# Chapter 5

# Australia's Mathematicians in World War 2

Many Australian mathematicians served their country through world wars and other wars, whether in military service or in a civilian capacity, in some cases interrupting university studies to do so. There are many records of service ably performed and there are accounts, too, of derring-do, some wise, some not so wise. More importantly for the annals of mathematics, there are instances of Australian mathematicians' development of areas of application of mathematics whose very existence is a result of the needs of war or which received great impetus at times of war.

Three such areas are sketched below, along with some Australian mathematicians' contributions. The first is cryptography, or the making and breaking of codes, a study that can be traced back at least to the days of Julius Caesar. It is fundamental to the secure transmission of data, which is now an economic necessity as much as a military one, and mathematical research in the area continues at a great pace. The second is operational research, now known outside England as operations research or management science. The name in the first instance referred specifically to the research of wartime operations, but it now refers to an area of study in its own right dealing with all manner of problems concerned with optimisation, for example the minimisation of cost or of time or the maximisation of personnel resources. The third area concerns public health: such fields as demography and epidemiology.

There is a fourth area of involvement of mathematicians in war, making use specifically of their training in applied mathematics, and of no lesser importance. These were the scientists who participated in rocket or ballistics research, aeronautical engineering, or the development of radar, to take a few examples. Finally, there were the teachers: the chapter ends with a tribute to the "Bailey Boys" and their lecturers at the University of Sydney.

There are many examples also of contributions of Australian mathematicians to World War 1. These are documented throughout the book within their general biographical notes.

## Individual exploits

When it comes to individual wartime exploits, Australian mathematics might lay claim to the deeds of Les Woods, although he had not at that time left New Zealand. He was born in 1922, 40 kilometres from Rotorua, with the name Leslie Colin Woodhead, and he came to Australia as senior lecturer in applied mathematics at the University of Sydney in 1954. Two years later, he was appointed the second Nuffield Professor of Mechanical Engineering at the New South

Wales University of Technology, soon to become the University of New South Wales. Woods was very active in the formation of the Australian Mathematical Society in 1956, but left Australia at the end of 1960 to become Foundation Fellow in Engineering Science at Balliol College, Oxford, and, in 1970, Professor of Mathematics (Theory of Plasma) at the University of Oxford. He subsequently returned for many visits to New Zealand and Australia and for a short time held the position of deputy head of mathematical sciences at the New South Wales Institute of Technology, concurrently with his Oxford post.

Woods enrolled at the University of Auckland in 1940 but volunteered for the Royal New Zealand Air Force at the end of that year. He used various devices to argue his way in at the age of 18, when the required age was 21, and to pass the eye examination, given his astigmatism. It was three years before he saw active service in the Pacific. In that time, Woods completed his studies for a BSc and in the 18 months that followed, in between flying Kittyhawk missions from Bougainville over Rabaul, completed extramural studies for an MSc. Woods published the story of his wartime shenanigans, along with all the serious bits in a very full life, in *Against the Tide*,[1] in 2000.

Basil Rennie was born in London on 24 December 1920. He came to the University of Adelaide as senior lecturer in mathematics in 1950 and, for four years from 1961, was professor of mathematics at the Royal Australian Air Force Academy, Point Cook, which offered the BSc and Bachelor of Engineering degrees of the University of Melbourne. Rennie is best remembered for the 20 years he then spent in the foundation chair of mathematics at the Queensland University College in Townsville, which was to become the James Cook University of North Queensland. He died in 1996.

An old friend and fellow student, John Parker, wrote to Rennie's widow, Barbara, in January 2000 of his memories of Basil. His letter included some insight into the workings of Cambridge University that will be useful to the uninitiated:

> Basil matriculated in 1938, a year before me. I believe he got a Senior Scholarship, £100 p.a., a lot of money in those days. A word here about how maths undergraduates were put through the hoop at Peterhouse and, presumably, throughout the University. The course lasted 3 years and there were two types of undergraduate. The clever ones skipped Part 1 of the Tripos, taking "Mays" in their first year and then Part 2 after which the man got his BA, probably as a Wrangler (a first) or at least an upper second (a 2.1). Part 3 was taken in the third year and this postgraduate year could be viewed as a stepping stone to a Ph.D. The second type of chap spent his first year on Part 1, his second on "Mays" and Part 2 in his third year ending up with possibly a first but far more likely a 2.1 or 2.2 or even a third.
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> But when the War broke out all this went for a Burton. Thus some of my 1939 mathematical colleagues just stayed for one year, taking Part 1 and then calling it a day and opting for military service. Others were advised to spend two years at Peterhouse . . . skipping Mays. This was tough going; two of us followed this route both landing up with 2.1 BA degrees. Meanwhile Basil, in his second year took Part 2, graduating as a Wrangler and then went on to take Part 3 in his (1940) postgraduate year. I believe he got a "star" (distinction) but am not sure.

Parker goes on to mention Rennie's subsequent war service in the Far East, where he was an acting petty officer with the Fleet Air Arm of the Royal Navy, and the two games of correspondence chess they played together during those years apart. Barbara Rennie still has Basil's record, in his own hand, of those two games. (Both employed the Ruy Lopez opening; Rennie drew with the white pieces and then lost with the black.) Later in the same letter, Parker recounted a tale of their joint experience with the College Boat Club: "I . . . got to know Basil

as a keen if distinctly unconventional oarsman. He invigorated our Boat Club by proposing a lot of controversial ideas such as the 'Syncopated Six', where you had three staggered pairs of oarsmen sitting in the Eight, with gaps between the pairs, each pair rowing one third of a stroke behind the pair in front. Typical Basil—a super scientific idea but it didn't go down with the powers that be." It was largely the prospect of sculling down the River Torrens that attracted Rennie to Australia.

Rennie was followed as professor of mathematics at the RAAF Academy by Maurice Norman (Maurie) Brearley, born in Perth on 21 January 1920. Brearley's entry into the RAAF was as conniving as could be imagined.[2] He initially took advantage of the exemption from military service provided to students of approved technical courses to complete his studies in engineering at the University of Western Australia, but, having completed his degree in December 1941, determined in March 1943 to enlist. He foresaw a number of difficulties. After graduation he had joined the de Havilland Aircraft Company in Sydney, and was thus in a reserved occupation, prevented by law from leaving it, and in any case his engineering degree precluded entry into the RAAF as an aircraft trainee. Furthermore, his father, Sir Norman Brearley, a Western Australian aviation pioneer and at that time a group captain in the RAAF, would surely not approve of the move. And he was colour blind.

Brearley's solution was to enlist under the name Maurice Burnett, with a fictitious birth date and a fictitious next of kin. He avoided the need for a letter of discharge from his employer by affirming that his last place of employment was a monastery where he had been training for the priesthood (though he was not a Roman Catholic). Incredibly, a few weeks later Brearley was asked by the RAAF to report for a medical and aptitude examination at the Woolloomooloo Recruiting Centre in Sydney. He later wrote:

> This was a big hurdle, for it would involve a test for colour-blindness. To prepare for this I persuaded a friend to borrow from the library of the CSIRO National Standards Laboratory the Ishihara Colour-Blindness Test book. She and I went through it together and I noted the number she said I should see on each page. The last four pages of the book appeared to me to contain nothing but arrays of randomly coloured dots, but my friend assured me that on each page a continuous line of similarly coloured dots could be seen wending from one side to the other, performing on the way sinuous curves of discouraging complexity. At my request she made tracings of these lines on transparent paper, and over the course of several weeks I memorized them thoroughly, drawing and re-drawing them and checking my efforts by superposing on them the master copies.

This ruse had to be called upon during the examination, and it worked. Somewhat surprised himself at this, Brearley determined "to admit my failing if I were made a navigator or a pilot of multi-engined aircraft, lest I should have to read complicated colour-code signals with other lives depending on my ability to do so." After more lies and deception, concerning for example the misplacement of his birth certificate, Brearley was ordered to report for duty on 19 June 1943.

It is just as incredible that when his flight training was completed, and having lived for almost twelve months as Maurice Burnett, Brearley confessed to the great hoax, to his father as well as to his superiors in the RAAF, and was able to receive his commission as pilot officer under his real name. He served for a year with 77 Squadron in New Guinea, Halmaheras and North Borneo.

At age 27, Brearley decided to convert himself into a mathematician, in his words, and he "cadged a job" in applied mathematics at the University of Sydney on the strength of his engi-

neering degree.[3] Studies there led to a BSc with honours and a university medal in 1952 and a scholarship to Cambridge where he obtained a BA in 1954. A lectureship with the University of Adelaide followed and then the position with the RAAF Academy at Point Cook from the beginning of 1966.

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There were many others who went on to achieve distinction in mathematics in Australia and who served in the armed forces in World War 2. Often, it was the war that perversely led to their undertaking university studies via the Commonwealth Reconstruction Training Scheme. Suitably qualified personnel who had been on active service for five years were eligible for discharge to attend university. The government paid course fees and other expenses and a stipend of £3 5s a week. This was the first instance of a substantial commonwealth government contribution to university funding and was designed to enhance the skills of the workforce in a growing economy as much as to assist individual servicemen and women.

One who used the scheme was Ted Hannan. Born Edward James Hannan in Melbourne on 29 January 1921, he went from school to a job as a bank clerk, before enlisting in the Australian Army in 1941. He saw active service as a lieutenant in the infantry in New Guinea, on one occasion being wounded in an ambush and evacuated from the front.[4] Following repatriation to Melbourne in 1946, Hannan enrolled in the Faculty of Economics and Commerce at the University of Melbourne. After graduation in 1948, he again took on a bank job, this time as a statistician, and was not to make his mark on academia for some years.

Reynold Gilbert (Reyn) Keats was another former bank officer who used the Commonwealth Reconstruction Training Scheme after the war. He was born in Port Pirie, South Australia, on 15 February 1918 and worked in the Adelaide Savings Bank where he gained qualifications in accountancy ("mainly to placate my parents") before enlisting in the 2/48th battalion of the AIF in 1939. Keats saw active service as a signalman in Tobruk, El Alamein and New Guinea, ending the war as a lieutenant in charge of signals and an instructor in signals at Maroochydore, north of Brisbane.

He was aged 27 when he attended his first university lecture, "still nominally a bank clerk," but the bank was not interested in his attending university even though Keats pointed out that he would be studying science, including the new subject of computing. "I was told in no uncertain terms that computers would never be of interest to banks," he wrote, so his career as a bank clerk "terminated".[5] With his government-sponsored BSc from the University of Adelaide, Keats in 1948 began 13 years as a research scientist, ending as principal scientific officer at the Weapons Research Establishment in Salisbury and Woomera, South Australia, and including three years in the Mathematical Assessment Division of the Royal Aircraft Establishment, Farnborough, UK. One of his projects in Salisbury, the formulation of mathematical models for the flight of the guided missiles then known as Bloodhound, Red Duster and Red Shoes, among others, was to form the basis of his PhD thesis on stationary linear systems. However, Keats' distinguished academic career was still ahead of him.

James Henry (Jim) Michael was particularly grateful for the Commonwealth training scheme. He was born near Port Augusta, South Australia, and left school, aged only 14, to work on his family's sheep property. During the war, he served with the 2/7th field regiment in Egypt, Syria and Palestine, earning the Africa Star with clasp, and then at Tarakan in the Pacific, earning the Pacific Star. Towards the end of his active service in the AIF from 1940 to 1945, he took advantage of the army's educational program to matriculate and pass first-year university

mathematics. Michael graduated BSc with first-class honours in mathematics in 1951, gained an MSc in 1953 and by 1957 had gained the University of Adelaide's first PhD in mathematics. A year later he was appointed lecturer in mathematics there. His wartime experience led to an involvement with competitive rifle shooting that continued throughout his life.[6]

Frederick John Daniel Syer was to gain a reputation in the teaching of engineering mathematics at the University of Melbourne. He was born on 25 December 1902 and studied intermittently for a BA DipEd, as well as towards a BSc, during the 1920s and 1930s while on a studentship from the Victorian Department of Education and teaching at schools across the state. Syer spent over four years with the RAAF as navigation instructor, scientific observer and research officer for which he was awarded an MBE (Member of the Order of the British Empire) for research on radar and meteorology. He joined the full-time staff of the University of Melbourne in February 1946 and in the following two years completed his BSc studies with the aid of a grant from the Commonwealth Reconstruction Training Scheme.[7] His first duties for the University were as "Temporary (Post-war) Lecturer". He then became "Senior Lecturer (in charge)" at the Mildura branch of the University, an entity that existed only between 1947 and 1949 at the RAAF training camp there. Margaret Lester, one of the first women appointed to a lectureship in mathematics in the University of Melbourne, was a member of Syer's small department in Mildura and Edward Nanson's daughter, Joan, was secretary to the warden.[8]

Andrew Paul (Andy) Guinand was born in Renmark, South Australia, on 3 March 1912. After graduating from the University of Adelaide in 1933, and having excelled in gymnastics, rowing and bicycling as well as mathematics, he won a Rhodes scholarship to the University of Oxford. One of the examiners for his thesis was the renowned number theorist G. H. Hardy and Guinand later claimed that his oral examination was postponed because Hardy was required for

**Fred Syer taking a class on the Mildura campus of the University of Melbourne. (University of Melbourne Archives)**


**"Flight Lieut. A. P. Guinand keeping his tryst on the steps of Eros in Piccadilly Circus." (Argus Newspaper Collection of Photographs, State Library of Victoria)**

a game of cricket. After further study at Göttingen and Princeton, he joined the Royal Canadian Air Force, returned to England and was navigator on many missions. Guinand did not return to Australia until 1955, when he was appointed professor of mathematics at the University of New England.[9]

Another Australian mathematician who served with the Royal Canadian Air Force was Albert Laurence (Larry) Blakers, born on 2 January 1917 in Perth. In the days when Charles Weatherburn constituted the entire mathematics staff of UWA, Blakers obtained first-class honours and was in fact the first mathematics honours student in the University. He had planned then to go to Cambridge for further study but with the outbreak of war, and following two academic terms as junior lecturer in the University, went with Weatherburn's assistance to Princeton University where he was awarded an MA in 1942. Rather than remain in the US, where he was likely to be drafted into the American army, he went then to Canada and enlisted in the Royal Canadian Air Force, which he served as a flying officer within the National Research Council of Canada until 1945. He returned to Princeton after the war and was awarded his PhD there in 1948.[10] In 1952 Blakers was offered, and accepted, the chair of mathematics at UWA following Weatherburn's retirement.

One of the great stories of heroism to come out of the war involved another West Australian, Ray Storer. His academic career at UWA had only just begun when he joined the RAAF in

1940. He trained as a pilot while serving as an instructor in navigation and meteorology and was posted to Geraldton in Western Australia and then Nhill in Victoria, where he switched to Hudson bombers. He joined 2 Squadron following the Japanese attack on Darwin in April 1942 and sustained a leg wound when, flying as navigator and second pilot, his Hudson was hit by tracer shells. Three of the squadron's eight Hudsons did not return from that mission and aluminium fragments which Storer carried in the leg for the rest of his life were a constant reminder of the action he had seen and was yet to see. In February 1945, Storer joined Flight 200 at Leyburn, Queensland, to give clandestine air support in occupied territories. He happened to be on other duties a month later when his American Liberator bomber took off on a mission to North Borneo. The aircraft, with its eleven-man crew and an army observer, was lost on its return flight.[11]

Maxwell Herbert (Max) McKay also flew with the RAAF. He was born on 2 January 1924 in Willoughby, New South Wales, attended North Sydney Boys High School where he was highly successful in the Leaving Certificate of 1941 (his second attempt, the first a year before being not at all successful) and joined the RAAF, where he was trained as a fighter pilot, soon after. McKay went to England following the Battle of Britain, switched to being a bomber pilot and flew Stirlings over North Africa. From there he was posted to 148 Squadron (RAF) in Italy, dropping supplies to the underground movements in Albania, Greece, Yugoslavia, northern Italy and southern France. University studies in Sydney began after the war. McKay was with the New South Wales University of Technology, and then the University of New South Wales, from 1954 until the end of 1966 when he became foundation professor of mathematics at the University of Papua New Guinea.[12]

## Cryptography

Thomas Gerald Room's involvement in codebreaking for the Australian military has now been well documented with the government's declassification of the relevant archives in the 1990s. Before that, Room's service in this general capacity was well enough known, but he personally stayed quiet on his knowledge of codes except for a lunchtime lecture he gave to the Sydney University Mathematical Society (appropriately, SUMS) in 1963 and a talk on ABC radio around the same time.

Presumably, and properly so, Room's colleagues at the time knew little of his wartime work. Ivan Turner, in his address for the centenary of the University of Sydney, wrote of "the difficult war years when Professor Room and Mr Lyons were on secondment to national service," although elsewhere on the same occasion he was a little more specific: "During the war (1941–1945) he [Room], with R. J. Lyons, was seconded for special service with the Central Bureau."[13] More was known by the time Room died in 1986.[14]

At the beginning of World War 2, there was no central signals intelligence organisation in Australia. In January 1940, in circumstances that are not fully known, Room and Dickie Lyons began an unofficial codebreaking group at Sydney University. They were soon joined by two others: Arthur Dale Trendall, who was professor of Greek and later, from 1948, the university's first professor of archaeology, and Athanasius Pryor Treweek, a lecturer in classical Greek who was well qualified also in mathematics. After the war, Treweek obtained a PhD from the University of London for research into the Greek mathematician Pappus of Alexandria.

Both Room and Lyons had needed to learn Japanese with great speed and efficiency. Room was happy to give credit to Margaret Lake, a lecturer at the teachers college within Sydney

University grounds and an occasional lecturer in the oriental studies department, who accomplished the task of teaching him Japanese in two terms, or around eight months. Lyons presumably had the same teacher.

By October 1940, the group's activities had been officially recognised by the Australian Army and already military intelligence would pass on intercepted Japanese messages for decipherment. By April of the following year, a cryptanalysis unit, known as the Special Intelligence Bureau, had been set up by the Royal Australian Navy under Eric Nave, who had been involved with considerable success in the interception and decoding of Japanese messages since 1923. Sydney mathematicians Peter Donovan and John Mack, in their detailed analysis[15] of the background to Sydney University's involvement in military intelligence and of the activities of Room and his group, disclosed the minutes of a secret meeting held in Melbourne on 2 May 1941. It was attended by six senior military personnel, including Commander Nave, together with "Professor Roon" and "Major Treweeke". (The same misspellings occur frequently in those minutes.) The meeting expressed appreciation "of the progress made by the unofficial Sydney group, which was started without any assistance", and Room and Treweek, speaking also for Lyons, indicated their willingness to join Nave's bureau in Melbourne, subject to suitable arrangements being made with the university authorities.

Consequently, in August 1941, the group was absorbed into the Bureau's activities. Treweek had earlier been commissioned as a major in the Sydney University Regiment, part of the Australian Militia, but Room, Lyons and Trendall remained as civilians. In fact, Room negotiated that he retain the title of "Professor", and that he retain his professorial salary. Room was sent soon after to Bandung, in Java, as part of an exchange of information with Dutch codebreakers, and then to Singapore to study the work of the longstanding Far East Combined Bureau, a British joint service codebreaking and intelligence centre.

Some detail of the work of Nave's bureau was given by the high-ranking Australian codebreaker, Geoffrey Ballard:

> Tucked away under the roof of Victoria Barracks, Melbourne, this unit had the task of decyphering the diplomatic and commercial traffic passing between Tokyo and the Japanese embassies in various countries of the Pacific region.
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> The observations and reports of Japanese diplomats, as well as the instructions they received from Tokyo, provided a most valuable "window" on Japan's aggressive intentions in the Pacific. The unit's most spectacular achievement was said to be the decyphering of a message dated December 4, 1941, from Tokyo to the Japanese Consul-General in Sydney, ordering him to destroy all his codes and cyphers—a sure indication of the imminence of hostilities.[16]

The "imminence of hostilities" was of course borne out by the Japanese attack on Pearl Harbor three days later, although Nave was later to say that "the Japanese Navy had mounted a massive deception exercise to prevent anyone realizing that Pearl Harbor was a target."[17] There were other successes that may be attributed at least in part to the codebreakers in Melbourne: they assisted in the decrypting of a number of messages in 1941 and 1942 regarding cash transfers from Japanese accounts in a number of South American countries, particularly Argentina, Chile and Peru, to cover the expenses of pro-German and pro-Italian initiatives, and a week before the Battle of the Coral Sea they deciphered messages detailing the organisation of the Japanese forces in the region.[18]

In April 1942, General Douglas MacArthur, allied commander-in-chief in the Far East and Pacific, created an army and air force signals intelligence facility in Melbourne, named Central

Bureau, containing Australian and US codebreakers. A few months later, the bureau, along with MacArthur's headquarters, moved to Brisbane. It was situated in huts on the Eagle Farm racecourse, organised in a manner similar to the famous Bletchley Park, surrounded by wire fences and patrolled by Australian military.

> Central Bureau was divided into four main sections: Traffic Analysis, employing six officers and sixty ORs [other ranks] . . . ; High-Grade Codebreaking under Major Sinkov, employing thirteen officers and sixty ORs (including a tabulating machine section), of which roughly a third were Australians; Air-Ground Codebreaking under Nave, with the naval air side led by a US Army major, the army air by an Australian major and a meteorological section under Professor Room; and Collateral Intelligence, employing four officers and six ORs, shared between the Australian Army and the RAAF.[19]

Major Abe Sinkov, mentioned here, was an American cryptographer who had worked with the US War Department from the early 1930s and had led the first US delegation to Bletchley Park. He had a PhD in finite group theory from George Washington University. Room's meteorological responsibilities concerned the decoding of Japanese messages that indicated weather conditions at sites of future air raids.

Trendall and Treweek remained in Melbourne with the diplomatic section of Nave's original bureau. Treweek worked primarily within FRUMEL (the Fleet Radio Unit, Melbourne), responsible for intercepting and decoding messages from the Japanese navy. Lyons also did not proceed to Brisbane, but instead returned to Sydney University. Donovan and Mack quote from a letter written by him to the vice-chancellor on 19 November 1942:

> However, before Commander Nave, the Head of the Bureau, left, I had the satisfaction of receiving from him what may be called a contingent invitation to go to the Foreign Office. When the decision was made to transfer control of the Office to the Americans Commander Nave told Room that if he were willing to go to London he could get him placed at the F.O. I was not surprised to hear this, because Room's intellectual power is phenomenal, but I was exceedingly gratified when he announced that the offer included me, adding that this was for my part in some rather spectacular success we had had earlier in the year. Room's immediate reaction was to accept enthusiastically, and for one thrilling morning I thought we were in for the super experience. However, when Room had weighed all the pros and cons of the proposal, he decided that much though he would have liked to go to London, his gifts could be used more effectively in Australia, and the invitation lapsed.[20]

Lyons' mention of "some rather spectacular success" appears to refer to "the first indication after the Battle of the Coral Sea that the Japanese Army would attempt to reach Port Moresby by the Kokoda Trail while the Japanese aircraft carriers would be sent somewhere else. USN cryptographers subsequently worked out that the 'somewhere else' was Midway" and this was to be the turning point in the war in the Pacific.[21]

Trendall recruited other Sydney University personnel to his diplomatic codebreaking group, notable amongst them being Eric Stephen Barnes. Barnes was born on 16 January 1924 in Cardiff, Wales, came to Sydney in 1929 and graduated from Sydney University in 1943 with first-class honours in mathematics and French. Although recommended for university medals in both subjects, the recommendation was rejected "because he had taken three and not four years for the honours courses."[22]

Barnes joined the Citizen Military Forces and served with Trendall with great distinction for three years, 1943–1945. He later recalled that he was commissioned as a lieutenant "because of his success in cracking a Japanese code that had baffled the British experts at Bletchley Park."[23]

After the war, Barnes taught for a year at Sydney University and then departed in August 1947 for Cambridge.

Donovan and Mack also wrote of Room's involvement in the design of codes for coast watchers around the country, and of his interest in obtaining, for the use of his university, one of the IBM tabulating machines used at Central Bureau. However, the Faculty of Science at the time saw no great need for such a machine.

Room was released from service at Central Bureau on 12 October 1945, following the surrender of the Japanese, and returned soon after to his professorial duties at the University of Sydney. During his absence, Edward Wellish had acted as professor and head of the department. The secretary of the Department of the Army wrote to the vice-chancellor at the time "to place on record its appreciation of the very valuable contributions made by Professor Room to the Allied War Effort since 18 August 1941."[24]

## Operational research

David Mellor, in his volume in the series *Australia in the War of 1939–1945*, wrote: "Among the many new applications of science in the war of 1939–45 few had a more far-reaching influence on tactics than operational research. For the first time in history . . . the methods of scientific research were applied on a large scale to the study of the performance of new types of equipment and to the operations of war."[25] He quoted also from Sir Charles Goodeve:

> Operational research was really born out of the Battle of Britain. As is well known, we had in 1940 few fighter aircraft compared with the number that would have been required to defend our shores against an air invader. We had very good fighter pilots and very good aircraft, but, with the equipment and methods used prior to 1940 it would have been impossible to obtain sufficient interceptions to defend our shores. The most important new feature that came in was, of course, radar. This equipment by giving ample warning, permitted the retention of aircraft on the ground until needed and then by plotting the positions of the enemy and defending aircraft, enabled a "ground control" to direct the aircraft to a position where the enemy could be sighted visually. The planning of this sequence of operations involved careful analysis of training and operational experiences and involved a full analysis of the technical possibilities of the equipment. But the process of combining these factors required mathematical calculations beyond the experience of the ordinary commanding officer. Accordingly a small party of half a dozen scientists was attached to Fighter Command to study and refine the deployment and the operational orders . . . It is estimated that radar itself increased the possibility of interception by a factor of about ten; but that, in addition, this small operational research team increased the probability by a further factor of two.[26]

The British experience was rapidly brought to Australia. Two operational research groups were established within the Australian Army, and four in the Air Force.

The Army Operational Research Group was attached to the Royal Artillery and headed by David Forbes Martyn, who had previously been chief of the radiophysics division in CSIR, the precursor of CSIRO. It began its activities on 1 June 1942, having recruited to itself "science graduates with honours in physics and mathematics . . . most of whom retained their civilian status",[27] until it had about 14 members. Its activities were largely restricted to weapons research and radar. The group's members were, for example, posted to different operational areas to advise on the tactical use of radar and the information gained from it.

The second army group, the Operational Research Section, was placed in the Branch of the Master-General of the Ordnance. It consisted initially of a team of three who had trained with

the British Army Operational Research Group and was later enlarged to include Australian officers with research experience.

One of these was Henry Maurice Finucan. Born on 6 July 1917 in Brisbane, he was outstandingly successful at school and university. After gaining first-class honours in mathematics at the University of Queensland in 1937, he went to Balliol College, Oxford, as a Rhodes scholar and, on completion of his studies there, spent two terms at Cambridge studying general biometrics and the design of agricultural experiments. Finucan returned to Australia towards the end of 1940 and in March 1942 enlisted in the army, serving in Australia, New Guinea and Borneo as an anti-aircraft gunner. In July 1942, he was promoted to sergeant and became an instructor in the Army School of Radiophysics. In September that year he was commissioned with the rank of lieutenant. Then in March 1944 Finucan was transferred to the Operational Research Section. He was demobilised the following October, at which time he held the rank of captain, and while awaiting demobilisation applied for and was appointed to a lectureship in the mathematics department of the University of Queensland.[28]

The Royal Australian Air Force Operational Research Group was established quite late in the war, on 18 January 1944, but more use was then made of it than had been the case with either of the army groups.

One member of the team of researchers gathered together for the purpose was then squadron leader Clive Selwyn Davis, later promoted to wing-commander. From 1956 he was professor of mathematics in the University of Queensland, but at that stage he was not too long graduated from the University of Sydney. Following his receipt of first-class honours in mathematics in 1937, first-class honours in physics in 1938 and an MSc in mathematics in 1939, Davis travelled to England on a CSIR scholarship. His intention was to return to Australia and work in the Aeronautical Research Laboratories, but he soon enlisted in the Royal Air Force. After two tours of duty flying heavy bombers in the Middle East, leading to the award of the Distinguished Flying Cross, he acted as liaison officer for operational research within the RAF. He was posted back to Australia in mid-1942 to apply his experience in the RAAF.[29]

**Clive Davis, photographed after obtaining the state's second best Leaving Certificate pass (top in mathematics, second in physics) in 1934. (Sam Hood Collection, State Library of New South Wales)**

Another of the members was squadron leader Alexander Renfrew Miller. Born on 4 September 1915, he graduated with an MSc with first-class honours in mathematics in the University of Melbourne in April 1938, briefly held a tutorship in the University and by October had entered Gonville and Caius College, Cambridge, as a research student. He gained his PhD in June 1941 for a mathematical study of certain physico-chemical problems and was appointed to Britain's Ministry of Home Security, Research and Experiments Division, to conduct research on the theory of

explosions. In July 1942, he was appointed to carry out operational research with the RAF as a scientific officer in the Directorate of Scientific Research of the Ministry of Aircraft Production. After serving in India and being invalided back to England in August 1943, Miller was made available on loan to the Australian government to join Davis and others.

Much of Davis' work in the Operational Research Group was carried out as section leader for about a year in New Guinea, with overall command taken by J. C. Bower. Miller's story hereabouts is taken from his unsuccessful application[30] in October 1945 for the position of professor of applied mathematics in the University of Sydney. He wrote:

> I left the United Kingdom in December 1943, spent two months in Canada and the United States studying recent research and development there relating to the air forces, and reached Australia in February 1944. Since then I have been in charge of the operational research section at R.A.A.F. Command (the R.A.A.F component of Allied Air Forces, S-W.P.A [south-west Pacific area]) ... My duties there have included the direction of the research of all members of the section at R.A.A.F. Command, advice to the A.O.C. [air officer commanding] on scientific developments and advice based on the analysis of air operations and the performance of weapons. In addition, since April 1945 I have exercised oversight of the other three operational research sections within the R.A.A.F.

One of those other sections was started in the First Tactical Air Force area with N. J. Loveday as leader. Mellor wrote: "There can be no doubt that operational research influenced wartime policy of the R.A.A.F. to a sufficient degree—at a late stage in the war at least—to justify its existence . . . Through the work of Bower, Miller, Davis and Loveday, operational research won the good opinion of many air force administrators."[31] He gave detailed and quantitative descriptions of a number of the group's projects.

For Davis there was then to be another flying stint, in command of a Darwin-based special duties flight of Liberator bombers. In 1946, at the end of hostilities, he gained a scholarship to Cambridge, where he graduated with a PhD in 1949. Nothing further is known of Alexander Miller.

Some have described Patrick Alfred Pierce (Pat) Moran as Australia's greatest contributor and administrator in the field of statistics. He was also involved in wartime operational research. Moran was born and educated in Sydney, travelled to Cambridge University in September 1937 and remained in England throughout the war. He was an experimental officer with the Ministry of Supply from 1940 to 1942 when he met up again with Clive Davis, whom he had known in Sydney. Davis assisted him to obtain a position with the Australian Scientific Liaison Office (ASLO), run by the CSIR in London, in late 1943. His duties were to liaise on general physics, including radar, and operational research:

> He covered a great diversity of applied physics including vision, camouflage, army signals, quality control, road research, infra-red detection, metrology, UHF radio propagation, general radar, bomb fragmentation, rockets and asdics. More valuable to him later, however, was the operational research and associated subjects. Every few months he visited each of the operational research sections in Fighter, Coastal, Bomber, Tactical and Training Commands and he was also accredited to the U.S. Bomber, Fighter and Tactical Air Force Commands.[32]

Moran left the ASLO in June 1945. After a year at Cambridge, he took a position as senior research officer at the Institute of Statistics at Oxford University. He had continued his studies during the war years in both analysis and statistics and remained in active research at Oxford until late 1951, when he moved to Canberra as foundation professor of statistics at the Australian National University.

## Public health statistics

The foundation professor of mathematical statistics at the University of Sydney, Henry Oliver Lancaster, was born in Sydney on 1 February 1913, and educated in various schools in rural New South Wales. He was intensely proud of his extended family, which included Sir John Forrest, the first premier of Western Australia, and Edward William Mattner, president of the senate in federal parliament in the early 1950s.

Lancaster's initial university studies were in economics. He had intended to become an actuary, but just four weeks into the course he transferred to the Faculty of Arts where he took the honours class in mathematics, taught by Carslaw and Lyons. Seeing no future as an academic, he transferred again at the end of the year, to the Faculty of Medicine from which his father had graduated nearly 35 years before. A junior fellowship in medicine at the Prince Henry Hospital in Little Bay, Sydney, allowed the young doctor to pursue interests in pathology, with evidence already of a substantial interest in the application of statistics. Then, on 31 July 1940, Lancaster joined the Australian Imperial Forces as a medical officer.

He spent a year in the Middle East, in Alexandria and Nazareth, as a pathologist with the 9th Australian General Hospital, returning to Australia in February 1942. According to his *Recollections*,[33] Lancaster's first use of statistics was in Townsville: "Major T. E. Lowe and I investigated the incidence of eosinophilia and found that it was usually caused by hookworms or strongyloides. I also investigated the incidence of intestinal protozoal infections. Here a statistical problem was to compare incidences in the four classes of troops according to whether or not they had been in the Middle East or New Guinea, a problem in 2 x 2 x 2 tables; higher orders could occur if several parasites were considered." This work led to his first publications, two papers with co-author Lowe in the *Medical Journal of Australia*, 1944.

Then, in 1944 in New Guinea: "I made a survey of more than a thousand native troops and civil workers from different areas and surprised the army Director of Pathology . . . by reporting the results in systematic form with properly drawn graphs and means and standard deviations correctly computed." Lancaster's interest in demography developed at this time. He saw possibilities for the application of physics or chemistry to demography, and realised the need to learn more mathematics:

> I began a serious study of pure mathematics. So in 1944 after a break of 14 years I borrowed Caunt's *Infinitesimal Calculus* from our adjutant, C. J. Stevens, later principal actuary of the Australian Mutual Provident Society, and found that I could remember an encouraging amount of mathematics after only a little practice. In 1945, I enrolled as [an] external student in the second-year honours course at Sydney University. There was plenty of time in the evening to study mathematics, sitting with a kerosene lamp in hot humid conditions. I obtained a high distinction in Mathematics II . . . Books I remember having liked are Hardy's *Pure Mathematics*, Bromwich's *Infinite Series*, Wood's *Calculus* and Sommerville's *Conic Sections*.

After two years in New Guinea, Lancaster's war service ended with the rank of major in April 1946. There is a fine pencil sketch, titled "Pathologist (Major Henry Oliver Lancaster) 1944", by the famous war artist Nora Heysen in the Australian War Memorial, Canberra. His statistical work during this time could perhaps have received more notice, since much later Edwin Pitman would claim that there had been no statistics in the Australian war effort.[34] Pitman was referring mainly to his offer, not taken up, to introduce statistical quality control into the government's munitions factories.

Oliver Lancaster subsequently gained a temporary appointment in the School of Public


**Nora Heysen's sketch of Lancaster, 1944. (Australian War Memorial)**

Health and Tropical Medicine at Sydney University, where he could continue his demographic work, "it being understood that my first year would be spent in acquiring expertise in medical statistics". So he also resumed his studies in mathematics:

> I attended the courses in applied mathematics under Professor K. E. Bullen FRS, who gave very clear lectures and who was a help and encouragement to me then and for many years later.
>
> I also attended the lectures of Professor T. G. Room FRS in pure mathematics, principally geometry . . . I have always been greatly impressed by Room's lectures and his virtuosity. No other lecturer in Australia has seemed to me to have such a command of the subject in hand.

He was awarded a BA in 1947. Further studies in "the pure half of the Mathematics IV course" followed, although Lancaster avowed at that time that he had no interest in becoming a professional mathematician. In July 1948, he left for a year in England as a Rockefeller Fellow in Medicine at the London School of Hygiene and Tropical Medicine.

## The scientists

Harrie Massey, who had been a student of Michell's at the University of Melbourne, was one of three Australians who worked on the development of the atomic bomb. The others were Eric Henry Stoneley Burhop and the eminent physicist, later to be appointed governor of South Australia, Mark Oliphant FRS. Burhop was born in Hobart in 1911 and, like Massey, educated in Melbourne and Cambridge, where he graduated with a PhD in 1938. He lectured in natural philosophy at the University of Melbourne from 1936 to 1942 and then took the wartime post of officer-in-charge of the CSIR Radio Research Laboratory in Melbourne.

Massey, Burhop and Oliphant all worked on the Manhattan Project, the "Tube Alloys" scheme in particular, in the USA in 1944–1945. Also involved was another who would make a great mark on Australian physics, Ernest William Titterton, the foundation professor of nuclear physics at the Australian National University. After the war, Burhop was a lecturer and then reader in mathematics at London's University College until 1950, when he was appointed reader in physics. He was promoted to professor in 1960, retired in 1978 and died in London two years later.

John Conrad Jaeger, like T. G. Room, is a striking example of a civilian mathematician who stayed in Australia and made a substantial contribution to its war effort. When war broke out, Jaeger and Edwin Pitman together constituted the mathematics staff of the University of Tasmania and the extensive collaboration with Carslaw had been operative for some years.

This collaboration was itself worthy of mention by D. P. Mellor. He wrote of "mathematical formulae developed by Dr Jaeger and Professor Carslaw, who some years before had made a special study of the conduction of heat".[35] This led to scientists in the CSIR National Standards Laboratory, including Jaeger himself, devising new goggles, with lenses of tinted, infra-red absorbing glass, which allowed their wearers to detect aircraft silhouetted against the sun. "These goggles, when tested in experiments carried out in conjunction with anti-aircraft defences . . . in which a dive bomber attacked from the sun, were found to improve the efficiency of the gun crew. The goggles were adopted first by the navy and later by the other two Services."

While still in Hobart, Jaeger undertook several military projects that made use also of his early inclination towards engineering. This work included problems concerned with the production of charcoal, in which he carried on work initiated by Leicester McAulay, and the fracturing of sandstone rollers used in newsprint production. Regarding the second of these, Jaeger's biographer, the Canberra physicist Mervyn Silas Paterson, wrote that the most interesting feature "lies in the way it reveals the effective combination of Jaeger the engineer singling out the essential elements of the problem and Jaeger the applied mathematician dealing with the theoretical questions posed."[36] The solution of these two problems led to a number of publications while at the same time Jaeger continued to publish on the conduction of heat. In December 1941 he received a DSc from the University of Sydney.

About one year later, Jaeger was requested to join the CSIR Radiophysics Laboratory in Sydney for full-time investigation of the generation and propagation of radio waves.

> At the Radiophysics Laboratory, the centre for radar research and development in Australia during the war, Jaeger was involved in a variety of theoretical problems. Some of these, such as the calculation of currents and potentials in electrical circuits, arose out of equipment design and development. However, Jaeger's main contributions were in the two areas of antenna patterns and radio wave propagation. He became involved in the wave propagation and absorption work initially through [F. W. G. White (later Sir Frederick), head of the Laboratory], whose

> responsibilities for ionospheric prediction had come to include the problem of predicting the lowest usable high frequency for radio transmission above 2MHz, a requirement of the armed services.[37]

There was also work on the effect of wind on nocturnal cooling and on diffusion in turbulent flow between parallel planes. The National Standards Laboratory was in the same building as the Radiophysics Laboratory, and it was during this time that Jaeger contributed to the design of the new lenses for goggles, mentioned above.

In September 1943, Pitman requested Jaeger's return to Hobart. He had been managing the department with the assistance only of three part-time lecturers and had discontinued all teaching in third-year subjects, a situation which, he wrote, would be "impossible to continue ... without a full-time lecturer."[38] Jaeger returned to the University of Tasmania in April 1945.

Eric Russell Love had only recently joined the department of mathematics at Melbourne University as a lecturer when he found himself seconded, in 1942, to the Munitions Supply Laboratories (later called the Defence Standards Laboratories) at Maribyrnong on the outskirts of Melbourne. There he worked on a variety of mathematical problems in armaments and equipment.

> For example, one of his tasks was to explain the failure of certain gyroscopes used in automatic pilots in aircraft; the problem came down to calculating the stress concentrations near defects in the gyro spindles, and to deal with the problem involved the enlargement of the then existing tables of Legendre functions. In 1944, he was transferred to the Aeronautical Research Laboratories, Fisherman's Bend, where he worked with J. P. O. Silberstein and others with the express purpose of enquiring into aircraft engine and propeller vibration.[39]

Josef Philipp Otto (Phil) Silberstein was born in Vienna on 5 July 1920. His first substantive job in Australia, in 1939 after leaving Austria with his twin brother and having spent just nine months in London, was with the newly formed CSIR Division of Aeronautics as a junior laboratory assistant. At the same time, he studied engineering in the evenings at "Melbourne Tech", now RMIT, but after two years transferred to the University for a BA with mathematics honours, still studying part-time. The degree was completed in 1944. Silberstein took three years absence in the late 1940s to obtain a Cambridge PhD and, back at the ARL, attained the position of principal scientific officer in 1955. Five years later, Silberstein embarked on an academic career and in 1966 was appointed professor of mathematics in the University of Western Australia.[40]

Many of the "others" at the Aeronautics Division at that time have been mentioned previously in connection with the University of Melbourne: they included George Batchelor, Dick Dalitz, Betty Gent, Julius Guest, David Hurley, Elizabeth Mann, Fenton Pillow, Rainer Radok and Roy Smith.[41] The future Canberra geophysicist Mervyn Silas Paterson was also there.

Dalitz, in the summer of 1944–1945, worked with a group on fluid flow problems, under Batchelor.[42] Mann began work in the division in December 1942, having previously spent a summer there, and returned briefly in 1949 after time off to complete her Cambridge doctorate.[43]

Pillow was a research officer there from 1943 to 1947 and senior research officer from 1950 to 1953 working for much of the time on problems of compressible flow and hydrodynamic stability. He spent the intervening years at Cambridge studying towards his PhD. Gent researched wind tunnel interference problems. Radok, following his internment, served in the Australian Army from 1942 to 1945 while studying part-time at the University of Melbourne; he subsequently worked in the division until 1950, and again from 1953 to 1955. Smith was in

the division from 1941 to 1948 and then began a long career in the University of New England, where he was professor of mathematics from 1957.

Walter Freiberger was another: he served in the Australian Army from 1943 to 1945 and was released early so as to join the division. His first-year university studies were completed while in the army and the rest of his course while working at Fishermans Bend on structural problems related to the Mosquito fighter. He and Radok in fact began there as assistants to Silberstein, although they did not get on well together.[44] Freiberger remained with the ARL until, having gained an MA from the University of Melbourne, he departed for Cambridge on a scholarship in 1950.[45] He returned in 1953 for two more years at the ARL before moving permanently to Brown University in the USA.

This chapter began with stories of Les Woods and Basil Rennie, who came to Australia after the war. Another who was to gain eminence in Australian mathematics but did not arrive until some time after the war was Herbert Sydney (Bert) Green. He came to Adelaide in August 1951 to take up the chair in mathematical physics. He had previously worked with Max Born in Edinburgh from 1945, where he obtained his PhD and a DSc two years later, and with Erwin Schrödinger in Dublin in 1950–1951. In between, he spent a year at the Institute of Advanced Study in Princeton, continuing the work on quantum mechanics and quantum field theory that had been initiated with Born. Green was born on 17 December 1920 in Ipswich, England, and completed his BSc with first-class honours in mathematics at the Imperial College of Science and Technology, London, soon after the war started. He joined the RAF in 1941 as a meteorological officer with the rank of flying officer and spent most of the war on the Isle of Man advising the RAF on flying hazards such as wing icing. As Angas Hurst recalled: "Bert's experience there remained with him throughout his career and gave him special insights into environmental questions and, more remotely, into problems in cosmic ray physics that were out of the normal run."[46]

## Bailey's radar courses

In Oliver Lancaster's *Recollections*, he lamented that in his Leaving Certificate mathematics examination in 1929 at West Kempsey Intermediate High School he was placed second to Jack Somerville, who, when war broke out, was lecturing at the New England University College. In August 1941, he was seconded to Sydney to be one of the assistants in the radiophysics courses conducted by Victor Albert Bailey, professor of experimental physics in the University of Sydney from 1936 to 1953.

Some 300 servicemen passed through Bailey's courses.[47] Initially they had been carried out by the Radiophysics Laboratory, but the assistance of the university was called on when the task became too large. There were six courses, of three to six months duration, during the period from September 1941 to March 1944. Graduates of the courses were commissioned as radar officers in one of the three services and in many cases were sent to the front.

Two of Bailey's other assistants, besides Somerville, were Dick Makinson, by that time in the physics department at the University of Sydney, and Bill Smith-White.[48] Their work for Bailey was additional to their university duties.

One of the tutors in the course, who later became Bailey's assistant director, was Alfred Hurlstone (Alf) Pollard. Pollard was born in Melbourne on 9 August 1916, but grew up on Norfolk Island and was educated in Sydney at Canterbury High School. He was the state's top

student in the Leaving Certificate of 1932 and in Room's first honours year won a BSc with the university medal in mathematics and a Barker graduate scholarship. However his family's circumstances did not allow him to take up the scholarship. Instead, with a letter of introduction from H. S. Carslaw, Pollard took a position with the MLC Assurance Company where he gained his actuarial training. At the age of 23, he had passed all papers towards his fellowship of the Institute of Actuaries.

"Out of the blue," he was invited by Bailey two years later to take the appointment in radiophysics despite having not covered the area in his university course. When that work came to an end in early 1944, Pollard joined the RAAF and spent two years as a flight lieutenant in acoustic research, another area initially foreign to him, in a laboratory at the University of Sydney. On his discharge from the RAAF he returned to the MLC.[49] In 1966 Pollard was appointed foundation professor of economic statistics and, in 1968, director of actuarial studies at Macquarie University. The biography of the brilliant Alf Pollard continues in Chapter 9.

The servicemen who went through Bailey's courses referred to themselves as the "Bailey Boys". They were mostly volunteers from around the country who had completed just one or two years of university studies. Walter Fielder-Gill was a Bailey Boy and has written their story, together with an account of the courses themselves:

> It was no mere service course, but combined theory and mathematical rigour, supplemented with practical exercises. Bailey made it clear in his introductory lecture that it would be no easy option . . .
>
> Bailey lectured on circuit theory, including analyses of series and parallel and more complex circuits using differential equations and a vector approach to the steady state; on the use of operators and complex numbers; on resonance, filters, transformers, networks, D-Y transformation, bridges, coupled circuits, transmission lines and chains; and on reflection, attenuation, matching, efficiency, and wave generation. Bailey's notes included some 125 numbered mathematical equations. Smith-White lectured on aerials of various types and their radiation patterns, with attention to arrays, reflection, refraction and the ionosphere. Makinson lectured on vacuum tubes, covering such topics as diodes, triodes, tetrodes, pentodes, cathode ray tubes and thyratrons . . . He also lectured on modulation and demodulation and noise, and radio tube testing and fault locating . . . Somerville gave about twenty-five lectures purely on amplifiers and oscillators . . . power output, distortion, efficiency, modulation methods, design of transformers, phase inverters . . .
>
> Pollard also taught Fourier series and integrals applied to periodic functions, Fourier integrals for non-periodic functions (e.g. pulses), and the building up of square, rectangular, triangular, sawtooth and other waves from a fundamental sine wave by progressively adding harmonics of appropriate amplitude.
>
> During the course, there were one-hour examinations on electricity and magnetism, and in mathematics—integration, differential equations, operators, time delay of pulses, Fourier theory, transmission lines and amplifiers and oscillators.[50]

Bailey himself maintained a long friendship with Smith-White and other university mathematicians. Apart from his major work on the ionosphere, he had a lifetime fascination with numbers and wrote papers in that area and in other areas of mathematics. Born in 1895 in Egypt, Bailey had studied at Oxford and came to Australia in 1924 as associate professor of physics at Sydney University. He retired from the University in 1961 and died in Switzerland in 1964.[51]

Charles Angas Hurst, always known as Angas, was a Bailey Boy. He was born on 22 September 1923 in Adelaide and was educated at Scotch College, Melbourne, before the war, and the University of Melbourne after it. Hurst answered a newspaper advertisement for university

students to enlist in the RAAF to assist with "radio direction finding" and ended up in the second batch of about 35 from all over Australia attending one of Bailey's six month "pressure courses" in theoretical and experimental radiophysics. He then went to Richmond in New South Wales for a further three-month course in radar and, still not 20 years of age, was commissioned as a pilot officer. His first job was as commanding officer of a radar station on the front line in New Guinea, on the D'Entrecasteaux Islands, never having seen a radar station before. Hurst returned to Australia and held a number of further posts as commanding officer and technical officer in radar stations, before ending his service in early 1946 as a flight lieutenant.[52]

He returned to Melbourne, obtained his BA with honours in 1947 and a BSc a year later, and then travelled to Cambridge to study for a PhD, coincidentally with Basil Rennie. Hurst accepted Tom Cherry's personal offer of a senior lectureship in mathematics at the University of Melbourne in 1952 and five years later went to a similar position in mathematical physics at the University of Adelaide. He was promoted to reader in 1961 and to professor of mathematical physics in 1964.

The experiences of Robert Philip (Phil) Loh as a student at Melbourne University for a year followed by attendance at one of Bailey's courses and then being sent to New Guinea were very similar to Hurst's. After the war and having completed his university studies, Loh taught mathematics and physics at the Bendigo School of Mines for seven years. He then gained experience in operations research with the Colonial Sugar Refining Company and was in the Department of Applied Mathematics at the University of Sydney for 20 years, teaching operations research until his retirement in 1983.

The University of Western Australia's David Hurley, a close friend of Hurst's as undergraduates, and John Makepeace Bennett, who was foundation professor of computer science in the University of Sydney from 1961 to 1986, were also Bailey Boys. Bennett would later say that he learnt all he knew of Fourier analysis from Pollard and Pollard returned the compliment by attending Bennett's second SILLIAC computer course at Sydney University in 1956.[53]

Charles Leonard Hamblin was another Bailey Boy: he began at the University of Melbourne before the war and returned afterwards to complete his studies in mathematics, physics and philosophy. He became a philosopher and computer scientist of considerable renown, teaching at the University of New South Wales, and is particularly remembered for his invention of the reverse Polish notation for computations.