

# Australian malariology during World War II (Part 3 of 'Pioneers of Australian military malariology')

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## Abstract

This is the third part in a five-part series on the development of Australian military malariology during the twentieth and early twenty-first centuries. Part 1, which appeared in *JMVH* 24(1) in January 2016, traced the course taken by Australian malariology between the South African ('Boer') War of 1898–1902 and the early 1920s in the immediate aftermath of World War I. Part 2 appeared in *JMVH* 24(2) in April 2016. It argued that Australian malariological research between the two World Wars depended largely on the efforts of specialists in tropical diseases who had acquired their knowledge of malaria through practical wartime experience as medical officers serving with the Australian Army Medical Corps (AAMC) in New Guinea and the Middle East during World War I.

This article shows how dire need — the near isolation of Australia after Japan entered World War II in December 1941, plus a series of major malaria epidemics among the troops in Papua — pushed the AAMC into a pioneering program of malariological research.

As with Parts 1 & 2 in the series, Part 3 tells the story biographically, through the lives and work of the Australian Army's medically trained scientists and administrators who led the Army's wartime anti-malaria effort. Because of their endeavour, during World War II the Army sponsored ground-breaking malariological research for the first time.

The nine AAMC medical officers profiled in the sections that now follow were instrumental in initiating and implementing the Army's anti-malarial policies and practices during the period of the 'Island Campaigns' 1942–1945. Without their collective effort, a rising malarial tide in Papua and New Guinea could well have engulfed the Allied forces as they sought to halt the Japanese thrust into Australia's external territories.

## Introduction

The rapid Japanese advance across South East Asia and through the archipelagos of the South West Pacific in late 1941 and early 1942 effectively isolated Australia and New Zealand. The lines of communication with their principal Allies, the UK and the USA, lengthened and became more hazardous. Further, the cinchona plantations of the Netherlands East Indies (now Indonesia) came under Japanese control. Until then the plantations had been the source of most of the world's supplies of quinine, the principal anti-malarial drug,

For the first time in the war, Australian forces suffered a series of major epidemics of malaria in Papua New Guinea<sup>1</sup> as the troops there struggled to stem the Japanese tide. Even before the epic battles of the Kokoda Trail, Milne Bay and the north Papuan coast between mid-1942 and early 1943, malarial

infection rates among the personnel deployed to the Port Moresby area for the campaigns ahead had soared to levels not seen since the great *falciparum* malaria epidemic suffered by the Australian-led Desert Mounted Corps in Damascus in September–October 1918, during the last weeks of World War I.

## The malaria epidemics in Papua New Guinea in 1942–43

The war against malaria in Papua New Guinea soon proved as crucial as that against the Japanese. It was led and conducted by a group of remarkable senior officers of the Australian Army Medical Corps (AAMC) who had trained in tropical medicine during the inter-war decades of 1920s and 30s.

The AAMC's specialists in tropical diseases had already performed a prelude to the sobering drama of the 1942–1946 war against malaria in Papua New

Guinea. In Syria in June–July 1941 the troops of the 2<sup>nd</sup> Australian Imperial Force (AIF) suffered the Army's first malaria epidemic of the war when 1400 troops succumbed to the disease during the six-week campaign against the Vichy French forces there. By a ratio of four to one, most of these were victims of *falciparum*, the more lethal form, rather than *vivax* malaria. The victims were promptly evacuated to the military hospitals in malaria-controlled Palestine.<sup>2</sup>

The medical officers feared the worst in Syria. AAMC veterans who had served in the Middle East during World War I remembered the catastrophic *falciparum* epidemic that had almost brought the Desert Mounted Corps to a standstill in Damascus in 1918. As in 1918, one of the main approaches into Syria from Palestine in 1941 was along the upper Jordan, still a highly malarious region.<sup>3</sup>



A 2<sup>nd</sup> AIF anti-malarial team disinfecting a malarial mosquito breeding ground using knapsack sprays, Syria, 1941. Left–right are Lance-Corporal A.W. Branch, Corporal R. Griffiths and Private G. Idle (Australian War Memorial photograph no. 021218).

Fortunately for the troops, the 1941 epidemic in Syria was contained without becoming a catastrophe of 1918 proportions. The reasons for this welcome outcome included the short duration of the campaign, which allowed most troops to be withdrawn from malarious Syria and Lebanon to the malaria-controlled areas of Palestine. In addition, the summer of 1941 in Syria was unusually dry, thus restricting the breeding of the anopheline malaria vectors. The likelihood of transmission was further reduced through strict observation of 'malaria discipline', including the taking of suppressive doses of five grains (0.324 grams) of quinine daily and then ten grains (0.628 grams) after the number of infections began rising. After the first rush of cases during June, in July the anti-malarial effort was intensified. Measures to reduce the troops' chances of being bitten by mosquitoes included placing camps in safer areas away from mosquito breeding sites, limiting night-time troop movements when possible and spraying

with insecticides the areas frequented by the troops. As well as these factors, the troops developed a better understanding of malaria through the dissemination of information about the disease and instruction by members of the 2/1<sup>st</sup> Field Hygiene Section, which had responsibility for malaria control.<sup>4</sup>

When the 2<sup>nd</sup> AIF returned to Australia in early 1942 to help face the Japanese invasion in Papua New Guinea, many of the AAMC's medical officers therefore had recent first-hand field experience of malaria in the Middle East theatre, and of the measures required to combat the disease effectively. Their knowledge, skills and experience were immediately relevant to the medical situation in Papua New Guinea, which, then as now, was among the most malarious regions on earth.

The Japanese invasion of Papua New Guinea had begun with capture of Rabaul, capital of the Territory of New Guinea, on 23 January 1942. Japanese forces then quickly overran the other towns in New Guinea and along the north coast of the Territory of Papua. By early May 1942 the Japanese had occupied the long chain of archipelagos to Australia's north, between Sumatra in the west and the Solomon Islands in the east.<sup>5</sup>

As the Japanese invasion of Papua New Guinea progressed, Australian forces were rushed there to meet the threat. Troop numbers built up rapidly, particularly around Port Moresby, the capital of Papua. Almost immediately, a series of malaria epidemics erupted. The first began in March 1942, as troop numbers around Port Moresby were rapidly increasing. With some fluctuations in infection rates, it continued for five months, until August.<sup>6</sup> Between early and late March 1942, the hospital admission rate of troops suffering malaria increased five-fold, from seven admissions per thousand troops a month to 36. The personnel of any unit being hospitalised at the latter rate would accordingly be entirely replaced within the space of 28 weeks.<sup>7</sup> This was *before* any major campaigns had been fought!

Further, worse epidemics of malaria followed during the campaigns at Milne Bay during the second half of 1942 and along the north Papuan coast at Gona, Buna and Sanananda at the end of 1942 and early in 1943.

The malaria hospitalisation rate during the battles for Gona, Buna and Sanananda quickly rose to a peak of 48 admissions per thousand troops weekly by late January 1943. That was the equivalent of 2496 cases per thousand troops annually, which in turn implied a yearly average of about 2.5 hospitalisations for malaria for each soldier participating in the campaign on the Papuan north coast.<sup>8</sup>

At Milne Bay the malaria epidemic was among the worst ever suffered by the Australian Army. There the malaria hospitalisation rate soared to 82 cases per thousand troops per week in mid-December 1942; i.e. equivalent to 4264 cases per thousand annually or an average of almost 4.3 hospitalisations for each soldier. If sustained, infection rates of that magnitude would have obliterated Milne Force. As the official medical historian, Allan S. Walker observed, 'had this alarming increase in rate continued, bounding upwards in geometrical progression,...the whole [of Milne] Force would have been lost in less than two months'.<sup>9</sup>

By early 1943, malaria hospitalisation rates were so high that drastic action became necessary. The form this took, strongly supported by the Army's Commander-in-Chief, General Sir Thomas Blamey, was the creation of an extraordinary Army malariological research institute — the Land Headquarters Medical Research Unit (LHQMRU) at Cairns. The program of malariological research undertaken by the LHQMRU over the three years from June 1943, was among the best completed anywhere in the world up till that time.<sup>10</sup> Applied in the field in Papua New Guinea, the findings flowing from the LHQMRU radically reduced malarial infection rates among the Allies. That in turn enabled the Allies to turn the tide of war and eventually to defeat the Japanese.<sup>11</sup>



AUSTRALIAN WAR MEMORIAL

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*Australian troops making their way along a muddy track at Milne Bay, 1942 (Australian War Memorial photograph no. 013339). The campaign was fought during an unusually wet 'wet season'; drainage ditches flooded; roads soon became rutted expanses of mud and water; mosquito breeding sites proliferated; malaria was endemic among the local indigenous village population; and at first 'malaria discipline' among the troops was slack. Under these circumstances, a serious malaria epidemic was inevitable.*

The following sections of this paper now profile nine AAMC medical officers, all but one of them malariologists, whose efforts to combat malaria made the Allied victory possible. Even brief profiles like the following demonstrate how Australian military malariology rose to the level of 'world best practice' because of the necessity of combatting malaria in Papua New Guinea.

## Sir Neil Hamilton Fairley KBE FRS (1891–1966)

Neil Hamilton Fairley, the son of a bank manager, was born in Inglewood, Victoria, on 15 July 1891. He was the third of six sons, four of whom survived to adulthood and became medical practitioners. He was educated at Scotch College, Melbourne, where he was dux of his year. He was also a talented athlete. He represented Victoria in tennis and became the Australian inter-varsity high jump champion while studying medicine at the University of Melbourne.<sup>12</sup>

After graduating MB BS in 1915, Fairley served a period as a resident at the Melbourne Hospital. He was awarded the MD degree from the university in 1917, but by that time he was serving overseas with the 1<sup>st</sup> AIF. He had enlisted as a captain in the AAMC in August 1915. His first published paper was a major report on the cases of meningitis he had studied during an epidemic of the disease in Victorian army camps.

In September 1916 Fairley joined the 1<sup>st</sup> Australian Imperial Force (AIF) and was posted to the 14<sup>th</sup> Australian General Hospital (AGH) in Cairo. He remained on the staff of the 14<sup>th</sup> AGH until demobilised in 1919. While at the hospital he came under the influence of Lieutenant-Colonel (later Sir) Charles Martin, the director of the Lister Institute of Preventive Medicine, a physiologist and pathologist who had earlier lectured at the Universities of Sydney and Melbourne. Martin had enlisted in the 1<sup>st</sup> AIF, served with the 3<sup>rd</sup> AGH in Cairo and established the Australian Mobile Bacteriological Laboratory there.



*Captain N.H. Fairley, probably 1915 after enlisting in the AAMC (Scotch College, Melbourne, photograph).*

While at the 14<sup>th</sup> AGH Fairley became interested in tropical diseases. He undertook research on schistosomiasis, dysentery, typhus and malaria, for which he was promoted to senior physician with the rank of lieutenant-colonel. He was also mentioned in despatches and awarded the OBE.

After the war Fairley went to London to work under Charles Martin at the Lister Institute, where he spent the rest of 1919. During this period he earned a Diploma in Tropical Health and Hygiene from Cambridge University and was admitted as a Member of the Royal College of Physicians. He returned to Melbourne in early 1920 to a position at the Walter and Eliza Hall Institute of Medical Research, where he was engaged in developing a test for echinococcosis (hydatids). He resigned after less than a year, however, to take up a position in Bombay (Mumbai), India.

In India Fairley became a medical officer at the Bombay Bacteriological Laboratory and consultant physician at two local hospitals. He undertook further research into schistosomiasis as well as dracunculiasis (Guinea worm disease) and tropical sprue (a nutrient malabsorption condition in which the symptoms are diarrhoea, anaemia and stomatitis). After suffering an attack of tropical sprue himself, he was invalided out of India. He recuperated in London, where he married Mary Evelyn Greaves in October 1925. (It was his second marriage. He had married Violet May Phillips (1893–1965), a 25-year old Army nurse from Mount Morgan, Queensland, in Cairo in 1919; but they had divorced in 1924.)

Fairley returned to the Walter and Eliza Hall Institute in Melbourne in 1927. He continued his work on echinococcosis and investigated tiger snake, death adder and copperhead snake venoms with the aim of developing anti-venoms. He left Australia again at the end of 1928 to take up appointments as a physician at the Hospital for Tropical Diseases and as a lecturer at the London School of Hygiene and Tropical Medicine. In London he worked on leptospiral jaundice and filariasis (elephantiasis), for which he devised a diagnostic test. He also undertook sustained research into Macedonian blackwater fever, a complication of malaria. In connection with this work, he made annual visits to the League of Nations Malaria Research Laboratory at the Refugee Hospital in Salonika, Greece. His work in London during the 1930s earned him election as a Fellow of the Royal Society (FRS), thus becoming one of the few Australian scientists ever so honoured.

Early in World War II, the AAMC head, Major-General Rupert M. Downes, the Australian Army Director

General of Medical Services (DGMS), appointed Fairley as Consultant Physician to the 2<sup>nd</sup> AIF. He formally took up the position on 15 July 1940 with the rank of colonel. In that capacity he joined the 2<sup>nd</sup> AIF headquarters staff in Gaza in September 1940. He also acted as Consultant Physician to the British Army in the Middle East.

Fairley remained with the Australian Army in the Middle East until January 1942, when the 2<sup>nd</sup> AIF units began returning to Australia. During his 17 months in the region he worked closely with Colonel J.S.K. Boyd, the senior British pathologist, and Colonel J.A. Sinton VC, the senior British malariologist. Together they produced a handbook on malaria for medical personnel, which 2<sup>nd</sup> AIF headquarters published.

Concerned by the threat of a malarial epidemic among the troops of Lustre Force sent to Greece, Fairley and Boyd first had to tackle the British commander in the Middle East, General Wavell, to try to convince him of the priority that anti-malarial measures deserved. Initially Wavell did not welcome their advice because he regarded their attitude as defeatist, but eventually agreed to give their recommended anti-malarial program high priority. Two months later, during the campaign in Syria and Lebanon, their advice became the basis for the anti-malarial measures implemented by the British-led invasion force. As well as malaria, Fairley was obliged to tackle the other diseases of the Middle East which commonly infected Australian troops. These included shigellosis (bacillary dysentery) and sexually transmitted diseases, the incidence of which was high among 2<sup>nd</sup> AIF troops. For his work in the Middle East Fairley was mentioned in despatches and awarded the CBE.

On his way back to Australia from the Middle East in January 1942, Fairley stopped over in Java to secure supplies of quinine, which he knew would be required in the forthcoming campaigns against the Japanese in Papua and New Guinea. He procured all the available stocks, about 120 tonnes, which was to be transported in two shiploads. Mysteriously, these supplies never reached Australia, probably because of sabotage.

Back in Australia, Fairley was promoted to Brigadier and appointed Director of Medicine of Allied Land Forces Headquarters during the Army reorganisation of April 1942. He immediately faced a series of medical crises in Papua and New Guinea, which the Japanese had overrun. These included epidemics of bacillary dysentery during the Kokoda campaign and of malaria during the Milne Bay campaign. In

September 1942, the Australian Commander-in-Chief, General Sir Thomas Blamey, sent Fairley to the USA and the UK as head of a medical mission charged with procuring anti-malarial supplies. The mission succeeded in guaranteeing the Australian armed forces adequate supplies of atebtrin, the anti-malarial drug which became the basis of the subsequent Allied campaign against malaria in the South-West Pacific theatre. It was used with great success both prophylactically and as a curative.

Strongly supported by the DGMS, by now his close friend Major-General S. Roy Burston, Fairley was instrumental in persuading Blamey to establish the Land Headquarters Medical Research Unit (LHQMRU) at Cairns in June 1943. The task of the LHQMRU was to assess the prophylactic and curative properties of quinine, atebtrin and other anti-malarials and the dosages required for each purpose. This was done in a series of experiments using 1189 volunteer human subjects recruited from the armed services. Mosquito larvae were collected and flown in from Papua New Guinea, grown to maturity, infected with malarial parasites and then used to transmit the parasites to their human hosts, who were carefully monitored. Fairley designed the program of experimental work, which was carried out by a highly skilled team of medically-trained specialist malariologists, microbiologists and entomologists.<sup>13</sup>



Brigadier N.H. Fairley at his desk in Victoria Barracks, Melbourne, March 1946 (Australian War Memorial photograph no. 126353.)

The LHQMRU malaria research program devised by Fairley was by far the most sophisticated and elegant ever undertaken in Australia. It placed the LHQMRU at the forefront of world malariological research during the three years the unit remained operative.

The LHQMRU research essentially demonstrated that a daily dose of 0.2 grams of atebtrin (also spelt atabrine as well as being called mepacrine and quinacrine) would suppress both *vivax* and *falciparum* malaria. That dosage would also cure *falciparum* malaria but would not prevent relapses of *vivax* malaria, to guard against which atebtrin levels in blood plasma must be maintained above 3.4 micrograms per litre.<sup>14</sup>

The practical outcomes of these findings had far-reaching effects because when the AAMC officers in the field applied the LHQMRU's recommended regimen of atebtrin treatment, the result was a dramatic fall in the rate of malarial infection. The rate soon dropped from 'plague' proportions of more than 100 cases of infection per 1000 troops a week in some places to less than one case per thousand weekly. That in turn helped keep the Allied forces relatively malaria-free. This became a significant factor in their eventual victory against the Japanese, whose mortality from malaria in Papua and New Guinea was a disastrous 10 per cent of their total strength.<sup>15</sup>

Important aspects of the LHQMRU's success were Fairley's leadership and his authority as a research scientist. His associates were inspired by his belief that the best way of achieving a result was to believe it could be achieved and then to select the right team to achieve it. One of his LHQMRU team members, Lieutenant-Colonel Charles R.B. Blackburn, later wrote that working with Fairley 'was a continuing pleasure' and that 'everyone always gave of their best to Neil'.<sup>16</sup>

Fairley returned to his life in London in 1946. He was appointed inaugural Wellcome Professor of Tropical Medicine at the London School of Hygiene and Tropical Medicine, where he continued his wartime malariological research. He was forced to resign this position after suffering a cerebral thrombosis in December 1947. After his recovery, which took a year and a half, he resumed private practice but his output of research papers diminished. He continued contributing articles to the leading journals of the day, including the *British Medical Journal*, the *Medical Journal of Australia* and the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, in which he most often published his research findings. His last journal article appeared in 1960.

Fairley remained a revered 'father figure' in his field even though he might no longer have been 'the acknowledged world leader in tropical medicine' that he had been at the end of the war.<sup>17</sup> In his later years he received many distinctions and awards. Those in medicine included the Strong Medal of the American

Foundation of Tropical Medicine, the Moxon Medal of the Royal College of Physicians, the Manson Medal of the Royal Society of Tropical Medicine and Hygiene and the Buchanan Medal of the Royal Society. He was knighted (KBE) in 1950.

After resettling in England in 1946, Fairley returned to Australia every two or three years to give lectures and visit family and friends. On his last visit in 1963 they noticed that he was slowing down. Unbeknown to them, he was suffering arteriosclerosis and had begun slipping into dementia.<sup>18</sup> After that trip he retired to Sonning, a village on the Thames in rural Berkshire 53 kilometres west of London, where his family thought life would be less stressful for him than in London.



*N.H. Fairley, age 65 in 1956, ten years before his death (photograph from the Fairley Collection, Australian Academy of Science, Canberra).*

Fairly died at home in 'The Grove', Sonning, on 19 April 1966 and was buried nearby in the graveyard of the ancient Church of St Andrew. His survivors included his second wife and three sons, the oldest of whom was an army officer in Australia and the other two medical practitioners in England. The family later donated his papers, including his extensive records of the LHQMRU experimental program, to the Basser Library of the Australian Academy of Science in Canberra.

In 1975 the youngest Fairley son, Gordon Hamilton Fairley (1930–1975), a renowned oncologist, was killed outside his London home when a bomb planted by the 'Balcombe Street Gang', a terrorist group within the Provisional Irish Republican Army, detonated prematurely. The bomb was intended

for his next-door neighbour, the Conservative parliamentarian Sir Hugh Fraser.

Although Neil Hamilton Fairley spent most of his life overseas, he was a great Australian medical scientist. He published 149 papers in scientific journals in addition to various booklets and manuals. He was also a great Australian Army doctor-soldier. He promptly suspended his professional career to respond to the call of duty in two world wars. He spent nine of his 75 years in full time active Army wartime service. The impact of his research on the health of his fellow soldiers was such that many were spared death from the killer diseases that afflict armies. In the case of malaria, his efforts became a war-winning achievement.

### Dr George Aloysius Makinson Heydon MC (1881–1963)

George Aloysius Makinson Heydon was an Australian-born medical parasitologist. He was the son of Charles Gilbert Heydon and his wife, Miriam Josepha (née Makinson). Heydon Snr. was a barrister, politician and later a judge.<sup>19</sup>

George's earlier education was at the Holy Cross College in Ryde, Sydney. He finished his schooling in Somerset, England, at Downside College, a Catholic boarding school run by Benedictine monks. After Downside he entered Christ's College at Cambridge University, from which he graduated with a BA degree. He then returned home to study medicine at the University of Sydney.



*Dr George A.M. Heydon MC (1881–1963) (photograph of the Sydney Medical School, University of Sydney).*

After graduating MB ChM in 1908 Heydon hoped to become an ophthalmologist, but service with the AAMC on Gallipoli and in France during World War I changed his career direction. He enlisted as an

AAMC captain in the 19<sup>th</sup> Battalion in May 1915. He served with the unit on Gallipoli and again in France in 1916–17. He was wounded in action in August 1916 in an engagement for which he was awarded the Military Cross. He was transferred to the 8<sup>th</sup> Battalion as Regimental Medical Officer in February 1917 and was promoted to major in June 1917. In September that year he suffered a gunshot wound in his left wrist and then spent two months in hospital in England before returning to active service in France.

Granted leave from the AIF in April 1919 until his demobilisation in August 1920, Heydon spent his leave living in London while studying for the Diploma in Public Health and the Diploma in Tropical Medicine and Hygiene at Cambridge University.

Heydon joined the laboratory service of the Commonwealth Department of Health after returning to Australia. During the early 1920s the department posted him to Rabaul to establish a government health laboratory for the mandated Territory of New Guinea. While there he became interested in parasitology and vector-borne diseases. His significant achievement was to demonstrate, through breeding and dissection experiments, that *Anopheles punctulatus* was the principal transmitter of malaria in Rabaul. That in turn enabled the local health authorities to institute a more effective mosquito control program in New Guinea.

In 1925 Heydon moved to Townsville to teach parasitology at the Australian Institute of Tropical Medicine (AITM). He also had responsibility for conducting field surveys for malaria and filariasis while at the AITM. In addition he studied human hookworm and the microscopic nematode worm *Onchocerca gibsoni* in cattle (a parasite transmitted by the Black Fly).

Heydon moved back to Sydney in 1930 when the AITM was merged with the School of Public Health and Tropical Medicine (SPHTM). He remained on the SPHTM staff until his retirement in 1946, teaching parasitology, conducting research and running a diagnostic service for general practitioners. He also served as the parasitologist to the Taronga Park Zoo, a job requiring him to examine for parasites post-mortem material from zoo animals.

Heydon's interest in malariology continued during his years at the SPHTM. He conducted a series of experiments to determine the extent to which the local Sydney anopheline species, *An. annulipes*, could become a malaria vector in the Sydney region.

During 1934 Heydon and a SPHTM colleague,

Arthur J. Bearup, spent some time at Mount Hagen and Kainantu in the recently opened and heavily populated highlands of New Guinea. The aim of their research there was to examine the extent of protozoan and helminth infections among the indigenous communities and to determine the degree of their exposure to bacterial infections such as tuberculosis, diphtheria and scarlet fever.



*A Junkers aircraft on the Mount Hagen, New Guinea, airstrip, Christmas 1934. Left-right are: Daniel J. ('Danny') Leahy (plantation owner), the pilot, Lord William F. Forbes-Sempill (pioneering aviator), Father William A. Ross (Catholic missionary), the two Fox brothers (Jack and Tom, prospectors), Dr George A.M. Heydon and an unnamed New Guinean (National Library of Australia photograph no. pic-vn3598868-v).*

In 1938 Heydon and Bearup conducted an experiment with *Aceylanicum* hookworms obtained from a patient from the Solomon Islands. They infected themselves and two other volunteers with larvae bred from the hookworms, developed the symptoms of infestation, treated themselves and recovered adult hookworms. Such experiments provided data and material for their practical classes at the SPHTM.

Heydon did not re-enlist in the AAMC during World War II but did much to assist the war effort. Among other contributions, he examined Army recruits for parasitic infections. He ascertained that three per cent of the recruits were infected with *Entamoeba histolytica*, a protozoan parasite which, among others, can cause dysentery and liver abscesses. In 1942 he was a member of a team of eminent malariologists that investigated an epidemic of *vivax* malaria in Cairns. He was the first to recognise that the vector, previously unknown, was *Anopheles punctulatus moluccensis* (later called *An. farauti*), the main transmitter of the disease in Australia.

Another of Heydon's wartime contributions was unrelated to parasitology. He learned to fly in 1935, subsequently becoming a highly proficient pilot who retained his licence for the next 21 years, until he

was 75. During the war he frequently flew his own aeroplane over Sydney to give searchlight and anti-aircraft batteries practice in tracking aircraft.

Heydon retired in 1946 after 21 years of training successive cohorts of Australia's emerging parasitologists. Colleagues regarded him as 'the father of medical parasitology in Australia'.

### Sir Edward ('Ted') William Spencer Ford OBE (1902–1986)

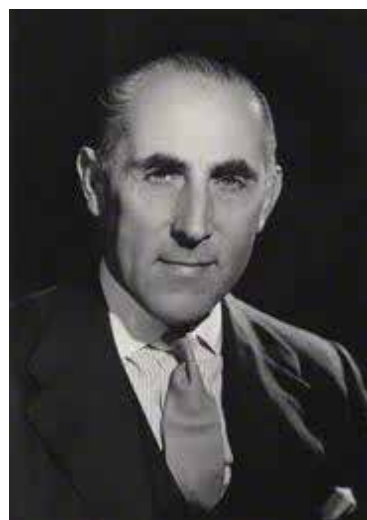
Edward ('Ted') Ford was born in Bethanga, Victoria, the son of Edward Ford Snr. and his wife Mary (née Armstrong). He received his schooling in Clunes in central Victoria then started work as a telegraph messenger with the Postmaster-General's Department after turning 15. He matriculated at 24 while working as an accounts clerk with the department then trained in medicine at the University of Melbourne. He graduated MB BS in 1932 and MD in 1946.<sup>20</sup>

After graduating, Ford became a resident at the Melbourne Hospital. In 1933 he was appointed as a lecturer in anatomy at the university and then senior lecturer in 1934. During this period he developed an interest in tropical medicine. In 1937 he moved to Sydney as a lecturer in the School of Public Health and Tropical Medicine (SPHTM), where he earned a Diploma in Tropical Medicine in 1938. During 1938–39 he undertook field studies in malaria and other tropical diseases in Papua for the Papuan administration. He then spent a period during 1939–40 as the medical officer in charge of the Commonwealth Health Laboratory in Darwin. His service there was cut short by his joining the Australian Army Medical Corps (AAMC) as a major and enlisting in the 2<sup>nd</sup> AIF.

Ford, who commanded the 1<sup>st</sup> Mobile Bacteriological Laboratory, arrived in Palestine in March 1941. During the campaign in Syria he was attached to the 2/3<sup>rd</sup> Casualty Clearing Station from July 1941. He returned to Australia in March 1943, was promoted to lieutenant-colonel and was appointed Assistant Director of Pathology for both I Australian Corps and New Guinea Force.

In early December 1942, during the near-catastrophic epidemics of malaria among the Allied troops at Milne Bay and on the north Papuan coast, Ford was selected by the Deputy Director of Medical Services (DDMS) of I Australian Corps, Brigadier W.W.S. Johnston, to give the Commander-in-Chief, Blamey, a personal briefing on the malaria situation. Ford is said to have told Blamey bluntly that unless

he gave the highest priority to the AAMC's campaign against malaria, very soon there would be no army left for him to command.<sup>21</sup>



*Professor Sir Edward William Spencer ('Ted') Ford, 1959. By the time of this portrait Ford was regarded as the 'Father' of Australian malariology because of the pivotal role he had played in the Australian Army's struggle against malaria during World War II. (This photograph, taken by Walter Bird in February 1959, is produced with the kind permission of the National Portrait Gallery, London, the copyright holder. Its reference number is NPG x167171.)*

Ford's advice to Blamey proved critical. Among other outcomes, it led to the establishment in June 1943 of the Land Headquarters Medical Research Unit in Cairns. This unit carried out pioneering malariological research. When the unit's findings were applied in the field, the results were war-winning. The malaria hospitalisation rate fell dramatically, enabling combat units to fight at full strength.

In March 1943 Ford was appointed as Malariologist at Land Headquarters in Melbourne. In this position he played a key role in the major effort the Australian Army made 1943–1946 to control malaria in Papua and New Guinea and the archipelagos to the north-west. Among others, his contributions included the publication of the booklet *Malaria in the South West Pacific* in 1943. His doctorate in medicine (MD) in 1946 was awarded for a thesis with the title 'Malaria Control in Australia and the Pacific Dependencies: With Special Reference to Anti-Mosquito Methods'.

Ford was appointed as the Army's Director of Hygiene, Pathology and Entomology in March 1945 and soon promoted to colonel. For his contributions to malariology in the Army he was mentioned in despatches in 1943 and appointed OBE in 1945.

In 1946 Ford travelled to the UK on a Rockefeller



Fellowship to study for the Diploma in Public Health at the London School of Public Health and Tropical Medicine. This was awarded in 1947, the year he was appointed as both Professor of Public Health and Director of the School of Public Health and Tropical Medicine at the University of Sydney. He held both positions for the next 21 years, until his retirement in 1968.



*Professor Sir Edward Ford, a hero of the war against malaria in New Guinea during World War II, unveiling a commemorative plaque at the official opening of the premises of 1<sup>st</sup> Malaria Research Unit at Ingleburn Military Camp on 19 April 1974 (Australian Army Malaria Institute photograph).*

Ford enjoyed a distinguished academic career. As well as his professional appointment, at the University of Sydney he variously served as Dean of the Faculty of Medicine, a member of the Senate, acting Vice-Chancellor and a board member of Sydney University Press. He retained his interest in the Army and military medicine by serving in the Citizen Military Forces as Director of Army Health for eleven years 1953–64.

As well as his military awards, Ford received many civilian and medical honours. He was knighted in 1960. His academic and medical honours included Fellowships in the Royal Australasian College of Physicians, the Royal College of Physicians of London, the Royal Australian College of Medical Administrators and the Royal College of Pathologists of Australia. He was also awarded an honorary D.Litt. by the University of Sydney.

Beyond the Army and medicine, Ford had diverse interests and tastes. He was a passionate bibliophile

who not only collected books but made many generous donations of books to universities and professional institutions. He never married but had a large circle of friends, including many from professional and artistic backgrounds.

### Colonel Esmond Venner ('Bill') Keogh MM DCM (1895–1970)

Esmond Venner Keogh was born in Malvern, Victoria. He was one of four children of an estate agent, Esmond Keogh, and his wife Helen (née Moore). The parents separated in 1900 after the estate agency failed. The father then became a bush labourer in Western Australia, leaving the mother to raise the children. Wishing her children to be well educated, she sent Esmond ('Es' within the family) to Catholic boarding schools at Mornington in Victoria and Bathurst in New South Wales. The poet and industrial activist Lesbia Venner Harford (1891–1927) was one of his sisters.<sup>22</sup>

Although a Catholic, Es won a scholarship to Melbourne's elite Anglican academy, Melbourne Grammar School, which he began attending at the age of 14 in 1910. After finishing school there, he enrolled in agricultural science at the University of Melbourne but after a year he enlisted in the 1<sup>st</sup> AIF and joined the 3<sup>rd</sup> Light Horse Field Ambulance at the age of 19. This unit was commanded by Lieutenant-Colonel Rupert M. Downes, who later led the Desert Mounted Corps campaign against malaria in Palestine and Syria in 1918. (As seen in the first article in this series, Downes later commanded the Australian Army Medical Corps [AAMC] and as the Director General of Army Medical Services [DGMS] led the Corps into World War II.)

Keogh served with the 3<sup>rd</sup> LHFA in Egypt and on Gallipoli and Lemnos before being withdrawn to Egypt at the end of 1915. Claiming to be a medical student, in March 1916 he returned to Melbourne, where he joined the 3<sup>rd</sup> Australian Machine Gun Battalion. He sailed for England with this unit in August 1916. Previously known as 'Es' among family and friends, from now on he called himself by the name his soldier mates used — 'Bill'.

Sent to the Western front in November 1916, Bill Keogh took part in the battle of Messines in June 1917. That October he was wounded in the hand during the advances near Ypres. His actions at the time earned him the Military Medal. After a period in hospital in England, he returned to his unit in April 1918. Promoted to sergeant, he took part in the capture of Mont St Quentin and in September he led a section without an officer at Quennemont

Farm, for which he was awarded the Distinguished Conduct Medal. After the end of the war he returned to Melbourne and was discharged in July 1919. Exhausted by his wartime experiences, Keogh drifted aimlessly for a year then spent 1921 working on the dairy farm near Maffra granted to his father as a soldier settler. (Keogh Snr. had served in the Camel Corps during the campaign in Palestine.)



*Major E.V. ('Bill') Keogh MM in 1940 in his laboratory in Gaza, when he was an AAMC pathologist attached to the 2<sup>nd</sup> AIF in the Middle East (AWM photograph no. 002235).*

In 1922 Keogh returned to university, studying medicine rather than agricultural science. After graduating MB BS in 1927, he joined the Commonwealth Serum Laboratories (CSL) as a pathologist; however, he spent periods at Bendigo and Kalgoorlie, where he worked among miners and became interested in public health. In 1935 he established his own pathology unit at CSL but was also seconded part-time to the Walter and Eliza Hall Institute, where he worked on viruses. He published a series of 18 papers on virology 1936–41.

Keogh was travelling in the USA attending medical conferences when World War II broke out. He hurried home and joined the Australian Army Medical Corps (AAMC) as a major in October 1939. The next month he was appointed pathologist to the 2/2<sup>nd</sup> Australian General Hospital. In April 1940 he travelled with the 2/2<sup>nd</sup> AGH to the Middle East. While there, he formed close working relationships with the Director of Medical Services, Major-General S.R. Burston, and Colonel N.H. Fairley, the 2<sup>nd</sup> AIF's consultant physician. With them, he helped persuade the British commander, General Wavell not to commit any large force to Macedonia because of the endemic malaria there.

After returning home from the Middle East with the 2<sup>nd</sup> AIF in March 1942, Keogh was promoted to lieutenant-colonel and was appointed as Director

of Pathology at Army headquarters at Victoria Barracks. His main task was to establish pathology laboratories at the military hospitals and appoint the staff to run them. Of necessity, he again worked closely with Burston and Fairley, who had respectively become the Director General of Medical Services (DGMS) and the Director of Medicine. He also worked collaboratively with Lieutenant-Colonel Ted Ford, formally his Assistant Director of Pathology but in effect (with Fairley) one of the AAMC's two chief malariologists.

Following the catastrophic epidemics of malaria in Papua New Guinea in 1942–43, Keogh became a key figure in the campaign against malaria. According to Ford, it was under pressure from Keogh that Burston persuaded General Blamey, to authorise the establishment of the Land Headquarters Medical Research Unit (LHQMRU) in Cairns in June 1943. Thereafter, as Keogh's biographer wrote, 'Fairley planned the strategy, Keogh the tactics, daily atebirin was forced on the troops [and] the result was a triumph'.

Another of Keogh's wartime successes was the use of penicillin by the AAMC. Without its effects being fully proven, Keogh followed his instincts with the new 'wonder drug'. He arranged for its production in Australia. The AAMC used it for the first time during the Finschhafen campaign in New Guinea in 1944. After its success there, Australia became one of the first nations to use penicillin extensively.

Keogh spent the nine months April 1945–January 1946 as the medical adviser of the Australian Military Mission in Washington. Among other duties, he arranged Carnegie and Rockefeller grants for Australian medical scientists to study in the US and also Nuffield grants for them to study in the UK. After the war Keogh returned to the CSL and resumed productive research there. In 1949 he resigned to join the Department of Health, where his responsibility was organising the Victorian phase of the national anti-tuberculosis campaign, which involved mass chest X-ray screening of the public. He retained the position until 1955, in the meantime working with Macfarlane Burnet of the Walter and Eliza Hall Institute to have the Salk vaccine against poliomyelitis manufactured at CSL. He then organised the mass immunization program that began in 1956. His next position was medical adviser to the Anti-Cancer Council of Victoria, which he retained until his retirement in 1968. Among his achievements here was an extensive program of smear-testing for the early detection of cancer of the cervix.



Colonel E.V. ('Bill') Keogh, *by unknown photographer, at his desk in Army Headquarters, Victoria Barracks, Melbourne 1946 (Australian War Memorial photograph no. 126249).*

Away from his involvements in public medicine, Keogh's main pastimes were racing, betting, bridge and poker. His cultural interests included modern art and both classical music and jazz. He also read widely. He never married, but with a talent for friendship, he made and retained a wide circle of friends of both sexes and was a popular 'Uncle Bill' to his nieces and his many friends' children.

After Keogh's death from cancer, his body was bequeathed to the Anatomy Department at the University of Melbourne. He had requested that no memorials or obituaries be arranged but his colleagues and friends conducted a memorial event at which the address was delivered by one of his protégés. This was Sir Benjamin Rank, a plastic surgeon and an AAMC colleague since their time together in the Middle East in 1940.

Lieutenant-Colonel Ian Murray Mackerras (1898–1980) and Major Mabel Josephine ('Jo') Mackerras (1896–1971)

Ian Murray Mackerras and Mabel Josephine ('Jo') Mackerras (née Bancroft) were pioneering Australian medical entomologists who were married to each other. They met as classmates while studying medicine at the University of Sydney then married in 1924, the year they graduated, while they were final year students.<sup>23</sup>

Ian Mackerras, born near Otago, New Zealand, was the son of a local farmer and his Australian wife. They separated when Ian was a boy; she then brought him to Australia, where he was educated at Sydney Grammar School. He enlisted in the 1<sup>st</sup> AIF

in December 1915 at the age of 17, having overstated his age. He served as a laboratory assistant on the hospital ship *Karoola* before joining the 13<sup>th</sup> Field Artillery Brigade on the Western Front, where he was gassed. After recovering in hospital in England, he returned to Sydney, where he enrolled as a medical student at the University of Sydney in February 1919. He graduated MB ChM, BSc in 1924 and also won the university medal in zoology.



*Left: Dr Ian M. Mackerras as a CSIRO scientist after World War II (National Library of Australia photograph no. nla.pic-an12107347-11-v); right: Dr M.J. ('Jo') Mackerras in 1971, the year of her death ('Spren't' photograph, from the 'Increasing Disorder' website, [www.increasingdisorder.wordpress.com](http://www.increasingdisorder.wordpress.com)).*

Mabel Josephine Bancroft, usually called by the shortened form of her middle name, was born near Caboolture, Queensland, the daughter of a Brisbane-born mother and her English-born husband, Thomas Lane Bancroft. The latter was a medical practitioner who developed an interest in parasitology and medical entomology. While at school at Brisbane Girls' Grammar, Jo assisted her father in his entomological work. After leaving school she completed a science degree at the University of Queensland then worked for the Walter and Eliza Hall Institute of Medical Research before beginning her medical training at the University of Sydney. She graduated MB in 1924 and was later awarded a MSc degree in 1930.

Ian and Jo's marriage was one of minds as well as of a couple mutually attracted through shared interests. As their joint biographer later observed, 'theirs was to prove one of the most productive and distinguished husband-and-wife partnerships in the history of Australian science'.

After their graduation Ian worked as a research fellow in zoology at the University of Sydney. He then spent two years as a microbiologist with the New South Wales Public Health Department before moving to Canberra in 1928 as a senior entomologist with the Council for Scientific and Industrial Research (CSIR). The position involved research in veterinary entomology and parasitology, mainly in the control

of sheep blowfly, buffalo fly and tick fever in cattle. During this period, Jo completed a year's residency at the Royal Prince Alfred Hospital in Sydney then combined private practice with a part-time appointment at a hospital for women and children. In 1926 she suspended her medical career to care for her infant son. She resumed her career in 1930, joining Ian's section of the CSIR as an assistant entomologist. They collaborated in publishing a series of papers on blowfly infestation and ephemeral cattle fever.

In October 1939 Ian enlisted in the 2<sup>nd</sup> AIF and was appointed as an AAMC major. Sent to the Middle East, he served as a pathologist at the 2/1<sup>st</sup> Australian General Hospital at Gaza. While there, he spent time in North Africa advising on the prevention of enteric diseases. After returning to Australia with the 2<sup>nd</sup> AIF in May 1942, he was appointed as Director of Entomology at Land Headquarters in Melbourne. Meanwhile, Jo had enlisted in the AAMC as a captain in February 1942 and had been serving in Sydney.

In June 1942 Ian was a member of the team of malariologists that investigated an epidemic of malaria in Cairns. That same month he travelled to Papua with the Director of Medicine at Land Headquarters, Brigadier N.H. Fairley, to investigate the preparedness of New Guinea Force for the malaria epidemics that they were certain would follow. It was the first of many tours he undertook in Papua and New Guinea to develop control procedures for malaria, dengue fever and scrub typhus. He also toured the US and the UK during 1944–45.



*Left-right: Lieutenant-Colonel Charles R.B. Blackburn (Commander of the Land Headquarters Medical Research Unit [LHQMRU]), Major M. Josephine Mackerras (head of the LHQMRU Entomology Section in Cairns) and Brigadier N.H. Fairley (Director of Medicine, Land Headquarters), who designed the LHQMRU research program. (Photograph from the website of the Joint Health Command of the Australian Defence Force, <http://www.defence.gov.au/health/>.)*

Following the disastrous epidemics of malaria during and following the Papuan campaigns of 1942–43, Ian was one of the group of senior AAMC officers who urged the DGMS, Major-General S.R. Burston, to create a discrete Army scientific organisation to undertake research on malaria. (The others included Fairley, E.V. (Bill) Keogh and Ted Ford.) The Commander-in-Chief, General Blamey, approved this proposal and the unit, formally called the Land Headquarters Medical Research Unit (LHQMRU), was established in Cairns in June 1943.



*Dr Ian M. Mackerras as Director of the Queensland Institute of Medical Health, 1950 (photograph of the Australian Academy of Science).*

Jo was appointed to the LHQMRU as the entomologist soon afterwards. Promoted to major, she became responsible for the LHQMRU Entomology Section. The section bred and maintained a large stock of infected mosquitoes, which were used to transmit malaria to volunteers from many Army units. The LHQMRU experimental program, which depended on the efforts of Jo's section, enabled malaria to be controlled in Papua New Guinea and elsewhere in the South-West Pacific Area theatre. That in turn was an important factor in the eventual Allied victory.

After the war, the Mackerras returned to Canberra to resume work with CSIR (soon renamed CSIRO). In April 1946 they moved to Brisbane to positions at the Yeerongpilly laboratories, where Ian worked on cattle tick and Jo on blackflies. In 1947 Ian was appointed foundation director of the Queensland Institute of Medical Research (QIMR); Jo also obtained a position there. He also returned to the Army part-time as the commander of the 1<sup>st</sup> Mobile Malaria Control Company in the Citizen Military Force.

Both Ian and Jo retired from the QIMR in 1961 and returned to Canberra, where they settled in the inner suburb of Turner. They remained very active in retirement. Jo made a detailed study of cockroaches while Ian edited and wrote substantial sections of a huge volume, *The Insects of Australia*, which was published in 1970. Their shared pastimes included boating, fishing and flying. Each held a pilot's licence and they became foundation members of the Canberra Aero Club. They remained active in a range of scientific organisations. Among many other honours, each was elected a Fellow of the Royal College of Pathologists of Australasia. Each became a Fellow of the Australian Society of Parasitology. Each was awarded the W.B. Clarke Medal of the Royal Society of New South Wales; and each was awarded an honorary doctorate in science, Jo by the University of Queensland and Ian by the University of Sydney.

Strangely, neither Ian nor Jo received military awards for their contributions to the war on malaria in the South-West Pacific Area. Ian received two 'Mentioned in Despatches' for his service in the Middle East, but that was all. Jo was recommended for a military MBE on three occasions by the DGMS, Major-General S.R. Burston. In his recommendations Burston wrote that '*few women can have made a greater contribution to the Allied war effort*'. That, however, was insufficient to sway the Chief of the General Staff, who rejected each recommendation. His reasons essentially reduced to her being a woman and one who had not served in a combat zone.

Jo died at home on 8 October 1971 and was buried in the Canberra Cemetery. Ian died in Canberra on 21 March 1980 in Canberra and was cremated. Their only child, David, a reader in electrical engineering at the University of Queensland, became an authority on lightning.

The Mackerras's biographer later wrote of Jo that she was 'characterised by her wisdom and strength of character'. In addition, she 'possessed a serene charm, a placid smile and a shy, self-effacing manner'. Further, 'quietly and unobtrusively, she fostered young scientists and won the esteem of senior colleagues'. Ian was 'a sympathetic, stimulating and critical researcher who gave time and often financial support to young scientists'. In addition, he 'instilled in his teams the qualities of trust, goodwill, and genuine pleasure in learning and discovery'.

Professor Frank John Fenner AC CMG MBE  
FRS (1914–2010)

Frank John Fenner was a medically trained virologist. He was born in Ballarat, Victoria, in

1914, the son of a geologist, Charles A. Fenner. In 1916 the family moved to Adelaide, where his father worked in technical education and eventually rose to become the State Director of Education. Frank was educated at Adelaide Boys' High School and the University of Adelaide, where he studied Medicine. After graduating in 1938 he completed a Diploma in Tropical Medicine at the University of Sydney in 1940 because he rightly guessed that the looming world war would be mainly fought in tropical countries.<sup>24</sup>

Fenner enlisted in the 2nd AIF as a medical officer in May 1940. After service in Egypt and Palestine with the AAMC, he served in Papua and New Guinea. In early 1943 he was promoted to major and appointed as one of three malariologists attached to New Guinea Force. He later served as the malariologist to I Australian Corps.

Among other duties as a malariologist, he chaired the Allied Malaria Control Conference, an inter-service forum with both US and Australian membership. In August 1943, while the campaign for Salamaua was being fought, he undertook a major malariological survey of the coast region between Salamaua and Morobe (to the south, near the Papuan border). As a result of his survey, more energetic mosquito eradication work was undertaken and anti-malarial discipline among the troops was more strictly enforced. His survey report also drew attention to high wastage of troop strength because of the disease. Having worked through a series of malaria epidemics during the New Guinea Offensives and the Final Campaigns, by the time of his discharge in 1946 he was one of the Army's most experienced malariologists. He was awarded the MBE for his wartime work.



AUSTRALIAN WAR MEMORIAL P02212.059  
Captain F.J. Fenner (2<sup>nd</sup> from left) with fellow officers of the 2/1<sup>st</sup> Casualty Clearing Station at Nazareth, Palestine, May 1941 (Australian War Memorial photograph no. P02212.059).

Fenner's scientific career took off in the early postwar years. After his discharge he spent two years working with Sir Macfarlane Burnet at the Walter and Eliza Hall Institute for Medical Research in Melbourne, where he worked on mouse pox, which he found to be a useful laboratory model for smallpox. He then spent a year at the Rockefeller Institute in New York, where he met many eminent medical scientists, including Albert Sabin, who developed the oral vaccine for poliomyelitis.

Fenner returned to Australia in 1949 at the urging of Sir Howard Florey, the pioneer of penicillin research, to become the foundation Professor of Microbiology within the John Curtin School of Medical Research at the new Australian National University (ANU) in Canberra. He remained based in Canberra for the rest of his life. In 1967 he became the Director of the John Curtin School, retaining the position until 1973, when he became the Director of the ANU Centre for Resource and Environmental Studies — a reflection of his interest in the environment. He formally retired in 1979 but retained his links with ANU as a Visiting Fellow (non-salaried staff member) at the John Curtin School and as a leading member of the adjacent Australian Academy of Science.



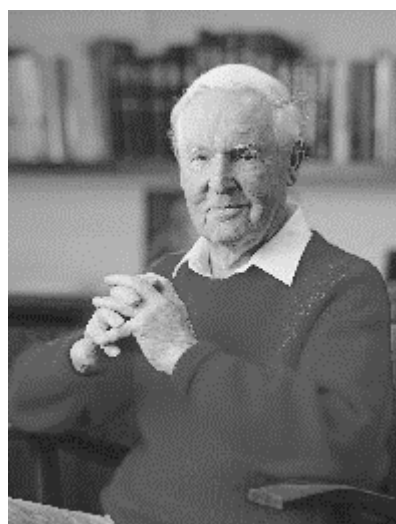
*Professor Frank J. Fenner in 1959 when head of the Department of Microbiology at the John Curtin School of Medical Research at the Australian National University in Canberra (photograph from Immunology and Cell Biology Vol. 77, 1999).*

Fenner had many research interests in virology and molecular biology. Among his projects were the Bairnsdale bacillus (which causes Buruli ulcer, the world's third most common mycobacterial disease after tuberculosis and leprosy); the development of myxomatosis in rabbits; the genetics of the vaccinia virus group; and smallpox and its eradication.

To prove that the Myxoma virus was harmless to humans, Fenner together with Sir Macfarlane Burnet and Sir Ian Clunies-Ross (Director of the CSIRO) publicly injected themselves with the virus. Arguably, Fenner's two greatest achievements were, first, the control of Australia's rabbit plague through the introduction of the Myxoma virus and, second, his work on the global eradication of smallpox. Significantly, it was Fenner who announced the worldwide eradication of smallpox to the World Health Organisation in May 1980. It was the first — and so far the only — occasion that a disease has been eliminated from the planet.

To these two achievements, malariologists might add a third — Fenner's painstaking, perseverance in helping reduce the risk of malaria among the Allied armies in Papua and New Guinea during the four years of the Pacific War 1942–45, the work that kick-started his long career in microbiology.

Fenner wrote 11 textbooks on medical and veterinary virology and a history of Australian microbiology. He also published some 300 research papers in specialist scientific journals. He published his first in 1934 when aged only 20 and was still publishing them 70 years later as he approached his 90s.



*Professor Frank Fenner at age 88 in 2002. By then he was among the most celebrated of all scientists in Australian history (photograph from the 'Prime Minister's Prizes for Science' section of the Commonwealth Department of Industry website.)*

Widely recognised as one of Australia's most eminent scientists, Fenner was showered with honours, awards and distinctions. As well as the wartime MBE, he was awarded the CMG (1976) and in 1989 was appointed as a Companion in the Order of Australia (AC). In 1958 he was elected a Fellow of the Royal

Society (FRS), becoming one of the few Australians ever to achieve that honour. In 1995 he was awarded the most prestigious scientific honour of all — the Copley Medal of the Royal Society. (Instituted in 1731, the Medal is awarded annually. Others to receive it have included Captain James Cook, Benjamin Franklin, Charles Darwin, Louis Pasteur, Albert Einstein, and the Australians Howard Florey and Macfarlane Burnet.)

In 1944 Fenner married Ellen ('Bobbie') Roberts, an Army nurse he had met while she was nursing the volunteers infected with malaria during the experiments of the Land Headquarters Medical Research Institute in Cairns. Frank and Bobbie had two adopted daughters. Bobbie predeceased Frank in 1994. In later life he was cared for by his younger daughter, who survived him. He died in Canberra a month short of his 96<sup>th</sup> birthday in November 2010.

### Dr John Iredale Tonge CBE (1916–2013)

John Iredale Tonge was a medically trained forensic pathologist. He was the last of six children of the English-born Rev. Arthur W. Tonge (1869–1947) and his wife Elsie (née Love, 1874–1963). Rev. Tonge was an ordained Anglican clergyman but spent most of his life as a peripatetic teacher of Classics in Church of England boys' schools. His appointments included the King's School (Parramatta, 1899–1905), Melbourne Grammar School (1905–1911), Trinity Grammar School (Melbourne, headmaster 1911–16), Guildford Grammar (Western Australia, 1920–1921), Ivanhoe Grammar (Melbourne, 1921–29) and King's School again (from 1932). In between these appointments he spent three years as a chaplain in the 1<sup>st</sup> AIF 1916–20, during which he saw active service in four of the major battles on the Western Front. He also spent a year in the late 1920s serving as a parish priest in England.<sup>25</sup>

Rev. Tonge's family accompanied him to most of these postings, with the result that his youngest son, John, who was born in Melbourne, was educated at Melbourne Grammar, Hurstpierpoint College (Sussex, England) and the King's School. After leaving King's, John studied Medicine at the University of Sydney. Graduating in 1939, he worked as a resident at the Prince Alfred Hospital, Sydney, where he began specialising in anaesthetics.



*Major John I. Tonge (left) and Private K. Watkins examining blood slides in the Malaria Control Section of 104<sup>th</sup> Casualty Clearing Station, Wewak, New Guinea, August 1945.*

After joining the Australian Army Medical Corps (AAMC) in December, Tonge helped establish the Blood Bank in Sydney before being posted to a series of Army hospitals at Cowra, Bathurst and Concord. In 1943 he was sent to Queensland as a pathologist at the 2/2<sup>nd</sup> Australian General Hospital at Rocky Creek on the Atherton Tableland, which was linked to the Land Headquarters Medical Research Unit (LHQMRU) in Cairns. That brought him into contact with the LHQMRU malariologists and their experimental program using Army volunteer patients.

Tonge's next posting was the command of the 104<sup>th</sup> Mobile Bacteriological Laboratory, with which he served on the New Guinea mainland and in New Britain. In mid-1945 he was sent to Wewak as a member of a LHQMRU field section investigating an alarming and atypical epidemic of *falciparum* malaria. As the LHQMRU team discovered, an atebirin-resistant strain of the *Plasmodium falciparum* parasite had emerged — the first known instance of drug-resistant malaria recorded. After the Wewak posting, Tonge spent the rest of the war working at the LHQMRU in Cairns as a malariologist, remaining with the unit until its closure in July 1946.

During the post-war decades Tonge did not continue in malariology. Like other LHQMRU 'alumni', however, he had a long and distinguished career in the field of his choice. In his case that was forensic medicine and pathology, in which he became a pioneer in Queensland. After obtaining a postgraduate Diploma in Clinical Pathology, in 1947 he was appointed Director of the Queensland State Laboratory of Microbiology and Pathology. He retained the position

for the next 32 years, until his retirement in 1979. As Director he pushed for the establishment of the Queensland Institute of Forensic Pathology, which he headed and which opened in 1961.

Tonge's achievements as Queensland's leading forensic scientist were many and varied. He expanded the State Laboratory to include a TB laboratory and a virology unit. He made special studies of sudden infant death syndrome, road trauma and aviation pathology. He persuaded the State government to adopt legislation imposing limits on drivers' blood-alcohol levels (1968), enforcing the wearing of crash-helmets by motor-cycle riders (1970) and the compulsory wearing of seat-belts (1972). He also introduced social work support for bereaved relatives brought to identify the bodies of those who had died.



*Dr J.I. Tonge in later life (photograph from the estate of E.N. Marks).*

In addition to these accomplishments, Tonge was a co-founder of the Royal College of Pathologists of Australasia, was among its inaugural Fellows and served as its third President 1959–1961. He also lectured in forensic medicine at the University of Queensland for over 30 years. Major-General John Pearn, the Surgeon-General to the Australian Defence Force 1998–2001, remembered Tonge as a significant influence on his own medical career.

In retirement, Tonge's interests included the Queensland Sudden Infant Death Syndrome Research Foundation, the Queensland Bush Children's Health Scheme, the Royal Society for the Prevention of Cruelty to Animals and the Council of the Queensland Institute of Technology. His honours and awards for his medical and community service included the CBE.

The John Tonge Centre of the Queensland Health Forensic and Scientific Services was named in his honour. The Centre, which opened in 1992 at Coopers Plains on Brisbane's southern fringe, is one

of the State mortuaries responsible for conducting autopsies under the Queensland Coroner's Act of 2003.

In 1947 Tonge married Loddie Marks, a member of a prominent Brisbane medical and military family. They had a daughter and three sons.

Putting personal principle into practice, at the end of his long life Dr Tonge bequeathed his body to the body donor program of the University of Queensland School of Biomedical Sciences.

### Major-General Sir Samuel Roy Burston KBE CB DSO (1888–1960)

Samuel Roy ('Ginger') Burston was a physician who spent most of his life as an officer of the Australian Army Medical Corps (AAMC). He was born in Melbourne in 1888, the fourth of seven children of James Burston, the head of a family malting business, and his wife Marianne (née McBean). Burston Snr. was an enthusiastic and ambitious officer of the Victorian Defence Force who served a term as Lord Mayor of Melbourne, later commanded the 7<sup>th</sup> Infantry Brigade at Gallipoli and retired from the Army as a major-general in 1920.<sup>26</sup>

Burston, who preferred being called by his middle name but was widely known by the nickname 'Ginger' because of his sandy-red hair, was educated at Melbourne Grammar School and Trinity College at the University of Melbourne, where he studied Medicine. His Army career began while he was still at school, when at age 13 he became a bugler boy. He spent five years bugling and only gave it up after beginning his medical course.

After an undistinguished academic career, Burston scraped through his final year medical exams. On graduating in 1910 he moved to Adelaide to become a resident at the Children's Hospital. He left the hospital after only a year to become a Medical Protector of Aborigines at Darwin in the Northern Territory. He returned to Adelaide in 1912. Soon afterwards he enlisted as a captain in the AAMC and married Helen Culross, a young woman he had met in Adelaide. They settled at Mile End, an inner Adelaide suburb where he ran a general practice from his home.

Burston enlisted in the 1<sup>st</sup> AIF as a major in April 1915. Sent to Egypt, he was assigned to the 7<sup>th</sup> Field Ambulance, which was posted to Gallipoli in September that year. After only six weeks' active service with his unit, Burston fell ill with a debilitating attack of paratyphoid fever. He was sent back to Alexandria then to a hospital in London for further



treatment. After a long period of recovery he was attached to the 11<sup>th</sup> Field Ambulance. He travelled to France with the unit in November 1916 and distinguished himself by commanding its advanced dressing station during the Battle of Messines in June 1917. His service with the unit earned him a Mentioned in Despatches and a DSO. After Messines he was promoted lieutenant-colonel and then filled a series of appointments as a unit commander in AAMC medical base depots and hospitals in both France and Britain.

After returning to Adelaide in 1919, Burston trained and qualified as a specialist physician, practised privately, held honorary appointments at the Royal Adelaide Hospital and lectured part-time in clinical medicine at the University of Adelaide. He also continued his active involvement with the AAMC. Promoted colonel, he spent the two inter-war decades as DDMS of 4<sup>th</sup> Military District, i.e. South Australia. A keen surf swimmer, in 1928 he was awarded the Bronze Medal of the Royal Humane Society for rescuing a woman being swept out to sea in a dangerous rip near Victor Harbour.



*Colonel S.R. Burston, a portrait by Damian Parer, May 1940, the month before Burston flew to Palestine to take command of the 2<sup>nd</sup> AIF's medical services in the Middle East. He was soon promoted Brigadier then Major-General and appointed Director of Medical Services of the AIF in the Middle East (Australian War Memorial photograph no. 001863.)*

Burston resumed full-time military service in September 1939 as soon as the 2<sup>nd</sup> AIF began enlisting recruits for overseas service at the outbreak of World War II. Appointed as ADMS of the 6<sup>th</sup> Division, he became the AIF's principal medical officer. He also became the trusted confidante of the AIF Commander, General Sir Thomas Blamey, with whom he travelled to Palestine in June 1940. They worked closely together for the rest of the war. Blamey promoted Burston to Brigadier and then

Major-General in quick succession and in November 1940 appointed him as DMS of the 2<sup>nd</sup> AIF in the Middle East. As such, Burston had responsibility for the medical support of all the campaigns the 2<sup>nd</sup> AIF fought in the Middle East–Mediterranean theatre during 1940 and 1941, viz. Cyrenaica, Greece, Crete, the Siege of Tobruk and Syria-Lebanon.

Soon after Blamey and Burston had returned to Australia with the repatriated AIF units in March 1942, Blamey appointed Burston as DGMS, that is the head of the AAMC with responsibility for all of the Army Medical Services in supporting the Army wherever its units were deployed. At that time the Army had actively engaged units strung out between the Middle East, Ceylon (Sri Lanka), Papua New Guinea, the Northern Territory, the Torres Strait Islands and northern Queensland as well as troops in every other State preparing for the defence of Australia against a feared Japanese invasion.

During the hard-fought campaigns in Papua New Guinea and Borneo between 1942 and 1945, Burston consolidated his reputation as a superb military-medical administrator. Burston was the quintessential charismatic leader. He easily attracted loyal friends and followers. Popular among Army officers and other ranks alike, his affable, gregarious personality readily won him devoted supporters. As DGMS, he managed the military and medical politics of the position adroitly. He was a shrewd judge of character and talent, ensuring that senior specialist medical officers like Neil Fairley, Ian and Josephine Mackerras, Bill Keogh and Ted Ford were placed in positions in which their talent and experience could be used to best advantage. He made the right appointments to the senior AAMC positions in the Army's operational divisions. He delegated effectively to the hierarchy of AAMC officers. He provided prompt, wise advice to his Commander-in-Chief, using his close links with General Blamey to the optimal advantage of the Army Medical Services.

Burston was not a malariologist; and unlike one of his distinguished predecessors as DGMS, Major-General Rupert M. Downes, he never had to manage an epidemic of malaria in the field. As DGMS from April 1942, however, he took command of the war against malaria in the South-West Pacific Area (SWPA).

Burston and Fairley, who were close personal friends as well as military and medical colleagues, worked productively together in a close professional relationship throughout the war. Thus, Burston ensured that Fairley was placed in a position of authority in which he had privileged access to

Generals Blamey and MacArthur in order to keep them fully informed about the Allies' struggle with malaria. He facilitated the establishment of the Land Headquarters Medical Research Unit (LHQMRU), arranged Fairley's appointment as its Director and ensured that it received the resources it needed to carry on its research program efficiently. He issued a continuing series of widely distributed 'Technical Instructions' to advise AAMC medical officers and units on how malaria was to be managed. Although these were drafted by his specialist advisers, and in particular Fairley, they bore his imprimatur and authority as DGMS.

Burston also convened a decisive high-level conference on malaria for the Army's most senior commanders at Atherton in June 1944. Known as the 'Atherton Conference on Tropical Diseases in Warfare', it was critically important in swinging the support of its audience behind the LHQMRU research recommendations. The main speaker on the program was Brigadier Fairley, who outlined the LHQMRU research findings. Burston himself spoke compellingly to the audience on what they must do to avoid catastrophic malarial epidemics during the Final Campaigns of the war. The Conference proved to be a turning point in the Army's struggle against malaria because Burston followed up on the Conference by persuading General Blamey to issue a General Regulation Order enforcing anti-malarial discipline throughout the forces in Papua New Guinea. Burston accordingly deserves his place on the 'honour roll' of those who furthered Australian military malariology during World War II, even if that meant militarily transforming malaria from a medical problem to a matter of discipline.<sup>27</sup>



Major-General S.R. Burston (right) chatting with the Minister for the Army (and later Prime Minister), F.M. Forde, during the official opening of the 115<sup>th</sup> Base Hospital at Heidelberg, Melbourne, on 4 December

1943. The others in the photograph are (left-right): an unidentified Army officer, Senator J.S. Collings (Minister for the Interior) and Matron C.J. McAllister (Australian War Memorial photograph no. 060879).

After the war, Burston remained DGMS until his retirement in late 1947. He was knighted (KBE) in 1952 for his services to military medicine. His many post-war business and community involvements included being the inaugural Chief Commissioner of the St John Ambulance Brigade in Australia (1945–1956), serving as the Chairman of the Moonee Valley Racing Club (1952–60) and assisting Australian Red Cross as its Honorary Medical Director (1948–60). He died suddenly at home in Melbourne from an aortic aneurysm in August 1960.

Burston was survived by his two sons and a daughter. His younger son, Robin ('Bob'), became a specialist physician in Adelaide. He joined the AAMC in 1945 and remained in the Corps as a medical officer until his retirement in 1978. In that time he reached the rank of colonel and served as a physician at the 1<sup>st</sup> Australian Field Hospital in Vietnam.

## Conclusion

The foregoing sections have profiled nine medically trained AAMC officers who helped shape the direction taken by Australian military malariology during World War II under the aegis of the Army's Land Headquarters Medical Research Unit. The historian of the LHQMRU, Tony Sweeney, has written that the unit's experimental program 'formed the solid foundation on which later advances in malaria research have developed'.<sup>28</sup> In coming to that conclusion he quoted *The Lancet*, the prestigious British medical journal, which opined that the LHQMRU experimental program 'brought a greater advance in the knowledge of chemoprophylaxis [of malaria] than had occurred in the previous 50 years or was to occur in the subsequent twenty'.<sup>29</sup>

Those profiled above were only nine of hundreds of Army Medical Service personnel who fought the war against malaria during the campaigns in the Middle East, North Africa, Greece, Papua New Guinea and South-East Asia. Many of that number are equally worthy of profiles in this article; unfortunately, however, space here does not permit the due acknowledgment of their contributions to Australian military malariology. Suffice to say that their collective effort placed Australia at the forefront of world malariology. The final two articles in this series will demonstrate how the Army's malariologists endeavoured to retain that place for Australian malariology during the post-war decades.

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*'VD: the Australian Army's historical experience of sexually transmitted diseases'.*

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## Abbreviations

AAMC	Australian Army Medical Corps (prefixed 'Royal' from 1948)
AC	Companion of the Order of Australia
ADB	<i>The Australian Dictionary of Biography</i>
ADMS	Assistant Director of Medical Services
AGH	Australian General Hospital
AIF	Australian Imperial Force
AITM	Australian Institute of Tropical Medicine
ANU	Australian National University
AWM	Australian War Memorial
BA	Bachelor of Arts
BSc	Bachelor of Science
CB	Companion of the Most Honourable Order of the Bath
ChM	<i>Magister Chirurgiae</i> (Latin: Master of Surgery)
CMG	Commander of the Most Distinguished Order of St Michael and St George
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSL	Commonwealth Serum Laboratories
DCM	Distinguished Conduct Medal
DDMS	Deputy Director of Medical Services
DGMS	Director General of Medical Services
DMS	Director of Medical Services
DSO	Distinguished Service Order
FRS	Fellow of the Royal Society
HQ	Headquarters
KBE	Knight of the Most Excellent Order of the British Empire
LHQMRU	Land Headquarters Medical Research Unit

MB BS	Bachelor of Medicine and Bachelor of Surgery
MBE	Member of the Most Excellent Order of the British Empire
MC	Military Cross
MD	Doctor of Medicine
MM	Military Medal
OBE	Officer of the Most Excellent Order of the British Empire
QIMR	Queensland Institute of Medical Research
RSTMH	Royal Society of Tropical Medicine and Hygiene
SPHTM	School of Public Health and Tropical Medicine (University of Sydney)

## References

- 1 Until after the end of World War II, Australia controlled Papua and New Guinea as separately administered territories. In 1946 they were administratively combined as the 'Territory of Papua and New Guinea'. That name was retained until the granting of self-government in 1973, when the present name Papua New Guinea was adopted. This name has continued since the nation achieved independence in 1975. For convenience, this article uses the present name.
- 2 Allan S. Walker, *Clinical Problems of War Volume 1 in Series 5 (Medical) of Australians in the War of 1939–1945* [the official war history], Canberra, Australian War Memorial, 1952, pp. 68–9, hereinafter referred to as 'A.S. Walker, *Clinical Problems of War*'; and Allan S. Walker, *Middle East and Far East Volume 2 in Series 5 (Medical) of Australians in the War of 1939–1945*, Canberra, Australian War Memorial, 1953, p. 304; hereinafter referred to as 'A.S. Walker, *Middle East and Far East*'.
- 3 A.S. Walker, *Clinical Problems of War*, pp. 68–9.
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- 5 Lionel Wigmore, *The Japanese Thrust Volume 4 in Series 1 (Army) of Australians in the War of 1939–1945* [the official war history], Canberra, Australian War Memorial, 1957.
- 6 A.S. Walker, *Clinical Problems of War*, p. 82.
- 7 Figures derived from Walker, *op. cit.*, p. 82.
- 8 *Ibid.*, p. 82
- 9 *Ibid.*, p. 91.
- 10 For an account of the work of the LHMRQ see Tony Sweeney, *Malaria Frontline: Australian Army Research During World War II*, Melbourne, Melbourne University Press, 2003; hereinafter referred to as 'Tony Sweeney, *Malaria Frontline*'.
- 11 For an account of the impact of malaria in the war in Papua New Guinea, see Ian Howie-Willis, *An Unending War: The Australia Army's struggle against malaria, 1885–2015*, Newport [New South Wales], Big Sky Publications, 2016, Chapters 7–9; hereinafter referred to as Ian Howie-Willis, *An Unending War*.
- 12 For details of Fairley's life and work see his entry in the *Australian Dictionary of Biography: Frank Fenner, 'Fairley, Sir Neil Hamilton (1891–1966)'* in *Australian Dictionary of Biography Volume 14*, Melbourne, Melbourne University Press and the National Centre of Biography, Australian National University, 1996.
- 13 For a detailed account of the LHQMRU research program see Tony Sweeney, *Malaria Frontline*.
- 14 A.S. Walker, *Clinical Problems of War*, pp. 117–8.
- 15 Estimates of Japanese losses from malaria are problematic. Gavin Long, the official war historian, estimated that of the 300,000 Japanese sent to Papua New Guinea and the Solomon Islands, 60,000 were killed in the fighting and 110,000 died from disease. See his *The Final Campaigns (Volume VII in Series 1 (Army) of Australia in the War of 1939–1945*, Canberra, Australian War Memorial, 1963, p. 386. Unfortunately neither he nor the official medical historian, Allan S. Walker, attempt to estimate the Japanese losses from malaria. The estimate used here is derived from work by the historian Steven

Bullard, who has used Japanese sources. See Steven Bullard, 'The Great enemy of humanity: Malaria and the Japanese Medical Corps in Papua, 1942–43' in *The Journal of Pacific History* Volume 39 No. 2, 2004; and Steven Bullard (translator), *Japanese Army Operations in the South Pacific Area: New Britain and Papua Campaigns, 1942–43*, Canberra, Australian War Memorial, 2007.

- 16 Tony Sweeney, *Malaria Frontline*, p. 268
- 17 E.V. Keogh, 'Obituary: Neil Hamilton Fairley' in *Medical Journal of Australia* 8 October 1966, pp. 723–725.
- 18 Correspondence on Fairley's medical history by his family doctor in File 65/272, 'Fairley, N.H.: Correspondence 1900s–1966' in Box 65/17, N.H. Fairley Collection, Basser Library, Australian Academy of Science.
- 19 For details of Heydon's life and work see his obituary in the *Medical Journal of Australia*, 14 September 1963, p. 465; and his biographical profile, 'Heydon, George Aloysius Makinson' in the 'People' section within the 'Online Museum' menu of the website of the Sydney Medical School, <https://sydney.edu.au/medicine/museum/>.
- 20 For details of Ford's life and work see his entry in the *Australian Dictionary of Biography*: [Michael B. Tyquin](#), 'Ford, Sir Edward (Ted) (1902–1986)' in *Australian Dictionary of Biography* Volume 17, Melbourne, Melbourne University Press and the National Centre of Biography, Australian National University, 2007; and his biographical profile, 'Ford, Sir Edward' in the 'People' section within the 'Online Museum' menu of the website of the Sydney Medical School, <https://sydney.edu.au/medicine/museum/>.
- 21 Ian Howie-Willis, *A Medical Emergency: Major General 'Ginger' Burston and the Army Medical Service in World War II*, Newport (New South Wales), Big Sky Publications, 2012, p. 270; hereinafter referred to as 'Ian Howie-Willis, A Medical Emergency'.
- 22 For details of Keogh's life and work see his entry in the *Australian Dictionary of Biography*: [Lyndsay Gardiner](#) and [Geoffrey Serle](#), 'Keogh, Esmond Venner (Bill) (1895–1970)' in *Australian Dictionary of Biography* Volume 15, Melbourne, Melbourne University Press and the National Centre of Biography, Australian National University, 2000. For a book-length account see [Lyndsay Gardiner](#), *E.V. Keogh: Soldier, Scientist and Administrator*, Melbourne, Hyland House, 1990.
- 23 For details of the life and work of Ian and Josephine Mackerras see their joint-entry in the *Australian Dictionary of Biography*: Lesley Williams, 'Mackerras, Ian Murray (1898–1980)' (shared entry with Mabel Josephine Mackerras) in *Australian Dictionary of Biography* Volume 15, Melbourne, Melbourne University Press and the National Centre of Biography, Australian National University, 2000. See also K.R. Norris, 'Ian Murray Mackerras 1898–1980', published on-line in 'Australian Academy of Science Biographical Memoirs of Deceased Fellows' on the 'Bright Sparcs' website of the Australian Science Archives Project, [www.asap.unimelb.edu.au/bsparcs/aasmemoirs/mackerra.htm](http://www.asap.unimelb.edu.au/bsparcs/aasmemoirs/mackerra.htm).
- 24 For details of the life and work of Professor F.J. Fenner see 'Professor Frank Fenner, microbiologist and virologist', transcript of interviews with Fenner by Dr Max Blythe in 1992 and 1993, published by the Australian Academy of Science under the 'History' menu in the section 'Interviews with Australian scientists', on the Academy's website, [www.science.org.au/learning/general-audience/history](http://www.science.org.au/learning/general-audience/history). See also Fenner's obituary in *The Australian newspaper*: 'Frank Fenner, who eradicated smallpox and ended rabbit plague, dead at 95', *The Australian*, 23 November 2010.
- 25 For details of the life and work of Dr J.I. Tonge, see his obituary by his son: Stephen Tonge, 'Dr John Iredale Tonge' in *DoctorQ*, May 2013. See also Dr J.I. Tonge's memoirs: John Iredale Tonge and Anne Chamberlain, *Just keep your knife sharp: Memoirs of John Tonge as told to Anne Chamberlain*, Durack (Queensland), John Tonge & Anne Chamberlain, 2009.
- 26 This section of the article is based on the author's biography of Burston. See Ian Howie-Willis, *A Medical Emergency*.
- 27 Ian Howie-Willis, *An Unending War*, Chapter 9.
- 28 Tony Sweeney, *Malaria Frontline*, p. 242.
- 29 *Ibid.*, p. 268, citing 'Neil Hamilton Fairley', obituary in *Lancet* Volume 1, 1966, pp. 987–8.