

George Aloysius Makinson Heydon was born in Sydney in 1881. After schooling in Sydney and in England, he obtained a B.A. from Cambridge in 1903 and medical qualifications from the University of Sydney in 1908. He had intended to follow a career in ophthalmology but the outbreak of World War I determined his immediate future and, ultimately, his life's work. He served with the Australian Army Medical Corps at Gallipoli and in France, where he was Regimental Medical officer of the 8th Battalion, achieved the rank of Major and was awarded the Military Cross. Before leaving Europe, Heydon obtained diplomas of Public Health and Tropical Medicine and Hygiene from Cambridge University. On returning to Australia he joined the laboratory services of the Commonwealth Department of Health and was appointed to Rabaul in the former German Territory of New Guinea, to establish a health laboratory. This position provided opportunities for research in parasitology that Heydon seized enthusiastically, his most significant contribution being the demonstration, through dissection and breeding experiments, that *Anopheles punctulatus* was the major vector of malaria in Rabaul. This placed malaria control in Rabaul on a firm footing and later proved to have general application in Melanesia. In 1925, Heydon moved from New Guinea to the AITM in Townsville where he taught parasitology in the DTM and carried out field surveys for malaria and filariasis in northern Queensland. His work on *Anopheles* in Melanesia and Northern Australia became the basis of the field malaria control methods employed by allied malaria control services in the South West Pacific in World War II. Whilst in Townsville, he also studied the microfilariae of *Onchocerca gibsoni* in the skin of cattle and the infective larvae of human hookworms.

In 1928 A.J. Bearup joined the AITM and became technical assistant to Dr Heydon. This was the beginning of collaboration between two men that lasted until Heydon retired in 1946 and a friendship that lasted until his death in 1963.

Arthur Joseph Bearup was born in Hamilton, Victoria in 1895 and attended school at Stawell. He served with the AIF in the Middle East in World War I and, on demobilisation, resumed work with his previous employer, the Postmaster-General's Department. In 1922, he transferred to the Commonwealth Department of Health and, following initial training at the Commonwealth Serum Laboratories at Parkville, he

moved to the Commonwealth Health Laboratory in Townsville. In 1928, he transferred to the AITM where his association with Dr Heydon was pivotal in determining his future career. When the AITM closed in 1930 and its functions were absorbed into the newly opened **School of Public Health and Tropical Medicine at Sydney University**, Heydon and Bearup, along with the other AITM staff, moved to Sydney. At Sydney University, Bearup studied science and graduated as Bachelor of Science in 1934.

These two men, who had worked together since 1928 in Townsville, rapidly developed into an effective team in Sydney, teaching, researching a variety of issues in parasitology and providing a specialist diagnostic service for medical practitioners. From the very first week, a close relationship with Taronga Zoo began. Examination of the daily records kept in the section reveals that a regular activity was review of post-mortem material from zoo animals for parasites. In fact, there were so many post-mortems that the impression could easily be gained that Taronga Zoo was a decidedly unhealthy place to be if you were not human. Records of examination of blood or faecal samples from humans are interspersed with details of dissections of orangutans, giraffes and pythons.

Heydon's interest in Australian malaria vectors continued in Sydney. Collections of a local species, *Anopheles annulipes* were made from various localities within the Sydney suburbs, particularly near Bearup's home at Penshurst and at Rhodes. Mosquitoes raised to maturity in the laboratory were fed on individuals infected with *Plasmodium vivax*. One of these was F.H. Taylor, the school entomologist, who had been working in New Guinea. It is uncertain from the laboratory records whether any mosquitoes became infected. Certainly there are no reports of positive results, but among specimens from that period now in the collections of the parasitology section at Westmead Hospital is a slide labelled 'First Anulipes Infection'. On the slide are stained salivary glands but no sporozoites are visible. They may have faded in the intervening 70 years. The susceptibility of *A. annulipes* to malaria, albeit the rodent parasite *P. berghei*, was conclusively shown by Elizabeth Kalucy following experiments at the SPHTM in 1969. Kalucy, a recent graduate in zoology from Sydney University, was the commanding officer of the Army Malaria Research Unit that had been established in the SPHTM in 1968 and where it remained for 10 years before moving to Ingleburn Army Camp.

In November of 1934, Heydon and Bearup travelled to Mount Hagen and Kainantu in the highlands of New Guinea. Their objectives were to investigate the extent of infection with protozoan and helminth parasites and to determine, by use of skin tests, the degree of exposure of the population to bacterial infections such as tuberculosis, diphtheria and scarlet fever. Europeans had first entered the Ramu Valley at Kainantu only two years before and the Wahgi Valley at Mount Hagen in 1933.

In Townsville, while working at the AITM, Heydon and Bearup had investigated the cause of cutaneous larva migrans. Using themselves as experimental subjects, they demonstrated that infective larvae of *Ancylostoma braziliense* would cause creeping eruption but found no evidence that it could produce intestinal infections in humans. In 1938, they obtained 35 adult hookworms from a resident of the Solomon Islands, after he had been treated with tetrachlorethylene. Twenty-seven of these worms were, at the time, identified as *A. braziliense*. Infective larvae from faecal cultures were used to infect four human volunteers, including Heydon and Bearup. All four developed patent infections and, following treatment, adult hookworms were recovered. These worms were initially identified as *A. braziliense* but following review about 15 years later, were re-identified as *A. ceylanicum*. This series of experimental infections, which extended over a period of several months, is meticulously recorded in the laboratory notebooks of the time. There are details of the numbers of larvae used, their sites of application, any resultant skin reactions, regular faecal examinations for the presence of eggs, blood counts to determine the degree of eosinophilia and descriptions of symptoms experienced. In an era before the advent of ethics committees and risk assessments, this kind of experimentation was common amongst parasitologists, though not all used themselves or their colleagues as subjects. Such experiments also provided material for the extensive practical classes in the DTM&H. Another source of teaching material was Callan Park Hospital, where some patients were treated by infecting them with malaria, usually *Plasmodium malariae* or *P. vivax*. Blood from these patients was used in practical classes until 1956, well into the antibiotic era.

The period from 1940 to 1945 was dominated by wartime activities. Heydon, Bearup and Jim Lawrence investigated the prevalence of parasitic infection in recruits in the Australian Army. Of particular interest was the prevalence of asymptomatic infection with *Entamoeba histolytica*. They concluded that the rate of infection in men who had

never left Australia was around 3%, but they included in their estimate the so-called 'small race' of *E. histolytica*. This is now recognised as a separate species, *Entamoeba hartmanni*. Exclusion of those isolates would approximately halve their rate to 1.5%, similar to estimates today. It is now recognised that the great majority of such infections are with the non-pathogenic *Entamoeba dispar*, not with *E. histolytica*.

With so many men fighting in Papua and New Guinea, malaria assumed great significance. In 1942, there was a large epidemic of *Plasmodium vivax* malaria in Cairns, initially amongst military personnel but ultimately involving civilians as well. The identification of the vector became imperative and Heydon was the first to recognise that it was *Anopheles punctulatus moluccensis* (= *Anopheles farauti*). A.R. Woodhill, entomologist in the Zoology Department of Sydney University, confirmed this identification. **George Merritt** who, later joined the CSIRO McMaster laboratory as a parasitologist, worked briefly at the SPHTM at this time and was one of the volunteers in important studies of antimalarial drugs in Cairns in World War II.

Commenting on the contribution of the staff of the SPHTM in the war effort, Sir Neil Hamilton Fairley, Director of Medicine, Australian Army, mentioned some individuals, including Dr Heydon, specifically. "For instance, the work of Dr G.A.M. Heydon in defining the anopheline vectors both for Melanesia generally, and also for Northern Australia, was of basic importance. On this work was based the whole of the field malaria control methods employed by Allied Malaria Control Services in the South West Pacific. Dr Heydon also provided important information on the feeding habits of anopheline vectors and on many problems of helminthology and protozoology and especially ancylostomiasis and filariasis".

One of Heydon's other wartime contributions was unrelated to parasitology. In 1935, he had learned to fly, an activity in which he became highly proficient, competing successfully in championships against much younger pilots. Over the 21 years during which he held a license, he owned six different light aircraft. During the war, he often flew at night and day over Sydney to provide practice for searchlight and anti-aircraft batteries. In 1936, he took up gliding and was an Australian pioneer in the sport, being the first in the country to tow a glider into the air by means of a powered aircraft.

In 1946 George Heydon retired from the SPHTM but continued his interest in parasitology, his last publication being in joint authorship with Bearup in 1963, the year of his death. He had many other interests including, in later years, astronomy and

cosmology. Heydon made numerous generous donations, including one of £35,000 to the University of Sydney for the Charles Gilbert Heydon Travelling Fellowships in the Biological Sciences, as a memorial to his father who was a judge of the NSW Arbitration Court. Another of £5,000 was made towards the erection of the Mills Cross, a radio telescope developed by the Physics School at the University. In recognition of Heydon's beneficence, the University, in 2001, renamed the Zoology building the Heydon-Laurence Building. Miss Joan Laurence, Heydon's cousin, made a bequest of over \$2.5 million to the University as a memorial to George Heydon. Clive Backhouse, Heydon's successor at the SPHTM, and Sir Edward Ford, Director of the school in 1963 commented in an obituary; "George Heydon was a rare personality, rich in scientific and humanistic attributes, mingled with little eccentricities and lovable traits peculiarly his own." Heydon should also be remembered as the first true medical parasitologist in Australia, a man whose contributions to the discipline in the region have not been surpassed.