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The Bancrofts:
A Century of Scientific Endeavour

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SYNOPSIS
Joseph Bancroft M.D. arrived in Brisbane in 1864 where he practised medicine until his death in 1894. His son Thomas Lane Bancroft M.B. (d. 1933) practised medicine in various parts of Queensland. T. L. Bancroft's daughter Josephine (d. 1971), a graduate in science and medicine, was a professional scientist whose last paper was published in 1970. All three served as Councillors of the Royal Society of Queensland, and were Honorary Life Members of the Society.

This family made a remarkable contribution to Australian science. Between 1866 and 1970 they published 232 papers ranging over such diverse fields as public health, insect-borne diseases and parasitology of man and domestic and native animals, insect taxonomy and biology, fish biology, animal and plant poisons, and plant acclimatisation, hybridisation and diseases.

INTRODUCTION
This is the story of three generations of dedicated medical naturalists—Joseph Bancroft, M.D., M.R.C.S., L.S.A. (1836-1894), his son Thomas Bancroft, M.B., Ch.M., C.M.Z.S. (1860-1933), and his grand-daughter Josephine Mackerras, M.B., D.Sc., M.R.C.P.A. (1896-1971)—whose combined scientific publications spanned the years from 1866 to 1970 and whose association with the Royal Society of Queensland was almost as continuous. Joseph joined the Philosophical Society of Queensland in 1866, served on the Council and as Curator, and was President when the Society was absorbed in the Royal Society of Queensland in 1883. He became Vice-President of the new Society in the same year, President in 1884, a Councillor in 1885, Treasurer from 1886 to 1888, and remained a member until his death, a total period of 28 years. Thomas was elected to the Royal Society of Queensland in 1888 and served on the Council, but resigned in 1892, possibly as a result of a disagreement with Dr Eugen Hirschfeld about the diagnosis of leprosy and the treatment of lepers, subjects on which he held strong opinions. He was elected again as an Honorary Life Member in 1915, his combined period of membership being 22 years. Josephine was elected a member in 1918, served on the Council in 1951, became an Honorary Life Member in 1954, and she had continuous membership of 53 years.

All three had lively enquiring minds and they shared a common interest in medicine and biology, but they differed greatly in temperament and in their
approach to their work. Joseph was the acute, enterprising, forceful applied
scientist, 'just the man for a new country'; Thomas, shy and retiring, found a
refuge in natural history from a world he did not like; and Josephine, quiet,
unobtrusive, the most equable of the three, was a distinguished professional
scientist in the modern sense. They lived, too, through the era from early
Victorian to mid Elizabethan, in the course of which social and family life
changed from rigidly hierarchical to egalitarian, the pattern of human ecology
from stagnation to expansion, and the curve of population from a moderate slope to almost vertically explosive. It is of interest to
attempt to trace the effect of all these influences on their respective careers.

It is a curious fact that, although their years of publication overlapped
considerably (Joseph 1866 to 1894, Thomas 1887 to 1933, Josephine 1918 to
1970), they published no papers under joint family authorship, although
Thomas collaborated with his cousin Peter in a short note in 1894.

JOSEPH BANCROFT, 1836–1894
(Plate 1, fig. 1)

Joseph, only son of Peter Bancroft (1793–1860), farmer, and his wife
Mary, née Lane, was born at Stretford, Manchester, on 21 February 1836.
His mother died young, his father married her sister, and from this line came
another Peter Bancroft who appears again later in the present history.

Joseph was given a liberal education and trained as a surveyor, but then
decided to enter medicine. He served for five years as apprentice to Dr
Jeremiah Renshaw of Cheshire, completed his training at the Manchester
Royal School of Medicine and Surgery, winning prizes for botany, materia
medica, pathology, and forensic medicine, and graduated M.R.C.S., L.S.A.
in 1859 and M.D. of St. Andrews in the same year. He went to
in Nottingham, where he showed his first concern with public health by assisting
in experiments on furnace processing of night soil. He had married Anne
Oldfield (1833–1905) while a student and they had two daughters, the elder
of whom died in infancy, and a son Thomas who was born in Manchester in
1860. Prospects in Nottingham were good, but Joseph suffered from dropy
and albuminuria and Thomas from severe whooping cough and bronchitis,
and they sailed for Australia in June 1864 in search of a better climate.

There are three significant aspects of this early period. The first is that
Joseph came from successful farming stock and grew up on a farm. That
undoubtedly had an important influence on his later life. Secondly, he
acquired a keen interest in natural history, especially in botany. He became
a member of the Nottingham Naturalists Society, was its President for three
years, and was made a Life Member when he left for Australia. He also
helped James Youl to pack the first consignment of trout eggs to reach
Australia alive. On his voyage out, he collected plants and marine animals
during calls at St. Vincent and St. Helena, dissected flying fish, and caught
and preserved 53 albatrosses in the southern ocean. Nevertheless, he always
regarded natural history—and, indeed, all branches of pure science—as a
hobby rather than a profession. Thirdly, he left England as a well trained and
experienced doctor who could expect to have a successful life in the colonies.

It is necessary to pause here for a moment to remind ourselves of the
state of medicine and biology at that time.

In medicine, a knowledge of anatomy, physiology, and pathology was
growing steadily; clinical methods had improved greatly in the preceding
fifty years; Bright had described the disease that bears his name and other
syndromes were becoming clearly defined; contagion was understood, at
least in general terms, and a good many infectious diseases were recognized
as separate entities; the quality of microscopes was improving rapidly and
trypanosomes in the blood of frogs had been described in 1845, but only the
larger animal parasites of man were known; anaesthesia had become available;
and surgical techniques were improving. Bancroft would have learned
a lot of materia medica and toxicology, but little of pharmacology. He would
certainly have learned to dispense his own prescriptions, and very likely to
collect at least some of his own raw materials in the field—hence the wide
medical interest in botany at that time. On the other hand, specific deficiency
diseases were known only from practical experience, less of idiotherapy
and only from some of the phenomena of tropical medicine and of venereal
diseases, and there was no medical microbiology. Spontaneous generation of microorganisms was still widely
accepted as a reality; Pasteur had not yet completed his fundamental work;
the first clear association of a specific organism, the anthrax bacillus, with an
infectious disease was not made until 1863; Listerian antiseptic-surgical
surgery was still in the future (though not far away); and the foundations of
public health and preventive medicine generally were still extremely shaky.
The flood of knowledge that changed all this did not come until after
Bancroft was established in Australia.

The situation in general biology was essentially similar. Darwin had
made his voyage in the Beagle, Huxley his in the Rattlesnake, and A. R.
Wallace was collecting assiduously in the Malay Archipelago. There was
intense curiosity about the great variety of plant and animal forms that were
being found in all parts of the world. Taxonomic natural history was
flourishing, and Owen had developed comparative anatomy into a respectable
discipline—but The Origin of Species was not published until the year in
which Bancroft graduated. The importance of heredity was being loudly
asserted in human and animal breeding, but even Darwin knew nothing about
the mechanisms of heredity. Pests and diseases of plants, as well as of
animals, were known—but economic biology did not exist as a recognizable
discipline, agriculture was almost entirely empirical, and veterinary medicine
lagged behind human medicine. There was little but good husbandry that
could be done for crops or stock.

This, then, was the state of knowledge when Joseph Bancroft, with his
wife, daughter Louisa and son Thomas, landed in Brisbane on 29 October
1861. They took a furnished house in Alice St, and Joseph began to look
around. The town was a small place, and in 1861 it had only about 12,000
people and growing rapidly. Back huts muddled with pretentious buildings
and accommodation was scarce. Areas of uncleared bush infiltrated the
town, and travellers wrote of the rich beauty of the dense scrub-lands of the
neighbourhood, the ring of axes as the clearings extended, and the heavy
perfume of gum, wattle and tea-tree within a mile or two of the post office
(Ford, 1961). The water supply, carried in casks from a dam near the
junction of Roma and George Streets, was already outgrown, and was
supplied by the Stand of St. Helena and St. Helena wells, and water drawn into bowls from the shingled roofs
of the houses, a method that was improved on only in detail for very many
years. The mosquitoes, it was said, bade fair to drive the people mad.
There were 15 doctors in Brisbane at that time, the Brisbane Hospital was in the old
Convent Hospital building in George Street (moved to its new site on Bowen
Ridge in January 1867), and the Lady Bowen Lying-in Hospital, with 11 beds,
had opened at Spring Hill in 1863.

Bancroft, whose health had been bad when he left England, became
almost overnight, a most vigorous, active and progressive citizen of the
infant city, concerning himself quite as much with its precarious food supply,
water supply and sanitation as with the prospects of medical practice. In
December 1864 he bought 12½ acres of virgin bushland on the banks of
Enoggera Creek, built a house (Plate 1, fig. 5), called it ‘Kelvin Grove’ after the gardens he had admired in Glasgow, and himself developed a beautiful garden which became a show-piece in Brisbane. It was here (Plate 1, fig. 6) that he began the plant-breeding experiments of which more will be said later. He was registered by the Queensland Medical Board on 6 April 1865, commenced to practise in Eagle Street, and was appointed visiting surgeon to the Brisbane Hospital in 1867. The hospital, now in its permanent home, had a medical staff of one resident house surgeon and five visiting surgeons who treated 581 in-patients and more than 4,000 out-patients during that year. In 1868 he was appointed house surgeon and moved into the cottage in the hospital grounds, but resigned in 1870 to commence practice at ‘Carlton’ in Wickham Terrace, when he was again appointed visiting surgeon to the Brisbane Hospital and also visiting surgeon to the Lady Bowen Hospital. He retained his association with both for the rest of his life. He bought a block of land at the corner of Ann and Wharf Streets in 1872 and subsequently built a two-storey house on it (Plate 1, fig. 7), but it is not clear whether he moved there before his world tour or after.

In 1877–78 he took his family to England, calling at Singapore, India and other countries to study ‘diseases peculiar to each place he visited, inspecting the hospitals and collecting all the information he could on sanitary science’ (Quarantine, 23 June 1894), and also collecting useful plants and seeds for the colony. He was well received by his colleagues in London, lectured on filaria to the Pathological Society, had valuable discussions with Cobbold, Owen, Ringer and others, and visited Paris for discussions with the eminent French chemist Petit. His health suffered badly in the English climate and he was glad to return to Australia. His practice continued to grow after his return, and he was called on increasingly for consultations with his colleagues. His other interests also made heavy calls on his time, but he was well situated in his new house, and was aided especially by having his son Thomas practising at ‘Maxwell Place’ nearby and his nephew Peter (p. 11) with him in the Ann Street rooms from 1889. Thus there were three Bancrofts working together, so that Joseph, in the full vigour of his middle age, became known as ‘the old doctor’.

We may visualize Bancroft in his prime as a senior consultant physician—surgeon, one who in a later day would have been a senior honorary in a teaching hospital followed on his rounds of the wards a throng of eager students. He would have been a good teacher too, clear and incisive, though laconic, sometimes irascible and emphatically never suffering fools gladly, but with his abruptness balanced by his great care and consideration for his patients and a humanity that earned him the warm affection of his family and friends. He was, too, a man of prodigious mental and physical energy, always seeking new ideas that could lead to useful ends and then testing them by practical trial. Derrick (1948) classed his approach as enlightened opportunism, and Ford (1961) has stressed the powerfully utilitarian motives that governed all his research. It remains now to consider his achievements in the field of medicine, agriculture and public service, though the last cannot be divorced from the other two.

His most notable contribution to medicine, in that it stimulated the greatest volume of subsequent research, was his discovery of the adult filarial worm which T. S. Cobbold named Filaria bancrofti (now Wuchereria bancrofti) after him. Following the earlier work of Lewis, and stimulated by the local discovery of microfilariae in urine by Dr Thomas Rowlands of Ipswich, he found them in the blood of a patient in December 1874 and subsequently in many others. He sent tubes of infected blood preserved in glycerine to Dr Roberts in Manchester in 1874–75, and some of them ultimately reached Cobbold in May 1876. It was already known that the microfilariae were larvae, but there had been nothing to indicate where they came from. Cobbold found an empty egg capsule among the liver fluke eggs in one of the tubes, but the parent worms must almost certainly live in the human host, and urged Bancroft to seek for them. This report reached him in September. He set to work, found a dead worm in a lymphatic abscess on 21 December, and extracted four living females from a hydroccele in March 1877. These he sent to Cobbold who published the discovery in July 1877, only a few weeks before Lewis recorded his own discovery of the adult in India. The much smaller males were not described until 1888, from specimens collected in India.

Bancroft recognized that the primary habitat of the microfilariae was in the blood and wondered how the disease could be spread. He took a patient to ‘Kelvin Grove’, allowed the local mosquitoes (Aedes vigilax) to feed on his blood, and found microfilariae in their stomachs. However, he thought that the mosquito was only a means to get the larval worms from the blood into water, and he added filariasis to the water-borne diseases that could be controlled by providing a more sanitary water supply.

He also made detailed observations on the clinical manifestations of filariasis, using blood examination as his diagnostic criterion, gave a masterly description of an outbreak of malaria among labourers working on the railway line between Dalby and Roma in 1877, and was the first to recognize leprosy in Queensland although it had certainly been present for at least thirteen years. In 1892 he published a comprehensive review of its occurrence in the colony, in which he recorded the first known case in an aborigine, the forerunner of the real leprosy problem in Australia today. He wrote, as well, on poisonous animals, tick paralysis, snake bite, the treatment of sunstroke and typhoid fever, and a variety of other clinical topics. He invented surgical implements and a rather temperamental apparatus for administering chloroform.

However, his second major claim to international fame lay in his studies of the medicinal properties of native plants. These began at ‘Kelvin Grove’, and he was already using native gums and barks for the treatment of bowel diseases when he was appointed to the resident post in the Brisbane Hospital in 1868. In 1870–71 he began to use extracts of Alstonia constricta (‘bitter bark’). He found that its action was not quinine-like, in that it had no effect on malaria, but he used it extensively as a tonic, with, he thought, considerable benefit. That it was found in 1952 to be a source of reserpine, an important tranquilizer and hypotensive, may account for some of its usefulness.

He had also become interested in the ‘pituri’ leaves that the natives were said to chew to allay fatigue and hunger, and he asked travellers to get him specimens of the plant. He received a badly crushed, unidentifiable sample of leaves in 1872, and found it to be highly toxic, producing excitement followed by convulsions, respiratory paralysis and death in experimental animals. Some years later, in 1877, he received a good sample of the plant which had been collected by W. O. Hodgkinson near the North Coast, but returned it to him. He tested extracts to assure himself that they had the same action as the earlier material and sent part of the specimen to Baron von Mueller, who replied that the plant was Duboisia hopwoodii and suggested that Bancroft should also try the locally available D. myoporoides (corkwood). This he did, but its effects were quite different. On his trip abroad he left specimens of pituri with Fraser in Edinburgh, Ringer in London and Petit in Paris. Petit identified the active principle as nicotine, which surprised Bancroft, but he
obtained supporting evidence from his own observations reported in 1879. It was subsequently found that pituri contains nor-nicotine as well as nicotine, and also that the natives of central Australia generally chew the leaves of local species of Nicotiana rather than pituri (Cléland, 1950). Bancroft tried it in dyspeptic patients, but found no real use for it.

The _D. myoporoides_ story is a good example of serendipity (Derrick, 1948), which began with the unexpected results that followed von Mueller's suggestion. Extracts of corkwood proved to have powerful atropine and hyoscyamine-like effects, and Bancroft used them extensively in his ophthalmic work, as did others in Brisbane and even abroad. They fell into disuse when purer preparations of the alkaloids became available, but a serious shortage of both drugs developed in allied countries during the 1939–45 war, and there was a heavy demand from the armed forces for Bancroft's preparation to prevent motion sickness in amphibious operations (Hines, 1947). Bancroft's work was remembered, and the Australian pharmaceutical industry was pressed into production of the alkaloids from corkwood. They did it very efficiently and, Australia became a major producer of hyoscine and atropine (Ford, 1961). Local manufacture has since declined, but a considerable bulk of corkwood leaves is exported annually for processing in overseas factories. Bancroft would have been pleased if he had known that his work had contributed, even in a small way, to the export wealth of the country.

His remaining contributions to medicine in Queensland were in public health and organization. He was vitally concerned with the prevention of infectious disease and improvement in the quality of medical practice. He was Health Officer for Brisbane for many years, appointed to the Queensland Medical Board in 1876, its President from 1882 until his death, President of the Central Board of Health from 1884, and, in that capacity, a member of the first Australasian Sanitary Conference held in Sydney later that year. He was the first President of the Section of Hygiene of the Australasian Association for Advancement of Science in 1888, his presidential address showing clearly that he treated hygiene broadly as including better standards of living in every way. At the more technical level he worked strenuously for better sanitation, a safer water supply, cleaner food, especially milk, and reduction in the high infant mortality of the time. At the Sanitary Conference he moved successfully for quarantine of imported dogs to keep out rabies. He believed, with reason, that the Chinese had introduced both filth and leprosy into Queensland, and pressed stringent measures against Chinese immigration and for thorough medical examination of both Chinese and kanakas on arrival, mainly to detect lepers. Alarmed by the Hawaiian experience with leprosy, he worked with equal vigour for early diagnosis, bacteriological examination of suspects (which Dr. Hirschfeld had introduced), and strict isolation of patients, even though this was effected in crude, often brutal conditions. Much of this he achieved—though not without controversy and argument—and he got great satisfaction from it.

So finally, there was his work in the Medical Society of Queensland. He was one of the founders, its first Secretary when the Society was established in 1871, and its President when it was re-established with a new policy in 1886, after two periods of abeyance. Medical politics were eliminated, discussions restricted to clinical and scientific topics, and the Society flourished until it was absorbed in the newly formed Queensland Branch of the British Medical Association in 1900. In 1926 the Branch established an annual Joseph Bancroft Memorial Lecture and medal to honour his great medical achievements and service to the State.

So far, we have told the story of what could reasonably be accepted as a full life in medicine, but he had another life too, that was almost as full and probably of even greater immediate value to the young community in which he lived. His deep and abiding interest in agriculture, horticulture, and food production generally, found an outlet in the pressing need of the growing colony. Food was almost always abundant and cheap, but plant products, especially cereals, were very short supply. Only 3,500 acres in the colony were under cultivation, mostly for sugar cane (Herbert, 1959), and all flour was imported until after 1888. Bancroft became a substantial landowner. In addition to his 12½ acres at 'Kelvin Grove' and his city properties at Eagle and Ann Streets, he bought 73 acres at Myrtle (Myrtletown), half in 1877 and the rest in 1878, small blocks at Oxley, Bulimba, Kedron Brook, Redland, and Manoora, and 150 acres on Burpengary Creek in 1881. He steadily increased his holdings there, until by 1890 he owned 3,780 acres between Burpengary and Deception Bay.

One of his earliest efforts was to develop a cheap way to preserve meat for export. He had been impressed by the availability of cheap beef in the colony and by the success of Australian experiments with canning, so he invented an apparatus 'to desiccate meat, vegetables, etc.', patented it in 1867, and undertook production on a pilot scale. The product was a hard-dried powder called 'Australian Pemmican', which was packed in tins for distribution but could be exposed to the air for long periods without decomposition. It was tried on patients in the Brisbane Hospital and by the Government Geologist, D'Oyly Aplin, on a long field trip, with considerable success, and was also reported on favourably by Sir William MacGregor in his exploration of Papua and by sea captains on long voyages. Probably the most encouraging report came from the master of the _Omar Pasha_ which was lost by fire at sea on 22 April 1869. He wrote: '... it was of great service throughout the voyage, but especially after the sand dessert. It was easily saved, and a small quantity was sufficient to keep a large number of passengers (87) all not only from starvation, but in an excellent state of health, for more than three weeks.' In 1890–91 Bancroft hopefully established a full-scale meatworks (Plate 2, fig. 2) at Deception Bay to produce desiccated mutton and vegetables as well as beef, but the venture was not profitable until after his death, when his son secured contracts for beef pemmican as an emergency ration for the British army.

Two of his subsidiary activities at Deception Bay may be conveniently mentioned here. These were his studies of the biology and culture of oysters and of the artificial production of pearls in collaboration with Saville Kent, both of which had some success.

The establishment of useful plants was of much more immediate concern to the colony, and many settlers were engaged in acclimatization activities with little organization and more or less success (Herbert, 1959). This was the kind of work that appealed strongly to Bancroft. He began his work on the establishment of useful plants in his plots at 'Kelvin Grove' soon after he arrived in Australia and became a councillor of the Acclimatisation Society of Queensland which was established in 1868. On his return in 1877–78 he organized the despatch of new varieties of rice from India, sugar cane from the West Indies and barley and other cereals from U.S.A., and between forty and fifty varieties of clovers and grasses from Europe. The greater part of his subsequent work was done on the Deception Bay property (Plate 2, fig. 1), which he laid out in experimental plots, orchard and farmland. He spent nearly all his week-ends there setting up and supervising his experiments.

Among his early experiments were trials with rice, which grew well and was rust-resistant, but he did not like the meal produced from it. Wheat, however, was the major problem, for commercial production was prevented...
He studied diseases of live stock too. In 1867 he had written on scab in sheep, and in 1876 he reported to the Board on inoculation of cattle to control the fly plague. 

In 1879, the Botanist of the Board, F. M. Bailey, had sent him young plants of a burr which had been found at ‘Noogora’, a property on the upper Brisbane River, where it was thought to poison cattle. Bailey had identified it as Xanthium strumarium, and suspected that it had been introduced from America with a consignment of cotton seed a few years earlier. Bancroft made extracts, and found that his experimental animals died in a similar way to the cattle in the burr-infested paddocks. He found, too, that Bathurst burr was equally toxic, but cattle would not touch it, whereas they fed eagerly on young Noogora burr. Moreover, the Noogora burr was of much more vigorous growth than the Bathurst burr—‘some growing in my garden are over five feet high... and produces hundreds of burrs’. He ended his report by saying: ‘It seems very necessary that most exact measures should be taken to avoid adding this poisonous weed to the flora of Australia’. The area infested at that time was less than 500 acres.

There remained one piece of public service that he was able to give for the benefit of primary producers. The ravages of the rabbit as a competitor for the soil and a destroyer of young plants had had great disastrous proportions, and in 1887 the Government of New South Wales offered a prize of £25,000 for an effective way to exterminate the pest. In April 1888 it set up a Royal Commission of notable Australian doctors and scientists, with Joseph Bancroft and Henry Tryon representing Queensland, to report on the methods recommended, with special reference to their possible danger to the health of humans and domestic animals. The Commission (which Bancroft joined with some reluctance) established an experiment station on Ross Island, near the mouth of the Swan River, and worked there for a year. It had 1500 rabbits to consider, but soon reduced them to three: Pasteur’s proposal to use fowl cholera, which he had proved to be lethal to rabbits; the proposal by Archibald Watson, the Adelaide anatomist, that Sarcopes cuniculi, the cause of rabbit scab, be used; and the recommendation of Drs Ellis and Butcher of New South Wales that the Tintinvald disease, which had greatly reduced rabbit populations along the Darling River in the previous year, be exploited.

One member suggested that they get on with field trials before the laboratory work was finished, to which Bancroft replied: ‘If they did not apply remedies with their eyes open, there was no use going on with their eyes shut. It was far better to learn first what could be learned, and then proceed to action’. Bancroft was greatly impressed by what he saw of the end results of the Tintinvald epizootic, but the disease had disappeared and the Commission could find no indication of what it had been; rabbit scab was adjudged dangerous to domestic animals; and fowl cholera, the most promising of the three, failed to spread after its introduction into the experimental colony. The Commission finally concluded that no method it had examined could be
recommended on grounds either of effectiveness or safety. Bancroft's own final words on the subject are worth quoting: 'All brute force, wire netting, and drug poisonings included, cannot destroy them (the rabbits), even if the population of Australia were set to the task. The only hope lies in the careful study of the natural history and pathological conditions of the rabbit, and the sooner this is perceived the better.'

No account of his life would be complete if it failed to record that he retained his enthusiasm for natural history through all his other multifarious activities. It gave him recreation and tranquility when he most needed them.

His general interest in the limitations and consequences of hybridization in flowering plants (he had studied Darwin's writings by then) has already been mentioned, and he also contributed notes on a variety of subjects to the Philosophical and Royal Societies of Queensland. Thus, he wrote in 1869 on mealy bugs; in 1876 on the freshwater plants Vallisneria and Hydroilla, on the movement of protoplasm in the cells of Vallisneria and filamentous algae, and on the heart of the dagon; between 1876 and 1882 on reproduction in the platypus, echidna and kangaroo; in 1882 and 1888 on reproduction in the rocks of shore plants, particularly mangrove, in 1884 on the food of aborigines; and his second Divinity Hall lecture (1879) on 'The Microscope in our Gardens' contains some delightful natural history as well as many observations on hybridization. In 1886 he was appointed a trustee of the Queensland Museum, and in 1893 he was a member of a deputation from the Royal Society of Queensland to the Colonial Secretary, seeking support for the Society's project for conserving the lungfish (Neoceratodus forsteri or, colloquially, Ceratodus) which was known only from the Mary and Burnett Rivers. A result of his campaign, the government bore the cost of stocking the PVCQ Reservoir and several streams in southern Queensland with Ceratodus from the Mary River (Marks, 1960). They became well established, especially in the Reservoir.

Joseph Bancroft died suddenly on 16 June 1894 from a coronary occlusion, at his home in Ann Street while he was preparing to leave for his customary week-end at Deception Bay. He was only 58 years old, and he had, so far as his colleagues knew, been in good health. He had, indeed, devoted himself unstintingly to medicine and scientific public service in Queensland for thirty years, and he left his mark on the whole community. 'There seemed to be nothing in the friendly, untidy town that was Brisbane that Bancroft was not connected with in some way or other . . . . He was consulted by everyone in the place, from the Government down. He was just the man for a new country' (Scott Skirving, quoted by Ford, 1961). His deep knowledge, searching mind, resourcefulness, unerring energy, widely diversified interests, and, above all, his powerful sense of public service, were his greatest assets, but he was also a kindly and friendly man. He published 57 papers and reports on medicine, agriculture and natural history, and he laid a firm foundation for the Bancroft tradition.

THOMAS LANE BANCROFT, 1860-1933 (Plate 1, figs. 2, 3)

Thomas, only son of Joseph and Anne, was born in Nottingham on 2 January 1860, and came to Brisbane with his parents and sister in 1864. His early years were spent in the bush at 'Kelvin Grove', where his initiation into the Australian flora began, and it appears that he assisted in his father's pharmacological experiments both there and after the family had moved to the city. He was educated at the Normal School and the Brisbane Boys Grammar School. He was a shy, sensitive, retiring lad, extremely short-sighted, and repressed rather than developed by the strict paternal authority and discipline that was normal even in the most affectionate families of those days. It is possible, too, that his abiding preoccupation with knowledge for its own sake caused his father to think him unpractical.

In 1877 Thomas accompanied his parents to England, entered the medical course at Edinburgh University in 1878 (in contrast to Joseph who had served an apprenticeship), and graduated M.B., Ch.M. in 1883 with the bronze medal for Botany. He spent a year in the Manchester Infirmary, gaining experience mainly in ophthalmology and also becoming an expert photographer, an art he continued to practise for the rest of his life (Plates 1, 2). The greatest advance since his father had been a student was the flowering of medical and veterinary microbiology. A good many pathogenic organisms had been identified, more were being found almost every day, and there was a growing feeling of optimism that all the problems of infectious disease would soon be solved. Metchnikoff had founded immunology, but the fight between the cellular and humoral theories of immunity had not begun (both were right!), and diphtheria antitoxin did not become available for use until 1894. The term 'virus' was still a cloak for ignorance, and, in another important field, vitamins were not named until 1911. There had also been great progress in zoology and botany, but Mendel's work was still unknown.

He was registered by the Queensland Medical Board on 17 January 1884. His first appointment was a brief one as relieving medical officer in the Brisbane Hospital, where Dr C. F. Marks, under whom he served, noted that he was a competent doctor but more interested in scientific pursuits than in medical practice. He was appointed to the General (now Innisfail) Hospital (Plate 1, fig. 8) in north Queensland in May 1885, remained there until February 1886, and travelled to the Flinders River, Gregory River and Normanton in the Gulf of Carpentaria collecting animals for the Queensland Museum and plants for the Herbarium before returning south. He then spent about two years in Christchurch Hospital, New Zealand (where he also collected plants quite extensively) before settling in Brisbane. He commenced practice at 'Maxwell Place' in Ann Street in the last part of 1888 or early 1889, and it is not clear whether he remained there or later joined his father and cousin at the corner of Ann and Wharf Streets; at any rate the three of them worked together.

A word about Peter Bancroft (1862-1911) is appropriate here. He was the son of Joseph's three-quarter sister, Jane, who had married a cousin Bancroft, and he came to Australia as a youth. He graduated M.B., Ch.M. from Sydney University, was registered by the Queensland Medical Board on 2 August 1888, and joined his uncle in the Ann Street practice in August or September 1889. He married Joseph's daughter Louisa (1858-1900) and subsequently another cousin, Louise Hulme. There was no issue of either marriage. He was a good doctor, keen on clinical work, kind to his patients, liked by them and by his colleagues, and it is probable that he had to carry much of the burden of the three practices when his uncle and cousin were away on their scientific investigations. He was President of the Medical Society of Queensland in 1894 and actively involved in the establishment of the Queensland Branch of the British Medical Association in 1894 (Anon, 1959). Thomas, on the other hand, was neither tough enough nor interested enough to shine in a competitive medical environment, and it is not surprising that Peter was still remembered in clinical circles a quarter of a century later but Thomas scarcely at all.

When Joseph died in 1894, his executors offered the Ann Street practice to Thomas, who declined it, and it was taken over by Peter, whose wife
Louisa and her mother jointly inherited the city properties and the house at Deception Bay. The Kelvin Grove property went to Joseph's widowed three-quarter sister, Eliza Holme (Peter's aunts). Thomas inherited the remaining land, including 3,602 acres at Deception Bay. By the mid-1870s he was growing 150 acres of experimental farm. He married Cecilia Mary Jones (1868–1961) on 10 July 1895, and they settled in a new farmhouse at the Bay, where Josephine was born in 1896 and their son Louis Oldfield (now a grazier in the Eidsvold district) in 1902. It may be that Thomas practised medicine among the sparse local population, but his scientific and managerial activities could have left little time over for anything else.

In his early investigations he followed closely in the footsteps of his father. In Manusiaj his interest must have been intensely stimulated by his first (and almost only) encounter with a rich tropical rain forest (Plate 2, fig. 3) and he collected many poisonous plants and studied their pharmacology. He did the same in New Zealand and also after his return to Brisbane. He discovered Carissa ovata var. stolonifera, 'a very poisonous plant', during a visit to Dalby in 1893. His method was to taste the bark or other parts of a strange plant, and, if it were bitter or astringent or reputed to be poisonous, to make extracts and inject them under the skin of frogs. If the frogs reacted in any noteworthy way, further physiological and chemical tests could be made. He tasted well over a thousand plants, tested more than 150 extracts, and wrote ten papers on their pharmacology between 1886 and 1894. His aim had been to make a broad survey of the toxicity of native plants (Hines, 1947), but he published no more on the subject, and the work was not continued on a large scale until the Queensland Poison Plants Committee and the C.S.F.R.O. drug plants investigation undertook it after the 1939–45 war.

He did not always follow his father, however, and in fact disagreed with him strongly on the subject of leprosy. He had a more modern appreciation of the limitations and uses of bacteriological diagnosis than Dr Hirschfeld and was completely opposed to his father's (and of fresh water alga (other than those known from Queensland, about 190 records in all, including three previously undescribed species (A. B. Cribb, personal communication). He collected fruit flies for Henry Tryon, distributed giant panic grass which his father had established, and in 1896 proposed to the Acclimatization Society that attempts should be made to control lantana, Noogoa burr and prickly pear by introducing insects that attacked them (Brisbane Courier, 17 April 1896). He made too, an excellent photographic record of the local aborigines and their activities (Plate 2, figs. 4, 5).

But he knew much more, for it was here that he did his classical work on the transmission of filariasis. Again he was following in his father's footsteps. Joseph had discovered the adult worm and defined many of its clinical effects: Thomas wished to complete the story of transmission which Manson had begun. There were two principal difficulties: one, the general belief that Anopheles bancrofti, Aedes bupercyrensis and the host of other mosquitoes (and other insects too) that he sent to the British Museum for description. He sent many plants to F. M. Bailey, and made many additions to his own collections of algae. Ultimately, including his later collections from north Queensland and the Burnett River, he provided more than half the specimens of freshwater algae (other than diatoms) known from Queensland, about 190 records in all, including three previously undescribed species (A. B. Cribb, personal communication). He collected fruit flies for Henry Tryon, distributed giant panic grass which his father had established, and in 1896 proposed to the Acclimatization Society that attempts should be made to control lantana, Noogoa burr and prickly pear by introducing insects that attacked them (Brisbane Courier, 17 April 1896). He made too, an excellent photographic record of the local aborigines and their activities (Plate 2, figs. 4, 5).

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The first was the crucial problem. Thomas had learned (possibly from Manson) that Ronald Ross had kept mosquitoes alive for eight to ten days in India by giving them repeated feeds of blood, but this did not suit him, and the solution ultimately came from his collecting activities for the British Museum. Many of his specimens were bred from larvae he had collected in the field, and he became curious about Lutzia halfaxii, a large and apparently vigorous species which he had never been able to induce to bite him. After
various trials he found that the females would feed readily and survive for many weeks on slices of banana suspended in the breeding cages. He tried *Culex fatigans* (at that time known in Australia as *Culex ciliarius*), and found that it too would live on banana for as long as he desired. He then bred a stock of *C. fatigans*, fed them on a young woman with microfilariae in her blood, maintained them on banana, killed them off at intervals, carefully dissected out their intestinal tracts—and found nothing. This baffled him until Lewis informed him that the larvae developed in the thoracic muscles, not the stomach, and Manson explained that his method of dissection was to roll the mosquito out on a slide with a towel. After that he had no further difficulty.

Thus, T. L. Bancroft, in 1899, was able to exclude mixed infections, to administer single doses of *microfilariae* to his mosquitoes at an accurately known time, and so define and illustrate each stage of development up to the long, slender infective larvae, over a developmental period which usually lasted for about 16 days under his conditions. He also demonstrated that the infective larvae died within a few hours when immersed in water, and suggested that they descended the proboscis and entered the skin when the mosquito was biting. However, his own technique was defective, in that he discarded the head and mouth-parts when dissecting, and the larvae were not actually seen in the proboscis until Low, in 1900, found them in cellloidin-embedded sections of infected mosquitoes that Bancroft had sent to England.

In the same year S. P. James, also acting on Bancroft's suggestion, found the larvae in the proboscis of *Anopheles rossii* in India, and Grassi and Néo, working with *Diophilaria inimitis* of dogs, demonstrated that they were not among the mouth-parts as the other workers had thought, but within the haemocoele in the labium. How then did they get out? Various suggestions were made, but it remained for Bancroft to solve this problem too. He began work on *D. inimitis*, confirmed and extended Grassi and Néo's findings, and showed in 1904 that, when a *Culex fatigans* with *D. inimitis* larvae in the labium was allowed to bite a dog and then examined under a microscope, the point where the larvae had emerged at the tip of a labellum could be readily detected by granular matter flowing out. That they normally break out at the tip of the labella is now generally accepted, and T. L. Bancroft was not only the first to demonstrate it, but, as the late G. M. Heydon wrote in a set of valuable notes now in the possession of Sir Edward Ford, it is 'the most satisfactory proof of the point of emergence which has ever been supplied because the emergence occurred when the mosquitoes were biting under natural conditions'.

Thus, T. L. Bancroft was the first to give a complete account of the transmission of filarial infections by mosquitoes. His findings were published in Australia, but also received considerable publicity in British journals, and he was deeply hurt that they were generally ignored or mentioned but casually by later writers. Yet his own reactions to those who might be considered his competitors were not unbalanced. He had a great respect for Cobbold, Lewis and Grassi, whose observations and suggestions helped him to find the truth; he respected Manson too, but thought him 'rather a mixed kind of experimenter'; Ross 'did not like giving credit to others' and Manson-Bahr was biased by 'his hero worship of Manson', which were no unfair comments on their earlier writings, although both made amends in later publications (Ross, 1930; Manson-Bahr, 1959) which Bancroft did not see.

Filaria, mosquitoes, collecting and photography were not his only interests at Deception Bay, for he also wrote on the ritual mutilations of aborigines, on provision of a pure water supply for Brisbane, and another important parasitological paper in 1902, in which he produced epidemiological evidence supporting the observations of Looss that hookworm larvae can infect man by penetrating the skin and emphasized, perhaps for the first time, the danger of children going barefooted.

In 1904 the price of cattle rose, the War Office did not renew its contract for pemmican, the meatworks were closed, and Bancroft moved his house from Deception Bay to Alderley (Plate 2, fig. 6) where the family settled for the next few years. He established a tannery on the banks of Kedron Brook and also served as quarantine officer for the port of Brisbane, meeting overseas ships outside Moreton Bay and, incidentally, observing how far from shore he would encounter *Aedes vigilax* (Hamlyn-Harris, 1933). He held a temporary appointment in the State Health Department in 1905–06 to investigate dengue fever, beriberi, and suspected cases of plague, the last of which involved him in a controversy between the hospital and the Queensland Government. *Brasier Courier*, 28 June and 2 July 1906). He published only two papers in this period, but both were important. In one he recorded epidemiological observations on the 1905 epidemic of dengue fever, which led him to suspect that the infection was transmitted by the day-biting *Aedes aegypti* and not by the night-biting *Culex fatigans* as previous workers had thought. He attempted to transmit the infection to five volunteers by batches of *A. aegypti* that had fed on dengue patients. Two developed fever within the expected incubation period, which the experiments were conducted in an area where natural transmission was occurring. Nevertheless, the Commissioner of Public Health was sufficiently impressed with the *Aedes aegypti* theory to advise householders to put kerosene on their rainwater tanks, or to screen them. It remained for Cieland and his colleagues to prove, in the 1916–17 epidemic in New South Wales, that Bancroft's surmise was correct.

The second paper, published as a Memoir of the Queensland Museum, was a compendium of Theobald's descriptions of the mosquitoes known to occur in Queensland supplemented by his own notes on habitats and breeding grounds.

In March 1908 he went as Government Medical Officer to Stannary Hills, a mining centre in the rough country west of Atherton in north Queensland, and he visited Kuranda, Cairns, Babinda, the Johnstone River and Cardwell while he was stationed there. He collected insects for the British Museum, fish, snakes and other animals for the Queensland Museum, more fruit flies for Hubert Jarvis and Henry Tryon, and plants for F. M. Bailey. One of his snakes was a taipan, from which he dissected out the parotid glands and sent them to Fraser in Edinburgh (to whom the father had taken pity on the body of the venom, before dispatching the rest of the body to the Museum). He did no special research, but it was probably here that he developed his interest in collecting minerals and grinding sections for study under the microscope, for which he had a polarizing attachment. He had retained the house and tannery in Brisbane, and he and the family returned to Alderley after 18 months in the north.

This was but an interlude, an inadvertent preliminary trial to test the pattern of his life was to follow thereafter. In 1910 he became Government Medical Officer, with right of private practice, at Eidsvold near the Burnett River a hundred miles west of Maryborough. Eidsvold had been a mining centre, but mining had declined and the town had come to depend increasingly on the cattle-raising industry in the district for its maintenance. It had a small hospital with a resident matron. These factors combined to provide one essential prerequisite that the medical officer's duties should be light and his practice small. That he was too soft-hearted for his patients, who knew (to the irritation of his family) that they could generally catch him at meal-times,
or that he was sometimes paid in kind rather than cash, did not matter; he had the leisure to do what he wanted to do.

The natural attractions, too, proved to be considerable. Most of the country was rather rough and covered with dry sclerophyll forest and coarse spear-grass, but it had a surprisingly rich and varied insect fauna, including an interesting mingling of coastal and inland forms; there were considerable patches of brigalow–bottle-tree scrub with an equally varied mosquito population; the town dam had a rich population of frogs which defied the observer with their diverse calls on humid summer nights; and, above all, there was the river with its own population of Ceratodus and other interesting fish—not to mention at least three species of freshwater tortoises that were already known to have parasites in their blood, or the birds, lizards and snakes in the bush, and even the geckos in the house, many of which had their quota of blood parasites too.

He cleared did not, at first, intend to stay long in Eidsvold, for he applied unsuccessfully for the position of director and microbiologist of the prickly pear investigations in 1912, and many of his books and effects were still in Brisbane at the end of 1913. Nevertheless, he settled down and continued to lead the life of a scholarly naturalist for the next twenty years. The M.O.'s house stood on a couple of acres of ground, with a stable and harness-shed behind it. Bancroft built a roomy, well constructed laboratory 'cottage' further back and a large wire-netted enclosure nearby, in which he kept scrub turkeys and watched them build their mounds. There were also some small enclosures near the 'cottage', a large tank in which he kept freshwater tortoises, a number of small aquaria, and, of course, his Ceratodus rearing troughs, so that the area rather resembled a small zoo. However, he kept no native mammals and, curiously, did not seem to have much interest in them, although he did collect some specimens for the Queensland Museum.

His old interest in the blood parasites revived. He had previously found parasites in the blood of freshwater fish, frogs, reptiles and birds for J. B. Clanden and T. Harvey Johnston, who had published several papers including them, and he provided more from Eidsvold, especially during Harvey Johnston's visits. He used to follow the course of the infections in his tortoises, and wanted to attempt transmission experiments with freshwater leeches. He failed in that, but succeeded in tracing the development of a lizard filaria in mosquitoes—work which was not amplified and published until his daughter completed it in 1953.

He continued to collect insects, especially mosquitoes, for the British Museum and also for taxonomists in Australia, including butterflies for G. A. Waterhouse and many fruit flies (Tephritidae) bred from native fruits for immature stages and accurate host-plant records as well as adults. He spent almost every Sunday in the 'scrubs', visiting the many pickles-bottles half full of water and pinched with dead leaves that he hung in the trees to collect mosquito larvae, and using his old buggy horse as bait for adults. It provided a rich harvest of mosquitoes, tabanids and sometimes simulids, and it was amazing what knowledge and assaults that horse would endure without blinking. He used to urge: 'If you find a very common insect, collect a hundred of it; you may never see it again!' He also made a large collection of maygamaspider, spiders for the Australian Museum, Sydney, including three new genera and 14 new species which were described by Rainbow and Pullen. Eidsvold is, indeed, the type locality of an astonishing number of terrestrial animals. He collected plants with almost equal assiduity for the herbaria in Brisbane and Sydney, and maintained a long correspondence with F. M. Bailey, C. T. White and J. H. Maiden. A by-product of his botanical work was the discovery of flagellate protozoa in the milky latex of some plants, and these were named Phytomonas bancrofti after him by Holmes in 1931.

This illustrates a characteristic feature of his work. He discovered a great many new species, mostly animals but also plants, and he almost invariably sent them to specialists for description. As a result, the specific name bancrofti appears in a wide diversity of groups; but he himself described only one new species in the whole of his life, Capillaria hepatica (Bancroft, 1894) from the rat.

Three minor studies must be mentioned to complete the general survey. One was his description, with Clanden, of a carcinoma in the liver of an aborigine, one of the earliest records of aboriginal pathology. The second was recorded in short papers in 1916 and 1923 on two fish, the Dawson River barramundi, Schizothorax leichardti, and the salmon catfish, Hexantichthys australis, which carried their ova in their mouths, and which he therefore thought should be a ready source of embryological material when they were breeding in the spring. The third was minor only in that he published none of his results. Cotton growing, as a side line, was becoming popular in the district, and Bancroft (like his father) carried out a considerable number of experimental hybridizations between varieties in an endeavour to find more productive strains acclimatized to local conditions. Samples of two such hybrids were sent to the Imperial Institute, London, for testing and the report was encouraging, but the Queensland Department of Agriculture was opposed to the distribution of hybrid cotton seed (Brisbane Courier, 19 July 1924).

He was elected C.M.Z.S. for his zoological work in 1923.

All this suggests a busy life, but his most enduring interest throughout these years was in the Queensland lung-fish, Neoceratodus forsteri, colloquially known as Ceratodus. He began studying it as soon as he had settled into his new home, and was quickly impressed—and greatly worried—by the fact that he could readily find eggs and mature fish, but, search as he might, he could never find young fish. He became convinced that the eggs and newly hatched larvae were completely destroyed by predators, especially dragonfly larvae, and that Ceratodus was rapidly approaching extinction. He therefore set himself to achieve three ends.

The first was to provide adequate material for research workers who needed it. The fish was protected, and the red tape associated with getting the necessary permits used to irritate him, but it irritated him more that the local police sergeant, who was responsible for enforcing the occasional laws, would not even attempt to stop this at weekends to get a feed of 'salmon'. He got an excellent embryological series for J. P. Hill in London (later supplemented by a visit from Dr Elizabeth Fraser to fill the gaps that remained in their work); anatomical material for Edgeworth in Bristol, Kesteven in Sydney, and others; whole fish and skeletons for museums in Australia and abroad; relatively young fish, when any were caught, for Harvey Johnston at the University and H. A. Longman at the Museum; and, finally, live fish for the Queensland Museum, where perhaps one or two may still be among the Ceratodus which he gave from the Bancroft Memorial Aquarium.

Eggs were not difficult to collect in the spring, and his next task was to rear the fish in captivity, as Semon and Illidge had already done up to a point. Following Illidge, he used a long, narrow tank hollowed out from a single log, and at first placed it on the river bank above flood level, but later moved it to his house where he could observe events more closely. He confirmed the helplessness of the yolk-filled, newly hatched larvae and their susceptibility to predation by dragonfly larvae, but encountered no major difficulty until they
entered what he came to call their 'teething period' between two and three months of age. Almost all weakened and died at that stage, but the few that survived began to thrive again, and continued to grow steadily for as long as he kept them. Again he suspected predation, but the most elaborate precautions against it had no effect, nor did anything else he thought of doing at that time.

This tantalizing state of affairs continued for several years, with only a drible of immature fish for Harvey Johnston and the Museum to study, until a chance observation on tadpoles led him to realize that his 'teething' young fish might need air. He immediately set up an aquarium with shallow water and emergent sandbanks, and observed that the young fish during those critical weeks spent considerable periods partly out of the water resting on the sandbanks—that, indeed, they led an amphibious life for this brief period before becoming fully aquatic again as older juveniles. He was delighted with this discovery, which solved all his problems, but, curiously, never seemed to have commented on its evolutionary significance.

All this led up to his third project, which became his greatest ambition: to establish adult fish in a freshwater lake on Stradbroke Island, with a hatchery and laboratory nearby, and himself in charge, for he could trust no one else to do the work properly. He ignored the earlier introductions of Ceratodus into coastal streams by the Royal Society of Queensland (p. 10), which he thought could not prevent extinction, and he did not realize how well they had become established in the Enoggera reservoir. He first launched his proposal in detail in a letter dated 8 September 1920 to Heber Longman, by then Director of the Museum, who helped him in every way he could though remaining pessimistic to the end. Essentially he wanted a grant or lease of a lake and 100 acres of surrounding land on Stradbroke Island from the Queensland Government, and a sum of £21,000 (later raised to £24,000) from some private source for construction and investment, with the professors of biology in the Australian universities to be a Committee of Trustees to administer the fund. He obtained letters of support from several eminent biologists, Longman was able to tell him unofficially that the lease might not present insurmountable difficulties, and he then wrote successively to John D. Rockefeller in U.S.A., two wealthy graziers in Australia, and Sir Alfred Yarrow in England, all of whom refused, or failed to reply. In 1925 he was considering writing to Scripps in U.S.A., and Graham-Kerr was trying to get a grant from the Royal Society of London to start the fund for him, but these too were forlorn hopes that came to nothing.

The project undoubtedly had merit—everybody agreed on that—but he would not accept advice and it was not handled in a way that was likely to bring success. Moreover, as some suspected at the time, it is evident in the light of modern knowledge that the Enoggera reservoir project was a much sounder exercise in conservation.

The rest of his story may be briefly told. He lost interest in Eidsvold and found his practice declining, so he obtained an appointment as Medical Officer to the Palm Island aboriginal settlement in November 1930, hoping to renew his interest in the natives and to collect once more in the rich kind of rain forest that he had found so profitable in his earlier days. He took his cotton plants and colony of young Ceratodus with him, intending to continue his work on them, but almost all the Ceratodus died on the way. And he found the vegetation on the island to be poor, collecting not as good as at Eidsvold—even to the scanty fish in the local sea—and the impoverished condition and unnatural life of the natives most depressing. He retired in April 1932 to Wallaville to his beloved Burnett River, where he conducted a small private practice, bred out young Ceratodus again, and wrote a last paper on Ceratodus and a pamphlet on Palm Island. He died from a cerebral haemorrhage on 12 November 1933 at 73 years of age.

It is difficult to assess Thomas Bancroft's place in contemporary science. As a naturalist he stood almost alone, and that was freely recognized, but in wider fields he felt short of what might have been expected of him. There were several reasons for this. Inability to communicate his scientific results adequately was one. He showed a very high order of ability and tenacity in his studies of the filarial life history and the early growth of Ceratodus, but what should have been fully documented monographs on these subjects ended as series of brief, vaguely unsatisfying papers, and the same seems to be true of his pharmacological work. This contributed to his failure to gain a whole-time position in laboratory research, which was clearly his main goal in life, and diseases added to his difficulties. Moreover, in these positions there were required qualities of organization and leadership that he did not possess: places for single-minded students working on subjects of their choice were few indeed, and the amateur in research (like his father) was much more common than the professional. And to cap it all, fortune did not favour him, for of his official tasks, tick fever, the one for which he was best fitted, was snatched from him, beriberi was beyond the resources of the time, and so, to a lesser extent, were 'rickets' in cattle and Birdsville disease of horses.

In spite of his difficulties, he did some notable research, published 84 papers and notes, and provided a great deal of material for other workers in many fields. It might even be said that, where the father was wedded to service to the community, the son was wedded to service to knowledge. Perhaps, on the whole, we should be glad that he was forced to take refuge in the natural history he had always loved.

MABEL JOSEPHINE MACKERRAS 1896-1971
(Plate 1, figs. 3, 4)

Josephine Bancroft ('Jo' to all her friends) was born at Deception Bay on 7 August 1896. We tend to trace this family through its professional and scientific activities, and indeed we know nothing of Joseph's mother, and of his wife Anne little more than that she helped him in his labours for the Nottingham Naturalists' Society, loved Deception Bay, and was remembered in Brisbane as a kind and generous old lady. Josephine's mother (Plate 1, fig. 3), however, was a notable personality. She was a daughter of Canon Theophilus Jones (1835-1918), a leading Anglican churchman in Brisbane, and grew up in a closely knit family strongly imbued with a sense of responsibility and service. Today she would have trained for a profession, but it was only with Queensland's financial crash in 1893 that she, as she wrote, 'who had hitherto led a life of ease and travel, was forced to go out as a governess'. She was a cultured woman with a quick, independent mind, balanced, decisive, and with a prodigious memory and a passion for accuracy. Withal she had a very human understanding and a ready sense of humour, and she maintained disarming modesty in her example rather than precept. She was awarded an M.B.E. in 1961 for services to the community, and died the same year, aged 92. Josephine was devoted to both her parents.

Her first eight years were spent at Deception Bay where, she believed, she acquired her lifelong tolerance of mosquitoes and sandy bites. She received her early schooling there from her mother and attended the local State Schools when they moved to Alderley and Stannary Hills. And in all these places her father was inducting her into natural history, so that she must
soon have been a useful companion for him in his various pursuits. When her parents moved to Eidsvold in 1910, Josephine remained in Brisbane and entered the Brisbane Girls’ Grammar School. At the earlier breaks in her schooling, it took her some time to catch up with the work. She won no prizes, except for swimming, but gained an open scholarship to the University of Queensland when she matriculated in 1914.

Like many Queensland students destined for medicine at that time, she began a Science course, but, unlike most of them, she completed it. The Head of the Biology Department, Dr (later Professor) T. Harvey Johnston, was already launched on the career that was to make him one of Australia’s outstanding parasitologists, and he was a very good teacher too (Sandars, 1954). He had received a substantial part of his research material from T. L. Bancroft (p. 16), and was quite excited when he told Mavis Walker, then a student demonstrator, that the daughter and granddaughter of two such eminent scientists was about to join the biology class. Miss Walker (now Mrs Sinclair) recalls that she was terrified at the prospect until she met Jo. Indeed, we have not found one among those who knew her at school or university who does not remember her with warm affection. She had three happy and stimulating undergraduate years, played hockey, greatly enjoyed the field excursions (Plate 3), and graduated B.Sc. with second class honours in biology in May 1918; she was admitted M.Sc. in 1930.

A high-light of her period with the Biology Department was a staff-student expedition to Masthead Island, where they camped in the abandoned turtle factory and were left to their own resources until the boat returned to pick them up two weeks later. It was her first experience of the amazingly varied life of a coral reef, and she retained a keen interest in coral reefs for the rest of her life. After she returned to Queensland in 1946 she became a member of the Great Barrier Reef Committee and presented the Heron Island Marine Station with its first boat, which the Committee called Josephine after her. She was a member of the Committee’s Low Isles Expedition in 1954, and also visited many reefs from Torres Strait to Heron Island in the course of her own research. She loved the natural beauty of the living reef and was equally impressed with its potentialities for teaching and research. She left a good photographic record of the reefs she had visited.

Josephine was appointed to a Walter and Eliza Hall Fellowship in Economic Biology in the University of Queensland on 1 January 1918 and held it until 31 March 1920. Thus began her career as a professional scientist, a career which falls into five distinct phases, each marked by a change of environment and a change of emphasis.

The first was the University phase. It prepared her for much that followed and may therefore be treated in some detail. She worked under Johnston’s guidance, and all the 14 papers they published together between 1918 and 1921 had him as senior author. Johnston had served on a Government-appointed committee to investigate the claims of Munro Hull, a Eumundi dairy farmer, concerning tick resistance in European cattle. He immediately put Josephine to work on the problem, and she spent a month on Hull’s property making daily counts of the numbers of engorged ticks dropping from 14 cows, recording the cows’ temperatures, conducting fertility tests of ticks from resistant and non-resistant animals, and gathering other relevant information. The findings were followed up, and their lengthy 1918 report included two important conclusions: that, subject to the effects of stress, the general level of an animal’s resistance was maintained for life; and that tick resistance in the European cattle studied was hereditable. Both were treated with casual scepticism until the first was confirmed by Wilkinson in 1961 and the second by Wharton and his colleagues, using greatly refined techniques, in 1970. In a footnote on p. 234 of the report, they also clearly forecast the modern use of pasture spiking in tick control.

Johnston had also been attempting to study the fatal epizootics that occurred in freshwater fish at irregular intervals. Josephine visited Longreach in August 1918 to collect dying fish from the Thompson’s. She failed to reach the conclusions other than to suggest that the disease might be bacterial and favouring high CO₂ content in the water. However, they described six new sporozoan parasites from freshwater fish and one from a frog.

Her next project was a study of selected Diptera as possible transmitters of onchocerciasis (worm nodule) of cattle and, quite incidentally at first, habronemiasis (stomach worms) of horses. This work was based on Eidsvold, and it allowed her to spend most of 1919 there, using her father’s laboratory. They failed (as had other workers) to transmit Onchocerca gibsoni by tabanid or muscid flies, but they found no Onchocerca larvae in 500 captured tabanids and 1,700 muscids. The work on Habronema spp. was more successful, in that they were able to study natural and experimental infections in nine species of muscids, involving extensive laboratory rearing of flies and about 1,500 dissections.

The entomological and parasitological by-products of the work were considerable. Johnston and Bancroft described three new species of Musca, the life histories of these and the bush-fly, M. vetustissima, the larvae and pupae of three species of Tabanidae, and five species of chironomid flies of Muscidae. They also described two larval nematodes from Muscidae and a larval aliroid from a tabanid (Dasybasis). They planned to feed tabanids on kangaroos infected with Dirofilaria roemeri, but the flies were too scarce, and it remained for David Spratt to prove the association in 1970.

All this was extraordinarily good training in collecting and sorting data, marshalling the results and preparing them adequately for publication—the regular work of the professional scientist. Harvey Johnston’s influence shows clearly in all of it, and we can well imagine how happily her father would have shared in the work his daughter did at Eidsvold. In 1920 Josephine had saved enough of her salary to enter the second year of Medicine in the University of Sydney. The classes were crowded with returned soldiers from the 1914–18 war, among whom she met her future husband. As a by-product of their sailing and fishing together in the weekend, they produced the first of their 23 joint papers, providing the first records of blood parasites from Australian marine fish and describing six new species.

The teaching at Sydney was good, some of it inspiring, and the teachers, especially Josephine’s clinical years, could still get to know their students as individuals. Moreover, every field of knowledge that impinged on medicine, but especially microbiology and immunology, had expanded greatly since her father had been a student. Viruses were now real entities; Zinsser’s famous textbook on infection and resistance had been published; endocrinology had become a discipline; most deficiency diseases were understood; and the foundations of genetics had been firmly laid. It is true that biochemistry was still distinctly immature and ‘colloid chemistry’ did not feature in molecular biology, but these deficiencies were not much noticed. Of more immediate significance, nothing was known of sulphonamides or antibiotics and scarcely anything about drug resistance in microorganisms or arthropods. Her own outlook, already prepared, broadened rapidly, and in her quiet way she made some lasting friendships among senior people as well as her contemporaries.

She graduated M.B. with second-class honours in March 1924, lacking the money to pay for the Ch.M. as well. Indeed, she and I. M. Mackerras,
having two microscopes between them, sold one in order to get to Edsvold for their marriage on 5 April 1924. Their best wedding present was a telegram from Sydney to tell them that they had both gained appointments, she as a Resident Medical Officer in the Royal Prince Alfred Hospital, he as a Science Research Scholar in the University.

After her year at the Royal Prince Alfred Hospital, she obtained a part-time appointment at the Rachael Forster Hospital and began a small suburban practice in Sydney. But she was also *persona grata* in the Zoology School, came to know the Sydney entomologists at meetings of the Linnean Society and the Entomological Section of the Royal Zoological Society of NSW — both very lively bodies at that time, spent week-ends at the Zoological Society's farm on the edge of the National Park. She joined Professor Lancelot Harrison's expedition to Barrington Tops in January-February 1925. Thus her biological, and especially entomological, interests were kept very much alive until her son David (now Senior Lecturer in Electrical Engineering in the University of Queensland) was born in June 1926 and she retired temporarily into domestic life.

At the end of 1928 her husband was invited by R. J. Tillyard to join the newly established Division of Economic Entomology of the C.S.I.R., and they moved to Canberra early in 1929. She remained domestic (with increasing dissatisfaction) until the advent of a local kindergarten school and a good housekeeper enabled her to take an appointment as Assistant Entomologist in the Division in October 1930. Running a contented home and full-time research was no trouble to her.

This second phase of her career was in applied biology, concerned with insects and insect-borne diseases affecting livestock, and with carefully planned and statistically tested experiments. Five of her papers were published in collaboration with her husband. Not surprisingly, with her experience of rearing muscids, she had considerable responsibility for maintaining breeding stocks of sheep blowflies, reported in her first single-author paper in 1933. She did cross-breeding experiments with a white-eyed strain of *Lucilia cuprina* from the colony and showed that white-eye was an ordinary Mendelian recessive, not sex-linked as in *Drosophila*, and she produced viable hybrids between *L. cuprina* and *L. sericata*, though that work was never published in detail. Joint studies with M. R. Freney and I. M. Mackerras included the pathogenesis of strike, the physiology of blowflies, fly repellents, and dressings for fly-stuck sheep. With I. M. Mackerras and C. R. Mulhearn she repeated transmission of anaplasmosis by biting flies, with negative results, and they also made an extensive unpublished study of the piroplasms and anaplasms of cattle, including establishment of *Anaplasmata centrale* from Africa as a vaccine strain and transmission of *Theileria mutans* to sheep. However, it was the joint experimental study with her husband of ephemeral fever in cattle that called on most of the resources of her broad training. There are no loose ends in this report, and recent studies have served to consolidate its findings.

She enjoyed recreation as well as work. She swam in the summer, went collecting at weekends, and had happy evenings with her friends. She loved listening to Beethoven and Mozart. In 1936 she took her mother and young son on an extended trip to England, Norway and New Zealand, largely to visit relatives, but also to widen her contacts with overseas workers. In 1938 she learned to fly with the Canberra Aero Club, of which she was a foundation member.

The third phase in her career was in wartime research on malaria. Her husband joined the AIF on 2 January 1940 and she followed on 7 February 1942, after refreshing her medical knowledge by part-time appointments in the Rachael Forster and Renwick Hospitals, Sydney, while waiting to be called up. She was appointed first as Captain pathologist in the Out-patients Department at the Recruiting Centre, Sydney, and then to the Lister Pathological Research Unit, Cairns, when it was established in 1943 to undertake urgently needed research into the control of malaria by suppressive drugs. The unit was directed by Brigadier N. (later Sir Neil) Hamilton Fairley, F.R.S., commanded by Lt. Col. (now Professor) C. R. Bickerton Blackburn, and Josephine Mackerras, soon promoted Major, was responsible for breeding and maintaining stocks of infected mosquitoes and using them to infect the volunteers (all Army personnel) who were the human material for the experiments. Some idea of the magnitude of her task may be gathered from the following figures (Ford, 1972): 233,000 engorged mosquitoes handled, 38,000 dissections performed, more than 20,000 infected bites inflicted, and more than 1,000 volunteers infected, some of them several times.

She and her devoted little team met every demand that was made on them, but it was by no means all plain sailing. Infected volunteers (or patients flown from New Guinea) would not produce gametocytes in response to the mosquitoes when they were wanted; batches of mosquitoes would die off before the parasites had matured, or would not bite just when they were needed; the supplies of larvae, flown regularly from Milne Bay in New Guinea to maintain the stocks, would fail at critical moments; and there were a dozen other contingencies. All were overcome without apparent effort, except the supply of larvae. This did fail, and she was faced with the task of establishing a breeding colony of the Papuan *Anopheles punctulatus* (the most efficient malaria-transmitter in the region) in her own laboratory. This was a remarkable achievement which no one has succeeded in repeating. All this work involved rigid quarantine precautions to prevent the escape of a dangerous species that was not established in Australia, and her most trying moment came, after all the difficulties had been overcome, when a cyclone warning caused her and her staff to stand for 24 hours with insecticides ready to destroy the whole of their stocks if the building had begun to go. As one of her colleagues proudly remarked: 'There's no panic with our Jo here. She knows about it, and the bits she doesn't she soon works out.' (Ford, 1972).

The whole operation was brilliantly planned and brilliantly successful, and it had a significant effect on the allied war effort in the tropics. Josephine's part in it was warmly praised, for example by Brigadier John Sinton, F.R.S., Consultant Malarialogist to the War Office, but her accolade was in Fairley's final words: 'Jo knows how to mother her boys, as well as her mosquitoes'. Her portrait was painted by Nora Heysen and hangs in the War Memorial in Canberra.

Her work at Cairns had produced a great deal of new information about anopheline mosquitoes and malaria parasites. After the unit was disbanded in March 1946, she gathered all the records together and published a series of important papers in collaboration with F. H. S. Roberts (1), Q. N. Ercole (6) and Corbett (1). Josephine and her husband returned to C.S.I.R. and moved to its Yeerongpilly laboratories in Brisbane in April 1946. She began to work on Simuliid parasitoids (blackflies), but was appointed Senior Parasitologist in the newly established Queensland Institute of Medical Research (of which her husband was Director) on 1 September 1947, and the fourth, most varied phase of her activities began.

A severe epidemic of *Salmonella* gastroenteritis in infants and children was raging in Brisbane when the Institute opened its doors. This, at first an
ad hoc problem, developed into a significant study of epidemiology and prevention in which almost the whole Institute was temporarily involved. Josephine played a major part in the work and published five papers on it in collaboration with her husband. Her discovery that domestic cockroaches were serving as minor reservoirs of infection initiated an interest in this ancient group of insects that was to lead to her final research project.

She made many expeditions, mostly to north Queensland, after the Salmonella investigations were finished. They included participation in an attempt to control the mite vector of scrub typhus by Gammexane; investigation of an epidemic of malignant tertian malaria on Murray and Darnley Islands; a more general parasitological survey and collecting expedition to Torres Strait and Cape York; a survey of amoebiasis at Palm Island, the Lockhart River Mission and the Cherbourg Aboriginal Settlement; a filariasis survey in hospitals from Rockhampton to Cairns; hookworm and echinococcus investigations at Mountanissa; and mosquito collecting for arbovirus research at Mildura (for the Hall Institute, Melbourne), Townsville, Mitchell River Mission (where she acquired antibodies to the M.V.E. virus) and Normanby. A side line of the last was the first collection of a haemogregarine from an Australian crocodile at Karumba. She and her husband visited research institutions in the Philippines and Malaya in 1953 to discuss malaria, filariasis and leprosy. She also later attended a conference on malaria in New Guinea. She also had a tour of duty in the Institute's Field Station at the Innisfail Hospital (nearly seventy years after her father had worked in its primitive forerunner), collecting mammals and their parasites and taking part in an investigation of the reservoir hosts of leptostrongylae.

Hookworm infection is a major cause of debility in aboriginal settlements and mental hospitals. She made many surveys of its incidence and clinical effects, co-operated with medical officers in carrying out therapeutic trials with various drugs, and put forward clear recommendations for improvements in hygiene, housing and water supplies at the missions and settlements. Some of these were implemented, and it may be said that she left the settlements at least a little better than she found them. She also obtained good evidence of the disappearance of filariasis from Queensland.

She became a foundation member of the (now Royal) College of Pathologists of Australia in 1954.

Arising partly out of the work at Innisfail, she attempted to breed several native mammals in captivity. She succeeded in inducing the rats Melomys lutilus littoralis, M. cervinipes, Rattus assimilis, and the bandicoot Isoodon macrourus to breed, more or less erratically, in the laboratory and made some useful observations on their reproductive behaviour; but she could not establish a permanent colony that would be amenable to routine management. This was disappointing for her, because a new laboratory animal, especially a marsupial, would have been a most useful acquisition.

Her purely entomological studies were also comparatively modest. At Yeerongpilly and her husband had studied the principal pest simuliid, which they named Austrostomus pestilens, found that it was Astrongylus onartipes, a much more aminable species, through from egg to adult in the laboratory in an ingenious apparatus that was designed and built by her son. Later, she and her husband revised the family, more than doubling the number of known Australian species, and, as it happened, providing useful current information for the C.S.I.R.O. workers on myxomatosis. They also wrote a short paper on Pletharchidae and another on a new tabanoid.

In contrast, Josephine published 25 parasitological papers during the period, five of them in collaboration with Dr Dorothy Saul. She carefully reviewed and added considerably to the known protozoan blood parasites and filarioid worms of Australian vertebrates, published a valuable, four-part, annotated catalogue of the internal parasites of native and introduced Australian mammals, and described a number of new nematode parasites from Australian marsupials. She also worked out four life histories of considerable interest: the development of a filarial worm of an agamid lizard in mosquitoes, complete life begun by her father at Edseld; the development of a haemogregarine and band; the development of a lizard; the life cycle of the rat lungworm (Australosilicylus calonemis); and the completely different life cycle of the cat lungworm (Australosilicylus abstrusus).

Unravelling the remarkable life cycle of the rat lungworm was a high light in her life, and she was greatly helped by Dorothy Sanders, although the crucial discovery of the developing worms in the brain was her own. The parasite is common in Rattus norvegicus in Brisbane, the adults living in branches of the pulmonary artery and discharging their eggs into the smaller vessels, which they block, producing a characteristic pale solid mottling of the lungs. The young larvae enter the smaller bronchi, ascend the trachea, pass down the esophagus, and are discharged in large numbers in the faeces. So far the story is normal. After considerable search, they found that the intermediate hosts were slugs, the young larvae in the soil penetrating the foot, mouthing twice, and then being ready to infect a rat that ate the slug. The ingested larvae pierced the wall of the intestine, and vanished in spite of intensive search for them, although adults duly appeared in the lungs about a month later. It was some time before the central nervous system was thought of as a further development. Then it was found that they grew and mouthing in the substance of the brain, migrated to the meninges as young adults, entered the meningeal veins, and passed through the right side of the heart into the lungs. All these movements, even the wanderings of the larvae in the cerebral tissue, provoked remarkably little reaction, the only danger to the rat being sudden heart failure occasionally produced by a crowd of young adults blocking the pulmonary valve on their way through the heart.

This was the first record of a nematode worm requiring a prolonged sojourn in the brain of its host before migrating to its definitive site. The work was done with laboratory rats, which were as well adapted to the parasite as the wild R. norvegicus from which it came. Josephine then made another important observation. She infected mice, and found that the worms induced inflammatory reactions in the brain and meninges and were blocked from completing their migration. She suggested that some obscure cerebral lesions in man might be due to larval nematodes that had accidentally entered a strange host, and this was confirmed when it was discovered by Frison in American workers that A. calonemis caused meningeal and meninges in the various islands of the Pacific. Man might be infected inadvertently by eating slugs in lettuce or, as in Tahiti, by eating raw freshwater prawns that have become parasitized by the larvae. Later still, it was found that there were two species of Astrongylus with similar life histories in Brisbane rats, and the new one was appropriately named A. mackerrasae after her.

Josephine retired from the Queensland Institute of Medical Research on 31 December 1961, and she and her husband returned to Canberra, where
they were given post-retirement Research Fellowships in the Division of Entomology of C.S.I.R.O. She was awarded a Clarke Medal of the Royal Society of New South Wales in 1965 and elected a Fellow of the Australian Society for Parasytology in 1966.

During this final phase of her career, she helped her husband with preparatory work for The Insects of Australia (Melbourne University Press, 1970) and wrote the chapter on the order Blattodea, as well as a joint paper on the classification of cockroaches with Frances McKittrick of Cornell. Her main work was a full revision of the family Blattidae, in nine parts, in which she reviewed more than 200 species, proposed two new genera and described 55 new species. This was followed by three short papers in which she described a blind blattellid from cavities in the Nullarbor Plain, revised the small family Polyphagiidae, and described a new genus of Blaberidae collected in Queensland. Her health was failing, and she retired finally on 30 June 1968. She was awarded a D.Sc. honoris causa, by the University of Queensland in 1967. She was too ill to be admitted in person, but still well enough to value it more than any other recognition that had come her way. She died from localized cerebrovascular degeneration on 8 October 1971. Thus, like her grandfather and father, her vascular system failed her while her intellect was still intact.

Josephine was a very good scientist. She had the capacity to see the most direct approach to a problem and would go to no end of trouble to make sure that her results could stand up to the most searching investigation (Currie, 1972). She published 91 papers. And she also had a truly remarkable influence on every one with whom she worked. To a degree, because her work was always most unobtrusively but thoroughly organized, and because she treated every one, from the small native child up, as a complete person—and her laboratory animals as if they were human beings. She had, too, great powers of concentration, but was never remote from everyday problems nor from anyone who sought her help or advice. Her quiet humour, gentle smile, imperturbability, wide knowledge, and complete honesty inspired confidence, respect, and lasting affection. She always thought of others before herself, and led a team by example rather than direction. She possessed, in short, perhaps even more than her grandfather, the quality of aequanimitas that the great physician Osler enjoined on every student of medicine (Ford, 1972).

CONCLUSION

Looking back over the three generations, it is apparent that Josephine had many advantages. Some may have been in temperament, but most depended on the times in which she lived. She was little, if at all, better prepared scholastically than her father or her grandfather, but very much better prepared for the profession of science. There was, too, a profession open to her in a way that did not exist for her father, however wistfully he might have sought it. The period after the 1914–18 war was a stimulating one, the C.S.I.R.O. began to exert its great influence on Australian science in 1927, and people of her quality did not have to seek far for exciting niches they could fill. True, there was the depression of the 'thirties, but it affected her salary, not her work. There was also the growth of team work, as may be seen from the number of papers published under joint authorship by the three generations: Joseph, 1; Thomas, 4; Josephine, 54 (22 as senior author). But probably the most potent influence (one of the very few virtues of warfare) was the urgent, unceasing, selfless striving that characterized the team work with which she was associated in the 1939–45 war. This developed her intellect to its keenest pitch and prepared her fully for the good years that followed. We may, perhaps, sum up the three careers by saying that Joseph was aptly described as just the man for a new country; that Thomas, in spite of his achievements, was born a generation too soon; and that Josephine was just the woman for the scientific explosion of the last half century.

ACKNOWLEDGMENTS

Joseph Bancroft's career has been reviewed several times, most notably and with full bibliographical data by Ford (1961). On the other hand, comparatively little has been written about Thomas (Schindler, 1933; Tryon, 1934; Mackerras, 1934; Hines, 1946) and his bibliography has not been published previously. Four accounts of Josephine's life have already appeared (Ford, 1972; Currie, 1972; Sprent, 1972, with bibliography; Marks, 1972). In addition, we are greatly indebted to the Directors of the following institutions for access to much published and unpublished information: Queensland Museum, Brisbane (correspondence between T. L. Bancroft and the Director about T.L.B.'s specimens and the Ceratodus project); Australian Museum, Sydney (mostly relating to specimens collected by T.L.B. at Edsvoid); Queensland Herbarium, Brisbane (correspondence between T.L.B. and F. M. Bailey); Queensland Institute of Medical Research (unpublished reports by M. J. Mackerras); Royal Historical Society of Queensland (papers relating to Joseph and T. L. Bancroft, including copies of the patents for desiccated meat, Davidson correspondence, etc.); Queensland Women's Historical Association (papers relating to Mrs C. M. Bancroft); and the Oxley Library, Brisbane (published reports by Joseph and T. L. Bancroft that are not readily available elsewhere). At a more personal level, we are particularly grateful to Mr L. O. Bancroft for family archives—letters, notebooks, negatives, cuttings, many photographs—relating to his father and grandfather; to Sir Edward Ford for much advice and material from his own collection of Bancroft papers; to Associate Professor Bruce McMillan and Mrs M. Macgregor for bibliographical and biographical help; to Dr S. T. Blake, Dr R. C. Colbran, Dr A. B. Cribb, Mr S. L. Everist, Mr C. G. Hughes and Dr J. H. Simmonds for guidance on botanical and entomological questions, including plant pathology and toxicology; to Dr R. H. Wharton for a critical appreciation of the work of Johnston and Bancroft on the cattle tick; to Miss Jean Hardie, Miss Nesta Brown and Mrs Doris Rollason (grand-daughter of Ellen Hulme) for their recollections of the older Bancrofts and their activities; to Josephine's surviving friends, especially Mrs Mavis Sinclair and Mrs Olive Thatcher, for their memories of her early career in Brisbane; and finally, to the many interested friends, including several of those named above, who read and criticized the draft manuscript for us.

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* Hereafter shortened to Votes and Proceedings Qd.

3. PUBLICATIONS BY T. L. BANCROFT


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FIG. 1: Joseph Bancroft, ca 1890.
FIG. 2: T. L. Bancroft, ca 1893.
FIG. 3: Josephine, T. L. and Mrs Bancroft, Eidsvold, April 1924.
FIG. 4: Josephine Mackerras, ca 1955.
FIG. 5: Joseph Bancroft's home, 'Kelvin Grove', ca 1866.
FIG. 6: Joseph Bancroft's plots at 'Kelvin Grove', 1884 (photo by T.L.B.).
FIG. 7: Joseph Bancroft's residence in Ann St., Brisbane, 1882.
FIG. 8: The Geraldton (Innisfail) hospital tents, May 1885 (photo by T.L.B.).
PLATE 2

Fig. 1: Joseph Bancroft's house and some experimental plots at Deception Bay, March 1889 (photo by T.L.B.).
Fig. 2: The meatworks at Deception Bay, ca 1891 (photo by T.L.B.).
Fig. 3: 'Johnstone River scenery—view from the streets in Geraldton, 1885' (photo by T.L.B.).
Fig. 4: 'King Jackey Delaney', Burpengary, March 1889 (photo by T.L.B.).
Fig. 5: 'The blacks' camp, Burpengary, March 1889' (photo by T.L.B.).
Fig. 6: T. L. Bancroft's house at Alderley, re-erected after removal from Deception Bay, ca 1906 (photo by T.L.B.).
PLATE 3

University of Queensland biology excursion, outside Hotel Francis, Caloundra, 1917.

Left to right.