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THE HISTORICAL BACKGROUND AND GLOBAL IMPORTANCE OF HEARTWATER

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ABSTRACT

PROVOST, A., & BEZUIDENHOUT, J. D. 1987. The historical background and global importance of heartwater. *Onderstepoort Journal of Veterinary Research*, 54, 165–169 (1987).

The first written record of what probably could have been heartwater originates from South Africa and dates back to 1838. Since then, the disease was described from almost aii the African countries south of the Sahara as well as from Madagascar, São Tome, Reunion, Mauritius and a number of islands in the Caribbean. Most research on the disease, at least until recently, was conducted in South Africa. Progress in research was slow but a few outstanding findings are mentioned in this paper.

Despite inadequate information on its actual economic impact on livestock production, it is generally accepted that heartwater is either the most or second most important tick-borne disease in Africa. Depending on the area, heartwater ranks either second or third amongst diseases such as East Coast fever, tsetse-transmitted trypanosomiasis, rinderpest and perhaps also schistosomiasis. Heartwater is a major obstacle with regard to the introduction of highly producing animals intended for the upgrading of local breeds. Furthermore, it remains a major threat to areas such as the American mainland, where potential vectors are present but where the disease does not occur.

HISTORICAL BACKGROUND OF HEARTWATER

The first record of what probably could have been heartwater was, according to Neitz (1968), made in South Africa by the Voortrekker pioneer, Louis Trichardt in 1838. On the 9th of March he mentions a fatal disease, "nintas", amongst his sheep, following on a massive tick infestation approximately 3 weeks previously and which is described in his diary on the 17th of February 1838.

Almost 50 years later a farmer, John Webb, reported to the Cattle and Sheep Disease Commission in Grahamstown, on a disease which apparently, by then, was generally known as heartwater. He was of the opinion that the disease was introduced into the Eastern Cape at about the same time that William Bowker found a bont tick on a cow which was imported from Zululand in approximately 1837. Subsequently, according to Henning (1956), the disease was reported from various parts of South Africa, but due to confusion with other conditions, such as verminosis and pasture deficiencies, all the earlier information regarding the incidence of heartwater cannot be fully relied upon.

It will, no doubt, be interesting to study other historical documents of the previous century in order to fill the gaps in our knowledge regarding the possible introduction and spread of the disease in South Africa, or for that matter, in Africa. Confusion with other prevalent diseases with unknown aetiologies at that time will, however, make this a very difficult task.

There is therefore, still no definite answer as to the question of whether heartwater is a disease indigenous to the African continent or whether it is an imported one. Lounsbury & Robertson, already in 1904, posed this question. The resistance to heartwater exhibited by Persian sheep which were introduced into South Africa during 1872 led them to believe that a possible reason for their resistance could have been previous contact with the disease in their countries of origin. Henning (1956), however, draws attention to the fact that heartwater was known in South Africa long before the first importation of Persian sheep in 1872. He again, was unable to decide whether the disease originated from Madagascar or South Africa.

Reports on the recognition or confirmation of heartwater in other parts of Africa and on certain islands in the rest of the world have been studied and summarized by Camus & Barré (1982). Their information was used as a basis to compile a map on the global distribution of heartwater (Fig. 1).

Despite the fact that certain *Amblyomma* species occur on the Asian continent, there is no evidence to believe that heartwater exists in that part of the world.

Apart from the distribution of 2 American *Amblyomma* species (*A. maculatum* and *A. cajennense*) which were found to be capable of transmitting the disease in the laboratory (Uilenberg, 1982a), the distribution of heartwater, in general, corresponds closely to that of its recognized vectors (Walker & Olwage, 1987).

In their review, Camus & Barré (1982) also mention a few countries where the presence of the disease has possibly been reported incorrectly or in which it may occur accidentally. Countries from where the disease has not been disecrebed, but where it is likely to occur, are also mentioned.

Although not conclusive, the above information suggests that heartwater is an indigenous disease of Africa.

Historical aspects of research on heartwater

The history of heartwater research is a story of great dedication and perseverance of many workers in this field. Progress has, however, been relatively slow and there have been very few significant breakthroughs. The mere fact that research over almost a century has still not provided a satisfactory method of control is a clear indication of the great difficulties that researchers have had to deal with.

An insight into the history of the different aspects of heartwater research will be gained from the different topics presented at this Workshop. It is fully realized that all available information on heartwater will be beneficial to a better understanding of the disease. There are, however, a few aspects which, from a historical point of view, deserve special mention.

The first major breakthrough came when Dixon (1898) and Edington (1898) proved that the disease could be produced artificially by the intravenous inoculation of blood from sick to susceptible animals. Despite the fact that no organisms could be demonstrated in the blood or other tissues of diseased animals, it was concluded that heartwater is caused by a living microorganism (Hutcheon, 1900), at that time believed to be a filterable or ultravisible virus (Spreull, 1904).

At about the same time Lounsbury (1900), in a series of well-planned experiments, confirmed the long-stand-

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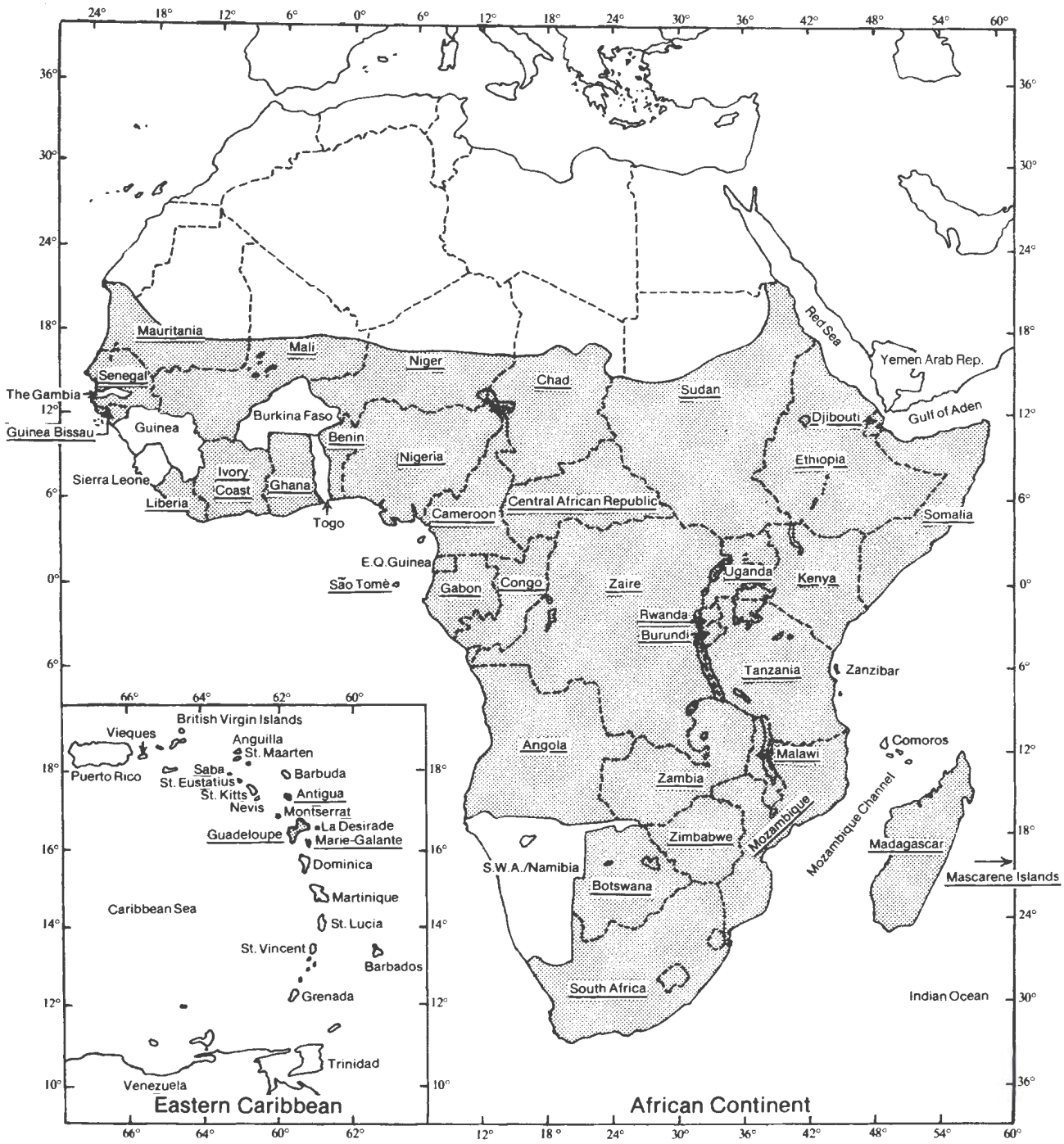

FIG. 1 The global distribution of heartwater. Names of countries and island from which the disease has been reported are underlined

ing suspicion that the bont tick *(A. hebraeum)* is the vector of heartwater in South Africa.

The discoveries of Dixon (1898) and Lounsbury (1900) made it possible to reproduce heartwater in the laboratory and from then on much attention was given to defining the disease in order to develop some form of control (Dixon & Spreull, 1899; Dixon, 1910; Spreull, 1904; 1922; Theiler, 1905; 1909; 1911; 1921; Theiler & Stockman, 1905).

One of the most important discoveries was made at Onderstepoort by Cowdry (1925 a & b), a visiting rickettsiologist from the Rockefeller Institute for Medical Research in New York. He confirmed the suspicion of Sir Arnold Theiler that heartwater is caused by a rickettsia, by successfully demonstrating the organisms in the tissues of affected animals and in infected ticks. He also named the aetiological agent of heartwater *Rickettsia ruminantium*. The name was later changed to *Cowdria ruminantium* (Moshkovski, 1947).

The discovery by Cowdry inspired other workers to develop an easy and practical method for the diagnosis of the disease (Jackson, 1931; Purchase, 1945). It is significant that the brain squash technique described by Purchase (1945) is today still the most widely used for the diagnosis of heartwater.

The susceptibility of wild and laboratory animals received much attention, and it was Neitz (1933; 1935; 1937; 1944) who first supplied definite proof that the blesbok *(Damaliscus albifrons)*, the black wildebeest *(Connochaetes gnu)* and the springbok *(Antidorcas marsupialis)* are susceptible to heartwater, or that they can act as asymptomatic carriers of the disease.

TABLE 1 Countries where heartwater has been diagnosed with certainty

Country	References[1]
African continent	
Angola	Conceição, 1949
Benin	Anon., 1963
Botswana	Roe, 1955
Cameroon	Anon., 1967
Central African Republic	Anon. 1960
Chad	Malbrant *et al.*, 1939; Provost, 1956
Congo	Rousselot, 1957
Djibouti	F.A.O., 1980
Ethiopia	Tarantino, 1939; Roetti, 1940
Gabon	Anon., 1960
Ghana	Stewart, 1933
Guinea Bissau	Tendeiro, 1945
Ivory Coast	Aillerie, 1932
Kenya	Daubney, 1930
Liberia	Anon., 1971
Malawi	Meza, 1938
Mali	Curasson, 1932
Mauritania	Anon., 1960
Mozambique (Maputo)	Valadão, 1969
Niger	Anon., 1972
Nigeria	Hall, 1931
Rwanda-Burundi	Anon., 1957
Senegal	Anon., 1967
Somalia	Evans, 1963
South Africa	Trichardt, 1838; Cowdry, 1925
Sudan	Kennedy, 1931; Karrar, 1959
Tanzania	McCall, 1930
Uganda	Lewis, 1939
Zaïre	Van Saceghem, 1918
Zambia	Anon., 1966
Zimbabwe	Sinclair, 1927
Islands around Africa	
East:	
Madagascar	Poisson & Geoffroy, 1925; Buck, 1965
Mauritius	Perreau *et al.*, 1980
Reunion	Perreau *et al.*, 1980
West:	
São Tomé	Uilenberg *et al.*, 1982
Caribbean region	
Antigua	Birnie *et al.*, 1985
Guadeloupe	Perreau *et al.*, 1980
Marie Galante	Camus *et al.*, 1984

[1] References mostly according to Camus & Barré, 1982, and which have, for the sake of completeness, been duplicated in the reference list of this paper. Two authors are cited where the disease was diagnosed clinically and then in the laboratory.

These references are merely an indication of the presence of the disease. It does not constitute all the references for any country.

Since the earliest days it was realized that animals which recovered from the disease were subsequently immune (Dixon, 1898; Dixon & Spreull, 1899). However, the extensive studies on the immunity of heartwater by Neitz (1939a) and Neitz, Alexander & Adelaar (1947), merit special reference. These studies still form the basis of our knowledge of immunity to heartwater, especially with reference to the duration of immunity in sheep. They also provided evidence that circulating organisms are detectable in the peripheral circulation of immune sheep following reinfection, irrespective of whether a demonstrable reaction is produced or not.

A major breakthrough with regard to the control of heartwater was the discovery by Neitz (1939b; 1940) of an effective chemotherapeutic agent, the sulphonamide drug "Uleron", against the disease. Subsequently other drugs, especially the tetracyclines, were found to be effective (Weiss, Haig & Alexander, 1952; Haig, Alexander & Weiss, 1954) and together they have saved the lives of many animals naturally or artificially infected with heartwater.

Between 1945 and 1970 relatively little new information on the disease became available. During this time a blood vaccine was developed at the Veterinary Research Institute at Onderstepoort and this is presently still the only commercial vaccine available against heartwater.

Since 1970 a number of findings have stimulated new interest in heartwater research. Very important was the discovery by Du Plessis & Kümm (1971) of an isolate of *Cowdria* which is highly pathogenic for mice. Initially its identity was, because of its somewhat atypical immuno- and pathogenicity, viewed with some suspicion. This has nevertheless led to the development of a usable serological test (Du Plessis, 1981). More recent techniques and information that have become available during research on this organism (Du Plessis, 1982) have led to the isolation of other, more typical murinotropic *Cowdria* isolates (MacKenzie & Van Rooyen, 1981; MacKenzie & McHardy, 1984; Du Plessis, 1985).

The discovery of heartwater on certain islands in the Caribbean (Perreau, Morel, Barré & Durand, 1980; Birnie, Burridge, Camus & Barré, 1985) and the threat of its possible introduction onto the American mainland (Uilenberg, 1982a), has led to the establishment of international research teams. This, no doubt, has already been and will continue to be a source of future information on heartwater.

The recent successful *in vitro* cultivation of *C. ruminantium* by South African scientists (Bezuidenhout, Paterson & Barnard, 1985) is another milestone in heartwater research. It opens many new avenues which hopefully in the near future will not only lead to a better understanding of the organism, but also to the development of a practical and safe method of immunization.

A wealth of information on many aspects of the disease has just recently become available. Much of this information will only become generally known during this Workshop, which in itself is an historic occasion. It provides an ideal opportunity for open discussion of findings and problems and most importantly, for the identification of short and long term research priorities.

The practical benefits of review articles on heartwater research can hardly be over-emphasized. Of special importance are those by Alexander (1931), Henning (1956), Ilemobade (1976), Uilenberg (1977; 1983) and Camus & Barré (1982), consolidating both published and unpublished data. Furthermore and most importantly, they also clearly indicated the gaps in our knowledge making it so much easier, especially for young researchers, to identify research priorities.

GLOBAL IMPORTANCE OF HEARTWATER

Most of the reports on the prevalence of the disease are either broad statements or estimated mortalities which, at best, can only be regarded as indications of its importance (summarised by Camus & Barré, 1982). Any discussion, especially on the economic impact of heartwater on livestock production, will be futile, the main reasons being that the disease is seldom reported and diagnosis only confirmed in exceptional cases.

Furthermore, the incidence of the disease is masked by the use of effective dipping compounds, resistance of certain animal breeds and enzootic stability.

Nevertheless, it has been stated (Donatien & Lestoquard, 1937) that heartwater is the most important rickettsial disease of animals in Africa and that it is as important in ruminants as typhoid fever is in humans.

Uilenberg (1983) ranked it second only to East Coast fever and tsetse-transmitted trypanosomiasis. Neitz (1968) stated that in enzootic areas, mortalities due to heartwater were 3 times as great as those due to babesiosis and anaplasmosis.

North of the equator, heartwater is probably the third most important disease after rinderpest and schistosomiasis (Provost, unpublished data, 1986).

A summary of all the available information on the importance of the disease clearly points out that—

(1) heartwater is a major, and in some instances, the most important obstacle against introducing highly producing animals into Africa with the aim of upgrading or replacing local stock (Uilenberg, 1982b),

(2) heartwater is a major disease problem when local animals are, usually for the sake of better grazing, moved from heartwater-free to heartwater-infected areas (Neitz, 1967),

(3) heartwater remains a problem and a threat in endemic areas especially amongst small stock (Thomas & Mansvelt, 1957). The effect of dipping and environmental changes (e.g. droughts) influences enzootic stability, which is often very difficult or impossible to manipulate (Bezuidenhout & Bigalke, 1987), and

(4) heartwater is a threat to areas such as the American mainland where potential vectors are present but do not harbour the disease (Uilenberg, 1982a; Uilenberg, Barré, Camus, Burridge & Garris, 1984). It is also a threat to countries where the vectors may be introduced and become established (Wilson & Richard, 1984; Barré, Uilenberg, Morel & Camus, 1987).

At present the control of heartwater remains a serious problem. Intensive dipping with acaricides is expensive and only effective under certain conditions (Bezuidenhout & Bigalke, 1987). Vaccination of livestock with a live blood vaccine is difficult and definitely not suitable for countries where potential vectors are present but where the disease organism is absent. In such instances it would be too dangerous to introduce viable organisms which may infect, and subsequently be spread by, such vectors.

On a global scale, heartwater will therefore remain a disease of major importance until such time as an effective and safe method of vaccination becomes available.

On the other hand, the actual economic impact of the disease on livestock production can only be estimated from specialized surveys or well-documented records on the prevalence of the disease. This in turn, is dependent on a definite diagnosis of heartwater which, at present, is not implemented on any significant scale. This could be due to difficulties in obtaining suitable brain material for diagnosis and to making a definite diagnosis on such material. Both these aspects should receive attention in the future if the true importance of the disease is to be established.

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