

# Rickettsioses in Australia

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The rickettsial diseases of Australia are described in their chronological order of discovery. They include epidemic typhus (*R. prowazekii*); murine typhus (*R. typhi*) found Australia-wide; scrub typhus (*O. tsutsugamushi*) only in tropical, northern Australia; Q fever (*C. burnetti*) found Australia-wide; Queensland tick typhus (*R. australis*) along the east coast of Australia; Flinders Island spotted fever (*R. honei*) in southeast Australia; Variant Flinders Island spotted fever (*R. honei*, strain “marmionii”) in eastern Australia; *Rickettsia felis*, Western Australia; eight new RFG rickettsiae from ticks (of unknown pathogenicity); and two nonhuman pathogens in *A. platys* (dogs) and *A. marginale* (cattle).

**Key words:** rickettsioses; Australia

The first rickettsial disease recognized in Australia was epidemic typhus (*Rickettsia prowazekii*), which was regularly introduced into Australia via the body lice of convicts and early European migrants. This era lasted from 1788 to 1869 (last known typhus case). There was rarely secondary spread on shore as the warm, sunny climate of Australia allowed residents to wash themselves and their clothes regularly. However, there was a small outbreak on the Victorian goldfields in 1853.<sup>1</sup> Outbreaks of Brill’s disease (recrudescing epidemic typhus) have been described in Australia,<sup>2</sup> and further cases should be anticipated as Australia currently receives immigrants from countries that are endemic for *R. prowazekii*.

The second rickettsial disease recognized in Australia was murine typhus (*R. typhi*), although it was initially called “endemic” typhus, to distinguish it from “epidemic” typhus. Hone,<sup>3</sup> a public health doctor in Adelaide, South Australia, recognized cases of a typhus-like illness among men loading wheat onto

ships, and residents of poor quality housing. In both environments, rodents were present, and this association was noted. This was in fact the first published report of murine typhus in the world (1922). Patients were not lice-infested, and mortality was much lower than in epidemic typhus. As the years progressed, the same disease was observed in Queensland, during a mouse plague,<sup>4</sup> and in Western Australia, associated with handling wheat.<sup>5</sup> The main differential diagnosis was recrudescent epidemic typhus; especially when the patient was an Australian soldier having returned from Europe post World War I. The disease is still being diagnosed in Western Australia,<sup>6</sup> and, recently, the first case in Victoria was reported.<sup>7</sup>

The third rickettsial disease recognized in Australia was scrub typhus (*Orientia tsutsugamushi*). As new settlers in Australia pushed north into tropical Queensland, they encountered many endemic febrile illnesses. Often these were referred to by their regional name (e.g., “Mossman” Fever). In fact, they were a mixture of diseases (malaria, leptospirosis, dengue, etc.), 1 of which was scrub typhus. As 1 of the key tasks of settlement was clearing the native vegetation (scrub), the disease was ultimately called

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“scrub typhus.” In 1935, 2 papers were published that identified a typhus-like disease, by positive OXK Weil-Felix serology, among patients in Cairns and Tully (both towns in north Queensland).<sup>8,9</sup> It was not epidemic typhus, so the authors initially called it “endemic typhus” (despite this name having already been used by Hone, to describe the typhus disease he had recognized, and which was later called murine typhus). Later, it was called “*tsutsugamushi* fever” when it was considered to be the same disease as that in Japan.<sup>10</sup> Ultimately, it was named scrub typhus. Today, the disease is still seen regularly in all regions of tropical Australia, including the Kimberley region of Western Australia,<sup>11,12</sup> the “top-end” of the Northern Territory,<sup>13</sup> north Queensland, and the Torres Strait Islands.<sup>14</sup>

The fourth rickettsial disease recognized in Australia was Q Fever (*Coxiella burnetii*). Q (query) Fever was an undiagnosed fever occurring among abattoir workers in Brisbane, Australia; it was first described by Derrick,<sup>15</sup> who inoculated the agent into guinea pigs, which then became febrile. The involvement of Burnet<sup>16</sup> resulted in its recognition as a rickettsial disease. Independently, workers in Montana, USA, who were studying a human pathogen obtained from a tick (*Dermacentor andersoni*), named their isolate the “Nine Mile” strain.<sup>17</sup> These 2 isolates were later shown to be the same microbe,<sup>18</sup> causing the same disease (Q Fever). Reflecting the contributions of both US workers (Cox *et al.*) and Australian workers (Burnet *et al.*), it was named *Coxiella burnetii*. It is found in many species of Australian ticks, especially those from bandicoots<sup>19</sup> and kangaroos.<sup>20</sup> Human infection, mostly in New South Wales and Queensland, is usually associated with aerosol spread from dried excreta of goats, cattle, and sheep. Recent Q Fever research in Australia has centered around Marmion’s group in Adelaide. They have developed and tested a Q Fever vaccine, which is now produced and given routinely to selected persons in Australia such as abattoir workers. The vaccine is very effective.<sup>21</sup> Australia is the only country to have a human Q Fever vac-

cine available for general use. It has resulted in a significant reduction in occupational Q Fever.<sup>22</sup> Recent work has described the post-Q Fever fatigue syndrome<sup>23</sup> and its relationship to persistent *C. burnetii* antigen in patients.<sup>24</sup>

The fifth rickettsial disease recognized in Australia was Queensland Tick Typhus (*R. australis*), but it was the first spotted fever group (SFG) rickettsiosis detected. Soldiers training in the bush in Queensland during World War II who were infected by tick bite developed an eschar, fever and vesicular rash (the differential diagnosis being chicken pox).<sup>25</sup> The *Rickettsia* was isolated and later shown to be a genetic outlier in the SFG. It has been isolated from *Ixodes holocyclus* and *I. tasmani* ticks. Cases have occurred only down the east coast of Australia, from the tip of the continent and Torres Strait Island to the southeastern corner (Wilson’s promontory, in Victoria). While the disease is generally considered to be mild, serious illness and death has occurred.<sup>26</sup>

The sixth (and final, at the time of writing) rickettsial disease is Flinders Island Spotted Fever (FISF), (*R. honei*), which is also a member of the SFG, albeit a mainstream member from a genetic viewpoint. The disease was recognized by Stewart,<sup>27</sup> the only doctor on Flinders Island, which is located in Bass Strait, between mainland Australia and the island state of Tasmania, at the southeast corner of the continent. It is a relatively mild disease, and no deaths have yet been recorded. The microbe was isolated from a patient during acute illness,<sup>28</sup> eventually described as a new species,<sup>29</sup> and to much surprise, was recognized as being widespread in the reptile tick *Aponoma* (now *Bothriocroton*) *hydrosauri*.<sup>30</sup> *R. honei* was named to honor Frank Hone, Australia’s first rickettsiologist, who described murine typhus in 1922. The reptile ticks on lizards and snakes were heavily colonized, with 63% positive for the rickettsia. Attempts at infecting laboratory-bred and immunologically naïve blue-tongued lizards with ticks carrying *R. honei* were not successful (unpublished data). The disease FISF is now known to be more

**TABLE 1.** Spotted Fever Group Rickettsiae Detected in Australian Ticks

Rickettsia (proposed name)	Tick Species	Vertebrate Host	In Pure Culture?	Location in Australia
" <i>R. antechini</i> "	<i>Ixodes antechini</i>	<i>Antechinus</i> (marsupial mouse)	No	SW
" <i>R. argus</i> " (sp. nov) <sup>a</sup>	<i>Argus dewae</i> (soft-tick)	Gould's Wattled Bat	Yes	SE
" <i>R. derrickii</i> "	<i>Bothriocroton hydrosaurii</i> <sup>b</sup> (reptile tick)	Snakes/Lizards; Humans	No	SE
" <i>R. gravesii</i> " (sp. nov) <sup>39 a</sup>	<i>Amblyomma triguttatum</i> <sup>b</sup> <i>A. limbatum</i>	Kangaroo; Humans; Euro, Wallaroo; Bandicoot; Bettong; Possum	Yes	NW & SW
" <i>R. guntherii</i> "	<i>Haemaphysalis humerosa</i>	Northern Brown Bandicoot	No	NE
" <i>R. sauri</i> "	<i>Bothriocroton hydrosaurii</i> <sup>b</sup> (reptile tick)	Snakes/Lizards; Humans	No	SE
" <i>R. tasmanensis</i> "	<i>Ixodes tasmanii</i> <sup>b</sup>	Tasmanian Devil (marsupial); Humans	No	SE
" <i>Koala Rickettsia</i> " <sup>40</sup>	<i>Ixodes tasmanii</i> <sup>b</sup>	Koalas	No	Eastern

This table represents work by Nathan Unsworth, Helen Owen, Inger-Marie Vilcins, and Leonard Izzard.

<sup>a</sup>in culture.

<sup>b</sup>Tick species that bite humans.

widely spread in Australia (Tasmania, South Australia, Queensland, Torres Strait Islands)<sup>31</sup> and may be worldwide (Thailand, Sri Lanka, Italy).

Recently, a genetic variant of *R. honei*, the "marmionii" strain (named in honor of the Australian rickettsiologist Marmion), was discovered causing acute disease in several patients in eastern Australia.<sup>32</sup> Only one patient had a history of tick bite, and the tick (*Haemaphysalis novaeguineae*) was shown to contain the "marmionii" strain.<sup>33</sup> This strain has never been detected in the reptile tick, so its epidemiology is clearly different from that of the parent strain of *R. honei*. This latter *Rickettsia* has also been detected in the blood of 3% of chronically unwell patients (many with chronic fatigue) in Melbourne, Australia,<sup>34</sup> suggesting that this microbe may establish a chronic infection with possible relapse in some patients. It is not yet known if the presence of rickettsial DNA and/or positive rickettsial serology in these patients is causally related to their symptoms of chronic illness, or simply a reactivation phenomenon, which is sometimes seen in herpes virus reactivation during other illnesses.

There is 1 small island in Torres Strait (Darnley Island) that has 3 endemic rickettsiae: *R. australis*, *O. tsutsugumushi*, and *R. honei* (marmionii strain).<sup>35</sup>

## Rickettsiales Associated with Australian Animals

*Rickettsia felis* has been detected in 4 species of fleas from dogs and cats in Western Australia,<sup>36</sup> but there have been no human cases yet described.

*Anaplasma platys*, transmitted by the dog tick *Rhipicephalus sanguineus* and dog louse *Heterodoxus spiniger*, is present in some Australian dogs,<sup>37</sup> especially in aboriginal communities.

*Anaplasma marginale* in cattle is transmitted by the ticks *Boophilus microplus* and *R. sanguineus*.<sup>38</sup>

No *Ehrlichia* sp. has yet been detected in Australia.

Several new spotted fever group *Rickettsia* have been detected in Australian ticks (Table 1). Two of these are growing in pure culture (*R. gravesii*, sp. nov), obtained from the kangaroo tick in Western Australia and *R. argus* sp. nov isolated from the soft tick *Argus dewae*. None is yet known to be a human pathogen.

In conclusion, our understanding of the epidemiology of rickettsiae and rickettsial diseases in Australia is still evolving and far from complete.

## Conflicts of Interest

The authors declare no conflicts of interest.

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