was worth US$40 billion.[530]

The web made ebusiness possible. The advantages of using computer networks for business purposes became apparent to many people in the 1980s, and various systems were devised to enable computer-based commercial transactions, initially known as electronic document interchange (EDI). By the mid-1980s EDI had become standardised and a number of organisations used it, but it was not a widespread success. For one thing, it relied on closed systems with specialised protocols and real-time communications – the two computers conducting the transaction had to be directly connected to each other.

EDI was successful in specific industries that used regularised transactions. It gained some popularity in Australia; large retailer Coles Myer Limited mandated its use when ordering from suppliers, and the Australian Customs Service used it to streamline its activities.[531] It was also widely used in the Australian motor industry. EDI's success in these areas meant that a decade later, its users were ready and willing to embrace a better and cheaper system. EDI systems transferred seamlessly to the Internet.

The rapid growth of the Internet and ebusiness in the late 1990s prompted many believe that the old rules of business no longer applied. There was much talk of the 'new economy', and many new companies were formed on the expectation that the Internet boom would instantly transform the way consumers and businesses behaved. Many of these new 'dotcom' companies

were based on unrealistic and unsustainable business models, but a feeding frenzy of investors eager to cash in on the speculative growth of these organisations led to a spectacular stock market boom now known as the 'tech bubble'. Like all bubbles, this one burst, in early 2000, setting off an equally spectacular crash just in time for the turn of the millennium.

Some dotcom companies had increased their market capitalisation by more than tenfold in 1999 and early 2000. In the US, many dotcom companies were listing on the NASDAQ even though they had never recorded any revenues, let alone made a profit.

Alan Greenspan, Chairman of the US Federal Reserve, had warned of 'irrational exuberance' in the stock market as early as 1996, but to no avail.[532] Even respected business publications didn't heed the warning. Even *The Wall Street Journal* published an article in 1999 suggesting that venture capitalists regarded the very concept of a profitable company as a 'quaint idea'.[533]

■ "Companies underwent a similar phenomenon to the one that gripped seventeenth century England and America in the early eighties: investors wanted big ideas more than a solid business plan. Buzzwords like networking, new paradigm, information technologies, Internet, consumer-driven navigation, tailored web experience, and many more examples of empty double-speak filled the media and investors with a rabid hunger for more.

■ "The IPOs of internet companies emerged with ferocity and frequency, sweeping the nation up in euphoria. Investors were blindly grabbing every new issue without even looking at a business plan to find out, for example, how long the company would take before making a profit, if ever."[534]

But it was apparent to many that the bubble would burst, and when it did, it did

so spectacularly. There was no single-day bloodbath as there had been in 1987, just a speedy realisation that the party was over. On 10 March 2000, the NASDAQ index of US technology stocks hit a peak of 5,049, having doubled in the previous year. Two years later it was hovering in the low 1,100s, a drop of more than 75 percent. In the three years following the top of the boom, nearly 5,000 computer companies in the US – and many more internationally – went broke or were acquired. Twenty thoUSnd jobs were lost in Silicon Valley alone. By early 2004, the market capitalisation of all the world's computer companies was about 20 percent of what it had been three-and-half years earlier.[535]

The crash led many to erroneously believe that the promise of the Internet was a fallacy. In fact, it was a minor correction after a burst of significant overenthusiasm. The Internet and its ecosystem – and the entire IT industry – recovered and continued to grow, driven by numerous key technologies. The most important of these were mobile telephony and smartphones; search; social media; and cloud computing.

MOBILE PHONES AND THE RISE OF MOBILE COMPUTING

The first mobile phone call in Australia occurred on 9 August 1981, between Telecom's Managing Director Bill Pollock, and its Chief Commissioner Tom May. The phones they used – and the related pieces of equipment – were so bulky that they could only be installed in a car. The equipment cost thoUSnds of dollars, and was limited to a few hundred users in Sydney, Melbourne and Brisbane.[536]

The mobile revolution really began on 23 February 1987, when Telecom Managing Director Mel Ward made a phone call over Telstra's new cellular mobile phone network to Michael Duffy, the Federal Minister for Communications.[537]

These first cellular phones were still very

bulky; they were often called 'bricks', and for good reason. The network they relied on was made up of 'cells' – small areas served by transmission and reception towers – and communications switched between these cells as the user moved around. The technology improved throughout the 1990s and into the new millennium, developing in stages through a series of generations. The biggest technology change was the move from analog to digital transmission, which happened in Australia with the introduction of GSM (Global System for Mobile Communications) technology in 1993.

By 1994, there were a million mobile phone users in Australia. The number more than doubled in the following year, driven by handsets that were cheaper and more available, and the introduction of GSM, which enabled text messaging. By 2001 the number of mobile phone connections in Australia passed 10 million, exceeding the number of fixed telephone lines.[538]

In 2003, Hutchison introduced Australia's first 3G (third-generation) mobile service, which enabled phones to connect to the Internet. But the small screens and limited user interfaces on early 3G handsets limited the usefulness of their Internet connectivity. That would all change with the advent of the smartphone.

The smartphone revolution is widely accepted as beginning with the release of the first Apple iPhone, on 29 June 2007. There were earlier smartphones – produced by BlackBerry, Nokia and others – but they had nowhere near the functionality of Apple's sleek new device, with its big screen and touchscreen keyboard. The iPhone was made to access the Internet.

At the same time, Apple launched an ecosystem of 'apps' (applications) sold through a proprietary app store, ensuring the device could be used for a wide range of purposes, from playing games to participating in ebusiness, to reading newspapers and magazines. A built-in web browser ensured easy access to the Internet.

iPhones and the dozens of smartphones that many other companies released soon afterwards also included cameras. Before long the cameras in smartphones were more popular than specialised digital cameras for taking pictures, and that technology was itself barely a decade old. Driven by the imperatives of Moore's Law, smartphones became more powerful, much cheaper and much smaller, and today they are ubiquitous. Never in history has a technology been adopted more quickly and more universally.

Mobile phones and smartphones changed the world, and not just in Australia. The early adopters were in the developed world, but as prices have dropped mobile phones – and increasingly smartphones – are owned by 63 percent of the population worldwide. Smartphones – not desktop computers or laptops – are now the most popular means of connecting to the Internet.

The widespread use of mobile phones in the developing world has done more to alleviate poverty and lift living standards than many aid programs. Communication is one of the most important things in life.

When people can communicate, they can do things they could never do before. The free flow of information oils the wheels of commerce; the ability to talk to a supplier or find out market prices in the next village – or even on the other side of the world – has worked wonders in subsistence economies. The world has changed.

Many developing countries have been able to leapfrog the entire wired infrastructure phase of telecommunications, going straight from no connectivity to fully wireless Internet access. The cost of installing a mobile phone network is comparatively small, and well within the reach of even the tiniest and poorest countries. Thanks to smartphones, virtually anyone in the world can now get online.

HOW SEARCH DROVE THE INFORMATION REVOLUTION

Internet use vastly accelerated in the early 1990s after the invention of the Internet and the web browser (see Chapter 24). But it was still tricky to navigate; users really had to know what they were looking for. There were of course some primitive, manually produced website catalogues, and a rudimentary system called Gopher based on a structure that competed with Tim Berners-Lee's World Wide Web.

That all changed very quickly with the advent of Internet search tools that used the power of the hypertext-enabled web. There were many attempts to build systems that would help users navigate the web, but the first to achieve widespread USge were WebCrawler and Lycos, both released in 1994. They were soon joined by many others, including Excite, Inktomi and Magellan. Yahoo! also became popular in 1995, but it was not a true search engine, relying instead on its own directory.

The most successful of these early search tools was AltaVista, created by minicomputer supplier DEC in 1995. It was technically superior to its competitors and soon became the market leader, entering into a deal with Yahoo! to power its portal. After Compaq acquired DEC in 1998, it sold AltaVista to CMGI, a short-lived Internet investment company, which then sold it to Yahoo! after the tech crash. AltaVista died after a new search engine called Google rose to prominence.

The name 'Google' is derived from 'googol', a mathematical term for the number one followed by a hundred zeros, indicating the search engine's power to deliver huge quantities of information. The company was brought to life in 1996 by two Stanford University doctoral students, Larry Page and Sergey Brin, who released it commercially in 1999.

With Google, Page and Brin developed an entirely different way to search the web

based on a page ranking, which analysed the relationship between web pages to determine which were most popular. It vastly improved the efficiency of web searches; by the time Google went public in 2004 it had rendered all of its competitors irrelevant. Today it is so ubiquitous that the name has entered the English language in general USge: 'to google' means to search the Internet.

The first announcement Brin made about Google happened in Australia, at a conference on the Gold Coast in 1997. An eyewitness, Glenn Irvine, tells what happened:

■ "In the mid-1990s I was a postgraduate student at the University of New England, working on a thesis on computer-aided training; when one of my supervising lecturers called me over to a computer screen and showed me this thing called the World Wide Web.

■ "It was a very simple HTML page, with a couple of images on it, that was the homepage of a University in the US. My supervisor, Dr Allan Ellis, said to me, 'Glenn, this is going to revolutionise education, and I can see a day when universities will provide all of their learning and services via this web based mechanism'.

■ "In 1997 Dr Ellis had become the convenor of the International World Wide Web Conference, which that year was being hosted at Bond University on the Gold Coast. There were two young postgraduates from Stanford University who were presenting a paper on a search engine that they had created. The title of the paper was 'The Anatomy of a Large-Scale Hypertextual Web Search Engine'. It was a young Larry Page and Sergey Brin, and at that conference Google was first announced to the world."[539]

Less than a decade after the emergence of the World Wide Web, Google revolutionised how people used it. The availability of a free and easy-to-use search engine made it incredibly easy for any person to find anything they wanted on the Internet. A whole ecosystem grew up around Google, leading to techniques such as search engine optimisation, which helps websites rank higher in Google's search results. Google also monetised its technology by developing a paid advertising model, and is now one of the most valuable companies on Earth.

THE RISE OF FACEBOOK AND OTHER SOCIAL MEDIA PLATFORMS

As important as the rise of search engines was the emergence of a phenomenon that would become known as social media. The 1980s, even before the invention of the World Wide Web, 'bulletin boards' had become popular on the Internet as a way to exchange information between groups of people interested in the same topic. These boards grew in popularity into the 1990s.

With the massive rise in Internet use towards the end of the decade, many more people started using bulletin boards to send messages and keeping in touch with others. In 1996, a website called SixDegrees.com (named for the supposed six degrees of separation between all human beings) was created in New York. It is generally regarded the first social networking site, and at its peak had around 3 million members.[540]

The next significant development was the rise of messaging applications, most notably Yahoo! Messenger and Microsoft's MSN Messenger in 1999. Early in the 2000s came a spate of websites with the sole purpose of getting people to communicate with each other, share personal information, post photos and so on. These included Friendster and LinkedIn in 2002; MySpace in 2003; and Flickr and Facebook in 2004. Skype, a voice messaging system based on Voice over Internet Protocol (VoIP) technology was formed in 2003, and the video-sharing service YouTube in 2005. Twitter, a popular

app that allows users to post whatever they wish in 140 characters or less, dates back to 2006.

Of these, Facebook would become by far the biggest. Today there are over 2 billion Facebook users in the world, including 17 million in Australia – well over half the adult population. YouTube – which Google acquired in 2006 – is almost as popular, with more than 15 million Australian users at the time of writing.[541]

These numbers are astonishing, and show the extent to which social media has permeated the modern world. For many people social media is their primary source of news and other information, and their main method of staying in touch with family and friends. With near universal use of smartphones, virtually anyone can access social media from anywhere, at any time.

Commercial organisations and government agencies increasingly use this massive new world of communication as an advertising medium; a public relations channel; and a means of gathering information about customers, clients and citizens. The pervasiveness of social media – and its comparatively recent emergence – have led many to criticise its influence and bemoan the way it has supplanted many traditional forms of communication.

CLOUD COMPUTING AND THE RISE OF THE INFORMATION UTILITY

One of the most important developments in the information millennium has been the rise of cloud computing. Cloud computing is not a technology as such, but rather the combination of various technologies that have come together to form a new processing paradigm.

These technologies are the Internet; the wide availability of devices – including smartphones – that connect to it; and the widespread USge of data centres that contain vast amounts of commoditised processing power and information storage. Users access

applications and data stored in these data centres via the Internet. Many simplified early diagrams of this processing model depicted the Internet as a cloud in the sky to which users connected from down on the ground – and the term 'cloud computing' was born.

Cloud has enabled the Software as a Service (SaaS) business model, where users access an application's functionality on a pay-as-you-go basis. Under this model a single application can run for thoUSnds of customers, bringing economies of scale and simplicity not possible with internally stored systems.

The cloud means we are moving towards the era of the information utility, where IT is delivered on demand via an invisible grid that encircles the globe. This idea of utility computing has been around for some time. Power, water and telephony are utilities, and now so too is the Internet. The concept suggests that a user can switch on their computer and have as much or as little computing power as they need. Like other utilities, users pay for what they use, plus a standing charge for being connected to the system.

KEY CHALLENGES OF THE INFORMATION MILLENNIUM

Digital technology has totally transformed the world. But as with any new technology, there are challenges. There are more winners than losers, and most people have embraced the many changes that have occurred in such a short space of time. But there are also many areas of concern. The traditional concept of intellectual property is being challenged, as is the nature of work, the security of the information we create, and – according to some – the very definition of life itself.

INFORMATION SECURITY

Protecting property and securing information have always been among society's primary aims. The proliferation of information has increased the focus on these concerns exponentially. In the early days of computers, data security was not a major issue. Computers did not communicate with each other, and security was essentially a function of keeping the devices physically safe.

As computer networking grew in the 1970s, information security became an issue. But it was not until the widespread use of personal computers in the 1980s and 1990s that it actually became a problem. In today's networked world – where every computer and every mobile phone is ultimately connected to every other – information security concerns everybody.

Problems have been exacerbated by a phenomenon widely known as 'hacking', a generic term for the practice of deliberately accessing somebody else's computer or information repository to steal data or cause mischief. Hackers can be motivated by greed or malevolence, or by other more sinister motives like extortion or terrorism.

They may wish to prove they can do it; they may wish to hold their targets to ransom; or they may wish to steal commercially or politically sensitive information. Data breaches can also happen by accident, due to faulty equipment or (much more often) as a result of human error. Hackers may be disgruntled ex-employees, teenage thrill-seekers, criminal gangs, or nation states – for which hacking is an increasingly popular form of espionage or sabotage. The data security industry refers to these groups collectively as 'the bad guys'.

The terms 'cybercrime', 'cybersecurity' and 'cyber warfare' have entered the lexicon, and information security has become a large and growing part of the IT industry. It is a constant game of cat and mouse between the burgeoning cybersecurity industry and the bad guys, with no end in sight.

THE CHANGING SHAPE OF INTELLECTUAL PROPERTY

Digital technology poses many challenges to the concept of intellectual property. The idea that the product of human thought can be copyrighted, protected by law and treated as an asset is a comparatively recent development in human history.

The concept of copyright originated in 17th-century England when some printers sought to prevent others from copying their books and pamphlets. The great writers, artists, musicians and inventors of antiquity, the Middle Ages and the Renaissance had no copyright protection. But today copyright and patent law is a major branch of the legal profession, and the ownership of what has come to be called 'intellectual property' is a major issue.

Digital technology has greatly challenged this legal construct, making it much easier to copy, store and propagate information. A piece of music can be copied and distributed to a million people in an instant. Any form of information that can be digitised – a piece of software, a song, a film or anything else – is susceptible to being copied.

The law has had great trouble keeping up with technology in this regard. Digitally breaching someone's copyright is often called 'piracy' by its adherents, who regard it as a kind of liberation. To its opponents it is simply 'theft'; they believe digitised information should have the same protection and ownership as physical objects.

The battle is far from over. The owners of digital content regard copyright as natural and immutable, while many others regard the very concept of intellectual property to be outmoded in the digital age. The ease with which digital information can be copied and distributed – even in the face of legal challenges and attempts to hobble the practice – have caused rights owners to re-evaluate their business models. A good example is the growth of music and video subscription services such as Apple Music

and Netflix, which are causing a decline in business models based on the illegal sale or transfer of discrete pieces of digital information.

WHO DOES THE WORK?

Since before the Luddites destroyed mechanical looms in the 19th century, humans have been concerned about technology displacing them in the workforce. The Industrial Revolution and the subsequent movement of the workforce from agriculture to manufacturing caused one of the greatest social upheavals in history. The worry now is that the information revolution will do the same, but that the work being displaced will not be replaced by other types of employment.

The fact that these fears have not come to pass has not been sufficient to allay them. Information technology has been instrumental in the growth of a two-paced economy in the developed world. The workforce is bifurcated into menial jobs at the low end – often in the services industries and marked by casual labouring conditions – and high-end 'knowledge workers' who earn good salaries and are the prime beneficiaries of IT developments.

That trend has led to a growing 'us versus them' mentality, which is threatening social cohesion in many countries. With the growth of technologies such as artificial intelligence (see below) and robotic process automation (RPA), even knowledge worker jobs are under threat, and there are fears that society may become even more fragmented. Attempts to spread the workload and the benefits more evenly have been piecemeal, and many challenges remain.

WHAT IS LIFE?

The term 'artificial intelligence' (AI) has been around for many years – indeed, the popular press called the first computers 'electronic brains'. AI generally refers to attempts to have computers mimic the functions of the human brain.

In the early days of computing when processing power was comparatively limited, AI was something of a plaything. Technologies like neural networking attempted to simulate human thought and some rudimentary systems bore the AI name tag but they were anything but.

As long as the concept has existed there have been philosophical debates around AI. If a computer could completely simulate human thought and pass the famous Turing test, would that mean it was thinking? At the metaphysical level, would that automatically make it alive, or mean it had a soul?

Advances in processing power in recent years have begun to make AI a reality. In 1997 IBM's Deep Blue chess program beat world champion Garry Kasparov in a tournament. Since then computers have become much more powerful, and the simulation of the most sophisticated and arcane of human thought processes are upon us.

Ray Kurzweil, a speech recognition pioneer and futurist, has popularised the idea of 'The Singularity', a time in the near future when AI will be more powerful than the human brain, driven by the continued exponential advance computer processing power. He sees advances similar to Moore's Law in other areas of human activity, and believes that AI-enabled tools and robots will soon rival humankind as the dominant life force on this planet.

Kurzweil sees this as a positive development, and believes that AI and human thought will coexist, with the whole being greater than the sum of the parts. Others – including SpaceX and Tesla pioneer Elon Musk – have warned that AI is a threat to the human species, and that development should cease, or at least be tightly controlled.

Whatever the case, the growth of AI and how it is used will be one of the key challenges of the 21st century.

NUMBER OF ICT WORKERS BY INDUSTRY (AUSTRALIA, 2016)

OTHER INDUSTRIES 165,040

ICT RELATED INDUSTRIES 309,313

FINANCIAL SERVICES 44,425

PROFESSIONAL SERVICES 75,806

PUBLIC ADMINISTRATION 46,262
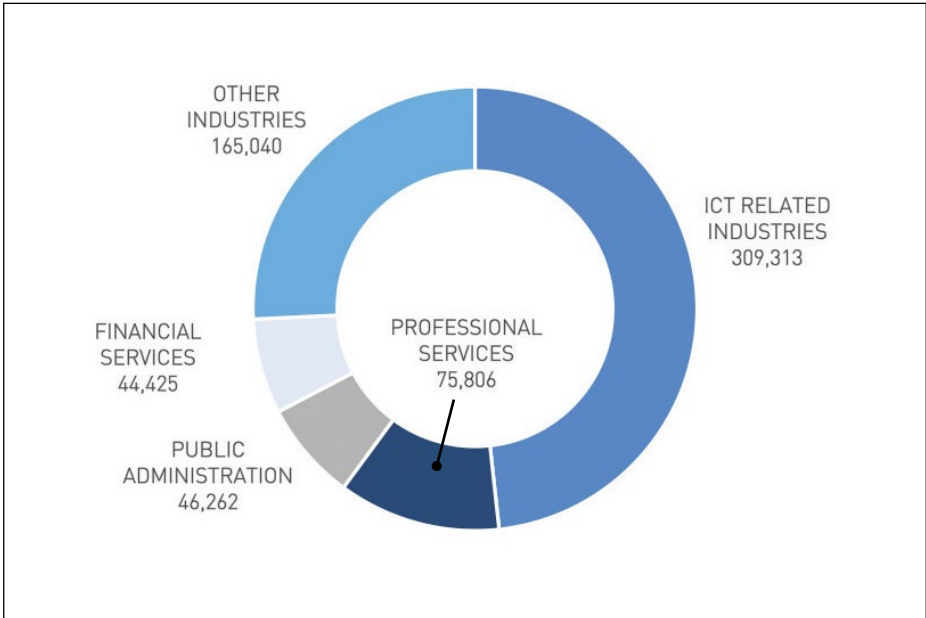
ICT WORKERS BY OCCUPATION (AUSTRALIA, 2016)

ADMIN AND LOGISTICS SUPPORT 112,684

MANAGEMENT AND OPERATIONS 189,503

ELECTRONIC TRADES AND PROFESSIONAL 3,974

OTHER ICT TRADES 75,368

SALES 32,461

TECHNICAL AND PROFESSIONAL 226,856
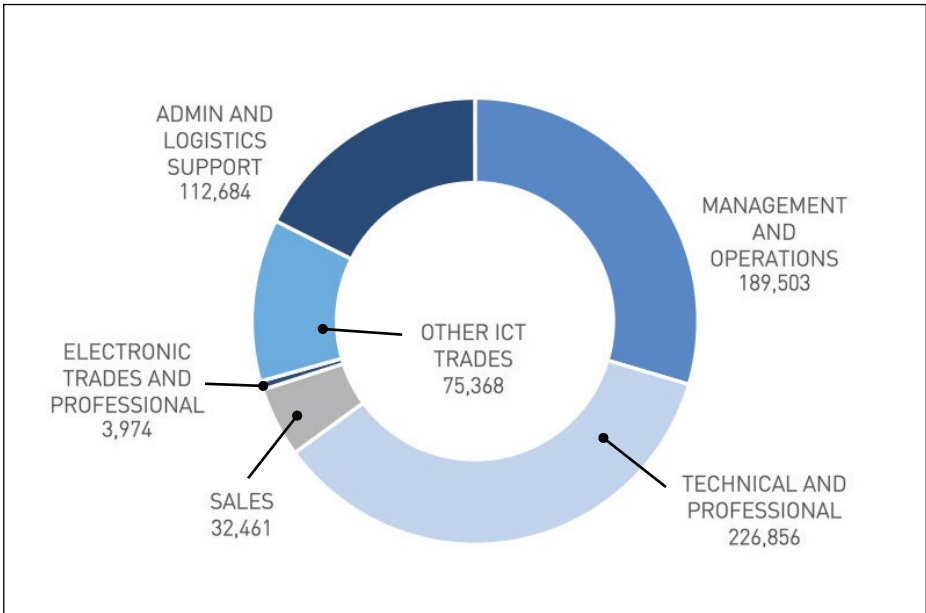
SOURCE: AUSTRALIAN BUREAU OF STATISTICS, 2017

AUSTRALIA'S COMPUTER PROFESSION IN THE 21ST CENTURY

In these first decades of the information millennium, what does the computer profession look like in Australia?

The Australian Computer Society, in conjunction with Deloitte Access Economics, publishes the annual *Australia's Digital Pulse* report, which provides a snapshot of trends in the Australian digital economy and workforce.

The most recent report quoted customised research from the Australian Bureau of Statistics, which showed that 640,846 Australians – more than 5 percent of Australia's workforce – were employed in ICT-related industries in 2017 (see graphs below).[542] The report broke down this data in two ways: by industry and by occupation.

■ "The increasing digitisation of Australian businesses' operations across all sectors of the economy has resulted in greater integration between ICT functions and broader business operations. For example, 52 percent of the current ICT workforce is employed outside ICT-related industries, in such areas as professional services, public administration and financial services."[543]

ICT professionals work in a range of occupations. The largest two groups are technical and professional services, and management and operations. These workers tend to be younger than the workforce as a whole, and the sector as a whole is growing more quickly than most others.

■ "The increasing prominence of digital technologies in all industries across the Australian economy means that there is growing demand for ICT workers and skills in a diverse range of sectors and roles. Digital technologies are increasingly a 'horizontal' element that overlays all 'vertical' industries, so there are many more opportunities for ICT employment.

■ "This trend is expected to continue to create strong demand for ICT workers in the future, particularly since digitally enabled innovation is and will continue to be a significant driver of growth and competitive advantage among Australian businesses."[544]

When the profession of computer programming was in its infancy in the 1960s, projections suggested that at the current rate of growth, eventually everybody on Earth would be a computer programmer. That is exactly what happened. Every time we add numbers to a spreadsheet, interact with an app on a smartphone or punch a destination into the GPS in our car, we are sending instructions to a computer.

Computer professionals, according to the statistics above, are a crucial part of the workforce. But in a very real sense, we are all computer professionals in this modern world. The technology defines our 21st-century existence.

POSTSCRIPT

THE POWER OF
A PROFESSION

ACS IN THE 21ST CENTURY.
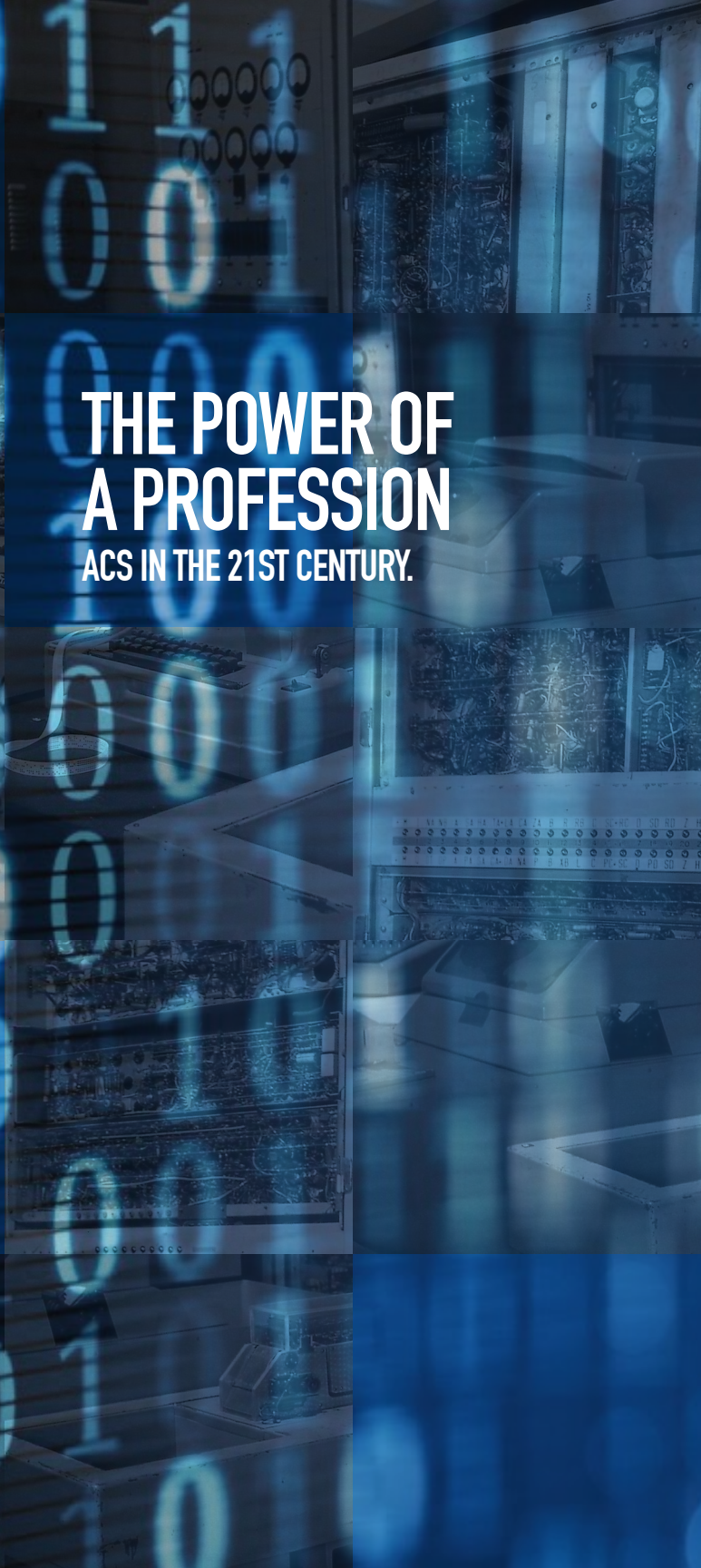
ACS has been inspiring success for 50 years. But, as always in the technology industry, its focus must remain on the future. What role should Australia play in the global digital economy? How should ACS, as the professional association for the ICT sector, help business, government, academia and civil society realise those ambitions?

In late 2017, ACS announced the launch of a new five-year strategy, designed to empower the Society and enable it to deliver on its vision – for Australia to be a world leader in developing technology talent that fosters innovation, and creates new forms of value.

This strategy is built on three Cs: Capacity, Capability and Catalyst. **Capacity** is about providing sufficient resources. How do we ensure Australia has enough ICT professionals to meet its economic growth needs? ACS will lead a national drive to support the development of resources, both within the technology industry, and also across the broader economy.

This means fostering domestic skills while attracting top talent from around the world. ACS will promote the study of science, technology, engineering and mathematics (STEM); encourage young people to take up technology careers; improve the employability of graduates, and work to improve workforce diversity. At the same time, ACS will validate the qualifications of skilled migrants while building and maintaining valuable international relationships.

Capability is about the development of superior skills. What skills do we need as a nation to make the most of opportunities presented by an increasingly digital economy? ACS has an important role to play in making sure Australia can meet these demands as technology becomes increasingly pervasive in all aspects of our personal and professional lives.

A key element of strengthening the profession means setting benchmarks, connecting members with other like-minded professionals, and providing education where it's needed. Beyond the technology industry, ACS will support industry by identifying the need for specific skills, and facilitate the development of capability while strengthening technology management and governance.ACS via its branches around Australia is engaged in growing talent locally through various engagement models.

"ICT PROFESSIONALS ARE EQUIPPED TO UNDERSTAND THE TRENDS AND THE POTENTIAL TECHNOLOGICAL IMPACTS OF RAPID CHANGES IN THE DIGITAL ECONOMY. HOWEVER, WE MUST ALSO SHARE OUR INSIGHTS, INFORM, EDUCATE AND PROVIDE STRATEGIC LEADERSHIP TO ENABLE AND FOSTER INNOVATION AMONGST OUR STAKEHOLDERS."

ANTHONY WONG, ACS PRESIDENT, PRESENTATION TO CONGRESS, FEBRUARY 2016

FROM A NATIONAL PERSPECTIVE, ACS WILL CONTINUE TO INFLUENCE THE NATIONAL AGENDA, DEVELOPING RESEARCH AND DEVELOPMENT LINKS WITH BUSINESS, AND SUPPORTING THE COMMERCIALISATION OF TECHNOLOGY WITHIN TARGET SECTORS.

These range from supporting hackathons and participation in computer clubs, and – in collaboration with others operating in this space – to providing training and computer support to senior citizens and other digitally-challenged community members.

Members are the mainstay of this aspect of grassroots engagement and form communities of practice to deliver on their various strengths and experience – all motivated by the professional imperative to support people through ACS community outreach. By this engagement, ACS is building the pool of professional talent as well as educating the community on the gains to be made from being discriminating technology users who understand the technology and disruption, and how to leverage it.

Catalyst is about sparking innovation. How can business and government use technology to transform processes and reimagine customer experiences? ACS will work to establish Australia as a global benchmark for the use of new technologies, driving economic growth while minimising the impact of cybersecurity threats.

From a national perspective, ACS will continue to influence the national agenda, developing research and development links with business, and supporting the commercialisation of technology within target sectors. Looking beyond these shores, ACS will shine a light on Australia as a competitive destination and stimulate the adoption of leading-edge technologies from around the world. ACS throughout its history has played a lead role in regional and global engagements and collaboration activities through its active leadership and engagement in the South East Asia Regional Computer Confederation (SEARCC) and the International Federation for Information Processing (IFIP), established under the auspices of UNESCO.

An increasing number of ACS members are Certified Professionals and Certified

Technologists, accredited through the IFIP International Professional Practice Partnership (IP3). ACS was the first international computer society to become accredited under IP3. ACS-certified professionals also subscribe to a Code of Ethics, a Code of Professional Practice and Continuing Professional Development (CPD) requirements. ACS is a member of the Australian Council of Professions. ACS's Professional Standards Scheme gives ICT professionals legal recognition on the same level as engineers, solicitors and accountants. The scheme has been approved by the Professional Standards Council, and complies with federal and state legislation that protects members of recognised occupational associations by limiting their professional liability.

In August 2017, the Hon Dan Tehan, Minister Assisting the Prime Minister on Cyber Security, unveiled the new ACS Certified Professional (Cyber Security) and Certified Technologist (Cyber Security) certifications. The certifications, advocated by Alastair MacGibbon, Special Adviser to the Prime Minister on Cyber Security, will allow ICT professionals to validate their expertise in this discipline and provide a clear benchmark for industry and government. The Cyber Security certification specialisation is one of the first such initiatives in the world to be backed by a government regulatory scheme.

In October 2017, ACS announced new advisory arrangements to deliver on the strategy's promise of leveraging knowledge capital from amongst ACS members. ACS has almost 100 subject matter experts helping shape and inform future positions across areas such as Professional Standards, Diversity, Education, Blockchain, the Internet of Things, Data Sharing, Artificial Intelligence and Cyber Security.

ACS has advocated that there are three key pillars to moving the Australian economy higher up the value chain, enabling it to deliver more rewarding and higher paying jobs. These are:

- a strong banking and finance sector
- a strong cyber security capability that delivers trust
- developing high-level STEM skills in the education system.

ACS recognises the importance the ICT profession has played in enabling productivity across the economy.

In the 2017 edition of Australia's Digital Pulse, ACS highlighted the success story of Australia's ICT services exports which increased by 12 percent to $2.8 billion in 2015-16 – and advocated as a policy priority the importance of building digital communities to facilitate collaboration and innovation.To that end, ACS is committed to playing its part in growing these digital communities, with enhanced services for ACS members with its investments in a new Digital Business Strategy Platform.

In July 2017, ACS Tasmania relocated to new Hobart and Launceston offices in partnership with start-up hub, Enterprize Space.

The ACS Sydney office will be next, moving to modern, collaborative workspaces in Sydney's new Barangaroo precinct. The shared spaces will include capacity for ACS members to demonstrate new products, crowdsource new ideas, and come in for meetings – all designed with the latest in audiovisual, and designed to help foster a sense of community among members and staff. This facility is planned to open in early 2018.

As a significant driver of productivity in our economy, much depends on the Australian ICT industry being the nucleus of innovation, development and job creation. ACS recognises its role in catalysing growth and innovation in ICT, and will be introducing an accelerator space initiative as part of its new premises.

ACS' core expertise for 50 years has been professional education, university

THE FOCUS FOR ACS WILL BE TO DEMONSTRATE DOMESTIC JOB CREATION – NOT JUST THROUGH DIRECT STAFFING NUMBERS WITHIN THE ACCELERATOR, BUT ALSO THROUGH REVENUE GROWTH OF BUSINESSES WITHIN THE ACCELERATORS, AND NEW JOBS CREATED THROUGH THEIR ACCOMPANYING SPENDING.

accreditation, certification and member services. With more than 24,000 members to call upon for collaboration opportunities, and an influential communications channel via its *Information Age* online publication to share success stories with a broader community, ACS' acceleration programs will be attractive to small businesses looking to scale.

The focus for ACS will be to demonstrate domestic job creation – not just through direct staffing numbers within the accelerator, but also through revenue growth of businesses within the accelerators, and new jobs created through their accompanying spending.

The Information Millennium has barely begun. There has never been a more exciting time to be a member of ACS. ∎

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