Poisonous Plants, Pastoral Knowledge and Perceptions of Environmental Change in South Africa, c. 1880–1940

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ABSTRACT

By the 1920s more livestock in South Africa died from plant poisonings (toxicoses) than from contagious and infectious diseases. This was important because livestock made such a significant contribution to the South African economy. By the mid-nineteenth century the Cape Colony had emerged as one of the world's largest exporters of animal fibres, whilst the country as a whole sought to increase milk and beef production during the twentieth century in response to growing industrialisation and urbanisation. African and settler farmers were already familiar with many varieties of noxious flora and local knowledge made an important contribution to veterinary studies, which began around 1890, into plant poisonings and their role in the changing nature of the veld. Long held assumptions that the grasslands were being degrading through overstocking received additional veterinary input as toxicologists added the rapid propagation of poisonous flora to the list of indicators of veld deterioration. This brought researchers into ecological debates about the transformation of the grasslands and challenged the state, scientists and stockowners to find new ways of managing pastoral farms. The paper discusses the expansion of toxicological and ecological knowledge about the grasslands of South Africa and explores some of the measures put forward to encourage more sustainable animal husbandry.

KEYWORDS

South Africa, livestock, plant poisonings, veterinary science, overstocking, degradation, environmental change.

Environment and History **13** (2007): 307–32. DOI: 10.3197/096734007X228291

In January 1934 John Quin, a veterinary physiologist based at the Onderstepoort Veterinary Research Institute north of Pretoria, visited the farm of 'Aarfontein', which belonged to a Mr K. van der Westhuizen, a denizen of the district of Victoria West in the semi-arid South African Karoo. Quin was investigated a sheep disease known as *geeldikkop*, or 'yellow thick head'. Symptoms included the yellowing of the skin and mucus membranes due to severe liver damage, as well as a nasty reaction to sunlight. In severe cases, photosensitivity was so intense that it led to the splitting of the facial skin and the loss of ears, lips and eyelids. Although the symptoms of the disease were well known to Karoo sheep farmers as well as to veterinarians, and an indigenous plant *Tribulus terrestris* had been inculpated as the cause, the link between liver damage and photosensitivity, as well as the reasons for the erratic seasonality of this condition

FIGURE 1. *Tribulus terrestris,* cause of *geeldikkop* in sheep. All plant illustrations are from Douw Steyn, *The Toxicology of Plants in South Africa* (1934).

remained a mystery. In his report to Petrus du Toit, the Director of Veterinary Services, Quin wrote:

> The scene is worth describing as emphasising the helplessness and hopelessness which farmers feel when they see such large numbers of their best sheep suffering from this disease. Round every bush and bit of shade, sick animals were standing or lying. In many cases the heads were thrown back and the body bent to escape the sun's rays. Lips were hard and set, nostrils blackened and choked with mucus, the eyes swollen and crusted or actually the eyeballs burst. Many fine rams were among the sick and carcases, dead animals and bones lay around everywhere.[2]

Quin's graphic description of sheep suffering from *geeldikkop* relates to an underrepresented theme in the historiography of veterinary medicine and grassland ecologies: the issue of plant poisonings (toxicoses) in livestock. In fact the literature on toxicoses has remained very much restricted to the scientific sphere.[3] Where historians have raised the issue of noxious weeds, the focus has been primarily on state and agriculturists efforts to stem the spread and impact of nuisances such as prickly pear, jointed cactus and burrweed. These species undermined the pastoral economy by overrunning valuable grazing land and, in the case of burrweed, the plant reduced the quality of the wool when the burrs attached themselves to the fleece. William Beinart has looked at some of the nineteenth century debates about plant invaders such as *Chrysocoma tenifolia* (or bitterbossie; the bitter bush), but he has not focused on the contribution made by veterinary scientists to discussions about poisonous plants and their relationship to perceptions of environmental change in the twentieth century. [4]

Poisonous plants are important because their impact on the pastoral economy, at least at a local level, could be far more dramatic than grassland invasion by burrweed or prickly pear. Toxic plants not only undermined the health of the animal and reduced the quality of wool and hides, but could also kill livestock in substantial numbers. At times the scale of mortality reached epidemic proportions. In the summer of 1926–7, for example, over 700,000 sheep died of *geeldikkop* in the Karoo, and one million fell prey to *vermeersiekte* (vomiting sickness) in Griqualand West (Northern Cape) in 1929–30.[5] Writing in 1934, Douw Steyn, a veterinary toxicologist also based at Onderstepoort, insisted that '[t]he state of affairs is not exaggerated when it is stated that in South Africa more stock is lost annually from plant poisoning than from any other cause'.[6]

The aim of this paper therefore is to address the gap in the literature by exploring two key questions. Firstly, it asks why poisonous plants became such a major preoccupation of farmers, veterinarians and state officials during the early twentieth century. Secondly it considers why, by the 1920s, some farmers as well as botanists and veterinarians became increasingly convinced that poisonous plants were spreading throughout the country. What brought about these assumptions and what effect, real or imagined, could toxicosis have upon

the sustainability of pastoral production? Additionally, from a historiographical perspective, this article on poisonous plants emphasises the ongoing importance of environmental explanations of disease. Recent work on veterinary history in South Africa has had a strong focus on the development of vaccines in response to enzootic and epizootic diseases, but as this paper illustrates, many stock diseases were not contagious infections caused by germs, but were attributable to broader ecological factors.[7]

This article tackles the aforementioned questions by examining changing ideas about livestock management and assumptions about rangeland ecology during the late nineteenth and early twentieth centuries. The first section examines the economic and environmental context of plant poisonings and illustrates how local people, both African and European settler, had learnt to adapt their animal husbandry to suit the observed realities of the pastoral environment. It goes on to show how knowledge about plants and the composition of the veld became increasingly hybridised during the early twentieth century as scientists analysed and recorded both popular knowledge and their own interpretations of disease and the reasons for ecological change. Where possible, inferences are drawn from African ideas about animal health and poisonous plants, although this is often difficult as the African voice is not always acknowledged in the primary literature. Many aspects of African husbandry such as specific patterns of livestock transhumance, as well as their knowledge and utilisation of local flora, became incorporated into settler practices, and their provenance was either forgotten over generations or not accredited in the testimonies of white farmers. Nonetheless, publications such as Andrews Smith's *A Contribution to South African Materia Medica* (1895), which recorded Xhosa use of medicinal herbs during the late nineteenth century, as well as John Watt's and Maria Beyer Brandwijk's *The Medicinal and Poisonous Plants of Southern Africa* (1932), show that African communities had an extensive pharmacopoeia and could identify a wide range of toxic and medicinal flora.[8]

The paper also demonstrates, how from the late nineteenth century, with the expansion of scientific bureaucracies in South Africa, veterinary scientists and botanists appropriated stockowners' understandings and concerns about toxicoses and introduced their own rhetoric and epistemologies, based on western biomedical conceptualisation of disease and the management of the environment. From the 1890s, scientists subjected poisonous plants to laboratory and field experiments and by the 1930s many had adopted the ecological language and assumptions surrounding the theory of a 'balance of nature', using this to explain why farmers felt the grasslands were deteriorating and being consumed by a range of toxic flora. The analysis additionally reveals how international economic factors, combined with local farming methods, contributed to the transformations of the grasslands.

THE ECONOMIC AND ENVIRONMENTAL CONTEXT OF PLANT POISONINGS

In the 1870s Africa's first colonial veterinary departments appeared in Natal and the Cape – two British colonies that joined with the former Afrikaner Republics, the Orange Free State and the Transvaal, to make up the Union of South Africa in 1910. The first state vets were British and their training familiarised them with livestock diseases common in Europe. On arrival in South Africa, however, they encountered a range of diseases that were not present in the north, or which were environmentally specific. Consequently, there was a strong dependence, initially, on the advice of local farmers to suggest the aetiology of a number of conditions. In Natal, for example, it was Zulu stockowners who first proposed a link between *nagana* (bovine trypanosomosis), tsetse fly and game, whilst settler farmers in the Eastern Cape informed vets that ticks might be the cause of a number of infections.[9] Likewise it was African and settler farmers who first alerted the veterinary departments to the likelihood that many diseases could be attributed to certain types of flora.

This knowledge about the veld had had an important bearing on animal husbandry in the past. In pre-colonial times Khoekhoen pastoralists drove their animals to seasonal grazing lands not only for forage but to avert disease. Dutch settlers copied this strategy after their arrival in 1652 and this practice continued well after British annexation of the Cape during the Napoleonic Wars. In fact, trekking was associated not with spreading pathogens, but with averting disease by optimising nutrition. During the nineteenth century, however, the days of transhumance gradually dwindled as more and more land became privatised and veterinary regulations, dating from the 1880s, periodically restricted stock movements to contain contagious diseases. With developments in fencing and the separation of private from communal (often African held) land, a farmer's room for manoeuvre declined. Although many properties, especially in the arid karoo, were very large, with some farms exceeding 100 square miles, more and more animals were nonetheless confined to individual farms.[10] This ultimately had an effect on the distribution of veld plants and, as will be discussed, this formed the context of debates not only about grassland degradation but also about the proliferation of toxic weeds.[11]

Transformations in landholding as well as a concern for the state of the veld were a response to changing economic opportunities during the nineteenth century. Under the Dutch, it had been wine from the Western Cape that constituted the main export, but from the mid-nineteenth century it was fibres – merino wool, mohair and ostrich feathers – that became the most lucrative rural commodities. The Cape competed with Australia for domination of the world's wool markets and was the largest producer of mohair by 1914. International demand for fibres had encouraged South African stockowners to increase their flocks. Losses due to disease were the main reason why the politically influential agricultural elites

of the Natal and Cape had pushed for the establishment of veterinary departments, created in 1874 and 1876 respectively. The containment of a number of stock diseases by the twentieth century, as well as the ongoing demand for fibres, complemented by an expanding market in beef and milk to feed the mining compounds and burgeoning towns, encouraged a further growth in stock numbers. Between 1911 and 1955, the figures for cattle doubled from 5,796,949 to 11,689,475 head, whilst the ovine population escalated from 16,322,503 to 37,042,504 animals between 1904 and 1955.[12]

This increase in animal numbers altered the composition of the veld, as livestock are selective grazers. Critiques about overgrazing and the degradation of the veld date back to the nineteenth century, but with developments in toxicological techniques for identifying poisonous flora, the question of toxic plants featured in veterinary commentaries about environmental change. The importance of livestock to the national economy meant that the veterinary department had considerable political leverage and their comments on degradation, in association with poisonous plants, influenced state policy. As several historians have shown, the 1920s and 1930s was a time when farmers, scientists and officials argued over whether apparent changes in the composition of the veld were due to climate or agricultural practices. By the 1930s the state blamed the farmers, and efforts to stem erosion and restore nutritive grass cover became political issues on settler farms and in the African reserves.[13]

VETERINARY SCIENCE, POISONOUS PLANTS AND LIVESTOCK DISEASES

When Duncan Hutcheon arrived in the Cape in 1880 as the Principal Veterinary Surgeon, he had little appreciation of the nature of the veld and it was farmers who first alerted him and his colleagues to the possibility that some fatalities could be due to toxicoses. In Europe, the 1880s was a time when medical scientists were increasingly looking to 'germs' as the cause of disease, and research into poisonous plants in the Cape reflected a partial divergence from these trends.[14]

The first scientific investigations into toxicoses in South Africa occurred in the 1890s. It was Khoekhoen and Xhosa herders in the District of Jansenville in the Eastern Cape who suggested that a disease known as *krimpsiekte* in goats was caused by a toxic herb they called the 'nenta' plant. *Krimpsiekte*, in which the toxins act on the neck muscles, twisting the body thereby impeding grazing and respiration, was the first toxicosis to be scientifically ascribed to a poisonous plant in South Africa. In 1890, the African veterinarian, Jotello Festiri Soga, was able to artificially recreate the disease by feeding goats with a 'nenta' plant, subsequently identified as *Cotyledon ventricosa*.[15] Soga's work was notable not only because it proved that the veld could be toxic to animals, but also because

FIGURE 2. *Cotyledon ventricosa,* a cause of *krimpsiekte* in goats.

FIGURE 3. *Gifblaar*

FIGURE 4. *Gousiektebossie*

he was the only African trained veterinarian employed by a South African government for the period this paper covers, as intensifying racism and political segregation resulted in the exclusion of blacks from this profession.

Despite growing discrimination, African observations nonetheless remained important for discovering a number of dangerous plants. In the Transvaal bushveld two dangerous species were *gifblaar* (poison[ous] leaf; *Dichapetalum cymosum)* and the *gousiektebossie* (quick sickness bush; *Vangueria* [now *Pachystigma*] *pygmaeum)*. *Gifblaar* was one of South Africa's most lethal plants. Less than 1 oz of *gifblaar* would incapacitate the heart and kill a sheep within a few hours; 3oz would kill a cow. The British botanist, Joseph Burtt Davy, who worked in the Transvaal, identified this plant as toxic in 1903 and commented on how

Africans (language unspecified) called it *Magaow* and tried to cure poisoned stock by feeding them 'kaffir' beer, made of sorghum.[16] Like *gifblaar,* the *gousiektebossie* killed by damaging the heart and it seems that African pastoralists recognised this plant to be toxic too.[17]

A third variety of plants that caused cardiac toxicosis and were also particularly invasive were species of 'tulp', notably *Homeria pallida* and *Moraea* (now *Homeria) polystachya*. These plants grew in the eastern parts of the country and some stock owners viewed them as a great impediment to transhumance and ox travel. Tulp thrived along the banks of streams and in vleis: the places where farmers and transport riders often chose to outspan their animals.[18] However, according to one settler farmer from Umtata in the Transkei (Eastern Cape), the Xhosa had found an effective way of protecting their cattle:

> Our Natives take from ten to 12 "tulp" bulbs, smash them up, and then boil them in about two bottles of water, allow to cool off and then give one bottle with the pulp in, followed about five hours later with the second bottle. They never lose a beast.[19]

Another dangerous plant from an economic perspective was *Senecio,* which could be lethal to cattle and horses. In 1905, the veterinary surgeon, W. Pakeman,

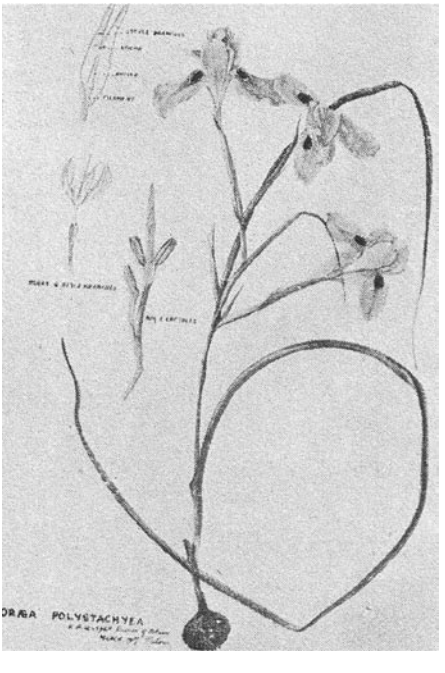

FIGURE 5. *Moraea polystacha* (a species of 'tulp')

FIGURE 6. *Senecio latifolius*, a cause of *dunsiekte* in horses.

who worked in the Queenstown District of the Eastern Cape commented how 'Native say that wherever the weed grows cows always die there'. He gave no indication as to whether Africans treated their animals for *seneciosis,* but his statement further reflected a veterinary reliance on African as well as settler observations of the pastoral environment.[20]

Despite popular convictions that certain plants were toxic, scientifically proving this was fraught with difficulty. This was because many plants were not dangerous throughout the year and even poisonous varieties were only lethal if they grew on certain soils and experienced particular climatic conditions that influenced the chemical composition of the plant. Some plants were only fatal if eaten in huge quantities or in combination with other flora thereby creating an adverse reaction in the gut. In addition, scientists could rarely draw upon knowledge from abroad because species that were toxic in South Africa, such as *Tribulus terrestris*, were innocuous in the United States and other parts of the African continent. In America, different plants, such as St John's Wort, brought on symptoms that mirrored photosensitivity in *geeldikkop*.[21] Some conditions also seemed totally unique to South Africa. In 1923 the Director of Veterinary Services, Arnold Theiler, claimed that 'Gousiekte is a disease of South Africa, and so far has been brought to our notice in the Transvaal only. It is very localised in distribution'.[22] As a result, toxicological research became very environmentally specific and explicating reasons for mortality often involved a long series of trials with a variety of suspected flora.

Although Hutcheon had instigated research into poisonous plants soon after his arrival in the Cape in 1880, it was nonetheless contagious and infectious diseases that most concerned him. Many investigations there, as well in the other South African states focused on developing vaccines to tackle problems such as anthrax, bovine contagious pleuro-pneumonia (lungsickness) and horsesickness. The most devastating infections introduced into southern Africa around the turn of the twentieth century, were the cattle diseases rinderpest and east coast fever, which arrived in 1896 and 1902 respectively. Both could cause 90 per cent mortality in a herd. Controlling these conditions remained the primary veterinary concern until circa 1910, by which time rinderpest had been eradicated throughout South Africa by vaccination and tick-borne east coast fever had proved controllable by restricting stock movements in infected areas, and organising three to five day stock dipping in arsenical solutions.[23]

With the ability to contain infectious diseases, there was more time for alternative research. After Union in 1910, the Onderstepoort Veterinary Institute became the main centre for veterinary research in South Africa and although 'germ diseases' continued to be investigated, toxicological studies gained new pre-eminence when death from poisonous plants came into comparative ascendancy. After 1910, under the aegis of the Director of Veterinary Services, Arnold Theiler, there was an increased interest in studying nutrition, which involved not only looking at poisonous plants but also ways of improving animal health by

enhancing their diet through better grasses and nutritional supplements.[24] At the same time, there was considerable pressure from leading commercial farmers who sought explanations as to why animals seemed to be dying from the veld. There were no accurate figures for stock deaths due to toxicoses as these were not scheduled diseases that had to be reported to the state and hence suspected cases often remained unreported. However, it was heavy losses on a number of farms in 1915 due to *geeldikkop* and *gousiekte* that caused Theiler to commence research into these two diseases. Similarly, the exceptionally high fatality rate due to *geeldikkop* and *vermeersiekte* during the late 1920s galvanised a new round of research into these conditions. In some areas of the country, toxicoses were such a problem that farmers had had to give up certain types of husbandry. In parts of the eastern Cape, it had become increasingly difficult to keep horses by the 1930s due to *dunsiekte* ('thin sickness'; emaciation), ascribed to *Senecio latifolius*. Similarly on the Ghaap Plateau in the Northern Cape, many farmers had abandoned sheep farming due to the proliferation of the *vermeerbossie* (*Geigeria passerinoides)*, the cause of *vermeersiekte*.[25] As a result of these losses toxicology became a central, as opposed to a peripheral aspect of veterinary research, and the extent of these investigations was highlighted by the fact that in 1925 only about 15 plants had been proved to be toxic. By 1950 the figure had reached 300.[26]

Research into poisonous plants occurred in the laboratory and on the estates of white farmers. Poisonous plants were also a problem in the African reserves, which after 1910 became increasingly congested with people and animals due to the government's racially discriminatory policies that restricted African access to land. However, the archival evidence gives no indication that toxicologists worked in the reserves, even though the state was concerned about veld degradation in these areas. In practice, it was those species that settlers felt posed the greatest threat to their livestock numbers that received the greatest attention. Nonetheless, as this paper goes on to show, there were also tensions between settler farmers over the economic value of scientific research.

In gathering data, toxicological studies required a range of expertise. Veterinary physiologists examined the effect that chemicals in the plant had on the growth and development of animals, whilst chemists tried to isolate, with mixed success, the toxic principles necessary for diagnostic purposes and developing antidotes. Veterinary researchers also liaised with botanists, attached to the Department of Plant Industry, who studied the inter-relationship between toxic weeds and the wider environment.

An example of this integrated scientific approach can be seen in relation to *geeldikkop*, probably the most extensively researched form of toxicosis in the early twentieth century. In 1918 Arnold Theiler scientifically proved that *Tribulus terrestris* brought on the symptoms of photosensitivity, characteristic of this disease.[27] Investigations resumed in 1929, when John Quin and his colleague the chemist, Claude Rimington, commenced their experiments in the

Northern Karoo, on farms where recent fatalities had been particularly high. To discover which plants were poisonous, scientists carried out field experiments that involved a mixture of techniques including grazing and tethering by which veterinarians cleared camps of all plants and grasses except those suspected of being toxic. Some animals grazed on these prepared fields, whilst others were muzzled as a control or placed on different veld as a comparison. Sometimes these experiments could be exceedingly tortuous as animals failed to cooperate, managing to knock off their muzzles or escape from their tethers and thence from the experimental camp.[28] Alternatively, ruminal contents of sick beasts, or solutions using mashed up plants or plant extracts were force fed into the animal by a drenching tube inserted into the mouth or nostrils.[29]

For all these trials, support from the farmers was essential, but researchers were not always successful in obtaining this. Whilst visiting the Biesjiespoort Farm in the District of Gordonia in 1931, for example, Quin could only muster ten sheep for his field experiments, even though this farmer had suffered heavy losses from *geeldikkop*.[30] In certain respects, research into *geeldikkop* reflected divisions within the farming community as to the value of modern science. Whilst some farmers lobbied politicians to allocate funds for toxicological investigations, others were less keen on statist interference and were reluctant to see their properties turned into experimental farms. Quin described the farmers of Gordonia, in terms of the latter category, dismissing them as backward, suspicious and apathetic.[31] Located in the Northern Cape, distant from the main commercial wool producing areas to the east, these stockowners had a tradition of resisting scientific knowledge and they maintained their own ideas about the aetiology of livestock diseases.[32] According to Quin, many farmers attributed *geeldikkop* to a little worm that lived in the *dubbeltjie doorn* ('devils thorn' – the popular name for *Tribulus,* referring to the spines on the fruit), whilst some ascribed it to sheep grazing on land still damp with the morning dew.[33] Unable to persuade some individuals that in his view, their ideas were anachronistic, Quin had problems obtaining rural backing. This situation indicated a dichotomy between the concerns of local stockowners and environmental realities. The arid, northern Karoo was particularly prone to annual outbreaks of *geeldikkop* and veterinary scientists therefore saw this as the most promising place to acquire scientific results because of the considerable amount of floral and faunal material.[34] Many farmers however remained uninterested in this type of research, showing how human as well as environmental contingencies could affect both the nature and outcome of field investigations.

Lack of enthusiasm could also be attributable to the dearth of useful results, as after five years of research, Quin and Rimington had not been able to identity the toxic principle and thus could not suggest a cure for this disease.[35] For many farmers, toxicology must have seemed a rather esoteric discipline as it could offer little in the way of practical solutions, not only for *geeldikkop,* but for plant poisonings in general. Consequently, farmers continued to rely on their own folk

remedies, which came to be endorsed by veterinary scientists, such as the use of purgatives like Epsom and Glauber Salts to flush out plant material, together with the administration of stimulants such as caffeine and cheap Cape brandy (*dop*) to activate the heart.[36] None of these could guarantee recovery and this, combined with scientists' inability to discover new ways of tackling toxicoses by biomedical or chemotherapeutic means, generated a more environmental approach to the poisonous plant problem.

In the absence of treatments, research into *geeldikkop* went beyond physiological investigations into the effects of the plant on the animal and also involved studies of the inter-action of *Tribulus terrestris* with the veld, which was to have important implications for animal husbandry. Working with Marguerite Henrici, a plant physiologist based at the experiment station at Fauresmith on the edge of the Karoo in the Orange Free State, Quin and Rimington studied the environmental conditions that rendered *Tribulus* toxic. Collectively, they deduced that climate was the major determinant as the disease was most virulent if only light rains fell in November and December after a period of prolonged winter drought. *Tribulus* seeds could survive in the ground for years and then germinate and spread rapidly with the slightest precipitation. In its green chlorophyll rich state many farmers regarded *Tribulus* as an excellent feed and let their animals graze on it. However, if they failed to change the veld before the plant wilted, *geeldikkop* could arise.[37] Henrici also had tons of different soils delivered to Fauresmith and from her pedological studies she discovered that *Tribulus* was only poisonous if it grew in limestone and red alluvial soils. This meant *Tribulus* was deadly in the Northern Cape but innocuous in the Transvaal. Such a revelation had significant implications for veld management and illustrated the complexity and localisation of flora communities, as there could be no single system of grassland rotation, suitable for all farms.[38]

POISONOUS PLANTS AND PERCEPTIONS OF ENVIRONMENTAL CHANGE

Veterinary statements about the effects of overgrazing need to be situated within a broader context of publicised assumptions about grassland degradation in South Africa. William Beinart has argued that the 1860s and 1870s was a period in which understandings of botanical change in the Cape became more sophisticated. Observations and opinions were highly contested as there was no accepted methodology for accurately accessing alterations in the composition of the veld. Commentators from both the scientific and farming communities presented a variety of views regarding the sustainability of pastures. By the late nineteenth century, valued species of rooigras (*Themeda triandra*) and ankeroo (*Pentzia incana*) seemed to be being replaced by less desirable varieties such as rhenosterbos (*Elytropappus rhinoceratis)* and steekgras (*Aristida* spp). Prickly

pear and jointed cactus also colonised swathes of veld in the eastern summer rainfall districts, whilst thickets and acacia appeared to be spreading in the more arid north. In some areas sweetveld, which was suitable for all year grazing, was being superseded by sourveld that was only nutritious after the summer rains.

Critics such as the Cape's first official veterinary surgeon, William Branford, writing in the 1870s, attributed vegetation change to overgrazing which reduced the ability of desirable grasses to seed so successfully.[39] Some farmers, however, rejected this and claimed that high stocking rates were necessary to ensure that the grasslands were not replaced by succulent Karoo bushes. The spread of bushes was indicative of environmental degradation in the sense that shrubs and thickets were inedible to grazing animals. The disappearance of wildlife, in particular browsers such as giraffes and elephants, partly explained the apparent proliferation of bushes. Farmers, eager to acquit themselves of any responsibility for any deleterious vegetation changes, were often quick to blame climatic factors, in particular recurrent droughts and declining rainfall, for these grassland transformations.[40]

Debates about the effects of overgrazing continued into the twentieth century. In 1919 a particular severe drought precipitated the convening of a government commission to investigate the possibility that climatic patterns were altering. 1919 was also the year in which the government's chief botanist, Illtyd Pole Evans, began what became an ongoing botanical survey, recording the distribution of plants throughout the Union and looking for evidence of changing floral communities. As Director of Veterinary Services, Arnold Theiler was a member of the advisory committee for the botanical survey reflecting a scientific and administrative linkage between the nature and distribution of South African flora and the possible implications of this for livestock yields.[41] When the final report of the Drought Commission appeared in 1923, its drafters dismissed the meteorological argument and criticised farmers for the apparent decline in nutritious vegetation and the increase in erosion and sluiting, which they attributed to overgrazing, kraaling and the consequent loss of soil-binding grasses.[42]

Botanists were also critical of farming practices. In 1932, Pole Evans described being 'struck by the lack of intelligent interest the majority of farmers take in the veld', as it was 'only when the veld has been ruined and the pasturage reduced to vanishing point, that the Department is called to their assistance.'[43] Pole Evans, like his colleague John Acocks, believed that noxious weeds were spreading. Based on extensive data gathering, Acocks became convinced that Karoo bushes were rapidly moving northwards and eastwards, replacing sweetveld, due to overstocking with selective domestic grazers, in particular sheep.[44] These botanical testimonies gave rise to political concerns about degradation and influenced veterinary explanations for the propagation of toxic flora.

So too did the writings of John Bews, an ecologist based at the University of Natal, whose writings provided an environmental context for the dissemination of the types of flora that most worried the veterinary department. In his

book *Plant Forms and their Evolution in South Africa,* published in 1925, Bews argued that there was a tendency for the grassland vegetation to develop more xerophytic (drought resistant) characteristics and overall the most successfully competitive species were those best able to adapt to dry conditions. To vie with other grasses, certain plants had evolved deep underground root systems to extract water from the water table, or else they had corms that conserved moisture and nutrients. Both features ensured that unlike varieties with shallow roots, these species could flower and propagate in the absence of significant rainfall. Many of South Africa's most toxic plants fell within that description. *Gifblaar, gousiektebossie* and *Senecio* had deep subterranean root systems giving them a comparative advantage over many grasses. Bews saw ephemeral annuals, the so called *opslag* vegetation that included *Tribulus,* as the most highly specialised form of vegetation because they were able to germinate rapidly with little rainfall and colonise large areas of veld. *Opslag* formed part of what he termed the 'vernal aspect societies': plants that could fulfil their flowering and reproductive cycle early in the summer before they were shaded from the sun by taller grasses. Many of the poisonous plants that farmers had to deal with were, like *Tribulus,* species that sprouted with the first summer rains and provided the only green cover on a forlorn veld, desiccated by a lack of rainfall during the winter months, exacerbated by severe frosts and winds. Hungry animals avidly devoured the green plants because they were the most tempting and succulent flora on the veld.[45]

Bews' interpretation of the shifting composition of the veld, which demonstrated the resilience of noxious weed resonated with veterinary assumptions about grassland degradation. However, in addition, veterinarians emphasised not just climatic realities but the impact of human agency on these transformations. At that time there were intense debates in the United States, Europe and South Africa between ecologists who disputed the reasons and mechanisms of plant succession and struggled to understand whether or not there was such a thing as an idealised, pristine 'natural climax' or a 'balance of nature'. An important view amongst ecologists was the assumption that livestock had disturbed the 'natural climax', creating a 'sub-climax' vegetation, which in some areas had resulted in the deterioration of edible grasses to sub-optimal levels. If allowed to continue, the fear was that the regenerative power of the veld could be reduced to such a level that it could not recuperate, thereby destroying profitable livestock industries.[46] The psychological as well as the real impact of the American Dust Bowl, which peaked in 1935, enhanced concerns, not only in North America but also in the dryland areas of colonial Africa, that the land might cease to sustain agricultural production unless farmers introduced soil and grassland conservation programs to regenerate the land.[47] From a veterinary perspective, the problem for scientists and stockowners was to find a balance between natural vegetation change and sustainable stock numbers in order to maximise pastoral output.

Veterinary researchers at Onderstepoort did not add anything new to the environmental debates in terms of intellectual content, but they demonstrated how the increase in toxic flora was an indicator of veld deterioration and they coached their concerns about grassland changes in the successional language of ecologists. Leading veterinary scientists publicly expressed an assumption that there was a 'balance of nature' that had been upset by poor pastoral methods. This also suited their agenda of trying to convince farmers that unless they reduced the number of animals on their properties, their livelihoods would be in jeopardy. One of the leading veterinary researchers at Onderstepoort, Philip Viljoen, for example, invoked images of a disturbed 'balance of nature' when he warned farmers in 1938:

> The incidence of these poisonous and inedible plants is closely bound up with the problem of proper veld management. As soon as the veld is over-grazed, Nature protects herself by means of such plants, and once they have become established, it is extremely difficult to eradicate them, unless the veld is allowed to rest. [48]

Viljoen suggested that nature reacted in that way to try to create a more stable environment. As veld grasses deteriorated and the flora became proportionately more toxic, there would obviously come a point when the vegetation proved a limiting factor in livestock accumulation. If livestock numbers fell there was a chance for regeneration. This situation reflected some of the paradoxes in the beneficence of veterinary advances. Livestock populations had increased exponentially during the early twentieth century, aided by the development of vaccines, the eradication of disease such as rinderpest and lungsickness as well as the containment of tick-borne infections through dipping. At the same time, the continued demand for fibres on the national and international markets, as well as the growing demand for foodstuffs at home had further encouraged the augmentation of flocks and herds. As the botanist Thomas Hall commented, the introduction of veterinary science had been a mixed blessing. By facilitating a growth in livestock numbers, veterinary researchers had inadvertently endangered the veld.[49] Veterinary scientists countered this by arguing that farmers should concentrate on rearing a smaller number of quality high-yield animals instead of tolerating low-grade 'scrub' stock. However, many farmers tended to ignore this advice due to market opportunities and the fact that the carrying capacity of the veld was never static and varied annually according to rainfall. Better to make money in good years to survive the consequences of drought in bad ones was a common philosophy.[50]

Nonetheless, veterinary researchers consistently tried to persuade farmers to reduce their herds. A Malthusian rhetoric of degradation and desertification accompanied statements aimed at appealing to stockowners wallets. Apart from Viljoen, the most vociferous critics of overstocking in the 1930s were Douw Steyn and John Quin – the scientists who were most actively involved in toxicological work. What is notable is that the focus of their critique was on settler farming and

not on that practised in the African reserves where overstocking had often been the focus of government and scientific opprobrium.[51] Many Africans kept cattle not so much because of their commercial value, but because they were essential for milk and draught, formed the basis of *lobola* (bridewealth) transactions and imparted prestige to those who owned a sizeable number of bovines. In fact the views of Quin and Steyn resonated with a broader veterinary castigation of settler husbandry. In the 1920s, for example, Herbert Curson criticised white farmers in Natal for encouraging the spread of nagana because they failed to clear the thickets that harboured the tsetse flies and overstocked their farms to such a degree that livestock wandered for grazing into the neighbouring unfenced Umfolozi-Hluhluwe and Mkuzi Game Reserves, coming into contact with wildlife that formed the reservoir for this disease.[52] Settlers might have benefited from some advances in veterinary medicine, but in the view of many veterinary scientists, they remained environmentally negligent.

Steyn saw ecological indifference as instrumental in enabling the spread of various toxic plants, the most invasive being four species of *Senecio*, which seemed to be establishing themselves on farms throughout the summer rainfall areas in the southern and eastern parts of the country. He attributed the propagation of *Senecio* not only to overgrazing but also to another contested practice: veld burning. Since the nineteenth century, many scientists had criticised this practice, and officially the veterinary department disapproved of veld burning as the heat aided the speedier germination of undesirable grassland species, especially those with deep roots and corms which were the first plants to shoot up after a conflagration.[53] Another effective coloniser of the veld was *Geigeria passerinoides,* which could explain why many farmers were having to abandon sheep farming in parts of the northern Cape, due to *vermeersiekte*.[54]

Steyn expressed his damning conclusions about many aspects of settler farming most forcibly in an article on a disease known as *kaalsiekte* (alopecia; literally, naked disease), which affected angora kids and merino lambs, and could result in the total desquamation of the fleece. Lambs and kids contracted it by suckling milk from ewes that during pregnancy had fed on the 'bitterbossie' (*Chrysocoma tenuifolia),* a drought resistant seeded plant whose presence botanists had long held to be symptomatic of veld degeneration.[55] In an article in *Farming in South Africa,* intended for an agricultural, as opposed to a scientific audience, Steyn insisted:

> There is no doubt that "kaalsiekte" results exclusively from over-stocking of the farm. Sheep and goats will eat in excess of "bitterbossie" only if they are forced to it through lack of good grazing. It is also a fact that "kaalsiekte" occurs only, or is most severe, on badly trampled out farms where, as we know, the "bitterbossie" increases at an astounding rate to crowd out the good Karroo shrubs and grasses. The result is that the carrying capacity of such farms is lowered and the ravages of droughts on them are far more severe than on farms where the grazing is well managed. We therefore want to warn the farmers in

the Karroo most urgently not to keep too much stock on their farms, because if they persist in doing so the "bitterbossie" will ultimately break them by causing "kaalsiekte" among the lambs.[56]

FIGURE 7. 'Bitterbossie', a yellow flowering shrub that causes *kaalsiekte* in kids and lambs.

John Quin similarly warned farmers about the dangers of overstocking and described overgrazing, rather than disease, as the 'greatest enemy of sheep-farming in the Karroo [sic]'.[57] However, what exactly constituted both ideal stocking levels and an appropriate assessment of the carrying capacity of the veld was never clearly revealed. Overstocking was very much an impressionistic term rather than a scientifically ascertained measurement that could be practicably addressed. Lacking definite criteria to determine optimal stocking rates, the veterinary department collaborated with botanists and concentrated on trying to find ways of successfully and cheaply eradicating poisonous plants rather than taking active steps to destock settler farms. This contrasted with state policy in the African reserves following the 1939 Betterment Act when large numbers of animals were culled to keep livestock numbers down to a level that the veld could allegedly support. Many Africans strongly opposed this policy which represented not only an unwelcome incursion by an undemocratic state, but also challenged their ideas about the socio-economic function of cattle.[58] On the other hand, the political influence of white farmers in South African society, as well as a reluctance on the part of the state to intervene excessively in the running of settler properties except when it came to eliminating contagious diseases, ensured that these stockowners had far greater control over their pastoral affairs. For settler farmers, destocking was merely an advisory, not an order.

Given the absence of biomedical preventatives and cures, advice to destock went hand in hand with recommendations to eradicate noxious weeds. Deracination was relatively easy if the plant had shallow roots that could be pulled out, dug up or ploughed under as was the case with *Geigeria passerinoides*. Some farmers devised their own tools to deal with such plants, such as Redmond Orpen of 'Hilldown Farm', near Hay in the Northern Cape, who marketed the so-called 'Hilldown Hoe' to dig up this weed.[59] Problems arose with the deep-rooted plants such as *gifblaar* and *gousiektebossie*. *Gifblaar* in particular resembled an underground tree as the roots could penetrate 60 to 80 feet below the ground. Broken fragments of these subterranean branches could give rise to a new specimen, making it exceptionally hard to clear. In the mid-1930s, the veterinary department worked with botanists to try to find a means of eliminating *gifblaar*. They achieved success by ringbarking the taproot and poisoning it with a copper sulphate solution that flowed through the root system. The government acknowledged veterinary opinion that this was a particularly treacherous and difficult plant to uproot, and in 1935 parliament voted £10,000 for *gifblaar* clearance on settler farms.[60]

The archival and published literature gives no hint that South Africa's official scientists questioned the broader ecological consequences of eradicating plants such as gifblaar. Notions of biodiversity and the value of protecting all types of flora were absent from the narrative. Despite the rhetoric of a 'balance of nature', their approach, paradoxically perhaps, was essentially anthropocentric and scientifically materialistic, as veterinary scientists and botanists were employed by the state to improve agricultural production and strengthen the pastoral economy. So long as particular species of flora were a problem, scientists held they should be cleared from the veld, especially since there were no real cures or preventatives for toxicoses. Their hope was that the removal of noxious weeds would enable the nutritious grasses to re-colonise the grasslands, which they argued farmers could achieve if they engaged in veld rotation and eschewed overstocking.

Official sponsorship of *gifblaar* eradication demonstrated that the elimination of certain poisonous plants, as well as rampant weeds such as prickly pear and jointed cactus, formed part of the government's general scheme for grassland reclamation during the 1930s. In the case of prickly pear, South African entomologists copied Australian experiences, whereby a species of moth borer, *Cactoblastis catorum,* originally from Latin America was introduced to the range and greedily devoured the noxious weed, providing a relatively effective biologically control.[61] From the evidence, there is no suggestion that veterinarians considered the introduction of parasitic insects to deal with toxic plants. A likely reason for the absence of experiments with potential predators was the fact that internationally no insects had been discovered that had a predilection for the type of poisonous flora that undermined South African production. There was also such a large range of poisonous plants and farmers from different

regions had competing views as to which species were most damaging. The cost of carrying out acclimatisation trials from scratch, for a wide variety of weeds, was therefore prohibitive. Furthermore, entomologists had encountered disappointing results in the 1930s when they had tried to control jointed cactus by liberating a South American variety of cochineal, *Dactylopius opuntiae,* highlighting how difficult and unrewarding biological introductions could be.[62] Veterinary recommendations focused instead on mechanical use of the hoe and the application of chemical herbicides.

Overall, however, the eradication of poisonous plants remained a problem for many farmers. There was always the danger of re-infestation, especially from plants that reproduced from seed, such as *Senecio,* and the cost of extirpating widespread or deep-rooted species was financially unviable for poorer stockowners, despite the government subsidies. Copper sulphate was expensive and as an herbicide was only effective against some plants, meaning that there was no universal weed killer that farmers could employ. *Gousiektebossie* was particularly resistant to all the available herbicides including the highly effective hormonal compound 2,4-d, developed in the United States during the Second World War.[63] There was also insufficient state funding to clear the country of *gifblaar* and the government dismissed veterinary advice to tackle *Senecio* by distributing free sodium chlorate on the grounds of cost.[64]

In practice, many stockowners could only fence off weed infested areas or else had to alter their grazing patterns to ensure animals were kept away from dangerous species at particular times of the year or under certain climatic conditions. This solution was possible in many cases as most plants were not toxic all year round. Experiments carried out by scientists at Pienaarsfontein Farm (Griqualand West), for instance, showed that over time it was possible to reduce the propagation of the *vermeerbossie* by exposing sheep to *Geigeria passerinoides* for limited periods only. This was feasible with the *vermeerbossie* because animals had to eat relatively large amounts of the plant to fall sick. Allowing sheep to graze on the plant enabled the gradual clearing of the land by 'natural means', in the hope of enabling innocuous grasses to reclaim the veld.[65] As a consequence, reducing cases of toxicoses could mean a total overhaul of farming practice. Veld rotation was no longer just about grassland regeneration in its simplest sense. It was also a question of risk assessment as dealing with poisonous plants meant that potentially dangerous species had to be incorporated into the animal diet in their non-toxic stages, the timings of which varied from plant to plant and from farm to farm.

CONCLUSION

Early veterinary studies into poisonous plants, most notably in the Cape from the late nineteenth century, corroborated the suspicions of African and settler

stockowners who had observed that some flora were highly toxic. After 1910 there was a great increase in the amount of toxicological research because poisonous plants began to supersede contagious and infectious diseases as the major cause of stock losses. The presence of toxic flora acquired a new political and economic importance as their proliferation threatened the viability and profitability of white commercial farming. Unlike immunological research, which resulted in the development of vaccines to combat a number of serious diseases, investigations into poisonous plants did not lead to the development of cures or chemical prophylaxes. However, toxicologists and their colleagues did demonstrate scientifically a direct link between certain plants and animal disease that enabled stockowners to make more informed grazing choices, so long as they had a sound knowledge of the floral composition of their farms. Dealing with poisonous plants necessitated a far more detailed understanding of the rural environment and the complex interaction of flora and fauna than many farmers had hitherto appreciated. Discoveries, such as the seasonal toxicity of plants, theoretically helped farmers to manage their estates more effectively by ensuring rotational grazing strategies took into account annual changes in the regeneration of the veld. Popular perceptions that poisonous plants were increasing both in numbers and distribution led veterinarians to attribute this process to a deleterious form of ecological succession brought about by overgrazing. Poisonous plants successfully competed with the residual grasses for control of the soils and available water supplies, thereby enhancing chances of toxicoses whilst reducing the carrying capacity of the veld. Unable to persuade many settler farmers to reduce their flocks and herds, veterinary scientists began to recommend more complex systems of rotational grazing as a means by which farmers could mitigate the economic impact of this environmental problem.

Since the 1940s the number of species scientifically proven to be poisonous has increased to 600 varieties reflecting an ongoing concern with toxicoses. Improvements in chemicals methodologies have also enabled the identification of more toxic principles, facilitating diagnosis. However, many of the practical problems remain the same. The high cost of herbicides, as well as concerns about their impact on the environment, have precluded eradication on many farms, and the difficulty of extirpating weeds on extensive properties remains an obstacle. Economically, toxicoses continue to cause financial losses to farmers, especially in the more arid parts of the country. Scientists still voice concerns about overstocking, despite certain shifts in ecological thinking over the last twenty years or so. Equilibrium theories about plant succession and stable climaxes may have been superseded by notions of more dynamic and less ecologically deterministic outcomes, encapsulated in questions about the randomised nature of 'disequilibrium' and terms such as grassland 'transformations' rather than 'degradation', but the challenge to stockowners, scientists and the state remains the same: how to protect the health, output and socio-economic value of livestock in a fragile pastoral environment.[66]

NOTES

[1] I would like to thank William Beinart, Daniel Gilfoyle, Daniel Rubenstein and Anthonie Snijders, as well as the anonymous reviewers for their helpful comments on this paper. Particular thanks go to Theuns Naudé for taking me around the Toxicology Department at Onderstepoort and for clarifying some of the complexities of toxicoses in South Africa. Thanks too go to the Wellcome Trust for funding my postdoctoral studies, from which this paper is drawn.

[2] John Quin to Petrus du Toit, undated report, Onderstepoort Veterinary Research Institute Archive (hereafter OVRIA), 63, 10/4/2/1, 9. The date of the visit was 3 January 1934. Petrus du Toit was Director of Veterinary Services from 1927 to 1948, having succeeded the bacteriologist Arnold Theiler who held that position from 1910–27.

[3] T. S. Kellerman, J. A. W. Coetzer, T. W. Naudé and C. J. Botha, *Plant Poisonings and Mycotoxicoses of Livestock in Southern Africa* (Cape Town: Oxford University Press, 2005) is the most detailed and latest account for South Africa.

[4] Lance van Sittert, '"The Seed Blows About in Every Breeze": Noxious Weed Eradication in the Cape Colony, 1860–1909', *Journal of Southern African Studies* (hereafter *JSAS*) 26, 4 (2000): 655–74; William Beinart, *The Rise of Conservation in South Africa* (Oxford: Oxford University Press, 2003), 122–3, 266–303.

[5] Douw Steyn, *The Toxicology of Plants in South Africa* (Johannesburg: Central News Agency, 1934), 70.

[6] Steyn, *Toxicology of Plants in South Africa,* 148.

[7] Daniel Gilfoyle, 'Veterinary Research and the African Rinderpest Epizootic: The Cape Colony, 1896–1898', *JSAS* 29, 1 (2003): 133–54; Daniel Gilfoyle, 'A Swiss Veterinary Scientist in South Africa: Arnold Theiler and the explication of *lamsiekte* in cattle', (unpublished paper presented at the conference on 'Imperial Culture in Countries without Colonies', University of Basle, 23–25 October 2003); Daniel Gilfoyle, 'Veterinary Immunology as Colonial Science: Method and Quantification in the Investigation of Horsesickness in South Africa, c. 1905–1945', *Journal of the History of Medicine and Allied Sciences* 61, 1 (2006): 26–65.

[8] Andrew Smith, *A Contribution to South African Materia Medica* (Cape Town: J. C. Juta & Co., 1895); John M. Watt and Maria Breyer-Brandwijk, *Medicinal and Poisonous Plants of Southern Africa* (Edinburgh: E & S Livingstone, 1932).

[9] Daniel Gilfoyle, 'Veterinary Science and Public Policy at the Cape 1877–1910' (D.Phil thesis, University of Oxford, 2002); Karen Brown, 'From Ubombo to Mkhuzi: Disease, Ecology and the Control of Bovine Trypanosomosis (Nagana) in KwaZulu Natal' (unpublished seminar paper presented at UNISA, Oxford and SOAS, October–November 2004).

[10] See for example, William M. Macmillan, *The South African Agrarian Problem and its Historical Development* (Johannesburg: Central News Agency, 1919), 43–4, 64–6.

[11] William Beinart, 'Transhumance, Animal Diseases and the Environment in the Cape South Africa', *South African Historical Journal*, forthcoming. For fencing, Sean Archer, 'Technology and Ecology in the Karoo: A Century of Windmills, Wire and Changing Farming Practice', *JSAS* 26, 4 (2000): 675–96 and Lance van Sittert, 'Holding the Line: The Rural Enclosure Movement in the Cape Colony, c. 1865–1910', *Journal of African History* 43 (2002): 95–118.

[12] UG32-1912, *Union Census* 1911, 1216–17; UG-1926, *Agricultural Census No. 7*, 22; UG49-1958, *Report on Agricultural and Pastoral Production* 1954–55, 121, 126, 134.

[13] See for example, William Beinart, 'Soil Erosion, Conservationism and Ideas about Development: a Southern African Exploration, 1900–1960', *JSAS* 11 (October 1984): 52–83; Peter Delius and Stefan Schirmer, 'Soil Conservation in a Racially Ordered Society: South Africa 1930–70', *JSAS* 26, 4 (2000): 720–42; Belinda Dodson, 'Above Politics? Soil Conservation in 1940s South Africa', *South African Historical Journal* 50 (May 2004): 49–64; Belinda Dodson, 'A Soil Conservation Safari: Hugh Bennett's 1944 Visit to South Africa', *Environment and History* 11 (February 2005): 35–54; William Beinart, *The Rise of Conservation in South Africa* (Oxford: Oxford University Press, 2003), especially chapters 7, 10, 11.

[14] For studies into microbes and vaccine technologies in Europe, see for example, Gerald Geisson, *The Private Science of Louis Pasteur* (Princeton: Princeton University Press, 1995); Thomas Brock, *Robert Koch: A Life in Medicine and Bacteriology* (Madison: Science Tech Publishers, 1988); Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain 1865–1900* (Cambridge: Cambridge University Press, 2000).

[15] Jotello F. Soga, 'Disease Nenta in Goats', *Agricultural Journal of the Cape of Good Hope* (hereafter *AJCGH*) 3 (29 January 1891): 140–42; Duncan Hutcheon, 'Nenta', *AJCGH* 14 (8 June 1899): 862–73. By the 1930s, veterinarians had linked other species of *Cotyledon* with the symptoms of *krimpsiekte,* see Douw Steyn, *Toxicology of Plants,* 220–30.

[16] Joseph Burtt Davy, 'Cattle Poisons of the Transvaal', *Transvaal Agricultural Journal* 2 (October 1903): 96–101**;** A. Mogg (Ecologist), **'**Some Poisonous Plants of South Africa', *Farming in South Africa* (hereafter *FSA*) 5 (December 1930): 453–4.

[17] 'Departmental Activities Veterinary Education and Research', *Journal of the Department of Agriculture* 3 (July 1921): 19–20; Arnold Theiler, Petrus du Toit and David Mitchell, 'Gousiekte in Sheep', *Ninth and Tenth Report of the Director of Veterinary Services,* 1923: 10–47.

[18] Duncan Hutcheon, 'The Poisoning of Stock by Tulp', *AJCGH* 17 (5 July 1900): 84–9; Duncan Hutcheon, 'The Poisoning of Stock', *AJCGH* 23 (1 October 1903): 390–99; Report by James Webb (Natal veterinarian), 'Vegetable Poisoning Amongst Stock in Natal', 1904, Pietermaritzburg Archive Repository, 44, 2106/04.

[19] H.H. Klette, 'Farmyard Problems: Tulp Poisoning', *Farmers Weekly* (hereafter *FW*) 50 (25 December 1935): 1159. (In 1990s, toxicologists were able to explain this by showing that animals developed an aversion to tulp if given in a sub-lethal dose, because of its unpleasant effects. Thanks to Theuns Naudé for this explanation).

[20] W. Pakeman to Duncan Hutcheon, 25 October 1905, Cape Archives, CVS, 1/11, 24.

[21] Walter C. Muenscher, *Poisonous Plants of the United States* (New York: The Macmillan Co., 1940) 134–6, 162–5. For *Tribulus* in East Africa see Bernard Verdcourt and E.C. Trump, *Common Poisonous Plants of East Africa* (London: Collins, 1969), 33.

[22] Theiler et al., 'Gousiekte in Sheep', 10.

[23] Paul Cranefield, *Science and Empire: East Coast Fever in Rhodesia and the Transvaal* (Cambridge: Cambridge University Press, 1991); Gilfoyle, 'Veterinary Science and Public Policy at the Cape'; Gilfoyle, 'Veterinary Research and the African Rinderpest Epizootic'.

[24] Karen Brown, 'Tropical Medicine and Animal Diseases: Onderstepoort and the Development of Veterinary Science in South Africa 1908–1950', *JSAS* 31, 3 (2005): 513–29.

[25] A. Pagan to Petrus du Toit, 22 June 1935, OVRIA, 64, 10/4/3/2, 1; John Nicol (senior veterinary surgeon in the Transkei and Eastern Cape) to Petrus du Toit, 21 September 1939, OVRIA, 39, 7/8/2, 36.

[26] Herbert Curson, 'Some Little Known South African Poisonous Plants and their Effects', Royal College of Veterinary Surgeon's Thesis 1926 (Thanks to Stephan Vogel for a copy of this); Douw Steyn, *Vergiftiging van Mens en Dier met Gifplante, Voedsel en Drinkwater* (Pretoria: J. L. van Schaik, BPK, 1949), v.

[27] Arnold Theiler, 'Geeldikkop in Sheep', *Seventh and Eighth Reports of the Director of Veterinary Research,* April 1918, 7.

[28] For example, Gilles de Kock, Petrus. du Toit and Douw Steyn, 'Studies on the Aetiology of Dunsiekte or Enzootic Liver Disease of Equines in South Africa', *Seventeenth Report of the Director of Veterinary Services and Animal Industry,* August 1931, 617–44.

[29] John Quin, 'Further Investigations into Geeldikkop (Tribulosis Ovis)', *Fifteenth Annual Report of the Director of Veterinary Services,* 1929: 765–7; John Quin to Petrus du Toit, undated report 1934, OVRIA, 63, 10/4/2/1, 9; Claude Rimington, 'Photosensitization Syndromes due to Porphyrins in Animals and Man', *Journal of the South African Veterinary Medical Association* (hereafter *JSAVMA*) 36 (September 1965): 313–18.

[30] John Quin's report to Petrus du Toit, February 1931, OVRIA, 63, 10/4/2/1, 1.

[31] Ibid.

[32] For example, Dawn Nell, 'For the Public Benefit: Livestock Statistics and Expertise in the Late Nineteenth Century Cape Colony 1850–1900', in Saul Dubow (ed.), *Science and Society in Southern Africa* (Manchester: Manchester University Press, 2000): 100–115; Mordechai Tamarkin, 'Flock and Volk: Ecology, Culture, Identity and Politics among Cape Afrikaner Stock Farmers in the Late Nineteenth Century' (paper presented at the Conference on 'African Environments, Past and Present', Oxford, July 1999).

[33] John Quin to Petrus du Toit, 28 March 1931, OVRIA, 63, 10/4/2, 8.

[34] John Quin's report on his visit to Fraserburg, February 1931, OVRIA, 63, 10/4/2/2.

[35] Claude Rimington and John Quin, 'Studies on the Photosensitisation of Animals in South Africa: The Presence of a Lethal Factor in Certain Members of the Plant Genus *Tribulus', Onderstepoort Journal of Veterinary Science and Animal Industry* (hereafter *OJVSAI*) 1 (October 1933): 469–91; Claude Rimington and John Quin, 'Studies on the Photosensitisation of Animals in South Africa: The Nature of the Photosensitising Agent in Geeldikkop', *OJVSAI* 3 (July 1934): 137–61; Claude Rimington and John Quin, 'Studies on the Photosensitisation of Animals in South Africa: The Biological Formation of Phylloerythrin in the Digestive Tract of Various Domesticated Animals', *OJVSAI* 4 (April 1935): 463–80. It was not until the 1990s that toxicologists understood the chemical reactions that caused this disease, see Kellerman et al *Plant Poisonings,* 42–8.

[36] For an overview of preventatives and remedies, see Douw Steyn, 'Animal Tolerance to Poisonous Plants', *OJVSAI* 1 (July 1933): 149–57; Steyn, *Toxicology of Plants,* 29–30 and *Vergiftiging van Mens en Dier,* 21–8

[37] John Quin to Petrus du Toit, 28 March 1931, OVRIA, 63, 10/4/2, 8; John Quin and Claude Rimington, 'The Geeldikkop Disease in Sheep', *FSA* 10 (March 1935): 101–2.

[38] Marguerite Henrici, 'Some Physiological Aspects of the Genus Tribulus', *OJVSAI* 10 (April 1938): 367–92; John Quin's report, 'Investigations into Geeldikkop and Related Problems amongst Farm Stock in South Africa', 24 February 1948; OVRIA 36, 7/2/4/1, 25.

[39] Annual Report of the Colonial Veterinary Surgeon for 1877, *Cape Parliamentary Papers,* G8-77, 10.

[40] Beinart, *Rise of Conservation,* chapter 3. See also Andrew Smith, *Pastoralism in Africa: Origins and Development Ecology* (London: Hurst & Co., 1992), 135–42; Nancy Jacobs, *Environment, Power and Injustice: A South African History* (Cambridge: Cambridge University Press, 2003), 86–101.

[41] Illtyd Pole Evans. *Botanical Survey of South Africa: A Guide to Botanical Survey Work* (Pretoria: Government Printing Press, 1922).

[42] UG49-1923, *Final Report of the Drought Investigation Commission,* 1923, 1–22. Many South African farms were unfenced and animals were kraaled, or driven to a pen, at night for protection from predators such as jackals. This trekking to the pen could form eroded trails across the veld, leading to sluiting or the formation of gullies by rain erosion.

[43] Illtyd Pole Evans, 'The Union as a Pastoral Country', *FSA* 7 (September 1932): 236.

[44] John Acocks, *Veld Types of South Africa* (Pretoria: Government Printer, 1953), 2.

[45] John Bews, 'An Account of the Chief Types of Vegetation in South Africa, with Notes on the Plant Succession', *The Journal of Ecology*, 4 (December 1916): 129–59; John Bews, *Plant Forms and their Evolution in South Africa* (London: Longman, Green and Co., 1925).

[46] For example, Frederick Clements, *Plant Succession: An Analysis of the Development of Vegetation* (Washington: Carnegie Institution, 1916); Arthur G. Tansley and Thomas F. Chipp, *Aims and Methods in the Study of Vegetation* (London: British Empire Vegetation Committee, 1926); Frederick Clements, 'Nature and Structure of Climax', *Journal of Ecology*, 24, 1 (February 1936): 252–84; Frederick Clements and Victor Shelford, *Bio-Ecology* (New York: John Wiley & Sons Inc., 1939); H. Oosting, *The Study of Plant Communities* (San Francisco: W.H. Freeman & Co., 1956); John Sheail, *Seventy-Five Years in Ecology* (Oxford: Blackwell, 1987); Ian Scoones, 'Range Management, Science and Policy', in Melissa Leach and Robin Mearns (eds), *The Lie of the Land: Challenging Received Wisdom on the African Environment* (Oxford: James Currey, 1996); Peder Anker, *Imperial Ecology: Environmental Order in the British Empire 1895–1945* (Cambridge: Harvard University Press, 2001); Helen Tilley, '"Africa as a Living Laboratory": The African Research Survey and the British Colonial Empire: Consolidating Environmental, Medical and Anthropological Debates 1920–1940' (D.Phil Thesis, University of Oxford, 2001).

[47] In the contemporary literature, see for example, Graham Jacks and Robert Whyte, *The Rape of the Earth: A World Survey of Soil Erosion* (London: Faber and Faber, 1939); Hugh H. Bennett, *Soil Conservation* (New York: McGraw Hill Book Company Inc., 1939); Paul Sears, *Deserts on the March* (London: Routledge & Kegan, 1949). More recently, David Anderson, 'Depression, Dust Bowl, Demography, and Drought: The Colonial State and Soil Conservation in East Africa during the 1930s', *African Affairs* 8 (July 1984): 321–43; Beinart, 'Soil Erosion, Conservationism and Ideas about Development'; Dodson, 'Above Politics?' and 'A Soil Conservation Safari'.

[48] Philip Viljoen, 'Annual report for year ended 31 August 1938', *FSA* 13 (December 1938): 474.

[49] Thomas Hall, *Our Veld: A Major National Problem* (Johannesburg: Association of Scientific and Technical Societies of South Africa, 1942), 6.

[50] Quin and Rimington, 'The Geeldikkop Disease in Sheep', 101.

[51] For example, Delius and Schirmer, 'Soil Conservation in a Racially Ordered Society'; Dodson, 'Above Politics?'; Dodson, 'A Soil Conservation Safari'.

[52] Herbert Curson, 'Notes on *Glossina pallidipes* in Zululand', *Bulletin of Entomological Research* 14 (May 1924): 445–53; Brown, 'Tropical Medicine and Animal Diseases'.

[53] The toxic varieties that had been identified by the 1930s were named *Senecio burchelli, Senecio latifolius, Senecio retrorsus* and *Senecio isatidius:* Steyn, *Toxicology of Plants in South Africa* 449–56; Gilles de Kock, Petrus du Toit and Douw Steyn, 'Studies on the Aetiology of Dunsiekte or Enzootic Liver Disease of Equines in South Africa', *Seventeenth Report of the Director of Veterinary Services and Animal Industry,* 1928, 617–44; Watt and Breyer-Brandwijk, *Medicinal and Poisonous Plants of Southern Africa,* 198–205. Douw Steyn to Petrus du Toit, 9 February 1938, OVRIA, 39, 7/8/2, 3; Douw Steyn to Petrus Du Toit, 23 November 1938, OVRIA, 39, 7/8/2, 29; Douw Steyn to John Phillips (Ecologist at the University of the Witwatersrand) 16 April 1940, OVRIA, 39, 7/8/1, 56. See also, Gilles de Kock, 'Diseases of Sheep in Relation to the Pasture Under South African Conditions', *JSAVMA* 1 (August 1928): 29–38.

[54] Watt and Breyer-Brandwijk, *Medicinal and Poisonous Plants,* 192–4; Douw Steyn 'Vermeersiekte in Stock', *FSA* 8, 87 (June 1933), 211–12.

[55] Beinart, *Rise of Conservation*, 122.

[56] Douw Steyn, 'Kaalsiekte in Kids and Lambs', *FSA* 13 (April 1938), 147.

[57] Quin and Rimington, 'The Geeldikkop Disease in Sheep', 101.

[58] See for example, Tom Lodge, *Black Politics in South Africa Since 1945* (New York: Longman, 1983), chapter 11; Peter Delius, *A Lion Among the Cattle: Reconstruction and Resistance in the Northern Transvaal* (Johannesburg: Ravan Press, 1996), chapter 2; Colin Murray, *Black Mountain: Land, Class and Power in the Eastern Orange Free State 1880s to 1980s* (Washington: Smithsonian Institution Press, 1992), chapter 5; Beinart, *Rise of Conservation,* chapter 10.

[59] 'Vermeersiekte', *FSA,* 3, 27 (June 1928), p. 841.

[60] 'The Eradication of Gifblaar (*Dichapetalum cymosum*)', *FSA* 10 (June 1935): 233–6; 'Science solves the Gifblaar Problem', *FW* 51 (15 July 1936): 1385; Philip Viljoen, 'Annual Report for Year Ended 31 August 1935', *FSA* 10 (December 1935): 491–541; Philip Viljoen's Annual Report for Year End 31 August 1936', *FSA* 14 (June 1939): 284–7.

[61] See for example, Beinart, *Rise of Conservation,* 235- 265, 367–390.

[62] T. J. Naudé (Chief Division of Entomology), 'Biological Control of Jointed Cactus', *FSA* 30 (May 1955): 259–60, 272.

[63] J. Leeman (Director of Soil Conservation and Extension) to Petrus du Toit, 18 December 1946, OVRIA, 64, 10/4/4, 8.

[64] Douw Steyn, 'The Toxicity of Sodium Chlorate', *OJVSAI* 1 (July 1933): 157–62; *Report of the Committee on Poisonous Plants,* 22 August 1938, OVRIA, 55, 7/8/3, 12; Philip Viljoen to Petrus du Toit, 11 November 1938, OVRIA, 39, 7/8/2, 28.

[65] Petrus du Toit, 'Investigations into the cause of Vomeersiekte[sic] in Sheep', *Thirteenth and Fourteenth Reports of the Director of Veterinary Education and Research,* 1928, 109–53; A.H. Pagan 'Vombeerbos Paradox', *FW* 39 (27 August 1930): 2077; A.H. Pagan, 'The only way with vomeerbos', *FW* 49 (8 May 1935): 597–598; A.H. Pagan to Petrus du Toit, 22 June 1935, OVRIA, 64, 10/4/3/2/1, 1.

[66] For example, Roy Behnke, Ian Scoones and Carol Kerven, *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas* (London: Overseas Development Institute, 1993); T.S. Kellerman, T.W. Naudé, N. Fourie, 'The Distribution, Diagnosis and Estimated Economic Impact of Poisonous Plants and Mycotoxicoses', *Onderstepoort Journal of Veterinary Research* 62, 2 (1996): 65–90; Kellerman et al, *Plant Poisonings*.