JOURNAL OF THE SOUTH AFRICAN VETERINARY ASSOCIATION

TYDSKRIF VAN DIE SUID-AFRIKAANSE VETERINÊRE VERENIGING

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CONTENTS / INHOUD

CHANGE OF EDITORIAL POLICY

Will intending contributors please note that henceforth all **references** must:

(a) be listed in **alphabetical order** according to the surname of the first author. (The superscript numeral system is retained, but the references must no longer be numbered in order of appearance in the text, but according to their alphabetical order);

(b) give the **full title** of the article to which reference is made.

WYSIGING VAN REDAKSIONELE BELEID

Sal alle voornemende bydraers asseblief kennis neem dat voortaan alle **vewysings**

(a) in **alfabetiese volgorde** moet verskyn, volgens die eerste outeur se van. (Die boskrifnumeringstelsel word behou, maar verwysings word nie meer genommer volgens orde van aanhaling in die teks nie, maar volgens alfabetiese volgorde);

(b) die **volle titel** van die artikel, waarna verwys, moet dra.

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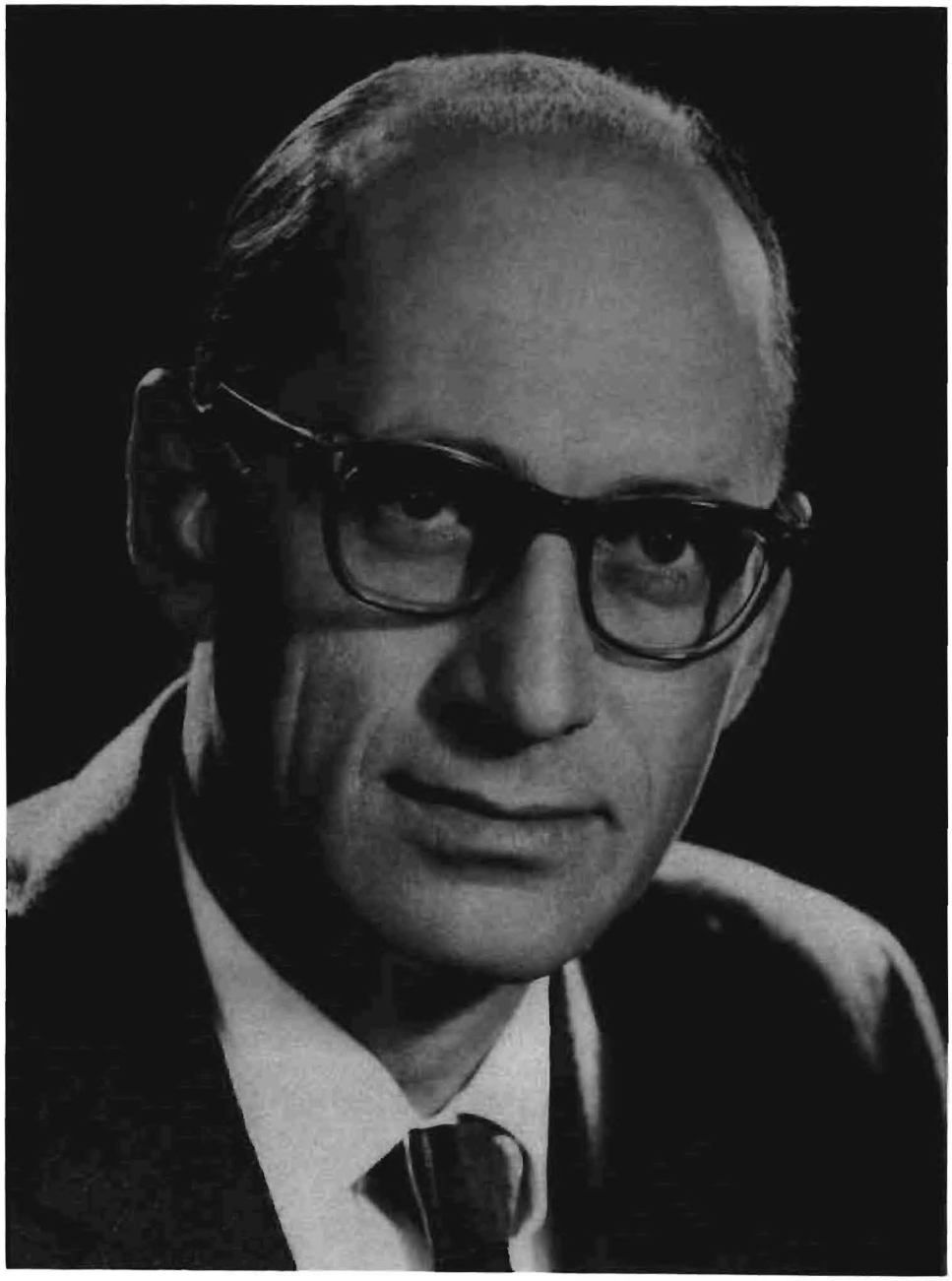

INTRODUCTION OF THE NEWLY ELECTED PRESIDENT OF THE S.A.V.A.— DR. A. B. LA GRANGE

It is my privilege to introduce the new President to members of the S.A.V.A. and readers of this Journal.

Andries Benjamin la Grange was born in Ladismith, Cape Province, in 1922 and received his initial schooling there; he matriculated at the 'Hoëre Jongenskool', Paarl, and spent four years at the University of Stellenbosch studying Physical Education. In 1944 he entered the Faculty of Veterinary Science of the University of Pretoria and was awarded the degree of B.V.Sc. in 1948. After graduation he was engaged most successfully in mixed private practice in Pretoria until 1955, when he took the position of Head and Veterinary Superintendent of the Transvaal A.I. Co-operative. It is in this latter capacity, in particular, that he has rendered sterling service to veterinary science and the animal industry. He is a member of the A.I. Board and the S.A. Society for Animal Production, President of the Charolais Breeders' Society, a Council member of the Brahman Breeders' Society and of the S.A. Stud Book Association, member of the Executive of the Transvaal Agricultural Society and chairman of the Cattle Committee of the Pretoria Show Society. In addition, he is a senior official judge of the Friesland, Charolais and Brahman Breeders' Societies and a Director of Beeskor Stud Farm.

In 1968 he was awarded the Ordre du Mérite Agricole by the French Government for his contribution to agriculture. He is well known throughout South Africa, wherever cattle are bred; his activities in these spheres have brought lustre to the profession. He has been a member of this Association since graduation and has served on various special and permanent committees of Council, i.a. as chairman of the Disciplinary Committee. He is at present chairman of the Reproduction Group and a member of the Veterinarians-in-Industry Group. He served as one of the two Vice-Presidents for the year 1971/72.

Our new President has had many years of experience in various spheres of veterinary and related activity. He has a balanced outlook and a clear and rational concept of the rôle of the veterinarian in society. He is, I am sure, in every way ideally and eminently suited to the task of heading the profession in South Africa, i.e. this Association. I congratulate the Association on its choice of a President and wish Dr. la Grange a most successful and fruitful term of office.

RETIRING PRESIDENT
September 1972

VOORSTELLING: NUUTVERKOSE PRESIDENT VAN DIE S.A.V.V.— DR. A. B. LA GRANGE

Dis my 'n groot voorreg om ons nuwe President aan u as lede van die Vereniging en belangstellende lesers van hierdie Tydskrif voor te stel.

Andries Benjamin la Grange is in 1922 op Ladismith, Kaapprovinsie, gebore; daar was hy op skool en het hy later aan die Hoëre Jongenskool, Paarl, gematrikuleer. Aanvanklik het hy in Liggaamsopvoedkunde belanggestel en vier jaar aan die Universiteit van Stellenbosch daaraan bestee. In 1944 het hy met opleiding as veearts aan die Fakulteit Veeartsenykunde van die Universiteit van Pretoria begin. Na toekenning van die graad B.V.Sc. het hy hom in 1948 in 'n besonder suksesvolle gemengde privaatpraktyk op Pretoria gevestig. In 1955 is hy aangestel as Hoof en Veterinêre Superintendent van die Transvaalse K.I. Koöperasie te Irene. Veral in hierdie hoedanigheid het hy sy besondere bydrae tot veeartsenykunde en die bevordering van die veebedryf gemaak. Hy is lid van die K.I.-Raad en die S.A. Vereniging vir Diereproduksie, President van die Charolais-Telersvereniging, Raadslid va ndie Brahman-Telersvereniging en van die S.A. Stamboekvereniging, Uitvoerende Bestuurslid van die Transvaalse Landbougenootskap en Voorsitter van die Beestekomitee, Pretoriase Skougenootskap. Verder is hy 'n amptelike senior beoordelaar van die Friesbees-, en Brahman-Telersverenigings en 'n Direkteur van Beeskor-Stoetery.

In 1968 het die Franse Regering die Ordre du Mérite Agricole aan hom toegeken in erkenning van sy bydrae tot die landbou. Hy is alom bekend in veeboerderykringe en het deur sy optrede die professie groot luister besorg. Hy is sedert graduering 'n lid van die S.A.V.V. en het op verskeie spesiale en staande Raadskomitees gedien, o.a. as voorsitter van die Dissiplinêre Komitee en van die Reproduksie-groep. Vir die jaar 1971-72 was hy ook een van die twee Visepresidente.

Ons nuwe President het dus baie jare van ondervinding in verskillende werksfere wat direk of indirek met veeartsenykunde te doen het. Sy breë en heldere uitkyk op die rol van die veearts in die samelewing maak hom 'n uitgesoekte persoon om aan die hoof van die veeartsberoep in Suid-Afrika, t.w. hierdie Vereniging, te staan. Ek wens dus die Vereniging van harte geluk met sy keuse van 'n President, en Dr. La Grange 'n baie suksesvolle en vrugbare ampstermyn.

UITTREDENDE PRESIDENT
September 1972

Jl S. Afr. vet. med. Ass. 43 (3): 233—234 1972

EDITORIAL

CONDITIONAL APPROVAL OF MEAT FOR IMPROVED UTILIZATION*

Before enactment of the Standing Regulations (no. 3505 of 1969) under the Animal Slaughter, Meat and Animal Products, Hygiene Act No. 87 of 1967, the edible parts of food animals could be evaluated either as fit or unfit for consumption. The only exception to this rule was in cases of slight cysticercosis, when the carcass could be detained, frozen under supervision and then released to the trade.

In certain European countries a so-called 'Freibank' system of provisional approval has existed for many years, whereby an intermediary decision could be given in certain cases. The purpose of this system is the provision of protein food which is safe for consumption, yet could not be made freely available to the trade for other reasons. In this way large quantities of meat could be salvaged for use as human food instead of being destroyed. This system still functions today in countries such as the Netherlands, Germany, France and Switzerland—countries with a high standard of living and well-developed social services. In all cases such meat is provisionally approved, processed under official supervision and deboned or sterilized, before being sold in small quantities by the official body directly to the consumer at a price that excluded the usual profit inherent in trading.

Of necessity such a system is subject to strict control by the veterinary meat hygiene services of the state and of the local authorities. Where the usual requirement with regard to the slaughter of animals, namely *ante-mortem* inspection, has not been met, the carcass may only be passed conditionally. In other cases carcasses are passed conditionally on account of conditions such as abnormal colour, consistence and flavour, poor exsanguination, emaciation, oedema, muscular haemorrhages, sarcosporidiosis, *ante-mortem* deviations of temperature, grass tetany, post-parturient paresis, paratuberculosis or in-

*Based on a paper delivered by Dr. H. G. J. Coetzee, City Veterinarian, Bloemfontein, to the Public Health Group Meeting, during the Biennial National Veterinary Congress held at East London, 13th—14th September, 1971.

REDAKSIONEEL

VERBETERDE VLEISBENUTTING DEUR VOORWAARDELIKE GOEDKEURING*

Voor inwerkingtreding van die Staande Regulasies (Nr. 3505 van 1969) onder die Wet op Higiëne by Diereslag, Vleis en Vleisprodukte Nr. 87 van 1967, kon die eetbare dele van slagdiere slegs as geskik of ongeskik vir gebruik as voedsel gekeur word. Die enigste uitsondering op hierdie reël was in gevalle van ligte sistiserkose, waar die karkas aangehou, onder toesig bevries en dan aan die handel vrygestel kon word.

In sekere lande van Europa bestaan daar reeds vir baie jare 'n sg. *tussenkeuringstelsel*, waardeur in sekere gevalle 'n intermediêre beslissing ook gegee kan word. Hierdie stelsel het ten doel die beskikbaarstelling van proteïnevoedsel wat veilig vir verbruik is maar wat om ander redes nie vrylik aan die handel beskikbaar gestel kan word nie. Op hierdie wyse kon groot hoeveelhede vleis vir gebruik as voedsel ‚gered' word in plaas daarvan dat dit vernietig moes word. Die stelsel funksioneer vandag nog in lande soos Nederland, Duitsland, Frankryk en Switserland — lande met 'n hoë lewenstandaard en goedontwikkelde maatskaplike dienste. In alle gevalle word sulke vleis *voorwaardelik goedgekeur*, onder amptelike toesig verwerk, ontbeen of gesteriliseer, alvorens dit van ampsweë en in klein hoeveelhede direk aan die verbruiker verkoop word teen 'n prys wat nie die gewone winsmotief in aanmerking neem nie.

Hierdie stelsel is noodwendig onderhewig aan streng kontrole deur die veterinêre vleishigiënediens van die Staat en die plaaslike owerhede. Waar die gewone vereiste t.o.v. die slag van diere, nl. 'n voordoodse ondersoek, nie uitgevoer is nie, kan die karkasse slegs voorwaardelik goedgekeur word. In ander gevalle word karkasse voorwaardelik goedgekeur omrede toestande soos abnormale kleur, stewigheid en geur, swak uitbloeiing, vermaering, watersug, spierbloedings, sarkosporidiose, voordoodse temperatuurafwykings, grastetanie, parese na kalwing, paratuberkulose of weivliesontstekings. Bakteriologiese

*Gebaseer op 'n voordrag deur dr. H. G. J. Coetzee, Stadsveearts, Bloemfontein, aangebied aan die Volksgesondheidsgroepvergadering tydens die Tweejaarlikse Nasionale Veeartsenykongres gehou te Oos-Londen, 13—17 September, 1971.

flammation of serous membranes. Bacteriological and, where necessary, toxicological examinations are conducted on such meat, and only after negative results have been obtained are such carcasses conditionally passed.

In South Africa there is undoubtedly a great demand for inexpensive protein food such as meat of this nature would provide. In Europe the price of conditionally approved meat is about half that of the usual retail price. Ample evidence also exists that about 0,73 per cent of our slaughter stock could be considered for conditional approval: in a city such as Johannesburg, this would mean th- about 615 000 kg meat would become available annually to the less affluent. Normally such meat would have been rendered into sterilized carcass meat and inedible fat.

The Standing Regulations under Act 87 of 1967 now make full provision for the conditional approval of carcasses and meat which otherwise could not be passed as fit for consumption. The necessary veterinary control is available, at least in the larger centres, where about 60 per cent of our slaughter stock is presently being handled. There is thus no hindrance in the way of inception of a so-called 'Freibank' system in the Republic.

There are, however, two aspects which require special attention:

(1) The question of ownership of meat which is provisionally passed, processed and then sold. At present the revenue derived from the sale of carcass meat, etc., obtained from condemned carcasses, is sold to subsidize the cost of services by public abattoirs.

(2) The demand for provisionally passed and processed meat. For this purpose the correct psychological and social conditioning of the relevant sector of the populace is necessary. In view of the consumption of offal and even of the tissues of animals that have died under circumstances where no control has been exercised, it is not unreasonable to assume that controlled safe meat will also be acceptable.

From the veterinary side the necessary steps have been taken to render larger quantities of meat available as food. It is now the responsibility of nutritional and social organizations, both at government and municipal level, to investigate this matter with a view to application under circumstances which are unique to the Republic.

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In Suid-Afrika is daar onteenseglik 'n goeie aanvraag na goedkoop eiwitvoedsel soos sulke vleis. In Europa bedra die prys van voorwaardelik goedgekeurde vleis ongeveer die helfte van die gewone handelsprys. Daar is ook genoeg bewys dat ongeveer 0,73 persent van ons slagvee vir voorwaardelike goedkeuring in aanmerking sou kom: in 'n stad soos Johannesburg sou dit beteken dat ongeveer 615 000 kg vleis per jaar aan minder gegoedes beskikbaar gestel sou kon word. Hierdie vleis sou andersins tot karkasmeel en oneetbare vet verwerk geword het.

Die Staande Regulasie onder Wet 87 van 1967 maak nou volledige voorsiening vir voorwaardelike goedkeuring van karkasse en vleis wat andersins nie vir gebruik as voedsel goedgekeur kan word nie. Die nodige veeartsenykundige beheer is beskikbaar, minstens in die groter sentra, waar ongeveer 60 persent van ons slagvee geslag word. Daar skyn dus geen struikelblok in die weg van die instelling van 'n sg. ,Vrybank'-stelsel in die Republiek te wees nie.

Daar is egter twee sake wat veral aandag moet geniet:

(1) Die kwessie van eienaarskap van die vleis wat voorwaardelik goedgekeur, verwerk en dan verkoop word. Huidig word die karkasmeel, ens., wat van afgekeurde karkasse verkry word, verkoop om die lewering van dienste by openbare slagplase te subsidieer.

(2) Die aanvraag na voorwaardelik goedgekeurde en verwerkte vleis. Hiervoor is die regte sielkundige en maatskaplike bearbeiding van die betrokke bevolkingsgroep noodsaaklik. Gesien die gebruik van afval en selfs die weefsels van gestorwe diere onder omstandighede waar geen beheer toegepas word nie, is dit nie onredelik om te aanvaar dat beheerde, gesonde vleis ook aanvaarbaar sal wees nie.

Die nodige stappe is nou van veeartsenykundige kant gedoen om in groter mate van beskikbare vleis as voedsel gebruik te maak. Dis nou die verantwoordelikheid van voedings- en maatskaplike instansies, op beide Staats- en munisipale vlak, om hierdie geleentheid te ondersoek met die oog op toepassing onder die omstandighede wat noodwendig eie is aan die Republiek.

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EDITORIAL

ORGANIZING THE SILENT POWER

Despite the often-joked-about garrulity of women, their contribution to the veterinary profession as wives of veterinarians truly constitutes the silent power; silent, because their voice is not heard in matters professional. Their contribution, be it physical or psychological, is calmly taken for granted. Its importance is so obvious that emphasis or detail requires no further expatiation here. What must be pointed out, however, is the need for wives themselves to come to clearer realization of the magnitude of the demands imposed upon them and to gain strength for their task by mutual exchange of ideas and experiences, preferably on a relatively informal and social yet organized basis.

What makes this need more urgent than ever before, is the increasing diversity and specialization taking place as the number of veterinarians increases, and with it the inevitable tendency of 'drifting apart'. Wives, with their uncanny ability of assuming remote control without physically 'acting the boss', have a duty of paramount importance in this respect and that is to assist in preserving the ultimate unity of purpose of the veterinary profession. For this, organisation is vital.

The Americans, with their penchant for organization, were the first on the scene: the American Veterinary Wives Association was founded in 1917. During the sixth World Veterinary Congress, held in London in 1949, Mrs. Anthony Bott, of Illinois, was responsible for forming the International Women's Auxiliary to the Veterinary Profession—IWA for short. As founder of IWA, Mrs. Bott is now its Honorary President. The aim of IWA can best be described in the words of Madame E. Godéchoux of Paris, a past president of the Auxiliary: 'to learn to know and appreciate one another in order to be of better assistance to each other'. The subsequent growth of this organization clearly proved that it fulfilled a need in the lives of those who are probably more involved in their husbands' profession than any other. The IWA is headed by a President, presently Mrs. J. Lauder of Brighton, England, assisted by seven Vice-Presidents and four Honorary Vice-Presidents from various countries. One

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Ten spyte van die dikwels-bekorswilde spraaksaamheid van vroue, stel hul bydrae tot die veeartsenykundige beroep as eggenotes van veeartse in der waarheid 'n stille krag daar. Stil, omdat hul stem nie in beroepskringe gehoor word nie; hul bydraes, fisies of sielkundig, word doodluiters vir lief aanvaar. Die belangrikheid daarvan is so in-die-ooglopend dat 'n diepte-ontleding hier oorbodig is. Wat wel beklemtoon moet word, is die noodsaak dat die veeartsvrouens self tot helderder besef moet kom van die reuse-omvang van die eise wat aan hulle gestel word en om krag vir hul taak te put uit onderlinge ervaring en gedagtewisseling, verkieslik op 'n betreklik informele en sosiale, maar tog georganiseerde grondslag.

Wat hierdie noodsaak des te dringender as ooit maak, is die toenemende diversifikasie en spesialisasie wat met die toenemende aantal veeartse plaasvind, met die onvermydelike neiging van ‚wegdryf van mekaar'. Eggenotes, met hul verbasende vermoë om afstandsbeheer toe te pas sonder om fisies die baas te speel, het 'n dure plig in hierdie opsig, en dit is om die eenheid van doel van die veterinêre beroep te help bestendig. Hiertoe is organisasie van uiterste belang.

Die Amerikaners, met hul slag vir organisasie, was eerste op die toneel: die „American Veterinary Wives Association" is in 1917 gestig. Gedurende die sesde Veeartsenykundige Wêreldkongres in 1949 te Londen gehou, was mev. Anthony Bott van Illinois verantwoordelik vir die stigting van die ‚International Women's Auxiliary to the Veterinary Profession', IWA in kort. As stigster van IWA, is mev. Bott nou die Ere-presidente daarvan. Die doel van IWA kan die beste weergegee word in die woorde van Madame Godéchoux van Parys, 'n vorige presidente van die organisasie: ‚om mekaar beter te leer verstaan en waardeer ten einde mekaar tot groter hulp te wees.'

Die daaropvolgende groei van die organisasie het duidelik bewys dat dit aan 'n vereiste voldoen het in die lewens van diegene wat waarskynlik meer betrokke is by hul eggenote se beroep as enigiemand anders. Aan die hoof van IWA staan 'n Presidente, op die

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ORGANISERING VAN DIE STILLE KRAG

Ten spyte van die dikwels-bekorswilde spraaksaamheid van vroue, stel hul bydrae tot die veeartsenykundige beroep as eggenotes van veeartse in der waarheid 'n stille krag daar. Stil, omdat hul stem nie in beroepskringe gehoor word nie; hul bydraes, fisies of sielkundig, word doodluiters vir lief aanvaar. Die belangrikheid daarvan is so in-die-ooglopend dat 'n diepte-ontleding hier oorbodig is. Wat wel beklemtoon moet word, is die noodsaak dat die veeartsvrouens self tot helderder besef moet kom van die reuse-omvang van die eise wat aan hulle gestel word en om krag vir hul taak te put uit onderlinge ervaring en gedagtewisseling, verkieslik op 'n betreklik informele en sosiale, maar tog georganiseerde grondslag.

Wat hierdie noodsaak des te dringender as ooit maak, is die toenemende diversifikasie en spesialisasie wat met die toenemende aantal veeartse plaasvind, met die onvermydelike neiging van ‚wegdryf van mekaar'. Eggenotes, met hul verbasende vermoë om afstandsbeheer toe te pas sonder om fisies die baas te speel, het 'n dure plig in hierdie opsig, en dit is om die eenheid van doel van die veterinêre beroep te help bestendig. Hiertoe is organisasie van uiterste belang.

Die Amerikaners, met hul slag vir organisasie, was eerste op die toneel: die „American Veterinary Wives Association" is in 1917 gestig. Gedurende die sesde Veeartsenykundige Wêreldkongres in 1949 te Londen gehou, was mev. Anthony Bott van Illinois verantwoordelik vir die stigting van die ‚International Women's Auxiliary to the Veterinary Profession', IWA in kort. As stigster van IWA, is mev. Bott nou die Ere-presidente daarvan. Die doel van IWA kan die beste weergegee word in die woorde van Madame Godéchoux van Parys, 'n vorige presidente van die organisasie: ‚om mekaar beter te leer verstaan en waardeer ten einde mekaar tot groter hulp te wees.'

Die daaropvolgende groei van die organisasie het duidelik bewys dat dit aan 'n vereiste voldoen het in die lewens van diegene wat waarskynlik meer betrokke is by hul eggenote se beroep as enigiemand anders. Aan die hoof van IWA staan 'n Presidente, op die

field that is presently being developed is the exchange of school pupils. At the moment this is operative between England, France and Finland, and most successfully so.

The continued development of the IWA is dependant primarily upon strong national Associations. For one, the money available was contributed on a voluntary basis. At the last World Veterinary Congress in Mexico City, it was decided to place the financial arrangements on a firmer footing by requesting each member country to guarantee an annual contribution.

In South Africa, the South African Veterinary Wives Association was inaugurated at a meeting of veterinarians' wives convened by Mrs. Joan R. Lambrechts, in the Transvaal Agricultural Union Building, Pretoria, on 28th June, 1967. At this meeting the Pretoria Branch was formed, soon to be followed by establishment of the Witwatersrand Branch and subsequently of the Cape West Branch and of the South West Africa Branch. The national body, the South African Veterinary Wives Association, is represented at present solely by the President, Mrs. Joan Lambrechts. The Association is affiliated with the IWA. On the occasion of that body's meeting in Mexico City in 1971, Mrs. Lambrechts' message and wishes for a successful meeting were duly published in the 1970/71 News Bulletin of IWA.

Copies of the Constitution of IWA and of the Pretoria Branch may be had on request from the Secretary of the SAVA, P.O. Box 2460, Pretoria.

Excellent work is being done by the existing branches, not the least of which is the valuable assistance to harassed organisers of veterinary congresses and the hospitality extended to overseas visitors. With the timely word of condolence to the bereaved, the 'get well' card to the physically afflicted, the bouquet here and the word of thanks or encouragement there, the veterinary wives are truly trying to smooth the path for everyone. Most important of all is the strengthening of internal bonds within the profession, however intangible or imperceptible this process may be. But it is not sufficient for the process to be restricted to a mere handful of people. To be of any significance to the veterinary profession, it is necessary that, if not all, then at least the vast majority of wives of veterinarians create local branches and form

oomblik mev. J. Lauder van Brighton, Engeland, bygestaan deur sewe onderpresidentes en vier ere-onderpresidentes uit 'n verskeidenheid lande. Een saak wat tans ontwikkel word is die uitruil van leerlinge. Huidig vind dit reeds plaas tussen Engeland, Frankryk en Finland, en dit met 'n groot mate van sukses.

Die volgehoue ontwikkeling van IWA hang ten nouste saam met sterk nasionale verenigings. So, byvoorbeeld, is die organisasie se beskikbare fondse verkry uit vrywillige bydraes. By die afgelope Wêreldkongres te Meksiko-stad is besluit om geldelike reëlings op 'n stewiger basis te plaas en elke lidland te vra om 'n jaarlikse bydrae te garandeer.

In Suid-Afrika is die Suid-Afrikaanse Veeartsvrouevereniging gestig ten tye van 'n vergadering van eggenotes van veeartse wat deur mev. Joan R. Lambrechts byeengeroep is en wat op 28 Junie 1967 in die Transvaalse Landbou-uniegebou, Pretoria, gehou is. Op hierdie vergadering is die Tak Pretoria in die lewe geroep, spoedig gevolg te word deur die Tak Witwatersrand, Tak Wes-Kaap en Tak Suidwes-Afrika. Die nasionale liggaam, die Suid-Afrikaanse Veeartsvrouevereniging word vir die huidige slegs deur die Nasionale Presidente, mev. Joan Lambrechts, verteenwoordig. Die Vereniging is met IWA geaffilieer en ten tye van die vergadering van laasgenoemde te Meksiko-stad in 1971 is mev. Lambrechts se boodskap en wense vir 'n suksesvolle byeenkoms in die 1970/71 Nuusbulletin van IWA gepubliseer.

Kopieë van die konstitusie van IWA en van die Pretoriase Tak is van die Sekretaresse van die SAVV, Posbus 2460, Pretoria, op versoek verkrygbaar.

Uitstekende werk word deur die bestaande takke gedoen, nie die minste daarvan is die waardevolle hulp aan gekwelde kongresorganiseerders verleen en die gasvryheid aan oorsese besoekers getoon. Met 'n tydige woordjie van deelname aan bedroefdes, die ‚word gou gesond'-kaartjie aan krankes, die ruiker hier, die woord van dank of kompliment daar, poog die veeartsvrouens die pad vir almal te veraangenaam. Die belangrikste bly egter die versterking van interne bande in die beroep, hoe onmerkbaar of ontasbaar die proses ookal mag wees. Maar dis nie voldoende dat hierdie proses net tot 'n handjievol vrouens beperk bly nie. Om van enige betekenis vir die veeartsenykundige beroep te wees, is dit noodsaaklik dat, indien

active groups all over the country. A strong plea is made that our wives make this their aim. In time to come the South African Veterinary Wives Association could not only play a bigger part in the organization of congresses of the SAVA, but at the same time hold its own congresses. By proper organisation the silent power should realize its potential for the common weal.

nie almal nie, dan tog die oorgrote meerderheid veeartsvrouens plaaslike takke stig en aktiewe groepe oor die hele land vorm. 'n Sterk pleidooi word gelewer dat ons vrouens hulle dit ten doel stel. Mettertyd kan die Suid-Afrikaanse Veeartsvrouevereniging nie alleen 'n groter rol speel by die organiseer van kongresse van die SAVV nie, maar terselfdertyd sy eie kongresse hou. Deur behoorlike organisasie moet die stille krag sy potensiaal tot aller heil ontplooi.

BOOK REVIEW — BOEKRESENSIE

VETERINARY OBSTETRICS AND GENITAL DISEASES (THERIOGENOLOGY)

S. J. ROBERTS

Published by the Author; Ithaca, New York. Distributed by Edwards Bros. Ann Arbor, Michigan, U.S.A. 2nd Edition, 1971. Price approx. R19.00. pp. 755

In the second edition of this book has been brought together most of the advances in this field since the first edition was published in 1956. The vast amount of additional material—a reflection of the great development in the fields of reproduction physiology, gynaecology, obstetrics, andrology and artificial insemination—has necessitated considerable rewriting and recasting. This may well explain the time lapse between the appearance of the two editions.

This is a most comprehensive work on all aspects of reproduction in domestic animals, despite the limitations the title implies. The incorporation of the term 'Theriogenology' is an attempt to correct this impression. The term 'Genesiology', which is used to reflect these fields of study in the Veterinary Faculty of the University of Pretoria, is one worthy of consideration.

Only one chapter is devoted to the physiology of reproduction and one to the physiology of gestation, but each chapter on infertility in the female of each of the species, viz. cow, mare, sow, ewe and doe, bitch and queen is introduced by a discussion on the physiology of that species.

One chapter is devoted to infertility in male animals and one to artificial insemination.

In the chapter on parturition, diseases and care of the newborn are discussed.

The nineteen chapters in the book contain 26 tables—summarizing data discussed in the text—and 205 figures, a number of which is line drawings, others are diagrams and many photographs.

References are given at the end of each chapter; this greatly facilitates the task of those who desire even more detail and enhances the value of the book as a work of reference. References are also classified according to subject matter.

The first edition has been prescribed in the courses on Genesiology in the Faculty of Veterinary Science at Onderstepoort for fifteen years and has served its purpose very well. This edition meets the requirements to an even greater degree.

The book can be recommended strongly for study and reference purposes to undergraduate students, practitioners and specialist clinicians. Although expensive, the book will prove to be well worth the money spent.

J. S. v. H.

Jl S. Afr. vet. med. Ass. 43 (3): 239—242 1972

SPECIAL REPORT SPESIALE VERSLAG

POULTRY HYGIENE AND INSPECTION

ROUND TABLE CONFERENCE ORGANIZED BY THE WORLD ASSOCIATION OF FOOD-HYGIENISTS, APRIL 3rd—7th, 1972, HANITA, ISRAEL

SUMMARY

Poultry inspection

In order to prevent zoonotic diseases, to protect the consumer's health and economic welfare and to control abnormal conditions of animals such as tumours, parasitic infestations, etc., *ante-mortem* and *post-mortem* inspections are necessary.

All efforts should be made to provide veterinary health certificates indicating that flocks have been raised under proper husbandry and veterinary control. This information greatly enhances the quality and efficiency of *post-mortem* inspection.

While it is currently necessary to continue the *post-mortem* inspection of each carcass and all of its parts, this inspection should only be considered one part of a complex system for assuring the public of a supply of poultry meat that is produced from healthy poultry, is free of adulterous and toxic substances, and is truthfully labelled.

Flocks which are carriers of *Salmonella* should be detected by microbiological examination, for example by litter sampling, before they are moved from the farm for slaughter. Examination for the possible presence of chemical, antibiotic and similar residues should also be undertaken before shipment. When positive findings are made, incriminated flocks should be handled in such ways that the possibility of health hazards is reduced.

Poultry hatching

Prevention of poultry diseases, and especially zoonoses, may be aided currently by immunization programmes and, in the future, by the use of pathogen-free animals in breeding units. Careful control of the sanitation of hatcheries is also important in this respect. Licensing, unannounced sanitary inspections, and microbiological sampling are useful for this purpose. The hygiene and movements of personnel working in and visiting the hatchery should also be regulated.

Hatching eggs should be produced by flocks maintained under controlled conditions. The production of *Salmonella*-free ready-to-cook poultry begins with the hatching of *Salmonella*-free chickens from eggs obtained from such flocks. The eggs should be fumigated as soon as possible after being laid but, in any case, before they enter the hatchery itself. The fumigation of equipment and of the eggs in the incubator is also important. The washing of eggs may contribute to greater contamination with *Salmonella* or other organisms; it is not recommended except in the case of waterfowl eggs.

Poultry raising

In order to produce healthy poultry, all factors related to housing, feeding and protection from disease must be supervised carefully. Since feed is a well-known source of *Salmonella* infection, the use of pellets should be promoted. Application of adequate temperatures for adequate times during the making of pellets is especially important in the production of *Salmonella*-free flocks. Since contamination of meals of animal and vegetable origin seldom can be prevented effectively at the source, treatment of contaminated materials in the importing countries is the best approach. This may consist of heat treatment of each of the components, of the pellet prepared from mixed ingredients, or a combination of both systems.

The successful protection of growing flock from contacts with pathogens, especially *Salmonella*, may be difficult, even under conditions of closed housing, in view of the increasing pollution of the environment in many of the poultry-producing countries.

Contamination by *Salmonella* of surface waters especially, has become a significant health problem. Insects may be important in transporting the organisms from contaminated water to chickens that are confined to poultry houses. In the case of laying hens, turkeys and waterfowl, which are not raised in a closed environment, *Salmonella* control is complicated by many additional factors, one of which is the presence of infected wild birds.

In addition to the human health hazard from *Salmonella*, the spreading of ornithosis viruses demands attention.

In several countries lymphoid leucosis and acute Marek's disease is found in relatively high incidence in broilers. Although the significance in relation to human health is not clear at this moment, the disease should be studied carefully with regards to possible zoonotic hazards.

Apart from the zoonoses, all poultry diseases should be prevented, because poultry is one of the main sources of protein in many countries.

To prevent the kinds of disease problems mentioned above, poultry houses and equipment should be thoroughly cleaned and disinfected before re-stocking. Sanitary control of manure removal and disposal is of utmost importance to maintain a healthy environment.

Transport of live birds to the processing plants

The movement of equipment for transporting poultry between farms and processing plants can carry disease organisms to farm flocks or allow birds of market age to become *Salmonella*-carriers while on their way to slaughter. For this reason cages should be constructed of corrosion-resistant, impermeable materials and designed to allow effective cleaning and disinfection. This should be accomplished immediately after removal of the poultry at the slaughtering plant. Similar precautions should be applied to the vehicles themselves.

Development and use of disposable cages could effectively promote hygienic conditions in poultry transport.

Scalding and defeathering

Cross-contamination can occur readily during scalding and defeathering. The use of scalding procedures whereby all poultry is immersed in a common tank of warm water, is unhygienic in principle. More sanitary methods for scalding, such as steam cabinets or showers, should be developed. When scalding tanks are used, a minimum volume of overflow should be required. Higher temperatures should be used for scalding of poultry to minimize the survival of bacteria in the water and thus cross-contamination. A lower water temperature (52°C.), on the other hand, while not preventing cross-contamination, enhances the keeping quality of fresh poultry by maintaining the epidermis intact. When chemicals are added to the scalding water, they should be used in accordance with official standards and under inspection control.

During defeathering material from the digestive tract and from the feathers, which may contain micro-organisms injurious to public health as well as to the keeping quality of poultry, is transferred from carcass to carcass by the beating action of the rubber fingers. At present no equipment is available capable of performing the task more hygienically. To minimize this problem, however, defeathering equipment should be cleaned at regular intervals, at least once daily. Cleaning should be adequate to remove accumulations of organic material and micro-organisms from picking fingers and other equipment surfaces. The defeathering process should be followed by a thorough washing of the carcass.

Opening of the abdominal cavity and evisceration

This stage of the processing system is also of great importance to the sanitary production of poultry. There are three basic methods of opening the abdominal cavity. They all serve to separate the cloaca and the terminal portion of the intestine from the body wall and provide access to the abdominal organs for their removal. When these methods are properly performed the cloaca and intestines are not cut and their contents are not spilled on to the carcass. The direction of cutting, the kind of cutting tool, the time needed and the skill required of the operator differ. All methods are somewhat unsatisfactory in a hygienic sense, due to the complexity of manipulation required.

An alternative to these methods, the so-called "cloaca pistol", has been developed. It performs a circular cut around the cloaca and separates it from the abdominal wall by a vacuum knife. The vacuum removes the intact cloaca with the entire intestinal tract from the abdominal cavity. This procedure does not comply with present concepts of *post-mortem* inspection. For the future it should be decided whether priority should be given to a potentially more hygienic procedure or to the need for the inspection of the intestines.

Evisceration as such must be accomplished in a way that permits proper inspection. There is much room for the improvement in the usual system of drawing the abdominal viscera by hand. Mechanical drawing equipment has been introduced with some promise of improving the hygienic aspects of processing. When using mechanical evisceration procedures, these should be sanitary and should enable a *post-mortem* inspection to be done that is adequate to assure the wholesomeness of the carcass.

In order to prevent cross-contamination of the carcass, facilities for washing hands and equipment should be located conveniently for each worker.

Chilling

The most common system for cooling large quantities of poultry involves the immersion of the poultry in water. This use of water for cooling should be accomplished in a manner that does not reduce the microbiological quality of the carcasses entering the system. This may be achieved by careful cleaning of the equipment and requiring minimum rates of overflow and chlorination for continuous chilling systems. The hygienic quality of the chilling operation is influenced by the microbiological contamination of the poultry prior to cooling.

Moisture absorption

Under the present conditions of poultry processing, unavoidable absorption of moisture occurs at many points in the processing system. The amount absorbed should be limited to the minimum amount which is necessary in the production of wholesome, ready-to-cook poultry. A system of inspection control should regulate moisture absorption.

Chlorination

Since the production of ready-to-cook poultry requires the use of large volumes of water, it becomes a potential vehicle for contamination by pathogens and spoilage organisms during many of the processing operations.

In-plant chlorination (5 ppm) is useful to prevent build-up of pathogens, especially *Salmonella*, and serves, furthermore, to control any indigenous, low temperature spoilage organisms that may be present in the otherwise potable water supply.

Chlorination in higher amounts (20 ppm or more) has been proven to be very effective in improving the microbiological situation and in preventing *Salmonella* cross-contamination of poultry in chilling tanks.

Packing and distribution

The identification, protection and control of poultry as it moves through marketing channels to the consumer is necessary to assure that the product will be wholesome when it enters the kitchen. All poultry and poultry products should be identified as officially inspected at the time of shipment from the processing plant. Since poultry is highly susceptible to microbiological decomposition, it should be shipped and stored at temperatures around 0°C to minimize microbial proliferation.

The giblets, because of their relationship with the digestive tract, are frequently of poorer microbiological quality than the carcasses. For this reason they should not be packaged with the poultry carcasses.

RECOMMENDATIONS

1. In order to prevent human health hazards and to provide poultry meat of optimal hygienic condition, as well as of good quality, official inspection of live poultry and poultry meat (i.e., *ante-mortem* and *post-mortem*) is necessary.

2. Inspection procedures should include continuous control of the health of broiler flocks and the hygiene of their feed and environment. This kind of control is of **importance to prevent contamination** with pathogenic organisms in processing plants by flocks bearing latent infections.

Requirements for veterinary certificates and for the utilization of information obtained during *ante-mortem* and *post-mortem* inspection to improve poultry health and hygiene at the farm level are important parts of such programmes.

The regulations should provide for sanitary plant environment and processing procedures and for the re-inspection as the carcasses are processed into poultry products.

3. Research is needed to develop more hygienic slaughtering procedures, such as the removal of intestines by vacuum. On the other hand, new slaughtering methods that interfere with the performance of proper *post-mortem* inspection should not be adopted.

   Ante-mortem and *post-mortem* inspection must be supplemented by monitoring to prevent health hazards from chemical and biological residues. The laboratory methods used for analyzing for these residues should be standardized.

4. Although several aspects of poultry inspection programmes can be carried out by specially trained technicians (lay inspectors), the final responsibility for the effective implementation of all inspections should rest with the supervising veterinarians.

5. The hygiene of the procedures currently used at the various stages of slaughter and further processing can be improved substantially. In particular more sanitary systems for scalding, defeathering, evisceration and chilling are needed.

   Closer co-operation with engineers for the purpose of developing more hygienic slaughtering and processing equipment is of utmost importance.

6. Where necessary, the use of in-plant chlorination (5—10 ppm available chlorine) is recommended in order to prevent the build-up of pathogens and cross-contamination throughout the plant, and to reduce the number of spoilage organisms which may be present in water of otherwise potable quality.

   Higher chlorination of water used in various equipment (i.e., pickers, chill tank, etc.) may be necessary for the same purpose, and may be helpful in preventing contamination by pathogens, especially *Salmonella.*

7. Poultry and poultry products should be labelled as having been inspected at the time of shipment from the processing plant.

8. The giblets should not be packaged with the poultry carcasses in order to avoid cross-contamination.

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DROUGHT AND SUPPLEMENTARY FEEDING OF SHEEP IN THE KAROO*

J. G. CLOETE**

SUMMARY

In a review of methods to carry sheep over seasonal droughts in the Karoo, the author stresses proper veld management, utilization of drought resistant fodder crops, and the importance of an adequate water supply. Carbohydrate lack is the major nutritional deficiency, whilst phosphorus supplementation appears to be advantageous. During seasonal droughts veld supplementation by a lick containing energy-producing food, phosphate, salt and molasses was not only cheaper than supplementary feeding with e.g. maize and lucerne, but eliminated pregnancy toxaemia and heightened oestrous activity. During protracted (periodic) droughts handfeeding must be resorted to, which must be begun when the body mass in the case of dry sheep has been reduced to about 85 lbs (38,6 kg). The best results have been obtained with a ration of maize and lucerne hay in equal parts.

INTRODUCTION

The severe drought during the last decade has again focussed attention on the vulnerability of our small stock industry to droughts. Droughts are nothing new to countries such as South Africa and Australia, and in view of their unpredictability should be regarded as an integral part of the climatic pattern [1]. Losses sustained during the disastrous droughts of 1915, 1933, 1945 and the sixties have crippled many South African farmers financially. Notwithstanding the recommendations of the Drought Investigation Commission of 1923 [2], Fodder Conservation Commission of 1949 [3] and the Drought Investigation Commission of 1965 [4], it seems that many farmers are still ignorant of efficient drought control measures.

The object of this paper is briefly to describe some recent research findings obtained at the Agricultural Research Institute of the Karoo Region, Middelburg, C.P., and at the Carnarvon Experimental Station. For more complete details on the mechanics of the drought feeding of sheep, the reader is referred to a publication by Cloete [1].

Correct application of efficient drought feeding procedures should distinguish clearly between two major types of drought, namely (a) seasonal droughts, which are reasonably predictable in scope and duration and (b) periodic droughts, which exceed the normal seasonal pattern and which are unpredictable in scope. The latter may vary from short term periodic droughts to long term or disastrous droughts. Measures for bridging these two types of droughts differ widely.

MEASURES TO BRIDGE SEASONAL DROUGHTS

Veld management

It is generally accepted that veld grazing is the cheapest source of feeding for ruminants. Notwithstanding this important fact, various reports indicate that the condition of our natural grazing continues to retrogress, particularly in arid and semi-arid areas [5-7]. Even earlier, the Drought Investigation Commission of 1923 [2] focussed attention on the drying up of large areas of the country and the encroachment of the 'Great Uninhabitable South African Desert.' Although they could detect no significant difference in the total annual rainfall, they concluded that its economic value had, to a large extent, been reduced by man-made changes in the characteristics of the natural grazing. They attributed losses during droughts primarily to overstocking. The suggestion of Cloete, Basson & Hugo [8] that sheep numbers should be governed by the longterm carrying capacity of the natural grazing needs no further elucidation. Any procedure adopted to counteract droughts should be based on efficient veld management and should form an integral part of sound farm planning.

*Paper presented at the Biennial National Scientific Congress of the South African Veterinary Association, East London, Sept. 1971.

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Veld supplementation

Divergent geological and climatic conditions in the area of approximately 30 million ha which compose the Karoo Region give rise to various major veld types[5]. The nutritive value of these veld types varies between extremes[9]. Seasonal droughts in the Karoo are not as well demarcated in terms of calender perods as are those in grass-veld and savannah. They last approximately from August to December, but, when winter rains fail, a seasonal drought may cover the period May to December. Basing his work on the chemical analyses of hand-plucked samples of grazing, Louw[9] established that phosphorus is commonly deficient in the Karoo during dry season grazing. His findings were corroborated by Van der Vyver & Van Niekerk[10] and Cloete[1]. Steenkamp[11], however, obtained no reaction from mature sheep by phosphorus supplementation at Petrusville and Hopetown. It would appear that the type of animal used in experiments should be carefully considered when phosphorus deficiencies are investigated, i.e., whether young, mature, pregnant or lactating. From the investigations of Louw, Steenkamp & Steenkamp[11, 13, 14, 15] it is evident that Karoo shrub veld contains excessive calcium and a decidedly unfavourable calcium: phosphorus ratio. It is possible that the high calcium content of grazing may cause metabolic disorders such as kidney and bladder stones which lead to losses among valuable rams and wethers. The phosphatic source employed for rectifying phosphorus deficiencies thus appears to be of the utmost importance and requires careful scrutiny.

In general, wool production and body weight on shrub *(Pentzia)* veld exceed those on mixed veld and on the higher mountain plateaux[16]. Analysis of the chemical composition of hand-plucked samples has yielded valuable information on possible nutritional deficiencies during droughts, but progress has been hampered by the lack of comprehensive quantitative information on such aspects of the nutritive value of Karoo grazings as digestibility and grazing intake. Some workers have resorted to a trial and error method of obtaining direct information on animal performance. Van der Vyver and Van Niekerk[17] supplemented Merino sheep on shrub veld grazing with maize, lucerne and a mixture of these feedstuffs and obtained the best results with maize supplementation. This may indicate that an energy deficiency may supervene during seasonal droughts.

The normal method employed by farmers in the Karoo to bridge seasonal droughts, namely, to use feeds such as maize and lucerne, is open to serious question, since such a method does not promote efficient grazing

Table 1: INFLUENCE OF ENERGY, PROTEIN AND PHOSPHORUS SUPPLEMENTATION DURING SEASONAL AND PROTRACTED DROUGHTS ON KAROO SHRUB VELD (**PENTZIA** spp.)

	Energy [1]	Protein [2]	Phosphate [3]	Control [4]
Seasonal droughts				
Body mass changes of sheep				
First 3½ months of pregnancy (lb/kg)	+ 6,7(3,04)	− 3,2(1,45)	+ 2,2 (1)	− 1,5(− 0,68)
Last 6 weeks of pregnancy (lb/kg)	+ 6,4(2,91)	+ 2,5(1,14)	− 0,40(− 0,18)	− 1,6(− 0,73)
Weaning mass of lambs (lb/kg)	32,3(14,68)	27,3(12,4)	26,0 (11,8)	21,9(9,95)
Protracted droughts				
Body mass of ewes after lambing (lb/kg)	95,9(43,6)	90,4(41,1)	94,3 (42,86)	86,9(39,5)
Body mass of ewes after weaning (lb/kg)	88,2(40,1)	85,3(38,77)	78,3 (35,59)	74,6(33,9)
Body mass loss of ewes from mating until weaning (lb/kg)	− 9,5(− 4,32)	−11,8(− 5,36)	−18,3 (−8,32)	−23,4(10,6)
Mortality of ewes from lambing until weaning (%)	0	0	5	15
Wool production (lb/kg)	11,7(5,32)	11,9(5,4)	11,9 (5,4)	11,1(5,05)

1 The energy lick consisted of mealie meal, starch, salt and molasses and was provided at an intake of ¼ of the maintenance requirement (M) for energy, $^1/_{12}$ M for protein and $^1/_{12}$ M for phosphorus.

2 The protein lick consisted of lucerne meal, ground nut meal, salt and molasses and supplied ¼ M for protein, $^1/_{12}$ M for energy and $^1/_{12}$ M for phosphorus.

3 The phosphate lick consisted of mono sodium phosphate, salt and molasses and supplied ½ M for phosphorus, $^1/_{12}$ M for energy and $^1/_{12}$ M for protein.

4 The control lick consisted of salt and molasses and supplied negligibile amounts of energy, protein and phosphorus.

utilization and also appears to be decidedly uneconomical. Major shortcomings of this method are a substantial reduction in grazing intake [18, 19] and inefficient utilization of labour and transport. These criticisms prompted Cloete and Rossouw [20] to investigate a new approach to the problem. Experiments started during 1965 and are still in progress. Some of the results obtained with energy, protein and phosphorus supplementation are presented in Table 1.

The results indicate that during the seasonal dry period the protein content of grazing in the shrub veld areas of the Karoo does not appear to be a limiting factor in the case of dry sheep but that energy and phosphate supplementation may improve body mass gain. During the last phase of pregnancy and during lactation, however, when protein requirements are higher, protein supplementation may also improve body mass gain. According to results obtained at both Grootfontein and Carnarvon, energy appears to be the major nutritional deficiency during seasonal droughts on shrub veld.

From Table 1 it is also clear that during periodic droughts, energy, protein and phosphorus supplementation would curtail losses. The influence of protein supplementation on body mass losses appears to be much more pronounced than during seasonal droughts. Contrary to previous reports [21], it appears that phosphorus supplementation may also promote maintenance of body mass and reduce mortality. Rectifying these deficiencies during seasonal droughts by means of a lick which contained energy, phosphate, salt and molasses was approximately 30 to 50 per cent cheaper than using feeds such as maize and lucerne. Grazing utilization appeared to have been improved; hence when such licks are used, grazing management has to be adapted. Additional advantages using the above-mentioned lick were (a) the complete elimination of pregnancy toxaemia and (b) a slight increase in oestrous activity during the period of low sexual activity (September—October).

Utilization of drought resistant fodder crops

Drought resistant fodder crops such as spineless cactus (*Opuntia* spp), old man salt bush (*Atriplex* spp), blue bush (*Kochia* spp), American aloe (*Agave* spp) and noors (*Euphorbia coerulescens*) may be used to good advantage during drought. Unfortunately farmers as yet do not fully appreciate their value.

Utilization of water during seasonal droughts

The optimal utilization of water during droughts is often ignored. It is a well-known fact that farmers often experience difficulties with the drinking water available to their sheep. During droughts it is not only quantitative aspects of water consumption which should be considered but also qualitative aspects. Although the supply may be sufficient, sheep may refuse to take it. It is surprising that in a country like South Africa, which is frequently plagued by droughts, the only authoritative study on the utilization of water should have been carried out by Steyn & Reinach more than 30 years ago [22]. They attributed the refusal of sheep to drink water during droughts in certain areas to an increase in the saline or 'brack' content of such water. As an example of how severe the problem may be in certain areas of the Karoo, analyses of water obtained on farms in the eastern (grass veld), central (mixed veld) and north western (shrub veld) areas are presented in Table 2 [23].

Table 2: MINERAL COMPOSITION OF WATER IN THE EASTERN (GRASS VELD), CENTRAL (GRASS AND SHRUB VELD) AND NORTH WESTERN KAROO (SHRUB VELD)

Constituent	Eastern Karoo	Central Karoo	North Western Karoo
Total salts (ppm)	877	1 758	4 296
Calcium (ppm)	60	109	385
Magnesium (ppm)	83	120	263
Sodium (ppm)	105	291	643
Bicarbonates (ppm)	543	414	374
Chlorides (ppm)	99	401	1 579
Sulphates (ppm)	91	305	613
pH	7,6	7,7	7,1

From this table it is clear that the total salts or 'brack' content of water increases from east to west. The concentrations of calcium, magnesium, sodium, chloride and sulphate in water are inversely related to the decline in annual rainfall from the eastern to western parts of the Karoo. It is also clear that only the water in the sour grass-veld areas meets the requirements proposed by Steyn & Reinach [22] and those which are currently used in the case of water for human consumption in the United States of America.

Water in the north-western Karoo contains far more total solids than permitted in the above-mentioned requirements, and in some cases concentrations of 18 000 ppm have been recorded. It is consequently not surprising that sheep so often refuse to take water during droughts in these areas.

The influence of the salinity of water on sheep has also been studied under controlled conditions. Additions of sodium chloride to rain water have shown that a concentration of 1,5 per cent was detrimental to a small proportion of the flock and a concentration of 2,0 per cent (20 000 ppm) adversely affected all sheep [24]. Additions of sodium chloride and calcium chloride [25], sodium chloride, sodium carbonate and sodium bicarbonate [26], sodium bicarbonate [27] or fluorine [28], have provided valuable information on the influence of salinity of water on wool and mutton production and have indicated the adverse effects which water may have in certain areas of the Karoo.

During severe droughts it is not only the quality of water which is affected but also the quantity. The type of veld often determines the quantity consumed. When it is green and succulent, the quantity of free water needed will be much less than when it is dry [29-31]. When it is considered that high ambient temperatures [32] and an increased salinity of water [33] during droughts in arid areas will increase water requirements, the lack of water in such areas may magnify drought problems. The latter aspect should be considered carefully, since restricted watering or a total lack of water leads to decreases in feed intake [34, 35], affects the type of feed the sheep select [36] and, furthermore, leads to (a) irreversible circulatory failure [37], (b) a decrease in water intake when it is again available [36, 38], (c) a decrease in the secretion of digestive juices [39] and (d) substantial losses in body mass and (e) sheep numbers [32]. Sheep in arid areas consequently should be allowed sufficient watering points.

METHODS OF COMBATING PERIODIC OR PROTRACTED DROUGHTS

When seasonal rains have failed during the period of normal expectancy, one of the following methods is usually employed to alleviate the position: (i) moving sheep to agistment; (ii) getting rid of old and excess sheep; or (iii) applying hand-feeding in small pens or paddocks. Under prevailing conditions of veld deterioration the first method may be hazardous and canot be supported. Getting rid of all old and excess sheep is basically sound and has also been proposed by Moule [40], Mc Clymont [41] and Cloete *et al* [8]. By incorporating methods developed at Grootfontein, it is possible to get old sheep, weighing approximately 31 kg (70 lb) into a marketable condition within four to six weeks [20, 42]. Since the teeth of old sheep are normally badly worn, it is impossible to fatten them on poor veld and the method of confining them to small pens under conditions of *ad libitum* feeding has proved to be an economical proposition.

Hand-feeding has been successfully practised in Australia since the experiments of Franklin and others [43-47]. The large-scale construction of drought-feeding units on farms in arid and semi-arid environments should receive top priority. Such units should comprise a number of small pens to be used for maintaining a nucleus breeding flock during disastrous droughts. Research at Grootfontein Research Institute dealing with the mechanics of maintaining young breeding ewes in pens has centred on two major aspects, viz., when to start feeding in pens and what to feed. These will be dealt with individually.

When to start hand-feeding in pens

The concensus of opinion of research workers is that hand-feeding should commence before the body mass of the sheep has fallen to a critical level. Simpson & Robinson [48] proposed a decrease in mass of approximately 30 per cent. The C.S.I.R.O. [49], in summarizing hand-feeding experiments in Australia, reported that dry, mature Merino sheep in good store condition can drop approximately 40 per cent in body mass before mortality becomes serious. Cloete *et al* [8] proposed that similar sheep may be allowed a mass loss of 15 to 20 per cent before hand-feeding should start in pens. The discrepancy between these recommendations may probably be attributed to the fact that Australian results refer to the commencement of hand-feeding while there is still some grazing available in the paddocks, while our recommendations refer to the complete withdrawal of sheep from the natural grazing, and the minimum body mass at which hand-feeding should commence in pens.

The influence of body mass at the commencement of complete hand-feeding on mortality rates of Merinos in the Karoo is presented in Table 3. The experiment had been in progress for 180 days.

Results in Table 3 clearly indicate that a loss in mass of approximately 20 per cent before hand-feeding commences may result in mortalities. Once accustomed to hand-feeding, it would appear that heavier sheep can drop more than 20 per cent in body mass before mortalities occur. Moule[40] supported a gradual mass decrease and mentioned that every one pound (0,45 kg) of body tissue catabolized in the process of mass decrement provides an amount of energy almost equivalent to that obtained from feeding 4 lb (1,8 kg) maize.

Table 3: INFLUENCE OF BODY WEIGHT AT THE COMMENCEMENT OF PEN-FEEDING ON THE MORTALITY OF MERINO SHEEP IN THE KAROO*

Treatment	Average initial body weight		Difference in mass (%)	Mortality (%)	
	Heavy group (lb/kg)	Light group (lb/kg)		Heavy group	Light group
100% lucerne hay	91,41 (41,55)	75,00 (34,09)	21,9	0	20
50% lucerne + 50% maize	91,89 (41,77)	75,00 (34,09)	22,5	0	10
25% lucerne + 75% maize	91,30 (41,50)	75,50 (34,32)	20,9	0	30
100% maize	91,19 (41,45)	75,31 (34,23)	21,1	0	30

*Cloete & Basson 1971, Unpublished observations.

No clear opinion is available on the exact stage at which sheep should be withdrawn from the natural grazing before permanent damage is inflicted. It has been suggested that, when conservation farming is practised, the most valuable sheep should be transferred to pens when their body mass has been reduced to approximately 85 lb (38,6 kg). Transference at the latter mass will curtail losses and reduce damage to grazing. The proposed mass refers to dry sheep, since it is known that dry ewes lose significantly less in mass on sparse grazing than lactating ewes[50].

What to feed

The decision on what to feed will depend on what feeds are available and the costs per feeding unit. It is commonly accepted that home-produced roughages are the cheapest feeds[40, 43, 51] but concentrates appear to be cheaper than purchased roughages and should receive greater attention. In the higher rainfall regions, roughages are seldom, if ever, in short supply. In the arid regions, however, the availability of roughage presents real problems. The most important roughage in these areas, namely, lucerne hay, is often unobtainable and, when obtainable, is expensive.

In view of these difficulties the optimal use of maize, which is fortunately freely available, has been tested at the Research Institute of the Karoo Region, Middelburg, C.P., and at the Carnarvon Experimental Station, since 1968[1]. Four groups consisting of 20 aged Merino ewes were each given maintenance rations of 100% maize, 75% maize plus 25% lucerne hay, 50% maize plus 50% lucerne hay or 100% lucerne hay for a period of 365 days. Some of the results are presented in Table 4.

Table 4: THE INFLUENCE OF VARIOUS DROUGHT MAINTENANCE RATIONS ON BODY MASS CHANGES AND MORTALITY OF SHEEP UNDER PEN-FEEDING CONDITIONS OVER A PERIOD OF 365 DAYS

	100% Maize	100% Lucerne	50% Lucerne 50% Maize	25% Lucerne 75% Maize
Initial body mass (lb/kg)	92,40 (42,00)	92,60 (42,09)	92,40 (42,00)	92,20 (41,91)
Final body mass (lb/kg)	71,10 (32,32)	71,39 (32,45)	77,31 (35,14)	76,21 (34,64)
Body mass change over 365 days (lb/kg)	21,30 (9,68)	21,21 (9,64)	15,09 (6,86)	15,99 (7,27)
Mortality rate (%)	55	10	10	25

From results presented in Table 4 it would appear that a drought maintenance ration consisting of 50% lucerne hay, based on nutritive value, yields the best results for maintenance of body mass and reduction in mortality. The higher mortality rate in the maize-fed group may cause some concern. It should be mentioned, however, that old sheep (±10 years of age) were used and that pen-feeding is not normally practised for such extended periods. Mortality rates in other groups do not exceed figures obtained in Australia [43, 44, 52]. When the experiment was repeated with younger sheep at Grootfontein, the mortality rate in the maize-fed group was reduced by virtually 50 per cent [53]. It is significant that a general tendency observed in the drought-feeding experiments conducted so far at Grootfontein has been a higher mortality in groups which received all-maize rations. Some sheep on the all-maize rations and also on the 75 per cent maize rations pulled out and consumed the wool of others. *Post-mortem* observations revealed that the wool thus consumed was changed into solid round balls of compressed and interwoven wool fibres. Wool-eating is probably a compensatory mechanism for the roughage deficiency.

The more basic aspects of this experiment were investigated at the Research Institute for the Karoo Region. Twenty-four adult Merino wethers were given similar maintenance rations for a period of 475 days. The digestibility of dry matter and nitrogen; calcium, phosphorus, sodium retention; plasma vitamin A levels and ruminal pH were determines at three-monthly intervals. During the first three-monthly period no supplementation was given in the case of the maize-fed group. During the rest of the experiment half an ounce (14 g) per feed of a mixture consisting of 35 lb defluorinated lime, 35 lb bone meal and 30 lb salt was given daily. The various nutritional balances are presented in Tables 5(a), (b), (c) and (d).

Table 5(a): DRY MATTER DIGESTIBILITY OF VARIOUS DROUGHT MAINTENANCE RATIONS FOR MERINO SHEEP

Ration	Three-monthly periods			
	1	2	3	4
100% maize	83,4	93,3	89,7	90,3
75% maize + 25% lucerne	80,6	80,2	80,9	80,1
50% maize + 50% lucerne	77,9	74,5	82,1	74,2
100% lucerne	61,9	65,1	59,5	66,7

Table 5(b): RETENTION OF NITROGEN, CALCIUM, PHOSPHORUS AND SODIUM ON DROUGHT MAINTENANCE RATIONS OF MERINO SHEEP

Component and ration	Three-monthly periods: balances (g/sheep/day)			
	*1	2	3	4
Nitrogen				
100% maize	−2,54	−0,06	+0,59	+1,04
75% maize	+1,83	+2,29	+2,02	+3,60
50% maize	+1,29	+2,32	+2,79	+4,28
100% lucerne	+0,90	+5,78	+2,43	+6,49
Calcium				
100% maize	−0,74	+0,07	+0,26	+0,07
75% maize	+0,76	−1,31	−0,64	−0,10
50% maize	+1,02	−0,22	+0,63	+0,63
100% lucerne	+1,81	+1,14	+0,98	+2,01
Phosphorus				
100% maize	−0,20	+0,55	−0,06	+0,42
75% maize	+0,16	+0,26	+0,21	+0,33
50% maize	+0,26	+0,07	+0,24	+0,24
100% lucerne	+0,27	+0,07	+0,36	+0,79
Sodium				
100% maize	−0,15	+0,21	+0,02	+0,23
75% maize	−0,15	−0,23	−0,05	−0,01
50% maize	+0,19	−0,21	+0,04	+0,01
100% lucerne	+0,34	+1,33	+0,95	+1,44

*No calcium supplement

Table 5(c): MEAN pH VALUES OF THE RUMEN CONTENTS OF MERINO SHEEP ON VARIOUS DROUGHT MAINTENANCE RATIONS

Ration	Hours before and after feeding			
	1 h before	1 h after	3 h after	6 h after
100% maize	6,33	5,97	5,92	6,05
75% maize	6,80	6,27	6,17	6,26
50% maize	6,83	6,38	6,34	6,36
100% lucerne	7,23	6,47	6,32	6,33

Table 5(d): PLASMA VITAMIN A LEVELS OF MERINO SHEEP ON VARIOUS DROUGHT MAINTENANCE RATIONS

	Three-monthly periods (Vit. A palmitate/100 ml plasma)				
	1	2	3	4	5
100% maize	112,7	108,3	88,6	83,1	80,3
75% maize	107,4	122,3	85,5	77,1	82,2
50% maize	98,6	130,1	95,5	81,9	94,0
100% lucerne	99,8	107,3	83,8	71,3	68,6

The dry matter digestibility of maize appears to exceed figures in the literature [54]. As might have been expected, calcium balances during the first three-monthly period were negative. Addition of 14 g of the mineral mixture daily changed virtually all negative balances into positive ones during the subsequent nine months of the experiment. Results in Table 5(c) also indicate that pH values of rumen contents were not substantially lower on the all-maize ration than values on other rations when samples were taken six hours after feeding. Plasma vitamin A levels on the all-maize ration were higher than those recorded on the lucerne ration. No symptoms of vitamin A deficiency could be detected. Results of this experiment indicate that, when their diet is supplemented, sheep can subsist on all-grain rations for extended periods. This result partially confirms the findings of Briggs, Franklin & McClymont [46], who found no differences in average body masses and mortality rates of sheep given all-grain rations of wheat, maize, oats, barley or grain sorghum for a period of 180 days.

There are, however, a few very important factors which should be considered when all-grain rations are used during extended droughts, namely (a) such rations should be introduced gradually in order to prevent purging, (b) the acute calcium deficiency should be rectified by giving 1½ per cent defluorinated agricultural lime per 100 lb grain, or licks containing calcium [55], (c) feed losses owing to forays by birds may be substantial [44, 45], and (d) grain should not be fed daily in order to encourage shy feeders and so curtail mortalities.

Results obtained in the various drought feeding experiments conducted so far indicate that the most economical results are obtained with a maintenance ration consisting either of 50 or 75 per cent maize and the rest hay. Provision was made to reduce losses amongst shy feeders, and the mortality rate has now been reduced to less than 5 per cent [53]. Pen-feeding thus appears to be not only a feasible but also an extremely important method of curtailing losses during protracted droughts; in some areas it also appears to be the only means of counteracting the retrogression of our natural grazing.

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CONVERSION OF BOVINE DIGESTIVE TRACT INTO HYGIENICALLY ACCEPTABLE, EDIBLE OFFAL*

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SUMMARY

Offal, consisting of ruminal and intestinal wall, is commonly consumed by low income groups who rely upon its good nutritional qualities to supply low cost protein in the diet. This report deals with two methods which were assessed as possible means of rendering such offal hygienically acceptable without materially increasing its cost, nor altering its appearance and nature.

Chlorination at about 5 000 ppm was effective in eliminating *E. coli* from the offal but problems such as instability of chlorine, post-processing residues and taste indicate that the method is unsuitable.

Parboiling and chilling in salt-nitrite curing solution eliminated vegetative organisms and achieved about 10% NaCl/W.P. This is considered adequate to control massive germination and outgrowth of surviving spores and recontaminants during short term distribution.

INTRODUCTION

Edible offal consists of those parts of a food animal other than the carcase. Concepts of edibility are influenced by preference and necessity. Preference is usually traditional and group-orientated. Necessity is dictated by cost and the availability of alternative animal protein; generally, offal is used by the lower income groups.

Certain offal is classified as 'rough' for the reason that it consists of the digestive tract which requires to be emptied of ingesta, flushed and washed, before being prepared as food. The degree and efficacy of such processing is again proportional to the level of sophistication of the consumer. Thus, ruminal wall is cleaned, scraped, steamed and bleached to produce the delicacy known as tripe. The majority by far of forestomachs, however, presently is simply emptied and roughly washed prior to issue for distribution and sale to the conventional consumer. The intestine is similarly slashed to allow escape of the ingesta and then rinsed before being released as food.

The digestive tract of food animals provides the consumer with inexpensive protein of food quality. It contains 82 to 85 percent of water, about 12 percent total protein (Table 1), and all the essential and semi-esesntial amino acids. Comparison with whole egg as reference sample for protein requirements *(World Health Organisation Technical Report Series No. 307)* indicates that beef stomachs and intestines have a good amino acid profile (Table 2).

Table 1: PROTEIN AND MOISTURE CONTENT OF RAW, WASHED OFFAL*

	Type of offal		
	Rumen	Small intestine	Large intestine
Protein (%)	11,5	13,6	12,0
Moisture (%)	85,7	82,5	83,9

*Nutrition Research, C.S.I.R., Pretoria.

Table 2: COMPARISON OF ESSENTIAL AMINO ACID CONTENT OF WHOLE EGG AND BEEF OFFAL* (Percentage of Total Protein)

Amino acid	Whole egg	Beef Tripe	Beef intestines
Lysine	6,4	5,8	6,0
Threonine	5,1	3,9	4,4
Valine	7,3	4,5	4,9
Methionine	3,1	1,9	1,9
Cystine	2,4	2,10	2,13
Isoleucine	6,6	3,6	3,8
Tyrosine	4,2	3,1	3,6
Phenylalanine	5,8	3,5	4,0
Tryptophan	1,6	0,5	0,8
Leucine	8,8	6,9	7,6

*From Olson (1970)[1]

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It is the responsibility of the meat hygienist, however, to ensure that edible portions of the slaughtered animal are fit for sale, distribution and use as food. In deciding what should be released from the abattoir as food, he must of necessity be guided by Section 113 of the Public Health Act No. 36 of 1919, which requires that 'food must be clean, sound and wholesome, and free of disease, infection or contamination.'

From a hygienic point of view, the gastrointestinal tract of apparently normal herbivorous animals is highly objectionable because it harbours numerous organisms of a large range of genera and species which cause spoilage and of which some are potentially pathogenic or capable of causing food poisoning. Rislakki isolated salmonella from two of 18 samples of offal wash water and in 4 of 36 samples of bovine gastrointestinal tract[2]. Richardson, Burnett & Koornhof[3] considered offal as source of enteric infections in a Bantu township; they found salmonellae in 48% of bovine tripes and 29% of bovine intestines and considered that transient human carriers of salmonella might well have derived their infection directly from such offal. They also found *S. aureus* and heat-resistant *Cl. welchii* A in numerous samples of intestinal offal and considered that epidemiological facts indicate the probability of direct or indirect transmission from case or carrier. Spencer & Coster[4] stressed that human gastroenteritis is a socio-economic problem and specifically recommended improvement in hygiene and sanitation of meat and offal supplies. Richardson *et al*[5] emphasized the role of offal as a source of salmonellae in the contamination of other foods during handling. Enteropathogenic *E. coli* may cause problems in both animals and man, and these are heightened by drug resistance and transmissible drug resistance amongst the Enterobacteriaceae[5].

Traditionally the digestive tract of food animals is partially or completely opened, evacuated and roughly washed prior to sale as offal. The Standing Regulations under Act 87/1967 now require paunches, tripes and intestines (not destined for use as casings) to be washed and cleaned to the specifications of the Chief Meat Hygiene Officer[6]. They also provide for treatment of conditionally passed contaminated material. The period of storage of the offal at an abattoir is restricted unless kept under refrigeration.

Clearly, forestomachs and intestines of ruminants, as commonly marketed, cannot be considered as fit for consumption in terms of the provisions of the Public Health Act[7].

The socio-economic status of consumers of offal has been emphasized. They frequently also prefer roughly washed offal to cleaned and processed offal: consideration of any method intended to render such offal hygienically acceptable must take into account the cost and the organoleptic characteristics of the final product. Levin[8] advocated conversion of offal in to a sterilized edible meat protein concentrate powder, but the cost and acceptability of such a product to Bantu people in South Africa are not yet known.

Short of outright sterilization, any process intended to render the gastrointestinal tract of slaughter animals fit for use as food, is fraught with difficulties. The total microbial and spore load of such rough offal is astronomical (see Table 3) and includes aerobic commensals and soil bacteria such as *Bacillus, Clostridium, Escherichia* and other Enterobacteriaceae, streptococci, yeasts, fungi, etc. In addition, and usually in smaller numbers, one may find pathogens such as *Staphylococcus aureus, Salmonella* spp., enteropathogenic *E. coli*, heat resistant *Cl. perfringens, Cl. botulinum* types, and others[3].

Table 3: pH, MOISTURE AND BACTERIAL CONTENT OF RAW, WASHED BOVINE DIGESTIVE TRACT OFFAL

	Ru	Ret	Om	Ab	Duo	Je	Il	Caec	Col	Rect
pH	7,0	7,0	7,0	6,3	6,3	6,4	6,9	6,9	6,7	6,6
Moisture %	76,0	79,5	85,1	83,1	83,3	82,1	86,3	83,5	86,0	83,7
Bact. Aer:	880	220	33	220	220	1760	1320	1540	187	132
$\times 10^6$/g Anaer:	2	7	2	3	4	154	2	22	132	11

In food in which natural microbial contamination is of a high order, there exists an important balance and a natural 'antibiosis'[9]. In general, the saprophytes outnumber pathogens, and during active growth the former will often exert a repressive effect on the latter. The opposite may also take place. Lactic acid bacteria promote *Cl. botulinum* due to a decrease in the oxidation-reduction potential, while *B. cereus* stimulates the growth of *S. aureus* and concomitant enterotoxin production[9].

Processing brings about disturbance of this balance by the introduction of adventitious factors such as heat and cold, or chemical substances such as acids, salt and nitrites. All these interacting factors influence survival, germination, outgrowth of spores and the multiplication of exogenous contaminants.

Prolonged heating would be required to sterilize offal properly[10] (see Table 4). In the absence of an hermetically sealed container, exogenous microbial recontamination would readily take place during handling, distribution and storage. This could be controlled by adequate refrigeration. These procedures would place such processed offal beyond the economic reach of that section of the community which is most dependent on it for food.

or the creation of an adequate concentration of permitted preservatives or other harmless chemicals within the offal, its distribution and short term storage would be facilitated.

The hydrogen-ion concentration in a food has a profound effect on vegetative cells and spores. At *pH* levels below 4,5 and above 8,0—8,5, growth of *S. aureus* and *Salmonella* spp. and the germination and outgrowth of *Cl. botulinum, Cl. perfringens* and *Bacillus* spp. are inhibited[9].

The percentage of NaCl in the aqeuous phase in the food ('brine concentration'), is vital in cured foods. Brines of 5 to 7% inhibit or delay germination and outgrowth of *Clostridium* spores in heat-processed meats; 9% brine completely inhibits toxin production[9]. Nine to 10% brine inhibits the growth of all food-poisoning organisms except *S. aureus* and fungi; these, however, have reduced growth rates in such an environment. Depending on species, temperature and medium, staphylococci are not inhibited effectively until a 15% NaCl concentration is achieved[9,11] but staphylococcal enterotoxin prodution is inhibited by concentrations of NaCl as low as 4 to 8%[11]. Where toxin is produced in salt foods, it is a slow process with levels only becoming significant after two weeks[9]. Staphylococci exposed to heat stress are prone to considerable loss of salt tolerance[9].

Table 4: DESTRUCTION TIMES (MINS) OF BACTERIAL SPORES BY MOIST HEAT*

Bact	100°C	105°C	110°C	115°C	120°C	125°C
B. anthracis	2—15	5—10				
B. subtilis	Hours					
Putref. anaer.	780	170	41	15	5,6	
Cl. tetani	5—15	5—10				
Cl. welchii	5—10	5				
Cl. botulinum	300—530	40—120	32—90	10—40	4—20	
Soil orgs.	Hours	420	120	15	6	4
Thermophils		400	100—300	40—110	11—35	3,9—4,6

*From Sykes (1958)[11]

A great deal could be achieved by reduction of the total microbial population, thus effectively eliminating at least the vegetative organisms and thus most of the pathogens. If, in addition, the germination and outgrowth of surviving spores, as well as the growth of recontaminants, could be inhibited effectively by inexpensive processes such as dehydration

Heat above 80°C readily destroys vegetative microbial organisms. *S. aureus* is destroyed in 3 to 7 minutes at 49 to 66°C, and except for strains of *S. senftenberg*, all *Salmonella* spp. have about the same thermal death points and are killed within 5 to 40 minutes at 60 to 85°C[9].

The resistance of bacterial and fungal spores to moist heat varies considerably, those of *B. anthracis* being killed in 2—15 minutes at 100°C while those of *B. subtilis* survive for many hours [11]. Whereas spores of the 'classical' strains of *Cl. perfringens* A are killed in 5—10 minutes at 100°C, heat-resistant strains responsible for food poisoning survive up to 5 hours at 100°C [12]. Most spores are most heat-resistant at pH levels of 6 to 8. Those of *B. subtilis* are most susceptible at 6,6, while for *Cl. botulinum* this point lies at pH 6,9[9].

EXPERIMENTAL PROCEDURES

The purpose was to render the offal both hygienically and organoleptically acceptable by destroying potentially pathogenic or toxigenic vegetative organisms and creating conditions preventing outgrowth of surviving spores and multiplication of recontaminating organisms during short-term storage and distribution.

Assessment of the efficacy of processing was based on the recovery of *E. coli* I. This organism is almost always present in and on the gastrointestinal tract. It was assumed that the thermal death rate of other vegetative organisms was similar to that of *E. coli* I and that absence of the latter would indicate destruction of all similar bacterial forms. The Eijkman test—production of acid (A) and gas (G) in MacConkey broth incubated at 44±0,25°C for 48 hours—was used to demonstrate the presence of *E. coli I.* Samples of material before and after processing consisted of ±5 g sections of the wall of the tract. All samples were finely comminuted before transfer to broth.

The offal consisted of portions of the forestomachs and intestines of freshly slaughtered normal adult bovines. The gastrointestinal tract was immediately opened, emptied, washed in clean, running tap water and finally suspended for 10 to 15 minutes at room temperature. This was considered to be a 'standard washing procedure', and the following methods of additional processing were undertaken individually and in combination:

A. Chlorination
B. Boiling (Parboiling, 'Pasteurisation')
C. Curing
D. Dehydration

*"Halamid", (K.O.P.)

A. CHLORINATION

Methods and Materials

Standard choline solutions were prepared from three commercial preparations, i.e., sodium hypochlorite solution (SHS), a chloramine* (CAM), and chlorinated lime (CL), sold as 'Chloride of Lime—Tropical'. The three preparations were labelled as containing 12 to 15%, 24% and 32,5% of available chlorine respectively. The pH and chlorine content of each solution was determined, the latter by means of iodimetric titration (Table 5). Based on these results, fresh working solutions of 1 000 to 5 000 ppm Cl in tap water were prepared in steam-cleaned, plastic containers for treatment of batches of offal at the rate of 5 kg of offal per 12 to 26 litres of chlorine solution. In some instances the solutions were acidified immediately before use to a pH level of 5 to 7 by addition of 5% acetic acid.

Table 5 : AVAILABLE CHLORINE IN THREE COMMERCIAL PREPARATIONS: MEAN OF FOUR ALIQUOTS

Preparations	Available chlorine (%)	
	By label	By analysis
Sodium hypochlorite	12—15	7,7
Chloramine	24	22,9
Chlorinated Lime	32,5	28,8

For bacteriological examination samples of offal (Rumen=Ru, Omasum=Om, Small intestine=Si, Colon=Co) were taken with the usual precautions against incidental contamination, washed in chilled, sterile, distilled water and shaken before transfer to MacConkey broth.

Results

The results are summarized in Tables 6, 7 and 8.

Discussion and Conclusions

Because the commercial chlorine preparations used were below labelled strength, direct accurate preparation of working solu-

Table 6: EIJKMAN TESTS ON OFFAL BEFORE AND AFTER IMMERSION IN CHLORINE SOLUTIONS FOR VARYING PERIODS OF TIME

SOLN	Av. Cl (PPM)	pH	Time (Mins)	Type of offal			
				Ru	Om	Si	Co
CONTROL	—	—	—	AG	AG	AG	AG
SHS	4 970	7,8	5	A	AG	AG	AG
			10	A	A	NEG	NEG
			15	A	A	NEG	A
SHS (ACID)	3 053	5,8	5	A	(—)	NEG	A
			10	A	(—)	AG	A
			15	A	(—)	A	A
			30	A	(—)	A	A
CAM	5 254	7,8	5	AG	(—)	AG	A
			10	AG	(—)	NEG	AG
			15	AG	(—)	NEG	NEG
			30	NEG	(—)	NEG	NEG
CAM (ACID)	4 189	6,0	5	AG	(—)	AG	AG
			10	NEG	(—)	NEG	AG
			15	AG	(—)	NEG	NEG
			30	AG	(—)	NEG	NEG
CL	5 786	11,7	5	AG	(—)	AG	A
			10	AG	(—)	A	NEG
			15	A	(—)	A	AG
			30	AG	(—)	A	NEG
CL (ACID)	3 621	7,1	5	AG	(—)	A	AG
			10	A	(—)	A	A
			15	A	(—)	A	A
			30	A	(—)	A	A

Key: A = Acid
G = Gas
(—) = Not tested.

Table 7: EFFECT OF IMMERSION OF OFFAL ON pH AND CHOLRINE CONCENTRATIONS IN WORKING SOLUTIONS

Solution	pH and available Chlorine (PPM)			
	Before		After	
	pH	Chlorine	pH	Chlorine
1. SHS	7,8	4 970	7,8	1 775
SHS (ACID)	5,8	3 053	5,7	2 698
2. CAM	7,8	5 254	7,8	3 600
CAM (ACID)	6,0	4 189	5,7	2 698
3. CL	11,8	5 786	11,7	1 952
CL (ACID)	7,1	3 621	6,4	3 017

tions was not possible. Sodium hypochlorite concentrate was most variable in this respect.

Working solutions were generally unstable and aliquots rarely gave the same titration readings. Chloramine solutions, however, were most stable. The available chlorine content of working solutions dropped markedly after a single immersion of offal, and although pre-acidification of working solutions resulted in an initial drop in titrable chlorine, it lead to greater stability during use. This applied particularly to solutions of chlorinated lime with an initial pH of 11,8.

In contrast to the finding of Dixon & Pooley[13], who successfully treated light salmonella infections of chicken carcasses with solutions containing about 200 parts of chlorine per million, we found that about 5 000 ppm of available chlorine was necessary to eliminate *E. coli* from offal; in some instances the period of immersion had to be extended from 10 to 30 minutes. Acidification of working solutions generally reduced the exposure times. *E. coli* could be more readily destroyed in intestinal than ruminal wall. The results were generally erratic and the process was

Table 8: EFFECT OF CHLORINATION (5 000 PPM FOR 15 MINUTES) ON pH AND CHLORINE CONTENT OF OFFAL

Solution	Offal	pH and chlorine residue (PPM)			
		Before		After	
		pH	Residues	pH	Residues
1. CAM	Rumen	7,4	—	7,2	—
(ACID)	Intestine	6,9	—	6,7	17
2. CL	Rumen	7,4	—	7,5	181
	Intestine	6,4	—	7,3	181
3. CL	Rumen	7,2	—	7,6	20
(ACID)	Intestine	6,25	—	6,0	20–181

considered unreliable. In addition, there were matters such as residues and palatability to be considered, as well as official approval of chlorine as a food preservative.

B. PARBOILING OR 'PASTEURISATION'

Methods and Materials

Strips of offal were placed in a steam-heated vat of boiling water; specimens were removed after varying periods of time with the usual precautions to avoid incidental contamination and immediately chilled in sterile, distilled water at 1 to 5°C for one minute before transfer to MacConkey broth for the Eijkman tests.

Results

The results are summarized in Table 9: boiling offal for 10 minutes at 95° destroys *E. coli* I.

Table 9: EFFECT OF PARBOILING OF OFFAL ON EIJKMAN TESTS FOR **E. COLI** I

Time (Mins)	Type of offal		
	Rumen	Reticulum	Small intestine
3	NEG	NEG	NEG
4	POS	NEG	NEG
5	NEG	NEG	NEG
6	NEG	NEG	NEG
7	POS	NEG	POS
8	NEG	POS	POS
9	NEG	NEG	NEG
10	NEG	NEG	NEG

Dicussion and Conclusions

Boiling alone cannot be considered satisfactory. Surviving spores germinate and grow out rapidly, unless conditions are created to prevent this process. Similarly, exogenous microbial recontamination and subsequent growth of organisms would take place readily. Immediate cooling of the heated offal is necessary, but refrigeration would have to be maintained throughout storage and distribution if bacterial growth is to be controlled continuously. Alternatively, 'pasteurized' offal would have to be dehydrated rapidly or cured. Curing would have to produce a satisfactory NaCl-nitrite level within a minimum period of time, so as to enable the material to be washed, cleaned, cured, distributed, cooked and consumed within as short a period as possible. With this in mind, parboiling and subsequent cooling in brine was investigated.

C. PARBOILING AND COOLING IN BRINE

Methods and materials

To be effective, curing would require achievement of a maximum of 200 ppm of nitrite (as $NaNO_2$) in the final product and a minimum of 10% NaCl, otherwise expressed as 10% brine, in the aqueous phase of the offal.

A standard pickling solution of 5,0 kg of salt and 3,5 g of $NaNO_2$ in 22,5 litres of tap water was prepared. Offal of various types was boiled in full and half-strength pickling solution or brine for various periods of time at 96° C. Aliquots were removed from time to time with the usual precautions against contamination and chilled in sterile water prior to bacteriological examination. Larger portions of the offal were removed periodically and transferred to full and half-strength brine at 1 to 5°C for chilling and for storage. After set periods of time the offal was removed from the chilling brine and suspended at room temperature for 15 minutes prior to determination of the moisture content (by evaporation at 100°C to constant mass), the salt content (by Mohr's method as modified by van Ende & Niewland [14]), and bacterial content.

Bacterial counts were established by homogenizing 1 g aliquots of the offal in sterile phosphate buffer, making serial decimal dilutions for the Miles and Misra drop technique [15] and counting the colony forming units (CFU) on pre-incubated (overnight) blood-tryptose-agar plates which were subsequently incubated at 37°C for 18 hours. For anaerobic incubation, hydrogen was introduced into an evacuated Gallenkamp jar. For *E. Coli* and coliforms, McConkey agar plates were incubated at 44° and 37°C respectively for 18 hours. For *Staphylococcus*, mannitol-salt (6,5%) agar was employed. Material was inoculated into selenite broth for 18 hours' enrichment prior to plating on to MacConkey agar for isolation of lactose-negative Enterobacteriaceae.

Results

The results of examination of offal which had been parboiled in water (control) and

Table 10: EFFECT OF PARBOILING AND COOLING IN BRINE ON SALT AND BACTERIAL CONTENT OF OFFAL

TYPE	BOIL TIME (MINS)	COOLING		MOIST. (%)	SALT CONC. IN: (%)		BACT. (1 000/g)	
		MED.	TIME		OFFAL	W/P OF OFFAL	AER.	ANAER.
CONTROL — WATER								
RU	15	WATER	1 m	80,3	0,15	0,19	1 540	176
INT	15	"	"	82,1	0,2	0,24	308	196
BRINE:								
INT	15	WATER	1 m	68,1	9,2	11,9	96	44
"	60	"	"	58,1	14,7	20,2	44	506
RU	15	"	1 m	69,8	5,1	6,8	66	79
"	15	BRINE	1 h	68,8	5,5	7,4	48	67
"	15	"	2 h	69,4	7,1	9,2	30	44
"	15	"	3 h	70,7	7,7	9,8	70	66

parboiled and cooled in brine are summarized in Table 10.

Concerning the destruction of vegetative organisms, it was demonstrated that ruminal wall, harbouring 96 800 CFU of coliforms, 12 200 CFU of *E. coli*, and 17 600 CFU of a Gram-positive, coagulase-negative coccus (*Staphylococcus* spp) per g as well as large numbers of lactose-negative organisms growing in selenite broth and on MacConkey agar, was rendered entirely free of these types by parboiling (15m) and cooling (1—3 h) in brine.

Limited palatability trials in which processed offal was given to traditional consumers of this commodity, for cooking in their own way, showed that parboiled offal originally containing about 10% brine was acceptable, whilst batches with 19% brine were not. Consumers were advised that the offal had been salted to avoid them adding salt during preparation.

CONCLUSIONS

Offal is a highly perishable product and ideally any processing prior to release as food should take place at or close to the abattoir to permit official supervision. For rapid and continuous processing of offal in synchrony with the slaughtering process, the time required for offal processing must be minimal.

Chlorination of offal is not considered feasible; acceptance of the method by both the consumer and the authorities is doubtful because of residues and taste, while problems such as corrosion of metal, instability of working solutions and the preparation and maintenance of effective concentrations cannot be ignored.

From the experimental work reported above it appears that for washed intestinal offal, parboiling in brine for 15 minutes and subsequent chilling in water would eliminate vegetative micro-organisms and bring about the 10% NaCl/W.P. which is necessary to control germination and outgrowth of surviving spores as well as the growth of, and toxin production by, exogenous recontaminants during short term storage and distribution. Ruminal wall would similarly require 15 minutes' parboiling in brine followed by cooling in chilled brine for two to three hours to achieve the same object. This processing should not prove too costly; it renders the end product relatively acceptable to the consumer. The consumer will, however, have to forego any preference for raw, rough-washed offal containing ingesta.

POST SCRIPT: DEHYDRATION

Since completion of the above study, dehydration of offal was suggested and limited trials were carried out in conjunction with a Rhodesian concern*. Pretreatment of offal is essential to eliminate enzymic and microbial spoilage during the early stages of dehydration; the process of parboiling and cooling in

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brine, described above, was found suitable. The final product was free from *E. coli* but total counts (spore-forming survivors) were high. Moisture content varied from 9,0 to 18,1%, and the product was easily reconstituted to an organoleptically most acceptable and palatable product. Storage in sealed containers at room temperature resulted in fungal spoilage after a few weeks.

The advantages of dehydration (decreased weight, ease of handling and distribution, etc.) are obvious. Cost involved in the process is said to be around 1 c/kg. The method deserves further investigation as it could well constitute a practical method of making offal available as food.

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SOME OBSERVATIONS ON THE CONTROL OF RAW MILK

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SUMMARY

The routine testing of raw milk supplies as performed by 15 municipal laboratories is critically analysed. From data obtained it appears that the efficacy of the control of fresh milk supplies for liquid consumption in the main urban areas is questionable and it is assumed that milk control in the rural districts is probably worse. The need for standardization of milk control in the Republic of South Africa is discussed and emphasized.

INTRODUCTION

Fresh milk is an exceedingly valuable but also easily perishable food, of which the palatability, keeping quality, safety and processing qualities are distinctly influenced by its chemical, cytological and microbial constituents.

To safeguard consumers from spoiled, unwholesome or adulterated milk and milk products, certain microbial standards have been established. These standards, when enforced, will ensure the satisfactory quality and safety of milk and milk products.

Control of fresh milk supplied to consumers in urban areas is the responsibility of local authorities, whose health departments exercise control through municipal by-laws promulgated in terms of empowering provisions of the local government ordinances of the respective provinces. In addition, local authorities are authorized to apply the provisions of the Public Health Act No. 36, 1919, and the larger municipal health departments also implement the Food, Drugs and Disinfectants Act No. 13, 1929 and its regulations. Where the magistrate constitutes the local authority, the Rural Sanitary Regulations, made under section 115 and others of the Public Health Act No. 36, 1919, are applied by State Health Department. Section 113 of the Public Health Act epitomizes the common concept of the purpose of milk control by stating, that 'no person shall sell... any milk which is not clean, wholesome, sound and free from any disease or infection or contamination...' The Food, Drugs and Disinfectants Act further defines 'normal milk' and deals with chemical composition and adulteration. Jointly, this legislation entitles consumers throughout South Africa to milk as a raw product which is free from foreign taints and flavours, is clean and safe, is unchanged by pathological processes in the udder, does not contain infectious or toxic agents of animal origin or originating from extraneous sources, does not contain chemicals or antibiotics intentionally added, or incidentally present as a result of cleaning and sterilizing procedures of the milking equipment or of treatment of diseased cows, or of the feeding of dairy cows on chemically impregnated food. To achieve this, many local authorities have instituted sytems of milk control on farms, supported by an array of laboratory tests to measure compliance with established milk standards. Apart from those concerning the 'normality' of milk, these standards are determined by each local authority in its own dairy or milk by-laws, and consequently vary to some extent. The person directly responsible for exercising milk control may be a medical officer, a veterinary officer or a health inspector. Because of differences in basic training and direct interests, each of these officials will emphasize particular aspects of milk control. To complicate matters further, many by-laws do not specify the methods by which the tests are to be carried out and there is little uniformity in this respect.

The main and understandable interest of municipal control authorities seems to centre around the bacteriological safety of milk and milk products, which can be obtained to a reliable degree by pasteurization, provided the raw milk is of normal composition with a limited bacterial content. On the other hand, it appears that the hygienic state of milk or cream intended for liquid consumption or industrial processing is considered of minor importance, although it is well-known that efficacy of pasteurization and the safety of the pasteurized product is significantly influenced by the hygienic quality of the pro-

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duct before pasteurization. The control of milk cannnot be simplified by ignoring the control of cleanliness of milk and merely concentrating on the bacteriological safety of milk, because the consumer cannot then be supplied with milk conforming to the requirements of the Public Health Act, No. 36, 1919 Section 113—114. This is particularly the case, and will remain so, as long as many dairy herds are badly affected by udder diseases.

MATERIAL AND METHODS

In order to obtain an over-all picture of the present state of control of fresh milk supplies, a questionnaire was sent to the larger local authorities and to those laboratories which serve municipalities not having their own facilities, fifteen in all.

The laboratories concerned were requested to provide information on tests and techniques regarding the following:

1. Raw milk:
   —flavour, odour, acidity, composition, adulteration, inhibitory substances, preservatives, somatic cell content, bacterial content, pathogens, *E. coli* and coliform content, keeping quality.
2. Pasteurized milk:
   —phosphatase, *E. coli* and coliform content, bacterial content, keeping quality.
3. Any other special milk examination.

In analysing the answers, information concerning techniques which were employed 'occasionally', 'if necessary', 'if demanded' and 'intended to employ' were not included in the table. The possibility of misinterpreting these answers cannot be excluded completely.

The following obvious conclusions are drawn:

Numerically it can be seen that sampling and testing for 'normal milk' as defined in the Food, Drugs and Disinfectants Act, is undertaken by most, but not all, laboratories. With one exception all laboratories testing for adulteration by added water use the Hortvet cryoscopic method. The percentage of milk fat is determined throughout by the Gerber method, but some differences occur in the technique, glassware used and in the concentration of H_2SO_4. The percentage of milk-solids-not-fat (SNF) is determined directly from milk fat percentages and lactodensimetric readings, using either the Richmond formula or gravimetry; the latter method is also employed as control procedure for the Richmond calculations.

The number of laboratories ensuring cleanliness of the milk by means of tests for *E. coli* I and keeping quality is even larger. Only three laboratories use the same Modified Eijkman Test whereas the rest use various procedures to determine *E. coli* I, the differences being mainly in nutrient media, volume of inocula, temperature and duration of incubation. In principle, the same may be said of the Methylene Blue and Resazurin Tests.

ROUTINE TESTING OF RAW MILK BY 15 MUNICPAL LABORATORIES

Test	No. of Labs.	% of execution	Test	No. of Labs.	% of execution
Fat %	11	73,3%	Pathogenic mycobacteria	8	53,3%
Solids — Not Fat %	10	66,7%	**Brucella** spp.	9	60,0%
Total Solids %	10	66,7%	EXAMINATION FOR MASTITIS:	7	46,7%
Specific gravity	11	73,3%	1. Bacteriological: cultural differentiation of		
Water adulteration	12	80,0%	**Streptococcus** spp.	3	20,0%
Protein	1	6,7%	**Staphylococcus** spp.	2	13,3%
Ash	1	6,7%	2. Cytological:		
Lactose			indirect	4	26,7%
Vitamins			direct	3	20,0%
Foreign milk			Total bact. content	7	46,7%
Reconstituted milk	3	20,0%	Total viable bact. content	8	53,3%
Chlorines	2	13,3%	**E. coli** (type 1)	12	80,0%
Formaldehyde	5	33,3%	Coliforms	8	53,3%
Q.A.C.			Thermoduric orgs.	1	6,7%
Therapeutic agents	5	33,3%	Macroscopically visible dirt	3	20,0%
Flavour			Keeping quality	10	66,7%
Odour			Acidity	5	33,3%

RESULTS

The details submitted by the 15 laboratories concerning examination of raw milk are summarized in the table.

Determination of the total bacterial content or/and the viable bacterial content is only performed in about 50% of laboratories, the techniques, however, are more uniform than in the case of the tests for *E. coli*. Total bacterial content is mostly determined by the direct microscopic count (DMC) and, with exception of one laboratory, the viable bacterial content is determined by standard agar plate techniques. The same can be said of the examination for the presence of tuberculosis and for brucellosis organisms, the latter examination usually consists of the brucella milk ring test (8 laboratories) with additional biological examination (4 laboratories) and whey agglutination (3 laboratories).

In comparison to the above, where either the number of laboratories using particular tests or the degree of uniformity of techniques gives some consolation, there is nothing to mask the complete inadequacy with regard to the number of laboratories, their methods or the interpretation of results concerning tests for harmful chemical and repulsive inflammatory elements in milk or the presence of infectious organisms of animal origin other than tuberculosis or brucellosis. Without considering differences in municipal facilities and by-laws, it is clear that the public health aspects of official control appear grossly neglected. Examination of milk samples for *Mycobacterium tuberculosis* and *Brucella* spp. is performed by only 53,3% and 60,0% of laboratories respectively. This cannot be considered as adequate, particularly as CA and TB are prevalent in dairy herds. Tuberculin-positive reactors can be found in an estimated 15% of all dairy cattle, up to 75% positive reactors[1] being present in some herds. In milk delivered to Johannesburg[2], the incidence of *Brucella* contaminated milk samples amounted to 14% in 1969 and 23,7% in 1970 and a similar situation undoubtedly also exists elsewhere.

The routine control of fresh milk supplies consists of a screening examination of milk, usually on a roster-basis, followed by special or more intensive examinations at shorter intervals where a producer has special problems. Nevertheless, as long as mastitis, brucellosis and tuberculosis are rampant in the dairy herds, and as long as many thousands of litres milk are returned to farmers for various reasons as unacceptable, milk control remains esesntially unsatisfactory. It is common knowledge that local auhorities are forced to condone substandard supplies for fear of creating a shortage by too strict application of the regulations. Perhaps the problem is accentuated by the lack of centralized control over milk production, the absence of financial incentive for better milk and the inability to provide the necessary advisory services essential for improved milk production.

The much-acclaimed nutritional value of milk can only be utilized fully if its quality is hygienically satisfactory. In order to assess practically attainable levels of compliance with the definitions of 'normal milk', fit for human nutrition, it would seem that routine milk control should ensure that milk is:

1. macroscopically normal,
2. free from pathogenic biological and chemical agents,
3. free from adulterous admixture, and contains
4. the lowest possible number of somatic cells and apathogenic biological agents.

The hygienic quality of milk is dependant basically on the condition of the productive organ, i.e., the milk gland, and the primary object of milk hygiene has to be the maintainance of udder health and conservation of the quality possessed by normal milk on leaving the healthy udder. Milk control, therefore, is vitally concerned with subjects such as:

1. Health of the dairy animals and their udders.
2. General hygiene of production, including milking, feeding, cleaning, sterilizing and cooling procedures and the health and personal hygiene of dairy workers.
3. Composition of the delivered milk, including natural chemical composition, harmful chemical additions, freshness and adulteration of milk.
4. Hygienic quality of milk, including the bacterial content of milk, i.e., total bacteria, faecal contamination, specific pathogens originating from animals, or extraneous contamination and inflammatory products.

Because the origin of hygienic and chemically 'normal milk' can only be the healthy dairy cow and correspondingly satisfactory conditions on the dairy farm, laboratory con-

trol of fresh milk cannot be considered adequate unless it is continuously supported by routine herd examination. This is the only reliable way to disclose and solve problems of fresh milk production.

CONCLUSIONS

Presuming that the general purpose of control of raw milk supply is the maintenance of certain standards of chemical composition and hygienic quality, and presuming that special tests are required to ensure the nutritional value and wholesomeness of milk, as well as the health of dairy cows in general and that of their udders in particular, it appears that none of these objectives is satisfactorily or uniformly attained in all parts of South Africa. The control of fresh milk for liquid consumption in the main urban areas—considered to be very important with regard to public health and hygienic standards—appears to be questionable. It may be assumed that milk control in the rural districts is probably worse.

These differences in fresh milk control systems or standards may well account, to some extent, for the disinclination of local authorities to permit the introduction of milk produced in regions outside their control. Consumers in various parts of the country do not enjoy the same hygienic safeguards, and dairy farmers have to meet varying legal standards applicable to milk production. Instead of the existing chaos, a uniform set of standards for milk control should be promulgated. At the same time the dairy farmer must have all the necessary advice, technical assistance and aids available to produce milk satisfactorily. Clarification and pasteurization of milk do not render intensive control of fresh milk unnecessary, and all laboratories concerned should exercise adequate control over the whole area by means of standard techniques. The results obtained should be recorded in a standardized manner so as to enable the annual completion of comparative reports and of evaluations. With these available, it would be possible to assess the necessity of various steps to bring about the desired improvement in production, quality and sanitary control of milk. The consumer's acceptance of milk and milk products is essential and for maximum consumption his rights and demands should be paramount. Dairy farmers and the entire dairy industry will eventually benefit from such a scheme. The possible advent of payment for milk on a quality basis, i.e., both chemical and bacteriological quality, would in any case require such uniformity of approach if it is to have its obvious advantageous effect.

ACKNOWLEDGEMENTS

We thank all personnel of the municipalities concerned that provided the data for this survey.

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CASE REPORT GEVALLEVERSLAG

EOSINOPHILIC GASTROENTERITIS: REPORT OF A CASE IN A DOG

R. C. BARTSCH* AND B. IRVINE-SMITH**

SUMMARY

A case of eosinophilic gastroenteritis in a dog is presented. A brief review of the literature on this syndrome in canines is compared with findings on a similar condition in man. Clinical, radiological and pathological parameters are discussed.

INTRODUCTION

Relatively few examples of eosinophilic gastroenteritis in dogs have been reported [1-3]. These cases involved young dogs (1—4 years of age), most commonly German Shepherds and Cocker Spaniels, which typically presented histories of intermittent diarrhoea and vomiting of several weeks' to one year's duration. Generally, the dogs had good appetites except while symptomatic; they did not respond to anthelmintic or symptomatic treatment. Laboratory procedures usually disclosed a leukocytosis (13 000—25 700 WBC/mm^3) with a prominent eosinophilia (12—28%) and a negative or negligible parasitic burden on faecal examination.

The lesion, focal or diffuse, is characterized by an eosinophilic infiltration anywhere between the stomach and rectum. Macroscopically, the intestine is thickened and may sometimes be clinically palpable. There may be pin-point ulcerations and narrowing of the lumen. The regional lymph nodes to the affected parts have been reported to be enlarged. Histologically, an infiltration of cells comprising mainly eosinophils and to a lesser extent lymphocytes and plasma cells into any of the three layers of the intestine is characteristic. Examination of affected lymph nodes shows lymphoid hyperplasia and acute or chronic focal inflammation and necrosis with an infiltration of neutrophils, eosinophils and macrophages [1, 3, 4].

In man a condition exists which closely resembles this canine syndrome. Eosinophilic gastroenteritis in man most frequently occurs in people 20 - 50 years old with a duration varying from 1—25 years [2]. Symptoms usually consist of recurrent abdominal pain, vomiting, diarrhoea and frequently haematemesis or melaena [2, 5, 6]. Eosinophilia is a constant feature but leukocytosis is not. When the stomach is affected, radiographs commonly show an irregular gastric outline, which appearance might lead one to suspect the presence of a carcinoma [6]. Gastric involvement may present itself only as delayed emptying and pylorospasm. When the intestine is involved, segments of the wall are thickened and rigid and the lumen narrowed [5, 6]. Most commonly, diffuse eosinophilic gastroenteritis involves thickening of the wall of the stomach, duodenum and upper jejunum [2]. Histologically, hypertrophy of the muscular lamina is characteristic with a diffuse infiltration of inflammatory cells consisting predominantly of eosinophils. This infiltrate may involve any or all of the intestinal layers. Macrophages and giant cells are occasionally seen [2, 5, 6].

The tentative diagnosis in man is based on radiological evidence of thickened foci in the stomach and/or intestine and eosinophilia. Histological examination of biopsied lesions and regional lymph nodes confirms the diagnosis [2, 5, 6].

Chronic gastrointestinal allergy is thought to be the most likely cause of the syndrome [2], specifically suspected are allergies to weed and grass pollens, feathers and house dust [6], and a history of familial allergy is very common [2, 5, 6]. Gastrointestinal parasitism is known to stimulate infiltration of eosinophils, but correlation with this syndrome is lacking. The high success rate of cortisone or adrenocorticotropin therapy and the condition's self-limiting nature lend support to the proposed allergic aetiology.

CASE REPORT

1. *History and clinical course*

A four-year old spayed cross-bred black Labrador Retriever bitch, which was being

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trained as a guide dog for the blind, was presented with a history of intermittent melaena. The animal had been treated with oral chloramphenicol for several days which had affected temporary remission of the symtoms.

Clinical examination revealed normal heart and respiratory rates, normal habitus, good appetite, slightly congested mucous membranes and a rectal temperature of 102,2°F. Slight pain over the posterior abdomen was evinced on palpation. The animal was hospitalized for further observation. Freshly clotted blood covering a normal stool or as a gelatinous clot was passed. Examination of the faeces for helminth ova (flotation in 50% glycerine) was negative.

Serial radiographs of the intestinal tract following a barium sulphate meal showed irregular lumen size and bowel wall thickening. Proctoscopic examination revealed numerous small erosions, approximately 2 mm in diameter, which bled on contact. A tentative diagnosis of ulcerative colitis was made. Systemic treatment with oral antibiotics was given and a suppository containing bismuth subgallate, bismuth resorcin compound, nicaraguan medical balsam, zinc oxide and boracic acid and pramoxine hydrochloride was used. The animal was fed a bland diet of 'Pro Nutro'. She remained bright, ate well and the temperature returned to normal within 24 hours. Over the next four days, the melaena was intermittent and the stools varied from normal to soft, often mixed with blood or coated with blood-tinged mucus.

Euthanasia was performed at the request of the owner.

2. *Gross necropsy findings*

Petechial and punctate ecchymotic haemorrhages, becoming more numerous distally, were present in most of the colonic mucosa. The rectum had no mucosal haemorrhages, possibly owing to the action of the suppository. The muscle layer of the colon appeared diffusely thickened. No lesions were evident in the colonic lymph nodes. Intestinal parasites were not observed. No lesions were observed other than in the digestive tract.

3. *Microscopic findings*

Examination of the colon revealed severe leukocytic infiltration into the lamina propria and mild infiltration of the submucosa (Fig. 1). The inflammatory infiltrate consisted primarily of eosinophils but also included increased numbers of neutrophils and plasma cells. Examination of sections made from the

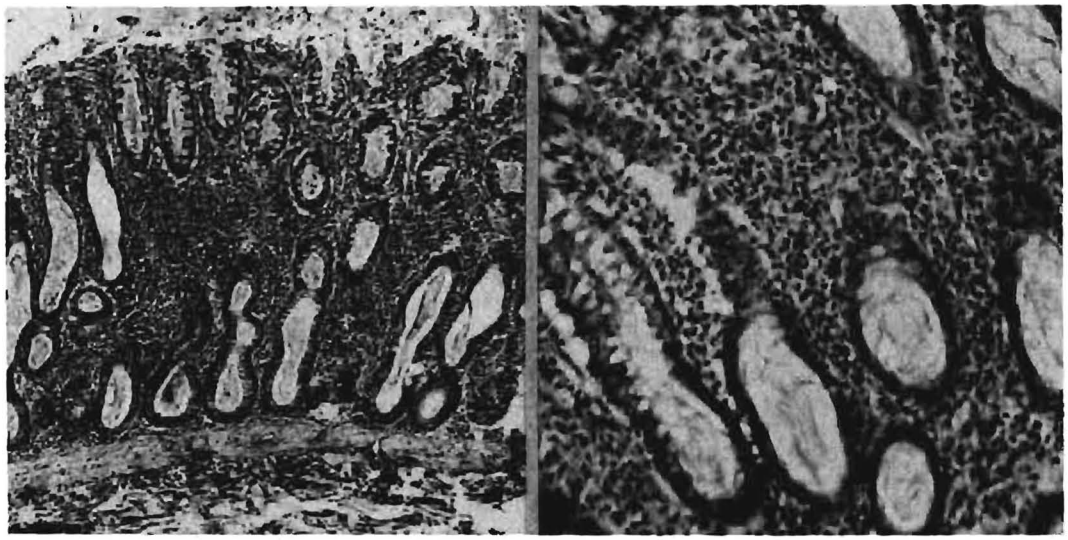

FIG. 1: Average percentage spermatozoa alive and linear movement after dilution.

FIG. 2: Average percentage spermatozoa alive and linear movement after four days' storage at 4—5°C.

ascending colon revealed slightly less leukocytic infiltration than those from the transverse and descending colon. Furthermore, the crypts of Lieberkühn were dilated and distended with mucus and the epithelium was reduced to a cuboidal shape apparently owing to pressure exerted by the excess mucus (Fig. 2). The muscularis mucosae of the transverse colon was diffusely infiltrated by eosinophils and the tunica muscularis was hypertrophic; the smooth muscle cells appeared large with foamy texture. A mild eosinophilic infiltration was noted in the tunica muscularis of the descending colon.

In the colonic lymph nodes a mild leukocytic infiltrate was present, composed entirely of eosinophils and a few neutrophils.

DISCUSSION

Although canine gastrointestinal problems are frequent in small animal practices, eosinophilic gastroenteritis is rare. More common causes such as helminthiasis, improper diet, or distemper should first be considered and treatment of undiagnosed chronic gastroenteritis with cortisone is not indicated. Nevertheless, chronic diarrhoea and eosinophilia without evidence of parasitism, and typical radiographic changes in the absence of neoplasia, may suggest this syndrome. Most affected animals treated with diminishing doses of cortisone for 10 to 20 days undergo dramatic improvement and recovery [3]. Relapses, however, may occur in a minority of cases, and owners must be warned of this possibility.

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BOOK REVIEW — BOEKRESENSIE

PRINCIPLES OF VETERINARY RADIOGRAPHY

S. W. Douglas and H. D. Williamson

London: Bailliere, Tindall, Second Edition. 1972. Pp. xi & 266.
Over 300 illustrations. Price not stated.

The first edition of this book, published in 1963 quickly established itself as an outstanding reference work on radiographic positioning and technique.

Veterinary radiography has advanced rapidly in the intervening period and is being used increasingly by veterinary surgeons as a diagnostic aid. The diversity of X-ray machines employed by practitioners has prompted the authors to re-arrange and adapt the first part of the book dealing with theory and equipment to make it more generally applicable. With this end in view, exposure charts for three different portable and mobile X-ray machines have been included in an appendix.

The lay-out of the second part of the book, in which positioning of patients is described and illustrated, remains basically the same and largely unaltered. Positions for illustrating the tympanic bullae and male urethra in canines, and oblique examination of the equine carpus, fetlock and third phalanx have been incorporated.

Roentgenograms of the canine temperomandibular joint have been added. Exposure factors are suggested for every position illustrated and space is provided for the reader to insert those factors found to be suitable for his own X-ray machine.

The chapter on contrast media techniques has been revised and expanded. The metric system has been adopted throughout. The detail and general quality of the roentgenograms has been improved considerably by enlargement. Some roentgenograms in the large animal section, however, could still be improved upon.

The book is strongly recommended for veterinary practitioners and students.

C. J. R.

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GELATINIZED MEDIA FOR DILUTING RAM SEMEN— A PRELIMINARY REPORT CONCERNING *IN VITRO* TRIALS

N. A. VINHA* AND R. I. COUBROUGH**

SUMMARY

The viability *in vitro* of ram semen diluted in a 1%, 2% and 3% gelatinized skimmed milk diluent was studied. The semen was stored for 4 days at 5°C. Highly satisfactory results (64% viability) were obtained, especially with the 1% gelatinized diluent. The relevant literature is reviewed briefly.

INTRODUCTION

One of the factors militating against the extensive use of AI in sheep, has been the inadequacy of the methods used for both short- and long-term semen preservation. With the increasing use of oestrus synchronization in sheep breeding programmes, short term semen preservation techniques allowing easy and safe transportation would open up new fields of progress. To this end, *in vitro* trials with gelatinized egg-yolk-milk diluents were carried out, aiming at a 4—5 day storage period which would coincide with most of the anticipated synchronized oestrous periods. With a view to future *in vivo* trials, a basic standard dilution rate was used so as to maintain a constant concentration of spermatozoa per unit volume of semen inseminated.

Review of the Literature

The literature pertaining to ram semen dilution has recently been reviewed extensively by Visser[1]. References relating to the use of gelatin, however, are sparse. As far back as 1936, Razumov[2] used gelatinized semen transported in paper capsules in a region where sheep farms were small and scattered. Milovanov, Najornyi, Sivokorj & Malohov[3] used gelatinized semen under similar circumstances, with satisfactory results when the gelatinized diluent had been filtered. Sokolovskaya[4], comparing the use of gelatin with a polyvinyl derivative in order to increase the viscosity of the diluent, had poor results. Visser[1] used a saturated solution of gelatinized citrate-egg-yolk, as well as gelatinized milk-egg-yolk diluents and found *in vitro* survival rates of the spermatozoa to be fairly good.

The optimum dilution rate of ram semen and the concentration of spermatozoa per unit volume inseminated have long been points of contention. The inherent advantages of semen dilution, namely storage, and the extension of the ejaculate used, apply in the same way to ram semen[5].

Mies Filho & de Almeida Ramos[6], in a small trial involving 10 groups of 25 ewes, found no significant difference in the results obtained when the semen volume had varied from 0,05—0,1 ml semen (undiluted or diluted with skimmed milk), and when the numbers of spermatozoa had ranged from 0,4 to 20×10^8. The average non-return rate obtained over a 45 day period by these workers was 53,2%. Terril[7] reported from Uruguay that intracervical insemination of 5×10^6 spermatozoa had given fairly good results. Keast & Morley[8] recorded a moderate level of fertility (46%) with spermatozoan dose rates estimated to number between 20×10^6 and 60×10^6 sperm in 0,1 ml. Their highest conception rate, however, was obtained with 350×10^6 spermatoza. Koger[9] and Kuznetzov[10] concur that a minimum dose of 50×10^6 spermatozoa is necessary for good results. Terril[7] indeed recommended that for the best results at least 60×10^6 spermatozoa should be inseminated intracervically or 50×10^7 spermatozoa where the semen is deposited in the cranial vagina. For optimal results, Milovanov *et al*[11] stated that each dose of semen inseminated should contain at least 75—80×10^6 active spermatozoa. Anderson[12], using still higher concentrations of spermatozoa (125×10^6) found no significant difference between the use of diluted or undiluted semen when the insemination had been done intracervically. Moore *et al*[13], also using a high concentration of spermato-

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zoa (140—220×10 ^{6}), diluted in pre-heated milk at a dilution rate of 1 : 2, only obtained a conception rate of 39%. Milovanov [14] suggested that where the inseminations were done intravaginally that at least 500×10 ^{6} spermatozoa were required for success. Emmens & Robinson [15] concluded, however, that with intracervical insemination, using 0,5—1,5×10 ^{8} spermatozoa in a total volume of 0,05—0,1 ml of semen, diluted or undiluted, a conception rate of 55—60% could be expected to a single insemination.

MATERIAL AND METHODS

Semen from five mature Merinos and one Karakul ram was collected using one of two types of electrical stimulator (Dynamo model or Ruakura model). The rams were worked at regular 8—10 day intervals over a 3½-month period (March—June), two ejaculates being collected at a time. During the trial period, the environment, management and nutrition of the rams were kept as constant as possible. A total of 48 ejaculates was collected during this time. Where the semen volume was large enough to allow it, each sample was divided into three equal amounts and diluted in 1%, 2% and 3% of gelatin in a basic pre-heated skim-milk diluent.

For semen collection in the Karakul ram and Merino 19266, the Onderstepoort model of electrical stimulator was used [16] while for Merinos 27622—25, the Ruakura model was employed [17]. Only semen samples with at least a mass motility rating of 4, a percentage of live spermatozoa greater than 75%, and a density of milky or better were diluted.

The basic diluent consisted of pre-heated, skimmed cow's milk (pH 6,7), 10% egg-yolk, penicillin (500 IU per ml diluent) and streptomycin (500 μg per ml diluent). To the basic diluent, concentrations of 1%, 2% and 3% gelatin were added. After mixing the gelatin with the diluent to ensure complete dissolution, the semen samples were diluted in the usual way. All solutions and equipment were maintained at 37°C in a waterbath. The dilution rate for each sample was based on the work of Gunn, Saunders & Granger [18], and is set out in table 1. This dilution rate was aimed at obtaining 300×10 ^{6} spermatozoa/ml of diluted semen.

Table 1: DILUTION RATE

Density	No. of Spermatozoa per ml	Dilution Rate
Super thick creamy	30 × 10^8	1 : 10
Thick creamy	25 × 10^8	1 : 8
Creamy	20 × 10^8	1 : 6
Thin creamy	15 × 10^8	1 : 5
Thick milky	10 × 10^8	1 : 3
Milky	5 × 10^8	1 : 1,5

After dilution, the samples were maintained in a waterbath, and allowed to cool down slowly in a refrigerator kept at a constant 4—5°C. Each sample was then evaluated after a four-day storage period for percentage live spermatozoa and directional motility Prior to evaluation each sample was allowed to warm up to 37°C.

RESULTS

The numbers of occasions the rams were worked and of samples diluted are set out in table 2. The pH of the samples ranged between 6,8—7,0.

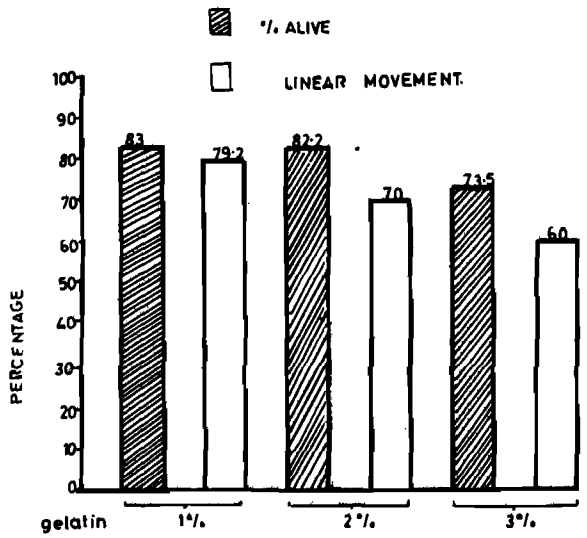
Table 2: NUMBER OF COLLECTIONS OF TWO EJACULATES EACH PER RAM AND NUMBER OF SAMPLES DILUTED

Ram	No. of collections	No. of samples diluted
Karakul	6	10
Merino 19266	10	21
Merino 27622	8	12
Merino 27623	8	12
Merino 27624	8	12
Merino 27625	8	12
TOTAL	48	79

The numbers of samples diluted with 1%, 2% and 3% gelatin were 28, 24 and 27 respectively.

The average percentage live spermatozoa and linear movement of all 79 samples evaluated immedialy after dilution, and after the 4-day storage period, are set out in histograms 1 and 2.

The percentage loss of spermatozoa during the cooling down process, storage at 4°C and subsequent thawing is shown in table 3.



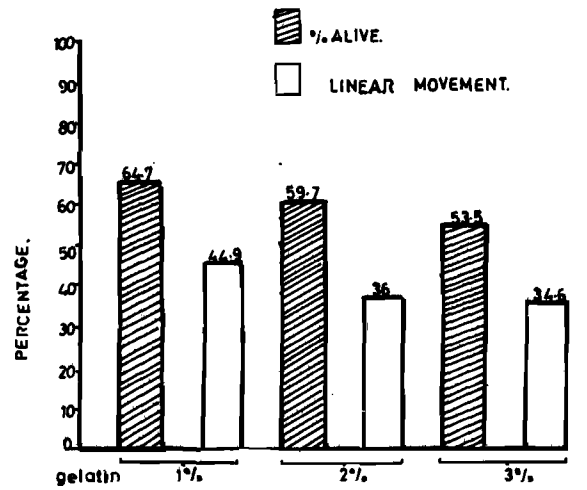


Table 3: PERCENTAGE LOSS OF SPERMATOZOA DURING PROCESSING

	1% gelatin	2% gelatin	3% gelatin
% Alive	18,3%	22,5%	20,0%
Linear movement	34,3%	34,0%	25,4%

DISCUSSION

The semen quality obtained for dilution with the two types of electrical stimulator was very similar. Basing selection for dilution on the standards set out earlier, we did not consider statistical comparison warranted.

As might be expected with electrical stimulation, the pH was somewhat higher than normal, ranging between 6,8—7,0. Visser [1] stressed the importance of pH when considering semen for dilution, especially with regard to the viability of the spermatozoa. The pH of the skimmed milk was 6,7, so in this trial no adjustment of final pH was carried out, since the pH of diluent and of semen were in most cases almost the same.

Although Visser [1] considered the use of gelatinized cow's milk for ram semen dilution unsatisfactory, the results of the *in vitro* trials in this work showed an improvement on the percentage of spermatozoa alive after four days' storage in relation to the results obtained by Visser. The viability obtained with the 1% gelatin solution after four days was 64%, as against the 50% obtained by Visser using a saturated gelatin solution. No indication was given by either Milovanov [3] *et al* or Razumov [2] as to the appearance of the semen after gelatin dilution, but the insemination results obtained by both workers augured well, being over 72% in each trial. The semen was used generally within six hours of dilution, however, and was transported at 15°C. Milonav [3] reports that after 30—36 hours at this temperature all the spermatozoa were dead.

In our experiment, using low percentages of gelatin in the diluent, we found that at 15°C the solution was still liquid: solidification only occurred at 5°C. This factor may be of importance in preventing undue shaking during transportation and is being investigated at the moment.

The loss of spermatozoa during the processes of dilution, cooling and re-warming are considered by most workers to range between 20% [19] and 50% [20]. With this in mind ,the method employed by Gunn *et al* [18] for determining dilution rate was employed. Even if the percentage loss were as high as 50%, the number of spermatozoa per unit volume for insemination would be in the region of 150×10^6 spermatozoa, the figure favoured by most workers for success [12, 15].

Contrary to the thoughts of Visser [1], then, our results in the *in vitro* trials using gelatinized milk diluents for ram semen appear highly satisfactory. Although spermatozoa

impedence during evaluation was about the same in a 1%, 2% or 3% gelatin diluent, the viability in a 1% solution was best. Solidification of the diluent was also obtained with this low percentage at 5°C, adequately fulfilling the purpose of increased diluent viscosity for transportation. It is concluded that the results *in vitro* warrant the *in vivo* use of gelatinized ram semen in field trials.

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THE ANTHELMINTIC EFFICACY OF MORANTEL TARTRATE* IN SHEEP AND GOATS

P. J. S. ANDERSON AND F. S. MARAIS**

SUMMARY

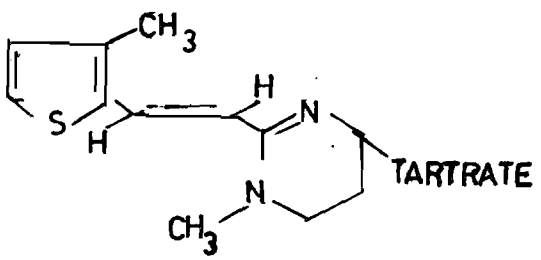
In a series of trials in sheep and goats the anthelmintic efficacy of morantel tartrate at 12,5 mg/kg bodyweight was found to be comparable with that of pyrantel tartrate at 25 mg/kg bodyweight.

Difficulties experienced in the assessment of the results in some instances are discussed.

INTRODUCTION

A series of compounds active against a wide range of nematodes parasitic in the gastrointestinal tract of animals was reported by Austin *et al*[1] in 1966. The first of these compounds to be tested extensively in laboratory and field trials and which found commercial application was pyrantel tartrate***. A further compound in this group, the 3-methyl analogue of pyrantel, given the common name morantel, has proven more potent than pyrantel in sheep[2]. This has been confirmed in the trials reported here, conducted with sheep and goats.

Morantel tartrate is a white, odourless, non-staining crystalline solid readily soluble in water (16,3 per cent m/v at 23°C).



GENERAL EXPERIMENTAL PROCEDURE

In Trials 1 to 5 inclusive the methods of Reinecke & Anderson[3] were used to test the anthelmintic efficacy of morantel tartrate against the following nematodes: *Haemonchus contortus, Ostertagia* spp. (*O. circumcincta* and *O. trifurcata*), *Trichostrongylus colubriformis, Nematodirus spathiger, Chabertia ovina* and *Oesophagostomum columbianum*. In addition fourth stage larvae, fifth stage and adult worms were present at the time of treatment in Trials 2 and 4. In Trial 6, however, experimental infestation was aimed at having only adult worms of *Ostertagia* spp. present at treatment. A modification of the method of Banks & Michel[4] was used to test the compound against all stages of development of *Gaigeria pachyscelis* in Trial 7. A critical anthelmintic test[5] was used in Trial 8 to test the efficacy of morantel tartrate against adult worms of *G. pachyscelis* and *O. columbianum*.

The commercially available 5% aqueous solution of morantel tartrate was used in these trials. The anthelmintic was dosed by intraruminal injection in all cases. The autopsy procedures as described by Shone & Philip[6] and by Reinecke[7] were followed. Total worm counts were made from all organ contents and mucosal filtrates processed in Shone's waterbath[6, 7]. In sheep infested with *O. columbianum*, total worm counts were made of worms recovered from the wall of the small intestine, caecum and colon, after digestion with pepsin/HCl.

A minimum of 1/10 of all residues was also examined for the presence of worms. Where worm recoveries from 1/10 aliquots of the residue were significant in relation to the total number of worms recovered from that particular organ, total worm counts were made.

While making worm counts, the specimens were thoroughly stirred to obtain a representative sample and the first 100 worms recovered were retained for identification. Larval stages were identified according to the descriptions of Veglia[8, 9], Ortlepp[10], Kates & Turner[11], Douvres[12, 13] and Threlkeld[14], and classified according to their various stages of development according to Reinecke[15].

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INDIVIDUAL TRIALS

TRIAL 1: EFFICACY AGAINST **O. columbianum, H. contortus** AND **T. colubriformis**

Materials and Methods

Twenty worm-free Dorper (Dorset Horn × Black Head Persian) lambs and one Dorper ewe, Sheep 22, the latter serving as larval viability control, were dosed *per os* with infective larvae of *O. columbianum, H. contortus* and *T. colubriformis* and divided into treated and control groups. The days on which they were treated and were killed are indicated in Table 1.

Table 1: TRIAL 1. EXPERIMENTAL DESIGN

Day	No. of infective larvae dosed to each sheep		
	H.contortus	T.colubriformis	O.columbianum
-8	-	-	96
-7	-	-	102
-6	-	-	93
-5	-	-	107
-4	-	-	97
-3	1052	995	106
-2	988	956	108
-1	1011	1032	104
Total	3051	2983	813
0	11 sheep treated		
+2	Sheep 22 (l.v.c.) * killed		
+6	5 control sheep killed		
+7	4 controls and 1 treated sheep killed		
+8	6 treated sheep killed		
+9	4 treated sheep killed		

* l.v.c. - Larval viability control sheep

Results

Worms recovered at autopsy are recorded in Table 2. The worm recoveries from the larval viability control, Sheep 22, indicated that the infective larvae were viable and that third stage larvae were present at the time of treatment. The worm burdens of *O. columbianum* were minimal in this larval viability control ewe.

Very uniform worm burdens were present in the 9 control sheep. With the exception of Sheep 25, which died on Day+3, uniform worm recoveries were also made from the 11 treated sheep. Total worm counts were made from both the ingesta and digested intestinal tract of Sheep 25.

It is interesting to note the marked difference between the total worm recoveries of *H. contortus* from the sheep killed on Day+8 (mean 42) and those killed on Day+9 (mean 7).

The data were analysed by using Clarke's modification of the methods of Groeneveld & Reinecke [16], as cited by Reinecke, Collins & Anderson [17]. This analysis is included in Table 2.

TRIAL 2: EFFICACY AGAINST **O. columbianum, H. contortus** AND **T. colubriformis**

Materials and Methods

Twenty-one worm-free Dorper lambs and two larval viability controls were dosed *per os* with infective larvae of *O. columbianum, H. contortus* and *T. colubriformis,* divided into treated and control groups. They were treated and killed according to the schedule in Table 3.

Results

Worms recovered are recorded in Table 4. Worm recoveries from the Day−6 and Day−1 larval viability control ewes, Sheep 20 and Sheep 21 respectively, indicated that the infective larvae were viable. The worm recoveries from the Day 0 control sheep show that all the desired stages of development of the worms were present at the time of treatment.

Although the total worm recoveries from the 10 control sheep were very uniform, considerable variation was seen in the stage of development reached by the worms in individual sheep. The majority of *H. contortus* recovered from the treated sheep 4 and 5 days after treatment was in the fifth stage; *T. colubriformis* was in the fifth or adult stage, while *O. columbianum* was in the fourth larval stage. The development stages are consolidated by including worms undergoing the fourth moult with fourth stage larvae and fifth stage worms with adults. These worm numbers were ranked; the statistical analysis is included in Table 5.

Table 2: TRIAL 1. WORMS RECOVERED POST MORTEM

Day Killed	Sheep No.	H.contortus (1) Stage of development					T.colubriformis Stage of development					O.columbianum Stage of development			
		L3	L4	M4	5	Total	L3	L4	M4	5	Total	L3	M3	L4	Total
Larval viability control Day - 8 to Day - 1															
+2	22	32	579	0	0	611	3	149	0	0	152	23	0	20	43
Controls															
+6	24	0	1460	365	0	1825	0	264	0	0	264	0	3	259	262
+6	26	0	1187	442	175	1804	0	387	1	0	388	0	20	193	213
+6	27	0	1098	181	58	1337	0	468	5	0	473	0	3	151	154
+6	32	0	1341	665	0	2006	0	440	19	0	459	0	0	226	226
+6	35	0	1305	372	0	1677	0	258	41	0	299	0	4	234	238
+7	39	0	1410	647	93	2150	0	202	277	74	553	0	0	318	318
+7	40	0	426	1451	375	2252	0	46	199	136	381	2	0	222	224
+7	41	0	251	513	646	1410	0	18	163	157	338	0	0	208	208
+7	44	0	211	934	857	2002	0	35	157	148	340	0	0	290	290
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally															
+3	25	0	0	1	0	1	0	0	0	0	0	0	3	14	17
+8	28	0	0	12	18	30	0	0	0	1	1	0	0	159	159
+8	29	0	0	17	37	54	0	0	0	4	4	0	0	210	210
+8	30	0	0	2	25	27	0	0	1	1	2	0	0	203	203
+8	31	0	0	3	19	22	0	0	0	0	0	0	0	131	131
+8	34	0	0	3	64	67	0	0	0	0	0	0	0	172	172
+8	36	0	0	0	55	55	0	0	0	0	0	0	0	203	203
+9	38	0	0	1	6	7	0	0	0	0	0	0	1	206	207
+9	42	0	0	0	7	7	0	0	0	0	0	0	0	114	114
+9	43	0	0	0	7	7	0	0	0	0	0	0	0	217	217
+9	45	0	0	1	8	9	0	0	1	0	1	0	0	235	235
Non-parametric grading															
		Control median 1825 1825 x 0,25 = 456 0/11 treated sheep exceed 456 Grading - Class A					Control median 340 340 x 0,25 = 85 0/11 treated sheep exceed 85 Grading - Class A					Control median 226 226 x 0,5 = 113 10/11 treated sheep exceed 113 Grading - Class X			

(1) Key to the stages of development
L3 = third stage larvae M3 = third moult L4 = fourth stage larvae
M4 = fourth moult 5 = 5th stage worm

TRIAL 3: EFFICACY AGAINST **C. ovina, Ostertagia** spp. AND **N. spathiger**

Materials and Methods

Twenty-two Dorper lambs, including one larval viability control (Sheep 72), were dosed *per os* with infective larvae of *C. ovina, Ostertagia* spp. and *N. spathiger*, divided into treated and control groups and treated and killed according to the schedule in Table 6.

Results

Worms recovered are recorded in Table 7. Worm burdens in the larval viability control (Sheep 72) showed that the infective larvae were viable and that third stage worms were present at the time of treatment, despite the delay of two days after treatment when this sheep was killed.

Table 3: TRIAL 2. EXPERIMENTAL DESIGN

Day	PROCEDURE Killed/ Treated	No. of infective larvae dosed to each sheep		
		H. contortus	T. colubriformis	O. columbianum
-50		-	-	92
-40		-	-	97
-30		-	-	101
-26		-	-	103
-24		-	-	100
-22		-	-	49
-20		305	277	55
-18		186	205	52
-16		266	267	45
-14		-	-	53
-12		196	200	53
-11		239	300	-
-10		189	188	61
-9		279	309	-
-8		189	198	56
-7		249	297	-
-6	Sheep 20 (l.v.c.)killed	200	208	-
-5		291	294	-
-4		302	340	-
-3		-	-	-
-2		-	-	-
-1	Sheep 21 (l.v.c.)killed	-	-	-
Total		2891	3083	917
0	11 sheep treated 5 control sheep killed			
+1	5 control sheep killed			
+4	6 treated sheep killed			
+5	5 treated sheep killed			

Uniform worm burdens were established in nine of the ten control sheep. Noticeably fewer worms were recovered from Sheep 51. Fairly uniform worm recoveries were made from the eleven treated sheep, with the exception of those from Sheep 92. This sheep had been seen to be ailing (temperature 106°F) and was killed that same day, Day +6. No reason for this high temperature could be established at *post-mortem* examination.

The statistical analysis of results is given in Table 7.

TRIAL 4: EFFICACY AGAINST C. ovina, Ostertagia spp. AND N. spathiger

Materials and Methods

Twenty-three Dorper lambs, two of which served as larval viability controls, were dosed *per os* with infective larvae of *C. ovina*, *Ostertagia* spp. and *N. spathiger*. They were divided into treated and control groups, and treated and killed according to the schedule in Table 8.

Results

Worms recovered are recorded in Table 9. The worms recovered from the Day −6 and Day −1 larval viability controls, Sheep 18 and Sheep 85 respectively, proved that the infective larvae were viable. Worm recoveries from the Day 0 control sheep confirmed that all stages of development, with the exception of third stage larvae, were present at the time of treatment.

More *N. spathiger* in the third moult were recovered five days after the last dose of infective larvae than was expected. Kates & Turner [11] found that the transformation of the majority of third stage larvae into fourth stage larvae occurred prior to the fifth day of parasitic life, probably between the third and fifth days.

Total worm recoveries from the 10 control sheep were fairly uniform. Recoveries of adult *Ostertagia* spp. and fourth stage larvae of *C. ovina* varied considerably in the individual sheep.

Relatively uniform worm recoveries were made from the 11 treated sheep. Worms in the fourth moult were added to fourth stage larvae and the fifth and adult stages were also added together. These were ranked and the statistical analysis is given in Table 10.

TRIALS 5 AND 6: EFFICACY AGAINST Ostertagia INFESTATION IN GOATS

Introduction

By using only one group of sheep, an attempt had been made in Trial 4 to determine that efficacy of morantel tartrate against fourth stage larvae, fourth moult, fifth stage (young adults) and adult worms of *Ostertagia* spp. It was found that morantel tartrate was only partially effective against fourth stage larvae of *Ostertagia* spp. While assessing the efficacy of this anthelmintic against adult *Ostertagia* spp. in Trial 4, it was felt that the method used had not taken into account the tardiness of this species to complete the fourth moult. It is our opinion that some of these fourth stage larvae that survived the treatment were recovered later as adults and that this had had an erroneously adverse effect on the efficacy grading of this compound against adult *Ostertagia* spp.

Table 4: TRIAL 2. WORMS RECOVERED POST MORTEM

Day Killed	Sheep No.	H.contortus					T.colubriformis					O.columbianum					
		Stage of development					Stage of development					Stage of development					
		L4	M4	L5	A	Total	L4	M4	L5	A	Total	L3	L4	M4	L5	A	Total
Larval viability control Day - 49 to Day - 10																	
-6	20	107	24	92	145	368	80	13	63	91	247	0	38	0	1	0	39
Larval viability control Day - 9 to Day - 4																	
-1	21	77	48	60	57	242	30	15	1	42	88	5	0	0	1	0	6
Controls																	
0	2	232	66	242	436	976	64	36	158	229	487	0	130	5	87	55	277
0	13	247	73	206	340	866	93	0	122	264	479	0	37	0	8	77	122
0	14	157	43	149	437	786	46	25	49	193	313	0	87	3	90	89	269
0	17	68	96	792	462	1418	85	0	201	364	650	0	132	11	65	103	311
0	21	148	94	279	500	1021	86	20	96	140	342	0	133	9	128	35	305
+1	5	348	61	147	394	950	19	9	75	155	258	0	79	16	54	116	265
+1	7	246	84	333	606	1269	24	23	98	306	451	0	67	2	37	61	167
+1	18	379	12	64	319	774	20	29	120	289	458	0	39	2	5	54	100
+1	20	53	2	38	313	406	24	18	100	207	349	0	80	16	109	138	343
+1	23	354	79	228	544	1205	66	23	162	200	451	0	87	7	105	58	257
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally																	
+4	1	0	0	1	1	2	0	0	6	0	6	0	23	0	0	0	23
+4	8	0	1	12	3	16	2	0	2	4	8	0	29	2	1	0	32
+4	9	0	0	10	4	14	0	0	7	36	43	0	59	0	23	0	82
+4	10	4	6	11	14	35	0	0	4	5	9	0	41	0	4	0	45
+4	12	0	0	20	4	24	0	0	11	26	37	0	47	3	22	10	82
+4	46	0	0	0	0	0	0	0	3	9	12	0	43	0	0	0	43
+5	3	0	0	0	0	0	0	0	1	4	5	0	68	0	0	0	68
+5	4	0	0	10	0	10	0	0	1	16	17	0	37	2	2	0	41
+5	11	0	0	10	5	15	0	0	1	24	25	0	44	6	12	21	83
+5	19	0	0	15	5	20	0	0	7	28	35	0	40	7	9	1	57
+5	22	0	0	1	0	1	0	0	10	34	44	0	40	5	0	0	45

Table 5: TRIAL 2. STATISTICAL ANALYSIS OF WORM RECOVERIES

H.contortus				T.colubriformis				O.columbianum			
Fourth		Adults		Fourth		Adults		Fourth		Adults	
Controls	Treated	Controls	Treated	Controls	Treated	Controls	Treated	Controls	Treated	Controls	Treated
55	0	351	0	28	0	230	5	37	23	59	0
164	0	383	0	42	0	236	6	41	31	85	0
200	0	541	1	47	0	242	6	69	39	98	0
242	0	546	2	49	0	307	9	90	41	142	0
298	0	586	10	71	0	362	12	94	43	163	1
320	0	678	14	85	0	386	17	95	45	163	2
330	0	772	15	89	0	387	25	96	47	168	4
391	0	779	15	93	0	404	35	135	50	170	10
409	0	939	20	100	0	409	37	142	50	179	23
433	1	1254	24	106	0	565	43	143	59	247	32
	10		25		2		44		68		33
Non-parametric grading											
Control median 309 309 x 0,25 = 77 0/11 treated sheep exceed 77 Grading - Class A		Control Median 632 632 x 0,25 = 158 0/11 treated sheep exceed 158 Grading - Class A		Control Median 78 78 x 0,25 = 20 0/11 treated sheep exceed 20 Grading - Class A		Control median 374 374 x 0,25 = 93 0/11 treated sheep exceed 93 Grading - Class A		Control median 94 94 x 0,5 = 47 4/11 treated sheep exceed 47 Grading - Class C		Control median 163 163 x 0,25 = 41 0/11 treated sheep exceed 41 Grading - Class A	

Table 6: TRIAL 3. EXPERIMENTAL DESIGN

Day	No. of infective larvae dosed to each sheep		
	Ostertagia spp.	N.spathiger	C.ovina
-8	-	-	110
-7	-	-	124
-6	-	-	92
-5	-	-	101
-4	-	-	104
-3	1022	957	107
-2	986	963	96
-1	981	998	103
Total	2989	2918	837
0	Treated 11 sheep		
+2	Sheep 72 (l.v.c.) killed		
+6	4 control and 1 treated sheep killed		
+7	6 control and 1 treated sheep killed		
+8	5 treated sheep killed		
+9	4 treated sheep killed		

It was decided, therefore, to retest the compound by carrying out two separate trials: in Trial 5 only fourth stage larvae and the fourth moult were included; in Trial 6 the intention was to have only adult *Ostertagia* spp. present at the time of treatment. Moreover, goats were used in these trials, as the goat is considered to be the normal host for this species of worm.

Materials and Methods

Weaned Angora goat kids, born, raised and maintained worm-free, were dosed with infective larvae, divided into treated and control groups, and subjected to a regimen of treatment and slaughter as indicated in Tables 11 and 13.

After treatment and slaughter of the Day 0 control goat, sufficient time was allowed for the worms remaining in the treated and control goats to have developed to the more easily recovered adult stage.

Recovery of worms from the contents of the abomasum and first portion of the duodenum was made by the methods described by Reinecke, Horak & Snijders[18], as modified by Reinecke[19]. Total worm counts, however, were made in every instance. Worm recovery from the Day 0 control goats, as well as from the mucosal scrapings of the abomasum in all goats in the two trials, was made by the method previously referred to[6, 7].

The experimental design of Trial 5 is set out in Table 11, and that of Trial 6 in Table 13.

Results: Trial 5

Worms recovered are recorded in Table 12. Worm recoveries from the Day 0 control (Goat 133) showed that 530 (55,6%) were in the fourth stage of development, 344 (35%) were still undergoing the fourth moult and 90 (9,4%) were fifth stage worms at the time of treatment.

Total worm burdens in the control goats were reasonably uniform, varying from 592 to 1 218, whereas total worm burdens in the treated goats varied from 255 to 511. Large numbers of very small worms were recovered, but all had completed the third moult.

The statistical analysis of the results is also presented in Table 12.

Results: Trial 6

Worms recovered are recorded in Table 14. Only 266 worms had completed the fourth moult by Day 0, as indicated by the worms present in Goat 117; 67 worms were still in the fourth moult and, unexpectedly, 429 fourth stage larvae were also present. Total worm recoveries from the control goats were very uniform, varying from 716 to 1 393. A variable number of immature worms was recovered from the control goats eight days after the day of treatment.

Worm recoveries from the treated goats varied from 76 to 301. Immature worms were also recovered from these goats seven days after treatment.

Statistical analysis of the results is also given in Table 14.

Discussion

The stages of development covered in Trial 4 were repeated in Trials 5 and 6 respectively.

In Trial 5, examination of the Day 0 control (Goat 133) indicated that 91,6% of the worms were still present as fourth stage larvae or were undergoing the fourth moult at the time of treatment. Total worm counts, therefore, were considered to be relevant

Table 7: TRIAL 3. WORMS RECOVERED POST MORTEM

Day Killed	Sheep No.	Ostertagia spp.					N.spathiger					C.ovina			
		Stage of development					Stage of development					Stage of development			
		L3	M3	L4	M4	Total	L3	M3	L4	M4	Total	L3	M3	L4	Total
Larval viability control Day - 8 to Day - 1															
+2	72	2	303	532	0	837	755	391	512	0	1658	33	23	306	362
Controls															
+6	62	0	0	218	2	220	0	0	1664	179	1843	8	5	289	302
+6	63	0	0	108	5	113	0	0	2239	96	2335	3	2	432	437
+6	75	0	0	300	9	309	0	0	1664	118	1782	2	1	441	444
+6	88	0	0	158	15	173	0	0	1907	73	1980	27	85	458	570
+7	51	0	0	73	3	76	0	0	936	36	972	0	0	156	156
+7	64	0	0	180	7	187	0	0	2146	35	2181	0	1	248	249
+7	69	0	0	409	15	424	0	0	2261	90	2351	0	2	373	375
+7	82	0	0	266	18	284	0	0	1916	175	2091	1	0	261	262
+7	90	0	0	179	3	182	0	0	2013	76	2089	0	0	259	259
+7	91	0	0	210	5	215	0	0	1736	64	1800	0	1	394	395
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally															
+6	92	0	0	460	9	469	0	0	0	28	28	0	0	141	141
+7	74	0	0	3	1	4	0	0	0	8	8	0	0	45	45
+8	53	0	0	7	0	7	0	0	12	0	12	0	0	106	106
+8	57	0	0	1	4	5	0	0	9	0	9	0	0	53	53
+8	59	0	0	2	1	3	0	0	13	0	13	0	0	72	72
+8	73	0	0	1	4	5	0	0	1	0	1	0	0	40	40
+8	79	0	0	0	2	2	0	0	3	0	3	0	0	48	48
+9	19	0	0	2	1	3	0	0	2	0	2	0	0	40	40
+9	55	0	0	4	2	6	0	0	1	0	1	0	0	44	44
+9	65	0	0	0	0	0	0	0	0	0	0	0	0	17	17
+9	70	0	0	1	6	7	0	0	0	0	0	0	0	62	62
Non-parametric grading															
		Control median 201 201 x 0,25 = 50 1/11 treated sheep exceed 50 Grading - Class A					Control median 2034 2034 x 0,25 = 508 0/11 treated sheep exceed 508 Grading - Class A					Control median 338 338 x 0,4 = 135 1/11 treated sheep exceed 135 Grading - Class B			

and were used in determining the efficacy of morantel tartrate against fourth stage larvae of *Ostertagia* spp.

In Trial 6, however, worm recoveries from the Day 0 control (Goat 117) showed that only 35% of the worms had completed the fourth moult at the time of treatment, 9% were undergoing the fourth moult and 56% were still in the fourth larval stage. This means that 65% of the worms had not yet developed to the adult stage required for this trial, as had been planned theoretically.

According to Threlkeld [20] and Denham [21], the fourth moult occurs between the 7th and 8th, or from the 7th to 9th day respectively, after infestation. Sommerville [22], however, showed that this could be delayed for as long as 84 days. The findings in these trials support Sommerville's observation, rather than that of the former two.

Actual adult worm counts and their percentages in terms of the total worms recovered from both control and treated goats are presented in Table 15. We feel that these

Table 8: TRIAL 4. EXPERIMENTAL DESIGN

Day	PROCEDURE Killed/ Treated	No. of infective larvae dosed to each sheep		
		Ostertagia spp.	N.spathiger	C.ovina
-55		-	-	112
-40		-	-	104
-31		-	-	105
-27		-	-	101
-24		-	-	49
-20		202	302	49
-18		-	-	53
-16		203	312	49
-14		-	-	55
-13		291	307	55
-10		304	154	50
-9		206	149	-
-8		208	149	58
-7		208	159	-
-6	Sheep 18 (l.v.c.) killed	201	155	-
-5		197	150	-
-4		189	152	-
-3		-	-	-
-2		-	-	-
-1	Sheep 85 (l.v.c.) killed	-	-	-
Total		2209	1989	840
0	11 sheep treated 5 control sheep killed			
+1	5 control sheep killed			
+4	6 treated sheep killed			
+5	5 treated sheep killed			

worm counts are more relevant than total worm counts in this trial.

In the control goats there was much more variation in the numbers of adult worms, which ranged from 377 to 1 340, than in the total worm burdens, which only varied from 716 to 1 393. To some extent this is probably due to variation in the susceptibility of individual goats but also to a variation in the percentage of the larvae that had completed the fourth moult twenty to thirty-six days after being dosed to the goat.

The mean percentage of adult worms recovered from the control goats was 80,3% but this varied from 44,7% in Goat 103 to 99,3% in Goat 121. The mean percentage of adult worms recovered from the treated goats was 49,1% which varied from 11,4% in Goat 115 to 71,1% in Goat 118. Statistical analysis of the results of the test with adult worms, indicated in Table 16, confirms the high efficacy of morantel tartrate against this stage of *Ostertagia* spp.

Table 9: TRIAL 4. WORMS RECOVERED POST MORTEM

Day Killed	Sheep No.	Ostertagia spp. Stage of development							N.spathiger Stage of development						C.ovina Stage of development						
		L3	M3	L4	M4	L5	Adult	Total	M3	L4	M4	L5	Adult	Total	L3	M3	L4	M4	L5	Adult	Total
Larval viability control Day - 55 to Day - 9																					
-6	18	0	11	112	5	20	6	154	0	464	40	20	0	524	9	4	126	15	69	60	283
Larval viability control Day - 8 to Day - 4																					
-1	85	20	49	49	0	0	0	118	20	219	0	0	0	311	0	1	11	0	0	0	12
Controls																					
0	61	0	0	106	3	8	48	165	71	360	63	201	316	1011	0	0	43	3	124	95	265
0	68	0	0	67	16	35	73	191	29	356	33	137	309	864	0	0	72	7	124	140	343
0	71	0	0	82	2	4	53	141	46	412	72	207	255	992	0	0	85	27	118	120	350
0	83	0	0	310	1	9	60	380	0	102	136	266	448	952	0	0	195	8	110	160	473
0	86	0	0	72	11	50	118	251	14	399	101	124	407	1045	0	0	84	11	114	190	399
+1	47	0	1	116	12	17	110	256	19	396	88	131	172	806	0	0	90	6	157	20	273
+1	52	0	0	253	12	11	42	318	13	485	36	75	175	784	0	0	72	17	72	130	291
+1	67	0	0	174	7	19	71	271	9	595	9	74	272	959	0	0	118	0	60	120	298
+1	84	0	0	179	11	24	85	299	62	512	97	140	229	1049	0	0	213	15	47	210	485
+1	89	0	0	185	6	22	151	364	21	294	112	157	376	960	0	0	133	12	110	100	355
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally																					
+4	48	0	0	17	6	4	6	33	0	12	0	0	1	13	0	0	5	0	0	0	5
+4	54	0	0	79	18	25	19	141	0	4	0	0	1	5	0	0	7	0	10	0	17
+4	56	0	0	62	9	12	2	85	0	4	1	0	12	17	0	0	3	0	0	0	3
+4	58	0	0	49	7	2	1	59	0	1	0	2	0	3	0	0	0	0	0	0	0
+4	66	0	0	34	7	1	1	43	0	0	0	1	0	1	0	0	1	0	0	0	1
+4	87	0	0	34	3	11	1	49	0	1	0	0	0	1	0	0	3	0	0	0	3
+5	49	0	0	33	27	41	39	140	0	2	0	74	26	102	0	0	5	1	0	0	6
+5	60	0	0	66	28	20	12	126	0	1	0	0	0	1	0	0	5	0	0	0	5
+5	76	0	0	34	8	5	2	49	0	0	0	3	0	3	0	0	3	0	0	0	3
+5	77	0	0	58	24	24	9	115	0	2	1	0	0	3	0	0	7	0	10	0	17
+5	78	0	0	41	21	14	3	79	0	6	1	1	0	8	0	0	18	0	0	0	18

Table 10: TRIAL 4. STATISTICAL ANALYSIS OF WORM RECOVERIES

Ostertagia spp.				N.spathiger				C.ovina			
Fourth		Adults		Fourth		Adults		Fourth		Adults	
Controls	Treated	Controls	Treated	Controls	Treated	Controls	Treated	Controls	Treated	Controls	Treated
83	23	53	2	238	0	250	0	46	0	177	0
83	37	56	3	389	0	303	0	79	1	180	0
84	41	57	7	406	1	346	0	89	3	202	0
109	42	69	10	423	1	369	1	95	3	210	0
128	56	90	12	484	1	446	1	96	3	219	0
181	60	108	14	484	2	462	1	112	5	238	0
190	62	109	17	500	3	517	1	118	5	257	0
191	71	127	32	521	4	531	2	145	6	264	0
265	82	168	33	604	5	533	3	203	7	270	0
311	94	173	44	618	7	714	12	228	7	304	10
	97		80		12		100		18		10
Non-parametric grading											
Control median 154,5 154,5 x 0,5 = 77 3/11 treated sheep exceed 77 Grading - Class C		Control median 99 99 x 0,4 = 40 2/11 treated sheep exceed 40 Grading - Class B		Control median 484 484 x 0,25 = 121 0/11 treated sheep exceed 121 Grading - Class A		Control median 454 454 x 0,25 = 113 0/11 treated sheep exceed 113 Grading - Class A		Control median 104 104 x 0,25 = 26 0/11 treated sheep exceed 26 Grading - Class A		Control median 228 228 x 0,25 = 57 0/11 treated sheep exceed 57 Grading - Class A	

Because a large percentage of the worms was retarded and had not yet reached the adult stage on the day of treatment, the total worm burdens cannot be used to assess the efficacy of the compound against adult worms. It is better to assess the results on the adult worm counts only, as long as it is recognized that, in common with any other method of analysing the results, there is no method known by which any estimate can be made of the unknown and presumably variable number of worms that complete the fourth moult between the time of treatment and the day the goats are killed.

Table 11: TRIAL 5. EXPERIMENTAL DESIGN

Day	No. of infective Ostertagia larvae dosed to each goat
-12	297
-11	297
-10	297
-9	297
-8	314
-7	313
-6	313
-5	297
-4	291
Total	2716
0	11 goats treated Goat 133 (Day 0 Control) killed
+16	11 treated goats killed
+17	10 control goats killed

As was the case in previous trials[23], we found that where there is no regular and predictable rate of development of the worm species in the trial, particularly where the efficacy of the anthelmintic against all possible stages of development of the worm does not approach 100%, one must kill the experimental animals as soon after treatment as is feasible for a more accurate assessment of the efficacy of the compound.

TRIAL 7: EFFICACY AGAINST G. pachyscelis AND Oesophagostomum columbianum

Methods and Materials

In this trial we used the method of Banks & Michel[4] to assess the efficacy of morantel tartrate against various stages of development of *G. pachyscelis*. In addition we made further use of two groups of goats in this trial to conduct a critical trial on *G. pachyscelis* as well as a critical test on fifth stage and adult *O. columbianum*.

Table 12: TRIAL 5. WORM RECOVERIES AND STATISTICAL ANALYSIS OF RESULTS

Worms Recovered post mortem					
Day Killed	Goat No.	Ostertagia spp.			
		Stage of development			
		L4	M4	Adults	Total
Day 0 control					
0	133	530	334	90	954
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally					
+16	125	83	0	253	336
+16	130	226	0	285	511
+16	132	272	0	236	508
+16	134	175	0	227	402
+16	136	116	0	159	275
+16	137	226	0	145	371
+16	138	275	0	189	464
+16	139	153	0	102	255
+16	140	132	0	239	371
+16	141	40	0	242	282
+16	142	40	0	355	395
Controls					
+17	123	323	0	790	1113
+17	124	325	0	532	857
+17	126	299	0	723	1022
+17	127	369	0	495	864
+17	128	426	0	305	731
+17	129	373	0	380	753
+17	131	470	0	561	1031
+17	135	149	0	443	592
+17	143	299	0	919	1218
+17	144	110	0	522	632

Non-parametric grading
Control median 860,5
860,5 x 0,5 = 430
3/11 treated goats exceed 430
Grading - Class C

The design of this trial is summarized in Table 17.

Fifty-eight Dorper ewes, including a Day +5 and a Day +15 larval viability control (Sheep 61 and Sheep 28, respectively) were used. Each of them was dosed percutaneously with 445 infective larvae of *G. pachyscelis* on Day 0. To each of all sheep, 410 and 388 infective larvae of *O. columbianum* were dosed on Day +25 and Day +27 respectively. Morantel tartrate at 12.5 mg/kg was dosed to four different groups of 11 sheep each on Day +5, on Day +15, on Day +30 and Day +64 respectively. Faecal collecting bags were attached to the hindquarters of each sheep dosed on Day +30 and Day +64. These bags were replaced every 12 hours and faecal collection was continued for 48 hours after treament. Faecal pellets were broken up gently and sieved through 100 mesh sieves and the number of worms present was recorded.

Table 13: TRIAL 6. EXPERIMENTAL DESIGN

Day	No. of infective Ostertagia larvae dosed to each goat
-28	202
-27	210
-26	-
-25	205
-24	-
-23	-
-22	199
-21	210
-20	198
-19	206
-18	206
-17	203
-16	203
-15	202
-14	198
-13	197
-12	197
Total	2836
0	Treated 11 goats Goat 117 (Day 0 control) killed
+7 +8	11 treated goats killed 10 control goats killed

Sheep were killed on Day +5, +15, +43, +52, +53, +57 and +66 as set out in Table 17.

In addition to the normal examination of the gastrointestinal tract, the lungs were examined in both of the larval viability controls. In the larval viability control, killed on Day +5, the parotid and lateral retropharyngeal lymph nodes were also examined for worms by the mehods of Anderson & Verster[24]. At autopsy the ingesta of the intestinal tract were sieved through 100 mesh sieves, the worms present counted and the number was recorded. The mucosa of the gut wall was also carefully examined and any adherent specimens of *G. pachyscelis* were removed and counted.

Results and Discussion

Worm recoveries from the larval viability controls are recorded in Table 18. The worm recoveries from the Day +5 larval viability control ewe indicate that third stage larvae of *G. pachyscelis* were predominantly in the

Table 14: TRIAL 6. WORM RECOVERIES AND STATISTICAL ANALYSIS

Worms Recovered post mortem					
Day Killed	Goat No.	Ostertagia spp.			
		Stage of development			
		L4	M4	Adults	Total
Day 0 control					
0	117	429	67	266	762
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally					
+7	102	114	0	41	155
+7	105	112	0	108	220
+7	106	79	0	136	215
+7	107	102	0	58	160
+7	109	108	0	34	142
+7	111	54	0	131	185
+7	113	114	0	94	208
+7	115	140	0	18	158
+7	116	67	0	163	230
+7	118	22	0	54	76
+7	120	109	0	192	301
Controls					
+8	101	339	0	377	716
+8	103	484	0	391	875
+8	104	322	0	462	784
+8	108	159	0	592	751
+8	110	154	0	812	966
+8	112	228	0	833	1061
+8	114	175	0	788	963
+8	119	140	0	1135	1275
+8	212	7	0	921	928
+8	122	53	0	1340	1393

Non-parametric grading
Control median 945,5
945,5 x 0,25 = 236,4
1/11 treated goat exceeded 236,4
Grading - Class A

Table 15: TRIAL 6. PERCENTAGE FOURTH STAGE AND ADULT WORMS IN TOTAL Ostertagia spp. RECOVERIES

Day Killed	Goat No.	Ostertagia spp.				
		Stage of development				
		L4	Adult	Total	% L4	% Adult
Treated with morantel tartrate at 12,5 mg/kg intra-ruminally						
+7	102	114	41	155	73,5	26,5
+7	105	112	108	220	50,9	49,1
+7	106	79	136	215	36,7	63,3
+7	107	102	58	160	63,7	36,3
+7	109	108	34	142	76,1	23,9
+7	111	54	131	185	29,2	70,8
+7	113	114	94	208	54,8	45,2
+7	115	140	18	158	88,6	11,4
+7	116	67	163	230	29,1	70,9
+7	118	22	54	76	28,9	71,1
+7	120	109	192	301	36,2	63,8
Controls						
+8	101	339	377	716	47,4	52,6
+8	103	484	391	875	55,3	44,7
+8	104	322	462	784	41,1	58,9
+8	108	159	592	751	21,2	78,8
+8	110	154	812	966	15,9	84,1
+8	112	228	833	1061	21,5	78,5
+8	114	175	788	963	18,2	81,8
+8	119	140	1135	1275	10,9	89,1
+8	121	7	921	928	0,7	99,3
+8	122	53	1340	1393	3,8	96,2

Mean percentage adult worms in control goats 80,3%
Mean percentage adult worms in treated goats 49,1%

Table 16: TRIAL 6. STATISTICAL ANALYSIS OF ADULT OSTERTAGIA spp. WORM RECOVERIES

Controls	Treated
377	18
391	34
462	41
592	54
788	58
812	94
833	108
921	131
1135	136
1340	163
	192

Non-parametric grading

Control median		800
800 x 0,25	=	200
0/11 treated goats exceed		200

Grading - Class A

lungs at the time of treament. The worms in the Day +15 larval viability control were fourth stage larvae in the lumen of the small intestine on the day of treatment. One worm, however, was found in the lungs.

The numbers of adult worms recovered from the control and from the treated sheep are ranked in ascending order in Table 19. The three sheep which had retained 1, 1 and 2 *G. pachyscelis* respectively after treatment on Day +15 probably had these worms in the lungs at the time of treatment.

The results of the controlled anthelmintic test showed that the compound was ineffective against third stage larvae of *G. pachyscelis* in the lungs when the worms were only 5 days old but easily reached a Class A grading (more than 80% effective in more than 80% of the flock) when the worms were fourth stage larvae (Day +15), fifth stage (Day +30) and adult (Day +64) worms. Its effect against 64-day-old worms was confirmed in the critical test (Table 20).

The evidence obtained from examination of the two larval viability controls and the Day +5 and Day +64 treated sheep precludes any possibility of lack of larval viability. All sheep in the trial were given equal doses of infective larvae of *G. pachyscelis* from one bulk source. We can only conclude that killed or detached fifth stage *G. pachyscelis* are digested prior to elimination in the faeces.

Table 17: TRIAL 7. EXPERIMENTAL DESIGN

Day	Dosing of Infective Larvae	Sheep Treated	Sheep Killed
0	445 G.pachyscelis to 56 sheep		
+5		11 sheep	Sheep 61 (l.v.c.)
+15		11 sheep	Sheep 28 (l.v.c.)
+25	410 O.columbianum to 11 sheep, treated on Day +64		
+27	388 O.columbianum to 11 sheep, treated on Day +64		
+30		11 sheep (Faecal bags for 48 hours)	
+43			6 control sheep
+44			6 control sheep
+52			11 sheep treated Day +5
+53			11 sheep treated Day +15
+57			11 sheep treated Day +30
+64		11 sheep (Faecal bags for 48 hours)	
+66			11 sheep treated Day +64

Table 18: TRIAL 7. CONTROLLED ANTHELMINTIC TEST. G.pachyscelis RECOVERED POST MORTEM

Larval viability Controls

Day	Sheep No.	Site	Stage of Development	
			L3	L4
+5	61	Parotid and atlantal lymph nodes	3	0
		Lungs	46	0
		Total	49	0
+15	28	Lungs	1	0
		Small Intestine	0	115
		Total	1	115

The critical anthelmintic test was found to be unsatisfactory for fifth stage *G. pachyscelis*. Not a single worm of this species was recovered from the entire faecal output of 11 sheep for 48 hours after treatment 30 days after infestation.

Table 19: TRIAL 7. CONTROLLED ANTHELMINTIC TEST - G.pachyscelis
ADULT WORMS RECOVERED POST MORTEM FROM THE CONTROL AND TREATED GROUPS OF SHEEP, RANKED IN ASCENDING ORDER

Control Sheep	Treated Sheep			
	Day of Treatment			
	+5	+15	+30	+64
59	47	0	0	0
69	54	0	0	0
111	57	0	0	0
122	59	0	0	0
134	61	0	0	0
140	78	0	0	0
147	90	0	0	0
154	122	0	0	0
157	167	1	0	0
171	168	1	0	0
193	169	2	0	0
194				
	Non-parametric grading			
Control median 143	143 x 0,5 = 71 7/11 treated sheep exceed 71 Grading - Class X	143 x 0,25 = 36 0/11 treated sheep exceed 36 Grading - Class A	No worms recovered Grading - Class A	No worms recovered Grading - Class A

Only 7 of 11 sheep infested with infective larvae of *O. columbianum* on Day +25 and Day +27 were still infested on Day +64 when this group was treated. The worms recovered from the 7 infested animals from all sources ranged from 5 to 115. This disappointing trial made a non-parametric analysis somewhat problematical. The results of Trial 2, however, as summarized in Table 5, clearly indicate that morantel tartrate at 12,5 mg/kg attained a grading of Class A against adult *O. columbianum*. The results of the critical test in Trial 7, despite the poor worm burdens of *O. columbianum* recorded, confirm this finding.

WORM SPECIES	Immature		Adults
	3rd stage larvae	4th stage larvae	
Haemonchus contortus	A	A	A
Ostertagia spp. (*O. circumcincta* and *O. trifurcata*)	A	C	A
Trichostrongylus colubriformis	A	A	A
Nematodirus spathiger	A	A	A
Gaigeria pachyscelis	X	A	A
Chabertia ovina	B	A	A
Oesophagostomum columbianum	X	C	A

KEY

Class	DEFINITION
A	More than 80% effective in more than 80% of the treated flock.
B	More than 60% effective in more than 60% of the treated flock.
C	More than 50% effective in more than 50% of the treated flock.
X	Ineffective

CONCLUSIONS

The anthelmintic efficacy of morantel tartrate at 12,5 mg/kg body mass could be classified as follows in terms of the requirements of the Registering Officer:

Table 20: TRIAL 7. CRITICAL TEST RESULTS

Site / Sheep No.	Worms recovered from sheep										
	57	48	52	36	91	60	75	68	51	84	46
From faeces	*G. pachyscelis*: 30 day old worms at treatment										
	0	0	0	0	0	0	0	0	0	0	0
post mortem	0	0	0	0	0	0	0	0	0	0	0

Site / Sheep No.	86	90	33	63	47	54	74	81	34	77	32
From faeces	*G. pachyscelis*: 64 day old worms at treatment										
	56	49	77	55	110	68	96	102	116	76	63
post mortem	0	0	0	0	0	0	0	0	0	0	0
	Non-parametric grading Since no worms were recovered from any of the sheep after treatment no analysis is necessary Grading - Class A										

From faeces	*O. columbianum*: 39 and 37 day old worms at treatment										
	17	82	13	5	115	13	72	0	0	0	0
post mortem	1	1	0	0	0	0	4	0	0	0	0
	Non-parametric grading The low worm burdens in the 7 infested animals and the absence of this species in four sheep make analysis by this method problematical										

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BOOK REVIEW — BOEKRESENSIE

SYMPOSIUM ON GASTROINTESTINAL MEDICINE AND SURGERY

The Veterinary Clinics of North America. Volume 2 - Number 1

GUEST EDITOR A. PALMINTERI

Philadelphia; W. B. Saunders Co., January 1972. Pp vi & 199. 75 Figures.
Price not stated.

"The Veterinary Clinics of North America" is published three times each year. Each number takes the form of a symposium in which the knowledge concerning a specific field or subject is brought up-to-date and summarized. Sixteen authors, including Prof. C. F. B. Hofmeyr, have contributed to the present symposium.

The scope of the number under review is limited to details of everyday small animal practice. Esoteric surgery and descriptive pathology are largely avoided. The diagnosis and treatment of most of the common, and often troublesome, problems encountered in veterinary practice, are discussed. These cannot be mentioned individually, but to give the reader some idea of the contents, the chapter headings are listed: surgery of the pharynx; surgery of the oesophagus; interpreting problem diarrhoeas of dogs; pharmacological principles of gastrointestinal therapy; nutritional management in gastrointestinal disorders; pancreatitis in dogs; oesophagoscopy; radiography of the gastrointestinal tract; diagnosis and management of intestinal obstruction; gastric dilatation and the gastric torsion complex; surgery of the small intestine and colon; surgery of the rectum and anus; gastrointestinal parasitism in the dog; peritonitis.

Amongst others, the technique of lavage in cases suffering from peritonitis and of pharyngostomy for post-operative feeding of patients, as well as suture patterns for preventing abdominal wound dehiscence and the technique for everted closure of the bowel following resection are described and illustrated. Except for the pancreas, the accessory organs of digestion are not dealt with.

This very informative book is a must for small animal practitioners.

C. J. R.

Jl S. Afr. vet. med. Ass. 43 (3): 287—294 1972

ANTHELMINTIC ACTIVITY OF MEBENDAZOLE IN EQUINES

R. K. REINECKE* AND D. J. LE ROUX**

SUMMARY

Critical anthelmintic tests were carried out on 5 donkeys and modified critical tests on 14 horses. A single dose of mebendazole was mixed with the feed at the rate of 2g for a donkey or horse weighing less than 400 kg. At this dose it was highly effective against adults of the following genera: *Strongylus, Alfortia, Delafondia, Triodontophorus, Oesophagodontus, Craterostomum, Trichonema, Schulzitrichonema, Cylicocyclus, Poteriostomum, Petrovinema, Gyalocephalus, Parascaris, Oxyuris* and *Probstmayria* but not against *Habronema, Trichostrongylus* and *Strongyloides*. Its efficacy against fourth stage larvae of *Trichonema* varied from 10—100% but critical tests are unsuitable for testing efficacy against these stages.

INTRODUCTION

A new broad spectrum anthelmintic, mebendazole — methyl n-[(5(6)-benzoyl-2 benzimadazolyl)] carbamate — has recently been developed by Janssen Laboratories, Beerse, Belgium [1]. This paper reports on critical anthelmitic tests [2] in donkeys and modified critical anthelmintic tests [3] on horses.

PRELIMINARY INVESTIGATION

Faeces from 11 horses and 14 donkeys were collected, worm egg counts using the modified McMaster method carried out [4] and faecal cultures made. The larvae that were harvested were identified according to the description of Russell [5] as cited by Dunn [6].

Results of this examination are summarized in Table 1. Small strongyles and *Strongyloides* were dominant but large strongyles were scare. Moreover, the worm egg counts were rather low.

EXPERIMENT 1: WORM RECOVERY POST MORTEM

Considerable experience had been gained with the technique of worm recovery in ruminants using a sophisticated Bearmann technique [7, 8]. Before any anthelmintic tests were carried out, this technique was applied to a horse to establish whether it could be used to recover worms *post mortem*.

Materials and methods

On examining the data summarized in Table 1, the horse known as "Mad Horse" was chosen because it had a very mixed infestation. The horse was shot, its throat cut, the thoracic and abdominal cavities were opened and the viscera removed. Stout twine was used to make double ligatures which were tied around the organs at the following sites:—

The oesophagus at its entry to the stomach; the stomach at the pyloric valve; the ileum at the ileo-caecal valve; the caecum at its junction with the colon transversum adjacent to the right kidney and the rectum ±10 cm cranial to the anus.

With the aid of a knife and a bowel scissors the mesentery was removed throughout the gastrointestinal tract and the gut cut between the double ligatures to yield separate specimens which were placed in separate containers and labelled as follows:—

Stomach, small intestine (i.e., the duodenum, jejunum and ileum), caecum, colon ascendens, including the right ventral colon, flexura sternalis, left ventral colon, flexura pelvina, left dorsal colon, flexura diaphragmatica and right dorsal colon, which were designated collectively as 'anterior colon', and colon transversum, colon descendens and rectum, which were designated as 'posterior colon'. The two names 'anterior colon' and 'posterior colon' have no anatomical standing: they were used merely for convenience.

The stomach and small intestine were left in buckets while the caecum and two parts of the colon were each treated in the following manner:—

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Table 1: DIFFERENTIAL WORM EGG COUNTS

DONKEY OR HORSE	WORM EGGS PER GRAM (EPG)	LARVAL IDENTIFICATION								
		TRICHONEMA	GYALOCEPHALUS	POTERIOSTOMUM	STRONGYLUS	TRIODONTOPHORUS	ALFORTIA	DELAFONDIA	TRICHOSTRONGYLUS	STRONGYLOIDES
DONKEY 185	0	+	+	+	+?	+	+	+	-	+
DONKEY 187	350	+	-	+	-	+	-	-	-	+
DONKEY 188	100	+	-	-	-	-	-	-	-	+
DONKEY 201	50	+	-	-	-	-	-	-	-	+
DONKEY 215	300	+	-	+	+	-	-	-	-	+
DONKEY 225	300	+	-	-	+	+	-	-	-	-
DONKEY 228	250	+	-	+	+?	+	+?	+?	-	+
DONKEY 230	0	+	-	-	-	-	-	-	-	+
DONKEY 233	300	+	-	-	+	+	-	+	-	-
DONKEY 234	300	+	+	+	+	+	+	+	-	+
DONKEY 238	0	-	-	-	-	-	-	-	-	+
DONKEY 243	25	+	-	-	+?	-	-	-	-	+
DONKEY 251	100	+	-	-	-	-	+	-	-	-
DONKEY 273	250	+	-	+	+	-	-	-	-	-
ROAN GELDING	100	+	-	-	-	+	+?	-	-	+
YOUNG BAY MARE	400	+	+	-	+	+	+	+	-	-
FOAL	100	+	-	+	-	-	-	-	-	-
SHY MARE	100	+	-	-	-	-	-	+	-	+
WHITE STRIPE	50	+	-	-	-	-	-	-	-	+
BLACK MARE	150	+	-	-	+	-	-	+	-	-
OLD MARE	200	+	-	-	+	-	+	+	-	+
MAD HORSE	50	+	-	-	+	-	+	+	-	+
CHESTNUT	100	+	-	-	-	-	-	+	-	-
CHESTNUT STRIPE	150	+	-	-	+?	-	-	-	-	-
CHESTNUT GELDING	0	+	-	-	-	-	-	+	-	+

Table 4: MODIFIED CRITICAL TESTS. WORMS RECOVERED FROM FAECES AFTER TREATMENT WITH 20g 10% GRANULES I.E. 2g MEBENDAZOLE IN FEED

	PARASCARIS EQUORUM	STRONGYLUS EQUINUS	ALFORTIA EDENTATUS	DELAFONDIA VULGARIS	OXYURIS EQUI
NAME: TRIUMPH AGE: 4 YRS MASS: 320 KG					
TOTAL NO.	0	23	5	3	6
NAME: BROWNIE AGE: 3 YRS MASS: 300 KG					
TOTAL NO.	3	3	10	0	6
NAME: GENISSA AGE: 8 MO MASS: 75 KG					
TOTAL NO.	14	0	0	0	48
NAME: ZANURE AGE: 3 YRS MASS: 350 KG					
TOTAL NO.	0	0	4	0	6
NAME: SHRIMP AGE: 5 YRS MASS: 400 KG					
TOTAL NO.	1	5	24	5	0
NAME: SHAH BURAK AGE: 8 YRS MASS: 350 KG					
TOTAL NO.	9	0	3	0	0
NAME: FARAH AGE: 7 YRS MASS: 400 KG					
TOTAL NO.	0	0	14	0	5
NAME: EPOCH AGE: 5 YRS MASS: 375 KG					
TOTAL NO.	0	0	0	0	2
NAME: TAMBOURLANE AGE: 9 MO MASS: 175 KG					
TOTAL NO.	57	0	0	0	0
NAME: DANCING MISS AGE: 4 YRS MASS: 300 KG					
TOTAL NO.	0	11	3	0	1
NAME: KIM AGE: 1 YR MASS: 180 KG					
TOTAL NO.	0	0	0	0	1
NAME: TWINKLE AGE: 7 YRS MASS: 175 KG					
TOTAL NO.	0	0	0	0	3

Table 2: EXPERIMENTAL DESIGN

DONKEY NO.	EPG		TREATED ON DAY 0 WITH 10% GRANULES I.E. 2 G M/M MEBENDAZOLE IN FEED	REMARKS
	INITIAL	FINAL		
187	350	NO COUNT MADE	RAPIDLY EATEN IN 1 HOUR	FAECES COLLECTED FROM DAY +1 TO DAY +4. KILLED DAY +5
255	300	NO COUNT MADE	EATEN SLOWLY FROM 12TH TO 24TH HOUR	FAECES COLLECTED FROM DAY +1 TO DAY +5. KILLED DAY +6
228	250	100 DAY +2 0 DAY +4	EATEN RAPIDLY WITHIN 1 HOUR	FAECES COLLECTED FROM DAY +1 TO DAY +4. KILLED DAY +6
233	300	NO COUNT MADE	RAPIDLY EATEN IN 1 HOUR	FAECES COLLECTED FROM DAY +1 TO DAY +4. KILLED DAY +5
234	300	200 DAY +2	SLOWLY EATEN OVER 24 HOURS	FAECES COLLECTED FROM DAY +1 TO DAY +5. KILLED DAY +12

The appropriate portion of gut was opened, the ingesta were removed and the mucosa was washed with physiological saline. The wall, the washings and the ingesta were placed into separate containers, so that nine specimens in all were finally obtained. The respective masses of ingesta and washed wall were recorded in each of the three instances.

The modified Bearmann Apparatus consisted of trays (traps) which were placed into the water bath. This had two layers for sieving: the lower layer was 1 cm from the trap floor, while the upper layer was 2 cm above this. Nylon gauze with apertures of 250 μm was used for the lower layer. A coarse fibreglass gauze mesh varying from 5,5 to 7,0 meshes to the linear centimetre with rectangular apertures 1,5 mm long by 1,1 mm wide was used for the upper layer. Physiological saline solution was placed into the traps to the level of the upper layer of fibreglass gauze. The ingesta were very thoroughly mixed and an aliquot of $\frac{1}{3}$ by mass of the ingesta of the caecum, anterior colon and posterior colon respectively, was carefully placed on the upper layer of fibre-glass. This involved the use of a large number of traps, particularly with the large mass of ingesta of the anterior colon. A rigid rule was never to allow the ingesta, spread over the upper layer of fibre-glass gauze, to exceed 2 cm in depth, nor to pour the ingesta on to this gauze with any force whatsoever. The apertures of this gauze were very large and if any force were to be used, the ingesta would merely run through it on to the lower layer. The whole process was repeated on another third of the caecal, anterior colonic and posterior colonic ingesta.

The entire wall washings were also placed in traps.

All these specimens were left in the water bath at 40°C for 1 hour, then removed, the worms killed at 60°C and mixed with formalin. The filtrates were sprayed with a shower rose on to Endecott sieves with 400 meshes to the linear inch (2,5 cm), the apertures being 39 μm in diameter. The ingesta trapped on the sieve's surface were poured into glass preserve jars and formalin added to constitute 10% of the final volume. The residue on the fibre-glass gauze was similarly dealt with but a 100 mesh to the linear inch (2,5 cm) sieve (Endecott) with apertures of 150 μm was used for sieving before the residue on the surface of the sieve was poured into glass jars and formalin was added as before.

The various specimens of gut wall were minced in an electric mincing machine and an aliquot of 1/5 by mass of the walls of the caecum, anterior colon and posterior colon respectively was placed in pepsin 2% m/v and 10N HCl 3% v/v. These specimens were put into 4 litre glass jars (biscuit jars) in the water bath and incubated for 3 hours at 40°C. Thereafter they were heated to 60°C, fixed with formalin, sieved on 400 mesh sieves and the residue on the surface of the sieve transferred to specimen jars and formalin added as above.

The ingesta of the stomach and small intestine were heated to 60°C to kill the worms, they were fixed with formalin, sieved on 400 mesh sieves and collected in formalin as described for the other specimens.

Another third of the caecal, anterior colonic and posterior colonic ingesta was processed in a similar fashion to that described above.

Results: Efficacy of Baermann apparatus

The residue on top of the coarsest sieve had less than 1% of the worms. This meant that for all practical purposes very few worms had failed to pass through the mesh with apertures of 1,1 by 1,5 mm in size.

Most of the small strongyles were recovered from the residue of the ingesta of the anterior colon on top of the nylon mesh (aperture size 250 μm) but in the filtrate below this sieve the vast majority of *Probstmayria vivipara* was located, with very few small strongyles. Similarly, in the anterior colonic wall washings most of the small strongyles were retained in the residue on top of the finer nylon mesh.

The digested gut yielded fewer worms than expected and most of these were partly or almost completely digested.

The stomach ingesta had a few *Habronema muscae*, while *Strongyloides westeri* were present in the small intestine.

Conclusion

This modified Bearmann apparatus is suitable for the recovery of parasitic nema-

todes of equines but only the coarse fibreglass gauze (apertures 1,1 to 1,5 mm) should be used to allow strongyles to migrate through into the filtrate and not the fine nylon mesh of 250 μm.

EXPERIMENT 2: CRITICAL ANTHELMINTIC TESTS

Materials and Methods

Donkeys 187, 225, 228, 233 and 234 were chosen on the basis of the worm egg counts and variety of larvae shown by faecal examination (Table 1). They were placed in an empty pen with a concrete floor and tied up, at least 4 m apart, on a short rope attached to the halter. Twenty grams of 10% m/v mebendazole granules, i.e. 2g mebendazole, were mixed with the mash and placed in a bucket before each donkey. The time taken for them to consume the compound in the mash varied from 1 to 24 hours. This is summarized in the experimental design (Table 2). Every morning and afternoon the total faecal output was collected from each donkey for periods varying from 4 to 6 days.

The faeces were broken between the fingers and well mixed before being weighed. In each specimen two aliquots of 1/10 and 1/100 by mass respectively were sieved with water on 100 mesh sieves. The faeces on the surface were placed into labelled bottles to which formalin was added and stained with a concentrated iodine solution. Worms were counted macroscopically in the larger specimen (1/10) and microscopically in the smaller specimen (1/100) and transferred to small labelled bottles containing 10% formalin solution.

Table 5: RESULTS OF FAECES EXAMINATION FOR WORM EGGS AND INFECTIVE LARVAE

DAY	WORM EGGS								INFECTIVE LARVAE			
	0		+7		+14		+21		0	+7	+14	+21
HORSE	P. EQUORUM	STRONGYLES	P. EQUORUM	STRONGYLES	P. EQUORUM	STRONGYLES	P. EQUORUM	STRONGYLES	STRONGYLES			
TRIUMPH	-	+	-	-	-	-	-	-	+	-	-	-
BROWNIE	+	+	-	-	-	-	-	-	+	-	-	-
GENISSA	+	-	-	-	-	-	-	-	-	-	-	-
ZAMIRE	+	+	-	-	-	-	-	-	+	-	-	-
SHRIMP	-	+	-	-	-	-	-	-	+	-	-	-
SHAH BURAK	+	+	-	-	-	-	-	-	+	-	-	-
FARAH	-	+	-	-	-	-	-	-	+	-	-	-
EPOCH	-	-	-	-	-	-	-	-	-	-	-	-
TAMBOURLANE	+	-	-	-	-	-	-	-	-	-	-	-
DANCING MISS	-	+	-	-	-	-	-	-	+	-	-	-
KIM	-	-	-	-	-	-	-	-	-	-	-	-
TWINKLE	-	-	-	-	-	-	-	-	-	-	-	-

The donkeys were slaughtered 5 to 12 days after treatment (Table 2). The worm recovery procedures at autopsy followed those already described, with the following modifications. After weighing, 1/5 of the ingesta from the caecum, anterior colon and posterior colon respectively was placed into the modified Baermann apparatus in the water bath. A similar 1/5 aliquot by mass of the walls of each of these organs was digested in pepsin/HCl. The finer nylon mesh was not used and only the coarser fibre-glass gauze was placed into the traps in the water bath.

Specimens of digested gut wall and the filtrates of the various specimens of the ingesta were stained with iodine, examined under the stereoscopic microscope and the worms transferred to labelled specimen bottles containing 10% formalin. The residues of the ingesta were stained with iodine and examined macroscopically for worms; any worms present were also placed into bottles containing formalin. At a later stage worms were recounted with a stereoscopic microscope, placed on slides, cleared with lactophenol, covered with coverslips and examined with the aid of a standard laboratory microscope.

Most of the worms were examined in this way. A notable exception was *P. vivipara*, which was expelled in many thousands in the faeces. Only a few hundred of these were placed on slides for confirmation of their identity.

In most cases the Strongylata were identified on a generic basis only, according to the descriptions of Skrjabin *et al* [9], Ihle [10] and Theiler [11]. With regard to larvae, no authorative descriptions could be found in the literature and their identification depended upon the knowledge of similar stages of the Oesophagostominae and Trichostrongylinae.

Results

Faeces: Most of the worms were expelled 48 to 72 hours after treatment, but very few were found in less than 36 or more than 84 hours after consuming the anthelmintic.

The microscopic examination of the 1/100 aliquots revealed vast numbers of *P. vivipara*, but only a few small strongyles and even fewer fourth stage larvae. As far as strongyles were concerned, macroscopic examinations of 1/10 aliquot was most fruitful but the larger worms were damaged and only fragments were present.

Autopsy: Although larval stages were relatively more plentiful than in the faeces, many of the dead larvae had been digested before expulsion. This has been shown to occur in the case of a parasite of the colon of sheep, *Oesophagostomum columbianum*, in which third and fourth stage larvae under the influence of successful treatment combined with digestive and/or putrefactive processes are markedly reduced in number in faeces collected *ante mortem* [12]. The anthelmintic had no effect on parasites of the stomach or small intestine, but once again this may be due to the limitations of a critical test. Enzyme activity probably would have digested most of dead worms before they had reached the caecum.

The following recovered worms were identified: *Probstmayria vivipara, Trichonema, Craterostomum, Cylicocyclus, Gyalocephalus capitatus, Oesophagodontus robustus, Petrovinema, Poteriostomum, Schulzitrichonema, Triodontophorus, Strongylus equinus, Habronema muscae, Strongyloides westeri, Trichostrongylus axei.*

Fourth stage larvae of *Trichonema* and fifth stages of *Trichonema, Cylicocyclus, Triodontophorus* and *Gyalocephalus* respectively, were recovered from some of the donkeys *post mortem* and were present in the faeces in smaller numbers.

Anthelmintic efficacy: Against adults of all the small strongyles present, efficacy of treatment varied from 91,8 to 100%. Mebendazole was also 100% effective in the only animal in which *S. equinus* was present (Donkey 225). It was consistently 100% effective against *P. vivipara*. It appeared to have little effect on the larval and fifth stages of small strongyles, nor did it have an effect on *H. muscae, S. westeri* and *T. axei*.

EXPERIMENT 3: MODIFIED CRITICAL ANTHELMINTIC TEST IN HORSES

The term modified critical anthelmintic test is used to denote a combination of faecal worm egg counts and counts of worms expelled in the faeces. The host is not killed after treatment [3].

TABLE 3

RESULTS OF CRITICAL ANTHELMINTIC TESTS ON DONKEYS

ANIMAL & SPECIMEN	PROBSTMAYRIA VIVIPARA		TRICHONEMA		CYLICOCYCLUS		POTERIOSTOMUM	TRIODONTOPHORUS		GYALOCEPHALUS CAPITATUS		CRATEROSTOMUM	SCHULZITRICHONEMA	PETROVINEMA	OESOPHAGODONTUS ROBUSTUS	STRONGYLUS EQUINUS	HABRONEMA MUSCAE		STRONGYLOIDES WESTERI	TRICHOSTRONGYLUS AXEI	TOTAL EXCLUDING P. VIVIPARA
		L4	L5	A	L5	A		L5	A	L5	A						L5	A			
DONKEY 187																					
FAECES	46 181	73	0	2 047	0	1 024	497	0	102	0	15	0	15	0	0	0	0	0	0	0	3 773
AUTOPSY	0	66	386	34	0	34	0	0	0	0	0	0	0	0	0	0	11	80	0	0	611
TOTAL	46 181	139	386	2 081	0	1 058	497	0	102	0	15	0	15	0	0	0	11	80	0	0	4 384
REDUCTION %	100.0	52.5	0.0	98.4	-	96.8	100.0	-	100.0	-	100.0	-	100.0	-	-	-	0.0	0.0	-	-	86.1
DONKEY 225																					
FAECES	34 273	21	0	1 038	0	281	97	0	86	0	11	0	0	0	*11	0	0	0	0	0	1 545
AUTOPSY	0	10	629	0	11	0	0	5	0	0	0	0	0	0	0	0	0	17	14	0	686
TOTAL	34 273	31	629	1 038	11	281	97	5	86	0	11	0	0	0	11	0	0	17	14	0	2 231
REDUCTION %	100.0	67.7	0.0	100.0	0.0	100.0	100.0	0.0	100.0	-	100.0	-	-	-	100.0	-	-	0.0	0.0	-	69.2
DONKEY 228																					
FAECES	51 000	56	0	2 049	0	367	66	0	56	0	19	0	28	66	28	10	0	0	0	0	2 745
AUTOPSY	0	0	119	178	0	23	0	0	0	0	0	0	0	0	0	0	0	12	0	1	333
TOTAL	51 000	56	119	2 227	0	390	66	0	56	0	19	0	28	66	28	10	0	12	0	1	3 078
REDUCTION %	100.0	100.0	0.0	92.0	-	94.1	100.0	-	100.0	-	100.0	-	100.0	100.0	100	100	-	0.0	-	0.0	89.2
DONKEY 233																					
FAECES	60 364	33	0	1 161	0	142	44	0	109	0	11	0	0	0	0	0	0	0	0	0	1 500
AUTOPSY	0	292	0	103	0	0	0	1	0	0	0	0	0	0	0	0	0	33	14	0	443
TOTAL	60.364	325	0	1 264	0	142	44	1	109	0	11	0	0	0	0	0	0	33	14	0	1 943
REDUCTION %	100.0	10.1	-	91.8	-	100.0	100.0	0.0	100.0	-	100.0	-	-	-	-	-	-	0.0	0.0	-	77.2
DONKEY 234																					
FAECES	34 909	12	0	1 546	0	700	123	0	61	0	0	12	0	0	0	0	0	0	0	0	2 454
AUTOPSY	0	0	181	0	16	0	0	44	0	1	0	0	0	0	0	0	0	82	4	0	328
TOTAL	34 909	12	181	1 546	16	700	123	44	61	1	0	12	0	0	0	0	0	82	4	0	2 782
REDUCTION %	100.0	100.0	0.0	100.0	0.0	100.0	100.0	0.0	100.0	0.0	-	100.0	-	-	-	-	-	0.0	0.0	-	88.2

L4 = FOURTH STAGE LARVAE
L5 = FIFTH STAGE LARVAE

*THESE WERE IN THE FOURTH MOULT I.E. L4

TESTS ON A MARE AND FOAL

Material and methods

A mare (4188) and her foal were used. The former was negative for *P. equorum* on faecal examination while the foal had 600 eggs per gram of *P. equorum*.

The mare weighed 548,8 and the foal 181,8 kg respectively. The mare consumed 40 g 10% mebendazole in 30 minutes and the foal took 1 hour to consume 20 g 10% mebendazole. The mare, therefore, had consumed 4 g and the foal 2 g of the active ingredient respectively.

Results

Two days after treatment the mare expelled 1 and the foal 2 *P. equorum*. On the sixth day the foal expelled a single *P. equorum*.

At no stage were *P. equorum* eggs detected in the mare's faeces. Although the egg count in the foal fell from 600 prior to treatment to 300 epg 5 days after treatment, its faeces were still positive at 7 days with sugar flotation. Subsequent faecal examination of the mare and the foal both for this species and for strongyle eggs at 11, 18 and 25 days after treatment respectively, were completely negative.

TESTS ON 12 HORSES

Materials and methods

Twelve horses from a riding school were selected after a preliminary examination of their faeces had revealed that some of them were infested with *P. equorum*. They were divided into two groups of six horses each, weighed and treated separately on Monday of two respective weeks. On the day of treatment feaces were collected for faecal worm egg counts and cultures for subsequent harvesting of strongyle larvae. Twenty grams 10% mebendazole granules, i.e. 2g mebendazole, were mixed with the feed of each horse which was confined to a stable for the next 6 days. The total faecal output after the first 24 hours was collected twice a day for the next 5 days i.e. from Day +1 (p.m.) until Day +5 (a.m.). The entire faecal output was examined macroscopically and any worm 15 mm or longer (large strongyles, *Parascaris, Oxyuris)* counted, removed and placed in a labelled container in 10% formalin for subsequent microscopic identification. Every 7 days for the 3 weeks following treatment faeces were collected for worm egg counts and cultures.

The number of worms expelled is summarized in Table 4. The following species were identified:—

Species	No. of horses infested
Parascaris equorum	5
Strongylus equinus	4
Alfortia edentatus	7
Delafondia vulgaris	2
Oxyuris equi	9

The results of the egg counts and larval identifications are summarized in Table 5.

The worms were expelled within 5 days of treatment and eggs of both *P. equorum* and strongyles were absent in all the horses for at least 3 weeks after treatment. Moreover, all the faecal cultures were negative for infective larvae during this period.

DISCUSSION

The anthelmintic efficacy of mebendazole at 2g/400 kg varied from 91,8 to 100% against adult strongyles. It was equally effective against *P. equorum, O. equi* and *P. vivipara* but had no effect against *H. muscae, S. westeri* and *T. axei*. Its efficacy against fourth stage larvae of small strongyles was variable. A critical test is not suitable for assessing anthelmintic efficacy against larvae because they disappear before being expelled in the faeces [12]. A controlled anthelmintic test is a more accurate method of testing efficacy against these stages.

The modified Baermann traps are very efficient for recovery of the nematodes of equines. In the donkeys killed, no worms were present in the coarse residue on top of the sieve. An experiment using layers of nylon mesh with apertures of 700 and 500 μm respectively has proved highly efficient [13] in separating the bulk of the ingesta from the parasites.

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TRIALS WITH RAFOXANIDE*

4. EFFICACY AGAINST THE LARVAE OF THE OESTRID FLY *GEDOELSTIA HÄSSLERI* IN THE BLESBUCK *(DAMALISCUS DORCAS PHILLIPSI* HARPER, 1939)

A. J. SNIJDERS AND I. G. HORAK†

SUMMARY

The efficacy of rafoxanide against the larval instars of *Gedoelstia hässleri* in naturally infested blesbuck is described.

Treatment administered orally at dosage levels of approximately 7,5, 10,0 and 15,0 mg/kg live mass was completely effective against first, second and third larval instars. These dosage levels were also highly effective against adult *Haemonchus contortus* present in the antelope.

A drenching programme in the event of an outbreak of specific oculo-vascular myiasis (uitpeuloog) in domestic animals is suggested.

INTRODUCTION

Myiasis in antelopes in Southern Africa caused by the larval instars of *Gedoelstia* spp. has been described by Basson [1]. He has also described the disease, specific oculo-vascular myiasis (uitpeuloog), occurring in domestic livestock when they are parasitized by the larvae of *Gedoelstia* spp. [2, 3].

Myiasis of the paranasal sinuses in sheep and goats caused by the larval instars of a closely related species, viz. *Oestrus ovis*, has been successfully controlled employing rafoxanide at a dosage level of 7,5 mg/kg live mass [4, 5]. This larvacidal activity indicated that similar efficacy could be expected against *Gedoelstia* spp.

An opportunity to test the efficacy of rafoxanide against *Gedoelstia* spp. in antelopes presented itself when reports were received that cattle in the Ventersdorp district of the Transvaal had developed eye lesions suggestive of uitpeuloog after grazing in close proximity to a herd of blesbuck *(Damaliscus dorcas phillipsi* Harper 1939). By kind permission of a local farmer and the Department of Nature Conservation it was possible to capture, treat and sacrifice a number of these antelopes.

MATERIALS AND METHODS

Seventeen blesbuck were netted and their eyes examined for the presence of *Gedoelstia* larvae. Three blesbuck kids, four adult ewes and an adult ram were selected. Two of the kids and three of the ewes were drenched orally with rafoxanide, the doses being approximately 7,5, 10,0 and 15,0 mg/kg live mass (see Table).

The dosage levels employed are approximations, as two kids and three adults from the remainder of the herd were weighed and the live mass of the experimental antelopes estimated from these.

The kids were transported to the laboratory at Hennops River where they were housed until slaughter one week after treatment. The adults were transported to a gameproof camp approximately 16 kilometres from the remainder of the herd, where they were kept until slaughter 13 days after treatment.

At necroscopy the trachea, bronchi, endocardium, aorta, vena cava, subdural cavity, eyes, nasal passages, conchae and paranasal sinuses were examined for the presence of larvae of *Gedoelstia* spp. which were collected, counted and identified. At the same time the abomasa of the antelopes were examined for *Haemonchus* spp.

An adult ram had fractured a leg during the netting operation and had to be destroyed. The head of this animal was taken to the laboratory, where it was examined the following day. The result of this examination

*"RANIDE": Reg. Trade Mark of MSD (PTY) LTD., Merck Sharp & Dohme International, Division of Merck & Co., Inc., Rahway, N.J., U.S.A.

†MSD Research Centre, Hennops River, P.O. Box 7748, Johannesburg.

is the first one listed in the table, the case in question being considered as an additional control.

RESULTS

The dosage levels used and the parasite recoveries are summarized in the table.

THE EFFECT OF RAFOXANIDE ON **G. HÄSSLERI** AND **H. CONTORTUS** INFESTATIONS IN BLESBUCK

Antelope	Approx. dose mg/kg	Day slaughtered†	No. of **G. hässleri** larvae recovered				Adult **H. contortus**
			1st	2nd	3rd	Total	
Ram	Control	0	28	1	0	29	—
Kid	Control	7	246	24	13	283	94
Ewe*	Control	13	135	12	27	174	113
Ram**	Control	13	101	5	0	106	9
Kid	7,5	7	0(2)	0(1)	0(2)	0(5)	2
Ewe	7,5	13	0	0	0	0	0
Ewe	7,5	13	0	0	0	0	0
Ewe	10,0	13	0	0	0	0	0
Kid	15,0	7	0(23)	0(3)	0(9)	0(35)	0

†Date of treatment reckoned as "Day 0"
*4 **Oestrus** sp. larvae recovered
3 **Oestrus sp. larvae recovered
( ) = Dead larvae

At the time of treatment, first instar larvae were present in the eyes of all the antelopes. At slaughter, larvae, where present, were recovered only from the nasal passages and paranasal sinuses.

The four untreated antelopes were all infested with larvae of *G. hässleri*, first instar larvae accounting for the major portion of the parasite burdens. Total counts varied between 29 and 283 larvae, while one ram and one ewe were also infested with three and four second instar larvae respectively of an *Oestrus* sp. The burdens of adult *H. contortus* in these animals varied between nine and 113 worms.

No living larvae of *G. hässleri* were present in the treated antelopes, although the two kids slaughtered one week after treatment both harboured a number of dead larvae. One of these animals had two adult *H. contortus*, the others being entirely free of these parasites.

DISCUSSION

The efficacy of rafoxanide against the larval instars of *G. hässleri* in the blesbuck is similar to that recorded against the larvae of *O. ovis* in sheep[4, 5]. It was not possible to determine whether the compound was effective against the first larval instars of *G. hässleri* while they were present in the eyes, or only after they had migrated from this site.

In *O. ovis* infestations the first larval instars appear to be more susceptible to the effects of rafoxanide than the older larvae, as they are the first to disappear after treatment[6]. In three separate trials rafoxanide also had a residual effect against the re-establishment of *O. ovis* infestations in sheep[5, 6, 7], lasting for 11 days to four weeks after treatment. This effect was probably accomplished by elimination of newly acquired first instar larvae. A similar situation may obtain in the case of *Gedoelstia* infestations.

Although the efficacy of rafoxanide against *Gedoelstia* spp. infestations in sheep and cattle has not been established, certain tentative suggestions can be made for the treatment of domestic livestock in enzootic areas during times of potential exposure. As soon as the first cases of uitpeuloog are observed, the entire flock should be treated and the treatment repeated three weeks later. In theory this should reduce or eliminate infestation for a total period of six weeks, by which time the danger of reinfestation from the proximity of game or fly activity may have passed. If not, treatment at three-weekly intervals should be continued.

ACKNOWLEDGEMENTS

We thank Messrs. J. van Zyl and J. J. Marx of the Department of Nature Conservation and D. Yssel and W. G. van Aswegen

of Ventersdorp for the assistance given with netting, drenching and transporting the antelopes.

Dr. P. A. Basson, of the Veterinary Research Institute, Onderstepoort, advised us on the autopsy procedure and Mr. R. du Plessis of the same institute identified the larvae.

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Jl S. Afr. vet. med. Ass. 43 (3): 299—300 1972

VISCERAL LOCALIZATION OF *CYSTICERCUS CELLULOSAE*

J. BOWLES*, ANNA VERSTER**, J. G. PIENAAR† AND L. W. VAN DEN HEEVER††

SUMMARY

A case is described in a Large White cross-bred porker carcase in which numerous cysticerci, subsequently identified as *Cysticercus cellulosae,* were present on the surface of the lungs and liver, as well as degenerated ones in the liver parenchyma. None was present in the musculature, myocardium and kidneys.

INTRODUCTION

Both *Cysticercus cellulosae* and *Cysticercus bovis* usually occur in the striated muscles and myocardium of infested pigs and cattle respectively. In heavy infestations, they are also present in virtually all the soft tissues but mature cysticerci rarely occur in the liver [1]. Van Logtestijn & Westendorp [2], however, described a severe infestation of *C. bovis* in the liver of an animal in which six cysticerci were also present in the masseters. Mazzotti, Davalos & Martínez-Maranon [3] recorded three *C. cellulosae* from the brain, two from the lungs and four from the liver of an experimentally infested coati *(Nasua narica).*

CASE REPORT

A Large White cross-bred porker carcase of good grade, weighing approximately 82 kg, was presented for detailed examination after numerous cysticerci had been detected on the surface of both the liver and the lungs. The surfaces of the liver were studded with cysticerci 1,0 to 1,5 cm apart. Numerous small white nodules were also present in the substance of the liver (Fig. A).

No cysticerci were present on the muscular surfaces exposed by routine dressing procedures and by incisions into the *M. triceps brachii* and the muscles of mastication. Detailed examination, including numerous incisions into the myocardium, the diaphragm and into the kidneys, failed to reveal any cysticerci. The carcase was passed for human consumption, conditional to the prescribed period of freezing. In view of the unusual nature of the infestation, material was sub-

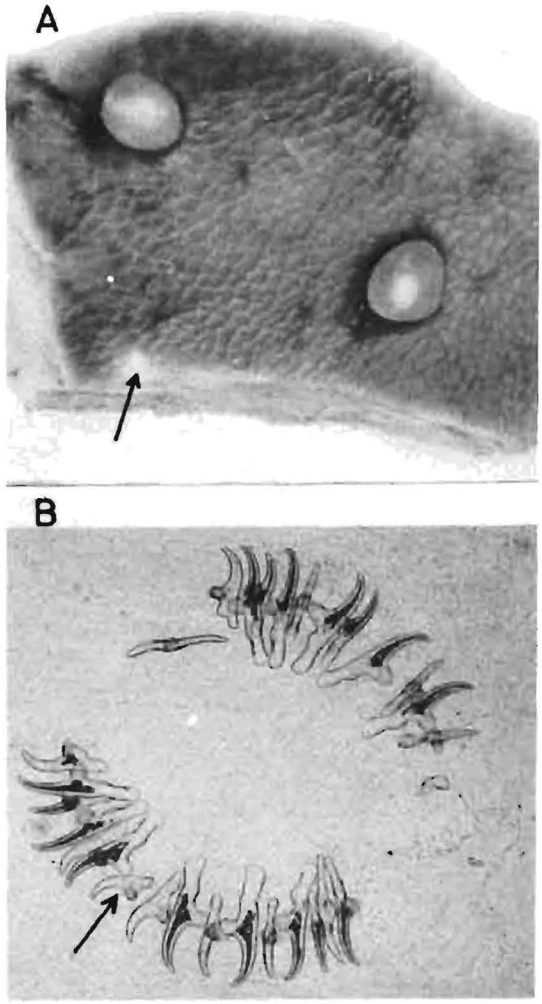

FIG. A: Surface of liver showing normal intact **C. cellulosae** lying in shallow depressions as well as lesion (arrow) resulting from degeration of cysticercus.

FIG. B: Rostellar hooks of **C. cellulosae** with arrow pointing to accessory hook.

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mitted for histopathological examination and identification of the parasite.

Histological examination of the liver revealed no generalized fibrosis. The host reaction around the apparently viable cysts partially embedded on the surface of the liver, consisted of a thin layer of connective tissue lined with a pallisade of macrophages. A few giant cells, eosinophils, plasma cells and lymphocytes were also present.

The degenerated parasites in the substance of the liver were in various stages of caseation and calcification. They were surrounded by a thickened layer of host connective tissue; giant cells and eosinophils were more numerous. In some instances the connective tissue consisted of more mature collagen, indicating an older lesion, perhaps the result of an earlier death of the cysticercus.

The number, size and shape of the rostellar hooks of these cysticerci fell within the range recorded for *C. cellulosae*[4]. In a cysticercus from the lung, the 24 rostellar hooks were arranged in two rows; each of two cysticerci from the liver had 24 and 26 hooks in two rows, as well as two accessory hooks in a third row. The large hooks varied from 160 to 176 μm in length, the small ones from 120 to 136 μm and the accessory hooks of the third row from 96 to 100 μm (Fig. B).

DISCUSSION

Heinz & Aron[5] recorded uneven numbers of hooks in *C. cellulosae* but did not differentiate between the small hooks of the second row and the accessory hooks. Accessory hooks occur in 28,4% of *C. cellulosae* in pigs from Europe, Africa and Brazil (Verster, unpublished data). Similar hooks are present in *C. cellulosae* from dogs and man; these are retained in the adult stage. The rostellar hooks of various *Taenia* spp. have been examined; in only one specimen from a polycephalic larva of *T. serialis serialis*[4] was a single accessory hook found.

Cysticercus tenuicollis, the larval stage of *Taenia hydatigena,* occurs in pigs, sheep, goats and cattle. These cysticerci sometimes remain attached to the surface of the liver and, in heavy infestations, may also occur in the thoracic cavity. The mature cysticercus of this species differs from that of *C. cellulosae* in that its cyst, as well as its rostellar hooks, is large.

The positive identification of the cysticercus as *C. cellulosae,* the presence of live mature cysts on the surface of the lungs and liver and the apparent absence of parasites from muscular tissue, combine to make this an unusual case. The inability of cysticerci to survive within hepatic tissue is emphasized by the normal appearance of those on the surface of the liver while those in its substance were degenerated.

ACKNOWLEDGEMENTS

Dr. Gertrud Theiler critically read the manuscript and Mr. du Bruyn prepared the photographs.

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STUDIES ON THE BIOLOGY OF *COSMIOMMA HIPPOPOTAMENSIS* DENNY, 1843 IN SOUTH WEST AFRICA

J. D. BEZUIDENHOUT* AND H. P. SCHNEIDER**

SUMMARY

A very rare African tick, first described in 1843[1], *Cosmiomma hippopotamensis*, has been found again, this time in relatively large numbers, on vegetation in Kaokoland, South West Africa. Studies on certain aspects of its ecology and on its reactions to various potential hosts suggest that under natural conditions it prefers to feed on the black rhinoceros, *Diceros bicornis*.

INTRODUCTION

Cosmiomma hippopotamensis Denny, 1843 has been found previously only in small numbers on a few occasions in south-western and eastern Africa. Little has been recorded about its hosts and nothing about its ecology.

Nine adults, including the types of this species, in the British Mueum (Natural History) are said to have been collected in the 'Interior of South Africa'. According to Hyatt[2], the original specimens (Accession No. 43.19: 1♂, 4♀♀) were obtained by a collector for the Earl of Derby, named Burke, at the 'parallel of Lalagor', a locality which cannot be traced now. The male and one female bear labels stating that they were found 'on Hippopotamus'. Three of the remaining four specimens (Accession No. 60.86: 1♂; 60.116: 2♀♀) were collected by Andersson at Lake Ngami but no mention is made of their hosts. The ninth specimen, a male, bears neither host nor locality data.

Later, a few specimens of *C. hippopotamensis* were recorded from East Africa by Neumann[3], Hoogstraal[4] and Arthur[5], also without host data. The species was found again in South West Africa in 1959, over 100 years after its original discovery there, when three males and three females were obtained at Ohopoho and Otjijanjasemo in Kaokoland, where they were said to be common on goats[6, 7]. In 1964 Serrano[8] recorded another two males from the black rhinoceros in the Cuando-Cubango Districts of Angola.

The intriguing fact that *C. hippopotamensis* was once said to be common on goats[6] and had never been seen again, stimulated a more thorough search for it in Kaokoland, a Bantu territory situated in the northwest corner of South West Africa.

MATERIAL AND METHODS

Photographs of *C. hippopotamensis* were shown to stock inspectors working in Kaokoland and they were asked to be on the watch for such ticks. At the same time a survey was conducted in the area and ticks were collected from goats, cattle and black-faced impala, *Aepyceros melampus petersi*[9, 10].

After about 80 *Cosmiomma* ticks had been found, the area was visited and its physical geography, vegetation and fauna were studied. The way in which the ticks awaited their host(s) was noted, special attention being paid to the level to which they had ascended on the vegetation.

The following attempts were made to feed *Cosmiomma:*

a) Turtles (*Pelomedusa subrufa*) and tortoises (*Testudo* spp.) were common in parts where collections were made and we suspected that they might be possible hosts. Five *Cosmiomma* ticks (2♂♂, 3♀♀) were therefore placed on a turtle with enough water to cover it in a container. This experiment was repeated twice.

   Similar experiments, but without water, were tried with turtles and also tortoises.

b) A monitor (*Varanus exanthematicus*) was put into a plastic container with some ticks for a period of 8 hours.

c) Rabits were tried as hosts by confining the ticks on their ears in bags.

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d) A goat was left for 18 hours tied to a bush which had about 20 *Cosmiomma* ticks on it. In another experiment a bag containing nine ticks (4♂♂, 5♀♀) was secured on the ears of a goat for an hour.

e) A black rhinoceros *(Diceros bicornis)*, kindly provided by the Department of Nature Conservation and Tourism of South West Africa, was challenged by means to be described in another paper.

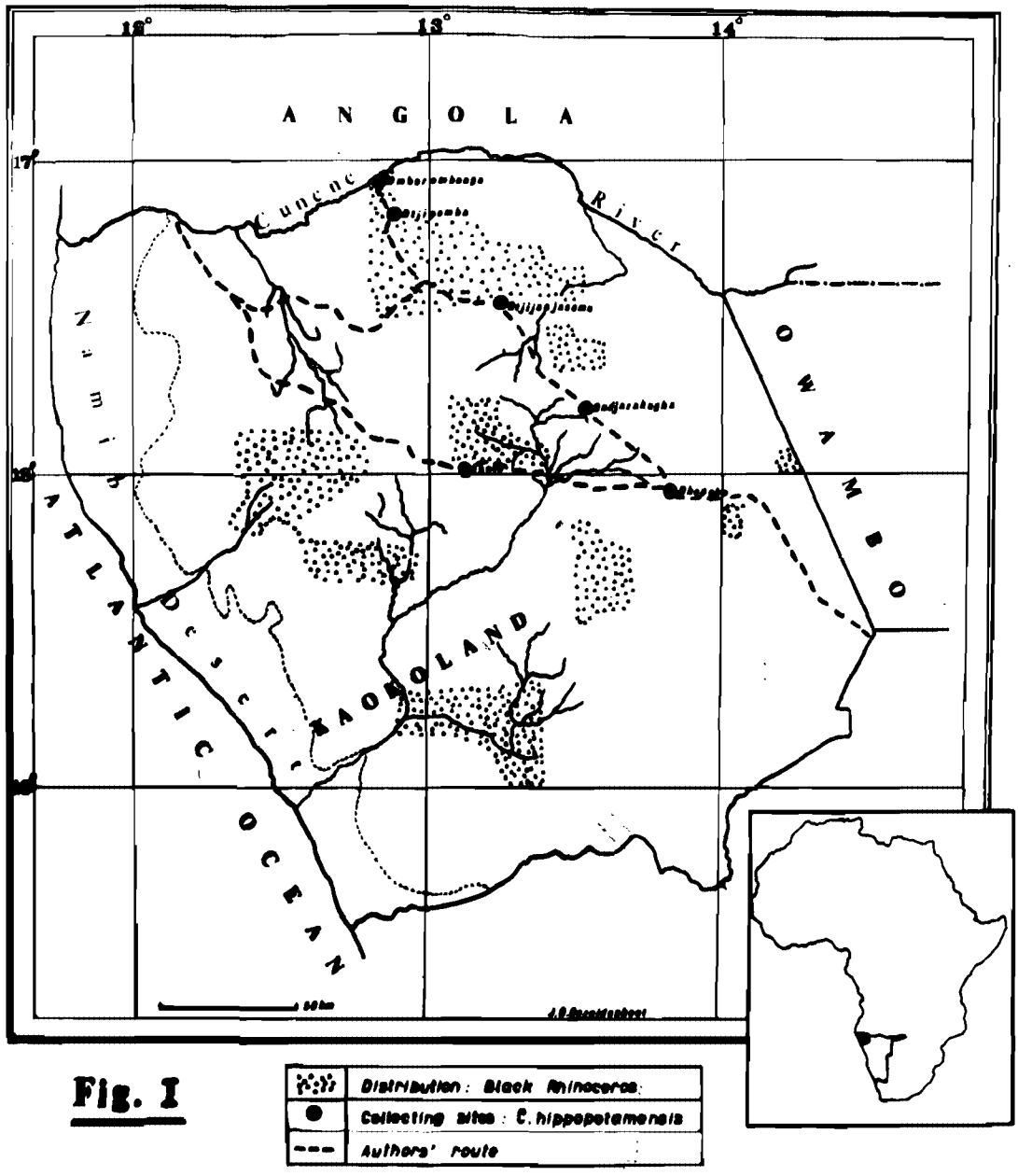

Fig. I

RESULTS

1. *Description of the collecting area*

Kaokoland is bounded on the north by the Kunene River, which separates it from Angola, eastwards by Owambo, southwards by Kamanjab District and westwards by the Atlantic Ocean.

Relatively high mountains, the Baynes, Zebra and Otjihipa, lie on the north, represent east and west sides of the collection sites and rise in places to a height of over 2 000 metres. The rest of the area is covered mainly by rocky hills. Scattered throughout are numerous dry, sandy river beds, where water flows for a few hours after storms, as well as springs, which only dry up during severe droughts.

The vegetation differs from place to place, depending on whether the area is mountainous or relatively flat. In general, however, the veld-type is savannah with abundant *Colophospermum mopane*. It is further characterized by the presence of various *Commiphora* spp. and *Terminalia prunioides*.

Game is still very prevalent, the commonest species being kudu, impala, zebra and black rhinoceros.

2. *Ecology of* C. hippopotamensis

During March, 1971, *C. hippopotamensis* was found at Ondjarrakagha, Otjiboronbonga, Otjipembe and Ekoto, in the north-eastern quarter of Kaokoland between about 17° to 18°E and 13° to 14°S.

These areas are at altitudes between 1 000 and 1 500 metres, with a mean annual rainfall of about 250 mm. Specimens of the tick were collected from the following species of plant: the trees *Acacia reficiens; Colophospermum mopane; Combretum apiculatum, C. imberbe* and *C. hereroense; Dichrostachys cinerea* subsp. *africana* and *Securinega virosa;* the shrubs *Catophractes alexandri; Euclea divinorum, E. pseudebenus; Grewia flavescens, G. bicolor* and *Ximenia americana;* the grass *Cenchrus ciliaris* and the sedge *Cyperus marginatus.*

Infested vegetation was found along some of the footpaths leading to springs; they were mostly rhino paths where relatively fresh tracks and dung deposits could be seen. The concentration of ticks was greatest near the water and decreased as one moved away from it; they were never found more than about 40 metres away.

C. hippopotamensis was usually collected from the tips of leaves or branches of bushes and from grasses at heights between 50 and 150 cm. Only two specimens were found at different levels. One was sitting 200 cm high in a *C. imberbe* tree and the other on the seed head of a grass, *C. ciliaris*, at a level of 17 cm.

Some bushes contained only one specimen but most carried more; from one a total of 56 ticks was collected. They sat on the side adjacent to the footpath, waiting for a host to pass by. They were only found on both sides of a bush when it was growing in the middle of a footpath. These ticks clumped together on top of each other, sometimes as many as seven being found at the tip of a leaf. Questing was pronounced when they were approached, but stopped immediately the observer got close to them, especially when they were touched. They made no attempt to climb on to the observers' hands or clothing.

3. *Experimental hosts*

a) In one of the three experiments with turtles in water, all nine of the females attached within about 20 minutes but only two of the six males. In the first experiment the ticks remained attached for 7 days but were then found to be dead when closely examined. In the second and third experiments they were dead by the third day. In the experiments conducted without water similar results were obtained.

   In the case of tortoises a lower percentage of ticks attached and they also died after a day or two.

b) *Cosmiomma* did not attach to the monitor.

c) Rabbits are possible experimental hosts because *C. hippopotamensis* attached and engorged on their ears, though only after these had been shaved. Not all the ticks attached, and those that did, took nearly 2 weeks to engorge partially. Whether these ticks will produce fertile eggs remains to be seen.

d) None of the *Cosmiomma* attached to the goat.

e) The black rhinoceros proved to be an excellent host. When the ticks were released on its back they attached in the perianal area within 5—15 minutes. After engorgement, the females laid fertile eggs from which larvae hatched successfully. The rearing of these larvae will be described later.

DISCUSSION AND CONCLUSIONS

The writers' initial observations, based on circumstantial evidence, suggested the black rhinoceros as the most likely host of *C. hippopotamensis* in Kaokoland. The hippopotamus, the first recorded host of this tick, does not occur in the area where the present collections were made. A few hippopotami are present in the Kunene River about 90 km upstream from the one collecting site, and they may therefore play a rôle as hosts along the river, but they definitely do not reach the other collecting sites. These sites, however, do correspond with part of the recorded distribution of the rhinoceros in this area (Fig. 1) [12].

The feeding habits of the rhinoceros are such that the ticks would be able to infest it readily [13]. It usually stands next to the shrub or tree on which it is browsing and sometimes pushes its head right in among the branches, slowly cropping the twigs. The optimum browsing height is between 60 and 108 cm, which corresponds closely with the heights at which the ticks were found.

Also, rhino deposit dung on certain footpaths leading to waterholes, the distances between these deposits becoming shorter the nearer one gets to the water. *Cosmiomma* ticks were also found along these footpaths, increasing in numbers nearer the water.

Subsequently the suitability of the black rhinoceros as a host was proved by infestation experiments with *C. hippopotamensis*. It was found afterwards that this animal already had been listed as a natural host in the Cuando-Cubango District of Angola [8].

Although cattle, goats and black-faced impala [9, 10] are known to visit infested springs, no *C. hippopotamensis* could be found on them.

The way *Cosmiomma* ticks clump together on top of each other on leaf tips and twigs might be interpreted as a method of moisture conservation.

ACKNOWLEDGEMENTS

We have pleasure in thanking the Director of Veterinary Services, S.W.A., for his permission to publish this report and Dr. G. Theiler for inspiring us to undertake this study and for translating certain papers.

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A REVIEW OF THE PARASITIC STATUS OF *CHEYLETIELLA PARASITIVORAX* (ACARINA: TROMBIDOIDEA) WITH SPECIAL REFERCENCE TO CASES IN DOGS AND MAN IN SOUTH AFRICA

R. S. DU PLESSIS*

SUMMARY

This article describes infestations with *C. parasitivorax* mites on dogs in a Johannesburg kennel and on one of the owners of a puppy bred at the kennel. Since there appears to be some confusion regarding its parasitic rôle, the parasitic status of the mite is discussed. A description is given of the various sites of infestation on humans and three species of host animals, viz. dogs, cats and rabbits, as well as of the accompanying symptoms as gleaned from the literature. The available control methods are reviewed.

CASE HISTORY

The occurrence of *Cheyletiella parasitivorax* (Megnin, 1878) on dogs and as a cause of dermatitis in a human in South Africa was recorded for the first time in Johannesburg in 1971 [1]. A breeding kennel with a high standard of cleanliness was involved. The infestation was discovered after a woman, one of the new owners of a Maltese poodle puppy bred at the kennel, contracted a dermatitis which consisted of areas of red-brown macular lesions 1 to 2 mm in diameter. The rash started on the anterior part of the neck and right shoulder and extended to the thorax and upper abdominal region. This skin condition was diagnosed by a medical doctor as an allergic response to insect bite and this lead to the discovery of the mites on the puppy.

Clinical signs present on some of the other dogs in the kennel included an accumulation of dandruff on the skin surface, oily appearance of the hair with little or no loss of hair and slight erythema and rash. The infestation was localized to the dorsal part of the lumbar region. Skin scrapings taken with liquid paraffin as a carrier from four dogs showed that only *C. parasitivorax* were present (Figs. 1 and 2).

TREATMENT

Two of the dogs, found infested by Irvine-Smith [1] and treated prior to this investigation with Tetmosol**, had no mites present in the skin scrapings. A Tetsomol bath was prescribed as treatment against the mites for the remaining dogs.

PARASITIC STATUS

C. parasitivorax, also known as the 'rabbit fur mite', has a world-wide distribution and is present wherever rabbits are kept [2]. It has been found in Australia [3, 4], Austria [5], Britain [6-10], Denmark [11, 12], France [13], Italy [14], New Zealand [15, 16], North America [17-19], South Africa [1, 2, 20], Switzerland [21], and the Netherlands [22]. In 1878 it was described by Megnin as a predator of other mites on a rabbit in Europe, presumably France [13]. *C. parasitivorax* belongs to the family Cheyletidae, which consists primarily of free-living predators. Some members of this family, e.g. *Hemicheyletus*, occur in the fur of mammals and *Cheyletus* and *Neocheyletiella* are found in South Africa amongst the feathers of birds, where they presumably live as predators on true parasitic mites [2, 23]. Only one species of the genus *Cheyletiella* is known in South Africa. It was reported from rabbits at Onderstepoort in 1932 and 1961 [2, 20]. No mention was made of any skin lesions being present on the hosts.

There is a difference of opinion regarding the effect of *C. parasitivorax* on its hosts. If it were a true predator of parasitic mites, then its presence on the host animal would be desirable, as its activities would lighten the parasite burden of the host. According to Cooper [18], this seemed to be the case from Megnin's original description: 'One finds *C. parasitivorax* in the company of soft-bodied mites, such as listrophorids, upon which it feeds'. This opinion was shared by several

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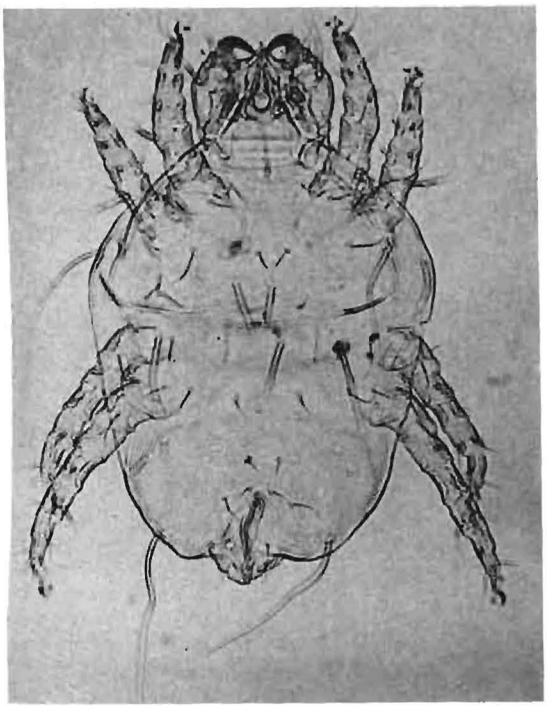
FIG. 1: **Cheyletiella parasitivorax** (Megnin, 1878) × 130.



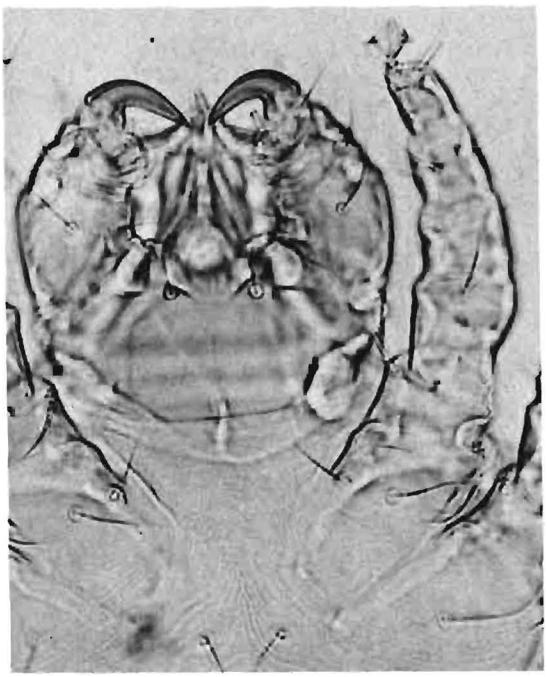


FIG. 2: A higher magnification (×300) of **C. parasitivorax** to show the charfacteristic palpal claws and combed tarsi.

other workers [5, 7, 18, 24]. The possibility of biological control of other mites with *C. parasitivorax*, 'which would roam through the hairs, a miniature hunting forest' [25] has never been investigated.

Nevertheless, several reports have been published which recorded heavy infestations on rabbits in the absence of other mites on which it was supposed to prey. In many cases lesions, apparently caused by parasitic activity, were present. Thus the innocuous nature of *C. parasitivorax* was questioned [3, 9, 26, 27, 28]. *Cheyletiella* was first recorded on cats in 1917 [7] and on dogs in 1940 [5]. In 1918 it had been incriminated as the cause of a skin condition in humans [11].

After the observations of Schaffer, Baker & Kennedy [29] were published, the parasitic nature of *C. parasitivorax* was no longer doubted. Examination of punch biopsies of infested dogs showed *C. parasitivorax* mites partly embedded in the keratin layer of the skin. The reaction to this infestation was intense and involved both the epidermis and dermis [29].

SYMPTOMS

Which regions of the body are affected in humans is probably influenced by the way an infested pet is cuddled; these include neck, arms, thorax, and upper abdominal region [10]. Direct contact with the skin surface is unnecessary as the mites can penetrate through clothing [10]. Symptoms shown by infested humans have been variously stated to be a severe pruritus, papular eczema [12], red, swollen, itching areas [11], an irritating rash with lesions [4, 15] and purplish-red spots of intense irritation [6].

Cats infested with this mite often have no visible lesions [15, 17, 18]. The mite, however may cause a pruritic dermatitis, with scabs up to 5 mm in diameter on the neck [30] although the mites are sometimes evenly distributed over the whole body [10]. Small scabs containing hair can be dislodged upon slight scratching and in heavy infestations cats become lethargic and lose their appetite [30] Several human cases of dermatitis have been recorded where the *C. parasitivorax* infestation was contracted from cats [4, 10, 11, 12, 15, 30].

Infested regions reported on rabbits include the skin of the abdomen and back [3], the scapular area [26] and the dorsal midline from

the shoulder blades to the sacrum [9, 28]. Among heavily infested rabbits the following symptoms were most commonly encountered: powdery dandruff in the fur on the dorsal midline [28], loose and rough fur with a layer consisting of hair, detritus, exuviae and mites on the surface of the skin [26], loose under-fur with a red and tender skin [28], inflamed skin with drops of exuded serum in an area of intense inflammation [26] and alopecia [31, 32].

Mainly the rump and shoulder areas have been found to be infested with *C. parasitivorax* in dogs [10, 19, 33, 34]. In more severe cases other areas can also be affected, viz., the head, neck, back, thorax, abdomen and extremities [35, 36]. Lesions are usually more severe in puppies than in older dogs and the mite is also found more comomnly on pups [29, 33, 34]. One or more of the following symptoms have been observed in dogs with varying degrees of infestation: generalized scurfiness accompanied by scratching [6]; oily fur with an accumulation of scurf at the base of the hair [19, 33]; hyperaesthesia of the skin with reflex scratching [28]; the presence of yellowish crusty scales on the hair and skin [34]; the entire body covered with heavy scale that matted the coat [6, 29]; a rash with raised areas and a thickening of the skin [35]; exfoliation of the epidermis and slight alopecia [29]; excessive shedding of hair and mild to severe pruritis [6].

CONTROL

In cases of human infestation with *C. parasitivorax* good results were obtained when only the pet animal that served as source of infestation was treated. The skin condition also improved if contact between the infested animal and its owners was avoided until the infestation in the animal had been cleared [10, 19].

The following insecticides have been tried against this mite on cats: DDT powder [12] (which is not to be recommended); derris preparations [12, 30] and mercaptothion [15].

Benzyl benzoate has been used successfully on rabbits [26]. Before the modern synthetic insecticides became available, a daily brush with a 'dandy' brush was said to have cured a case of *C. parasitivorax* infestation in a rabbit [9].

Carbon bisulphide [5], monosulfiram [10], BHC [29, 34] benzyl benzoate-lindane solution [19], pyrethrum and lime-sulphur preparations [34] have all given good results on dogs. Three [29] or four [19] treatments with any one of these insecticides at 4-day intervals cleared up the infestation; three weeks thereafter the skin had returned to the normal state [29].

DISCUSSION

These mites are possibly a much more common problem than is generally realized. They occur widely on various breeds of dogs and are continually being overlooked in the diagnosis of skin disorders. Dogs with symptoms previously diagnosed as dry eczema and dandruff have been found to be infested with *C. parasitivorax* [34].

An infestation can exist unrecognized for a long time in a kennel because many of the adult dogs are asymptomatic carriers of the parasite [33]. Extensive outbreaks have been recorded in kennels in the U.S.A., where the infestation constitutes a serious kennel problem [33, 34].

The danger of human infestation from pets is very real. It is very difficult to detect a small number of these minute, free-moving parasites on a human host. A diagnosis can be made more easily by examining the suspected pet [10]. It is also important that a veterinarian examining animals for *C. parasitivorax* infestation should enquire from the owner whether any cases of dermatitis or eczema have recently occurred amongst members of the household.

ACKNOWLEDGEMENTS

I am grateful to Dr. C. J. Howell, who initiated this investigation, to Mr. E. M. Nevill and Dr. R. D. Bigalke for helpful advice in the preparation of this article, and to Mr. A. M. du Bruyn and the photography section of Onderstepoort for the photographs.

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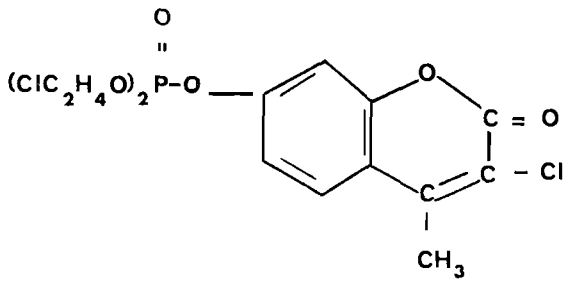
HALOXON



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Jl S. Afr. vet. med. Ass. 43 (3): 311—313 1972

SPECIAL REPORT SPESIALE VERSLAG

BIOTELEMETRY SYMPOSIUM

PRETORIA, NOVEMBER / DECEMBER 1971

INTRODUCTION

A most successful symposium in biotelemetry was held in Pretoria, South Africa, from 29 November to 3 December 1971 under the auspices of the South African Council for Scientific and Industrial Research, the South African Medical Research Council, the South African Wildlife Foundation, the Wildlife Protection and Conservation Society of South Africa and the National Parks Board of Trustees.

The symposium, the first of its kind in South Africa, was held on the campus of the University of Pretoria and was attended by 138 delegates, most of them from Southern Africa but including a few overseas visitors in addition to the 8 speakers from the U.S.A., U.K. and Australia.

Keynote Speaker: Prof. R. Stuart Mackay

The well-known authority on biotelemetry, Prof. R. Stuart Mackay of Boston University and Boston Medical School, U.S.A., was the keynote speaker. He reviewed the various applications of miniature radio transmitters: by swallowing, by surgical implantation or by external mounting on human beings and animals (including birds and fishes) to enable a great variety of parameters to be measured and the results transmitted. One of the latest applications he dealt with was the implantation of a miniature transmitter inside the human eye to measure changes in pressure.

FIRST TECHNICAL SESSION: MEDICAL, BIOLOGICAL AND ECOLOGICAL USES OF BIOTELEMETRY

Dr. A. M. Harthoorn, a veterinary surgeon and physiologist, discussed some of his pioneering studies in East Africa. He described how radiotelemetry had been used to study physiological variables of wild animals under tropical conditions, and the reactions of animals to environmental changes. Most of these studies could not have been carried out by **any other technique.**

Peter Hitchens, a Game Warden of the Natal Parks Board, gave some of his findings on the territorial habits of black rhino in the Hluhluwe Game Reserve, Zululand, South Africa. For tracking purposes he used radio transmitters designed to fit into the horn of the rhino, enabling him to study their daily and seasonal movements.

Norman Owen-Smith, Research Fellow from the Natal Parks Board, used similar equipment in a study of white rhino in the Umfolozi Game Reserve in Zululand, South Africa, and found that rhino cows, although travelling as far as 10 kilometres to a waterhole during the winter, always returned to their original territory.

Dr. D. H. M. Cumming of the Department of National Parks and Wildlife Management, Rhodesia, also used radio tracking techniques to determine the habits of warthog, and mentioned that there existed a need for miniature equipment which could be mounted on tsetse fly: the tracking of these would enable him to pursue his studies further. Suggesions for possible microminiature design approaches were made during the discussion period by both Prof. Mackay and Howard Baldwin.

Dr. K. Lewer-Allen, Head of the Department of Neurosurgery of the University of the Witwatersrand, Johannesburg, showed how delicate pressure changes of the cerebrospinal fluid in man could be observed by using suitable transducers and transmitters implanted in the skull. Such equipment enabled him to carry out a unique range of observations relating pressure changes in the spinal fluid with coughing and Valsalva reaction and he established that there was an abnormal frequency of momentary stresses above the compliance level in the case, for instance, of hydrocephalic patients. He said that further investigations were being made of pathological states involving dynamic intracranial disturbances.

Dr. M. Milner, Head of the Department of Bio-engineering at Groote Schuur Hospital, Cape Town, reviewed other, especially medi-

cal and clinical applications of radiotelemetry, also the employment of the same techniques in exercise physiology and ergonometrics. He indicated that it would become standard procedure, for instance, to use endoradiosondes in the gastrointestinal clinic at Groote Schuur.

SECOND TECHNICAL SESSION: THE INSTRUMENTATION AND TECHNICAL ASPECTS OF TELEMETRY SYSTEMS

During the second session various aspects of instrumentation techniques, equipment design and component limitations were discussed.

Jerry L. Stuart, of the Jet Propulsion Laboratories, U.S.A., described in his paper some of the latest medical transducers used on astronauts.

Dr. A. Gilmour of Mallory Batteries Ltd., England, dealt with the other most important single component in biotelemetry systems, viz., energy sources.

Dr. John Craighead, of Montana Cooperative Wildlife Unit, U.S.A., dealt with biotelemetry systems employing earth satellites, considered the most sophisticated equipment for tracking and monitoring wild animals.

Biotelemetry equipment for remotely observing physiological phenomena and studying the behaviour of free-roaming animals was also discussed by *Mr. Howard Baldwin* of Sensory Systems Laboratory, Tucson, U.S.A.; he mentioned a number of interesting discoveries which had been made, for instance, that the ears of an elephant have a convection cooling function, as there is a difference in temperature of 9,4°C between incoming arterial and outgoing venous blood. Similarly, an experiment on zebra showed that temperature differences between adjacent black and white stripes are maintained and may actually be reversed as the level of solar radiation changes.

Dr. G. D. Brown, of the C.S.I.R.O., Australia, dealt with the development of a multichannel biotelemetry system for measuring various parameters on sheep and kangaroo in a comparative study of the temperature regulating mechanisms of animals in a semi-arid pastoral environment.

Dr. E. D. Smith, of the C.S.I.R., South Africa, gave a brief but interesting description of the use of special radio pills for investigating the movements of the tail of a shark in response to an electrical stimulus. This study led to the design of the first electrical shark barrier to be used in the sea.

The design in the C.S.I.R., South Africa, of radio tracking equipment for various animals was discussed by *Dr. F. Anderson* who also mentioned various problems which had been encountered and described how the final system was evolved as a compromise. He made the points that for best results in dense bush horizontally polarized waves should be used; that a double-yagi receiving antenna had good directional properties; and that the exceptional filtering ability of the human ear could be made use of to achieve greater sensitivity of reception and a simplified design of receiver.

During the subsequent discussion the unique position of the C.S.I.R. in regard to biotelemetry was stressed. Most of the equipment development carried out in South Africa is centralized within this organisation; this applies to both the clinical field (e.g. the cerebro-spinal fluid pressure monitor as used by Dr. Lewer-Allen) and to radio tracking systems (e.g. the work done on monkeys by Dr. de Moor and that on black and white rhino by Messrs. Hitchens and Owen-Smith).

Dr. A. Lutsch, Head of the Solid State Electronics Division of the C.S.I.R., concluded this session with a discussion of the influence of new electronic techniques, for instance monolithic integrated circuits, on the design of biotelemetry equipment.

EXHIBITS AND DEMONSTRATIONS OF BIOTELEMETRY EQUIPMENT

The C.S.I.R. organized an exhibit of manufacturers' brochures on commercially available biotelemetry equipment and also displays of books and periodicals dealing with the subject. Photographs were exhibited depicting the radio tracking equipment developed by the C.S.I.R. for use on antelope, lion, monkeys and rhino.

Various demonstrations on the use of such radio tracking and telemetering equipment were also organized as part of this session.

THIRD TECHNICAL SESSION: ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

During a short third session *Dr. John Tester* of the University of Minnesota gave a stimulating report on the research carried out at Cedar Creek, where data are monitored from 52 animals simultaneuosly, using automatic tracking equipment. He discussed the accuracy and reliability of the observations and also the short-term and long-term effects of mounting the tracking equipment on animals. He pointed out, as various earlier speakers had done also, that if the signals received from the transmitter were suitably analyzed, it was often possible to obtain additional data: for instance the transmitted signal varied according as to whether the animal rested, walked or ran, and thus such a signal could provide information on the animal's activity.

Dr. P. P. de Moor of the South African Medical Research Council, and *Dr. F. E. Steffens* of the C.S.I.R. reviewed the data obtained in a study of the movements of monkeys in the Ndumu Game Reserve, South Africa. They showed that when such an experiment, including its statistical aspects, was carefully planned beforehand, the number of observations necessary could be estimated in advance and it would become evident at an early stage of the experiment whether insufficient data were being gathered.

FOURTH TECHNICAL SESSION: DISCUSSION PANEL

During this session a panel consisting of the guest speakers from overseas and various experts from South Africa discussed aspects of biotelemetry not covered during the previous technical sessions, including proposed improvements to equipment and further potential applications of such equipment in Southern Africa.

Reverting to the stress laid by various speakers during the earlier technical sessions on the importance of interdisciplinary teamwork in the development and use of biotelemetry equipment, the discussion panel commented on the special position of the C.S.I.R. in South Africa, where all the personnel required for such a team was concentrated and all the necessary facilities were available to assist anyone with such problems. As, however, the commitment by the C.S.I.R. had up to now been merely informal, a formal proposal was unanimously adopted to the effect that a committee be set up under the aegis of the C.S.I.R. to co-ordinate future developments in bio-engineering and that a central group be built up within the C.S.I.R. to undertake research and development and also to standardize equipment and maintain an instrument bank where research workers could lease equipment for specific projects.

A resumé of a panel discussion which was held at the end of the symposium as well as of discussion which followed each paper is presented as part of the proceedings.

PUBLICATION

The Papers and Proceedings of this Symposium have been published in book format by the C.S.I.R. and may be ordered at a cost of R5.00 ($7,25 for overseas orders) post free by surface mail, from:

The Institute Secretary,
NEERI,
CSIR,
P.O. Box 395,
PRETORIA,
South Africa.

In Memoriam

NEVILLE HAYES BOARDMAN
1910—1972

We regret to announce the sudden passing of Neville Hayes Boardman on May 5th, 1972.

Born in the Pretoria district on 9th November 1910, he was educated at Pretoria Boys' High School and the University of Pretoria, qualifying from Onderstepoort in 1935.

From early 1936 he was attached to the field division of the Union Government Service and was stationed in the Transkei. In 1939 he was appointed as Veterinary Officer, Bechuanaland Protectorate Government, and apart from a short period during 1954, he remained in Colonial Service until his retirement in 1965.

Neville was highly respected by his colleagues, by the public and the farming communities. He was a perfectionist in his work, an able administrator, and his knowledge of disease control in the field, especially with regard to foot and mouth disease was of the highest order.

In 1954 he was appointed to the post of Director of Veterinary Services, Swaziland Protectorate, but because of failing health he returned to Bechuanaland after a few months. The administration there, aware of his exceptional abilities, promptly appointed him Principal of the Veterinary Training College at Ramathlabama. This training centre for lay field staff was of great value to the territory and many scores of studentst have passed through its gates.

He retired from Colonial Service in 1965 and returned to the Republic. Then followed short periods of service in the State Veterinary Department in Johannesburg and later also at Newtown Municipal Abattoir, until January, 1969, when he retired finally for health reasons.

His sudden death on 5th May, 1972, although anticipated, was nevertheless a great shock to his colleagues and friends. He is survived by his wife, Winnie, and two sons, Ivan, a chartered accountant and Patrick, a mining engineer, to whom we extend our heartfelt sympathy.

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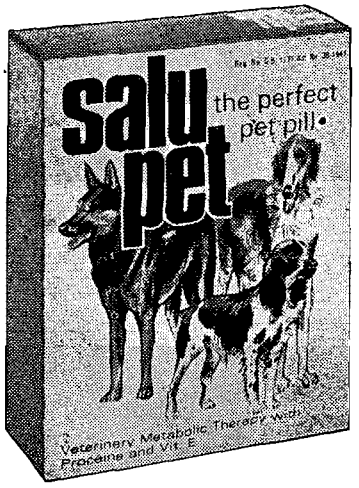

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MAMMAL REVIEW

Blackwell Scientific Publication, Oxford, London, Edinburgh, Melbourne.

Mammal Review is the official organ of the Mammal Society and its object is to extend the Society's aims in the promotion of mammalian studies. There are nowadays relatively few people who study a taxonomic group **per se**; many more become interested in the groups through pursuit of one of the subdisciplines such as ecology, behaviour, anatomy, physiology or genetics. Mammalogy today is an interdisciplinary subject. It has a large and growing following both amateur and professional but, because so many different approaches and disciplines are involved, everyone to some degree is an amateur and everyone actively interested in the subject needs to explore beyond their own discipline to obtain a broader view. The Journal is a medium for review articles on any aspect of mammalogy of interest to the wide readership that it serves.

Mammal Review is published quarterly at £6.00 ($20.00) per annum, post free. Single issues may be obtained at £1.75 ($6.00), postage extra. Volume 2, No. 1 has appeared in May, 1972.

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Maximum reach of the unit is 26 inches (650 mm). Finish is standard ALLEN blue/grey stove enamel with chromed fittings and three alternative mounting bases are available—a screw down type, a bench clamp version and a wall bracket. Operation is direct from 220/240 AC mains or 110/115 Volt AC mains via a separate transformer unit.

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MANAGEMENT AND DISEASES OF POULTRY

THE BRITISH COUNCIL

Edinburgh, 1—13 April, 1973

Course 330

The course will be based at the Easter Bush Centre for Tropical Veterinary Medicine of the University of Edinburgh. The Director of Studies will be Professor Sir Alexander Robertson, Royal (Dick) School of Veterinary Studies, University of Edinburgh, who is the Director of the Centre.

This course will deal with recent developments in production and management of poultry, the causes of the more important diseases and the application of modern knowledge in their prevention and control. It will cover a wide range from the breeding through to the packing and distribution stages. Lectures will be given by leading specialists in the various fields and there will be adequate opportunities for discussion. The programme will include visits to centres for breeding, production and research in the Edinburgh area.

It is hoped to include the following topics in the programme:

The structure of the poultry industry in Britain
Poultry breeding
Control of the physical environment
Nutrition
Management and hygiene
Processing and distribution

The organisation of laboratory diagnosis and research on poultry diseases
Poultry diseases including Coccidosis, Newcastle Disease, Infectious Bronchitis, Marek's Disease, Leucosis, Mycoplasmosis, Salmonella infections and Ornithosis.

Qualifications of members

This course is designed for graduates or others of senior standing with experience in poultry production or poultry disease, including research workers and teachers of these subjects in universities or similar educational institutions.

Numbers

There are vacancies for 25 members.

Fee

£125, including cost of board and lodging, lectures and travel during the course.

Accommodation

Course members will be accommodated in a university hall of residence. No provision is made for accommodation before or after the course. Those requiring such accommodation should book through a travel agent. In the event of real difficulty, the British Council may be able to assist if application is made in writing at least three weeks beforehand. Any such applications must be accompanied by a deposit of £2 for each night's accommodation required. In any event no guarantee can be given that accommodation will be available.

Travel to and from Britain

Members must make their own travel arrangements to and from the course centre. Return reservations should be made if possible before members leave their own country, as it may be difficult to secure them while in Britain.

Joining instructions

These will be issued by Courses Department through Representatives, giving directions for reaching the course centre, including postal address and telephone number of the centre and the latest time of arrival.

Duration of course

Members will assemble at the course centre on the afternoon of the first date shown and will be free to disperse during the afternoon of the last date, unless anything to the contrary appears in the joining instructions.

Cancellation of course

The British Council reserves the right to cancel any course, without notice and without indemnity, subject to the return of any registration or enrolment fee already paid.

Closing date

Applications must be received in London by 1 January 1973.

INFORMATION INLIGTING

EUROPE'S AGRICULTURAL WEIGHT IN THE WORLD

The Common Market of the Six is a major economical power. When enlarged to ten members it will measure very successfully with the other superpowers of the world: the U.S.A., Russia and Japan:

	Six*	Ten§	U.S.A.	U.S.S.R.	Japan
Surface (1 000 m^2)	1 167,5	1 847,3	9 363,4	22 402,2	369,7
Population (1 000)	189 787	257 242	205 395	244 000	103 540
P.N.B. (milliard dollars)	485,2	637,4	933,3	288	—
Importations (% world total)	30,3	41,0	13,7	4,0	6,5
Exportations (% world total)	31,8	41,2	15,5	4,6	6,9
Total cereal production (average 1968/70) (1 000 tons)	69 161	91 187	192 966	160 145	1 742
Total meat production (1969) (1 000 tons)	11 669	16 216	23 227	9 250	1 136
Total milk production (1969) (1 000 tons)	75 834	98 924	32 707	81 300	4 513

*Six: France, West Germany, Italy, Netherlands, Belgium, Luxembourg.

§Ten: France, West Germany, Italy, Netherlands, Belgium, Luxembourg, Great Britain, Ireland, Norway and Denmark.

The "industrial" power of the E.E.C. is well known by all, but it must now be emphasized that the enlarged Community of ten will be:

a—the principal commercial power in the world;

b—the principal provider of aid to underdeveloped countries;

c—a major agricultural power and scientific component of the world.

Bulletin d'Information du Ministère de l'Agriculture, France; 1972, No. 542. 30 Jours d'Europe, E.E.C.; 1972, No. 165. From: Agricultural Report, Agricultural Counsellor (Technical) South African Embassy, Paris, No. 6, June 1972.

Fig. 1 Cornu cutaneum on the mandibular region of a kudu.
Cornu cutaneum van die onderkaakstreek van 'n koedoe.

Fig. 2. Cornu cutaneum on the left carpometacarpal region of an eland.
Cornu cutaneum van die linker karpometakarpale streek van 'n eland.

TWO UNUSUAL CASES OF **CORNU CUTANEUM** IN FREE-RANGING WILD GAME SPECIES

Recently two unusual cases of **cornu cutaneum** in a kudu **Trágelaphus strepsiceros** (fig. 1) and eland **Taurotragus oryx** have come to light.

A kudu, 'with its tongue partly torn out and hanging pedulously from its throat', was reported by tourists near the Punda Milia Rest Camp in the northern part of the Kruger National Park. A predator was thought to be responsible. After a chance sighting by one of the authors (V de V.), the animal was destroyed in order to make a closer examination of the condition. On the macroscopic and microscopic appearance of the specimen, a diagnosis of **cornu cutaneum** was made. The mass (530 gm) was supported entirely by the skin and subcutis of the mandibular region. This explains the length of the skin stalk and pendulous nature of the growth. The animal, an aged female, was in good condition.

An adult female eland with an unusual leg condition was seen and subsequently shot in the Tjolotjo Tribal Trust, south of the Wankie National Park, Rhodesia. On closer examination an aberrant growth of enormous proportions was observed to be attached to the skin and subcutis of the left carpometacarpal region as depicted in fig. 2. The growth consisted of a hard, keratinized outer layer and an inner space containing a quart of clear fluid with globules of fat. A diagnosis of **cornu cutaneum** was made.

In spite of the obvious hindrance caused by the bulkiness of the growth, the animal was in good physical condition.

TWEE ONGEWONE GEVALLE VAN **CORNU CUTANEUM** IN VRYLEWENDE WILDSOORTE

Onlangs is twee ongewone gevalle van **cornu cutaneum** in 'n koedoe **(Tragelaphus strepsiceros)** (figuur 1) en in 'n eland **(Taurotragus oryx)** teëgekom.

Toeriste het beweer dat hulle naby die Punda Milia-ruskamp in die noordelike deel van die Nasionale Kruger-Wildtuin 'n koedoe gesien het ‚met sy tong gedeeltelik uitgeskeur en wat van sy keel gebengel het'. 'n Roofdier was vermoedelik hiervoor aandadig. Na toevallige raaksien deur een van die skrywers (V de V.) is die dier afgemaak ten einde die toestand van naderby te ondersoek. Na makrokopiese en mikroskopiese ondersoek van die monster is 'n diagnose van **cornu cutaneum** gemaak. Die massa (530 g) het net aan die vel en onderhuidse weefsel om die onderkaak gehang. Dit verduidelik die lengte van die steel van vel en die bengelende aard van die groeisel. Die dier, 'n ou wyfie, was in 'n goeie voedingstoestand.

'n Ou elandwyfie met 'n buitengewone voorbeenletsel was in die Tjolotjo-stamtrustgebied, suid van die Wankie Nasionale Park, Rhodesië, gesien en geskiet. By nadere ondersoek is 'n abnormale groeisel van die linker karpometakarpale streek gesien, soos afgebeeld in figuur 2. Die groeisel het uit 'n harde, horingagtige buitelaag bestaan en 'n binneruimte wat omtrent een liter helder vloeistof met vetdruppeltjies bevat het. 'n Diagnose van **cornu cutaneum** is gestel.

Ten spyte van die ooglopende hindernis a.g.v. die massa van die groeisel, was die dier in 'n goeie fisiese toestand.

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