SA ISSN 0038-2809
Dewey Cat. No. 636,089

JOURNAL OF THE SOUTH AFRICAN VETERINARY ASSOCIATION

TYDSKRIF VAN DIE SUID-AFRIKAANSE VETERINÊRE VERENIGING

MARCH 1985/MAART 1985

VOLUME 56 No. 1
JAARGANG 56 Nr. 1

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Reg. No. S4 clavulanate + amoxycillin = Synulox

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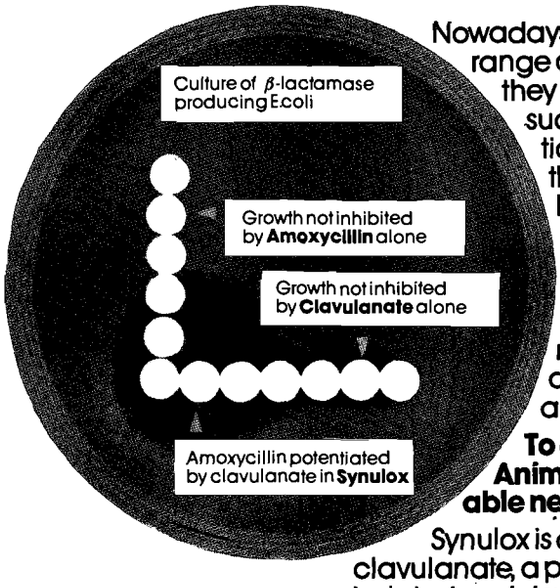

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Financial subvention by the Department of National Education is gratefully acknowledged.

Geldelike steun deur die Departement Nasionale Opvoeding word met dank erken.

Typeset, printed and bound by Heer Printing Co (Pty) Ltd.
Tipografie, gedruk en gebind deur Heer Drukkers (Edms) Bpk.

THEILER – HIS PERSONAL SIGNIFICANCE TODAY

THELMA GUTSCHE*

DELIVERED ON THE OCCASION OF THE FIRST FACULTY DAY OF THE FACULTY OF VETERINARY SCIENCE, UNIVERSITY OF PRETORIA ON 5 SEPTEMBER 1984

It may seem absurd that, in the light of a massive tome recording the life and times of Sir Arnold Theiler, there should be anything left to say about him. On the contrary, there is a great deal of information – of singular appropriateness today – which, on your kind invitation, I propose to impart. It is not the duty of a biographer to moralise or to speculate on possible sequelae of a great man's life; but the passage of time qualifies a keen observer for that role. May I add that when speaking of Arnold, I am also speaking of Lady Theiler without whom he could hardly have lived. It is a sober warning to all veterinarians to choose their lifemates carefully.

I saw Theiler only twice in my life – first when I was a very small child. He came to the Dynamite Factory near Somerset West (subsequently the Cape Explosive Works) of which my father was the manager. His mission was to discover whether the newly-erected Fertiliser Factory (still a feature of the landscape near Firgrove) could supply phosphates suitable for combatting Lamsiekte. All I remember about the visit was a shiny black-gloved hand and a stocky bearded man much admired by my father.

On the second occasion, I sat one seat away from him in the Jameson Hall of Cape Town University. I was awaiting the awarding of my M.A.-degree subsequent to his being invested with his sixth honoris causa doctorate. Of that occasion I remember again the black-gloved hand and the short, stocky, quietly-dynamic man. His was definitely a presence. Today I know everything about him vividly and intimately; all his triumphs and failings and unfulfilled ideals.

In Switzerland, the Theiler family, led by Arnold's nephew Alfred (a most endearing man practising as a civil engineer who, to my great sorrow, died before my work was completed), went to extravagant lengths to impress upon my that Arnold had come of peasant stock. They took me to call on relatives living as smallholders, on perhaps, only an acre of land, in a simple wooden house of which the lower floor accommodated six cows. That was all. They lived virtually in poverty and had only cherries to offer us from their single tree. I was taken to his birthplace at Frick, his secondary school at Aarau, the first Veterinary College he attended at Berne University and the second at Zurich. They also showed me the village – Beromunster – where he first tried to practise in a hostile Canton. Other members of the family including his two nieces, accompanied us. There emerged in me a strong admiration for the courage and doggedness of this young man in a highly competitive and depressed community, who had sought salvation by emigration.

I remember too that he had been educated and had grown up in the aura generated by Pasteur, Robert

*The late authoress of "There was a man: the life and times of Sir Arnold Theiler K.C. M.G. of Onderstepoort" 1979 Howard Timmens, Cape Town.

Koch and others around the new science of Bacteriology. Theiler had served as an assistant in the Bacteriological Department of Berne University. Although he had hoped to emigrate to South America he acted on mistaken advice and in fact sailed for South Africa.

We all know what happened to Arnold Theiler when he landed at the Cape and lost his baggage together with his indispensable instruments. Later, in the Transvaal, he lost his left hand. It is an enduring memorial to perseverance that the only woman in his life, Emma Jegge who, on receiving his letter explaining about his accident and advising her not to join him, replied that now more than ever he needed her and she came out soon after.

From this unfortunate introduction to a foreign country whose language he did not understand, there emerged in Theiler a strong compassion for suffering animals. He could hardly bear to watch the barbarous treatment inflicted on them in the name of cures – bags of suffocating hot bran round their heads to deal with Horse Sickness, unhygienic inoculation against diseases administered by ignorant savages and resulting in valuable animals becoming infected and dying, or merely losing their tails – essential protection against flies. Nor could he bear the stolid indifference of the farmers (and even educated citizens) to the existence of Veterinary Science. The attitudes of both sections of the community were hostile – with one exception – the famous farmer and public servant, Danie Erasmus.

In time and in the name of Science, Theiler probably did worse things himself in treating animals but with good reason. By then, his compassion extended to the people of South Africa whose defective agrarian economy deprived them of the benefits of sound agricultural practice. This situation was to reach its apogee with the recurrent Riderpest epidemic.

Essentially a student with a limitless love of scientific literature and periodicals, Theiler ran up enormous bills with his Swiss bookseller. Coming from a competitive society, he had to keep up with the latest developments, particularly as he was confronted by a host of diseases unscientifically named and barbarously treated. He had made a preliminary investigation of them before his accident but without his microscope and instruments. After brooding for months in the old *Volkshospitaal* in Pretoria and by then assured of Emma's unflinching support, he resolved that research was his best road to success, though he would be compelled to practice in order to earn a living.

He became a free-lance veterinary surgeon in Johannesburg but spent much of his time testing his hypotheses with such animals and equipment as he could obtain. Suspecting the forthcoming Jameson Raid, he moved to the outskirts of Pretoria and in desperation started raising pigs and poultry to support his family. Providentially for him, the Rinderpest epidemic moved relentlessly southward and President Kruger sent him to the then Rhodesia to identify the disease and devise preventative measures. He thus became persona grata with the Transvaal Republican Government.

It is an epic story which I will not retail. Suffice it to say that when in 1899, Theiler applied to the *Uitvoeringraad* for permission and a subsidy to attend the Seventh International Veterinary Conference in Baden Baden, Germany, he had sufficient standing with the government to have his request granted. In my opinion, this was the most significant of turning points in his life. It was then that he became truly inspired and subsequently burnt with an unquenchable enthusiasm.

But here I must diverge for a moment to note a curious fact. International Veterinary Conferences had been inaugurated in 1863 (four years before Theiler was born) by a stubborn Scots veterinarian, John Gamgee who, at first vainly but later with extraordinary success, circularised his colleagues throughout Europe. A year or so ago, a Mrs D'Arcy Thompson published a book entitled "Forgotten Corners of the Cape" which included Montagu (where I live) and I wrote to her in furious remmonstrance. It emerged that she was the grand-niece of John Gamgee and she later brought me the published history of the family "THE REMARKABLE GAMGEES – A Story of Achievement" written by a relative Ruth D'Arcy and published by the Ramsay Head Press in Edinburgh in 1974. I wish I had known about it during my research. If it is not in the Onderstepoort Library I hope it will be acquired soon.

John Gamgee and his followers brought his enterprise to the point where Conferences were started and attended by Royalty. It is regrettable that ours do not have the same significance today; but the situation can and will, I hope, be rectified. The life of the whole nation largely depends on the success of these conferences.

Theiler became inspired. He conferred with the most knowledgeable scientists of his day and was almost unique in his knowledge of tropical animal diseases. He associated with research scientists and distinguished bacteriologists from all over the world. His role among them became clear. He became a man with a mission and now he had similar and inspired men throughout the world to help him. From then on, they corresponded with one another until their deaths.

A most inevitable, misfortune dogged his return. He caught the last train to Pretoria before war was declared. As had happened once before, his baggage with all his new apparatus and literature, was lost. It only reached him long after the British occupied the Transvaal.

It had been popularly supposed at the time that Paul Kruger was nothing but a feeble-minded peasant. A man who had toured Europe three times as leader of Government deputations between 1877 and 1883 was hardly likely to fit that image. He and his Executive Council, under pressure from the dreadful Rinderpest and recurring animal diseases, had voted money to build Theiler a corrugated-iron laboratory with concomitant installations at Daspoort. Theiler staffed it with Swiss immigrants, the only knowledgeable men then available but they subsequently became a source of resentment. Here he continued his bacteriological and other investigations, particularly into Horse Sickness, which he and Emma had been conducting in the backyard of their small-holding (Emma continued work while he was overseas and kept his cultures alive).

It was neither appreciation nor high-mindedness that impelled the occupying British Army to seek him out and employ him. They were about to lose the guerilla war through animal diseases, particularly Horse Sickness which nullified any cavalry action. They gave him carte blanche. At last his day had dawned after a gloom-infused night – which, let it be emphatically stated, would have felled a lesser man unsupported by Emma.

What ensued has been recorded in the greatest detail

and I will not repeat these facts. But there are certain factors which, in my estimation, require re-emphasis. With some of the world's experts in his field in British Army uniform assisting him, Theiler instituted the multi-disciplinary approach to veterinary problems. First the British and then the Transvaal Colonial Government gave him full rein in securing the co-operation of imported specialists such as Burtt-Davy the botanist, Pole Evans the plant pathologist, ecologists, agronomists, entomologists, zoologists, anyone who would cast light on animal diseases – even ignorant farmers. Together they made enormous advances in veterinary research under appalling working conditions.

Today the multi-disciplined technique is commonplace. Even I at this moment, am closely concerned in the work of the Department of Environmental Studies of the University of Cape Town in which there could hardly be a more widely-flung field nor more interesting results. The CSIR is of course a more heroic example of the practice of this technique, but in Theiler's early days, the idea was preposterous.

At the other end of the scale, he had the highest regard for the apparently fanciful and superstitious theories of the farmers, from the backveld, and he would sit for hours patiently discussing their ways of treating animal diseases and the sometimes ludicrous practices that were still maintained throughout South Africa. As much as he co-ordinated expert knowledge, he kept an open mind and had high respect for the sons of the soil.

Of this period, I would like to mention that another of Theiler's outstanding contributions to the status quo which we now enjoy and which brings us here today, was his relentless campaigning for a South African Veterinary Association. The ludicrous image of the "Horse Doctor" continued. It might interest you to know that after reading Theiler's biography, a friend in Germany informed me that when a veterinary surgeon was summoned to deal with the animals on the family estate in the late thirties (in, be it noted, the home of Koch and while Theiler was still alive), the veterinarian took his meals with the servants in the kitchen.

Theiler worked endlessly to elevate the profession to its proper level. He would have scorned the practice of cosmetic surgery, however rewarding it was financially. To him the veterinary scientists and practitioners basically upheld the health and subsistence of the nation and were deserving of the highest honour and repute. The view is unassailable but not yet fully acknowledged. I am happy to be here today on this distinguished occasion and to have the opportunity both to reiterate this fact and to express the hope that the popularly yclept "vet" holds his and her head high and gratefully bears the responsibility of enhancing the profession.

When I read veterinary scientific publications and the agricultural supplements of various newspapers today, I am wryly amazed to note the wholehearted acceptance of scientific method and application by farmers in every field of agriculture. It was perhaps Theiler's greatest battle to convince people of this fact. When he retired from Onderstepoort in 1918, Gilles de Kock spoke at the farewell ceremony of his stiff-necked Arikaner brethren, remarking that in the distant districts, farmers still talked of *daardie ou kêrel Taylor*.

He got on with almost everyone – from Her Royal Highness Princess Alice, Countess of Athlone (who found him infinitely diverting and admired his dynamism and thereby hangs an amusing tale not to be told now) to his African labourers. But these personal relationships were marred by myopia and certain faults of character often found in dedicated men.

With the possible exception of his younger daughter Gertrud who acceded to his ambitions for her and became a world-famous parasitologist, he never understood his children. His younger son Max, South Africa's first Nobel Prize winner, went his own way. Theiler was incapable of accepting human beings as having frailties and limitations and respected only their capabilities. Empathy was beyond him. He was authoritarian to the point of being bullying and pathetic private letters attest to his bafflement in failing to understand the psychological and other difficulties of his offspring. He saw and experienced only – as well he might – the glory of Onderstepoort which was now acknowledged throughout the world.

The same attitude deeply afflicted his multi-national staff. Theiler had a clear and vivid vision of the necessity for rigidly disciplined research by men devoted to benefitting humanity. If, on his regular morning inspections, he noted that a student had written "N.U." on the report of the animal case in his case, he would immediately question him. "Nothing Unusual" was not to be expected in a sick animal.

He was authoritarian in his methods, failing entirely to recognise that with his staff, he was dealing with sentient human beings. I think it was Professor Bisschop who told me how Theiler had driven from Onderstepoort to the Pretoria station to fetch his latest recruit, W.H. Andrews after a scorching journey from the Cape. Fresh from England, Andrews was laid very low; but Theiler occupied the entire journey back to Onderstepoort instructing him in his new duties which were to begin at dawn the next day. He could descend to brow-beating and haranguing (known among the personnel as "barking") and there were indeed weaklings among the staff who, projected into a situation demanding super-human achievement, might have benefitted from power-play and risen to the occasion. On the whole however, Theiler was a hard but rewarding task-master, his eye ever upon the sanctity of scientific method and the unique reputation of Onderstepoort throughout the world.

In the same manner, practitioners in every field of Science were brow-beated by Theiler into delivering papers at the meeting of the Transvaal Biology Society of which he was a co-founder. Some were very bad but that is neither here nor there. What was significant was that he encouraged women to attend and experts among them to contribute lectures. The Society later burgeoned into a significant force.

He never became reconciled with Government procedures and, like many men of humble birth, easily took offence. He was always a thorn in the flesh of the Union Government, often with every justification. The crowning glory that he craved was that his Veterinary Research Laboratory be named for him like The Pasteur Institute, the Koch Institute and other tributes to renowned scientists; but it was never even mooted and Onderstepoort it had become and ever would remain.

When the Prime Minister, General Smuts unveiled Theiler's statue at Onderstepoort in 1939 (immediately after commencement of the War), he generously eulogised the man with whom he had been long and closely associated. "I have sometimes felt", he said, "that in the years past, I did not do my duty and give his

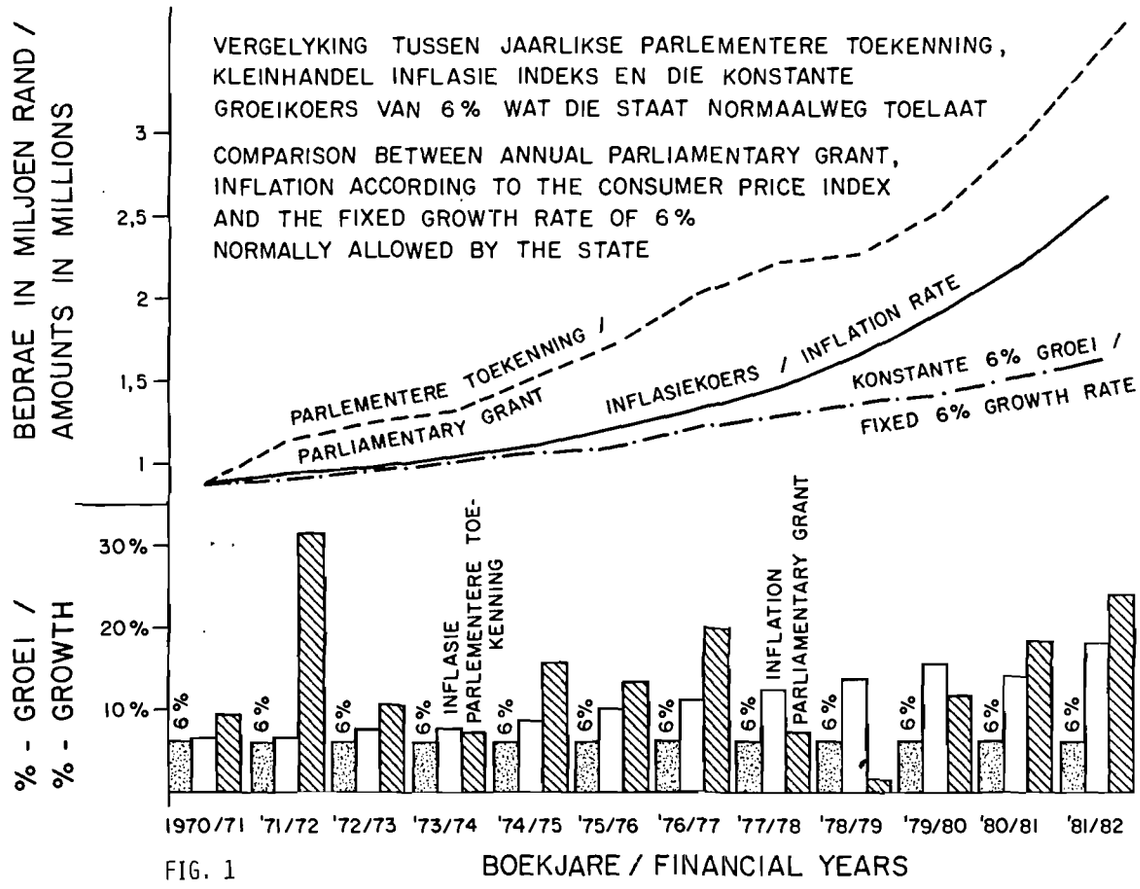


FIG. 1

Fig. 1 aangedui, *tot* 'n baie *groot* bedrag waarmee ons egter aan maar net 40% van die versoeke wat aan ons gerig word kan voldoen. In 1969 is die finansiering van mediese navorsing aan die Mediese Navorsingsraad oorgedra wat in daardie jaar as statutêre raad sy beslag gekry het. Die ondersteuning van navorsers in mediese en landboufakulteite word egter na oorlegpleging deur die WNNR-agentskap onderneem.

Studentebeurse vir nagraadse studie word ook deur die agentskap aan verdienstelike studente toegeken. Fig. 2 gee 'n aanduiding van die toename in hierdie toekennings oor die afgelope tien jaar. Twee feite verdien veral

SNO AFDELING VIR NAVORSINGSTOEKENINGS FONDSTOEDELING DEUR DIE VERSKEIE TOEDELINGSKOMITEES VIR 1970

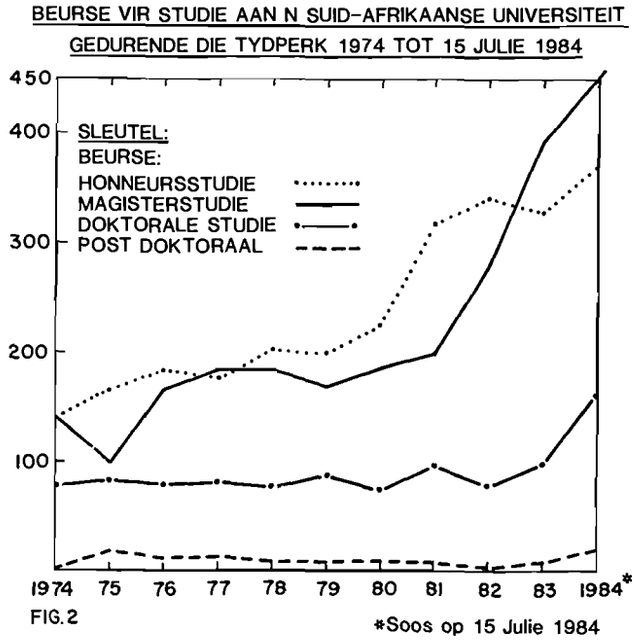
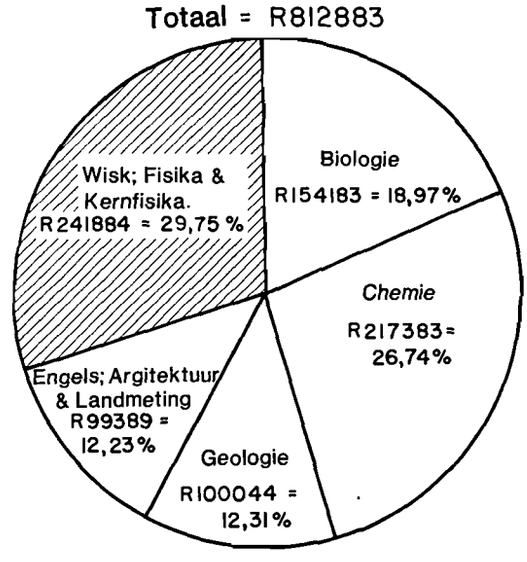


FIG.2



Stigting vir Navorsingsontwikkeling (SNO)

FIG.3

vermelding, naamlik dat daar nou meer magister- as honneursbeurse toegeken word en dat ons vanjaar altesaam meer as duisend beurse toegeken het.

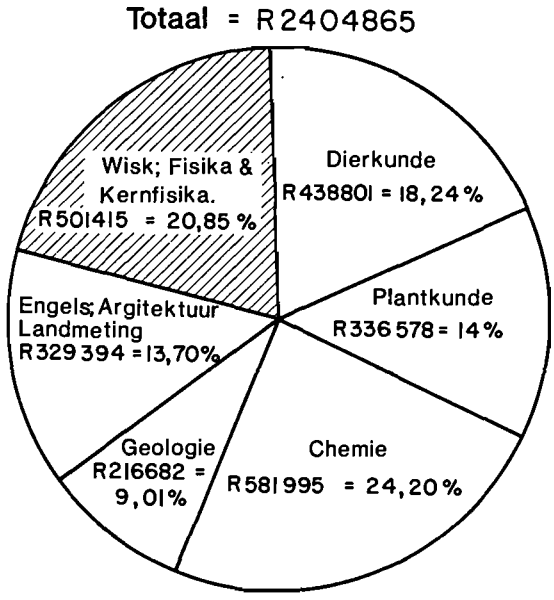
Die verdeling van fondse onder verskillende vakdissiplines en die veranderings daarin oor 'n tydperk van tien jaar word in Fig. 3 & 4 aangedui. Fig. 5 gee 'n aanduiding van die fondse wat u fakulteit van die WNNR en van die Departement Landbou vir navorsing ontvang en Fig. 6 toon die verdeling van die toekennings in die verskillende kategorieë van moontlike ondersteuning vir die 1984-begrotingsjaar.

In 1983 het die WNNR besluit om 'n studie te maak van die behoeftes van navorsers aan universiteite en die moontlike verbetering van die toekenningstelsel soos dit oor die jare in noue samewerking met die universiteit ontwikkel het. Prof Jack de Wet, voormalige dekaan van die Fakulteit Wis- en Natuurkunde van die Universiteit van Kaapstad, is as spesiale adviseur vir hierdie ondersoek deur die President van die WNNR aangestel.

'n Nuwe bedeling van navorsingsondersteuning vir universiteits- en museumpersoneel is vir inwerkingstelling in 1985 deur die Raad van die WNNR aanvaar en sal as die nodige fondse beskikbaar gestel word teen die einde van 1986 volledig in gebruik wees.

Die nuwe bedeling is gebaseer op die beginsel dat die *kwaliteit* van die navorsers en die waarskynlikheid dat hulle goeie navorsing resultate sal lewer indien hulle ondersteun word, die *hooffaktor* moet wees wat die vlak van ondersteuning bepaal. Die aansien van die navorser

SNO AFDELING VIR NAVORSINGS TOEKENNINGS FONDSTOEDELING DEUR DIE VERSKEIE TOEDELINGSKOMITEES VIR 1980



Stigting vir Navorsingsontwikkeling (SNO)

FIG. 4

FAKULTEIT VEEARTSENYKUNDE SE AANDEEL AAN BESKIKBARE TOEKENNINGSFONDSE (1980 — 1984)

	WNNR (ANT.)	AANDEEL	%	DEPT. LANDBOU	AANDEEL	%
1980	2990800	7000	0.23	173050	14650	8.46
1981	3719100	5500	0.14	212093	26636	12.55
1982	4657000	24000	0.51	218800	22500	10.28
1983	6038300	36000	0.59	250375	23500	9.38
1984	10100830	31000	0.30	295300	43600	14.76

FIG. 5

hang van internasionale eweknie-beoordeling af. Hierdie beoordeling sal gebaseer word op wat navorsers reeds werklik as navorsers en opleiers van nagraadse studente bereik het. Navorsing wat nog net beoog word, sal nie 'n rol in die beoordelingsprosedure speel nie. Daar sal wat die vlak van ondersteuning betref, duidelik onderskeid gemaak word tussen navorsers wat erkenning as leiers op hulle gebied geniet en dié wat hierdie peil nie of nog nie bereik het nie. Navorsers sal hulle eie navorsingsgebied kan kies en hulle navorsing kan aanpak op die wyse wat hulle die beste ag, omdat geglo word dat die beste klimaat vir goeie navorsing geskep word waar navorsers self besluit watter navorsing hulle graag wil onderneem.

Vir die uitmuntende navorser sal daar volgens behoefte voorsiening gemaak word deur die finansiering van poste vir navorsingsondersteuningpersoneel sowel as van die bedryfskoste van die navorsingsprogram van medewerkers en studente, met inbegrip van binnelandse sowel as buitelandse reiskoste. Dié omvattende ondersteuning sal vir vyf jaar gewaarborg word, daarna sal die kwaliteit van die navorser om die drie jaar opnuut

WNNR-STIGTING VIR
NAVORSINGSONTWIKKELING (SNO)
PROGRAM VIR SELFGEINISIEERDE NAVORSING
FONDSTOEDELING : 1984

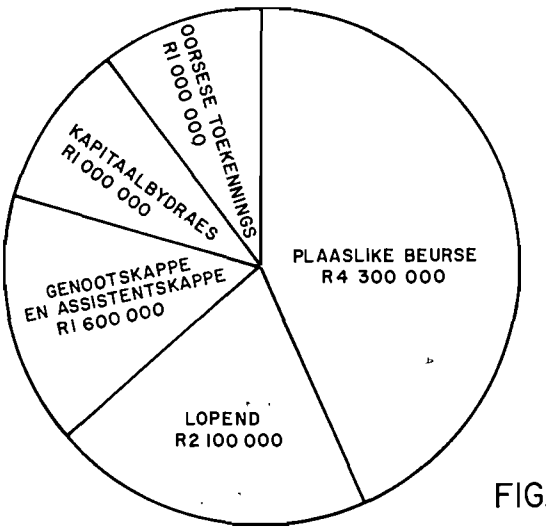


FIG.6

PLAASLIKE BEURSE ——— 43 %
LOPEND ——— 21 %
GENOOTSKAPPE EN ASSISTENTSKAPPE ——— 16 %
KAPITAALBYDRAES ——— 10 %
OORSESE BEURSE, REISE, KONFERENSIES ENS. ——— 10 %

beoordeel word. Hierdie prosedure sal sorg dat die navorser sy navorsing ongesteurd met die minimum burokratiese inmenging kan doen. Navorsers wat nie tot hierdie groep behoort nie, sal aanspraak kan maak op 'n gedeelte van die bedryfskoste van voorgenome navorsingsprojekte.

'n Spesiale toekenning vir die jong personeellid met 'n besondere studierekord word ook voorsien. Die waardes van beurse vir nagraadse studie, binnelands sowel as buitelands, sal realisties aangepas word om vir werklike studiekoste voorsiening te maak.

In die afgelope jaar is 900 universiteits- en museumpersoneellede geëvalueer. Dit was 'n groot maar ook 'n opwindende taak, en dit was besonder verblydend om te verneem van die hoë aansien wat 'n groot aantal van ons navorsers internasionaal geniet. Die eerste 22 omvattende toekennings is reeds met ingang van 1 Julie 1984 vir vyf jaar aan 'n groep van ons beste navorsers beskikbaar gestel. Ons hoop om teen die einde van die jaar die volgende toekennings in hierdie kategorie te kan doen mits die fondse dit toelaat. Ons het ook vir die eerste keer die benaming "Sentrum van Uitmuntendheid" aan twee universiteite toegeken, naamlik vir professor Friedel Sellschop se werk aan die Universiteit van die Witwatersrand in die kernwetenskap en aan die Universiteit van Kaapstad vir professor Claus von Holt se werk in die molekulêre biologie.

In die komende jaar sal 'n ondersoek na navorsingsinstrumentasiebehoeftes aan ons universiteite onderneem word. Die aanduidings is dat daar groot onrus aan die universiteite bestaan ten opsigte van toegang tot die beste navorsingsinstrumentasie, wat noodsaaklik is as 'n navorser kompeterend in sy vak wil bly. Aandag sal ook gegee word aan die moontlikheid van gesentraliseerde fasiliteite waar die hoë koste duplisering onmoontlik maak.

Bo en behalwe die toekenning van fondse vir vrye navorsing en van beurse aan universiteite, is die WNNR sedert 1957 besig met koöperatiewe wetenskaplike programme wat 'n belangrike invloed op universiteitsnavorsing uitoefen. Hierdie programme het ontstaan uit die deelname van Suid-Arikaanse navorsers aan internasionale navorsingsprogramme, byvoorbeeld die Internasionale Geofisiese Jaar in 1957/58 en die Internasionale Antarktiese Navorsingsprogram. As gevolg van die sukses van hierdie internasionale koöperatiewe programme wat daarin geslaag het om 'n deel van die navorsersgemeenskap in die land te mobiliseer om saam te werk aan geïdentifiseerde probleme wat te omvattend of kompleks is vir een persoon, groep of organisasie, is die koöperatiewe konsep uitgebrei tot nege nasionale programme waarvan die meeste multidissiplinêr van aard is en ook multi-institusioneel aangepak word.

Figuur 7 dui die toename in die fondse vir hierdie programme oor die afgelope 15 jaar aan, en Fig. 8 toon die verskillende programme wat tans aan die gang is.

Sedert 1 April 1984 word die ondersteuning van vrye navorsing en die koöperatiewe nasionale programme saam deur die WNNR-Stigting vir Navorsingsontwikkeling (SNO) behartig om die maksimum doeltreffendheid van albei hierdie finansieringsprogramme te verseker. Met hierdie nuwe bedeling en organisatoriese struktuur wag daar vir die aktiewe navorser aan ons universiteite 'n opwindende tyd en is daar ruim geleentheid vir die belowende student om nagraadse studies binnelands sowel as oorsee aan te pak.

SNO NASIONALE PROGRAMME (KWP KOMPONENTE)
TOTALE BEGROTING 1970–1984

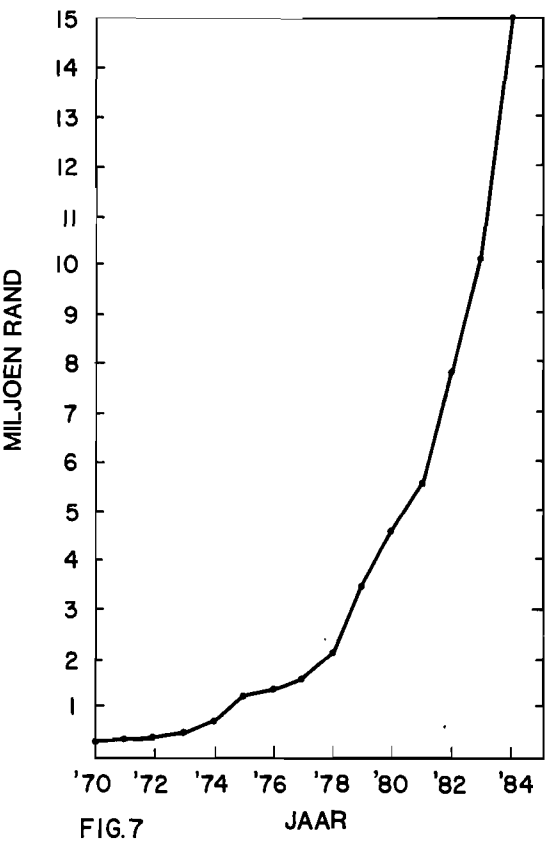


FIG.7

SNO NASIONALE PROGRAMME 1984

PROGRAM	AANVANGS-DATUM	'84 BEGROTING IN R1000
ANTARKTIKA	1960	*[R1 868] R 182
OSEANOGRAFIE (SANCOR)	1963	R2 022
AARDWETENSKAPPE	1981	R 834
OMGEWINGSWETENSKAPPE	1972	R2 065
AFSTANDSGEWAARWORDING	1975	R 692
ENERGIE	1978	R3 740
MATERIALE	1979	R2 018
WEER, KLIMAAT EN ATMOSFEER	1981	R 976
MIKROëLEKTRONIKA	1982	R2 220
BIOTEGNOLOGIE	1983	R 158
AKWAKULTUUR	1984	R 94
	TOTAAL	R15 001

*[Nie in SNO begroting ingesluit nie]

FIG.8

Ek wil graag nou kortliks aandag gee aan 'n studie wat die afgelope drie jaar onder beskerming van die WNNR onderneem is om vas te stel in watter mate Suid-Afrika toegerus is om uit moderne biologiese navorsing voordeel te trek en aan die pogings om hierdie navorsingsrigting by die WNNR sowel as aan die universiteite te bevorder.

Verlede jaar op 25 April was dit dertig jaar gelede dat daar in *Nature* 'n artikel deur Francis Crick en Jim Watson verskyn het waarin hulle voorstel dat die genetiese inligting van die sel opgesluit is in twee lang stringe van vier letters – die nukliensure van DNS – wat inmekaar gevleg is in die vorm van 'n dubbele heliks. Hierdie revolusionêre insig kan vergelyk word met dié van die Heisenberg en Schrödinger in die hart van die atoom dertig jaar vroeër. Net soos die kwantum-meganika het hierdie genetiese model reeds van sy voorspellingssowel as sy verklaringskrag bewys gelewer.

Hierdie modelontwikkeling het dan ook die kunsmatige skeiding tussen die biologie en die fisiese wetenskap vir altyd afgebreek, alhoewel die verandering oor baie jare nie tot Suid-Afrika deurgedring het nie.

In die sewentigerjare is 'n hele aantal nuwe tegnieke opeenvolgend in die biologiese wetenskappe ontwikkel, wat aanleiding gegee het tot snelle vooruitgang in navorsing en ook beloftes ingehou het van wesentlike verbeterings in die mens se lewenspeil. Van die belangrikste van hierdie tegnieke is waarskynlik die r-RNS wat spoedig op die ontdekking van restriksieensieme gevolg het. Hierdie tegniek het krag verleen aan die poging om die natuur te bemeester deur die benutting van die eienskappe van lewende sisteme deur middel van die biotegnologie tot voordeel van die gemeenskap. Dié tegnologie loop vandag hand aan hand met die mikroëlektronika en robotika as die hoogste prioriteite vir ekonomiese groei in ontwikkelde lande.

In September 1981 het die WNNR op versoek van professore verbonde aan die Universiteit van Kaapstad 'n byeenkoms gereël van persone, instansies en nywerhede wat by die ontwikkeling en toepassing van die biotegnologie belang kon hê. Hierdie vergadering het tot die slotsom gekom dat die RSA as 'n ontwikkelde land nie die moontlikhede van die biotegnologie kan verontagsaam nie; dat die suksesvolle benutting van die biotegnologie eerstens afhang van die kwaliteit van hoogs gekwalifiseerde molekulêre bioloë, dit wil sê biochemici, mikrobioloë, fisioloë en genetici; dat werkgeleenthede in die navorsingslaboratoria van institute en die nywerhede geskep moet word om afgestudeerde studente vir die land te behou; dat die nywerheid beïnvloed moet word om die kommersiële potensiaal van hierdie tegnologie te besef.

Statistieke het getoon dat heel weinig magister- en doktorsgrade in die molekulêre biologie en verwante vakke in die RSA behaal word. Die statistieke toon ook dat navorsingsfondse vir hierdie vakgebiede slegs 20% uitgemaak het van die fondse wat deur die WNNR-SNO aan die biologiese vakke toegeken is, nieteenstaande die hoë koste wat daar aan hierdie navorsing verbonde is.

'n Taakkomitee onder voorsitterskap van professor Walter Prozesky het op versoek van die vergadering 'n verslag aan die President van die WNNR voorgelê met aanbevelings oor stappe wat in die RSA gedoen moet word om aan die behoeftes van die land sowel as die behoeftes van die wetenskaplikes te voldoen. Ook uit hierdie verslag het dit duidelik geblyk dat opleiding die hoogste prioriteit moet geniet. Die WNNR her addisionele fondse beskikbaar gestel vir 'n gekoördineerde opleidingsprogram in die biotegnologie onder die bekwame leiding van professor Dave Woods van die Universiteit van Kaapstad. Vyf verskillende departemente asook die Navorsingsinstituut vir Veeartsenykunde neem aan hierdie program deel. Na oorlegpleging met 'n hele aantal bioloë en buitelandse vakkundige konsultante het die WNNR in 1983 besluit om 'n laboratorium vir molekulêre en selbiologie te stig. Professor Jennifer Thomson, destyds van die Universiteit van die Witwatersrand, is teruggeroep uit die VSA, waar sy besig was om oorweging te skenk aan meer as een aantreklike aanbieding van die biotegnologienywerheid, om hierdie laboratorium, wat op die oomblik by die Universiteit van die Witwatersrand gehuisves word, te lei. Die laboratorium sal alle reeds-bestaande navorsingsaktiwiteite op hierdie gebied by WNNR-institute koördineer, en ook sy eie navorsingsprogram aanpak. Hierdie navorsingsprogram sal by verskeie sentra op 'n gedesentraliseerde basis uitgevoer word onder die beheer van die Hoof van die WNNR-laboratorium. Die sentra waar die projekte en navorsers geplaas sal word, sal gekies word op grond van die beskikbare kundigheid by so 'n sentrum. Hierdie benadering, 'n nuwe wat die WNNR-organisasie betref, sal sorg dat kundigheid maksimaal benut word en kundigheidsentra uitgebou word. Die navorsingsprioriteite van hierdie laboratorium sluit in die molekulêre biochemie van mikroorganismes, byvoorbeeld by bioërtsloging, die bepaling van watersuiwerheid en die verbeterde benutting van dierevoeding; die molekulêre biologie van virusse, byvoorbeeld by die bereiding van entstowwe, diagnostiese peilmiddels en ensieme; die behandeling van afvalmateriaal en water, byvoorbeeld die omsetting van uitvloeisel in suiwer water en bemarkbare produkte. Hierdie laboratorium moet gesien word as 'n belangrike toevoeging tot die bestaande aktiwiteite op die mediese

sowel as die landboukundige terrein.

Noue skakeling op die hoogste vlak sal nodig wees om te sorg dat Suid-Afrika die maksimum voordeel trek uit navorsing op hierdie gebied. Die WNNR-laboratorium nooi navorsers op alle gebiede wat wil saamwerk of net gedagtes wil uitruil om hulle kragte saam te snoer vir die sukses van hierdie poging. As gevolg van hierdie toevoeging is die WNNR nou meer as ooit betrokke by nywerheidsvooruitgang in Suid-Afrika en sal 'n tot nog toe afgeskeepte maar uiters belangrike navorsingsgebied gestimuleer en ontwikkel word.

Meneer die Dekaan, mag die lede van u fakulteit ook voordeel trek uit die nuwe bedeling van finansiering vir navorsing asook uit die totstandkoming van die Laboratorium vir Molekulêre en Selbiologie, wat in die algemeen tot voordeel van die wetenskap in ons land sal strek.

Ek wens u 'n leersame en produktiewe fakulteitsdag toe.

BOOK REVIEW — BOEKRESENSIE

AN INTRODUCTION TO THE FUNCTIONAL ANATOMY OF THE LIMBS OF THE DOMESTIC ANIMALS

G.C. SKERRITT and J. McLELLAND

1st Edn. John Wright and Sons, Bristol, 1984 pp ix and 251, illustrations 122 (including 16 radiographs), Price £14,95 (ISBN 0 7236 0715)

As stated by the two authors, the main purpose of this book is to equip the preclinical veterinary student with a background of information on the anatomy of the forelegs and hindlegs of the dog, horse, and ox. This information should enable him to make a success of his clinical training. To this extent, and further, the authors are successful in their purpose.

The validity of the text becomes evident immediately when one has read through the first chapter, where the terminology is set out in a straight-forward and readable manner, using the established 'Nomina Anatomica Veterinaria' (N.A.V.) international nomenclature. Common synonyms that are still in use in general practice are included for explanatory purposes and completeness.

A short, interesting, and informative chapter follows, dealing with the embryological development of the mammalian limb and the evolution of the pentadactyl limb and quadrupedalism.

A succession of chapters deals with, firstly, the skeleton of the dog. The diagrams are greatly simplified with Anglicised versions of the N.A.V. terms used in the labelling. To make the section on osteology more complete, similar sections follow later, describing the bovine and equine bones. These chapters are appealing because of their simplicity, since the authors indicate only salient features of the bones, as opposed to a mass of terms that characterises the preclinical anatomy course offered during most veterinary curricula. Then follow interesting and easily readable chapters concerning joints and their ligaments, relevant muscle tables using the abbreviations O = origin, I = insertion, N = nerve supply, and A = action. Unlike the sections on osteology and arthrology, these chapters deal with all 3 animal species simultaneously. The angiology and neurology of the foreleg is based mainly on the canine, however, further details of relevance to the distal portions of the equine and bovine limb follow in later chapters. Occasional mention is made of salient differences in the feline and porcine forelimb. Considerable emphasis is given to the important synovial structures in the forelimb of the ox and horse. Fixation of the various joints in the large animals receives the attention it deserves.

This entire description by the authors is repeated with the details of the pelvic limb.

Then follow important chapters on the anatomy of the manus and pes ('the foot') of the bovine and equine.

There is a highly informative section dealing with the radiographic anatomy of the fore- and hindlimb, demonstrating the mature and immature dog in detail, and a brief section on the digit of the horse. This is presented in a very informative 'atlas-type' fashion by having labelled line-drawings accompanying the radiographs, all of which are of high quality. What is lacking in this chapter is the coverage of carpal and tarsal joints of the horse, since these areas are of such great importance in clinical diagnostics. It is a pity that no radiographic presentation of the bovine was included, even if it were limited to the digits.

A superficial look at general aspects of mammalian locomotion is the concluding chapter of this worthwhile book.

Brief mention is made of certain pathological conditions which occur fairly frequently in the horse. At the back of the book there is an extensive list of books and articles used as reference material by the authors, which may also be used for further reading on this comprehensive subject.

If the authors were to have gone one stage further by including the numerous nerve-blocks used in diagnostic work by the clinician, possibly specifically by the equine practitioner, this book would be a highly prized manual for diagnostics. But in the light of what the authors wished to cover by writing this book, it serves a useful purpose in concentrating the functional anatomy of the limbs of the dog, horse, and ox for its study by preclinical students, and provides a valuable source of reference for veterinarians in practice wishing to revise these aspects of anatomy. The authors have indeed been highly selective in the information included in this book, but have succeeded in making the text sufficiently detailed and yet also easy to assimilate. Such a text removes the uninspiring and awesome nature of conventional anatomical study of this material.

I highly recommend this book to all veterinarians and veterinary students, as an adjunct to the detailed anatomy texts already in their possession.

G.J. Louw

SOME OBSERVATIONS ON THE MORPHOLOGY OF THE BOVINE TEAT CANAL (*DUCTUS PAPILLARIS MAMMAE*)

N.J. VAN DER MERWE*

ABSTRACT: Van der Merwe N.J. **Some observations on the morphology of the bovine teat canal (*Ductus papillaris mammae*).** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 13-16 (En). Department of Anatomy, Faculty of Veterinary Science, University of Pretoria, P.O. Box 12580, 0110 Onderstepoort, Republic of South Africa.

After reviewing traditional and present day concepts of the mechanism by which the external orifice of the teat canal control the outflow of milk and the entry of bacteria etc. into the cavities of the mammary gland, this paper reports on the results of electron microscopic and other studies of the teat tip. This leads to the conclusion that the concept of a sphincter surrounding the teat canal should be substituted by one of a multi-spiralled, net-like integrated musculo-elastic system. This system may facilitate automatic closing and opening of the teat canal depending on the state of its major functional elements, namely (i) elastic fibres for passive closure under normal conditions (ii) smooth muscle fibres augmenting the former and (iii) the level of the intra-cisternal milk pressure. This closure is enhanced by soft teat canal keratin.

Key words: Bovine teat canal, functional morphology.

INTRODUCTION

From an appreciable range of investigations on diverse facets of the bovine teat canal it is apparent that the latter is a device intended for keeping mammary secretions in and bacteria out of the udder cavity. Although that purpose is readily understood in principle, it is not necessarily clear how the teat canal functions in detail.

There are, for instance, several workers who attribute closing of the teat canal mainly to its smooth muscle sphincter and Fürstenberg's rosette[6 7 19 21]. Explicit histological data[14] suggest, however, that earlier descriptions of the smooth muscle sphincter may not be correct. Radiographic work[15] further indicates that Fürstenberg's rosette, as illustrated by Foust[6], differs considerably from reality. Other investigations make it clear that:

(i) Some 84% of the force for keeping the teat canal closed seems to be related to tissue components which function irrespective of whether or not the animal is alive[18].

(ii) Major portions of that force may depend on connective tissue supporting the ductular structure, elastic tissue facilitating passive spring-loaded closing of the duct and pliable epithelium and soft teat canal keratin augmenting the former by actually sealing the ductular lumen[9].

(iii) Some portions of the smooth muscle "sphincter" of the teat canal may act as an automatic pacemaker for rhythmic contractions of the teat wall. These are intended to reduce intracisternal milk pressure where it has escalated to levels that may affect the elastic closure of the teat canal[3], whilst other portions may be related to additional fluctuations of the tone and activity of the teat canal closure[3 22].

Further uncertainties involve data on the development of mastitis related to intramammary infection. From several investigations it is obvious that teat canal infections do occur[10] and then quite frequently[11] and that they are important precursors to intramammary infection proper[17].

However, in terms of the morphology and function of the teat canal, the frequency and different levels of teat canal infections and, respectively, their relationship to the leukocytic udder barrier[11], it seems conceivable that the normal teat canal, exposed to contaminations as it is, may on the one hand be intended for preventing gross infections of the mammary cavity, whereas on the other hand it may also be part of a system in which bacteria can be trapped, killed, destroyed and antigenically identified. Adams et al.[1] have shown that bacteria in the teat canal may be destroyed biochemically.

For a better understanding of the role of the teat canal epithelium in teat canal closure and as a potential site for direct, though limited, monitoring of antigenic stimuli, further histological studies on the teat canal were undertaken.

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MATERIALS AND METHODS

Immediately after slaughter the teat tips of 2 heifers and 2 lactating cows were removed, fixed in 10% formalin and embedded in paraffin wax. Serial sections, each 10 μm thick, were cut of the whole teat canal. Wax reconstructions of the lining epithelium of the teat canal were made. Material of the preparation of sections for electron microscopy was taken from the external skin and teat canal epithelium, fixed and cut according to standard procedures. These sections were examined using a Philips 301 electron microscope.

RESULTS

Wax reconstructions of the epithelial lining of the teat canal revealed its tendency to form folds with a predominantly spiralling course (Fig. 2 & 3). Electron microscopic investigations of the teat canal epithelium further showed numerous Langerhans cells, some of which contained Langerhans cell granules (Fig. 5). Migrating lymphocytes were also seen in the teat canal epithelium (Fig. 4). Because the teat skin is virtually impervious to water, difficulties were encountered in fixing the whole teat; the fixative could only penetrate from the ductal side. It was therefore impossible to fix the teat canal in the most contracted state.

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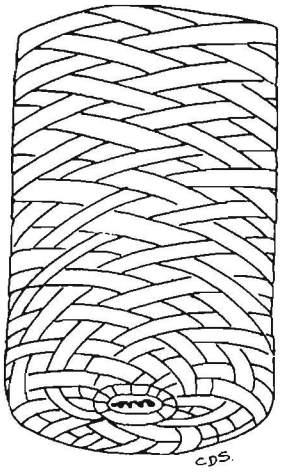

Fig. 1: A schematic representation of the lamellated net-like arrangement of the elastic fibres and smooth muscle fibres in the bovine teat canal.

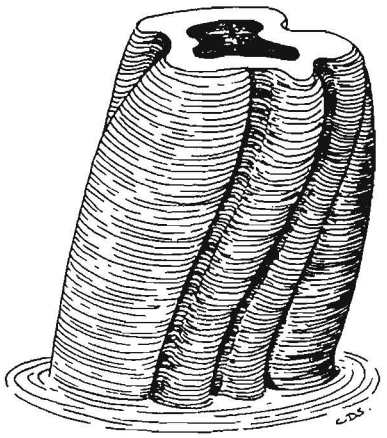

Fig. 2: A sketch of one of the wax reconstructions made from serial sections of a slightly extended teat canal revealing the tendency towards spiralling of the epithelial folds.

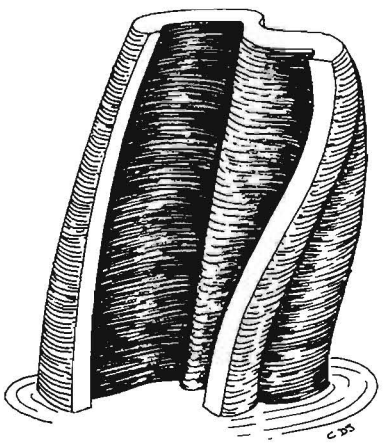

Fig. 3: A cut-away section of a wax reconstruction revealing the same tendency towards spiralling as in Fig. 2 but seen from the inner surface.

DISCUSSION

There are very few recent investigations on the morphology of the bovine teat canal and even less on its functional anatomy. From a rather limited range of data generated under different conditions, a functional anatomical concept, generally accepted to date, holds that smooth muscle bundles of the teat wall surround the teat canal like a distinct circular sphincter which closes the teat canal by means of its contraction. This concept seems oversimplified in the light of work on histological[14], radiographic[4] and pharmacological[3] findings applicable to the teat canal.

Where smooth muscle is used in the body as contractile propelling fibres around tubular viscera or other organs such as the uterus[12], ductus deferens[13], blood vessels[2] and the human mammary papillae[16], one finds that the smooth muscle is invariably arranged in contracted or extended spiral layers or networks. As the bovine teat is also a hollow tubular organ, it seems reasonably to expect that its smooth musculature also would have a spiral or netlike arrangement, consistent with the structural principles as outlined above. Goertler[13] considers the use of the same anatomic structural principle in different organs as the economy of the organism.

The explicit findings of Meissner[14], augmented by others[9] and this investigation, make it clear that such a principle is also applicable to the bovine teat.

Erroneous descriptions of a distinct circular sphincter of the teat canal thus may be considered obsolete. Similarly, the functional concept of the teat canal based on such descriptions should be augmented by one which suggests that the teat and teat canal musculature is arranged and functions in a three dimensional, net-like and spiral mechanism as depicted schematically in Fig. 1.

Although the muscular network is predominant in the teat wall it becomes rather limited in the region of the teat canal[14]. In this region elastic fibres become conspicuous around the internal and especially numerous around the external opening of the teat canal. This distribution of elastic fibres provides a logical explanation for the data presented by Pounden & Grossman[18]. They suggest that the smooth muscle may not play a major direct role in the closing of the teat canal which apparently is closed primarily by passive action of elastic fibres[14].

Smooth muscle fibres at the proximal aspect of the teat canal, apparently act and react in a manner similar to that of other smooth muscle fibres in the animal body. Their tonus may affect teat canal closure (this tonus is caused by elastic fibres of the myo-elastic sheath of the muscle fibres); nor-adrenaline (principally an α-receptor stimulant) causing contraction and isoprenaline (a β-receptor stimulant) relaxation[3 20 22].

Rhythmic contractions are initiated by stretching of smooth muscle fibres. Increasing intra-cisternal milk pressure would progressively stretch the fibres especially in the region of the internal opening of the teat canal. The result of this stretching is rhythmic contractions of the teat wall. These contractions start in the teat canal area and move upwards towards the udder proper[4] thus producing a pumping action which decreases the milk pressure in the teat by pumping the milk into the gland cistern and beyond. The efficacy of such a reverse pumping action may be gauged from the inhibition of milk leakage by nor-adrenaline which under conditions

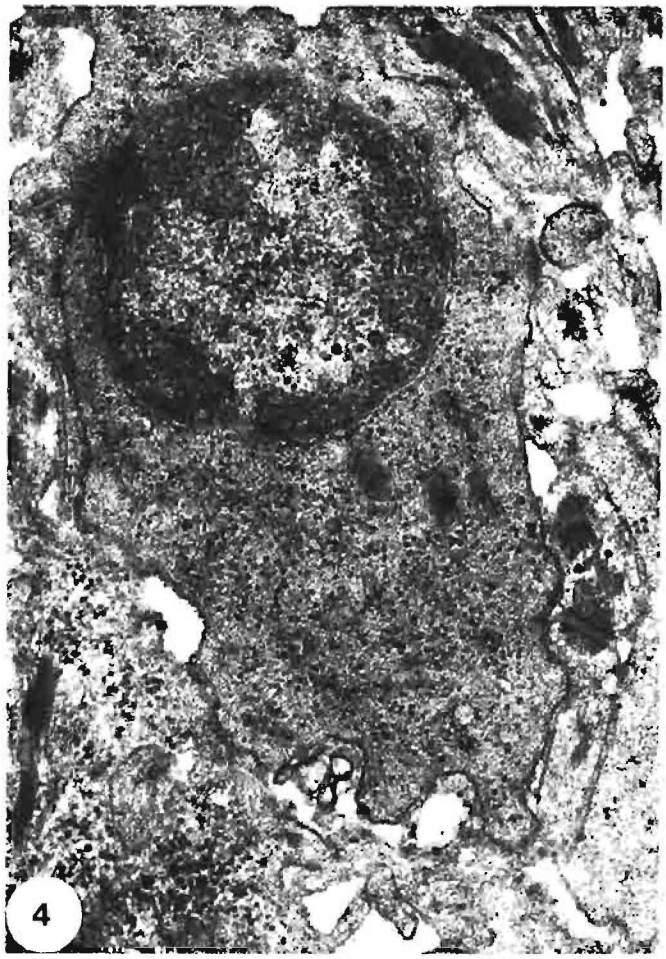

Fig. 4: A dendritic macrophage (Langerhans cell) as seen between the lining epithelial cells of the teat canal. Its cytoplasm contains a few mitochondria (rather strongly electrondense with cristae not revealed as a result thereof) and an abundance of polyribosomes but no Langerhans cell granules. Microvilli, tonofilaments and desmosomes of the epithelial cells are obvious. E M x 42 000

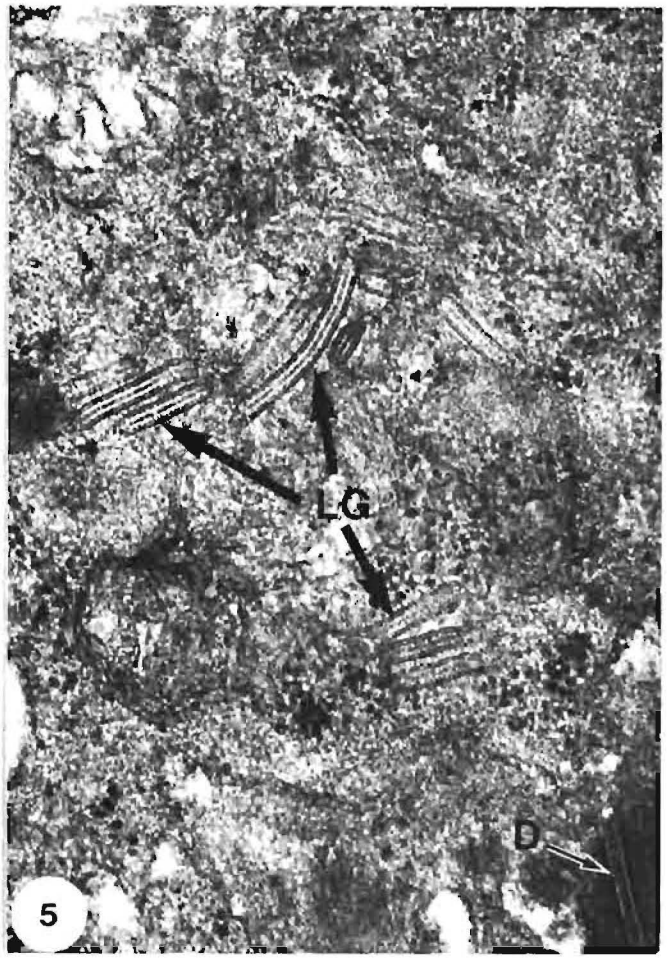

Fig. 5: A poorly defined dentritic macrophage (Langerhans cell) as seen in the teat epidermis with its collection of Langerhans cell granules (L G) and polyribosomes. At D an epithelial desmosome is seen. E M x 68 500

of increased intracisternal milk pressure stimulates rhythmic contractions of the teat wall musculature[3,20]. Blocking of α-receptors or stimulation of β-receptors induces significantly escalating milk leakage[3,20].

All the abovementioned data suggest that the teat canal closure normally depends primarily on passive elastic contraction augmented by the tone of the smooth muscle fibres[14].

Closure of the teat canal during contractions of the teat wall seems inconsistent with the findings of Fischer[5] who investigated the functioning of a net-like system similar to that found in the bovine teat canal. If these findings are applied to the bovine teat, a strong contraction of smooth muscle fibres would be expected to cause widening of the teat cistern and possibly also the teat canal. However, during contractions, the teat shortens, is drawn towards the udder similar to the human mammary papilla[16] and its lumen does not widen but becomes narrower[4] instead.

Conditions during the act of milking or nursing obviously differ considerably from those during milking and nursing intervals, due to the engorgement of blood vessels and elevated intra-cisternal milk pressure. It is therefore conceivable that under these circumstances the nature and magnitude of contractions of smooth muscle fibres depend on the cumulative effect of all forces responsible for the increase in intra-cisternal milk pressure which may escalate to levels causing extension of the smooth muscle fibres to thus temporarily incapacitate them.

Apart from its unique opening and closing mechanism the teat canal also has a well adapted defence mechanism. The presence of Langerhans cells as dendritic antigen detectors[8] in its surface and canal epithelium (Fig. 5) and of lymphocytes in the cisternal epithelium presumably indicate mechanisms for detecting antigenic agents and initiating responses.

CONCLUSION

In the light of the more recent findings on the morphology of the teat canal, it appears that the concept of a spincter surrounding the teat canal should be substituted by one of a multi-spiralled, net-like integrated musculo-elastic system. This system may facilitate automatic closing and opening of the teat canal depending on the state of its major functional elements, namely (i) elastic fibres for passive closure under normal conditions (ii) smooth muscle fibres augmenting the former and (iii) the level of the intra-cisternal milk pressure. This closure is enhanced by soft teat canal keratin.

ACKNOWLEDGEMENT

I thank Prof W H Gerneke, Department of Anatomy, Faculty of Veterinary Science, University of Pretoria and Dr W H Giesecke, Mastitis Research Unit, Section of Food Hygiene, Veterinary Research Institute, Onderstepoort, for their invaluable help and criticism in preparing this article, Mr D J Coetzer for his help in preparing the wax reconstructions, Miss C D Seegers for preparing the diagrams and Mr J Soley for the ultramicrographs.

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BOOK REVIEW

BOEKRESENSIE

THE PENGUIN BOOK OF DOGS

ROGER CARAS and MICHAEL FINDLAY

2nd Edn. Penguin Books Ltd, Harmondsworth, Middlesex, England 1983 pp 347, photographs 158, Price £6,95 (ISBN 0 14 046.531 6).

Roger Caras has been in the vanguard of nature conservation in the United States for many years. He has published several books on Nature, on the environment and on companion animals. Michael Findlay has been in practice as a veterinarian and has been involved in dog and cat shows – in short a real specialist in "companion animal zootechnology". *The Penguin Book of Dogs* is aimed as a guide to would-be purchasers of the pedigree animal and also as a reasonably priced reference for veterinarians, kennel-owners, pet-shop proprietors, dog breeders, judges, schools and libraries.

It is good to learn the classification of breeds according to groups following the regulations of the Kennel Club of the U.K. We have the Sporting breeds with the Hound-, Gun-Dog, Working- and Terrier-Group and the Non-sporting breds with the Utility- and Toy-Group. The first nine pages are particularly enjoyable to read – they are aimed at the caring, thinking responsible owner of the dog. The chapters are entitled: Does a dog deserve me?; Thoroughbred versus Mongrel; Dog versus Bitch; Size; Coats and Coat care; Where from?; How Much?; First steps; Your Dog and the Law; Your Vet; Shows; Showing and Breeding.

The two authors are able to present from the 325 internationally recognized dog breeds not less than 158 breeds which are registrable and therefore recognized by the U.K. Kennel Club.

Each breed is presented in alphabetical order starting with the Affenpinscher and ending with the Yorkshire Terrier with at least one photograph and with the following information: Country of origin, original purpose, recent popularity ranking by Kennel Club registration and furthermore height, weight, coat, colour, amount of care required, amount of exercise required and suitability for urban/flat life.

The description of the different dogs are done in straight easy to read language and every page gives new enjoyment in reading. The book is a "must" to every Veterinarian and at the given price also to every Veterinary student.

D.R. Osterhoff

OVINE WET CARCASS SYNDROME INDUCED BY WATER DEPRIVATION AND SUBSEQUENT OVERHYDRATION: PRELIMINARY FINDINGS

J.P.J. JOUBERT*, P.G. MARAIS** and F.J.C. SMITH*

ABSTRACT: Joubert J.P.J.; Marais P.G.; Smith F.J.C. **Ovine wet carcass syndrome induced by water deprivation and subsequent overhydration: preliminary findings.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 17-19 (En). Regional Veterinary Laboratory, Private Bag X528, 5900 Middelburg, Cape Province, Republic of South Africa.

Two groups of 25 one-year-old Dorper rams were deprived of water for 52 h and then allowed free access to water for the last 18 h before they were slaughtered. One of these groups received a maize-meal and bone-meal lick containing 28,5% salt (sodium chloride) during the last 18 h period. A control group of 20 sheep received water throughout the experiment. The salt group had an average intake of 4,5 ℓ of water per animal in the 18 h rehydration period while the other water deprived group drank about 3,8 ℓ of water per animal. After being slaughtered, all the sheep in the salt group had typically wet and glistening carcasses, 18 of the other water deprived group had wet carcasses while none in the control group were affected. These results seem to indicate that the wet carcass syndrome is caused by overhydration after a period of dehydration and that salt intake during rehydration can exacerbate the condition.

INTRODUCTION

Brock et al.[2] described the ovine wet carcass syndrome as a condition characterised by a wet shiny appearance of carcasses due to the accumulation of a watery fluid in the subcutaneous and other connective tissues of the buttocks, flanks, sides and subscapular areas. Affected carcasses have poor keeping qualities and are aesthetically unacceptable to the customer. From January 1981 (when it was first noticed) to July 1984 the loss to the South African mutton industry as result of condemnations and trimming of wet carcasses amounted to approximately R1,5 million[1]. This syndrome cannot be diagnosed clinically in the live animal[2].

Hattingh et al.[6] studied the composition of the watery interstitial fluid and found the following significant ($P < 0,01$) differences to normal ovine interstitial fluid, using the Student's t-test:

(a) Total protein content (g/ℓ) of normal interstitial fluid was 52 while that of wet carcass interstitial fluid was 14.
(b) Albumin to globulin ratio of normal interstitial fluid was 1,5 as compared to 3,2 of wet carcass interstitial fluid.
(c) Osmotic pressure (mm Hg) of normal interstitial fluid was 9 and 3 in wet carcass interstitial fluid.

They found no significant differences between plasma values of normal ($n = 5$) and wet ($n = 12$) sheep carcasses with respect to chloride, sodium, potassium, osmolality, protein, colloid osmotic pressure and A:G ratio on examination of blood which was withdrawn at slaughter.

These findings were explained as indicative of a possible selective increase in permeability of capillary blood vessels combined with a raised mean capillary hydrostatic pressure, which can be caused by histamine or histamine-like substances.

No histopathological lesions were seen in any of the wet carcasses examined, nor was any infectious, or other cause, determined, despite exhaustive investigations[2]. This condition was first seen in sheep from the Gordonia district and subsequently in sheep from all over the country and in most abattoirs.

Recently it was reported that the use of lick blocks in the holding pens increased the incidence of the wet carcass syndrome dramatically at the Port Elizabeth abattoir (G W Burroughs 1984 State Veterinarian, Port Elizabeth Abattoir, personal communication). About 7 sheep and 1 cattle wet carcasses were condemned each month when lucerne was fed, while the incidence increased to an average of 270 sheep and 3 cattle carcasses when lick blocks were offered instead. On removal of the lick blocks, the number of condemnations dropped to the previous low figure.

Similar findings were reported from the Upington area where a farmer had 150 sheep on veld grazing. He divided them into 2 groups of 75 each and despatched them simultaneously by road transport to 2 different abattoirs in the Transvaal about 700 km from Upington. One group was off-loaded at an abattoir where lick blocks were fed in the holding pens and the others, 2-3 h later, at the abattoir where teff hay was given. On the following day they were slaughtered, again with a delay of 2-3 h between groups to enable the veterinarian in charge to assess both groups on the slaughter lines. There were no wet carcasses in the group which received teff hay but the group which received lick blocks did have a 12% incidence of wet carcasses (P Jordaan 1984 State Veterinarian, Upington, personal communication).

About the same time (July 1984) 2 different groups of sheep were slaughtered at the Beaufort West abattoir. They showed an incidence of 50% and 75% wet carcasses, respectively. Both groups of sheep came from natural grazing and were kraaled with access to water before being taken to the abattoir the next day, where they received no feed or water until being slaughtered within 9 h since they left the kraals. (J P J Joubert 1984 Regional Veterinary Laboratory, Middelburg, Cape Province, unpublished report).

The first two cases indicate that lick blocks can increase the incidence of wet carcasses but the Beaufort West incident clearly points out that some other factor must be the primary cause of wet carcasses. At this stage the high salt (sodium chloride) contents of the lick blocks were thought to increase the water intake of the animals, leading to the development of wet carcasses. The Beaufort West sheep most probably did develop an excessive thirst while grazing and when they were kraaled with sufficient water available they must have overhydrated themselves. These observations seem to indicate that wet carcasses result from excessive water in-

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0038-2809/85/01/0017-0019

take by dehydrated sheep and that the condition can be worsened if salt was taken in in some form during the rehydration period. This paper reports on the results of an experiment designed to test this hypothesis.

MATERIALS AND METHODS

Seventy one-year-old Dorper rams were randomly divided into a control group of 20 and into experimental groups A and B consiting of 25 sheep each. The sheep were previously kept on Karooveld supplemented with a lick containing 66,5% maize meal, 28,5% salt and 5% bone meal.

Each group was kraaled separately. After being kraaled, they received milled lucerne hay and water ad lib for 3 days. Groups A and B were then deprived of water for 52 h while the lucerne hay was given to all groups until they were slaughtered. Water was again made available to Groups A and B for the last 18 h before they were slaughtered. During this final 18 h period Group A (alone) had access to the salt containing lick described above. The control group had access to water and milled lucerne hay until they were slaughtered.

Water was supplied to Groups A and B in rectangular troughs which was filled to the brim and the volume of water consumed by the group of sheep was calculated by measuring the difference between the initial water level and that attained before water was added at 3 stages during the 18 h rehydration period. Average water intake for this period was calculated from this data. The control group received water from a continuous flow system which was also used for other animals on the experimental farm. Therefore the water intake of the control group was not measured.

Heparinized, vanous blood specimens were collected from all sheep when they were kraaled initially, when Groups A and B had been deprived of water for 24 h and shortly before slaughtering.

About 20 g of connective tissue containing watery fluid was collected from the flanks of 3 wet carcasses out of Group A and the fluid was extracted per centrifuge and pooled for further analyses.

The haematocrit was determined by means of a micro haematocrit technique described by Frankel & Reitman[4] on all blood samples. Blood plasma of all sheep and the watery fluid were used to determine concentrations of sodium with a Varian Techtron AA5 atomic absorption spectrophotometer, potassium concentrations with a Beckman flame photometer, total proteins according to a modified biuret method of Weichselbaum[3] with a Lambda III spectrophotometer and albumin:globulin ratios according to the Helena electrophoresis manual method[5] with a Titan micro electrophoresis system and a Quick Scan junior scanner. Results of these determinations were tested for significant differences within groups and group to group (at all stages) using the Student's t-test.

All carcasses were inspected while they were slaughtered or shortly thereafter. None of the carcasses were washed down. Degree of wetness was assessed according to the following scale:

Dry: The whole carcass has a normal dry appearance.
Slightly wet: One third of the carcass is shiny wet.
Medium wet: Half of the carcass is shiny wet.
Grossly wet: Most of the carcass is shiny wet.

Following inspection the carcasses were kept hanging in a coolroom at 0°C for 18 h and then again judged for wetness.

RESULTS

All the animals in Group A had wet carcasses and 84% were classified as being medium to grossly wet. In Group B, 18 out of 25 sheep showed wet carcasses of which 40% were medium to grossly wet. No wet carcasses were seen in the control group. After 18 h in the coolroom 20% of all carcasses in Group A and 52% in Group B appeared dry. These results are shown in Table 1.

During the last 18 h before slaughter (rehydration period) the average water intake per sheep in Groups A and B was approximately 4,5 ℓ and 3,8 ℓ respectively. Interstitial fluid taken from 3 wet carcasses of Group A contained 23 g/ℓ of total proteins, an albumin: globulin ratio of 8,4, potassium ion concentration of 11,0 mmol/ℓ and 142 mmol/ℓ of sodium ions.

Table 1: THE EFFECTS OF WATER DEPRIVATION FOLLOWED BY OVERHYDRATION AND SALT SUPPLEMENTATION ON OVINE CARCASSES

Groups	Feed	Water	Salt/ Maizemeal/ Bonemeal lick	No. of sheep per group	Appearance of carcasses							
					Immediately after slaughter				After 18 h in coolroom			
					Dry	Wet			Dry	Wet		
						Slightly[1]	Medium[2]	Grossly[3]		Slightly[1]	Medium[2]	Grossly[3]
Control	Milled lucerne hay	Free access	None	20	20	0	0	0	20	0	0	0
A	Milled lucerne hay	Deprived for 52 h. Then ad lib for last 18 h before slaughter	Ad lib for last 18 h before slaughter	25	0	4	7	14	5	8	9	3
B	Milled lucerne hay	Deprived for 25 h. Then ad lib for last 18 h before slaughter	None	25	7	8	7	3	13	9	3	0

[1]Slightly = one third of the carcass shiny wet
[2]Medium = half of the carcass shiny wet
[3]Grossly = most of the carcass shiny wet

Specimens of blood plasma collected from all animals at 3 phases of the experiment had values within normal bounds for total proteins, albumin:globulin ratio, haematocrit as well as potassium- and sodium ion concentrations. There were no significant differences between groups and within groups (at the 3 stages of blood collection).

DISCUSSION

Hatting et al.[6] stated that interstitial fluid is contained in 2 phases: a free fluid phase of relatively small volume and a gel fluid phase constituting the major part. They also pointed out that the gel phase is normally saturated and that alterations in the water content of the interstitial space is determined by changes in the free fluid content. Based on this information, wet carcasses in the experimental animals seem to have developed as follows: enforced dehydration of the sheep must have decreased the volume of free fluid in the interstitial space. The subsequent overhydration resulting from excessive intake of water then increased the volume of free fluid in the interstitial space well beyond its normal level. Overfilling of the interstitial space occurred more readily in the easily expandable connective tissue layers of the subcutaneous-, subscapular- and certain intermuscular areas. Macroscopically this change was seen as the wet and glistening appearance of a wet carcass.

Where a salt lick was supplied to the sheep in the rehydration phase, the thirst-stimulating effect of the salt added to the substantial volume of water taken in and this was reflected in the increased incidence of wet carcasses in that group.

Results from the pooled wet carcass fluid were not compared statistically with that obtained by Hattingh et al.[6] but it appeared to be more closely related to the figures they have for wet carcass fluid than to their normal sheep interstitial fluid.

The haematocrit, total proteins, albumin:globulin ratio, sodium- and potassium concentrations showed no significant differences between or within groups at any of the 3 stages. These findings are in accordance with that of Hattingh et al.[6] and indicate that blood constituents of sheep can have normal values at 24 h of dehydration[7]. Furthermore, it seems that wet carcasses occur when there is only a slight increase of fluid in the interstitial tissues, as more fluid would probably gravitate to the lowest part of the body resulting in an observable clinical oedema.

As it is known that it takes but one minute for the fluid to reach the interstitial space from the blood vessels[7], it may be expected that the surplus water would be removed equally fast. Therefore, the mechanisms involved in maintaining the overhydrated state sufficiently long to be observed in the slaughtered carcass, will have to be clarified.

However, the results of this experiment indicate that the wet carcass syndrome is caused by overhydration after a period of dehydration and that the intake of feeds with a high salt content during rehydration can exacerbate the condition.

ACKNOWLEDGEMENTS

The Director of the Karoo region is thanked for making available sheep and facilities for this experiment. Diligent work of Mr P Schlebusch, Mrs Monica Sutherland and Mrs Sophia S van der Merwe is greatly appreciated, as well as the helpful criticism of Dr E M van Tonder.

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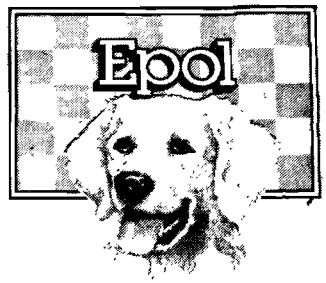

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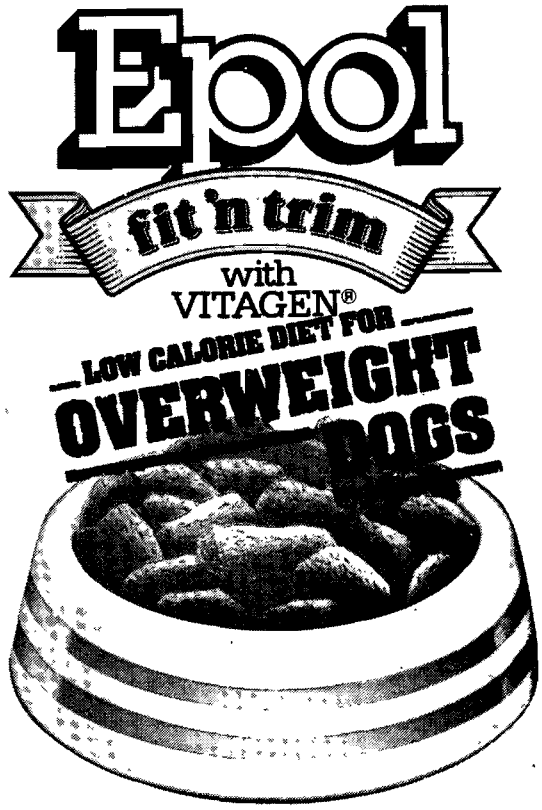

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EFFICACY OF IVERMECTIN AGAINST GASTROINTESTINAL NEMATODES IN CATTLE IN SOUTH AFRICA

G.E. SWAN*, J. SCHRÖDER** and J.P. LOUW***

ABSTRACT: Swan, G.E.; Schröder, J.; Louw, J.P. **Efficacy of ivermectin against gastrointestinal nematodes in cattle.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 21-23 (En), MSD Research Centre, Private Bag 3, 1685 Halfway House, Republic of South Africa.

The efficacy of ivermectin administered at 200 μg/kg was evaluated against induced infestations of 5 gastrointestinal nematode species in cattle. Results were analysed by the modified non-parametric method and a "A" class (more than 80% effective in more than 80% of the treated animals) was achieved with an oral drench and subcutaneous injection against the third and fourth larval and adult stages of *Bunostomum phlebotomum*, *Cooperia* spp. (*C. pectinata* and *C. punctata*), *Haemonchus placei*, *Oesophagostomum radiatum* and *Ostertagia ostertagi*. Ivermectin was 77,5-100% effective against naturally acquired infestations of *Trichuris* spp.

Key words: Gastrointestinal nematodes, cattle, ivermectin

INTRODUCTION

Ivermectin (22-23 dihydroavermectin B_1) (Ivomec Injectable, MSD) has been shown to have a high efficacy against a number of immature[1,4,5,7,8,12] and adult[1-3,5,7,8,10] gastrointestinal nematodes including inhibited larval stages of *Ostertagia ostertagi*[1,6,7,11] and lungworm (*Dictyocaulus viviparus*)[4,5,8,10] of cattle. This paper describes a series of 4 South African trials in which the efficacy of ivermectin in an oral as well as an injectable formulation was tested according to the modified non-parametric method (NPM) against induced infestations of all 3 parasitic stages of 5 nematode species and natural infestations of *Trichuris* spp.

MATERIALS AND METHODS

Animals:

A total of 114 Friesian steer calves, reared under conditions which as far as possible precluded previous helminth exposure, were used. Four trials were carried out in which cattle were experimentally infested. The animals were treated once with either cambendazole (Noviben, MSD) or thiabendazole (Thibenzole, MSD) prior to induction of infestations. Either 11 or 12 animals were used for each treatment group and 7 or 8 animals served as untreated controls within each trial.

Gastrointestinal nematode infections:

Ivermectin in an oral and in an injectable formulation was tested against induced infestations of all 3 parasitic stages of *Bunostomum phlebotomum*, *Cooperia* spp. (*C. pectinata* and *C. punctata*), *Haemonchus placei*, *Ostertagia ostertagi* and *Oesophagostomum radiatum* in 3 trials (Trials 1-3); each trial included the same parasitic stage (third larval, fourth larval or adult stage) of each parasite species. In the fourth trial (Trial 4) the efficacy of ivermectin in an injectable formulation was confirmed against induced infestations of third stage larvae of *O. radiatum*, fourth stage larvae of *H. placei* and adults of *Cooperia* spp. and *O. ostertagi*. In addition the animals in all four trials had naturally acquired infestations of *Trichuris* spp.

The procedures used to infest calves with nematodes were described by Reinecke (1973)[9].

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Treatment:

In three trials (Trials 1-3) both the oral and subcutaneous routes of administration were included; in all three trials ivermectin was dosed at 200 μg/kg. In the fourth trial ivermectin was only administered subcutaneously at 200 μg/kg. Two different injectable formulations were employed; an aqueous micelle formulation in Trials 1-3 and a solution in organic solvents in the fourth trial.

Larval indicator control (LIC):

One LIC animal was included in each trial. On the day of treatment in each trial the LIC animal was slaughtered to confirm the stage of development of the various parasitic nematodes at that time.

Worm recovery and counting:

Animals were slaughtered for recovery of worms 14-28 days (fourth larval and adult stages) and 46-50 days (third stage larvae) after treatment in Trials 1-3. In the fourth trial, which included mixed parasitic stages, the animals were slaughtered 35-38 days after treatment. Worms were recovered by methods previously described[9].

Statistical analysis:

The gastrointestinal parasite burdens were ranked for each species and treatment group for determination of NPM claims[9]. In addition the data from 3 trials (Trials 1-3) were analysed by transformation of data to the natural logarithm. The data for parasites for which total counts were made, were transformed to the natural logarithm of (count + 1). For parasites counted in aliquots, 0,25 was substituted for a zero count in any location. Counts for a particular parasite within each location were multiplied by the appropriate aliquot factor and summed over all locations where found. These counts were transformed to natural logarithms. Various statistical procedures were then applied to the results: in Trial 1 the t-test was used to compare mean worm burdens in treatment groups with unequal variance and Duncan's new multiple range test for multiple comparisons; in Trial 2 the overall treatment effect was tested by Kruskal-Wallis procedure and pairwise comparisons of the mean worm burdens of the treatment groups by Wilcoxon's rank-sum procedures; and in Trial 3 the variances of the mean worm burdens for each parasite were compared using Hartley's maximum F-test and the treatment group worm burden means

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with either unequal variances or with poolable variances, using a t-test.

RESULTS

The mean worm burdens for each species, percentage reduction after treatment and the classes estimated by the NPM are listed in Tables 1-3 for induced infestations and in Table 4 for *Trichuris* spp.

With the exception of third stage larvae of *O. radiatum* (89% for the oral formulation; 95-99,4% for the injectable formulation), fourth stage larvae of *B. phlebotomum* (98,9%) and *O. radiatum* (98,6%) and adult *Cooperia* spp. (97,4-98,7%) the percentage reduction of the mean worm burdens of animals treated with ivermectin either subcutaneously or orally were >99% for all induced infestations.

The reduction in numbers of all induced parasitic nematode species and development stages using both the oral and subcutaneous routes of administration of ivermectin qualifies for an A class by the NPM[9].

Mean reductions in burdens of naturally acquired *Trichuris* spp. in animals treated with ivermectin sub-

Table 1: EFFICACY OF IVERMECTIN AGAINST THIRD STAGE NEMATODE LARVAE AT 200 µg/kg. MEAN WORM BURDENS, PERCENTAGE REDUCTIONS AND NPM CLASS

Third Larval Stage	Trial No	Mean Worm Burdens[1]			Percentage Reduction		NPM Class	
		Control	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously
B. phlebotomum	2[1]	165,8[a]	1,32[b]	1,25[b]	99	99	A*	A
Cooperia spp.	2[1]	2 472[a]	5,3[b]	5,0[b]	99	99	A	A
H. placei	2[1]	728,7[a]	3,75[b]	3,75[b]	99	99	A	A
O. radiatum	2[1]	546,7[ac]	59,3[b]	29,7[c]	89	95	A	A
	4[2]	1 751	—	11	—	99	—	—
O. ostertagi	2[1]	1 733[a]	1,25[b]	1,25[b]	99	99	A	A

[abc]Values for a species with no superscript in common are statistically significantly (p 0,01) different. Overall treatment effect tested by the Kruskal-Wallis test; pairwise comparisons of mean worm burdens in treated groups by Wilcoxon's rank-sum procedure

[1]Transformed to natural logarithims after 0,25 was substituted for zero in an aliquot for calculation of geometric means

[2]Arithmetic means

*A = more than 80% effective in more than 80% of treated sheep

Table 2: EFFICACY OF IVERMECTIN AGAINST FOURTH STAGE NEMATODE LARVAE AT 200 µg/kg. MEAN WORM BURDENS, PERCENTAGE REDUCTIONS AND NPM CLASS

Fourth Larval Stage	Trial No	Mean Worm Burdens[1]			Percentage Reduction		NPM Class	
		Control	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously
B. phlebotomum	1[1]	235,6[a]	2,5[b]	2,5[b]	98,9	98,9	A*	A
Cooperia spp.	1[1]	1 699,5[a]	2,5[b]	2,7[b]	99,0	99,0	A	A
H. placei	1[1]	938,9[a]	3,8[b]	4,0[b]	99,0	99,0	A	A
	4[2]	1 280	—	0,6	—	99,0	—	A
O. radiatum	1[1]	181,6[a]	2,5[b]	2,5[b]	98,6	98,6	A	A
O. ostertagi	1[1]	2 050,8[a]	2,8[b]	2,7[b]	99,0	99,0	A	A

[ab]Values for a species with no superscript in common are statistically significantly (p 0,05) different. The t-test was used for treated groups with unequal variances; Duncan's New Multiple Range Test was used for multiple comparisons

[1, 2] *See Table 1

Table 3: EFFICACY OF IVERMECTIN AGAINST ADULT NEMATODES AT 200 µg/kg. MEAN WORM BURDENS, PERCENTAGE REDUCTIONS AND NPM CLASS

Adult Parasite	Trial No	Mean Worm Burdens[1]			Percentage Reduction		NPM Class	
		Control	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously
B. phlebotomum	3[1]	689,6[a]	1,3[b]	1,3[b]	99	99	A*	A
Cooperia spp.	3[1]	105,6[a]	2,8[b]	2,6[b]	97,4	97,6	A	A
	4[2]	1 410	—	19	—	98,7	—	A
H. placei	3[1]	1 213,4[a]	2,5[b]	2,5[b]	99	99	A	A
O. radiatum	3[1]	388,5[a]	2,5[b]	2,5[b]	99	99	A	A
O. ostertagi	3[1]	3 024,2[a]	1,5[b]	1,8[b]	99	99	A	A
	4[2]	1 654	—	0,8	—	99	—	A

[ab]Values for a species with no superscript in common are statistically significantly (p 0,05) different. The variances of the mean worm burdens in treated groups were compared using Hartley's maximum F-test and using a t-test for means with unequal variances and with poolable variances

[1, 2] *See Table 1

Table 4: EFFICACY OF IVERMECTIN AGAINST NATURAL INFESTATIONS OF *TRICHURIS* SPP. AT 200 μg/kg. MEAN BURDENS AND PERCENTAGE REDUCTIONS

Trial	Mean Worm Burdens			Percentage Reduction	
	Control	Ivermectin Orally	Ivermectin Subcutaneously	Ivermectin Orally	Ivermectin Subcutaneously
1[1]	1,7[a]	0,3[b]	0,3[b]	85,2	83,4
2[2]	26,4[a]	2,0[b]	1,3[b]	92	95
3[2]	7[a]	0[b]	0[b]	100	100
4[3]	4	—	0,9	—	77,5

[ab]Values for a species with no superscript in common are statistically significantly (p 0,05) different
[1]A substitution was made whenever a zero count occurred in the data and then converted to a log transformation for calculation of geometric means
[2]Transformed to natural logarithm of (count + 1) for calculation of geometric means
[3]Arithmetic means

cutaneously varied from 77,5-100%. In animals treated with ivermectin orally, reductions varied from 85,2-100% when compared with the control animals. The numbers of *Trichuris* spp. were, however, too small to be able to carry out an estimation of an NPM class.

DISCUSSION

These are the first trials in which the efficacy of ivermectin in cattle has been evaluated according to the modified NPM. The results demonstrate the high efficacy of ivermectin given either orally or subcutaneously at 200 μg/kg against both larval and adult stages of the major gastrointestinal nematodes in cattle and are consistent with overseas reports by other workers[1-5 7 10 12]. Except for the third stage larvae of *O. radiatum*, of which there were significantly ($p < 0,01$) fewer in animals treated subcutaneously than in those treated with the oral formulation, the results obtained from both routes of administration were similar for all parasite species and stages of development (Table 1). The variable efficacy of ivermectin against *Trichuris* spp. may well be due to low and variable burdens in the untreated controls.

Both injectable formulations of ivermectin gave comparable efficacies when evaluated against the same parasites.

ACKNOWLEDGEMENTS

The technical assistance of Messrs R G Harvey and C J Z Smith, Mesdames I Penderis and S Meyer is acknowledged. Mesdames M C Calitz and J Oliver typed the manuscript. The statistical analyses of three trials were performed by the Planning and Data Management Staff of Merck Sharp and Dohme Research Laboratories, Rahway, New Jersey, United States of America.

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LETTER TO THE EDITOR — AAN DIE REDAKSIE

"TISSUE REACTION AND RESIDUES IN SLAUGHTER CATTLE AFTER ADMINISTRATION OF LONG-ACTING OXYTETRACYCLINE FORMULATIONS" *PETZER, VAN STADEN & GIESECKE SEPTEMBER 1984*

I believe it is necessary that you publish the following facts which will assist your readers in viewing this article in true perspective.

1. It is readily acknowledged that all injections will cause tissue necrosis.
2. The work carried out by Petzer, Van Staden & Giesecke confirm what is, and has been for some time, stated in all technical literature on Terramycin® injections – that the injection site, in animals intended for slaughter, should be the neck and that this volume should, in cattle, not exceed 10 ml per site. It is thus of academic interest to show necrosis resulting from Terramycin® LA and Liquamycin® LA injection at twice the recommended volume and in the thigh.
3. The formulation of injectables is most important in controlling the amount of tissue damage caused by their injection – not only the "carrier" but also the other excipients and pH of the solution.

Trials done locally (Moore, Marnewick & Henning and Moore & de la Ray, unpublished data) and overseas (data on file, Pfizer Laboratories) has to date shown *no* long-acting oxytetracycline injectable which has better toleration characteristics than Liquamycin® LA or Terramycin® LA.

In fact only one product matched these and most caused a much more severe tissue reaction.

C.W. Moore
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Pfizer Laboratories, P.O. Box 783720, 2146 Sandton, Republic of South Africa.

BOOK REVIEW — BOEKRESENSIE

LIVESTOCK FEEDS AND FEEDING

D.C. CHURCH

2nd Edn. O and B Books Inc., 1215 NW Kline Place, Corvallis, Oregon 97330, U.S.A. 1984 pp vi and 549, illustrations 191, plates 4, tables 337, Price US $28,00 (ISBN 0-960-15868-5 hard cover, 0-960-15868-3 soft cover)

Most veterinarians are in general not well enough equiped to handle the wide variety of problems that arise due to nutritional problems in domestic animals. To correct this position it would seem appropriate to embark on a study of nutrition, using a suitable book that could help one become acquainted with the nutritional field. One such book is this second edition of Livestock Feeds and Feeding. It is presented in three parts.

Part I introduces the reader to digestive physiology and nutrient metabolism. It also deals with the various nutrients, feeding standards and feed additives. The main analytical methods used in the nutritional field are briefly explained.

Part II deals with feedstuffs and explains which feeds supply the various nutrients, and what the contents of various feeds are e.g. energy feeds, protein sources, mineral and vitamin supplements and roughages. The processing and preparation of these various feeds are discussed at length and the resultant effects are explained. Ration formulation is extensively covered, from the most simple Pearson Square method to the advanced computer Linear programming methods. A host of tables, figures and photographs assist in making this one of the most successful parts of this book.

Part III deals with the practical feeding of the various species of livestock. These include beef and dairy cattle, sheep, goats, pigs, poultry and horses. Sections are also included on dogs and cats as well as on rabbits. The section on ruminant nutrition is very adequately done, although some parts are not strictly applicable to South African conditions because of differences in climate, etc. Poultry and pig nutrition is dealt with satisfactorily. The section dealing with equine nutrition is very basic and could possibly be improved on. Dog nutrition is handled well as far as basic information is required, but it is insufficient for the small animal practitioner who would like to broaden his knowledge in this field. Cat nutrition is not dealt with satisfactorily at all. Rabbit feeding, for those who are interested, is handled well.

A very valuable part of this book lies in the large amount of information given in the Appendix tables. For study purposes, for reasons of comparison, etc., the tables are invaluable to anyone who keeps himself busy in the nutritional field.

There are a few printing errors here and there but they don't distract from the good format and solid binding in which this book is presented. For its relatively low price, it should be a good investment in helping the reader as a reference to the necessary information as well as to understand nutrition a lot better.

P.D. Botha

ARTHROPOD-BORNE VIRUS ZOONOSIS SURVEILLANCE IN THE CAPE PROVINCE: 1. PROSPECTIVE SEROLOGICAL INVESTIGATIONS FOR VIRUS ACTIVITY IN THE BEAUFORT WEST AND MIDDELBURG DISTRICTS DURING 1981†

F. de St. J. VAN DER RIET*, A.R. SAYED**, B.J.H. BARNARD***, E.M. VAN TONDER+ and W.J. CROUSE++

ABSTRACT: Van der Riet F. de St. J.; Sayed A.R.; Barnard B.J.H.; Van Tonder E.M.; Crouse W.J. **Arthropod-borne virus zoonosis surveillance in the Cape Province: 1. Prospective serological investigations for virus activity in the Beaufort West and Middelburg Districts during 1981.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 25-29 (En). Department of Medical Microbiology and State Health, Department of Virology, University of Cape Town, Medical School, 7925 Cape Town, Republic of South Africa.

In addition to the routine sero-epidemiological surveillance for arthropod-borne viral zoonoses in the Cape Province carried out by the Department of Medical Microbiology and State Health Department of Virology laboratory, we conducted a prospective serological investigation for virus activity during 1981 in two districts of the Province, namely the Beaufort West and Middelburg districts, which experienced heavy rainfall during the first two months of that year. The approach used was to obtain paired serum samples from identified domestic stock representative of several species from 2-5 months apart and to test them for haemagglutination inhibition antibodies to Rift Valley fever, Wesselsbron and Middelburg virus antigen preparations in order to ascertain, as an indication of viral activity, whether changes in antibody levels occurred between the collection dates. The results indicated that there was probable activity of Rift Valley fever virus and activity of Wesselsbron virus (or related flaviviruses) and Middelburg virus (or related alphaviruses) in the Karoo between the middle of February and the end of July 1981. Despite this activity and heavy rainfall registered at meteorological stations in both the Beaufort West and Middelburg districts as well as general reports of heavy rainfall and considerable mosquito activity over widespread areas of the Karoo, Eastern and S.W. Cape Province, there were no epizootics or epidemics of overt arthropod-borne zoonotic viral disease in the province during 1981.

Key words: Arthropod-borne virus, zoonosis, surveillance

INTRODUCTION

Infections of man and domestic stock with arthropod-borne viruses are common in the Cape Province[3]. On several occasions following unusually heavy rains and warm weather which favour haematophagous insect activity, there have been epidemics and epizootics of such infections in the Karoo° and North Western Cape. Previous studies by others have indicated that the most likely zoonotic arthropod-borne viruses to be encountered in the Cape Province are the phlebovirus Rift Valley fever (RVF) virus, the flaviviruses West Nile and Wesselsbron and the alphaviruses Sindbis and Middelburg (B M McIntosh 1980 Arbovirus Research Unit, National Insitute for Virology, Sandringham, personal communication).

Since 1979 primary epidemiological surveillance for human virus diseases in the Cape Province has been conducted from the virological laboratory at the University of Cape Town Medical School. Before this study, the surveillance for zoonotic arthropod-borne viral disease from this laboratory had been retrospective in that only reported outbreaks were investigated. However, following reports of the heavy rains early in 1981 in parts of the Karoo and South Western Cape which resulted in disastrous floods in several districts we decided to conduct, in addition to our normal surveillance, a prospective serological study to monitor zoonotic arthropod-borne viral activity in the Karoo during the next five months. Although the primary objective was to acquire useful information from the public health point of view, clearly the findings would also have implications for the domestic stock industry and veterinary medicine.

Paired serum samples were obtained from identified animals representative of several domestic stock species on farms in the Beaufort West and Middelburg districts in the Karoo for testing for antibodies to antigen preparations of selected zoonotic arthropod-borne viruses to determine whether, as an indicator of viral activity, changes in antibody levels to these preparations occurred in the interval between the collection dates of each pair.

Thus far the samples have been tested for antibodies reactive with Rift Valley fever virus, Wesselsbron virus and Middelburg virus antigen preparations.

The purpose of this communication is to present the results of these tests, to correlate them with the information gathered in routine epidemiological surveillance for zoonotic arthropod-borne virus infection in the Cape Province during 1981 and to discuss the combined information in relation to rainfall registered in the Beaufort West and Middelburg districts and general reports we received of rainfall and mosquito activity in the province during that year.

MATERIALS AND METHODS

Serum samples tested

The origin, dates of collection and number of the paired serum samples tested from the animals in the study and the intervals between the collection dates of the members of various pairs are given in Table 1.

No attempts were made to keep the different groups of animals on a farm in the same camp. All of the animals were born and raised on the farms and remained there at least until the second sample had been col-

†A prelliminary report on some of the information contained in this article was presented at the Biennial Congress, South African Veterinary Association, Cape Town, September 7-11, 1981.

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°The Karoo falls in the Cape Province and forms part of the temperate inland plateau of South Africa. It has an arid climate and its vegetation is comprised mainly of small shrubs. It is the major sheep rearing region in South Africa

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Table 1: THE ORIGIN AND COLLECTION DATES OF PAIRED SERUM SAMPLES USED IN THIS STUDY

District	Farm	Species (No. Tested)	Age in Years	Dates of Sample Collection		Interval in days
				First	Second	
Beaufort West	Courlandskloof	Goats (12)	1-2	10 March 1981	18 May 1981	69
	Nelspoort	Sheep (12)	1-6	25 Feb. 1981	19 June 1981	114
	"	Cattle (12) (cows)	3-5	25 Feb. 1981	5 June 1981	100
Middelburg	Grootvlei	Goats (12)	2-5	19 Feb. 1981	4 June 1981	105
	"	Sheep (12)	3-5	19 Feb. 1981	4 June 1981	105
	"	Horses (12)	3 and over	19 Feb. 1981	4 June 1981	105
	"	Cattle (12) (cows)	2-6	19 Feb. 1981	28 July 1981	159

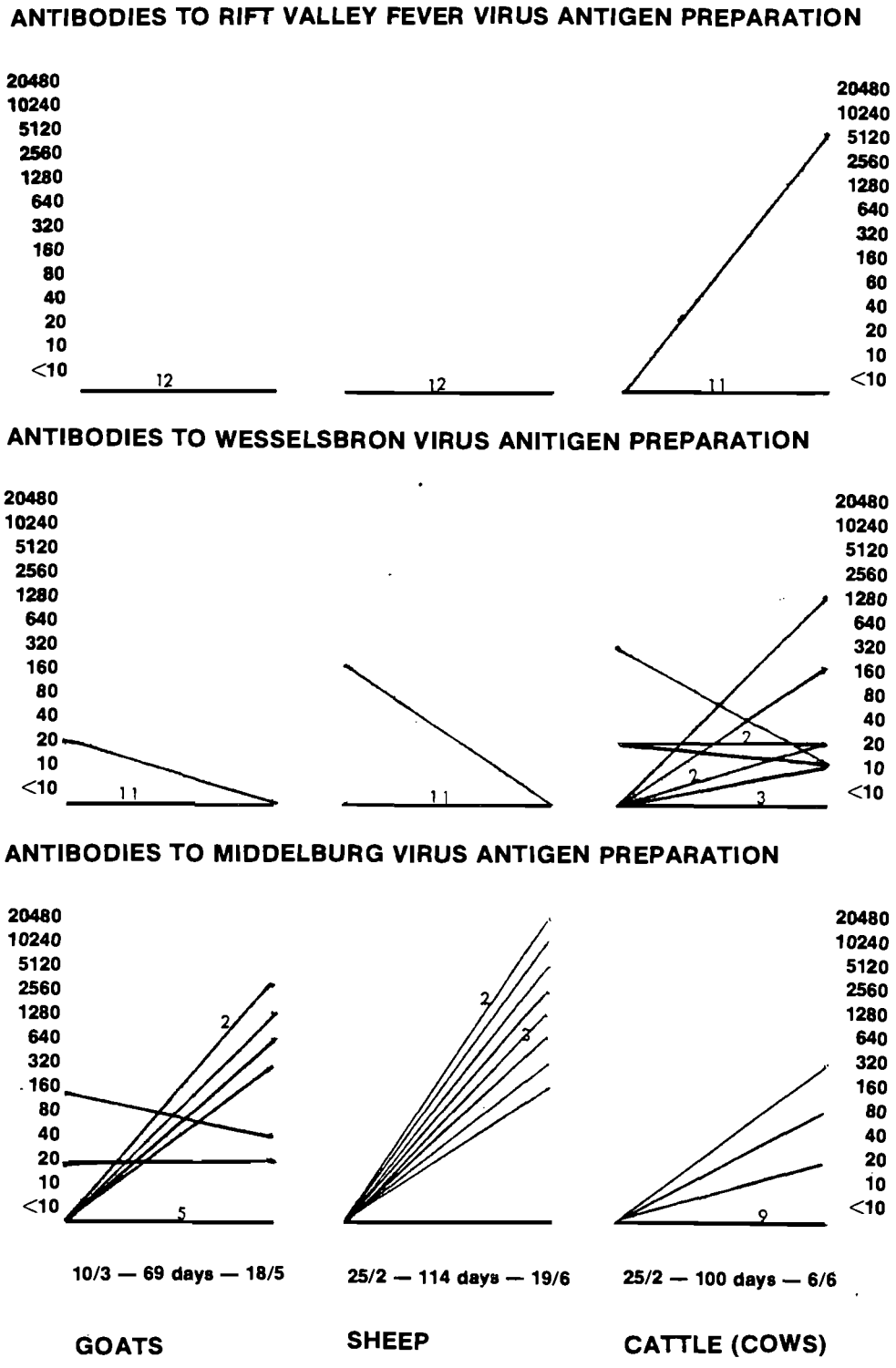

Fig. 1: Haemagglutination-inhibition antibodies to Rift Valley fever, Wesselsbron and Middelburg virus antigen preparations in serum samples obtained on two occasions during 1981 from identified animals on farms in the Beaufort West district and in the Middelburg district. The notations beneath the abscissae indicate the dates on which the paired samples were obtained and number of days in between. The numbers on the lines indicate the number of animals which each line represents. A line without a number represents a single animal.

Fig. 1(a): Beaufort West district

lected from each animal. None of the animals in the study had been vaccinated against any of the viruses present in the antigen preparations used or against antigenically related viruses.

Tests for haemagglutination-inhibition antibodies

The test for haemagglutination-inhibition (HI) antibodies to the antigen preparations were done according to the method of Clarke and Casals[2]. The lowest dilution of serum tested was 1 in 10. The first and second serum samples from each animal were tested concurrently. A four-fold or greater rise in antibody titre between the collection dates of a pair of samples was considered significant and a four-fold or greater rise during this period was interpreted as an infection. The Rift Valley fever virus antigen was a sucrose-acetone extract of infected hamster liver and the Wesselsbron and Middelburg virus antigens were sucrose-acetone extracts of infected mouse brain.

Rainfall data for the Beaufort West and Middelburg districts

The rainfall data for the Beaufort West and Middelburg

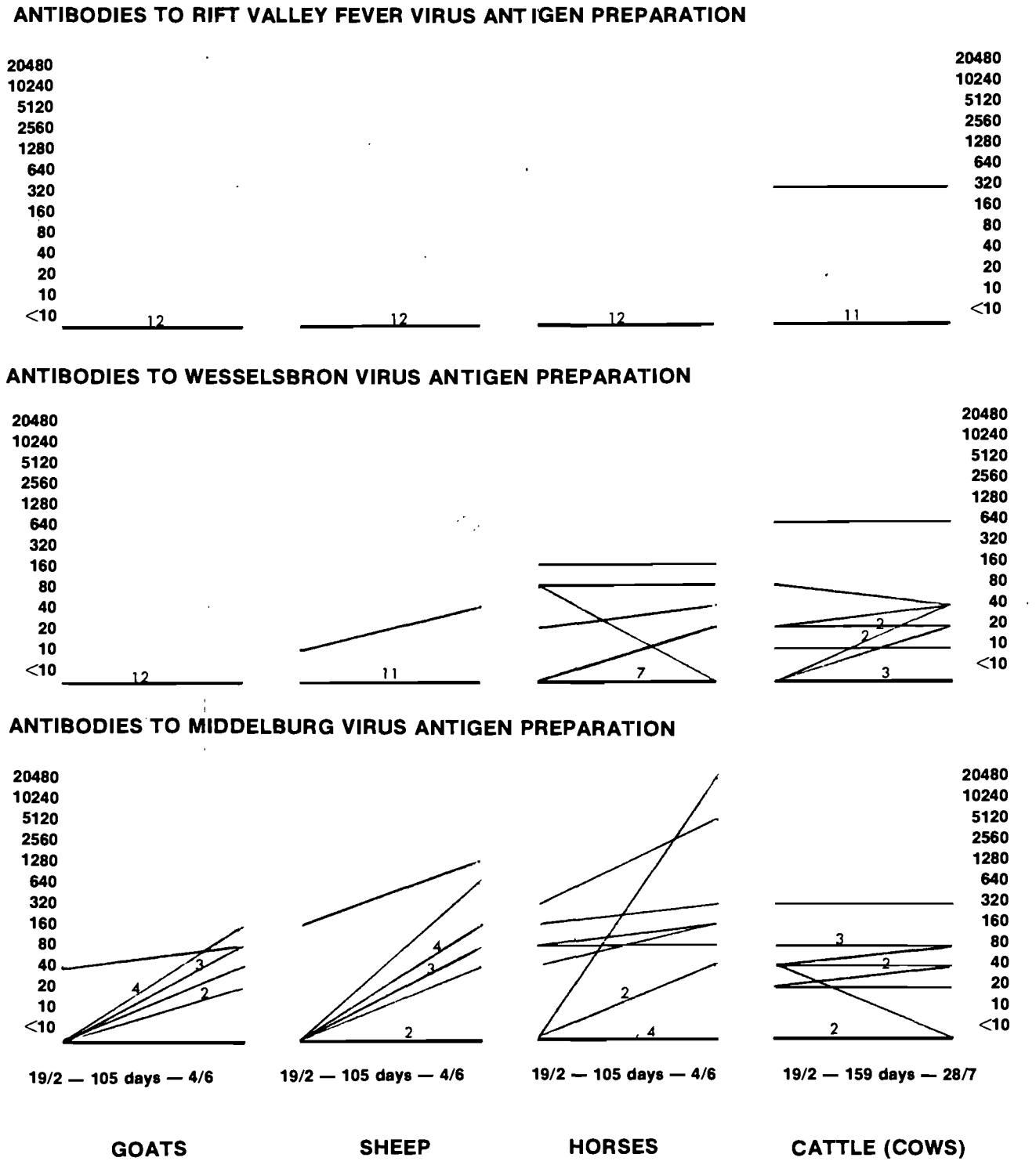

Fig. 1(b): Middelburg district

districts was obtained from two sources – Mr. J. Hoon of the Research Institute for Soil Conservation and Irrigation at Elsenburg, Cape Province and Mr. J. Bothma (for A.B. Eksteen, Director-General: Transport) of the Weather Bureau in Pretoria.

RESULTS

The results of the HI tests done on the serum samples from the animals in the Beaufort West and Middelburg districts are presented in Fig. 1(a) and (b) respectively.

In the Beaufort West districts one cow showed a significant rise in antibody titre with respect to the RVF antigen preparation, two cows with respect to the Wesselsbron virus antigen preparation and five goats, eleven sheep and two cows with respect to the Middelburg virus antigen preparation.

In the Middelburg district a sheep and two cows showed a significant increase in antibody titre with respect to the Wesselsbron virus antigen preparation and eight goats and ten sheep and five horses with respect to the Middelburg virus antigen preparation.

In the interval between the first and second serum sample collection dates a few animals experienced a significant decline in antibody levels to either the Wesselsbron or Middelburg virus antigen preparations. In the Beaufort West district the antibody titre to Wesselsbron virus antigen preparation in a sheep dropped from 160 to below 10 and in a cow from 320 to 10 and the antibody titre to Middelburg virus antigen preparation in a goat from 160 to 40. In the Middelburg district the antibody titre to the Wesselsbron virus antigen preparation of a horse fell from 80 to below 10 and the titre to the Middelburg virus antigen preparation of a cow from 40 to under 10.

The total annual rainfall registered at Nelspoort meteorological station 6090 during 1981 was 84,8 mm above the average (225 mm) and at Middelburg meteorological station 6490 it was 203 mm above average (362 mm). In addition we received general reports of heavy rainfall and considerable mosquito activity over widespread areas of the Karoo, Eastern and Southern Western Cape Province during that year.

In our routine epidemiological surveillance for arthropod-borne zoonotic viral diseases in the province during 1981 we received a few reports of small suspected but unproven outbreaks of overt Rift Valley fever and Wesselsbron disease in domestic stock as well as a few reports of small outbreaks of clinical disease in humans which may have been caused by an arbovirus but were also not proven.

DISCUSSION

In the HI tests positive reactions were obtained with all three of the antigen preparations used. Before discussing the results further it is necessary to comment briefly on the significance of the HI test with respect to each type of preparation. With regard to RVF preparations it has been found that they do not cross-react with antibodies in domestic stock to the other known sub-Saharan phleboviruses and thus positive reactions against such preparations almost certainly indicate infection by RCV virus (R Swanepoel National Institute for Virology, 2131 Sandringham, Republic of South Africa). On the other hand, Middelburg and especially Wesselsbron virus antigen preparations do cross-react with related viruses in the same Togavirus group and thus positive reactions with Middelburg virus antigen preparations could be due to infection either by Middelburg virus or antigenically related alphaviruses and positive reactions with Wesselsbron virus antigen preparations to infection either by this virus or by antigenically related flaviviruses[1] (R Swanepoel 1984 National Institute for Virology, 2131, Sandringham, Republic of South Africa).

The results of the HI tests showed that between the middle of February and the end of July 1981 there was probable activity of Rift Valley fever and Wesselsbron viruses or related flaviviruses and Middelburg virus or related alphaviruses in the Karoo. In addition, based on the abovementioned reports it is possible that there were a few outbreaks of overt zoonotic arthropod-borne viral disease amongst man and domestic stock in that year.

Although the heavy rainfall over wide areas of the Cape Province in the late summer of 1981 alerted us to the possibility that the year might bring zoonotic arthropod-borne viral epizootics or epidemics and prompted this investigation, there was no certainty such epizootics or epidemics would occur and in fact they did not. Usually, dense mosquito populations following heavy rainfall have been associated with large-scale outbreaks of zoonotic arthropod-borne viral disease in animals in the region but there is also a need for prevalence of the correct vector species, for suitably virulent strains of virus and large susceptible animal or human populations. Nineteen eighty-one clearly did not bring together all the factors necessary to generate epizootics or epidemics of zoonotic arthropod-borne viral disease in the province.

Until recently it was believed that the periodic epidemics and epizootics of RVF in the inland plateau region of South Africa, which includes the Karoo and N.W. Cape, are a consequence of contiguous spread of the virus during years of widespread heavy rains from the South Eastern and Eastern coastal regions of the country where the virus is enzootic. However, present thinking on the matter is that the virus may also occur in enzootic foci in the interior and that it is maintained there in interepizootic years by transovarial infection in mosquitoes and possibly also by limited infection of domestic stock and wild animals (R Swanepoel 1984 National Institute for Virology, 2131 Sandringham, Republic of South Africa). The discovery in the present investigation of a single animal at Nelspoort that was probably infected with RVF virus in a year in which there was no overt RVF epizootic or epidemic in the Cape Province supports the 'limited infection' possibility.

Regarding the few animals in which there was a significant decline in HI antibody levels to either the Wesselsbron or the Middelburg virus antigen preparations, although HI antibodies to arthropod-borne viruses are normally long-lasting, at least in the case of flaviviruses, they do sometimes drop fairly rapidly as was illustrated in a recent Zimbabwe-Rhodesian study[1].

This study has shown that the approach used of obtaining paired serum samples from unimmunized animals available locally to monitor virological activity in an area of interest during a particular time period can be useful under circumstances where time or financial considerations preclude either the introduction of sentinels from elsewhere or pretesting locally available animals for susceptibility. Clearly success with this approach

depends on finding sufficent numbers of susceptible animals at the time of collection of the first sample.

ACKNOWLEDGEMENTS

We wish to thank former State Veterinarians Drs P M Gilfillen and P Kitshoff and the Stock Inspectors at Middelburg and Beaufort West for collecting the serum samples from the sentinel animals, Mr M van Lingen of Grootvlei, Mr J J Brits of Nelspoort Sanatorium Farm for making animals available for the study; the State Veterinarians Drs S Vermeulen and H Viljoen and private veterinarians Drs D J Thornton and C H B Marlow for information on the occurrence of the arthropod-borne virus infections of animals in the Cape Province; Dr A J Barnard for information concerning possible human cases of infection with arthropod-borne viuses in the Oudtshoorn district and finally Professor J W Moodie of the University of Cape Town Department of Medical Microbiology and Dr B W McIntosh of the Arbovirus Research Unit of the National Institute for Virology for their valuable comments concerning this work and the presentation thereof.

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BOOK REVIEW **BOEKRESENSIE**

GOAT PRODUCTION IN THE TROPICS

C. DEVENDRA and MARCA BURNS

2nd Edn. Commonwealths Agricultural Bureaux, Farnham Royal Slough SL2 3BN U.K. 1983 pp viii and 1983, illustrations 56, Tables 36 Price £12,00 (ISBN 0 85198 519X)

Although goats have served man from the earliest times and are numerous in the widely scattered areas of the Tropics, they have received limited scientific attention. In an attempt to stimulate new thinking about the future of goats in the tropics the authors have made a very timely contribution with their publication. The well-prepared book is an extensive review on existing knowledge on goat production and covers the topics of classification, distribution and importance of domestic goats, breeds, variation in size, meat production, milk production, reproductive performance, feeding and nutrition, skin and hair production, husbandry for improved production, genetic improvement and economic potential and prospects.

The book contains a vast amount of information, nicely tabulated and illustrated. It is interesting to note that a great deal of information originates from South Africa. In the tropics the goat has always played an important role in providing the basic needs for human beings and the authors are able to prove how production can be increased without greater deterioration of the basis of everything, the veld. The extensive list of references indicates that we really deal with the most comprehensive book on goat production. This book should be on the shelves of all veterinarians, students of veterinary and animal husbandry science, farmers and extension officers dealing with small stock. The price of about R16,00 is very reasonable considering the value of the information obtained.

D.R. Osterhoff

BOOK REVIEW **BOEKRESENSIE**

GUIDELINES FOR THE CONTROL OF NARCOTIC AND PSYCHOTROPIC SUBSTANCES

B. REXED, K. EDMONDSON, I. KHAN and R.J. SAMSON

World Health Organisation, Geneva. 1984 pp 141, Price not given (ISBN 92 4 154172 5)

This WHO study deals *inter alia* with the global strategies for drug control under the guidance of the United Nations Commission on Narcotic Drugs and the international treaties (which the Republic of South Africa is party to since its inception in 1961).

It deals with the licit and illicit use of the listed 110 drugs and 44 psychotropic substances and with aspects like registration, surveillance and the treatment and rehabilitation of drug-dependent persons.

The book is aimed at regulatory and drug controlling agencies and is not of direct interest to the average veterinarian.

T.W. Naudé

BOOK REVIEW **BOEKRESENSIE**

THE PRACTICE OF LARGE ANIMAL SURGERY

PAUL B. JENNINGS

1st Edn. W.B. Saunders Company, Philadelphia 1984 pp XX and 1233, Price R130,68 (ISBN 07216-1347-0)

This book comprises two volumes which satisfies a long-felt want for a handbook on large animal surgery. It is lavishly illustrated with photographs and sketches.

The book is intended to fulfil the needs of the academic, the student and the private practitioner. It is not an atlas. The book has been compiled with contributions by various well-known authors who are all specialists in their field.

The text is not purely surgical but attention has also been paid to nutrition, patient physiology, anaesthesiology, preoperative procedures, surgical and non-surgical interventions.

The hasty practitioner might find the rendering a little extensive, but I can recommend "The Practice of Large Animal Surgery" without reservation.

S.S. van den Berg

EFFICACY OF IVERMECTIN AGAINST ECTOPARASITES OF CATTLE IN SOUTH AFRICA

J. SCHRÖDER†*, G.E. SWAN†, M.D. SOLL† and I.K. HOTSON**

ABSTRACT: Schröder J.; Swan G.E.; Soll M.D.; Hotson I.K. **Efficacy of ivermectin against ectoparasites of cattle in South Africa.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 31-35 (En). M.S.D: Research Centre, Private Bag 3, 1685 Halfway House, Republic of South Africa.

The efficacy of various formulations of ivermectin administered at the recommended dose rate of 200 µg/kg was evaluated in cattle infested with mange mites (*Sarcoptes scabiei* var. *bovis.*), lice (*Linognathus vituli* and *Damalinia bovis*) and ticks (*Boophilus decoloratus, Amblyomma hebraeum, Rhipicephalus appendiculatus* and *Hyalomma* spp.) in 8 trials conducted in South Africa.

Mange mites (*S. scabiei*) were eliminated from animals treated subcutaneously, resulting in marked clinical recovery. Oral administration reduced the numbers of, but did not eliminate these mites.

Sucking lice (*L. vituli*) were eliminated from animals treated orally or subcutaneously. Numbers of biting lice (*D. bovis*) were reduced but not eliminated, subcutaneous injection being more effective than oral drenching.

Subcutaneous injection with ivermectin every 14 d over a period of 84 d significantly reduced numbers of engorged female *R. appendiculatus* and *A. hebraeum*. Numbers of *Boophilus* spp. and *Hyalomma* spp. were also reduced.

A single subcutaneous injection resulted in significantly fewer engorged female *B. decoloratus* on treated animals for up to 28 d after treatment. In one trial significantly fewer *A. hebraeum* males occurred on treated animals for up to 28 d after treatment.

Too few *R. evertsi* were present in these trials to evaluate the effect of ivermectin against this parasite.

Key words: Ectoparasites, ticks, lice, mites, cattle, ivermectin

INTRODUCTION

Ivermectin, a derivative of a fermentation product of the actinomycete *Streptomyces avermitilis*, has been shown to have activity against several nematode and arthropod parasites[2 6]. Efficacy has been reported against a number of ectoparasites of cattle including mange mites[1 7 12 13], lice[1 11], various tick species[3 5 10 18], as well as warbles[4] and the larval stages of various flies[9 14].

This paper describes a series of South African trials in which the efficacy of ivermectin was evaluated in cattle against mange mites (*Sarcoptes scabiei* var. *bovis.*), lice (*Linognathus vituli* and *Damalinia bovis*) and ticks including *Boophilus decoloratus, Hyalomma* spp., *Amblyomma hebraeum,* and *Rhipicephalus appendiculatus.*

Studies on the effect of ivermectin against the sand tampan, *Ornithodoros savignyi,* and gastro-intestinal nematodes have been described elsewhere[16 17].

I. MANGE MITES

Two studies were conducted to evaluate the effect of treatment with a single dose of ivermectin at 200 µg/kg orally or subcutaneously in cattle naturally infested with *S. scabiei.*

MATERIALS AND METHODS

Experimental Animals:

Eighteen Friesian crossbred cattle were used. To prevent cross infestation, cattle from different treatment groups were held in separate pens that were not contiguous.

Diagnosis:

Animals naturally infested with sarcoptic mange were randomly allocated to treatment groups. In order to quantify infestations, skin scrapings were taken from standard-sized areas at regular intervals after treatment. The material from each scraping was placed in a test tube and processed by a modified vacuum- assisted mite recovery technique based on a technique described by Meleney[12]. A convenient volume of water, plus a few drops of liquid detergent, were added to the material and the test tube placed in a sonicator for 10 minutes to break up the crusts. The mixture was then thoroughly washed through a coarse sieve (to retain hair and large crusts) onto a ruled black filter paper disc in a Buchner funnel to which light vacuum was applied. The filter paper disc was then removed, placed in a petri dish, examined, and live mites were counted under a stereoscopic microscope.

RESULTS

The results are summarized in Table 1. A single subcutaneous treatment at 200 µg/kg was highly effective, no live mites being recovered from treated animals from 7 d after treatment. Marked clinical improvement was recorded with loss of crusts and hair regrowth resulting in complete clinical recovery by Day 56.

Mite numbers were reduced but not eliminated by the oral treatment.

II. LICE

Two trials were conducted to evaluate the effect of treatment with ivermectin on sucking lice (*L. vituli*), and biting lice (*D. bovis*).

MATERIALS AND METHODS

Experimental Animals:

Sixty Friesian calves, naturally infested with *L. vituli* and *D. bovis* were used. In one trial, animals were housed in concrete-floored pens which precluded contact and cross infestation between different treatment groups. In the other, all trial animals were housed in the same pen.

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0038-2809/85/01/0031-0035

Table 1: THE EFFECT OF IVERMECTIN AT 200 µg/kg ON *SARCOPTES SCABIEI*

Treatment	No. of animals	Mean* numbers of mites				
		Day 0**	Day 7/8	Day 14/15	Day 28/29	Day 56
Vehicle treated control	6	57,3	85	72,2	126	40,3
Ivermectin oral solution 200 µg/kg	6	11,2	0,6	4,0	15,8	21,4
Ivermectin injectable solution (200 µg/kg)	6	8,6	0	0	0	0

*Arithmetic means.
**Day 0 = day of treatment.

Diagnosis:

In both trials, five squares, 50 x 50 mm, were examined macroscopically on each side of every animal at regular intervals after treatment and the numbers of *Linognathus* and *Damalinia* recorded. In addition, in one of the trials, all lice were counted when the animals were slaughtered at the conclusion of the trial.

Treatment:

The efficacy of ivermectin administered either orally or subcutaneously at 200 µg/kg once, or twice with an interval of 7 d, was evaluated.

Statistical Analysis:

For one trial, geometric means were calculated for each treatment on each day after transforming the data to the natural logarithm of (count + 1). The Kruskal-Wallis procedure was used to test for overall treatment effect; when such was present, each pair of treatment means was compared using the Wilcoxon rank-sum procedure.

RESULTS

The efficacy of ivermectin against *L. vituli* is given in Table 2. Ivermectin administered orally or subcutaneously either in a single or a double treatment regimen eliminated *L. vituli* from treated animals in one trial. In the other trial, in which treated and control animals were housed together, both a single oral and a single subcutaneous treatment significantly ($p < 0,01$) reduced the number of *L. vituli* counted at all examinations after treatment. No *L. vituli* were found on cattle treated subcutaneously between 4d and 29d after treatment nor on cattle treated orally between 4d and 15d after treatment.

The efficacy of ivermectin against *D. bovis* is given in Table 3. Numbers of *D. bovis* were substantially reduced by treatment with ivermectin but the parasite was not eliminated. In both trials, it was found that subcutaneous injection was more effective than oral drenching. In one trial, subcutaneous treatment significantly ($p < 0,05$ on Day 4; $p < 0,01$ thereafter) reduced the numbers of *D. bovis*. Oral treatment significantly ($p < 0,01$) reduced *D. bovis* burdens between 8d and 36d after treatment.

The subcutaneous treatment group had significantly ($p < 0,01$) fewer *D. bovis* than the oral treatment group from 8d after treatment until the end of the trial.

III. TICKS

The efficacy of ivermectin was evaluated against *B. decoloratus, Hyalomma spp., A. hebraeum* and *R. appendiculatus* in 3 field trials and against *R. appendiculatus* in a laboratory study.

Table 2: THE EFFECT OF IVERMECTIN AT 200 µg/kg ON *LINOGNATHUS VITULI*

Treatment	No. of animals							
Trial 1		Mean† number of *L. vituli*						
		Day: 0*	3	7	10	28	42	56
Control	6	97,5	111	145	121	152	113	106
Oral (once)	6	57	0	0	0	0	0	0
Oral (twice)**	6	77,5	0	0	0	0	0	0
Subcutaneous (once)	6	65	0	0	0	0	0	0
Subcutaneous (twice)**	6	56	0	0	0	0	0	0
Trial 2		Mean†† number of *L. vituli*						
		Day: 0	4	8	15	29	36	43-46
Control	8***	142,9	225,4	149,5	89,5	27,4	12,4	21,6
Oral	12	149,7	0	0	0	0	0,1	0,6
Subcutaneous	12	182,1	0	0	0	0	0,1	0,5

*Day 0 is the day of treatment
**with a 7-day interval
***One control animal died on Day 13.
†Arithmetic means
††Geometric mean, based on transformation to the natural logarithm of (count + 1)

1. Laboratory study:

The efficacy of a single subcutaneous treatment at 200 µg/kg was evaluated against repeated artificial infestation with *R. appendiculatus* over a period of 30 days.

MATERIALS AND METHODS

Animals:

Twenty-two calves artificially infested with *R. appendiculatus* were held in individual metal crates.

Infestation:

Ten recently moulted *R. appendiculatus* adults were placed on the animals 7 times over a period of 30 d. The ticks were confined by linen bags glued to the animal's backs with contact adhesive and closed off with rubber castrator rings.

Parasite counts:

Engorged female ticks were collected, counted, weighed and incubated until egg laying was completed. The eggs were regularly examined and an estimate of percentage hatch recorded.

RESULTS

Treatment did not affect the attachment of ticks. The engorgement of female ticks placed on animals either 2 d before or on the day of treatment was inhibited (Day 2) or prevented (Day 0) and these ticks did not produce eggs. The engorgement period of ticks placed on treated animals was considerably longer than the engorgement period of ticks placed on control animals. Mean percentage hatchability was lower for eggs produced by ticks fed on treated animals.

Table 3: THE EFFECT OF IVERMECTIN AT 200 µg/kg ON *DAMALINIA BOVIS*

Treatment	No. of animals							
Trial 1		Mean† number of *D. bovis*						
		Day: 0*	3	7	10	28	42	56
Control	6	6	6	7	7	18	23	44
Oral (once)	6	8	13	6	5	2	1	8
Oral (twice)**	6	6	1	2	1	3	16	30
Subcutaneous (once)	6	10	7	4	2	0,2	0,2	1
Subcutaneous (twice)**	6	8	10	7	4	0	0	0,2
Trial 2		Mean†† number of *D. bovis*						
		Day: 0	4	8	15	29	36	43-46
Control	8***	275,7	199,0	197,5	198,1	298,1	311,9	506,9
Oral	12	218,6	129,9	77,7	60,1	94,2	118,7	306,0
Subcutaneous	12	227,4	65,6	3,0	0,4	0,3	1,1	9,8

*Day 0 is the day of treatment
**with a 7-day interval
***One control animal died on Day 13.
†Arithmetic means
††Geometric mean, based on transformation to the natural logarithm of (count + 1)

Table 4: THE EFFECT OF REPEATED SUBCUTANEOUS TREATMENT WITH IVERMECTIN AT 200 µg/kg ON TICK BURDENS

Species/genus	Engorged female tick counts[1] by day					
Treatment group	0	14	28	56	84	112
a. *R. appendiculatus*						
Control	0	0,7	$19,7^{a}$	$12,2^{a}$	$1,7^{a}$	$2,1^{a}$
Ivermectin every 14 days	0	0	0^{b}	0^{b}	0^{b}	$1,2^{a}$
Ivermectin every 28 days	0,2	0	$1,9^{b}$	$3,9^{a,b}$	$2,2^{a}$	$0,3^{a}$
b. *A. hebraeum*						
Control	0	$9,4^{a}$	$7,6^{a}$	$5,5^{a}$	$6,8^{a}$	$3,5^{a}$
Ivermectin every 14 days	0	$1,3^{b}$	$1,3^{b}$	0^{b}	0^{b}	$2,1^{a}$
Ivermectin every 28 days	0	$3,9^{b}$	$7,3^{a}$	$6,3^{a}$	$6,9^{a}$	$3,9^{a}$
c. *Boophilus sp.*[2]						
Control	0	0	0	1,1	7,0	1,4
Ivermectin every 14 days	0	0	0	0	0	0
Ivermectin every 28 days	0	0	0	0	0,5	0,1
d. *Hyalomma spp.*[2]						
Control	0,2	0	0,1	0,6	1,0	0,4
Ivermectin every 14 days	0,1	0	0	0	0	0
Ivermectin every 28 days	0,1	0	0,4	0,9	0,5	0

[1] Retransformed means, based on started square root transformation
[a,b] Treatment means for each tick species and observation day with no superscripts in common are statistically different ($p < 0,05$) (Analysis based on pairwise comparisons examined using Duncan's multiple range test)
[2] No statistical analysis performed

Because of the small number of ticks placed on the cattle and experimental design considerations which decreased the sensitivity of statistical procedures, these results were not conclusive.

2. Field studies:

Trials were conducted to determine the effect of a single dose of ivermectin (two trials) and repeated treatments (one trial) on naturally acquired tick burdens under field conditions.

MATERIALS AND METHODS

Animals:

Sixty-nine crossbred cattle run on natural pasture at Hennops River, Transvaal, or in the East London district of the Cape Province were included in the trials.

Infestation:

In the first trial, animals were continually exposed to natural infestation with *B. decoloratus, Hyalomma* spp., *R. evertsi, A. hebraeum* and *R. appendiculatus.*

Animals included in the second and third trials were exposed to similar infestations, but *R. appendiculatus* was not present in one and *Hyalomma* spp. were absent from both trials. In these two trials, animals were ranked according to pretreatment counts of engorged *B. decoloratus* females, and allocated to replicates of two animals each. Within each replicate, animals were randomly allocated to treatment groups.

Parasite Counts:

Animals were examined at regular intervals after treatment and adult engorged ticks on one or both sides of each animal counted.

Treatments:

The cattle in the first trial were treated at 200 μg/kg either orally or by subcutaneous injection at either 14 or 28 d intervals, over a period of 84 d. In the other trials, the effect of a single subcutaneous treatment at 200 μg/kg was evaluated.

RESULTS

The effect of repeated subcutaneous treatments with ivermectin on *R. appendiculatus, A. hebraeum, Boophilus* sp. and *Hyalomma* spp. is given in Table 4. In this study no engorged female *R. appendiculatus* were recorded on animals treated subcutaneously every 14 d during the peak period of infestation (Days 28-70). Animals which received injections of ivermectin every 28 d also had fewer *R. appendiculatus* than the oral treatment groups and the controls during this period.

From 14-84 d after commencement of the trial, subcutaneous injection limited the numbers of engorged *A. hebraeum* for up to 14 d after treatment relative to controls and orally treated animals.

A reduction in the number of *Boophilus* spp. was observed in animals treated with ivermectin subcutaneously at 14 and 28 d intervals compared to the control group.

Due to insufficient numbers of engorged female *Hyalomma* spp. and *R. evertsi,* conclusions concerning the efficacy of ivermectin against these ticks were not possible in this trial.

The effect of a single subcutaneous treatment with ivermectin on female *B. decoloratus* greater than 6 mm or 4 mm in size is given in Tables 5 and 6 respectively. There were significantly ($p < 0,05$) fewer *B. decoloratus* on medicated cattle than on controls until 28 d after treatment. In both trials, numbers of female *Boophilus* ticks increased on control animals. In one trial, ivermectin-treated animals had significantly ($p < 0,05$) fewer male *A. hebraeum* ticks than controls up to 28 d after treatment. Too few ticks of other species were present to make meaningful conclusions as to the effect of treatment on them.

Table 5: ENGORGED FEMALE *BOOPHILUS DECOLORATUS* COUNTS* FOLLOWING A SINGLE SUBCUTANEOUS TREATMENT WITH IVERMECTIN (FIRST TRIAL)

Treatment	Day				
	1	3	7	15	28
Control	7,7[a]	14,2[a]	9,7[a]	62,9[a]	81,1[a]
Ivermectin (200 μg/kg)	1,9[b]	0,4[b]	0[b]	2,3[b]	2,2[b]

[a,b] Treatment means with no superscripts in common are statistically significantly different ($p < 0,05$) (Analysis based on a paired observation t-test)

* Retransformed means based on started square root transformation

Table 6: ENGORGED FEMALE *BOOPHILUS DECOLORATUS* COUNTS[1] FOLLOWING A SINGLE SUBCUTANEOUS TREATMENT WITH IVERMECTIN (SECOND TRIAL)

Treatment	Day						
	0	3	7	14	28	35	42
Control	57,1	15,1	4,1	2,4	130,0	137,6	165,8
Ivermectin (200 μg/kg)	59,2	4,8	0,3	0,1	0	2,5	46,4
p[2]-Value	—	0,028	,022	,042	,01	,01	,058

[1] Geometric means based om transformation to 1n (count + 1)

[2] Two tailed, from a paired value t-test

DISCUSSION

The systemic activity of ivermectin against *S. scabiei* has practical significance because it is difficult to apply a topical acaricide to kill all mites on an animal and thereby bring about total parasitological cure. Although highly effective against *L. vituli*, ivermectin is less effective against *D. bovis*. This may be explained by the difference in feeding habits between these two lice – *Linognathus*, which feeds on blood is more rapidly exposed to a relatively larger amount of ivermectin than is the surface-feeding *Damalinia*. The lice recorded on the treated animals 56 days after treatment could be the result of eggs hatching some time after treatment, when ivermectin levels have fallen below an effective concentration.

Ivermectin effectively prevents development of all stages of *B. decoloratus* for at least 7 d after treatment, engorged females only being observed on treated animals more than 28 d after treatment (larval attachment to complete engorgement takes approximately 3 weeks[8]).

Although ivermectin is active against the other tick species examined, the activity of the present injectable formulation is too short-lived for it to offer a viable alternative to current control measures, particularly in areas where multi-host ticks are a problem. The use of the compound in a slow release system may be a practical consideration for the future[15]. The only practical application presently available may be that, depending on tick burdens and challenge, the weekly frequency of dippings could possibly be reduced in the period immediately following a subcutaneous injection administered to control gastrointestinal nematodes[17].

ACKNOWLEDGEMENTS

Technical assistance was rendered by Messrs J P Louw, R G Harvey, C J Z Smith, M G Rathogwa and Mrs S Meyer, in six of the trials and by Messrs D Swift, R Luck and D N Odendaal in two. Dr J D Bezuidenhout kindly supplied the *R. appendiculatus* used in the artificial infestation trial.

Statistical analysis of the data presented in Tables 4 and 5 was performed by Dr T Capizzi and Mr N Rahowsky, Biometrics Research Division, Merck & Co. Inc., Rahway, New Jersey. Statistical analysis of the data presented in Table 6 was performed by Dr S Gross, International Animal Science Research, Merck & Co. Inc., Rahway, New Jersey.

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AN OUTBREAK OF CEREBROCORTICAL NECROSIS (POLIOENCEPHALOMALACIA) IN GOATS

S.J. NEWSHOLME* and T.P. O'NEILL**

ABSTRACT: Newsholme S.J.; O'Neill T.P. **An outbreak of cerebrocortical necrosis (polioencephalomalacia) in goats.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 37-38 (En). Veterinary Research Institute, 0110 Onderstepoort, Republic of South Africa.

In a herd of 30 Boer goats, 3 young goats developed nervous signs including apparent blindness. In 2 of the goats a diagnosis of cerebrocortical necrosis was confirmed by the demonstration of lesions typical of the disease on histopathological examination. Lead concentrations in the renal cortex were well below the level regarded as indicative of lead poisoning in ruminants. The reason for the outbreak was not clear, but the feeding of concentrate and poor quality roughage may have been contributory factors.

Cerebrocortical necrosis appears to be unusual in goats, compared to cattle and sheep, but it should be entertained in the differential diagnosis of caprine nervous diseases.

Key words: Polioencephalomalacia, goats.

INTRODUCTION

Cerebrocortical necrosis (CCN), also known as polioencephalomalacia, occurs frequently in cattle and sheep. In Britain, for example, it is now held to be one of the commonest nervous diseases of ruminants[8]. CCN has also been described in goats[7 9 12 15], but it appears to be far less common than in cattle or sheep. The records of the Section of Pathology, Veterinary Research Institute (VRI), Onderstepoort, similarly indicate that CCN is common in cattle and sheep in South Africa, but the records contain only 2 cases of the disease in goats.

Herein we report a small outbreak of CCN that occurred in a herd of goats in South Africa.

HISTORY OF OUTBREAK

A herd of 30 Boer goats was kept on Highveld grazing near Witbank in the Transvaal. Throughout the winter of 1984, the goats were provided with a daily supplement of pelleted concentrates. The owner estimated that each goat did not receive more than 0,5 kg of pellets per day.

On 8th June 1984 the owner noticed that a 6-month-old male goat was lagging behind the herd. The following day it was found licking a wire fence and appeared to be blind. This goat seemed to have lost condition rapidly, and was found dead on the third day. Subsequently, two more goats developed similar clinical signs, one on 2nd July (Goat 1) and the other on 27th July (Goat 2). Goats 1 and 2 were submitted to the VRI, Onderstepoort for clinical examination and necropsy.

Goat 1: This 6-month-old, female goat was examined 3 days after the owner first noticed that it was sick. It was thin and laid on its side while manifesting opisthotonus. Both pupils were constricted. Direct and consensual pupillary reflexes were absent and there was no menace response. Withdrawal reflexes were depressed. The rectal temperature was subnormal (35°C). The goat was killed by intravenous injection of pentobarbitone sodium. At necropsy no macroscopical changes were noticed, other than depletion of body fat depots. No *Cowdria* organisms could be found in Giemsa-stained brain smears, prepared from the hippocampus. Light microscopical examination of paraffin sections of the brain, stained with haematoxylin and eosin (HE), revealed lesions in the cerebral cortex which were compatible with acute CCN[4 5 13 14]. The concentration of lead in the renal cortex was determined as 5 ppm (wet tissue).

Goat 2: This 7-month-old, male goat was examined the day after it was first noticed to be sick. It stood still and was reluctant to move. Both pupils were constricted. Pupillary reflexes and menace response were absent. Fully formed faecal pellets were voided, but the perineal hairs were stained and matted by dried faeces.

The rectal temperature was 39°C. The goat was killed by intravenous injection of pentobarbitone sodium. At necropsy two gyri of the parietal cortex of the left cerebral hemisphere were swollen. Inspection of coronal slices of the brain revealed that the cortex in the swollen gyri and adjacent sulci was softened and slightly yellow. No other macroscopical changes were observed elsewhere in the brain or in the other organs. No *Cowdria* organisms were found in brain smears. The coronal brain slices were inspected under an ultraviolet (350 nm) light source, and showed brilliant, white fluorescence in the softened, discoloured areas of cortex. Light microscopical examination of HE sections of the brain revealed lesions in the cerebral cortex compatible with acute CCN. The lesions were seen not only in the gyri which were macroscopically swollen but also in cortex from the opposite hemisphere. The concentration of lead in the renal cortex was determined as 2,3 ppm (wet weight).

DISCUSSION

Although CCN is apparently unusual in goats compared to cattle and sheep, this outbreak illustrates that it does occur in South Africa. It is important, therefore, to distinguish CCN from other conditions with which it might be confused clinically in South Africa, such as heartwater, lead poisoning, meningitis, hypophyseal abscessation, organic phosphorus poisoning and the subacute form of enterotoxaemia (focal symmetrical encephalomalacia).

In CCN, the general absence of a febrile response may aid in distinguishing it from heartwater and infectious meningitis, but a firm clinical diagnosis of CCN

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0038-2809/85/01/0037-0038

can be supported by demonstration of raised thiaminase activity in faeces and depressed erythrocyte transketolase activity[2]. Favourable response to thiamine therapy, if achieved, also aids in substantiating the clinical diagnosis.

In this outbreak the diagnosis of CCN was confirmed by histopathological examination and by the demonstration of lead concentrations in the renal cortex which were well below the level of 40 ppm regarded as indicative of lead poisoning in ruminants[1]. Analysis of tissue lead may be important in distinguishing acute CCN from lead poisoning. Cerebral lesions have been reported in goats with lead poisoning[3], although not described in detail. In calves, however, it has been claimed that acute CCN and lead-induced encephalopathy are not clearly distinguishable on morphological grounds alone[16].

Transient diarrhoea has been reported in calves[11] and goats[12] with CCN. In lambs experimentally poisoned with amprolium it has been shown that diarrhoea consistently precedes the onset of nervous signs and the development of lesions which closely resemble those of CCN[10]. In Goat 1, faecal matting of the perineal hairs suggested that a recent episode of diarrhoea had occurred. The reason for this association between diarrhoea and CCN is not clear.

The underlying cause of this outbreak was not determined, but the feeding of concentrates and the poor-quality roughage provided by the veld grasses in winter may have been contributory factors. The goats did not have access to any plants known to contain thiaminase. Some cases of CCN in sheep have been reported to occur following the administration of the anthelmintics, levamisole hydrochloride and thiabendazole[6]. Neither of these anthelmintics nor any thiabendazole analogues, however, had been administered to this herd of goats.

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REDUCED MATING EFFICIENCY DUE TO OSTEO-ARTHROSIS IN A RAM

S.J. TERBLANCHE*

ABSTRACT: Terblanche S.J. **Reduced mating efficiency due to osteo-arthrosis in a ram.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 39-41 (En). Department of Genesiology, Faculty of Veterinary Science, University of Pretoria, P.O. Box 12580, 0110 Onderstepoort, Republic of South Africa.

An apparently clinically normal ram with excellent semen quality, an intact pituitary-testicular axis and good libido displayed abnormal mounting behaviour when subjected to a mating test with 3 oestrus ewes. The ram adopted a peculiar mounting stance, he moved backwards several paces and then lunged forward becoming momentarily airborne in an attempt to mount. After a number of these airborne attempts at mounting the ram managed one successful service, striking the ewe with his sternum while airborne. At completion of the service the ram lost all sexual interest in the other two oestrous ewes. Radiographs revealed a chronic osteo-arthrosis of the right femero-tibial joint. It was concluded that the osteo-athrosis caused the ram to suffer a great deal of pain interfering with his mounting ability which in turn affected his mating efficiency and serving capacity severely.

Key words: Ram, mating behaviour, gonitis, osteo-arthrosis, serving ability, serving capacity.

CASE HISTORY AND CLINICAL EXAMINATION

A 4 year old Ile de France ram with a bodymass of 120 kg was presented by the most recent purchaser. He had the ram for a short period only and had not yet bred the ram to ewes. The ram had changed owners on several occasions and although a certificate of genital soundness accompanied the ram he became alarmed when fellow breeders informed him that the ram had only sired a small number of offspring. Examination was carried out as described by van Tonder[6]. No clinical abnormalities could be detected.

SPECIAL EXAMINATIONS

1. Genital tract

Examination was carried out with the ram in a standing position. Symmetry, consistency and elasticity of the testes as well as free movement in the scrotum were noted. Both epididymal tails were carefully palpated for size, consistency and elasticity. The scrotal circumference was measured by pressing both testes down into the scrotum and placing a tape measure around the broadest part of the scrotum. The tape was pulled tight and two readings obtained for accuracy. The sheath, prepuce and penis were examined with the ram in a sitting position.

2. Semen evaluation

Three ejaculates, collected on separate occasions by electro-ejaculation, were evaluated. Electrical stimulation was carried out as described by van Tonder[6]. Standard methods of semen evaluation were used[4].

3. Serology

Complement fixation tests for *Brucella ovis, B abortus* and *Actinobacillus seminis* were done at Middelburg Regional Veterinary Investigation centre, as described by van Tonder[7].

4. Gonadoliberin stimulation test

A gonadoliberin (GnRH) stimulation test was carried out by injecting 8μg buserelin (Receptal, Hoechst) intramuscularly. Blood for testosterone assay was collected in heparin prior to GnRH injection at 12h00. Three more collections were made at hourly intervals after GnRH administration. The plasma was stored at $-20°C$ until assayed for testosterone by means of a ^{125}I radio-immunoassay ("Coat-a-Count" solid phase testosterone, Diagnostic Products Corporation, Los Angeles, USA). The secretory response curve of testosterone is presented in Fig. 1.

5. Mating test

Medroxyprogesterone acetate vaginal sponges (Repromap, Upjohn) were inserted into mature South African Mutton Merino ewes and left in situ for 12 days. On Day 12 sponges were removed and 500 iu of pregnant mare serum (Fostim, Upjohn) administered subcutaneously. Three oestrus ewes were introduced with the ram 36h after sponge removal. The ewes were let into a pen individually. The next ewe was introduced after the ram had lost all interest in the previous female. This procedure was continued until all 3 ewes were present with the ram. The sheep were under constant observation for 1 hour after which the unmated ewes were placed with a Dorper ram. Lambings to the 2 sires were recorded 5 months later.

6. Radiographic examination

The hips and both femero-tibial joints were examined radiographically.

RESULTS AND DISCUSSION

The ram had a scrotal circumference of 40 cm. The testes revealed a slight asymmetry with the right slightly larger that the left testis. Testicular consistency was firm with good elasticity. Epididymal tails were large and firm indicating good sperm reserves. The protruded penis and exposed mucous membrane of the sheath revealed no abnormality. All ejaculates were of excellent quality (See Table 1).

Serological tests for *B ovis, B abortus and Actinobacillus seminis* were negative. Although male sexual behaviour is androgen dependant, it is not practical to measure testosterone concentration in the blood as tremendous fluctuations occur during a 24h period[3]. It was therefore decided to carry out a gonadoliberin stimulation test. Plasma testosterone concentrations 1h, 2h, and 3h after GnRH injection were 34,9 nmol/ℓ 37,2

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Table 1: SEMEN EVALUATION OF THREE EJACULATES COLLECTED BY ELECTRO STIMULATION.

Day	1	6	14
Volume	1,5 ml	1,0 ml	0,75 ml
Colour	ivory	ivory	ivory
Consistency	creamy	creamy	creamy
pH	7,1	7,0	7,0
Motility:			
Wave motion	4	4	4
% live	90	85	85
% linear	80	80	80
% abnormal	10	5	5
% dead	10	15	15
Morphology:			
% normal sperm	85	90	85

nmol/ℓ and 39,9 nmol/ℓ respectively. The peak response represents a 10-fold increase in comparison to pre-injection levels. The stimulation test was carried out during the breeding season. Wide variations in response to GnRH are reported even when dosage and route of injection is kept constant[5]. The plasma testosterone concentrations obtained indicate an intact hypophyseal-testicular axis and can be regarded as adequate for the purpose of normal libido[1] (Fig. 1).

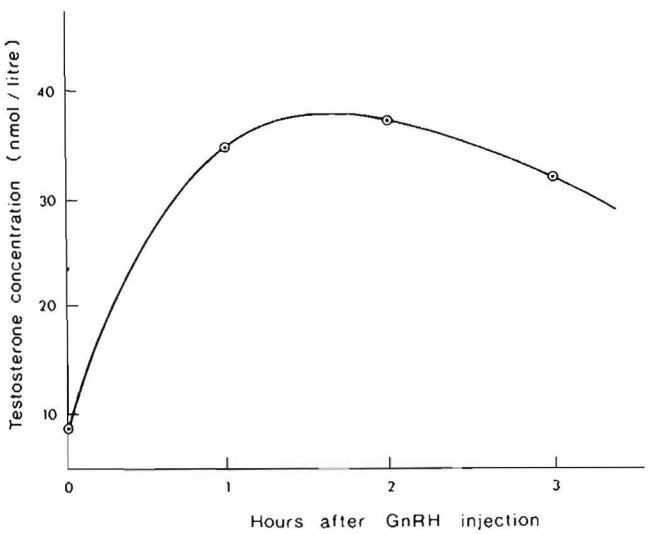
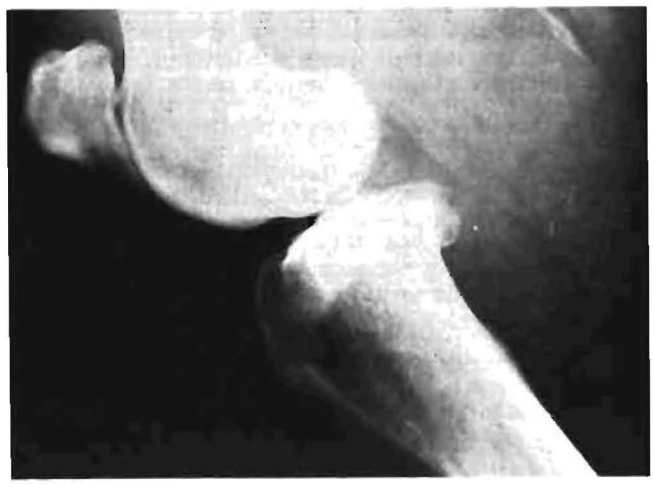


Fig. 1: Testosterone secretory response curve after GnRH injection

A mating test is normally not included in a routine examination, but it was decided that this ram should be placed with oestrus ewes and his mating behaviour carefully recorded. The practical importance of rams displaying good libido and mating dexterity was illustrated by Pretorius[2]. The ram attended the first ewe vigorously but as soon as he attempted to mount it was noticed that he had considerable difficulty. He moved several paces backward and then lunged forward, becoming airborne in an attempt to mount.

After several attempts and considerable difficulty, intromission was achieved with intra-vaginal ejaculation as evidenced by pelvic thrusting. A second ewe was then allowed to enter the pen. The ram again displayed vigorous pre-copulatory behaviour but after a number of unsuccessful attempts to mount he lost all sexual interest in the ewe and returned to the feed trough. A third ewe was then introduced. The ram however, took no notice of this ewe. Both ewes were allowed to remain with the ram for 1 hour, during which time the ram made no further attempt to mount. The two unmated ewes were placed with a Dorper ram and both were promptly served. All 3 ewes lambed after 5 months. The first ewe mated to the test ram produced a set of twins, while the latter two ewes had single lambs to the Dorper ram.

The radiographs revealed a serious chronic osteoarthrosis of the right femero-tibial joint, with severe damage to the articulation surface between the patella and trochlea (Fig. 2).



a) Normal left femero-tibial joint.

Fig. 2: Latero-medial radiographs of the left (a) and right (b) femero-tibial joints

b) Right femero-tibial joint. Note osteo-arthrosis and damage of the articular surface between the patella and trochlea.

CONCLUSION

The lunging mounting action of the ram, and the loss of sexual interest in the second and third oestrus ewe were ascribed to severe pain caused by osteo-arthorosis of the right femero-tibial joint. According to radiologists, the osteo-arthrosis was of an extremely serious nature (S S van den Berg, Dept. of Surgery, Faculty of Veterinary Science, University of Pretoria, personal communication). An arthrotomy to inspect the cruciate ligaments was suggested but not carried out. A final conclusion was then expressed that the ram was not sound for natural breeding purposes under paddock mating conditions, because his mounting ability and serving capacity

were severely affected. The usual clinical examination does not detect a concealed defect of this nature. Radiographs and the application of a mating test were essential procedures to evaluate the physical breeding ability of this ram. After discharge, a second certificate of genital soundness was issued by a veterinary practitioner. However, if a mating test had been included in the evaluation, the inability of the ram to mount and serve naturally would have been apparent. A mating test is therefor regarded as an essential procedure before a certificate of genital soundness can be issued.

ACKNOWLEDGEMENTS

The author wishes to thank Prof N Roos for interpretation of radiographs, Mr I. Painter for testosterone determinations and Prof H J Bertschinger for assistance and advice in preparation of the publication.

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ABSTRACTS

ABSTRACT: Van Heerden, J., Reyers, F. & Stewart, C.G., 1983. **Treatment and thrombocyte levels in experimentally induced canine ehrlichiosis and canine babesiosis.** *Onderstepoort Journal of Veterinary Research*, **50**, 267-270 (1983).

Three dogs which were carriers of *Babesia canis* were infected with *Ehrlichia canis*. These animals developed clinical signs and haematological evidence of ehrlichiosis and made an uneventful recovery, despite the fact that they were subsequently treated with doxycycline only.

Three control dogs which were also carriers of *B. canis* were clinically normal, despite the fact that they showed a distinct drop in the thrombocyte levels associated with increases in the numbers of parasitized red cells.

ABSTRACT: Els, H.J., Malan, F.S. & Scialdo-Krecek, Rosina, C., 1983. **Scanning electron microscopy of *Strongylus* spp. in zebra.** *Onderstepoort Journal of Veterinary Research*, **50**, 257-265 (1983).

The external ultrastructure of the anterior and posterior extremities of the nematodes, *Strongylus asini*, *Strongylus vulgaris*, *Strongylus equinus* and *Strongylus edentatus*, was studied with scanning electron microscopy (SEM). Fresh specimens of *S. asini* were collected from the caecum, ventral colon and *vena portae* of *Equus burchelli* and *Equus zebra hartmannae*; *S. vulgaris* from the caecum, colon and *arteria ileocolica* of *E. burchelli*; *S. equinus* from the ventral colon of *E. z. hartmannae* and *S. edentatus* from the caecum and ventral colon of both zebras, during surveys of parasites in zebras in the Etosha Game Reserve, South West Africa/Namibia, and the Kruger National Park, Republic of South Africa.

The worms were cleaned, fixed and mounted by standard methods and photographed in a JEOL JSM-35C scanning electron microscope (SEM) operating at 12kV. The SEM showed the following differences: the tips of the external leaf-crowns varied and were fine and delicate in *S. asini*, coarse and broad in *S. vulgaris* and, in *S. equinus* and *S. edentatus*, closely adherent, separating into single elements for half their length. The excretory pores showed only slight variation, and the morphology of the copulatory bursae did not differ from those seen with light microscopy. The genital cones differed markedly: *S. asini* had a ventral triangular projection and laterally 2 finger-like projections: in *S. vulgaris* there were numerous bosses on the lateral and ventral aspects of the cone; in *S. equinus* 2 finger-like processes projected laterocaudally; and in *S. edentatus* 2 pairs of papilla-like processes projected laterally on the central aspects, and a pair of rounded projections and a pair of hair-like structures adorned the dorsal aspects. The most significant micrograph was the shedding of the cuticle of the 4th moult of a female *S. asini*.

ABSTRACT: Horak, I.G., De Vos, V. & Brown, Moira R., 1983. **Parasites of domestic and wild animals in South Africa. XVI. Helminth and arthropod parasites of blue and black wildebeest (*Connochaetes taurinus* and *Connochaetes gnou*).** *Onderstepoort Journal of Veterinary Research*, **50**, 243-255 (1983).

Fifty-five blue wildebeest (*Connochaetes taurinus*) were shot for parasite recovery at approximately monthly intervals during a period of 13 months in the Kruger National Park. Thirteen nematode species, 4 cestode species, 1 trematode, the larvae of 5 oestrid flies, 3 lice species, 7 ixodid tick species, 1 mite species and the nymphae of a pentastomid were recovered. The seasonal prevalence of 8 nematodes, 2 cestodes, the larvae of 4 oestrid flies, 2 lice and 4 ixodid tick species was determined.

The endo- and ectoparasite burdens of 7 black wildebeest (*Connochaetes gnou*) shot in the Golden Gate Highlands Park in the Orange Free State and 3 shot in the Rietvlei Reserve in the Transvaal were determined. These animals harboured 4 nematodes species, 1 cestode, the larvae of 5 oestrid fly species, 2 lice species, 4 ixodid tick species and a mite species.

ABSTRACT: Boomker, J., Du Plessis, W.H. & Boomker, Elizabeth A., 1983. **Some helminth and arthropod parasites of the grey duiker, *Sylvicapra grimmia*.** *Onderstepoort Journal of Veterinary Research*, **50**, 233-241 (1983).

Sixteen grey duikers were culled on the farm Riekert's Laager in the central Transvaal at irregular intervals from May 1979-March 1981. One trematode species, 3 cestode species and 16 nematode species were recovered from these animals. Of these the following are new helminth records for this antelope: *Cooperia hungi*, *Cooperia neitzi*, *Cooperia pectinata*, *Trichostrongylus axei*, *Trichostrongylus colubriformis*, *Trichostrongylus falculatus*, *Trichostrongylus instabilis*, *Impalaia tuberculata*, *Nematodirus* sp. and *Paramphistomum* sp.

In addition, 6 species of ixodid ticks were collected. These, in order of abundance, were *Amblyomma hebraeum* (55,9 %), *Rhipicephalus appendiculatus* (36,6 %), *Rhipicephalus evertsi evertsi* (5,1 %), *Boophilus decoloratus* (2,3 %), *Boophilus microplus* (0,05 %) and *Haemaphysalis* sp. (0,05 %). Only 60 (2,8 %) of the 2 118 ticks that were collected were adults. Of the 3 species of lice that were recovered, *Linognathus zumpti zumpti* was most abundant (58,9 %), but, out of a total of 1 498 collected, 1 496 occurred on 1 animal only. *Linognathus breviceps* constituted 29,5 % and *Damalinia lerouxi* 11,6 % of the total. A total of 277 specimens of the hippoboscid fly *Lipoptena paradoxa* were collected from 12 of the 16 animals examined.

Trends in the seasonal fluctation of *Haemonchus*, *Trichostrongylus*, *Impalaia*, *Lipoptena* and the immature stages of *Amblyomma* and *R. appendiculatus* are graphically illustrated.

ABSTRACT: Rechav, Y., 1983. **A bioassay technique for the pheromone emitted by *Amblyomma hebraeum* males.** *Onderstepoort Journal of Veterinary Research*, **50**, 133-135 (1983).

Attachments of *Amblyomma hebraeum* females, either around feeding males or in areas in which extracts of fed males had previously been placed, was studied. The percentage attachment of female ticks around feeding males was significantly higher that that inside extract-treated areas. It was also found that the percentage attachment around the males increases with time, but there is litte or no increase in attachment with time inside the treated areas.

The amount of pheromone released by 1 feeding male was enough to stimulate attachment of females, although the rate of attachment accelerated as the number of males increased.

THE TREATMENT OF CANINE DEMODECOSIS WITH AMITRAZ

D.A. DAVIS*

ABSTRACT: Davis, D.A. **The treatment of canine demodecosis with amitraz.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 43-46 (En). Coopers Animal Health (Pty) Ltd, P.O. Box 5034, 5208 Greenfields, Republic of South Africa.

The treatment of a series of 27 clinical cases of canine demodecosis is reported. Three of 4 applications of a wash containing 0,025% amitraz, together with antimicrobial and antipruritic therapy where necessary, were sufficient to effect clinical cure in 25 out of 26 cases mildly to severely affected. In one case, very severely affected, 9 weekly applications, together with antimicrobial and antipruritic therapy, effected clinical and parasitological cure.

Key words: Canine demodecosis, amitraz.

INTRODUCTION

The problem of demodecosis in dogs has been a persistent challenge to the practising veterinarian. *Demodex canis* is a normal inhabitant of canine skin and may be found in small numbers in many healthy dogs[2]. The life cycle, which is not completely understood, consists of a larval, a protonymphal, a deutonymphal and an adult stage. All stages possess eight legs with the exception of the larva which is six-legged. The sites of predilection are the hair follicle and the sebaceous gland but mites may be found in many organs of the body. Soulsby[6] states that *D. canis* can survive away from a host for several days and under experimental conditions mites were found to survive for 21 days in skin that was kept moist and cool. Notwithstanding this fact, artificial infection of experimental animals is difficult since the immunological status of the host is an important factor in the pathogenesis of demodectic mange. Scott et al.[3,4] suggest that dogs suffering from generalised demodectic mange have marked cell-mediated immunodeficiency. For these reasons, naturally occurring clinical cases generally have to be used for the development of a potential treatment.

Demodectic mange, characterised by larger than normal numbers of mites inhabiting visible lesions on the patient, is usually a disease of young dogs and may be seen either in squamous, pustular or squamo-pustular forms. Localised demodecosis is usually squamous and frequently resolves spontaneously in 3-8 weeks. The generalised form is always severe, is mostly pustular because of the secondary bacterial infection that occurs, never resolves spontaneously and may terminate fatally both because the disease can be fatal and because owners opt for euthanasia of their pet in preference to continual treatment providing little or no improvement.

The difficulty encountered by the practising veterinarian in treating generalised demodecosis is well illustrated by the large number of methods of treatment that have been advocated. Scott et al.[3] list over 60 preparations ranging from garlic to organophosphates which have been used over the years. Some of these preparations have obtained a reputation for efficacy only because they have been applied to spontaneously resolving localised demodecosis. According to these authors, the most successful treatments in their experience consisted of clipping and bathing the dog, and then the application of 8,5% fenchlorphos solution to one third of the body surface daily. In addition, antibiotics and whirlpool baths were given where severe deep pyoderma was present. The skin lesions were usually dry and healing after 2-3 weeks of treatment but noticeable scaling was also evident, becoming severe and continuing for 4-6 weeks after treatment had stopped. Courses of treatment varied from 5-10 weeks.

Amitraz is a diamidide having marked acaricidal properties with low toxicity for cattle and pigs, a relatively low toxicity for cats and dogs and an idiosyncratic toxicity for horses. It is used primarily for the control of ticks on cattle. It is also used for the treatment of mange in cattle and pigs. The chemical, either by itself or in combination with organophosphates is highly efficient in the control of sheep scab (*Psoroptes ovis*) and goat mange (*Sarcoptes scabiei*). When combined with diazinon it is highly efficient in the control of itch mite infection in sheep (*Psorergates ovis*), a mite that is most difficult to eradicate from any flock.

In Kenya amitraz has been used for the treatment of demodecosis in dogs (D.G. Rae 1979 The Wellcome Foundation Ltd, Nairobi, Kenya, personal communication). Treatments consisted of bathing dogs in a wash containing 0,025% or 0,05% concentration of amitraz applied on 2-4 occasions at intervals of 7-14 days. A 95% success rate (based on the clinical signs) was achieved. Farmer & Seawright[1] reported on successful treatment with amitraz, at the above concentration, in 3 cases of generalised demodecosis, which had been refractory to the standard treatment with fenchlorphos. They also reported that a single wash with 0,025% amitraz was sufficient to cure dogs affected with localised demodecosis within 2-4 weeks. They recommended a thorough pre-wash of the patient with soap and water followed by the application of the amitraz wash by vigorous scrubbing and then allowing the wash to dry naturally on the animal's skin.

In America, Shirk[5], using 3 applications of amitraz wash of unspecified concentration at fortnightly intervals, achieved a 93,6% success rate in 299 dogs, 74,5% of which had been treated without success with other therapies on previous occasions. A 99% success rate was achieved when longer courses of treatment with amitraz were applied to those not fully responding to the first course.

In the present paper the results of treatment are reported on 27 naturally infested dogs.

MATERIALS

Twenty seven dogs were used in the trial, the ages of which ranged from 3 months to 5 years. Eighteen were

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0038-2809/85/01/0043-0046

male, 8 were female and 1 was a neutered female. Fifteen were mongrels with hair coats which ranged from smooth to long and shaggy, 4 were first crosses of the Corgi, Labrador or Whippet breeds. The remainder were apparently pure bred animals of the Bull Terrier, Staffordshire Bull Terrier, Labrador, Rottweiler or Whippet breeds.

These dogs were presented over a period of 18 months for examination and treatment either at private veterinary practices or at the clinic or mobile clinic of a welfare society. Once a diagnosis of demodecosis had been made, no dogs were rejected as trial subjects for any reason. Cases were identified by the numbers 1-27.

Amitraz emulsifiable concentrate (Triatrix Cattle Spray, containing 12,5% m/v technical amitraz, Coopers), was used as the parasiticide in all cases.

Ampicillin (Penbritin, Beecham), or oxytetracycline (Oxytetracycline, Centaur) or trimethoprim/sulphadiazine (Tribrissen 20, Wellcome) was used where necessary to control secondary infection. Promethazine hydrochloride (Phenergan, May Baker) was used to control pruritis where necessary.

METHODS

Diagnosis of demodecosis was based on clinical findings and, when possible, confirmed in the laboratory. In each of 19 cases one area of a lesion was softened, using potassium hydroxide (10%), and a scraping of the lesion taken and examined under the microscope for the presence of *D. canis*. In one case (No. 27) scrapings were taken from 3 sites regularly and biopsies were taken before the last treatment.

The severity of each case was assessed on a scale of 1-28, in which up to 4 points reflecting the size and character of lesions were scored for each of 6 sites, namely the head, neck, hind legs, forelegs, ventrum and dorsum. In addition up to 4 points could be scored for the degree of hair loss.

Treatment consisted of diluting the emulsifiable concentrate at the rate of 20 ml concentrate to 10 ℓ water to give a wash containing 0,025% amitraz. A fresh wash was prepared at the time of each treatment. This was applied either by a hand spray or by dipping the dog in a bath containing the wash and working the wash into the coat. In all instances care was taken to wet the entire skin of the animal. The eyes of the patient were protected by the application of ophthalmic ointment (Chloramex, Dumex) into the conjuctival sack. Treatment was administered every 7 days. On re-examination, immediately before each treatment, attention was paid to the increase or decrease of the size of the lesions, the state of the hair coat, the report of the owner or kennel attendant concerning persisting pruritis, general health and any adverse effects associated with the treatment.

It was necessary to give antibiotic treatment to animals No. 5; 9; 13 and 23 and antipruritic treatment to animals No. 9; 13 and 23.

Post-treatment examinations were carried out between 2 and 4 weeks after treatment. Cases were judged to be cured when the character and texture of the skin

Table 1: TREATMENT OF DEMODECOSIS WITH AMITRAZ: SUMMARY OF TYPE, SEVERITY, TREATMENTS AND RESULTS OF CASES 1-26

Case Number	Breed	Age (mnths)	Severity Score	Additional Treatment	Laboratory Confirmation of Diagnosis	Number of Treatments	Results
15	Mongrel	6	3	No	Yes	3	E
17	Mongrel	7	3	No	Yes	3	E
18	Mongrel	5	3	No	Yes	3	E
21	Labrador	7	3	No	Yes	3	E
22	Whippet	4	5	No	Yes	3	E
4	Mongrel	6	6	No	Yes	4	G
14	Bull Terrier	12	6	No	Yes	3	E
24	Staffordshire Bull Terrier	6	6	No	Yes	3	G
25	Rottweiler	8	6	No	Yes	3	E
10	Labrador Cross	3	7	No	Yes	3	E
11	Labrador Cross	3	7	No	Yes	3	E
20	Whippet Cross	7	7	No	NT	3	E
23	Labrador	7	7	Yes	Yes	3	E
26	Mongrel	5	7	No	NT	4	E
3	Mongrel	36	9	No	NT	3	E
5	Mongrel	12	9	Yes	NT	4	E
12	Corgi Cross	3	9	No	No	3	G
16	Mongrel	8	10	No	Yes	4	G
6	Mongrel	3	13	No	Yes	3	G
13	Labrador Cross	8	13	Yes	Yes	3	G
9	Mongrel	6	14	Yes	Yes	4	G
19	Mongrel	3	14	No	No	3	E
2	Mongrel	5	16	No	NT	4	E
1	Mongrel	18	17	No	NT	4	G
7	Mongrel	36	21	No	Yes	3	R
8	Mongrel	60	21	No	Yes	4	E

Legend: E: Excellent regrowth of haircoat.
G: Good regrowth of haircoat.
NT: Scrappings not taken.
R: Relapsed at later date.

and density of hair growth was normal.

Animal No. 27 was very severly affected. A previous course of four treatments with fenchlorphos (Demadeth, Pfizer) concluded 10 weeks previous to the commencement of this trial had failed to affect the progressive deterioration of the condition of this animal. For the purposes of this trial, the patient was hospitalised and the course of the disease studied in more detail. A skin scraping was taken from the head and alternate forelegs before each of 8 treatments. Before the 9th treatment skin biopsies were taken from the head and the right foreleg, fixed and mounted and stained with haematoxylin/eosin and examined under the microscope for the presence of mites. Twice daily doses of trimethoprim/sulphadiazine combination tablets were given for 14 days in order to control the extensive secondary bacterial infection present. A post-treatment examination was carried out 6 months after the last treatment.

RESULTS

Diagnosis of demodecosis was confirmed in 18 of the 20 cases from which skin scrapings were taken.

Of the 27 dogs treated, 14 were mildly affected, being scored 3-7 points on the scale and only one of these, (No. 23), required supportive therapy to control pruritis. Clinical cure was achieved in 12 cases after three treatments and in the other 2 cases after 4 treatments. In all cases regrowth of hair and its general condition was either good or excellent (Table 1).

Eight dogs were moderately affected, scoring 9-14 points. Supportive antimicrobial and antipruritic treatment was given in 3 of these cases: No. 5; 9 and 13. Clinical cure was achieved in 5 cases after 3 treatments and in the remainder after 4 treatments. Re-growth of hair and its general condition at the time of post-treatment examination was good in 5 cases and excellent in 3 others (Table 1).

Four dogs were severly affected, scoring 16-21 points. Three were clinically cured after 4 treatments, with re-growth of hair and the general condition being good or excellent. In the 4th case, clinical cure was achieved after only 3 treatments, but the condition relapsed 2 months later and a further more prolonged course of treatment was administered with successful results (Table 1).

Table 2: TREATMENT OF DEMODECOSIS WITH AMITRAZ: PROGRESS OF TREATMENT AND CONDITION OF CASE NO. 27

Week No.	Treatment No.	Result of Scraping		Clinical Assessment & Severity Score	Secondary Infection	Pruritis	State of Hair	Bodily Condition
		FL	H					
1	1	+ + +	+ + +	Very severe – 28	Marked	Continuous	Large areas alopecia. Hair generaly coarse.	Emaciated
2	2	+	+ +	Severe – 25	Reduced	Reduced	Regrowth visible	Poor condition
3	3	+	Neg	Improvement visible – 21	Minor	Minor	Regrowth general	Poor condition
4	4	Neg	Neg	Thickening of skin reducing – 18	Neg	Neg	Regrowth general	Condition improving
5	5	1 Dead Mite	Neg	Significant improvement – 15	Neg	Neg	Marked regrowth all areas	Condition and weight improving
6	6	Neg	Neg	Significant improvement – 10	Neg	Neg	Regrowth maintained	Weight increasing
7	7	1 Dead Mite	Neg	Virtually normal – 5	Neg	Neg	Nearly normal distribution	Weight increasing
8	8	Neg	Neg	Virtually normal – 2	Neg	Neg	Nearly normal distribution	Weight increased
9	BIOPSIES TAKEN							
10	9	Biopsies Negative		Skin texture normal – 0	Neg	Neg	Normal fine texture	Good, healthy appearance

Legend: FL: Foreleg; H: Head; Neg: Negative

One case (No. 27), a 7 month old male cross bred terrier with long hair, was very severely affected, scoring 28 points on the scale (Table 2).

Examination after 9 treatments with amitraz showed no clinical signs of demodecosis and the dog was in good bodily condition. Examination of the skin biopsy taken after the 8th treatment failed to reveal the presence of mites.

No adverse reactions were reported in any of the cases treated.

DISCUSSION

The series of cases reported covers a wide range of the clinical aspects of demodecosis. In only one case was the result not entirely satisfactory. The results of the series compare favourably with those obtained by Rae (personal communication), Farmer & Seawright[1] and Shirk[5].

Failure to find mites in 2 cases may be ascribed to the fact that scrapings were taken from one area only on each dog, apart from dog No. 27.

Temporary sedation lasting from 1-24 hours and resolving spontaneously is a known adverse reaction shown by some dogs subjected to treatment with amitraz wash at concentrations above 0,025% active ingredient (R.J. Taylor 1980 Kwanyanga Research Station, personal communication). Shirk[5] records mild to moderate tranquilisation lasting 8-36 hours in one third of those treated in the first course. No instances of sedation were observed in this series. Veterinarians using amitraz must be aware of the possibility of this reaction to concentrations above those advocated, but such a possibility does not detract from the value of the treatment as specified.

ACKNOWLEDGEMENTS

The assistance of Drs M Lowry, B Longmore, G Davis and J Corbett in carrying out the diagnoses, treatments and recording is gratefully acknowledged.

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BOOK REVIEW — BOEKRESENSIE

MEDICAL AND VETERINARY ENTOMOLOGY

D.S. KETTLE

1st Edn. Croom Helm, London & Sydney 1984 pp ii and 658, numerous illustrations, Price not stated (ISBN 0-85664-839-6)

Part I of this book is the introductory part that deals comprehensively with the structure and function of insects. Part II deals with the important medical and veterinary insects by order. These descriptions follow the standard format, i.e. morphology, distribution, life cycle, classification, and importance. In some cases, especially those of medical importance, a section on the bionomics of the insect is included. The 3rd part is a handy reference section, in which the diseases of mammals, the pathogens which are transmitted by arthropods, are discussed.

Apart from the section on ticks, which is not all that informative on the Ethiopian species, this is a good book. It is well written, amply illustrated and contains a wealth of information both in the text and in the numerous references which are listed after each chapter.

The book should prove a valuable addition to under- and post-graduate students, teachers and researchers on pure and applied entomology.

J. Boomker

ANTHELMINTIC EFFICACY OF FENBENDAZOLE AGAINST *LIBYOSTRONGYLUS DOUGLASSI* AND *HOUTTUYNIA STRUTHIONIS* IN OSTRICHES

A. FOCKEMA*, F.S. MALAN**, G.G. COOPER** and EVELYN VISSER***

ABSTRACT: Fockema A.; Malan F.S.; Cooper G.G.; Visser E.L. **Anthelmintic efficacy of fenbendazole against *Libyostrongylus douglassi* and *Houttuynia struthionis* in ostriches.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 47-48 (En). 106 Main Road, 6065 Walmer, Republic of South Africa.

Fenbendazole at a dosage rate of 15 mg FBZ per kg body mass, was 99,7% effective against adult and 82,5% effective against 4th stage larvae (L_4) of *Libyostrongylus douglassi*. Fenbendazole at the same dose removed scolices and strobila of *Houttuynia struthionis* from 4 out of 5 treated birds and in the other there were only degenerating scolices, but all 5 untreated control birds were positive for *H. struthionis*.

Key words: Anthelmintic, fenbendazole, *Libyostrongylus douglassi, Houttuynia struthionis,* ostriches.

INTRODUCTION

Fenbendazole: methyl 5-(phenyl-thio)-2-benzimidazole carbamate (FBZ) is being successfully used as an anthelmintic in most domestic animals but has not been tested against the helminths of ostriches (*Struthio camelus*). The present paper reports on the results of a trial using FBZ at a dosage rate of 15 mg/kg live mass against natural infestations of the nematode *Libyostrongylus douglassi* and the cestode *Houttuynia struthionis*.

MATERIALS AND METHODS

Locality

The trial was conducted on the farm Buffelsdrift in the Oudtshoorn district of the Cape Province.

Birds

Ten birds, aged 12-14 months were selected out of a group of 150 birds running in a small lucerne pasture. Only birds excreting proglottides of *H.struthionis* were used and each bird was identified and the mass of each bird determined.

Anthelmintic

Commercially available fenbendazole (Panacur, Hoechst) 10% containing 100 mg FBZ per ml, was administered orally to the treated birds using a 20 ml syringe. Five birds were treated at a dosage rate of 15 mg FBZ per kg live mass and 5 birds were left as untreated controls. After treatment the birds were placed in a camp where no birds had grazed for 6 months, before slaughtering them 5 days later.

Worm recovery

The birds were killed, the proventriculus, gizzard and intestines of each bird were removed and labelled. The proventriculus and the gizzard were seperated, each cut open and the ingesta washed into containers. Five ml of Lugol's iodine to kill the worms and 50 ml of formalin to fix them were added before the gastro-intestinal ingesta were washed with a strong stream of water on a sieve with apertures of 150 μm which was placed on top of a sieve with apertures of 38 μm. The 2 samples obtained, proventriculus and gizzard, were preserved with formalin for subsequent microscopic examination. The mucosa of the proventriculus was scraped off using a blunt knife and then minced in a blender. The minced mucosa of the proventriculus of each bird was placed in a 1 ℓ glass jar, digested in pepsin/HCl for 45 min, incubated at 40°C in a water bath after which the digest was sieved on a sieve with 38 μm apertures[1]. The residue on the sieve's surface was washed into a jar, formalin was added and the digest sample labeled for subsequent identification.

The small intestine of each bird was cut open and the gut pulled between the thumb and forefinger under a stream of water and all the contents washed into a container. The wall was then carefully scrutinized for residual scolices which if present were recovered and counted. The contents were then sieved on a sieve with apertures of 150 μm. The residue on the sieve surface was poured in 1 ℓ glass jars to which 10% formalin was added as a preservative.

Three 1/10 aliquots were made of each sample which was then examined with a stereoscopic microscope and all the worms were removed and placed in a seperate bottle, containing 10% formalin. The balance of the small intestinal residue was macroscopically examined and all tapeworms recovered. The nematodes were mounted on microscopic glass slides in lactophenol and identified with the aid of a compound microscope.

The tapeworms were placed in a known volume of water and the volume of water they displaced was recorded.

RESULTS

L. douglassi recovered are summarized in Table 1 and *H.struthionis* in Table 2.

L. douglassi

Fourth stage larvae (L_4): Recoveries in the treated birds ranged from 5-582 with a mean of 277,8 and in the untreated controls from 1034 to 2175 with a mean of 1503. On analysis a 82,5% reduction was recorded when compared with the controls.

Adults: The mean burden of the treated birds was 272,8 ranging from 163-345 and in the untreated birds burdens ranged from 42 454-130 320 with a mean of 78 898. The reduction after treatment was 99,7% when compared with untreated controls.

H. struthionis

No strobilae were recovered from the intestines of the treated birds while they were present in 3 out of 5 controls. In one of the treated birds 35 scolices were recovered but on microscopic examination they showed signs of degeneration.

Scolices were recovered from all the control birds ranging from 5-62.

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0038-2809/85/01/0047-0048

Table 1: *L. DOUGLASSI* RECOVERED FROM THE PROVENTRICULUS OF OSTRICHES TREATED WITH FENBENDAZOLE AT A DOSAGE RATE OF 15 mg/kg AND FROM THE UNTREATED CONTROLS

Ostrich no.	Treatment	*L. douglassi*	
		L_4*	Adult
1D	15 mg/kg FBZ	582	345
2D	15 mg/kg FBZ	124	335
6D	15 mg/kg FBZ	5	163
7D	15 mg/kg FBZ	180	289
9D	15 mg/kg FBZ	498	232
Mean		277,8	272,8
3K	Untreated Control	2 175	117 607
4K	Untreated Control	1 405	61 740
5K	Untreated Control	1 034	42 279
8K	Untreated Control	1 734	130 320
10K	Untreated Control	1 167	42 545
Mean		1 503	78 898
	Reduction	82,5%	99,7%

*L_4 = Fourth stage larvae

Table 2: *H. STRUTHIONIS* RECOVERED FROM THE SMALL INTESTINES OF OSTRICHES TREATED WITH FBZ AT A DOSAGE RATE OF 15 mg/kg AND FROM THE UNTREATED CONTROLS

Ostrich Number	Treatment	Scolices	Volume of Strobilae (ml water replaced)
1D	15 mg/kg FBZ	0	—
2D	15 mg/kg FBZ	35*	0
6D	15 mg/kg FBZ	0	—
7D	15 mg/kg FBZ	0	—
9D	15 mg/kg FBZ	0	—
3K	Untreated Control	35**	50
4K	Untreated Control	5	0
5K	Untreated Control	52	60
8K	Untreated Control	62	0
10K	Untreated Control	6	40

*All scolices were degenerated with no strobilae
**17 Scolices were degenerated without strobilae

DISCUSSION

Fenbendazole was 99,7% effective against adult *L. douglassi* but fell to 82,5% against L_4. This may be due to a reinfestation of larvae after treatment when the birds were kept in an infested paddock before slaughtering them 5 days later.

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CASE REPORT GEVALVERSLAG

MORTALITY OF A WHITE RHINOCEROS (*CERATOTHERIUM SIMUM*) SUSPECTED TO BE ASSOCIATED WITH THE BLUE-GREEN ALGA *MICROCYSTIS AERUGINOSA*

M.D. SOLL* and M.C. WILLIAMS**

ABSTRACT: Soll M.D.; Williams M.C. **Mortality of a white rhinoceros (*Ceratotherium simum*) suspected to be associated with the blue-green alga *Microcystis aeruginosa*.** *Journal of the South African Veterinary Association* (1985) 56 No. 1, 49-51 (En). Private Bag 3, 1685 Halfway House, Republic of South Africa.

Three of four white rhinoceroses died within 3 months of introduction into a game reserve. Post-mortem examination of one of the animals revealed marked hepatomegaly with haemorrhage and severe necrosis of the liver as well as numerous ecchymoses and petechiae in the subcutaneous tissue and subserosa of the thorax, abdomen and diaphragm. Histologically, severe hepatic necrosis was the most significant finding. Algae recovered from the dam from which the animals drank were identified as *Microcystis aeruginosa*. A diagnosis of suspected *Microcystis* poisoning was made.

Key words: White rhinoceros, *Microcystis aeruginosa,* algal toxin, mortality, hepatic necrosis.

INTRODUCTION

Poisoning of domestic animals by toxic "waterblooms" has been an infrequent but repeated occurrence in several countries of the world since the first case was reported from Australia in 1878[4]. Clinical signs and mortalities occur when livestock ingest wind-concentrated surface blooms of toxic strains of freshwater cyanophytes, which develop in eutrophic freshwater dams, pans and lakes.

Three toxic genera, *Microcystis, Anabaena* and *Aphanizomenon* are most commonly implicated in these poisonings, although others may also cause toxicity[6]. *Microcystis toxica*, responsible for the death of thousands of cattle and sheep around the Vaal Dam in the 1940's[14 16] is considered to be synonymous with *M. aeruginosa*[8]. At least two toxins are produced by *Microcystis* spp., a fast death factor and a slow death factor, which may cause the death of livestock from minutes to days after ingestion of a critical dose[5].

A variety of clinical signs are manifested as a result of algal poisoning including incoordination, muscular weakness and fibrillation, unsteady gait, recumbency, laboured respiration, salivation, lacrimation, diarrhoea and, in cases surviving for longer periods, icterus, photodermatitis and loss of condition[3 9 16].

On post-mortem examination of acute cases the liver shows striking changes, with severe congestion, hepatomegaly and necrosis of hepatic cells being frequent findings[7 9 12 16]. Haemorrhages in the intestine and on the abdominal serosa, splenomegaly, pulmonary oedema and haemorrhage and hyperaemia of the kidneys may also be found[16]. In chronic cases, lesions may vary according to the severity of the condition[11].

In South Africa, mortality of a number of domestic species including horses, mules, cattle, sheep and dogs has been attributed to the toxin produced by blooms of *Microcystis* in dams and pans[16].

Recently, mention has been made of deaths of wild animals in the William Pretorius Game Reserve caused by a toxic bloom of *Microcystis*[1]. In this case, a number of black wildebeest (*Connochaetes gnou*) were suspected to have succumbed to a toxic strain of *M. aeruginosa,* although the diagnosis was not confirmed (P le Roux 1984 Division of Nature Conservation, Orange Free State, personal communication).

The present report deals with mortality of a white rhinoceros associated with the blue-green alga, *M. aeruginosa*.

CASE HISTORY

In May 1979, four white rhinoceroses (*Ceratotherium simum*) were released at the Barakologadi Game Reserve in the Odi district of Bophuthatswana. The reserve, some 9 000 ha in extent, is situated on the banks of the Klipvoor Dam (26°57' E, 25°5' S), approximately 100 km north of Brits).

The animals originated from the Umfolozi Game Reserve in Natal where they had been captured and boma trained for approximately 3 months prior to transport by road to Bophuthatswana. After release, the animals paired off, the older pair remaining closer to the dam and the two younger animals higher up in the reserve.

In Mid-July 1979 the younger animals were found dead. Interpretation of post mortem findings could not be made because the animals were in an advanced state of decomposition. It was estimated that they had been dead for 7-10 days at the time of examination.

Both older animals appeared clinically normal on subsequent daily observation, but their condition remained poor. On July 25, 1979 the female was found dead in sternal recumbency, although she was reported to have been active and lively the previous day. Apart from signs of mild diarrhoea, the male animal appeared to be otherwise healthy.

The dead animal was inspected and, apart from signs of excessive lacrimation, dried soft faeces around the anus and moderate infestation with *Amblyomma* ticks, no other external abnormalites were evident. A full necropsy was conducted.

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MACROSCOPICAL PATHOLOGY

The most striking finding was severe hepatomegaly. The organ was markedly swollen with rounded edges and was a deep red-purple colour. When incised, the cut surface bulged and red fluid seeped from the incision. The parenchyma itself was soft and friable. The consistency of the organ resembled a liver with advanced autolytic changes even though the animal had only been dead for a few hours and the other organs showed no signs of autolysis.

Widespread petechiae and ecchymoses occurred in the subcutaneous tissues and serosa of the thorax, abdomen and diaphragm. Severe subendocardial and subepicardial haemorrhage was evident as well as severe focal disseminate subcapsular haemorrhage in the spleen.

The blood vessels supplying the intestines were congested. Approximately 5ℓ of serous fluid was present in the abdominal cavity. The condition of the animal was poor with serous atrophy of fat in the mesenterium and pelvic area. Localized areas of congestion about 1cm in diameter were scattered throughout the lung.

MICROSCOPICAL PATHOLOGY

Samples of liver, spleen, kidney, heart and lung were collected and fixed in 10% buffered formalin. Appropriate tissue blocks were embedded in paraffin wax and 3-5 μm sections were cut and stained with haemotoxylin and eosin for light microscopic examination.

In the liver all of the hepatic lobules examined showed that 90-100 per cent of the hepatocytes had undergone lysis necrosis. A few small groups of 3-10 viable hepatocytes were randomly scattered through the parenchyma. The connective tissue framework which had supported the liver cell plates was distorted or absent and the resulting confluent sinusoids were filled with large numbers of erythrocytes admixed with cytoplasmic debris from lysed hepatocytes. No inflammatory cells were observed and the portal triads showed no lesions. These lesions are similar to those reported in rats fed an extract of *M. aeruginosa*[2] as well as those reported in cattle and sheep dying from *Microcystis* toxicity[7 9 12 16]. The spleen showed severe subcapsular haemorrhage with a marked atrophy of the white pulp.

The red patches seen in the lungs macroscopically were confirmed to be the result of congestion, probably due to hypostasis.

ALGAL IDENTIFICATION

At the time the animal died, the Klipvoor Dam in the park was covered with large quantities of blue-green algae which floated on the surface of the water forming a porridge-like green scum 4-12 cm thick.

Samples of water containing algae were collected and submitted to the Department of Botany, University of Pretoria, for identification. The water was shown to contain an almost pure culture of *M. aeruginosa*. (J C Coetzee and A Eicker Department of Botany, University of Pretoria, personal communication).

DISCUSSION

The literature on toxic freshwater blooms dates back to 1878 when the occurrence of a green scum was reported on Lake Alexandrina in Southern Australia by Francis[4] who described the phenomenon as follows:

> "A conferva that is indigenous and confined to the lakes has been produced in excessive quantities, so much as to render the water unwholesome.
> It is, I believe *Nodularia spumigena*, allied to protococcus. Being very light, it floats on the water, except during breezes when it becomes diffused. Thus floating, it is wafted to the lee shores, and forming a thick scum like green oil paint, some two to six inches thick and as thick and pasty as porridge, it is swallowed by cattle when drinking, especially such as suck their drink at the surface like horses. This acts poisonously and rapidly causes death".

This description of the algae on the lake corresponds closely to what was observed at Klipvoor Dam at the time of the mortalities. The Klipvoor Dam is a large dam, 880 ha in extent with a capacity of 44×10^6 cubic metres. Some years ago, a large amount of fertilizer was added to the dam as part of a fish breeding scheme. This resulted in the development of highly eutrophic water which is known to stimulate the growth of blue-green algae[10].

The cyanophyte responsible for the first reported mortalities of livestock in South Africa was named *Microcystis toxica*[14]. It was considered to be a distinct though closely allied species to *M. aeruginosa,* differing in its larger size, peripheral network of cells, toxicity, odour and colour in decay[14].

Although cell size plays an important role at the species level in the taxonomy of *Microcystis*, numerous morphological deviations, which are not genetically stable, exist[10]. Comparison of cell size and cell size distribution of a toxic and a non-toxic isolate of *Microcystis* grown under different environmental conditions showed that cell size varied to such a large extent that its use as a taxonomic criterium was invalid, unless environmental conditions were carefully taken into consideration[10]. It has further been noticed that waterblooms of *Microcystis* may vary in toxicity without any noticeable differences in microscopic morphology[13]. Colony habit as a taxonomic criterium is also considered to be suspect, since many variations exist even under natural conditions[13].

Lewin, cited by Smit et al.[13], typified the chaotic state of blue-green algal taxonomy in that *Anacystis nidulans* has been assigned to four different genera in a four year period. According to Stanier et al.[15] there is little value in the older taxonomic treatments. Because of this and the fact that *M. toxica* has been given as a synonym for *M. aeruginosa* in a taxonomic review of blue-green algae[8], it appears that livestock mortalities in South Africa as a result of ingestion of toxic algae may be attributed to a single species of cyanophyte viz. *M. aeruginosa.*

No mortalities attributable to *Microcystis* poisoning were observed in any other species of game found in the reserve. These include giraffe, zebra, wildebeest, impala, kudu, jackal and warthog. Occasionally carcasses of these species are found, but they are usually decomposed or have been partially consumed by scavengers and the cause of death is therefore seldom established.

The specific susceptibility of the rhinoceros to algal toxins is unknown. Despite the wide variety of species

(including horses, mules, cattle, sheep, dogs and laboratory animals) affected by the toxin[2 7 9 12 16] there is apparently a wide interspecies variation in susceptability to *Microcystis* poisoning. For a certain strain of

The toxicity is further determined by dominance of toxic strains of algae, concentration of toxic organisms, release of toxin and consumption of toxin in sufficient amounts by susceptible animals before appreciable dilution, absorption or destruction occurs[5]. Experiments in sheep revealed a remarkably sharp dose response curve in that up to 90 % of the lethal dose of bloom could be ingested in a single administration without measurable effect[7]. Relative to other species found in the reserve, the rhinoceros would drink a large volume of water and therefore ingest more toxic algae, which may be a further explanation as to why they were specifically affected. Apart from a small number of dried *Senecio* plants (which had not been eaten), no other known hepatotoxic plants were found in the reserve.

M. aeruginosa, the LD 100 for mice was found to be 19 mg of dried algae/kg whereas a dose of more than 950 mg/kg was required to induce symptoms in sheep[7].

It has been shown that variations in the toxicity of *Microcystis* may occur over short periods of time due to the influence of environmental factors such as light intensity, temperature, age of cells and pH[5 17]. The algae in the dam are therefore probably not always toxic and the mortalities may have occurred because the rhinoceros happened to drink at a time when the correct environmental factors prevailed for the production of toxin.

On the basis of the liver lesions, which are similar to those described for laboratory animals exposed to a toxic extract of *M. aeruginosa*[2 9] and those described for domestic animals ingesting the toxin[7 9 12], mortality of the rhinoceros was suspected to be the result of *Microcystis* algal poisoning. This diagnosis was supported by confirmation that the dam from which the animals drank was heavily contaminated with *M. aeruginosa*, although no tests were conducted to establish the toxicity of this particular strain.

The remaining male rhinoceros was captured, successfully transported and released in the Pilanesberg Game Reserve in August 1979.

This report emphasizes the important role that toxic flora may play in the successful introduction or reintroduction of indigenous and exotic game to reserves and farms which may be unnatural habitats or disturbed ecosystems.

ACKNOWLEDGEMENTS

Mr J C Coetzee and Prof A Eicker, Department of Botany, University of Pretoria are thanked for identifying the algae. We would also like to thank Prof R C Tustin, Department of Pathology, Faculty of Veterinary Science, University of Pretoria for technical advice and assistance.

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ABSTRACTS

ABSTRACT: Reinecke, R.K., De Villiers, I.L. & Joubert, Gerda, 1984. **Studies on *Haemonchus contortus*. X. The effect of *Trichostrongylus axei* in Merinos on artificial pasture.** *Onderstepoort Journal of Veterinary Research*, 51, 33-39 (1984).

A recently established *Eragrostis curvula* pasture 1,1 ha in size at Hennops River in the Transvaal Highveld was contaminated from 6 October 1976 until 20 May 1977 by 30 weaned Merinos, each infested with 7 000 infective larvae of *H. contortus*. On 2 November 1976 3 groups of weaned Merinos and again on 10 January 1977 a further group of Merinos were infested with 40 000 infective larvae of *Trichostrongylus axei*. From 19 November a single group of sheep, predosed with *T. axei*, and a control group grazed with the seeders for 8 weeks. After 6 weeks another group of sheep dosed with *T. axei* grazed with them, thus ensuring a 2-week overlap. This continued until autumn, when the last groups were removed. Efficacy against challenge reached Class C (>50 % effective against total worm burdens of *H. contortus* in >50 % of sheep) in early summer and autumn, but only reached significant levels of either $P<0,01$ or $P<0,05$ in summer. Peak worm burdens in controls were recorded in early autumn.

ABSTRACT: Reinecke, R.K., De Villiers, I.L. & Brückner, Christel, 1984. **Studies on *Haemonchus contortus*. IX. The effect of *Trichostrongylus axei* in Merinos on natural pasture.** *Onderstepoort Journal of Veterinary Research*, **51**, 25-31 (1984).

Four groups of 6-7-month-old Merino lambs were each dosed with 40 000 infective larvae of *Trichostrongylus axei* on 2 November 1976 and subsequently exposed to challenge with *Haemonchus contortus* on natural grazing at the University of Pretoria's Experimental Farm in the eastern suburbs of Pretoria. One of these groups and one group of controls were killed every 8 weeks from the end of December 1976-June 1977. Predosing with *T. axei* was >50 % effective against 5th stage and adult *H. contortus* in >50 % of sheep for 164 days (Class C), improving to >60 % in >60 % of sheep (Class B) 220 days after dosing *T. axei*. The numbers of retarded 4th stage larvae (L_4) of *H. contortus* in the undosed controls as well as in the sheep predosed with *T. axei* rose from a low level in summer (December) to a peak in late autumn (June).

ABSTRACT: Giesecke, W.H., Durand, Anette M. & Petzer, Inge-Marié, 1984. **Fluctuations in the glucose level of cow's milk from normal and subclinically diseased udders.** *Onderstepoort Journal of Veterinary Research*, **51**, 15-19 (1984).

Individual quarter samples from some 19 cows on average were investigated monthly over 12 months for determining the udder health status of cows and the glucose concentrations of foremilk and strippings.

Foremilk showed a mean 0,1311 mM concentration of glucose which remained fairly stable during the period of investigation and lactation. A fluctuating mean value of 0,2037 mM was determined in strippings in which glucose levels were consistently and appreciably higher than those of foremilk.

Foremilk from completely normal quarters and others affected by non-specific cellular reaction, relevant or irrelevant teat canal infection and aseptic or septic subclinical mastitis, showed mean glucose concentrations of 0,1410; 0,1392; 0,1337; 0,1417; 0,1262 and 0,1248 mM, respectively. Strippings from the same quarters showed corresponding values of 0,2056; 0,2861; 0,2100; 0,1733; 0,1661 and 0,1617 mM glucose.

ABSTRACT: Payne, Anna-Lise & Verwoerd, D.W., 1984. **A scanning and transmission electron microscopy study of jaagsiekte lesions.** *Onderstepoort Journal of Veterinary Research*, 51, 1-13 (1984).

A scanning electron microscopy (SEM) and transmission electron microscopy (TEM) study was made of lesions from acute, experimentally induced cases of jaagsiekte. In the SEM study tumour cells were easily identified by the abundant microvilli on their peripheral surface. The SEM study gave further insight into the development of lesions and the spatial relationship of cells involved in jaagsiekte. TEM revealed that the tumour cells were in a state of rapid protein synthesis and had many characteristics in common with other malignant cells.

ABSTRACT: Payne, Anna-Lise, Verwoerd, D.W. & Garnett Helen M., 1983. **The morphology and morphogenesis of jaagsiekte retrovirus (JSRV).** *Onderstepoort Journal of Veterinary Research*, **50**, 317-322 (1983).

Jaagsiekte retrovirus (JSRV) was recently shown to be the aetiological agent of jaagsiekte (ovine pulmonary adenomatosis). The morphogenesis of JSRV was studied in jaagsiekte tumour tissue. Intracytoplasmic particles, often associated with centrioles, were found in tumour cells. JSRV budded from tumour cells with a complete core which appeared to mature during the budding process. Extracellular particles were found in the alveolar lumen. Immature extracellular particles were rare. Mature extracellular JSRV was membrane-bound and had a slightly eccentric nucleoid with an electron-dense perinucleoidal space. In negatively stained preparations of JSRV the envelope was covered with spikes. JSRV is morphologically distinct from all known retroviruses.

ABSTRACT: Verwoerd, D.W., Payne, Anna-Lise, York, D.F. & Meyer, M.S., 1983. **Isolation and preliminary characterization of the jaagsiekte retrovirus (JSRV).** *Onderstepoort Journal of Veterinary Research*, **50**, 309-316 (1984).

Jaagsiekte, or ovine pulmonary adenomatosis, is caused by a recently discovered retrovirus. The virus cannot be cultivated *in vitro* at present, but a procedure is described for the isolation and purification of small amounts in the form of immune complexes with IgA from affected lungs. The virion was shown to possess a 70S RNA genome which can be transcribed by an endogenous reverse transcriptase. Nine polypeptides, ranging in size from 94 000 to 25 000 daltons, were found in purified preparations. Using neutralization of the viral reverse transcriptase and an enzyme immunoassay as criteria, no serological relationship could be demonstrated to representatives of type B, C and C oncoviruses, or to bovine leukemia virus, maedi-visna virus of sheep or caprine arthritis-encephalitis virus.

CASE REPORT **GEVALVERSLAG**

INDUCTION OF OESTRUS AND OVULATION BY MEANS OF PROSTAGLANDIN AND GONADOLIBERIN (GnRH) TREATMENT IN AN OLD MARE BARREN FOR TWO BREEDING SEASONS

B.L. PENZHORN* and R.O. GILBERT*

ABSTRACT: Penzhorn, B.L.; Gilbert, R.O. **Induction of oestrus and ovulation by means of prostaglandin and gonadoliberin (GnRH) treatment in an old mare barren for 2 breeding seasons.** *Journal of the South African Veterinary Association* (1985) **56** No. 1, 53-54 (En). Department of Genesiology, Faculty of Veterinary Science, University of Pretoria, P.O. Box 12580, 0110 Onderstepoort, Republic of South Africa.

A 17-year-old Nooitgedacht mare was presented in mid-summer after failing to conceive during the previous 2 breeding seasons. The mare conceived to service during a PG-induced oestrus when synthetic GnRH was used to induce ovulation.

Key words: Mare, induced oestrus, induced ovulation, prostaglandin, gonadoliberin (GnRH).

MATERIALS, METHODS AND RESULTS

A 17-year-old Nooitgedacht mare was presented to the Genesiology Clinic, Faculty of Veterinary Science, University of Pretoria, in mid-summer after failing to conceive during the 2 previous breeding seasons. Her breeding history until then had been excellent. She foaled for the first time at 3 years 8 months, and had 9 foals in 11 years 3 months. The mean foaling interval was 17 months (range 12-29 months).

The mare was teased daily while at the Clinic. She was regarded as being in full oestrus when she showed tail raising, squatting, vulvar "winking" and urination in the presence of a stallion. Her 6 observed oestrus periods tended to be rather short, lasting 2-5 days (mean 3,4 days); one lasted 8 days in total, but may have been a split oestrus (2 days on, 2 days off, 4 days on). The mean interval between oestrus periods was 13 days (range 6-21 days).

No obvious cause of infertility could be detected. Examination of an endometrial biopsy showed that the mare had a normal endometrium, and no pathogenic bacteria were cultured from endometrial swabs.

The mare did not conceive to service during her first oestrus after admission to the Clinic. She was served again on Day 3 and 4 of her second oestrus. In order to stimulate ovulation, 6000 IU HCG (Chorulon, Panvet) were administered intravenously to the mare shortly after the first service. The dose was repeated 48 h later. The mare failed to conceive and showed a 2-day oestrus 13 days later, followed by a 5-day oestrus after a further 21 days.

As the stallion used for service was at stud elsewhere during several of the mare's oestrous periods and could not be brought to the Clinic when required, it was decided to induce oestrus to coincide with his availability. For this purpose, the mare received 5 mg $PGF_{2\alpha}$ (Lutalyse, Upjohn) intramuscularly 8 days after the end of the previous oestrus. Full oestrus was observed 3 days later. The mare was served on Day 3 of oestrus and again 48 h later. She received 40 μg synthetic GnRH, Buserelin (Receptal, Hoechst), intramuscularly immediately after each service. The mare conceived during this oestrus and foaled 323 days after the second service.

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DISCUSSION

The cause of the mare's protracted barren period remains speculative. A follicle was still palpable rectally 2 days after the end of one oestrus. Mares usually ovulate during the last 48 h of oestrus and delayed ovulation, a rare occurrence[4], was probably not of primary importance in this case. Mares can show oestrus when only small follicles, which would be anovulatory, are present. This could be a cause of infertility, but on rectal palpation of the mare in oestrus, large follicles were found to be present. Large follicles are apparently essential to enable HCG to induce ovum maturation and ovulation; small follicles are refractory to stimulation of oocyte maturation and ovulation by HCG[8]. HCG can be used during the breeding season to shorten oestrous periods of mares by 1 or 2 days[1,5]. Of 35 mares which had not ovulated by Day 5 of oestrus and were given 6000 IU HCG, 69% ovulated within 48 h, versus 44% of the 34 untreated controls, while HCG treatment on Day 7 did not induce ovulation[6].

Injection of GnRH, which leads to endogenous LH release, should have the same physiological effect as injecting HCG. The use of GnRH to hasten ovulation in mares has had variable results[2,3,7]. Although GnRH administration does produce a peak of endogenous LH levels, these apparently do not approximate levels of the normal preovulatory LH surge. The success of this form of therapy in this case is therefore interesting. The fact that a GnRH analogue was administered twice during oestrus may have resulted in a more sustained and therefore more physiological LH surge. Although only one case is reported here, the fact that the mare conceived with the combined prostaglandin/GnRH treatment 2 years and 9 months after the birth of her previous foal suggests that this approach may be justified in treating infertility in similar cases.

ACKNOWLEDGEMENTS

We thank Dr S J Schoeman and Mr G C le Roux for supplying the mare's breeding history.

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BOOK REVIEW — BOEKRESENSIE

ENVIRONMENTAL MANAGEMENT IN ANIMAL AGRICULTURE

STANLEY E. CURTIS

1st Edn. The Iowa State University Press, Ames, Iowa 50010. 1983 pp 410, illustrations 176, tables 237, Price £47,50 (ISBN 0-8138-0556-2).

The necessity for the intensification of animal production practices to meet the ever increasing demand for animal produce in Southern Africa has been emphasised by many researchers. However, the phenomenal development in this sphere, particularly in Poultry and Pig production, during the past quarter of a century has brought with it manifold problems. These problems have largely been metabolic disturbances in the animal, elicited by environmental stresses and distresses on the animal; brought about by these intensive animal production systems. The publication of this book dealing with the environmental management of the animal is therefore extremely timely.

The author, Stanley E. Curtis, of the Animal Science Department of the University of Illinois is a well-known teacher of applied ecology having extensive experience in animal science and is a recipient of several awards from the ASAS. He succeeds admirably in his aim – "to provide for teachers, students and practitioners of animal production", in all the associated fields, "an information resource which can serve as a course textbook, an individual study guide or a reference base".

A vast fund of information is provided in the book which is divided into six parts.

The author leads the reader through a general preview of the effect of environment on animal function and performance (Part I) through the effects and control of thermal (Part II) and electromagnetic factors on performance, (Part III) environment, animal behaviour and management (Part IV), environment and animal health (Part V), culminating in animal accommodations, its philosophy, alternatives of design, modifications thereof, and finally, the assessing and measurement of animal environments (Part VI).

The ploy of using "Boxes" next to information in the text is interesting and useful. These boxes provide explanatory notes and/or tables and are strategically placed alongside the relevant text which to a large extent eliminates the necessity of referring to other sources when further explanation of a point made is required or when conversion to systems other than that used in the text is needed.

Chapters 20 (Behavioral management), 21 (Environment and animal health) and Chapter 25 (Accommodations; philosophy and alternatives) are extremely thought provoking. For example in Chapter 20 (Box 20A) the question is posed, "What does an animal need?" The author cites Roger Ewbank as having said that any case of cruelty to animals falls into one of three categories.

- Abuse – such as beating an animal with a stick.
- Neglect – such as confining an animal then not providing it with feed or water; or
- Deprivation – the absence of some factor in the environment for which the animal has a need for its behavioural well being.

"Abuse and neglect are clearly cruel and just as clearly counterproductive, and thus undesirable for humane and economic reasons. The question of animal welfare in agricultural systems boils down to whether modern production deprives the animal of needs – needs that are certainly not as critical as those for feed and water, for example, and needs that have to be founded on scientific grounds, . . . In the forseeable future, it will not be possible to determine our animals' innate motivations for many of the subtle needs which animal-welfare activists believe they are being deprived of in some modern animal production systems".

In Chapters 21 and 25 the author indicates that diseases are complex in their origins and manifestations. "The animal producer, the animal scientist and the veterinarian traditionally view disease problems from different perspectives. Their various interests and abilities come together in an interdiscipline known as animal hygiene, preventative veterinary medicine or simply sound animal management". In providing accommodations for producing animals the principle that the animal comes first is all too often neglected and an interdisciplinary approach is called for involving animal scientists, veterinarians, agricultural engineers, agricultural economists and finally, the agricultural producer.

One aspect, that of the effects of transport on animal behaviour and health is perhaps not dealt with sufficiently. This aspect is of particular importance in Southern Africa where many stud and slaughter animals are conveyed over large distances.

Nevertheless, with the wealth of information and comprehensive bibliography provided, no teacher or student can afford, in the present day, to be without access to this book.

J.E.F.M. Denny

CASE REPORT **GEVALVERSLAG**

HEARTWATER CHALLENGE OF TWO CAPE BUFFALO (*SYNCERUS CAFFER*)

R.H. KEFFEN*

ABSTRACT: Keffen R.H. **Heartwater challenge of two Cape buffalo** (*Syncerus caffer*). *Journal of the South African Veterinary Association* (1985) **56** No. 1, 55 (En). State Veterinarian, Private Bag X1005, 0302 Mogwase, Republic of Bophuthatswana.

Two fifth generation male Cape buffalo (*Syncerus caffer*) born in a European zoo, produced no signs of disease when injected with *Cowdria ruminantium* infected blood. It would suggest that this species has an inate natural resistance to Heartwater.

Key words: Buffalo, Heartwater challenge.

INTRODUCTION

Heartwater has proven to be a fatal disease of antelope species such as springbuck (*Antidorcas marsupialis*)[3], eland (*Taurotragus oryx*)[4] and blackbuck (*Antilope cervicapra*)[2]. Gradwell et al.[1] found that no reaction occurred in impala (*Aepyceros melampus*), blue wildebeest (*Connochaetes taurinus*), buffalo (*Syncerus caffer*), kudu (*Tragelaphus strepsiceros*), giraffe, (*Giraffa camelopardalis*) and warthog (*Phacochoerus aethiopicus*), when infective heartwater blood was administered intraveneously. Negative results were thought to be due to inate natural resistance or acquired immunity resulting from previous exposure to the organism[1].

MATERIALS, METHODS AND RESULTS

Two ten month old male Cape buffalo (*Syncerus caffer*) were imported to the Mankwe district of Bophuthatswana from the Dvüa Kralové N.L. zoo in Czechoslovakia.

Their arrival into a heartwater endemic area of the country, and being a fifth generation captive species, aroused concern about their susceptability to the organism.

The two animals were caught manually and secured through the use of a cattle crush and head clamp. Infective heartwater blood was obtained from the Veterinary Research Institute, Onderstepoort and kept frozen on dry ice until its use six hours after being issued. The blood was thawed using cold water and was slowly injected intraveneously via the jugular vein. Prior to the injection, the rectal temperatures were taken. For two weeks after the challenge, rectal temperatures were taken every other day in order to minimize the stress of handling. The pre-challenge rectal temperature of buffalo A was 41°C and buffalo B was 39,5°C. These high temperatures were a result of struggling while they were being caught. Post challenge temperatures varied; buffalo A varied from 38,5°C to 40,1°C and buffalo B from 39,0°C to 40,5°C. After two weeks post challenge the decision was made to stop taking temperatures and to observe the animals for clinical signs. This was due to increased difficulties in managing the buffalo when trying to capture them for examination.

During the five weeks post challenge there was no evidence of inappetance, depression or nervous system disturbance. It is very likely that the buffalo has an inate natural resistance to the infective organism *Cowdria ruminantium*, and in support of the evidence provided by Gradwell et al.[1], the Cape buffalo can be expected to survive in heartwater endemic areas with minimal problems.

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QUALIFICATIONS:

1956 –	Matriculated at St. John's College, Johannesburg.
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1963 –	Obtained B.V.Sc., Pretoria University.
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EXPERIENCE:

1964 – 1969	Partner in private practices in Johannesburg and Durban in predominantly small animal practice.
1969 – 1975	Veterinary Meat Hygiene Officer, Durban Abattoir. Employed by the Durban City Council. Duties: Hygiene Management and Control; Ante-mortem inspections; Secondary post-mortem inspections; Liaison with livestock producers.
1975 – 1979	State Veterinarian, Durban Abattoir. Duties essentially the same as above but with Staff Administration and Control.
1979 – 1982	Transferred to the Natal Regional Office in Pietermaritzburg as Regional Meat Hygiene Officer for the Province of Natal. Duties: Administration of the Animal Slaughter, Meat and Animal Products Hygiene Act (Act No. 87 of 1967); Advising owners, consultants and architects on hygiene principles in abattoir construction and requirements; Inspection of red meat and poultry abattoirs in Natal; Inspection of export approved establishment; Training of personnel; The coordination of the 1981 game cropping for export season in South Africa.
1982 –	Transferred to the Transvaal Regional Office as Assistant Director: Meat Hygiene, Transvaal. Duties the same as above, with the exception of game cropping coordination, but including staff administration and control.

AFFILIATION:
Member of the South African Veterinary Association. Completed thirteen years on the Committee of the Natal Branch, having served as Secretary, Vice-Chairman and Chairman.
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