Veterinary parasitology in South Africa: Some highlights of the past 100 years

B.L. Penzhorn*, R.C. Krecek

Abstract

The reasons for the wide range of parasites occurring in South Africa are mentioned. An account is given of the establishment of veterinary research and training in South Africa. Some major breakthroughs and advances in the study or the control of ecto- and endoparasites as well as protozoal diseases are listed.

With its great topographical and geographical differences – a large country ranging from tropical to temperate climes, and from rain forests to the oldest desert on the planet – South Africa offers an infinite variety of habitats to an overwhelming variety of animal species, and an equally diverse parasitic fauna. Superimposed on this system are the parasites of domestic animals, brought into the country by successive waves of immigrants: first, the sheep-herding Khoi and later, in the early iron age, the Bantu with their cattle, goats, dogs and chickens. Western Europeans added horses, donkeys, pigs and various species of poultry. The commensal *Rattus rattus* is found in archaeological deposits dating back to 700 A.D. (Plug, 1996).

During the later decades of the previous century, the present Republic of South Africa consisted of four separate states: two British colonies (Natal and the Cape of Good Hope) and two republics (Zuid-Afrikaansche Republiek or the Transvaal and Orange Free State), which were soon to be locked in mortal combat with the might of the British Empire for independence. Natal led the way with the appointment of a colonial veterinary officer: C. Wiltshire was appointed in 1874, followed by the appointment of Duncan Hutcheon in the Cape in 1880. The first colonial Bacteriological Institute was established at Grahamstown in the Eastern Cape in 1891. C.P. Lounsbury was appointed government entomologist in the Cape in 1895. Arnold Theiler, who had immigrated to South Africa in 1891 from Switzerland, was appointed state veterinarian ('paardenarts' or horse doctor) and government bacteriologist in the Transvaal in 1896. The laboratory which he established at Daspoort, Pretoria in 1898 had grown into the Onderstepoort Veterinary Institute (OVI) in 1908. In 1897, H. Watkins-Pitchford succeeded Wiltshire in Natal, and the Allerton Laboratory was founded outside Pietermaritzburg (Theiler, 1975).

Veterinary parasitology really got underway in South Africa during the 1890's. The stimulus for sustained veterinary research in the subcontinent was the onslaught of Rinderpest, which had swept down the continent and reached South Africa in April 1896 (Vogel and Heyne, 1996). By that time a major discovery had already been made. Two years previously, the British army doctor David Bruce, after solving the Malta fever riddle in the Mediterranean, was sent to Natal to investigate nagana, long thought to be associated with tsetse flies, *Glossina* species. He discovered that a trypanosome was the causative organism, and that tsetse flies were the biological vectors (Bruce, 1895). The trypanosome species which he discovered, and which was later named after him, also causes human sleeping sickness.

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Ticks and tick-borne diseases are of great importance in South Africa. Although ticks had long been suspected by South African farmers of being implicated in disease outbreaks, primarily heartwater (cowdriosis), it was the discovery of Smith and Kilbourne, 1893 that bovine babesiosis or 'Texas fever' was transmitted by ticks, that opened up a vast new field of research. In South Africa, the pioneering studies of Lounsbury, 1899, 1900 on the life cycle of *Amblyomma hebraeum* were paramount when he identified *A. hebraeum* as the heartwater vector. He also established that *Haemaphysalis leachii* was the vector of the virulent southern African *Babesia canis* (Lounsbury, 1901).

In 1899, war broke out between the two republics and Britain. This further depleted the already decimated bovine population. The new colonial authorities imported cattle from East Africa and these introduced East Coast fever (ECF) to southern Africa via the ports of Beira and Maputo (previously Lourenço Marques) (Cranefield, 1991). The disease rapidly spread along the transport routes and by 1910 virtually the entire Transvaal, barring the Highveld, as well as Natal and the Transkei region of the Eastern Cape were infected. The protozoan parasite involved, initially regarded as immature babesias by Robert Koch (1898), was named *Piroplasma parva* by Theiler (1904). The genus name

* banie.penzhorn@up.ac.za

Theileria was established in 1907 (Bettencourt *et al*., 1907). Lounsbury (1904), working under primitive conditions in a shed near the Cape Town docks, established that *Rhipicephalus appendiculatus* was the vector. To combat ECF, the authorities instituted compulsory short-interval dipping, a procedure which had been developed in Natal by Watkins-Pitchford (Norval *et al.,* 1992). Although this reduced the occurrence of ECF, it was only when compulsory slaughter of all cattle on infected farms, as well as adjoining farms, was enforced that the disease was finally eradicated in South Africa in the early 1950's (Norval *et al*., 1992).

Shortly after the eradication of ECF, cattle grazing in the corridor between Hiuhluwe and Umfolozi Game Reserves in Natal succumbed to a similar disease. The causative organism, named *Theileria lawrencei* by Willi Neitz (1955) and now regarded as a variant of *Theileria parva,* is also transmitted by *R. appendiculatus*. It has the African buffalo, *Syncerus caffer*, as natural host, but is highly virulent when transmitted to cattle.

Arnold Theiler's pioneering studies on equine babesiosis, undertaken soon after his arrival in South Africa, earned him a doctorate at the University of Berne (Theiler, 1901). Soon after the war he described *Anaplasma marginale*. Although a rickettsia, it is vector-borne and therefore closely associated with the development of parasitology. Theiler succeeded in isolating a mild strain, which he named *Anaplasma centrale* and used as a vaccine (Theiler, 1912). It is still the basis of the vaccine produced in South Africa to this day. A method of vaccinating against bovine babesiosis had been developed by the first decade of the century (Robertson, 1912).

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As director of the OVI, Theiler devoted a lot of attention to parasitic diseases, and recruited various specialists from abroad to assist him. One of the most prominent was Veglia, an Italian who did pioneering work on the nematodes *Haemonchus contortus* and *Oesophagostomum columbianum* (Veglia, 1915, Veglia, 1923). G.A.H. Bedford was appointed as entomologist at the OVI in 1912. He was a taxonomist par excellence, producing a major checklist in 1932 (Bedford, 1932).

Ostrich farming was a major export industry in South Africa in the decades prior to the First World War. After a spectacular crash, the industry stabilised and ostrich farming is currently gaining popularity worldwide. The definitive study on *Libyostrongylus douglassi,* the major helminth of ostriches, was published by Theiler and Robertson (1915).

Veterinary education in South Africa was initiated by Theiler at the University of Pretoria in 1920. Since the inception of the first faculty, there has been a strong emphasis on parasitology in the curriculum. Traditionally, helminthology, ectoparasitology and protozoal diseases are taught as three separate but coordinated subjects, a total of 165 hours (Verster, 1994).

One of the first South African-born parasitologists to enter the field was H.O. Mönnig. Originally trained as a zoologist, Mönnig was persuaded by Theiler to study veterinary science and was a member of one of the first classes graduating at the new faculty. The pioneering book of Mönnig (1934) on veterinary parasitology, lavishly illustrated with his own meticulous drawings, was the standard text for decades. It survives to this day, now edited by Lord Soulsby (1982).

Heartwater was, and remains, one of the main diseases of ruminants in southern Africa. Cowdry (1925a,b), a visitor to the OVI from the Rockefeller Institute for Medical Research in New York, confirmed Theiler's suspicions that the disease is caused by a rickettsial organism by demonstrating the organisms in tissues of infected animals and ticks (Provost and Bezuidenhout, 1987). Until recently, research on heartwater was hampered by the lack of an *in vitro* cultivation system; the breakthrough in this regard by Bezuidenhout *et al.* (1985) was therefore of major significance.

After Bruce's discovery in Zululand, there were various attempts at eradicating tsetse flies from the area. Wildlife was shot on a large scale, but to no avail (Harris, 1932; Mentis, 1976). Harris (1930) studied the ecology of the flies, and devised his famous trap. After the Second World War, large-scale aerial spraying with DDT finally got rid of the tsetse pockets, or so it was thought. This programme was directed by René du Toit (1954). The tsetse flies were never totally eradicated, and trypanosomosis is making a comeback.

Following her father's footsteps, Gertrud Theiler studied biology and was awarded a doctorate by the University of Neuchâtel for a pioneering study on worms of equids in South Africa (Theiler, 1923). She later returned to the OVI, where she became established as a tick expert. Regrettably her magnum opus, a documentation on the ticks of vertebrates of the Afrotropical region was never published; although widely quoted in the literature, it never progressed beyond a cyclostyled report (Theiler, 1962). Her position was later filled by Jane Walker, who must rank as the foremost tick taxonomist on the continent today (Walker, 1982).

Other helminthologists of note at the OVI were the taxonomist Ortlepp and Richard Reinecke who developed various anthelmintic tests, including a nonparametric larval anthelmintic test (Groeneveld and Reinecke, 1969; Reinecke, 1966; Reinecke, 1972). He stimulated research on the epidemiology of helminth parasites of livestock in various parts of the country, notably those of Muller (1968) and Viljoen (1964, 1969). Anna Verster, also working at the OVI, produced treatises on *Taenia* and *Echinococcus* which are still consulted today (Verster, 1965, 1969). She was also a pioneer in using irradiation for the sterilisation of *Taenia cysticerci* in meat (Verster *et al*., 1976).

Bovine besnoitiosis, or 'elephant-skin disease,' was first recorded in South Africa in the 1940's (Hofmeyr, 1945). This tissue cyst-forming coccidian has a fragmented distribution in various parts of the world; the definitive host is as yet unknown. Bovine besnoitiosis was studied intensively at the OVI (Pols, 1960; Bigalke, 1968). A chance finding of *Besnoitia* cysts in the endothelium of large blood vessels of some antelope species in Kruger National Park (McCully *et al*., 1966) led to the isolation of a viscerotropic, rather than dermatropic, strain of *Besnoitia besnoiti* which is grown in tissue culture and used as a vaccine against the disease in cattle (Bigalke *et al*., 1967; Bigalke *et al*., 1974). This was the first commercially available vaccine against a tissue cyst-forming coccidian worldwide.

Karoo paralysis is a peculiarly South African tick toxicosis affecting small ruminants, primarily in the Eastern Cape and Free State provinces, caused by engorging female *lxodes rubicundus*. The ticks are active in winter. All limbs of the host are affected simultaneously. If the ticks are removed, the rate of recovery is high. By studying the ecology of the tick, *Stampa* (1959) could pinpoint the danger zones on farms, which led to rational preventative and control measures.

Ivan Horak's studies on the conical fluke *Calicophoron microbothrium* (previously *Paramphistomum microbothrium*) yielded a successful experimental vaccine against the fluke in cattle and the first highly effective remedy in the world against immature conical flukes in sheep (Horak, 1967). Horak and coworkers published a series of papers on the clinical pathology of various helminth infections in sheep, a field which at the time was only just beginning to be exploited (Horak and Clark, 1963, 1965, 1966; Horak *et al*., 1968). He was also the first to discover that some of the benzimidazole anthelmintics also have cestocidal effects in ruminants (Horak *et al.,* 1972).

After the development of vaccines against bovine babesiosis, very little research was done locally on this disease and its causative organisms, until a detailed investigation of the ultrastructure of various stages of both *Babesia bigemina* and *Babesia boris* was conducted (Potgieter and Els, 1976, 1977a,b, 1979; Potgieter *et al.*, 1976).

Bovine parafilariosis or 'false bruising,' caused by the nematode *Parafilaria bovicola* and transmitted by various *Musca* flies, is an economic factor in beef cattle ranching in the tropical and subtropical parts of South Africa. This prompted an in-depth investigation of the host-parasite interaction and epidemiology (Carmichael, 1981; Nevill, 1981, 1984, 1985; Viljoen, 1976; Viljoen and Boomker, 1977; Viljoen and Coetzer, 1982).

With the advent of many new parasiticides in the 1960's, several of the international pharmaceutical companies established research farms or laboratories in South Africa where these products were tested both for efficacy and toxicity. This work led to a multiplicity of published papers (e.g., see Louw *et al.*, 1980; Snijders and Louw, 1966; van Schalkwyk *et al*., 1983).

Traditionally, wildlife in South Africa was looked upon as a source of parasites or diseases infectious to livestock. Gradually, perceptions have changed and wildlife parasitology has become a field of study in its own right. Over the past two decades a team of parasitologists led by Ivan Horak (ectoparasites) and Joop Boomker (endoparasites) has accumulated a wealth of data on naturally occurring parasites of South African wildlife (e.g., see Horak, 1989; Boomker, 1990). The parasites of wildlife in this region have probably been better documented than in any other region of the world.

Acknowledgement

Previously published in the *Veterinary Parasitology,* Vol 71, 69-76.

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