The heartwater mystery: veterinary and popular ideas about tick-borne animal diseases at the Cape, c.1877 - 1910

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Tick-borne diseases have been and remain an important influence in shaping and limiting pastoralism in southern Africa. Historically, the control of such diseases has constituted an important element of state veterinary policy and has entailed the employment of considerable resources.[1] Redwater fever, heartwater, East Coast fever and gallsickness (anaplasmosis) are perhaps the most economically important of a range of stock diseases transmitted by ticks in the region, but of these only East Coast fever has received significant attention from historians. Cranefield describes the scientific explication of East Coast fever and the campaign to eradicate it from Rhodesia and the Transvaal from 1902, while Bundy analyses the political consequences of enforced dipping in the Transkei during the 1910s.[2] In this article I examine earlier veterinary and entomological research into tick-borne diseases at the Cape. I argue that the groundwork for subsequent research into East Coast fever in the Transvaal was laid by scientists employed by the Cape government in an effort to overcome the threat which other stock diseases posed to pastoral production.[3] I emphasise the importance and influence of government scientists at the Cape before the reconstruction period in the Transvaal.

This article is therefore a study of colonial science in action, in the sense that it examines veterinary and entomological practices, as well as theory and knowledge.[4] Practice provided a field in which scientists and farmers met, engaged in dialogue and constituted a body of knowledge about stock disease. In a society in which European farmers held considerable political power, this knowledge was constituted mutually by colonial vets and the settler farmers with whom they primarily dealt. Accordingly, I emphasise the importance of popular ideas in shaping both veterinary knowledge and preventive technology.

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1. D.T. de Waal, 'Vaccination against babesiosis', *Acta Parasitologica Turcica*, vol. 20, supplement 1, 1996, 487-500.
2. P. Cranefield, *Science and Empire: East Coast Fever in Rhodesia and the Transvaal* (Cambridge: Cambridge University Press, 1991); C. Bundy, '"We Don't Want Your Rain, We Won't Dip": Popular Opposition, Collaboration and Social Control in the Anti-Dipping Movement, 1908-1916', in W. Beinart and C. Bundy, *Hidden Struggles in Rural South Africa: Politics and Popular Movements in the Transkei and Eastern Cape, 1890-1930* (London and Johannesburg: Ravan Press, 1987), 191-22. For historical perspectives on East Coast fever in other parts of Africa, see J.L. Giblin, 'East Coast fever in socio-historic context: a case study from Tanzania', *International Journal of African Historical Studies*, vol. 23 (3), 1990, 401-421; and R. Waller and K. Homewood, 'Elders and experts: contesting veterinary knowledge in a pastoral community' in A. Cunningham and B. Andrews, eds., *Western Medicine as Contested Knowledge* (Manchester: Manchester University Press, 1997), 69-93.
3. The use of veterinary science in supporting agricultural development in reconstruction Transvaal has been outlined by J. Krikler, *Revolution from Above, Rebellion from Below: The Agrarian Transvaal at the Turn of the Century* (Oxford: Clarendon Press, 1993) and S. Milton, '"To make the crooked straight": settler colonialism, imperial decline and the South African beef industry, 1902-1942 (Unpublished PhD thesis, University of London, 1996). More recent work has examined earlier veterinary science at the Cape of Good Hope. W. Beinart, 'Vets, viruses and environmentalism: the Cape in the 1870s and 1880s', *Paideuma*, vol. 43, 1997, 227-51; and D. Gilfoyle, 'Veterinary science and public policy at the Cape of Good Hope, 1877-1910' (Unpublished DPhil. thesis, University of Oxford, 2003).
4. The importance of practices is suggested by M. Worboys, *Spreading Germs: Disease Theories and Medical Practices, 1865-1900* (Cambridge: Cambridge University Press, 2000).

I also attempt to contextualise the material within some wider themes in the history of medicine and veterinary medicine in particular. Worboys has argued that following the successful 'stamping out' of the 1865 rinderpest epizootic in Britain by a policy of slaughter and quarantine, a germ theory of infection came to permeate British veterinary science. The consequence of this, however, was less the adoption of germ practices (such as preventive inoculation) so much as the enforcement of a regulatory regime. British vets employed by the Cape Department of Agriculture regarded bacteria or 'virus' as the prime and specific cause of many diseases and they were certainly imbued with the reductionist theories of cause associated with bacteriology. Discoveries about the role of ticks in disease transmission, which were at least to some extent suggested by farmers' observations and beliefs, changed the vets' perception of cause. This suggests one way in which the trajectory of colonial veterinary science, with its emphasis on the control of tick vectors, differed from the British metropolitan model of prevention. With regard to human medicine, Mendelsohn has argued that the study of protozoan parasites was an important factor in the emergence 'of the modern, ecological understanding of epidemic infectious disease', which had begun to reform the causal reductionism of bacteriology by 1919.[5] I argue that by 1900 veterinary scientists at the Cape complimented reductionist germ theories of disease causation with theories which took into account wider environmental factors.

The first section of this article discusses some veterinary and popular ideas about the causes of disease. The veterinary emphasis on germ theory is contrasted with farmers' concerns with other environmental factors, but this dichotomy is critically examined. The second section deals with veterinary entomological research between 1898 and 1902, when a substantial body of knowledge about tick transmission was generated. I suggest that this research was prompted both by popular beliefs and by veterinary research in the USA. Finally, I describe the development of technology for preventing disease, again stressing co-operation between government vet and farmer.

The link between ticks and disease: some popular and veterinary ideas

In 1876 the Cape government appointed its first Colonial Veterinary Surgeon and set up a Stock Diseases Commission in response to the perception that a substantial fall in domestic wool production, which had peaked in 1872, was caused by the proliferation of stock disease.[6] While scab and internal parasites were identified by the Commission as important causes of loss, substantial decreases in sheep numbers in some Eastern Cape districts were blamed on more obscure diseases.[7]

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5. J. Andrew Mendelsohn, 'From Eradication to Equilibrium; How Epidemics Became Complex after World War I', in C. Lawrence and G. Weisz, eds., *Greater Than the Parts. Holism in Biomedicine, 1920-1950* (New York and Oxford: Oxford University Press, 1998), 303-304.
6. Beinart, 'Vets, viruses and environmentalism', 229-230. Wool production peaked in 1872 at close to 50 million lbs, but fell to just under 35 million lbs by 1976, despite continued high prices.
7. Gilfoyle, 'Veterinary science and public policy', 32-33, 46. According to the census, the number of woolled sheep in Albany, for example, fell from 308,000 head in 1865 to 87,980.

In giving evidence to the Commission, John Webb, who farmed near Grahamstown, Albany district, explicitly linked the perceived increase of stock disease to the introduction of the bont (variegated or tortoiseshell) tick. This tick had proliferated and spread since it was first observed in Albany in the 1830s on cattle brought from Zululand. Webb thought that fatal diseases, 'gallsickness' and 'boschsickness' (bushsickness) in cattle and 'heartwater' in sheep, were caused by 'inflammation brought on by the tick'. The perceived increase of these diseases, which were common south of Grahamstown towards the sea but less so to the north, was linked to the spread of the bont tick.[8] One Fort Beaufort farmer, Bezuidenhout, testified that the bont tick had first been observed around the Gonubie River in 1835 and had gradually invaded surrounding districts, spreading disease wherever it settled.[9] Other farmers described how the bont infested bushy places only, avoiding the open veld; sheep which remained healthy on the open ridges died of heartwater if taken into the bosky ravines.[10]

Albany farmers were familiar with ticks, which they considered to be generally harmful, and one identified four distinct types: the bont, blue, skilpad (tortoise) and the small red ticks.[11] The bite of the large bont tick, it was said, could destroy the nipples of a milch cow, while smaller specimens caused lameness by lodging between the 'klauws' of a sheep's foot. The small red ticks seemed to cause paralysis in lambs, which might die if the ticks were not removed. But they did not necessarily agree that ticks caused 'heartwater' or 'gallsickness', the obscure diseases which, some claimed, were ruining wool production in the Cape's eastern districts.[12] Some argued that overstocking, with the consequent decline in the quality of pasture, was the cause of the new diseases.[13] Hobson, a Jansenville farmer, linked outbreaks of heartwater in the interior to ox-wagon transport from coastal districts such as Uitenhage. He believed that pastures on which transport oxen from the coast were allowed to graze would subsequently become fatal for goats.[14]

Heartwater was an important disease for Eastern Cape farmers and this was reflected in the state veterinary research agenda. Following the appointment of Duncan Hutcheon as Colonial Veterinary Surgeon for the Cape in 1880, the government acquired an experimental farm 'Leeuwfontein' in a block of land which was considered to be badly infected. Hutcheon prioritised heartwater and examined many cases in sheep brought from the Bontebok Flats, an upland area which farmers considered healthy for sheep.[15] Post-mortem evidence, which revealed a coagulating effusion of a 'pale straw-coloured fluid' in the heart sac, suggested to him that this was distinct from the common 'dropsy' associated with worm infestation which farmers also called 'heartwater'.[16] Hutcheon, however, was sceptical

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8. Cape Parlimentary Papers (CPP), [G.3-'77] *Report of the Commission Appointed to inquire into and report upon Diseases of Cattle and Sheep in this Colony*, 108-9; for a similar account see evidence of B. Booth, 135.
9. *Ibid*., evidence of J. Bezuidenhout, 129.
10. *Ibid*., evidence of J. Gush, 115; W. Ayliff, 120.
11. *Ibid*., evidence of J. Bowker, 118.
12. *Ibid*., evidence of J. Gush, 115, J. Bowker, 118. See Chapter 1 above.
13. Beinart, 'Vets, viruses and environmentalism', 241.
14. CPP, [G.64-'83] *Report of the CVS (CVS) for the Year 1882*, 36.
15. CPP [G.3-'77] *Stock Diseases Commission,* evidence of C. Currie, 104; M. Bowker, 105.
16. CPP [G.25-'82] *Report of the CVS, for the period from March 16th, 1881, to February 28th, 1882*, 6; Beinart, 'Vets, viruses and environmentalism', 240

that heartwater was in some way connected with ticks. While he knew that the prominent British vet, William Williams had linked the bite of ticks to 'trembling' or 'louping ill', a common disease of sheep in Scotland, it seemed to him unfeasible that a tick bite could introduce the agent of disease without causing serious inflammation of the skin. Instead, he looked to recent scientific developments in Europe for an explanation.[17]

Hutcheon was strongly influenced by the 'germ theory' of infection which rapidly gained ground among the British veterinary profession after the outbreak and suppression of rinderpest in the mid-1860s.[18] More specifically, recent discoveries about the 'germ' cause of anthrax by the bacteriologist Robert Koch in Germany and the demonstration of a vaccine by Louis Pasteur in France suggested both an explanation and a course of action. Although the disease did not seem to be directly infectious, Hutcheon was convinced that this was a 'specific' disease, that is one caused by a particular germ 'which gains access to the blood, and sets up morbid changes within it.'[19] Sheep were dying at Leeuwfontein because the veld was 'poisoned by something similar to *charbon* or anthrax'.[20] Hutcheon was sufficiently convinced to order a batch of Pasteur's vaccine to treat sheep at Leeuwfontein, but several contracted anthrax as a result of the vaccination.[21] The episode, however, allowed Hutcheon to make a direct comparison between cases of anthrax and heartwater by microscopic examination as well as clinical observation. Apart from some clinical and post-mortem differences, the blood of the anthrax cases swarmed with bacteria, which were entirely absent in the heartwater cases.[22]

Nevertheless, Hutcheon found the idea of a spore-forming bacillus useful in accounting for some of the characteristics of the disease. Firstly, it could explain why the disease did not seem to be directly infectious. Secondly, it accounted for the apparent influence of climate and geography on the disease, which was most common in summer and in damp, shady locations. Germ spores of heartwater were, perhaps, deposited on the veld by infected animals, remaining dormant until activated by warm summer weather, particularly on low-lying shady ground.[23] A fire which burned part of the veld on the Leeuwfontein farm in 1882 stopped the disease because, Hutcheon theorised, the flames destroyed the germ spores.[24] On the other hand, germ practices and procedures revealed little about the disease. Microscopic examination failed to reveal a causal organism of any kind.[25] Hutcheon also found he was unable to transmit heartwater to a healthy animal by inoculation with blood taken from a sick animal, as would be expected for a 'germ' disease such as anthrax or rinderpest.[26]

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17. CPP [G.64-'83] *Report of the CVS for the Year 1882*, 10. Williams believed that 'trembling' or 'louping ill', a seasonal disease in Scotland, was caused by a bacillus transmitted to sheep by the bite of a tick. W. O. Williams, *Principles and Practice of Veterinary Medicine* (London and Edinburgh, 1882), 786-801.
18. Worboys, *Spreading Germs,* 60; Beinart, 'Vets, Viruses and Environmentalism', 240.
19. CPP [A.88-'82] *Supplementary Report by the CVS upon his investigations at the Lieuwfontein Government Farm*, 1.
20. Cape Archive Depot (CAD), Public Works Department (PWD) 2/75, CVS to Commissioner for Crown Lands and Public Works, 23 Jan. 1882.
21. CPP [G.64-'83] *Report of the CVS for the Year 1882*, 35-6.
22. CAD, PWD 2/75, CVS to Commissioner for Crown Lands and Public Works, 18 May 1882.
23. CPP [G.64-'83] *Report of the CVS for the Year 1882,* 37.
24. CPP [G.25-'82] *Report of the CVS, for the period from March 16th, 1881, to February 28th, 1882*, 61.
25. CAD, PWD 2/75, CVS to Commissioner for Crown Lands and Public Works, 18 May 1882.
26. CPP [G.64-'83] *Report of the CVS for the Year 1882*, 34. Hutcheon was incorrect in this.

Bacteriological practices thus failed to reveal the cause of the disease. Hutcheon admitted that his experiments and investigations had generally been a failure, but argued that these obscure diseases were difficult to explain because 'the agencies which produce them are of a very hidden and subtle character and it will be very difficult to isolate and identify them.'[27] Furthermore, Hutcheon's position as sole government vet, the outbreak of redwater fever (a disease which seemed to have many characteristics in common with heartwater) in the Eastern Cape in 1883 and attempts by the Cape government to impose more effective legislation against scab during the mid-1880s combined to prevent consistent research. He was instructed to close the Leeuwfontein experimental farm following some public criticism.[28]

For progressive farmers in the Eastern Cape,[29] however, the decline of sheep and Angora goat farming in the region remained an important issue. In 1889 Andrew Smith, an Albany farmer, published an article in the *Agricultural Journal of the Cape of Good Hope* which sought to account for the virtual disappearance of sheep farming from districts such as Victoria East, Lower Albany and East London, which had once held some of the best sheep runs in the colony. Smith argued that the immediate cause of this decline was a deterioration of the veld caused by over-stocking. Sheep ate out the nutritious sweet grasses first, leaving the poor grasses and allowing opportunistic noxious weeds, such as ragwort, to gain a hold.[30] The plants which Africans used as 'germ-killers and anti-septics' were among the first to go. The soil became exhausted of mineral salts (potash, lime and phosphorus) so that the 'balance of replenishment is overturned' and animals starved as a result. Disease had also played a part in the decline because the proliferation of sheep in the early years of farming had poisoned the pasture. 'Diseased sheep pass out the bacterial spores and the eggs of low forms of animal life,' which, Smith claimed, were able to survive for a time on the veld to infect susceptible animals.[31] Smith's article thus encapsulated and combined a number of popular theories about the causes of stock disease: nutritional deficiency; plant poisoning and a version of germ theory which was linked to 'worm theory'.

Smith's ideas stimulated a debate in the correspondence pages of the *Agricultural Journal* over the next few years.[32] William Rogers, a Cathcart farmer who had moved from Albany because of the prevalence of stock disease there, turned Smith's argument about overstocking on its head. Rogers claimed that the decline in sheep farming in these Eastern Cape districts was primarily due to diseases, identifiable by the accumulation of fluid around the heart and swollen gall bladder, which were known as 'heartwater' and 'gallsickness'. These diseases had

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27. CAD, PWD 2/77, CVS to Commissioner for Crown Lands and Public Works, 20 June 1883.
28. CAD, PWD 2/77, Commissioner for Crown Lands and Public Works, memo to file, 12 Aug. 1883.
29. For a discussion of the meaning of progressivism in the Cape context, see K. Brown, 'Progressivism, agriculture and conservation in the Cape Colony circa 1902-1908' (DPhil. thesis, University of Oxford, 2002), 1-15.
30. For the ideas and policies on noxious weeds, see L. van Sittert, '"The seed blows about in every breeze": noxious weed eradication in the Cape Colony, 1860-1909', *Journal of Southern African Studies*, vol. 26 (4), 2000, 656-74.
31. *Agricultural Journal of the Cape of Good Hope (AJCGH)*, vol. 2, 33 (1889), 286-7.
32. It had, however, been noted in Britain and Australia that long-established sheep runs became unwholesome for sheep. Editorial, 'Tainting of pasture: what is it?', *Journal of Comparative Pathology and Therapeutics (JCPT)*, vol. 12 (2), (1899), 168-170; J.R. Fisher, 'Technical and institutional innovation in nineteenth century Australian pastoralism: the eradication of *psoroptic mange* in Australia', *Journal of the Australian Historical Society*, vol. 84 (1), 1998, 38-55. This was thought to be caused by the proliferation of internal parasites which infected the pasture.

spread, since their first appearance around 1860, slowly up the valleys of the Eastern Cape and across contiguous low-lying land. Rogers was impressed by the localised occurrence of disease and its apparent correlation with altitude; like witnesses to the Stock Diseases Commission, he noted that sheep still did well on higher ground in 'heartwater' districts, although nearby kloofs and valleys, characterised by a more luxuriant vegetation, were fatal. Overstocking had, through constant manuring, actually enriched pastures to the extent that they became poisonous, especially in the 'semi-tropical' environment of the valleys.[33] 'L.I.R.', an Adelaide farmer, speculated that germs which were unable to survive on 'sour' veld, might be able to live on veld which had become 'richer and sweeter'.[34]

One Sandflats farmer agreed that overstocking could lead to veld deterioration, but argued that in the case of the Eastern Cape the decline of sheep farming was caused specifically by heartwater. Heartwater was a 'germ' disease, but one that depended on certain vegetation types for its propagation. The difference in vegetation between, for example, the valleys of Victoria East and the uplands of Bedford accounted for the presence of the disease in the former district and its absence from the latter.[35] In particular, he linked the incidence of 'heartwater' to the presence of thorny mimosa or acacia. Pasteur had shown that the addition of thistles to sheep fodder had increased their susceptibility to anthrax; thorns might fulfil a similar function, puncturing the lips and mouth of the animals and allowing the germ of heartwater to enter.[36]

Ralph, a Fort Beaufort farmer, put what was perhaps the opinion of 'the majority of the more experienced farmers' in reiterating John Webb's evidence to the Stock Diseases Commission. The disease was caused by the bont tick, which, Ralph claimed, was invariably present during an outbreak. The adult female, 'about the size of a medium plum', was capable of producing thousands of eggs and posed, he argued, a worse threat to the Colony than scab. Legislation similar to the Scab Act, and the appointment of inspectors would be necessary if the tick was to be eradicated.[37] Farmers did not, however, perceive ticks as transmitters of germs. These comparatively large and highly visible creatures were described as a cause of disease in themselves, and something with which farmers could perhaps deal.

This correspondence shows that some farmers had begun, by 1890, to incorporate germ theory into their understanding of stock disease in a way that they had not at the time of the Stock Diseases Commission. 'Germs' were linked to observable environmental factors such as vegetation, moisture and heat, and provided an invisible agency through which these factors could act upon animal health. But these ideas about the relation between germs and disease were rather different from Hutcheon's theories. Farmers tended to see germs as one of a number of environmental causes of disease rather than the prime, specific cause. These were not the reductionist arguments of bacteriology.

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33. *AJCGH*, vol. 3(3), 1890, 320-1.
34. *AJCGH*, vol. 3(11), 1890, 86.
35. *AJCGH*, vol. 3(6), 1890, 45. Letter signed 'J.E.S.'.
36. *AJCGH*, vol. 3(14), 1891, 124.
37. *AJCGH*, vol. 3(10), 1890, 68. For the political controversy surrounding the promulgation of the Scab Act, see M. Tamarkin, *Cecil Rhodes and Cape Afrikaners: The Imperial Colossus and the Colonial Parish Pump*, (London: Jonathan Ball, 1996), 200-210.

In 1890, Hutcheon had little to offer farmers beyond their own ideas and experience to explain diseases like heartwater. As another leading Eastern Cape farmer, Henry Ogilvie noted in addressing a meeting of the Cradock Farmers' Association in 1891, they had heard nothing from Hutcheon on the heartwater mystery since the closure of the Leeuwfontein experimental farm. Ogilvie probably spoke for many in stating that it was:

> an unaccountable thing that our veterinary surgeons have failed to give any satisfactory explanation of, or suggest any effective remedy for, the disease that destroyed the sheep industry in these districts.[38]

Nevertheless, the government vets, still few in number and pressed by the requirements of the Animal Diseases Act, the operation of the Scab Act, various routine duties and by rinderpest after 1895, avoided the heartwater question until the late 1890s.[39]

Laboratory research: 'The life and habits of the notorious bont tick'

The notion that ticks were implicated in the transmission of stock disease was first given scientific authority by Drs Smith and Kilborne of the United States Bureau of Animal Industry, who published a study on Texas fever during 1892.[40] The disease was caused by a protozoan *Pyrosoma bigeminum* (later named *Babesia bigeminum*) which invaded and destroyed the red blood corpuscles of its bovine host, producing the diagnostic symptom of reddish-brown urine. In spite of professional scepticism, Kilborne demonstrated that the protozoan was transmitted by the common cattle tick, thus confirming the belief of many Southern farmers.[41] An unsigned article in the Cape's *Agricultural Journal* of March 1892 described these findings in some detail and speculated that Texas fever was 'a plague probably not differing specifically from our colonial Redwater.'[42] Since the early 1880s, Hutcheon had speculated that redwater fever might be the same as Texas fever, but was sceptical about tick transmission of germs in southern Africa. He thought it more likely that germs were deposited directly on the pasture by infected animals.[43]

Speculation about the identity of redwater fever with Texas fever was resolved during the late 1890s. Early in 1897 the German bacteriologist Robert Koch, who was researching a vaccine against rinderpest at the behest of the Cape government, found a parasite apparently identical to *Pyrsoma bigeminum* in blood samples obtained from the Taungs reserve, Bechuanaland.[44] Alexander Edington, the Cape's government bacteriologist, provided further proof when he observed

38. H. Ogilvie, 'Fifty years of sheep farming in South Africa', *AJCGH*, vol. 4(2), 1891, 14-6.
39. Heartwater is barely mentioned in the *Annual Report of the CVS* from the late 1880s to 1897.
40. T. Smith, and F. L. Kilborne, *Investigations into the Nature, Causation, and Prevention of Texas or Southern Cattle Fever* (Washington, 1893).
41. C.K. Hutson, 'Texas fever in Kansas, 1866-1930', *Agricultural History*, vol. 68(1), 1994, 93; J.F. Smithcors, *The American Veterinary Profession: Its Background and Development* (Ames, 1963), 448.
42. *AJCGH*, vol. 4(18), 1892, 202; Beinart, 'Vets, viruses and environmentalism', 247.
43. CPP [G.24b-'93] *Report of the CVS and Assistant Veterinary Surgeons for the Year 1892*, 7.
44. CPP [G.70-'97] *Reports by Professor R Koch upon his Investigation into Rinderpest, at Kimberley, December, 1896, to March, 1897*, 9.

the characteristic double pear-shaped protozoan in blood specimens taken from animals with redwater fever at the Waai Nek rinderpest station near Grahamstown.[45]

The identification of redwater with Texas fever by bacteriologists stimulated veterinary interest in the possible link between ticks and other diseases, which had characteristics in common with redwater. By late 1898 Hutcheon, now heading up a substantially expanded department,[46] had become very interested in ticks, an interest shared by R.W. Dixon, a vet who had been recruited by the Cape government during the rinderpest epizootic. Dixon was impressed by the testimony of Fort Beaufort farmers about the damage inflicted on wool production by heartwater and hoped that the government would support a systematic investigation.[47]

In spite of the heavy work load which was imposed on the veterinary branch, Hutcheon was able to assign Dixon to heartwater investigations which ran for several years.[48] Ticks were notoriously common in much of Fort Beaufort, which had a bad reputation for heartwater, so the district rinderpest station at Klu Klu was considered a good place to resume the experiments abandoned by Hutcheon in the early 1880s. Dixon intended to test the theory that heartwater was transmitted or caused by the bite of ticks. Like Hutcheon, he thought that heartwater was probably a 'specific' disease caused by a micro-organism communicated either by ingestion, inhalation or inoculation.[49] The method was to expose two groups of susceptible sheep and goats (animals imported from outside the heartwater area) to all likely sources of infection, while using tick infestation as a variable. Only animals which became infested with ticks sickened, strong evidence that heartwater was related to tick bites.[50] They were also able to produce heartwater in sheep and goats by injecting them with blood taken from a sick animal.[51] This was an established practice for demonstrating the germ cause of a disease and strong circumstantial evidence that it was caused by a germ circulating in the blood. If a 'heartwater germ' did exist, however, it did not yield to microscopic examination. But blood inoculation seemed analogous to tick bite so, given the observations of farmers over the last 40 years, the bont tick was the most likely candidate.

By 1899 the vets were taking the question of tick infection very seriously. As their focus shifted from the germ to the 'carrier', they tried to determine the life cycles and habits of the various ticks of domestic animals. This study, however, turned out to be far from straightforward. Bont tick eggs failed to hatch, while the red tick larvae disappeared as soon they were placed on the cattle. The blue tick, the common cattle tick in southern Africa, presented fewer problems as it seemed to remain on the same host as larvae, nymph and imago, occupying about seven days between each moult.[52]

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45. CPP [G.24-'98] *Report of the Director of the Colonial Bacteriological Institute, for the Year 1897,* 122.
46. The Veterinary Branch was expanded from six professional member of staff at the beginning of 1896 to about twenty from 1897. D. Gilfoyle, 'Veterinary research and the African Rinderpest Epizootic: the Cape Colony, 1896-1898', *Journal of Southern African Studies*, vol. 29(1), 2003, 133-154.
47. CPP [G.55-'98] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1897*, report of Dixon, 87.
48. CPP [G.24-'99] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1898*, 1-2. The assistant was James Spreull, who was later replaced by J. Shepherd. CPP [G.24-'99] *CVS, 1898*, report of Spreull, 95.
49. CPP [G.24-'99] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1898,* report of Dixon, 68.
50. *Ibid*., report of Shepherd, 88.
51. R.W. Dixon, 'Heartwater experiments', *AJCGH,* vol. 14(4), 1899, 206.
52. J. Spreull and R.W. Dixon, 'Tick experiments', *AJCGH*, vol. 13(11), 1898, 691-3.

In the context of a strengthening conviction that ticks were an important factor in the incidence of stock disease in southern Africa, the Cape's Entomological Department, headed by Charles Lounsbury, took up this research more systematically.[53] Claude Fuller, Charles Lounsbury's assistant, demonstrated that the blue tick (*Rhipicephalus decoloratus*), was closely related to the ticks which transmitted Texas fever in the USA and Queensland tick fever in Australia, thus further strengthening the tick infection theory of redwater fever. By early 1898, Lounsbury wanted to undertake a thorough investigation of the southern African ticks and had requested contacts in the eastern Cape to send him specimens of these 'small brutes',[54] of which he admitted to having only a very limited knowledge.[55] He contacted Hutcheon, suggesting co-operation between the veterinary and entomological branches of the Agricultural Department.[56] A precise knowledge of tick life cycles was essential if methods of eradication such as dipping and spraying, which needed to be correlated with the ticks' sojourn on the animal, were to be used effectively.[57] The beliefs of many farmers seemed well founded, he argued, and deserved systematic investigation.[58]

Lounsbury was interested in the question from 'an economic standpoint'.[59] He emphasized the potential economic benefits of his research, arguing that the eradication of heartwater might again open up the south-eastern districts of the Colony for wool production.[60] It was not only a question of the damage already done but also the possible further expansion of the heartwater area. Lounsbury speculated that heartwater had been introduced into the Peddie area by goats belonging to the Mfengu who were moved from Gcalekaland, further to the east, after the 1835 frontier war.[61] It had probably spread to sheep and goats belonging to European settlers in that area during the 1860s.[62] Ox transport between the eastern Cape coastal districts, the Transkei and the interior then provided an efficient means of carrying infected bont ticks to other districts.[63] But whatever the means, it seemed certain that the heartwater area had expanded steadily since 1865. It now

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53. C.P. Lounsbury was appointed Government Entomologist at the Cape in 1895 to work on pests of fruit. He was an American who had trained at the Amherst Agricultural College and Experimental Station in Massachusetts. Brown, 'Progressivism, agriculture and conservation', 145-150.
54. CAD, ENC (Entomologist, Cape) 1/5/4, Lounsbury to W. Allen, Glengrieve, Maclear, 18 Apr. 1898.
55. CAD, ENC 1/5/5, Lounsbury to CVS, 27 June 1898. Out of several species of ticks sent by Hutcheon, Lounsbury was able to identify formally only the bont tick.
56. CAD, ENC 1/5/5, Lounsbury to CVS, 27 June 1898.
57. CAD, ENC 1/5/5, Lounsbury to Du Plessis, Administrative Assistant, Veterinary Branch, 29 June 1898.
58. *AJCGH*, vol. 15(11), 1899, 729-31. Eleanor Ormerod's book on insect pests at the Cape which was published in 1889 makes no mention of ticks and concentrates on insects harmful to crops and fruit trees. E.A. Ormerod, *Observations on Some Injurious Insects of South Africa* (Cape Town, 1889).
59. CAD, ENC 1/5/5, Lounsbury to J. Rodway, Assistant Secretary, Royal Agricultural Commission, Georgetown, British Guiana, 7 Sep. 1898. Palladino argues that economic entomology, with its emphasis on the eradication of pests by means of insecticides, increasingly dominated the discipline from around the beginning of the twentieth century. P. Palladino, *Entomology, Ecology and Agriculture: The Making of Scientific Careers in North America, 1885-1985* (Lancaster, 1996), 26-31. For Lounsbury's perception of himself as an economic entomologist, see Brown, 'Progressivism, agriculture and conservation', 146.
60. *AJCGH*, vol. 19(4), 1901, 305.
61. For an account of the resettlement of the Mfengu by the colonial authorities, see J. Lewis, 'An economic history of the Ciskei, 1848-1900' (Unpublished PhD thesis, University of Cape Town, 1984), 239-42; C. Bundy, *The Rise and Fall of the South African Peasantry* (London: Heinemann, 1979), 32-3. Further land grants were made to the Mfengu in Fort Beaufort, Victoria East and King William's Town during the 1840s and 1850s. Bundy has demonstrated, however, that groups of Mfengu which originated in Natal were already entering the Ciskei in the 1820s following the *Mfecane*.
62. CPP [G.29-1902] *Report of the Government Entomologist for the Year 1901*, 40-1.
63. For an account of transport riding in the Eastern Cape, see G. Pirie, 'Slaughter by steam: railway subjugation of ox-wagon transport in the Eastern Cape and Transkei, 1886-1910', *International Journal of African Historical Studies*, vol. 26(2), 1993, 319-343.

comprised a block of land extending westwards along the coast to Humansdorp and inland for 50 to 100 miles including parts of Jansenville, Somerset East and Bedford. The eastern limit of its range was unknown.[64] Lounsbury pointed out that if the area affected by heartwater continued to expand inland, angora farming in the Eastern Cape interior would come under threat. The Cape angora industry was not, he argued, safe from the fate of production in the eastern coastal districts.[65] In Albany, for example, the population of angora goats had fallen from 31,500 in 1875 to 5,300 in 1899.[66]

Lounsbury began his research on the bont tick late in 1898 using facilities provided by the Fort Beaufort dairy farmer, Llewellyn Roberts, at the Cottesbrook creamery, Adelaide.[67] He identified the bont tick as *Amblyomma hebraeum*, which had been classified by the German scientist C.L. Koch fifty years previously.[68] The eggs of the bont failed to hatch unless they were kept continually moist and in the shade, suggesting that its habitat was probably limited to the wetter, more densely vegetated regions of the Cape and confirming the farmers' association of the disease with damp, bushy habitats.[69] Both the blue and bont ticks produced enormous numbers of eggs (perhaps between 10,000 and 20,000), which hatched into the minute larvae which farmers called 'grass ticks' because in summer they could be seen in great numbers on the pasture as they waited for a passing host. There were, however, important differences between the two species. Unlike the sedentary blue tick, the bont tick remained on its host for only about eight days at each stage of its life cycle (larvae, nymph and imago), living on the ground during the intermediate periods.

Furthermore, the time required for the completion of the bont tick's life cycle varied considerably with temperature and humidity. Lounsbury thought the minimum period required was probably around eight months, but the process might take as long as two years if retarded by cool conditions. He was surprised by the extraordinary vitality of the ticks, which were able to survive on the pastures for six months without feeding. The differences between the life cycles of the bont and blue ticks had obvious significance for techniques of attacking the tick on the animal, for it was now understood that during a life cycle which might last a year or 18 months, the bont tick lived on its host for less than a month.[70]

The link between heartwater and the bont tick was, however, not yet proven. Lounsbury commenced attempts to infect animals by means of bont ticks in September 1899 and published important results by mid-1900. At Fort Beaufort, Dixon infected goats by inoculating them with blood taken from an animal at the height of the disease. When these goats became ill they were deliberately infested with larval red and bont ticks.[71] The resulting nymphs ticks were taken to

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64. *AJCGH*, vol. 15(11), 1899, 730.
65. CPP [G.36-1900] *Report of the Government Entomologist for the Year 1899*, 20.
66. CPP [G.29-1902] *Report of the Government Entomologist for the Year 1901,* 39.
67. *AJCGH*, vol. 15(11), 1899, 742. Lounsbury noted that the 1899 Farmers' Congress held in Kimberley emphasised the need for research into the tick-heartwater question. See CPP [G.36-1900] *Entomologist*, *1899,* 18.
68. C.L. Koch, a German scientist who had published a work entitled *Ubersicht das Arachnidansystems* in 1843.
69. CPP [G.36-1900] *Report of the Government Entomologist for the Year 1899*, 22.
70. This information is summarised from C.P. Lounsbury, 'The bont tick - *Amblyomna hebraeum*, Koch: its life and habits', *AJCGH*, vol. 15(11), 1899, 728-42.
71. CAD, ENC 2/1/2, Diary entry for 21 Aug. 1899.

Lounsbury's Cape Town office, so that the experiment, which was conducted 'in an old shed in the heart of Cape Town', could be completed away from sources of accidental 'natural' infection. When the nymphs had moulted into adults they were allowed to infest susceptible goats, several of which soon became fatally ill.[72] The vets confirmed from temperature charts and post mortem evidence that this was heartwater. As further proof, the veterinary bacteriologist William Robertson used their blood to reproduce the disease in other goats. The red ticks, on the other hand, were apparently non-pathogenic, while a group of goats kept clean of ticks remained perfectly healthy, a result which corroborated the vets' observation that the disease was not directly contagious.[73] Lounsbury concluded that the bont tick was 'unquestionably' an agent in the transmission of heartwater and that 'intermittent parasites such as ticks are the chief if not the sole agents is, it seems, beyond question.'[74]

This was convincing evidence and Hutcheon, previously sceptical, now agreed that the bont tick was the principal if not the only medium of communicating heartwater to sheep and goats.[75] There was a growing perception both among Eastern Cape farmers and officials that this was worthwhile and important research. This was reflected in an increase in the scale of the heartwater experiments in 1901, when the Cape government purchased 50 goats and funded an experimental station at Rosebank, near Cape Town, with costs charged to the veterinary vote.[76]

There was also some controversy about which animals were affected by heartwater. In giving evidence to the Stock Diseases Commission, John Webb had explicitly linked heartwater to cattle. 'Boschsickness' or 'gallsickness' of cattle were also, he argued, caused by the bont tick.[77] Lounsbury, however, noted that Edington claimed to have produced a case of heartwater in an ox by blood inoculation, which suggested that the disease might occur naturally in cattle.[78] Hutcheon thought that it would be of great practical value to know the relations between cattle, sheep, goats and ticks in the propagation of the disease, for although heartwater seemed to affect small stock exclusively, the bont was primarily a cattle tick.[79]

Hutcheon doubted that heartwater was a cattle disease,[80] but nevertheless sent Lounsbury two calves from the Elsenburg Agricultural School for transmission experiments.[81] Lounsbury and the vets began by infesting the calves with infected nymphs collected in Somerset East. Both of these animals became ill, but post-mortem failed to reveal the characteristic lesions of heartwater. The next

72. CPP [G.18-1901] *Report of the Government Entomologist for the Year 1900*, 16. The goats were brought from Stellenbosch which was free of heartwater to ensure that they could not have acquired immunity through exposure to the disease.
73. *AJCGH*, vol. 19(4), 1901, 310.
74. The above paragraph is largely a summary of C.P. Lounsbury 'Tick-heartwater experiments', *AJCGH*, vol. 16(11), 1900, 682-7.
75. CPP [G.27-1901] *CVS, 1900*, 8.
76. CPP [G.29-1902] *Report of the Government Entomologist for the Year 1901,* 44-5.
77. CPP [G.3-'77] *Stock Diseases Commission,* evidence of J. Webb, 108-9.
78. CPP [G.29-1902] *Report of the Government Entomologist for the Year 1901*, 35. Edington reported that he had transmitted heartwater between goats and oxen. He was at that time developing a theory that horsesickness, heartwater and gallsickness were the same disease manifest in different animals. See CPP [G.27-'99] *Report of the Director of the Colonial Bacteriological Institute for the Year 1898*, 79-82.
79. CPP [G.27-1901] *Reports of the CVS and the Assistant Veterinary Surgeons for the Year 1900*, 8.
80. CPP [G.41-'94] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1893*, 4-6. Hutcheon thought that the high incidence of deaths in calves was caused by 'liversickness', which had first appeared in Bathurst and Peddie in the late 1870s, and had subsequently spread to Albany, Victoria East and Bedford.
81. *AJCGH*, vol. 21(2), 1902, 165.

phase of the experiment was to determine whether the disease could be transmitted from the calves to susceptible goats. The scientists fed larval bont ticks on the sick calves and collected blood samples. Both the bite of nymph and blood inoculation killed goats, but while the temperature curves were characteristic of heartwater, the characteristic post-mortem lesions were absent. The vets, however, found that they could produce heartwater in its typical form by 'passaging' the disease through several generations of goats by blood inoculation.[82] Lounsbury concluded that there was 'no doubt whatever' that heartwater could be transmitted between calves and small stock by the bont tick.[83] He conducted a series of experiments using similar techniques to settle several significant questions about heartwater: if the bont tick was infective in all the stages of its life cycle; if other species of tick were also carriers; if there was a specific stage of the disease when animals were most likely to infect ticks; and if recovered animals remained a source of infection.[84] Thus germ practices, combined with the observational methods of entomology, were used to determine the pathogenicity and transmission of heartwater.

By the end of 1902, therefore, the role of the bont tick in the transmission of heartwater was well documented and substantially proven. The collaboration of vets, entomologists and some progressive farmers had confirmed long-standing popular beliefs about heartwater. But relatively little was known about the aetiology of the disease and germ practices (such as microscopic examination) failed to reveal a 'bacteriological' cause. From the public perspective, the most convincing feature of the experiments was Lounsbury's demonstration of the transmission of heartwater by ticks. Thus the role which various environmental factors played in the propagation and transmission of the disease was more important than germ theory in suggesting methods of prevention.

This success pointed to new lines of research. During the mid-1890s Hutcheon first encountered a disease in dogs which he called 'malignant jaundice' or 'malignant malarial fever'. The major clinical features, fever, brown urine and a generally jaundiced condition were similar to redwater. By 1893, Hutcheon (evidently influenced by the Smith and Kilborne report) thought it was a specific 'blood disease' in which the red blood corpuscles were broken up and destroyed by a parasite.[85]

As part of the considerable surge in experimentation which followed the expansion of the veterinary branch during the rinderpest epizootic, the government vet James Spreull began a study of malignant jaundice of the dog in Cape Town during 1899. Using a series of dogs which had been impounded by the Sanitary Department and supplied free of charge by the Mayor, Spreull found he could pass the disease from one animal to another by blood inoculation - strong evidence that this was also a 'germ' disease.[86] He sent blood samples for analysis at the Bacteriological Institute, Grahamstown, where Edington's assistant, Carrington Purvis, discovered 'a pyriform intracorpuscular microbe, bearing a strong resem-

82. Pasteur had found the virulence of some disease causing micro-organisms could be altered by a series of passages through animals. This technique was used for Pasteur's rabies vaccine. Geisson, *The Private Science of Louis Pasteur* (Princeton, 1995).
83. *AJCGH*, vol. 21(2), 1902, 169.
84. C.P. Lounsbury, 'Heartwater in sheep and goats', *AJCGH*, vol. 21(4), 1902.
85. *AJCGH*, vol. 6(24), 1893, 746.
86. CPP [G.35-1900] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1899*, report of Hutcheon, 8.

blance to the now well-known redwater organism.'[87] Although redwater did not occur on the Cape peninsula, Spreull had often seen ticks on dogs suffering from 'malignant malarial fever' and thought that they probably transmitted the disease.[88]

Research into 'malignant jaundice' was a collaboration between Lounsbury and William Robertson, newly acquired by the veterinary branch from the Bacteriological Institute, where he had been working as Edington's assistant.[89] Robertson, who had taken over the investigation of the disease from Spreull during 1900, confirmed the presence of Carrington Purvis's blood parasite in 'malignant jaundice' cases. While the intracorpuscular parasite of malignant jaundice in some ways resembled the *Pyrosoma bigeminum* of redwater fever, he thought that the 'oat-shaped' parasite of 'biliary fever' was a distinct organism which caused a specific disease.[90]

Lounsbury's experiments were simplified by the veterinary observation that only one species of tick infested dogs in the Western Cape, which Prof. Neumann of the Veterinary School at Toulouse identified as *Haemaphylasis leachi*.[91] The behaviour of the canine tick was very different from the blue tick; it was a very active creature which left its host at each stage of its life cycle, remaining on the animal only briefly. The canine tick, like the bont tick, therefore had the potential to transmit disease to other hosts at later stages in its life cycle.[92] The transmission experiments revealed some surprising variations. Larvae and nymphs hatched from eggs laid by adults which had fed on a sick dog failed to produce symptoms. To Lounsbury's surprise, however, dogs infested with the adults derived from this generation died of typical malignant jaundice. By September 1901 Lounsbury was able to conclude that:

> It appears satisfactorily proved that the common dog tick at the Cape, *Haemaphysalis Leachii*, Audouin transmits the infection of malignant jaundice through its progeny; and that such progeny normally remains incapable of transmitting the infection it inherits until it attains the adult stage.[93]

These findings were significant in two ways. First, they provided substantial evidence that the tick did not merely transfer the causal parasite mechanically from diseased to healthy animal, but that the parasite developed within the tick, a point of considerable scientific interest.[94] Secondly, they demonstrated a variance in patterns of disease transmission that was of great significance for strategies of disease control. Redwater, heartwater and 'malignant jaundice' were transmitted by different species of tick with varying life 'habits', which became infective at different stages of the life cycle.

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87. Edington, who was researching horsesickness in Mashonaland at this time, failed to mention this discovery in his published annual report. Carrington Purvis left the Bacteriological Institute shortly afterwards, apparently because of conflict with Edington about work. Gilfoyle 'Veterinary science and public policy', 132.
88. CPP [G.35-1900] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1899,* report of Spreull, 45.
89. *Ibid*., 1.
90. CPP [G.27-1901] *Reports of the CVS and the Assistant Veterinary Surgeons for the Year 1900*, 24.
91. CPP [G.6-1903] *Report of the Government Entomologist for the Year 1903*, 27; CPP [G.57-1902] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1901*, report of Robertson, 26.
92. C.P. Lounsbury, 'Transmission of malignant jaundice of the dog by a species of tick', *AJCGH*, vol. 19(11), 1901, 716.
93. *Ibid*., 722.
94. This was one feature of Texas fever which was not settled by Smith and Kilborne.

When outbreaks of an extremely virulent disease called 'Rhodesian Redwater' were reported in Rhodesia and the Transvaal late in 1901,[95] much was therefore already known about the role of ticks in the transmission of animal disease. As consensus emerged among the various veterinary researchers in the Transvaal and Cape that this was a new disease, East Coast fever, tick propagation was virtually taken for granted.

Lounsbury began a new series of experiments which revealed the brown tick (*Rhipicephalous appendiculatus*) as the most important vector, although some others, for example, the Cape brown tick (*R. capensis)* were potential carriers.[96] Again there were variations in transmission. The infection did not pass from the adult to the egg and the ticks left the animal at each stage of their cycle, so Lounsbury concluded that the 'transmission of African Coast fever depends on this change of hosts.'[97] Unlike in heartwater, the infected tick lost the infection once it fed on a 'clean' animal, and was therefore likely to infect one host during its life cycle. Each infected animal, however, could scatter thousands of infective larvae or nymphs onto the pasture. This was important for prevention, because the experiments showed that cattle might be capable of infecting ticks several days before they became visibly ill and could be isolated or destroyed.[98]

Between 1898 and 1903 vets and entomologists established that ticks transmitted several animal diseases. This was laboratory research, but the methods used were systematic rather than complex or esoteric. Although causal micro-oganisms were identified for several diseases (redwater, East Coast fever and canine 'malignant jaundice'), it was the account of the relation between various ticks, their lifecycles and environment, animal hosts and the transmission of disease which convinced the farming public. Lounsbury's methods were transparent to the stock-owning public and confirmed long held beliefs.

During the same period vets at the Cape attempted to devise protective inoculations or vaccines against some of these diseases. These were based on methods which had been used with some success during the rinderpest epizootic, but tick-borne diseases presented veterinary researchers with considerable technical difficulties. At this stage, in spite of a considerable amount of experiment, they were unable to demonstrate effective prophylactics. Consequently they saw tick destruction as a more promising means of prevention than methods based on germ practices, such as protective inoculation.[99] Reductionist germ theories did not therefore dominate veterinary discourse about the nature and prevention of these diseases. The Cape vets perceived that the relation of the disease to environmental factors was essential to both understanding and prevention. Accordingly, vets and experimentally minded farmers in the Colony began to devise strategies for dealing with the tick threat.

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95. Cranefield, *Science and Empire*, 22-3.
96. C.P. Lounsbury, 'Ticks and East Coast fever', *AJCGH*, vol. 28(5), 1906, 634-43.
97. *Ibid.,* 635. For a detailed account of East Coast fever research, see Cranefield, *Science and Empire*, 150-163; also Brown 'Progressivism, agriculture and conservation', 166-168 ; Gilfoyle, 'Veterinary science and public policy', 227-233.
98. Lounsbury, 'Ticks and East Coast fever', 643.
99. Gilfoyle. 'Veterinary science and public policy', chapter 6. The Cape vets found they could use a blood injection to protect susceptible cattle against redwater, but this was a risky operation.

Experimenting with technology

The experimental proof that ticks transmitted several stock diseases was a powerful influence on the way vets, officials and farmers thought about prevention. For Hutcheon, previously sceptical, tick transmission explained much about the apparent relation of certain diseases to climate, environment and locale.[100] For many farmers in the heartwater area, Lounsbury's work was authoritative. Ticks were something that farmers could understand as a factor in the incidence of disease. They were visible, sometimes large and infested stock in enormous numbers, while their blood-sucking habits and vicious bite were an obvious source of harm to animals.[101] They were more convincing as a *cause* of disease than 'microbes', which inhabited a mysterious and invisible world, revealed only through the esoteric language and practice of bacteriology. Ticks were something with which practical men might be able to deal.

From late 1902, officials in the Cape's Department of Agriculture began, through the *Agricultural Journal*, something of a 'propaganda war' against ticks, which were now accepted as the cause of the collapse of the wool industry in the Eastern Cape. Ticks had become 'a terrible scourge' in parts of the Colony, upon which they imposed a 'peculiar form of blood tax'.[102] The significance of Lounsbury's work was described in terms of its potential economic importance; tick eradication was a means of:

> Ultimately winning back the thousands of acres which have been rendered useless for small stock owing to the prevalence of this scourge … That part of the country would be rehabilitated, and again become the great meat and wool producer of South Africa.[103]

By 1902 the time had come, according to the *Journal*, when 'the destruction of ticks becomes as much an affair of national importance as the eradication of scab.'[104] The tick problem, it was argued, threatened both the urban and rural communities because it limited pastoral production and reduced the food supply.[105] Nevertheless, the *Journal* was unable to support legislation against the tick menace or to justify public expenditure on tick eradication campaigns. Instead, it exhorted farmers to begin the task of tick eradication by using sprays and linked the problem of disease control to fencing, that other mainstay of progressive farming. Farmers were urged to divide the pastures into paddocks, which would allow the regenera-

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100. Although Hutcheon did not mention 'tropical diseases', he was working at the time of the establishment of the discipline of tropical medicine and was undoubtedly aware of the growing significance of insect vectors. On tropical medicine see M. Worboys, 'Germs, malaria and the invention of Mansonian tropical medicine: from 'diseases in the tropics' to 'tropical diseases', in D. Arnold, ed., *Warm Climates and Western Medicine: the Emergence of Tropical Medicine* (Amsterdam, 1996), 181-207.
101. Colin Story, the dipping tank supervisor, reported counting 1,752 larval ticks on a piece of hide measuring 7.5 by 3.5 inches. See CAD, CVS 1/68 417, Story to CVS, 21 May 1905.
102. *AJCGH*, vol. 21(4), 1902, 290.
103. *Ibid*., 291-2. Uitenhage, Jansenville, part of Somerset East, Albany, Alexandria, Bathurst, Peddie, King William's Town, Komgha and Stutterheim were identified as the districts most seriously affected by the 'tick plague'.
104. *AJCGH*, vol. 21(5), 1902, 406.
105. *AJCGH*, vol. 23(3), 1903, 235-6.

tion of natural vegetation and enable the segregation of tick-infested from clean cattle.[106] As early as 1894, the Secretary for Agriculture, Charles Currey, had urged farmers 'to adopt some inexpensive means such as sulphur, for keeping the cattle free of ticks.'[107] In 1902, in the light of his discoveries about the bont tick and the transmission of heartwater, Lounsbury urged farmers in the affected areas to 'bestir themselves to learn what measures are of most value in destroying the tick'[108] and to experiment with various means of killing ticks and 'starving them out'.[109]

In this regard, the lead was taken from both from the USA and Australia, where, following Smith and Kilborne's discoveries, tick eradication was being used to prevent Texas fever.[110] Drs Francis and Connaway at the Texas Agricultural College demonstrated that lime and sulphur dips could damage ticks on the host, while in Australia arsenic dips were found to be effective in tick killers.[111] Spraying with these fluids was another method of tick destruction, although dipping in tanks, which entailed the immersion of the whole animal, was considered more effective. In the USA, the construction of public and private dipping tanks was subsidised from public funds.[112] Cape officials began to report these developments in the *Agricultural Journal* in 1896, a few years before Lounsbury's discoveries.[113]

At the Cape, where there was a strengthening belief that similar methods could be used, farmers took the initiative in investigating anti-tick measures. The rinderpest epizootic temporarily eclipsed the heartwater problem, but by 1898 some farmers were investigating various means of tick eradication. One was Arthur Douglass, the Albany MLA, who had a long-standing interest in stock disease and had served on the Stock Diseases Commission of 1876-77.[114] He was particularly interested in using spray pumps to kill ticks. Finding the various American pumps unsatisfactory, he designed and patented his own model which he marketed around the Eastern Cape.[115] In 1898 Douglass arranged a public display of the spray at his model farm 'Heatherton Towers' during which cattle were driven through a funnel and along a narrow concrete race where pumps installed in the walls sprayed the animals with an emulsion of paraffin oil. He claimed that it killed all the ticks within half an hour and that cattle could be treated at a rate of 60 per hour.[116]

Official parsimony perhaps dictated that spraying was favoured over a subsidy for dipping tanks. It was a 'farmer's remedy' that could be carried out and paid for by the individual.[117] The government vet, R.W. Dixon, began an evaluation of

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106. *AJCGH*, vol. 21(5), 1902, 407.
107. CAD, BIG (Bacteriological Institute, Grahamstown) 1/1/1, Under Secretary for Agriculture to Edington, 28 June 1894.
108. CPP [G.29-1902] *Report of the Government Entomologist for the Year 1901*, 70. This report appeared in full in *AJCGH*, vol. 21(4), 1902, 315-35. With the exception of Robert Koch on rinderpest, Lounsbury was the only scientist investigating animal disease who had the full text of his reports published regularly in the *Agricultural Journal*. It was a measure of the importance that officials ascribed to Lounsbury's work.
109. CPP [G.29-1902] *Report of the Government Entomologist for the Year 1901*, 72-3.
110. Texas fever was known as Queensland tick fever in Australia.
111. Smithcors, *The American Veterinary Profession*, 444; Hutson, 'Texas fever in Kansas', 93.
112. Hutson, 'Texas fever in Kansas', 93-95. Arsenic dips were first used in the USA in 1906 but were in use before that at the Cape. Palladino argues that the use of arsenic against crop pests became a 'hallmark of progressive agriculture' in the USA from the 1870s. Palladino, *Entomology, Ecology and Agriculture*, 30.
113. See *AJCGH*, vol. 9(8), 1896, 186-7; vol. 9(12), 1896, 229; vol. 9(15), 1896, 388; vol. 9(20), 1896, 517; vol. 10(11), 1897, 638; vol. 11(5), 1897, 240; and vol.13(6), 1898, 331, 336.
114. CPP [G.3-'77] *Stock Diseases Commission*, v.
115. This device was known as 'Douglass's Patent Syphon Pump' and could be used both for spraying cattle and fruit trees. See *AJCGH*, vol. 14(12), 1899, 814.
116. *AJCGH*, vol. 12(9), 1898, 498-9.
117. *AJCGH*, vol. 21(5), 1902, 405-6.

various insecticidal sprays on ticks in 1899. Without funds specifically earmarked for these experiments, Dixon was dependent on the goodwill of farmers interested in the heartwater question. Cross, an Adelaide farmer, made his farm 'Umdalo' available and donated some cattle, while Dixon appealed to farmers to send in 'a few old sheep and goats' for experimental purposes.[118] Using an American 'Deming Success Pump',[119] Dixon sprayed cattle with several substances, including Dynamo Cattle Oil (a commercially marketed American product consisting of paraffin oil mixed with sulphur), various grades of paraffin, Cooper's Dip (a commercially marketed arsenic-based sheep dip) and a local 'solution of Cape aloes'. Apart from the aloe solution, all these substances killed ticks, but the paraffin and sulphur mixture blistered the skin. Dixon was particularly impressed by the insecticidal properties of the arsenic dip, which seemed to prevent re-infection for a longer period than paraffin.[120]

The investigation of arsenic dips at the Cape was particularly associated with the Adelaide dairy farmer Llewellyn Roberts, whose farm, Cottesbrook, became a centre for dipping experiments in the early 1900s. Roberts was convinced that if ticks had ravaged stock farming in the eastern districts, farmers could use technology to control them. In 1899 he read a paper to the Fort Beaufort and Adelaide Farmers' Association. Adopting the moral tone of a self-conscious 'progressive', he exhorted his fellow farmers to take action:

> Now gentlemen, you have got to face this. Are you satisfied to sit still and gradually see your farms ruined by these little pests? Will you be satisfied in twenty years or less to give up your sheep and your cattle for fruit growing as the Lower Albany farmer is doing today.[121]

Roberts invited Lounsbury to Cottesbrook to devise a means of destroying the large and resilient bont tick.[122] They worked on a comparatively large scale with 70 head of cattle, which were driven through a concrete spraying race built on the Douglass model.[123] The hardy adult female bonts were impervious to both the old lime and sulphur scab dips and the arsenical Cooper's dip.[124] More effective was 'Smith's Scrub Exterminator', an imported product consisting of arsenic and caustic soda which was used to destroy prickly pear.[125] Strong solutions were fatal to all kinds of tick but seriously scalded the cattle. It seemed possible, however, to devise a concentration which would kill ticks without damaging the animals. The Cape government was importing 'Scrub Exterminator' from London at a cost of £32 per ton, but Lounsbury found that an equally effective non-proprietary 'arsenite of soda' could be purchased at £19 per ton.[126] Furthermore, Hutcheon reported

118. CPP [G.35-1900] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1899*, report of Dixon, 37.
119. This was an American pump, first marketed in 1894.
120. CPP [G.35-1900] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1899*, report of Dixon, 38.
121. *AJCGH*, vol. 14(6), 1899, 371.
122. CAD, CVS 1/68 417, Lounsbury to CVS, 21 Nov. 1899.
123. CAD, CVS 1/68 417, 'Tick destruction experiments - notes of various substances tested at Cottesbrook', undated memorandum by C.P. Lounsbury, 8.
124. The Government Analyst found Cooper's Dip to contain 20 per cent arsenic.
125. On the eradication of prickly pear, see W. Beinart, 'Colonialism and species suppression: prickly pear in South Africa', Conference on Environmental History, Funchal, Madeira, April 1999.
126. CAD, CVS 1/68 417, 'Tick destruction experiments - notes of various substances tested at Cottesbrook', undated (probably August 1904) memorandum by C.P. Lounsbury, 3.

an article in the *Queensland Agricultural Journal* about the use of arsenic solutions in dipping tanks and speculated that this might be the most effective means of dealing with ticks.[127] The South African War, however, was now in progress and the Cape government shelved further investigations, which were left in the hands of individual farmers.

By 1903 'African Coast fever' brought the tick problem back to the top of the pastoral agenda. Lounsbury's demonstration that the brown tick, a species common and widespread in the Cape Colony, could transmit this disease did nothing to reassure farmers.[128] The *Agricultural Journal* noted that 'uneasiness and anxiety' were growing among farmers in the eastern districts of the Cape as the spread of the disease in the Transvaal was reported. With a reported mortality rate of above 90 per cent, the disease seemed frighteningly virulent. It was feared that the African Coast fever might work its way down from Natal and reach the Eastern Province through the Transkeian 'native territories'.[129]

The 'tick plague' was a major subject of discussion at the annual Congress of the South African Agricultural Union in April 1903. Elliot, the delegate of the Lower Albany Farmers' Association, urged legislation for the compulsory eradication of ticks. The work of the 'progressive man' in spraying, he argued, was undone by 'the carelessness and apathy of the others', particularly those from the inland districts who continually introduced tick-infested cattle. The need to eradicate ticks in order to enable economic development was thus presented as a moral imperative. Hutcheon, however, argued against compulsion; given the importance of ox-wagon transport, legislation which interfered with the movement of cattle would be difficult to enforce. But the Congress did agree to call on the Cape government to establish an experimental farm to investigate methods of tick eradication more fully.[130]

By the end of 1903, however, nothing had been done. This embarrassed Hutcheon because he had assured Farmers' Congress that dipping experiments would be carried out over the summer of 1903-04.[131] He argued that this was 'the most important matter at the present moment' and urged the Secretary for Agriculture that 'the department will simply be disgraced if it is not hurried through'. It was impossible for the vets to give farmers authoritative advice on dipping while they were 'not in a position from personal experience to give them any.'[132] This had the desired effect, for, early in 1904, Hutcheon was at Cottesbrook discussing with Roberts the construction of a funded dipping tank, which was completed in 1904.[133]

Private enterprise, however, preceded the government on the dipping issue. A Fort Beaufort farmer, Gordon Campbell of Rocklands, completed a tank in May 1903. This tank, which had cost about £100 to construct, was claimed to be very effective at killing ticks and could allegedly process 60 cattle in four minutes.[134]

127. CPP [G.35-1900] *Report of the CVS and the Assistant Veterinary Surgeons for the Year 1899*, 31-2.
128. CPP [G.6-1904] *Report of the Government Entomologist for the Year 1903*, 12-3.
129. *AJCGH*, vol. 23(4), 1903, 385.
130. *AJCGH*, vol. 23(3), 1903, 249-53.
131. CAD, CVS 1/68 417, Chief Veterinary Surgeon to Under Secretary for Agriculture, 24 Dec. 1903.
132. CA CVS 1/68 417, CVS to Under Secretary for Agriculture, 25 Nov. 1903.
133. CPP [G.41-1904] *Reports of the CVS and the Assistant Veterinary Surgeons for the Year 1903*, 4.
134. *AJCGH*, vol. 24(2), 1904, 244.

Others soon followed: in Bathurst, two farmers, William Ford and Stephen Smith, began the construction of a cement and concrete structure at a cost of £150;[135] and at Kei Road, King William's Town, another farmer, Robert Warren was arranging for the construction of a public dipping tank.[136]

These tanks were based on Australian models, or more specifically on a tank that was already in operation at Nel's Rus in Natal. Cattle were driven into the crush pen and then along a fenced concrete race, perhaps 40 foot in length, before entering the dipping tank itself. The tank, constructed of concrete and about five and a half feet deep, was sunk into the ground. Cattle plunged from a shelf into a tank and emerged thoroughly soaked into a fenced yard, where they remained until the excess dip had drained from them. These were substantial, permanent and expensive structures which cost between £100 and £150, a significant investment of capital.[137]

At Cottesbrook the tank supervisor, Colin Story,[138] investigated the effectiveness of the various dips and worked out that fortnightly dipping would be enough to reduce tick numbers.[139] All the arsenic dips killed ticks if used in sufficient concentrations. The blue ticks were relatively easy to kill in all stages of the life cycle, but the large female bonts were highly resistant and could only be destroyed by strengths sufficient to harm the cattle. Nevertheless, the bont larvae and nymphs could be destroyed by useable strengths and Story thought the bont tick population could be 'exhausted' by regular long-term dipping.[140] The major drawback to dipping in arsenic solutions was that cattle were unable to work for several days afterwards, making it difficult for small farmers and transport riders to dip regularly.[141]

Commercial dip manufacturers were aware of a potential market at the Cape. Several requested Hutcheon to include their products in the Cottesbrook trials in the hope that official endorsement would lead to increased sales.[142] The British dip manufacturer, William Cooper & Nephews, acquired a tick-infested farm at Gonubie, near East London, for tick eradication experiments. The trials ran until 1910 when Laws and Manning, two chemists employed by the company to manage the experiments, reported the farm to be virtually free of both ticks and heartwater. Veld burning and 'starving out' ticks by removing animals for extended periods had some effect, but dipping was the essential method for eradication, not only killing ticks on the animal, but also breaking their reproductive cycle.[143]

Hutcheon was unwilling to endorse any of the proprietory dips, instead concentrating the cheaper arsenite of soda which had been recommended by

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135. *Ibid*., vol. 24(6), 1904, 717.
136. *Ibid*., vol. 25(1), 1904, 7.
137. Instructions on constructing a tank were published in *AJCGH*, vol. 25(2), 1904, 193ff. The cost was substantially less than that of fencing an average farm, which was estimated at between £600 and £1,000 in the 1880s. See chapter 3.
138. Hutcheon arranged for his appointment at a rate of 15 shillings a day. CAD, CVS 1/68 417, CVS to Under Secretary for Agriculture, 24 Nov. 1903.
139. Dips used were 'Little's Cattle Tick Dip', 'Hayward's Paste Dip', 'Alderson's Cattle Tick Dip', 'Royal Cattle Dip', 'Dr Muth's Cattle Dip', 'Quibble's Cattle Tick Dip' which were imported from Britain, as well as a local produce 'Fletcher's Albany Tick Dip'. The manager of Fletcher's in Grahamstown was G.D. Atherstone. CAD, CVS 1/66 351, G. Atherstone to CVS, 25 July 1908.
140. CAD, CVS 1/68 417, Story to CVS, 6 Mar. 1905.
141. CPP [G.47-1906] *Report of the CVS and the Assistant Veterinary Surgeons for 1905*, 34.
142. See CAD, CVS 1/65 346, Morris, Little and Son to CVS, 22 Aug. 1904; CAD, CVS 1/65 347; Hayward, Young and Co. to Chief VS, 26 Oct. 1903; CAD, CVS 1/66 351, J. Fletcher to CVS, 29 Sep. 1904.
143. H. Laws and B. Manning, 'Eradication of ticks by the starvation method', *AJCGH*, vol. 37(1), 1910, 9-17.

Lounsbury. Story found that a pound of arsenite of soda dissolved in 25 gallons of water killed most ticks without seriously harming cattle, while the addition of soap gave the solution an added 'stickiness', which kept it on the animals' hide for a longer period. He noted, however, that cattle could not be worked for several days after dipping, and that arsenical dips were probably unsuitable for use on sheep. Nevertheless, Hutcheon offered the dipping of cattle in a solution of arsenite of soda and soap as a cheap and effective method of killing ticks.[144]

Not all farmers were convinced of the benefits of dipping. William Piggott, a Highlands farmer, thought that tick eradication would be 'a most costly operation', which would take 'half-a-lifetime to complete',[145] and even F.D. MacDermott, the editor of the *Agricultural Journal*, acknowledged that it was 'a tall order'.[146] Perhaps the staunchest opponent of dipping among progressive farmers at this time was Arthur Douglass, who continued to advocate spraying as a more effective method. At the 1905 annual congress of the Agricultural Union of the Cape Colony, Douglass criticised dipping because it failed to kill the adult female bont tick, thus allowing, he thought, the propagation of a new generation of the species. Perhaps concerned that his own spray pump would be driven from the market, he accused Roberts of having 'done much harm' by making exaggerated claims for arsenic dips. Dipping every 14 days was, he argued, unlikely to have much impact on the bont tick, a creature that spent most of its life off the animal.[147] He also believed that the idea of centralised dipping tanks was seriously flawed, because it allowed opportunities for cattle to both pick up and disseminate infective ticks. The veterinary department was fond of pointing to the example of Australia, but, he argued, 'Queensland is a far-off country where they have no bont ticks, and where we have no exact information of what they are doing.'[148] Douglass thought that the peculiar nature of the problem at the Cape required particular technological solutions.

In spite of these objections, a broad consensus was emerging among farmers, officials and government vets in favour of dipping against ticks. Story was able to visit 14 dipping tanks in Fort Beaufort and Albany during 1905.[149] By 1909 the number of dipping tanks in the Colony had increased to 175.[150] As the Coopers scientist, Williamson put it, 'all the most progressive men are leaving spraying for dipping.'[151] The perceived need for measures to control disease by tick destruction was voiced politically through farmers' associations and their congresses. By 1904, Cape farmers were aware that the common brown tick was a means of transmitting 'African Coast fever', and demands for legislation became more pressing and specific. In 1904 the Cape Farmers' Congress submitted that 'a very large percentage of cases and deaths now affecting the herds of the country, especially the coast lands, are caused directly and indirectly by ticks.'[152]

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144. CPP [G.47-1906] *Report of the Chief Veterinary Surgeon and the Assistant Veterinary Surgeons for 1905*, 34.
145. *AJCGH*, vol. 21(5), 1902, 475.
146. *Ibid*., vol. 22(6), 1903, 642.
147. *AJCGH*, vol. 27(3), 1905, 391.
148. *Ibid*., vol. 27(1), 1905, 110-1.
149. CAD, CVS 1/68 417, Story to CVS, 6 Mar. 1905.
150. *AJCGH*, vol. 35(4), 1909, 472-3.
151. *Ibid*., vol. 27(4), 1905, 536.
152. *Ibid*., vol. 24(4), 1904, 497.

Congress requested the government to introduce mandatory cattle dipping measures, arguing that 'natives' would never dip unless compelled, and demanded loans from the divisional councils for the construction of dipping tanks.[153] These demands lay behind the Cape government's initiation of a policy on cattle dipping in September 1904, when limited funds were appropriated to subsidise 50 per cent of the cost of dipping tanks in the eastern districts of the Colony. They also led to the promulgation of a Cattle Cleansing Act in 1908, which made it illegal for owners to drive tick-infested cattle on public roads, commonages and outspans.[154] This provoked little controversy in the House of Assembly as the decision to impose the legislation was devolved to divisional councils. The act was quickly adopted in the predominantly Anglophone Eastern Cape districts.[155] The Cape government also extended its dipping policy to the Transkei, although after the outbreak of East Coast fever there in 1910, quarantines and embargoes on cattle movement formed the major elements of policy.[156] Dipping legislation was subsequently strengthened, while the technology was refined so that the process could be carried out more frequently.[157] Both were used extensively in later attempts to prevent and suppress East Coast fever in the Eastern Cape districts such as King William's Town after 1910.[158]

Conclusion

Between 1898 and 1902, veterinary and entomological scientists at the Cape constructed a substantial body of knowledge about several tick-borne diseases. Collaboration with the entomologists proved a productive enterprise for the veterinary branch of the Cape's Department of Agriculture, as research revealed the means of transmission for several diseases and detailed the life cycles of various tick species. If the methodology was derived from the work of the Americans Smith and Kilborne, this was nevertheless groundbreaking research into diseases which had not previously been effectively investigated. It formed a basis for the investigation of East Coast fever in the Transvaal. Although vets thought of these diseases as germ diseases in the reductionist sense that microbes were the primary and specific cause, the research into transmission suggested a wider range of environmental factors in explaining disease. By 1902 vets at the Cape linked microbe, vector and environment in a system of causes to explain the incidence of disease. While germ theories and practices informed and underpinned research, such practices failed, however, to suggest effective methods of prevention.

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153. *Ibid*., 496-7.
154. Act no. 31 - 1908. Act to Provide for the cleansing of Tick-infested Cattle in certain Divisions of the Cape Colony. 11 Sep. 1908.
155. In 1909 the Act was in force in East London, Bathurst, King William's Town, Komgha, Albany, Port Elizabeth, Fort Beaufort and Alexandria and was about to be extended to Peddie and Victoria East. *AJCGH*, vol. 35(4), 1909, 472.
156. CAD, CVS 1/60 292, Secretary, Native Affairs Department to Chief Magistrate Umtata, 10 June 1909.
157. The 'five day dip' which was devised by the Natal Vet, Herbert Watkins-Pitchford, was an important innovation in this regard. R.W. Dixon, 'East Coast fever its prevention and eradication', *Agricultural Journal of the Union of South Africa*, vol. 11(1), 1911, 17.
158. CAD 1/89 879 Principal Veterinary Officer, Pretoria to Senior Veterinary Officer, Cape, 19 Sept. 1912.

Policy on disease prevention was therefore aimed at the tick rather than the 'germ'. In this regard, popular opinion was as important as science. Although Lounsbury and his veterinary collaborators had access to a laboratory in Cape Town, experiments were also conducted on farms in the Eastern Province; there was no decisive removal of research to the laboratory at this time. Furthermore, the methods used were systematic rather than complex and remained transparent to public observers. Tick transmission simultaneously confirmed the beliefs of many farmers and explained the 'mystery' of heartwater. Scientific theories about disease and its transmission meshed with popular ideas about the ticks as a *cause* of disease and suggested a means of disease prevention. A consensus therefore emerged between farmers, vets and officials on the need to eradicate ticks. In the Eastern Cape, farmers collaborated with the veterinary branch in experimenting with technology to achieve this end. These experiments provided the basis for and rationale behind later policy on cattle dipping.