

# **HISTORY of ACAROLOGY**

Editor:  
**V. PRASAD, M.D.**

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**Indira Publishing House**

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## PREFACE

During the last two decades, the study of Acarina has undergone extensive growth. This includes not only a great increase in the number of workers but also in the output of publications dealing with ticks and mites. For this reason, it is virtually impossible for acarologists to become acquainted with more than a small percentage of the other researchers in their field.

The objective of this volume is to present biographies of acarologists by country and, to the degree dictated by space considerations, a list of their publications. A few countries, in which complete biographies and bibliographies would have comprised volumes in themselves, had to be omitted.

The editor is very grateful to those who accepted the invitation to prepare a chapter on the history of acarology in their country for, without them, this work would not have been possible. Thanks also go to Dr. Robert W. Husband for reviewing several of the articles and giving valuable suggestions. I wish to express special thanks to my wife and children for their patience and encouragement during the preparation of this work and, without the assistance of my daughter, Nilima, who typed several drafts including the final type set, this book would not have been completed on schedule.

West Bloomfield  
September 1982

Vikram Prasad

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## AUSTRALIA

R. V. Southcott<sup>1</sup>

### INTRODUCTION

Australia was remote from the literate civilizations of the Northern Hemisphere so that initial and limited discoveries of some of its coasts were made by Europeans only in the seventeenth century, and no European settlement occurred until the latter part of the eighteenth century following the epic voyages of James Cook. Early biological collections were sent back to Europe for study and formal description. Initially, the main interest was in the major elements of the fauna and flora, and Australia could not be said to have developed any indigenous acarologists or even arachnologists until the end of the nineteenth century.

From Cook's expedition a number of insects and other arthropods were collected. Among these was a tick described by Fabricius in 1775 as *Acarus undatus*, from the collections made along the eastern coastlines of Australia during the first exploring voyage of Cook in the "Endeavour" in 1770. This tick is now called as *Aponomma undatum* (Fabr., 1775) (Roberts 1964, 1970) and is generally parasitic upon reptiles. This species of tick was referred to again by Fabricius in 1781 and 1787 without the addition of any new data; it was referred to also by various other authors similarly (Oudemans, K. H. O. A., 1929, Vol. II: 227-228). Another acarine from the present day political region of Australia was also described by Fabricius (1775). This was *Acarus phaetontis* Fabr. 1775, also stated to be in the Banks collection, taken from the tropic bird *Phaeton* ? *fulvus* Brandt at Christmas Island. Possibly this species was an *Alloptes*, as Oudemans (1929 : 694) suggested.

Shaw (1798) described a tick taken "on a large serpent in the British Museum" as *Acarus rhombeatus* Shaw, 1798 (which Oudemans (1929, K. H. O. A., II: 226-227) allotted to *Aponomma* or possibly *Amblyomma*<sup>2</sup>). Although Oudemans (1937, K. H. O. A., Vol. IIIG: 2973) recorded this as coming from Australia, there is no good evidence that it was of Australian origin. (Oudemans, 1936, IIIB: 517, synonymized Shaw's species with *Aponomma triguttatum* C. L. Koch, 1844, on slight grounds. However, this latter species is a complex of four forms which feed upon mammals, particularly macropodid marsupials).

It was not until 1803 and 1804 that a further species of Australian acarine was recorded, this being by Latreille, who identified it as *Sarcoptes* sp. (Oudemans, K. H. O. A., II, 1929: 699), taken from the wombats *Phascolomys ursinus* Shaw, brought back from "nouvelle Hollande". The mites were present in prodigious numbers and were recorded as causing irritations to the hands and arms of the

1. 2 Taylors Road, Mitcham 5062, South Australia.

2. And later (1936, K. H. O. A., Vol. IIIB: 517, and Vol. IIIG: 2973) to *Haemalastor*.

persons preparing the hide. The description given by Latreille fits well with *Sarcoptes scabiei*, and the scabies mite of the wombat (from Tasmania) was later given subspecific rank by Railliet in 1893, as *Sarcoptes scabiei* var. *wombati* (Oudemans allotted Latreille's mites to *Psoroptes* (1929: 699) and to *Sarcoptes* (1929: 758)).

During the next half-century only a small amount of interest was taken in the acarine fauna of Australia and this was devoted virtually exclusively to the ticks. Thus Fabricius (1805) described *Ixodes australasiae* from New South Wales, a species not dealt with by Roberts (1970) in his monograph of the Australian tick fauna, but placed by Nuttall and Warburton (1911: 282) as a doubtful *Amblyomma* in their list of "condemned and doubtful species of *Ixodes*".

Denny (1843) described *Ixodes hydrosauri*, a species of tick "obtained from one of the large lizards of Van Diemen's Land, known to the colonists by the general name of Guana (most probably the *Hydrosaurus gouldii* of Mr. Gray) ... and given to me on his return from investigating the ornithology of Australia". This tick is now identified as *Aponomma hydrosauri* (Denny) (Roberts, 1970: 116). Roberts (*loc. cit.*) recorded that this species of tick is largely restricted to reptilian hosts but has been found on a few mammals (ox, horse, and echidna). Denny's host attribution could well have been wrong, as Gould's goanna (*Varanus gouldii* (Gray)) does not occur in Tasmania. (In fact, H. G. Cogger, 1979, Reptiles and Amphibians of Australia (A. H. & A. W. Reed: Sydney and Wellington) does not record any species of *Varanus* from Tasmania).

*Ixodes coxalis* Gervais, 1844, was described from a tick taken in Australia by Péron and Lesueur (1801-1803) but not further localized (see Oudemans, 1936, IIB: 576). It also has not been subsequently identified by Roberts (1970). Nuttall and Warburton (1911: 283) put this species also in their "list of condemned and doubtful species of *Ixodes*" commenting that from the original description it was possibly a male of *Dermacentor*.

C. L. Koch (1844) described *Amblyomma triguttatum* from Swan River, Western Australia. It has since been found as an abundant species in Queensland, New Wales, and in the south-west of Western Australia (Roberts, 1970).

Lucas (1845) described *Ixodes ornithorhynchi* from an unlocalized platypus (*Ornithorhynchus anatinus* (Shaw)). This is a very distinct species and has since been found to be widely distributed on the platypus in eastern Australia, from Queensland to Tasmania, also in western Victoria and the south-east of South Australia.

The second half of the nineteenth century saw the continuing interest in the tick fauna of Australia, possibly largely from the three reasons that they were large and obvious, of possible economic and medical interest, and in many cases remained attached to their hosts when these were sent preserved to collections in Europe. There was also the increasing tendency of European arachnologists and acarologists to specialize in particular groups of mites and to attempt to make world surveys, e.g. Trouessart on the mites affecting mammals and birds, or of the works of Lucas and Neumann on the ticks (Nuttall *et al.*, 1908, 1911, 1915).

In this second half of the nineteenth century a few mites from a number of families of the Acarina came to the attention of European workers. Thus L. Koch, a noted German arachnologist, described in 1867, in a paper on various

arachnids and myriapods, three species of ticks and two other acarines. The ticks were *Ixodes decorosus* and *Ixodes varani* (both being synonyms of *Aponomma undatum* (Fabr.)) and *Ixodes moreliae* L. Koch, 1867, now recognized as *Aponomma moreliae* (L. Koch) (Nuttall and Warburton, 1911; Roberts, 1964, 1970). The other acarines were *Gamasus flavolimbatus* and *Smaridia extranea*. The identity of the latter species is doubtful; possibly it was a *Calyptostoma*. The acarine specimens were all collected in the neighbourhood of Brisbane, Queensland. Canestrini, another well-known European acarologist, described a general collection of Australian mites in 1884. In his account mites were allotted to the genera *Megisthanus*, *Celaeno*, *Hydrachna*, *Laelaps*, *Sejus*, *Berlesia*, *Gamasus*, *Haemaphysalis*, *Uropoda*, *Fedrizzia*, *Pullea* and *Tyroglyphus*. A larval trombidid mite described as *Trombidium papuanum* was probably a larval *Neotrombidium*.

The feather mites of a number of species of birds from Australia and New Guinea were described by Mégnin, Neumann, Robin and Trouessart, specimens being largely obtained from the skins of birds in European museums; a similar approach was taken with mammal ectoparasites (see the list of species detailed in Rainbow, 1906).

In 1893 Lohmann described various halacarid mites from the Deutsches Plankton Expedition to the Pacific Ocean; some of these mites were collected along the eastern shores of Australia.

Neumann (1897, 1901) recorded the tick now generally identified as *Boophilus microplus* (Canestrini, 1887) in Australia, as *Rhipicephalus annulatus* (Say) (see further in Arthur (1960) and Roberts (1965)). In 1899 Neumann described *Ixodes holocyclus* Neumann, 1899 from Australia.

These two species, one introduced, the other native, are the two most important ticks in Australia from a veterinary and medical viewpoint. Later, a great deal of work was to be done in Australia with these aspects of both species.

The only early published indigenous observations upon the Acarina in Australia were contained in a few references to the ill-effects of native ticks. Thus in 1827 the surgeon P. Cunningham, R. N., commented that the coastal wood tick in New South Wales could kill dogs and would attack man. This was undoubtedly a reference to the paralysis tick, *Ixodes holocyclus* Neumann. An even earlier observation had been made by Hovell in 1824-1825, in the Illawarra District of New South Wales, but his diary was not published until 1921.

It would seem likely that a number of factors in Australia militated against any significant indigenous effort to study the acarines before the present century. Notable amongst them must be the absence of a leisured class, the general lack of reference libraries and museums except in the capital cities, the absence of an optical industry producing microscopes and other requirements, and the general lack of an indigenous scientific publishing industry.

During the nineteenth century the population of Australia increased rapidly, being heavily supplemented by increasing immigration, mainly from Europe. With this there was an almost unrestrained introduction of plants and animals into all the Australian States, in an effort to re-create the life of the original homelands in the southern hemisphere. Among these introductions there were a number of pest species, both vertebrate and invertebrate, but it took a number of years for their full consequences to be realized. For the whole of the nineteenth century all the Australian States were independent of each other, deriving



their legal authority from Great Britain, and each of the States developed its own agricultural and medical quarantine services.

The first Australian indigenous studies of any depth, for the Acarina in Australia, were nearly all the results of encounters with potential agricultural pest species. One such early encounter occurred in South Australia in April, 1881, when Sir Robert Dalrymple Ross, a prominent politician and orchardist, recognized the injuries to his pear trees by *Phytoptus pyri* (now *Eriophyes pyri* (Pagenstecher)), the pear leaf blister mite (Crawford, 1882a,b; Crawford, 1886: 9, 46-47; French, 1891: 120).

In 1886 the tetranychid mite *Bryobia speciosa* Koch, 1838 was reported by Crawford in the Adelaide area of South Australia, attacking almond, apple and plum tree shoots, and making the trees sickly. In a supplementary note (Crawford, 1886: 68) it was stated by a Mr. Pascoe, at a meeting of the South Australian Gardners' Society, that this mite had been present on trees in the Mt. Lofty Ranges ("in the [Adelaide] hills") for twenty years.

Another early worker was Henry Tryon (1856-1943), who served as Assistant Curator, Queensland Museum, 1884-1894, and was later Entomologist to the Department of Stock, Queensland (Musgrave, 1932b). He referred to mites on two or three occasions. In 1889, in his book on Australian insect and fungus pests, he mentioned tetranychid mites which he allotted to *Bryobia* and *Tetranychus* as attacking various plants. He referred also to an oribateid mite upon grapevines in southern Queensland as ?*Leiosoma* sp. In that article, however, he did not propose any new taxa. In 1898 he described a new species of phytophagous mite, a pest of the pineapple, as *Tarsonemus ananas* Tryon.

In 1890 Michael (1890: 86) referred to a mite found in association with damage to growing sugarcane as *Tarsonymus bancrofti* stating that he believed that this mite was the "principal destroyer" in a case where there had been heavy damage to sugarcane in Queensland, particularly of the growing shoots. Bancroft had appended drawings to his report (1876) which resulted in the identification from Michael. This mite was also referred to by later authorities (Rainbow, 1906: 177). Bancroft appears to have referred thrice to this mite in print (1876, 1877a,b).

In 1890 Charles Hedley (1862-1926), a prominent naturalist who was later to work mainly as a conchologist at the Australian Museum, Sydney, recorded the presence of mites upon the introduced slug *Limax maximus* L. at Launceston, Tasmania. C. T. Musson, in whose article Hedley's observation was included, remarked that *Limax flavus* L. "also suffers in the same way"; presumably this latter remark was based upon observations in New South Wales. In 1906 Rainbow (p. 150), writing from Sydney, identified the slug mite as *Erynetes limacum* Schrank, 1781, stating that *Limax maximus* L. "slugs may often be seen with numbers of this Acarid swarming over them".

In 1891 Charles French, senior, (1842-1933), Government Entomologist, Victoria (a post he held from 1889-1911) produced Part I of the work "A Handbook of the Destructive Insects of Victoria." In this he referred to the "red spider" mite, *Tetranychus telarius*, as a serious nuisance to the orchardist and gardener, affecting beans and other vegetables, as well as apples, almonds and other fruit trees. He referred also (see above) to the eriophyid mite affecting pears (as *Phytoptus pyri*).

In 1894 Walter Wilson Froggatt (1858-1937), the most prolific writer on Australian entomology, wrote a short paper describing *Heteropus alastoris* Froggatt as a new species. This was possibly the first taxon described in the Acarina by an indigenous Australian worker. His main appointment was as Government Entomologist to the Department of Agriculture, New South Wales. In a later paper (1898) he recorded the presence of "*Argas americanus*" (probably a member of the *Argas persicus* group) on fowls in New South Wales. He made several further contributions to the literature on the Acarina. Thus in 1906 (1906a) he described a new species of tick, *Argas lagenoplastis* Froggatt, from the fairly martin (*Petrochelidon ariel*). This tick is apparently confined to this species of bird and has since been recorded from South Australia and Queensland as well as New South Wales (Roberts, 1970). Froggatt also wrote on fowl ticks (1901a, 1901b, 1906b, 1912a) and upon the starling and the starling mite, *Ornithonyssus bursa* (Berlese, 1888) (Froggatt, 1912b), and earth mites (1921).

It will be observed that the main interest taken in the Acarina in Australia during the latter part of the nineteenth century was with regard to their role as economic pests. One introduced species of acarine was to fulfill that role par excellence. With the increasing importance of the cattle industry in the northern part of Australia, the tick *Boophilus microplus* became of major significance, either through direct damage to skins, by causing anemia and toxicity to the cattle, or by the transmission of diseases such as the protozoal infection piroplasmiasis. The tick was introduced into northern Australia with Brahman cattle imported to Darwin in 1872 from Java.

From its point of introduction the tick has spread to Queensland and Western Australia and ultimately to New South Wales. Heavy mortalities in cattle were observed in 1880 and 1881 in animals taken from the Northern Territory to Queensland. The disease probably passed into Queensland in 1891 and into Western Australia in 1895 (Seddon and Albiston, 1968) (see also Wilkinson, 1971). The seriousness of this cattle pest resulted in the initiation of many studies into its distribution, life-history, and the possibilities of its control. Thus over the period 1894-1900 papers were published by Pound (1895-1900), Barnes (1896), Francis (1896), Fuller (1896-1899), Hunt (1897, 1898), Froggatt (1898, 1900), Rainbow (1899), Stewart (1899), Tidswell (1899, 1900a, b) and R.G. Smith (1900). Since then hundreds of papers have been written by many workers. Tick investigations have been done on a large scale by the Governments of Queensland and New South Wales, and by the Commonwealth, the latter through the Commonwealth Scientific and Industrial Research Organization (C.S.I.R.O., formerly the Council for Scientific and Industrial Research, or C.S.I.R.). As control of this species of tick has been only partially achieved, studies upon it represent at the present time the major Australian effort into economic acarology.

Up until the time of the First World War and even subsequently, the major part of the taxonomic work upon the Australian ticks was done by European workers, particularly by Neumann in France (over 1896-1911), and subsequently by the English workers Nuttall, Warburton, Cooper and Robinson. Nevertheless, taxonomic papers were published over this period by the Australian worker W.W. Froggatt and the parasitologist Georgina Sweet. Studies on ticks related to human epidemiology as well as veterinary epidemiology were published by Bancroft (1884), Stuart (1894), F.H. Taylor (1911) and Cleland (1910), and later Cleland (1912 and subsequently) made continued efforts to systematize the knowledge of the medical effects of ticks, mites and the remainder of the animal kingdom to man for the Australian region.

With the amalgamation of the separate colonies to a federation at the beginning of the century, and the assumption by the Commonwealth of Australia of quarantine and other responsibilities, together with the rise of indigenous museums, agriculture departments and universities, it was clear that a local capability of identifying and excluding possibly dangerous plants and animals, including insects and other arthropods, was required. Eventually this developed into a number of organizations which had associated with them the necessity of studying and identifying acarines of possible economic significance and of the measures that might be required to attempt their control if they proved to be potentially harmful.

The first general consensus of the Australian Acarina was attempted by W. J. Rainbow, Entomologist to the Australian Museum, Sydney, New South Wales, in 1906. Among his duties as entomologist, he studied the larger arachnids, particularly the spiders, which were probably his major interest among the arthropods. In 1906 he wrote his only general paper on the Acarina, in which he gave in synoptic form an account of the Acarina that had been recorded up to then in Australia, together with their synonyms. In that paper he described five new species of mites, including one trombidoid, two erythraeoids and two hydrachnellans. In general the Australian acarines were left to overseas workers to study. Thus Lohmann (1909) described a smaller number of marine water-mites from Western Australia. In 1916 the American worker Nathan Banks described a collection of mites that had been found in ants' nests, and forwarded by A. M. Lea, then entomologist, South Australian Museum, but who had earlier been stationed in Tasmania and other Australian states. This collection was described as containing 38 species of "myrmecophilous mites", allotted to such families as Bdellidae, Erythraeidae, Trombididae, Parasitidae, Uropodidae and others. It is probable that a number of the species described were merely accidental stragglers into the ants' nests, but it provided a small general collection of identified mites, the largest indigenous one that had so far been described.

The first virtually full-time acarologist in Australia was Arthur Stanley Hirst (1883-1930) who generally wrote papers under the name of Stanley Hirst. A member of the staff of the British Museum, London, in 1927 he resigned for health reasons, and worked at the University of Adelaide, principally during the absence of Thomas Harvey Johnston, Professor of Zoology, in the Antarctic with Mawson's British Australian New Zealand Antarctic Research Expedition ('BANZARE') of 1929 onwards. Hirst had written papers on various Acarina and also arachnids more generally while working at the British Museum; in his period in Australia (1927-1930) he concentrated on the trombidiform mites, especially the superfamilies Trombidioidea and Erythraeioidea. During his stay in Australia he made a collecting expedition up the Darling River system, into southern Queensland. (See also Calman, 1930).

During the 1920's and 1930's studies were made by several workers into mites of economic importance in agriculture, particularly the earth-mites (Eupodidae). The principal studies among these were by Froggatt (1921) in New South Wales, Newman (1923 and subsequently) in Western Australia, and Swan (1934a, b, c) in South Australia.

Later students of the horticulturally and agriculturally important tetranychid mites, or their acarine predators (phytoseiids) were L. W. Miller, L. A. Miller, E. Schicha, J. J. Davis and others.

Increasing interest in mites of potential medical significance had also occurred, and during the period 1900-1930 and there on were a number of contributions to medical and veterinary acarology by Cleland (1912, 1916, 1932), I. C. Ross (1923 and subsequently), and Lawrence (1915, 1916, 1921a, b, 1935).

A number of these made reference to ticks, including (as well as those mentioned earlier) contributions by Froggatt, Cooper and Robinson (1908), Nuttall (1916), Ferguson (1925), Warburton (1926), Fielding (1926), Hirst (1930), Swan (1931), Schulze (1936), Taylor (1944), Taylor and Murray (1946), Arthur (1955) and Seddon (1951).

The importance of ticks in Australia from an economic viewpoint was apparent, from the ill-effects of the paralysis tick *Ixodes holocyclus* affecting domestic animals, and particularly dogs, along the eastern coastlines of mainland Australia, with occasional toxicity and even death in man, as well as the important blood-sucking tick of cattle, *Boophilus microplus*. Additional factors of importance with regard to the ticks in Australia have been the roles of several species as disease vectors, including that of *Boophilus* as a carrier of protozoal disease, and of other ticks as vectors of tickborne typhus which is transmissible to man from a mammalian host, including Q fever and Queensland tick-borne typhus. These factors have given an impetus to the continued study of the taxonomy and biology of the ticks, by Roberts (1933-1969) culminating in his monograph (1970), and a number of other workers of the staff of the Commonwealth Scientific and Industrial Research Organization, including Bagnall, Doube, Kemp and others.

Contributions to many aspects of tick biology and its applications have been made by many workers in Australia. Thus the development of a tick antivenene was made at the Commonwealth Serum Laboratories, Melbourne, Victoria (Kaire, 1966).

In Queensland D. J. W. Smith, together with H. E. Brown and E. H. Derrick (1939-1942) made important contributions to our knowledge of the role of various tick species in the transmission of Q fever in the laboratory and in the field (Doherty, 1972, 1976, Doherty *et al.*, 1975, and Doherty and Tonge, 1976). There have also been contributions from a number of medical and other workers, e. g. Domrow and Derrick (1965), D. J. Lee (1962), Campbell and Domrow (1974) and others (Southcott, 1976, and contained references).

The study of the ticks and of their importance in human and veterinary medicine in Australia has included many significant and continuing contributions which cannot be dealt with in any detail here. The interested reader will find further references to this subject in the papers by Mackerras (1948), Waterhouse, R. H. Wharton, Seddon and Albiston (1968), Roberts (1970) and others.

Before World War II the study of Australian Acarina revolved largely around the agricultural aspects of the biology of pasture and crop pest species, notably the red-legged earth mite, together with the possibility of its control (and of pasture pest springtails) by predatory anystid mites, secondly the mites and ticks of veterinary importance, for domestic livestock, and thirdly the therapeutic and public health aspects of a few species of mites and ticks that were parasites of, or capable of feeding upon, man. To these factors may be added the personal interests in the taxonomy of Acarina by a number of workers, notably Hirst and Womersley.

During World War II mite studies in Australia received an intense stimulus. Probably the most significant reason for this was the military importance of the

trombiculid-mite-borne disease scrub typhus, endemic over much of south-east Asia, and in the islands north and north-east of Australia over which the Pacific war was fought, as well as in parts of northern Australia. This disease resulted in a high mortality, and the Australian Army created an Entomological Control Unit under the command of Major R. N. McCulloch (q.v.) to study and institute possible control measures. Investigations on the vector trombiculid mites led to extensive taxonomic studies on these mites, not only in Australia, but also the United States of America, and this interest has continued post-war, in Malaya as well as the other countries mentioned.

In Australia, during World War II, human infections with *Sarcoptes scabiei* did not assume the same importance as occurred in war-time Britain, presumably from the lack of over-crowding in civilian populations subjected to bombing attacks.

Post-war, another stimulus to studies on mites has come from interest in the possible role of the house dust mites (Epidermoptidae) in the causation of allergic asthma. As, however, this is a world-wide problem, the major taxonomic studies in this group of mites have been done in the Northern Hemisphere.

The person who has made the greatest impact on general acarology in Australia has been Herbert Womersley (1889-1962). Born in England, he worked as an industrial chemist, but gradually his interest in entomology took precedence, and in 1930 he migrated to Western Australia, to take up an appointment with the CSIRO (then known as the C.S.I.R.) to study possible control methods for agriculturally important Collembola, but part of his duties was to study mites. He had been given some initial training in the British Museum before leaving for Australia. Gradually his interests changed from general entomology and Collembola to the Acarina, an important stimulus to this being the observation that predatory bdellid mites were apparently playing a significant role in reducing numbers of the springtail *Sminthurus viridis* (L.) in Western Australia. Transferring to the South Australian Museum in 1933 as Entomologist, he began to monograph various groups of Australian mites as well as the Collembola and a few other groups of insects and other arthropods. His initial papers on the Acarina referred to the predatory role of the Bdellidae upon the springtails as well as the taxonomy of this mite family (Womersley 1933 a, b); however he soon made wider studies and was within a few years he had made inroads upon the families Trombididae, Erythraeidae, Penthalodidae, Cryptognathidae and others, being aided by being able to use some of the material Hirst had left in Australia. A detailed account of Womersley's career in acarology and in more general entomology has been given by the present author earlier (Southcott 1963, 1964).

Probably Womersley's greatest contribution to acarology lay in his studies of the Trombiculidae and associated mites of the Asiatic-Pacific region, which were produced in a large monograph in 1952. After producing this he continued to work at classifying these and other mites until his death, producing a long series of papers, several of which appeared posthumously. He worked in joint authorship with several authors, notably W. G. Heaslip, J. R. Audy, G. M. Kohls, E. H. Derrick and others.

Students of the Acarina who worked with Womersley at various times in his career in Australia were W. G. Heaslip, R. V. Southcott, R. N. McCulloch, R. Domrow and others, and some of these have had independent careers in acarology.

In the following pages it is proposed to give, in order of year of birth, summaries of the contributions and brief biographic notes on a number of workers

who have contributed to Australian acarology, particularly those who have seen themselves as acarologists. Of necessity, some degree of selection had had to be exercised in these entries. In general, if a worker has had his or her main working area in other areas of the world, that person has been omitted, as being more suitably included in a history of acarology orientated to some other area or region. In a number of cases it has not been possible to get a suitable obituary or biographical account of an author, and a biography of that person has had to be omitted. It is hoped, however, that if a revised edition of this work can be made at some time in the future, that amends can be made for such omissions.

The term "Australian" has been interpreted rather liberally. In many of the early works on Australian entomology and arachnology material from New Zealand, New Guinea and adjacent islands was included, so that a rigid delineation of the areas to be included has not been practicable. Additionally, Australia's political responsibilities extend to a few islands in the Pacific and Indian Oceans, and there are also Antarctic and sub-Antarctic responsibilities, in which however, there are only a few acarological connotations.

**WILLIAM JOSEPH RAINBOW (1856-1919)**—He was born in Yorkshire, England, and educated at the naval towns there and at Edinburgh, Scotland, his father being a Warrant Officer in the Royal Marines. He worked as a journalist in New Zealand and New South Wales, and from a position in government printing became Entomologist at The Australian Museum, Sydney. He wrote on a number of entomological subjects, including a book "A guide to the study of Australian butterflies" in 1907, but worked principally at the arachnids, particularly the spiders, which were his major contributions. In 1906 he published a synopsis of the Australian Acarina, in which he summarized the work of previous authors, and described several new species. Further details can be obtained of his life and publications in Musgrave (1920).

**JOHN W. FIELDING (1889-1954)**—He was born at Wigan, Lancashire, in Great Britain. Primarily interested in microscopy, he commenced work at the Runcorn Research Laboratories at the University of Liverpool, working on sleeping sickness and relapsing fever. In 1910 he migrated to Australia, to work with Dr. Anton Breinl at the Australian Institute of Tropical Medicine at Townsville, Queensland. Here his main work was in surveys of the prevalence of hookworm, malaria and other tropical diseases in north Queensland. Other work was in the areas of helminthology and entomology. In 1926 he produced a volume on the tick fauna of Australia, this being mainly compiled from previous works, but was nevertheless a useful publication for a number of years in Australia.

In 1930 the Institute was closed in Townsville, and its functions and staff were transferred to Sydney. There his work was mainly in bacteriology, particularly in the study of leprosy, spirochaetes and other tropical pathogens; he held the appointment of Demonstrator in Bacteriology. He was particularly interested in microscopic techniques including staining methods, including those for rickettsiae and leptospirae (see Anon., 1954, and D. J. Lee, 1980).

**ANTHONY MUSGRAVE (1895-1959)**—He was born at Cooktown, Queensland. He joined the staff of the Australian Museum, Sydney, as a cadet in 1910, and spent the remainder of his professional life as an officer at that institution. He worked at a variety of areas in entomology and arachnology, specializing in Diptera, Hemiptera, spiders and ticks. His initial duties at the Australian Museum were as assistant in the library, and then as Assistant Entomologist to W. J. Rainbow. He was particularly interested in economic entomology, and was a most meticulous



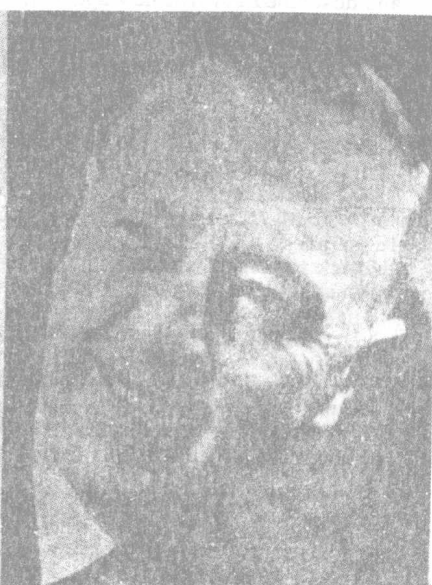
William Joseph Rainbow



Arthur Stanley Hirst



Herbert Womersley



Anthony Musgrave



bibliographer. His published contributions to acarology lay mainly in several more or less popular articles on ticks (see bibliography). He was particularly interested in the history of entomology. His "Bibliography of Australian entomology 1775-1930 with biographical notes on authors and collectors" (1932b) was published as a separate volume by the Royal Zoological Society of New South Wales, and will remain a lasting monument to him. Unfortunately, a projected second volume, of Australian arachnologists was never completed for publication. Nevertheless, many of the entomologists over the period nominated saw entomology and arachnology as almost a single subject, so that the biographical notes given by Musgrave cover a significant proportion of scientists who have worked at arachnology, including acarology, in Australia. Further details of Musgrave's wide-ranging activities will be found in G. P. Whitley's (1961) obituary notice in Proc. Linn. Soc. N. S. W. 86 (1): 122-125, and the further sources mentioned there.

IAN CLUNIES ROSS (1899-1959)—He was born at Bathurst, New South Wales. Graduating in veterinary science at Sydney University he later became lecturer in veterinary parasitology at that institution, and later co-authored a volume on the parasites of sheep (Ross and Gordon, 1936). In acarology his early studies were on the possible transmission of the cat mange mite, *Notoedres cati*, to man (1923).

Later, he was to make a series of studies of the paralysis tick, *Ixodes holocyclus*, in eastern Australia, with particular reference to the effects of the toxin on dogs and other animals. In addition to these experimental studies, he published accounts of the life history of this species of tick, and the morphological characteristics of the larval, nymphal and adult stages.

In 1926 he joined the Council for Scientific and Industrial Research (CSIR) as veterinary pathologist, and within that organization became head of the McMaster Animal Health Laboratory in Sydney. Thereafter he was little concerned with acarological researches, but held many important administrative posts and became Professor of Veterinary Science at Sydney University in 1940. He resigned to become part of the executive of CSIR, and eventually became Chairman of the Commonwealth Scientific and Industrial Research Organization, which had been reformed out of the CSIR. He was an important Australian scientific executive, and received many honours for his efforts in the scientific and academic administrative areas, as well as more widely. He is the only acarologist whose portrait appears on a banknote, as far as is known, gracing the Australian \$50 bill. He was knighted in 1954.

FREDERICK HUGH SHERSTON ROBERTS (1901-1972)—He was born in Rockhampton, Queensland. Graduating in science (biology) at the University of Queensland in 1923, he worked initially for a short period as a microscopist for the Australian Hookworm Campaign, and then transferred to research officer and officer-in-charge of field stations for the Commonwealth Prickly Pear Board, including work with the lepidopteran *Cactoblastis*. Later he became research entomologist and parasitologist with the Queensland Department of Agriculture and Stock. His Doctor of Science thesis was on *Ascaris lumbricoides*, the common roundworm of pigs. During World War II he was concerned with malarial control for the Australian army, working on the biology of Australian anopheline mosquitoes and the transmission of experimental malaria to volunteers in drug-testing schedules for malarial suppression, in collaboration with M. J. Mackerras, (née Bancroft), then of the Australian Malarial Research Unit based at Cairns, Queensland.

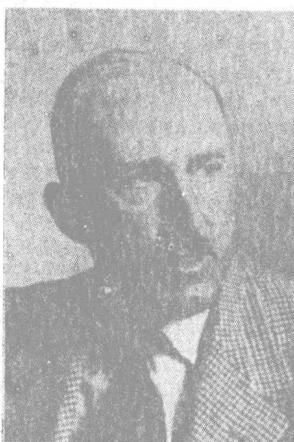




Ian Clunies Ross



Frederick Hugh Sherston Roberts



Robert Nicholson McCulloch



Carl Ernest Mitchelmore Gunther