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CONTENTS / INHOUD

CORRIGENDA

1. Band 44, nommer 2, bladsy 109, regterkolom bo-aan: Transponeer die eerste twee reëls na die regterkolom bo-aan, op bladsy 111.
2. Volume 44, number 2, page 120, right column, second paragraph, ninth line: Read "...sarcolemma in frog muscle..." instead of "...sarcolemma in from muscle..."
3. Volume 44, number 2, page 152, left column: Transpose second and third lines. In right column, lines one and seven: Read 5 mm instead of 5 cm.

The illustrations on pages 146—151 of the previous number are reproduced at the end of this number, as many of them were not satisfactory.

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EDITORIAL

THE VETERINARIAN, THE MEAT INDUSTRY AND THE ABATTOIR

The rôle played by local authorities in providing public slaughtering facilities and a meat inspection service for their ratepayers is well known. In our larger cities such abattoirs were operated under the direction of veterinarians, who were also responsible for continuous *ante-* and *post-mortem* inspection of livestock together with all that is ancillary to such a service. In this task the services of the health inspector were essential. The service was rendered as a delegated function on behalf of the Department of Health in terms of the Public Health Act No. 36 of 1919 and the Meat Inspection Regulations, Government Notice 2118 of 1924, as amended. In smaller cities and towns the service was the responsibility of the Medical Officer of Health and the health inspector, sometimes assisted by a veterinarian employed on a part-time basis.

In 1964 the De Villiers Commission reported on its inquiries into Abattoirs and Related Facilities, and stated, *inter alia* that the veterinarian should be placed in charge of meat hygiene at all government levels, i.e. local as well as central. This led to the Animal Slaughter, Meat and Animal Products Hygiene Act No. 87 of 1967, which came into effect with the Publication of Standing Regulations R3505 of the 9th October, 1969. This legislation made meat hygiene in the abattoir the responsibility of the Department of Agricultural Technical Services. The task was entrusted to veterinarians, one of whom is appointed Chief Meat Hygiene Officer (C.M.H.O.) For the purposes of implementation of the Act, both the State and local authorities are empowered to appoint full and part-time veterinarians.

At that stage there were some 1 200 red meat abattoirs in the Republic. Most were small: 773 private and 73 local authority abattoirs slaughtered fewer than 5 cattle units (c.u.) per week, while only 70 had an output in excess of 50 c.u. per week. In all there were 334 abattoirs owned by local authorities and the 18 large abattoirs handled about 65% of the country's food animals.

REDAKSIONEEL

DIE VEEARTS, DIE SLAGBEDRYF EN DIE ABATTOIR

Die rol van die plaaslike bestuur in die verskaffing van openbare slagfasiliteite en 'n vleisinspeksiediens aan sy belastingbetalers is welbekend. In ons groter stede is sulke abattoirs onder die direksie van veeartse geplaas, en hulle was verantwoordelik vir die bestuur van die abattoir sowel as die lewering van 'n volledige, deurlopende voor- en nadoodse inspeksiediens t.o.v. slagvee tesame met alles wat daarmee gepaard gaan. By hierdie taak was die dienste van die gesondheidsinspekteur onontbeerlik. Die opdrag is uitgevoer as gedelegeerde funksie namens die Departement Staatsgesondheid kragtens die Volksgesondheidwet Nr. 36 van 1919 soos gewysig en die gewysigde Vleisinspeksieregulasies, Staatskennisgewing 2118 van 1924. In kleiner stede en dorpe is die taak uitgevoer deur die mediese gesondheidsbeampte en die gesondheidsinspekteur, soms bygestaan deur 'n deeltydse veearts.

In 1964 het die De Villierskommissie verslag gedoen oor 'n ondersoek na Abattoirs en Verwante Fasiliteite. Daarin is dit o.a. gestel dat vleishigiëne op plaaslike sowel as sentrale vlak by die veearts tuishoort. Dit het weer gelei tot die Wet op Higiëne by Diereslag, Vleis en Dierlike Produkte Nr. 87 van 1967 wat in 1969 met die afkondiging van Staande Regulasies R3505 van 9 Oktober (soos gewysig) van krag geword het. Die Wet het die verantwoordelikheid vir vleishigiëne in die abattoir opgedra aan die Departement Landboutegniese Dienste en spesifiek aan veeartse, een waarvan as Hoof, Vleishigiëne (HVHB), aangestel word. In die distribusiehandel sou die taak, soos altyd, onder die mediese gesondheidsbeampte en die gesondheidsinspekteur ressorteer. Vir die implementering van die Wet sou sowel voltydse as deeltydse veeartse deur die Staat en plaaslike besture aangestel kon word.

In daardie stadium was daar ongeveer 1 200 rooivleis-slagplekke in die Republiek. Meeste was klein: 773 private en 73 plaaslike bestuursabattoirs het minder as 5 beeseenhede (BE) per week geslag, terwyl slegs 70 'n deur-

Initially it appeared that the situation would remain unchanged. The new Act provided for local authorities to implement the Standing Regulations in their abattoirs, while the State would do so in private abattoirs. It appeared that a relatively small central control unit and State Veterinarians and auxiliaries in their areas could deal with the matter.

With only a few exceptions, abattoir development in the Republic had been sadly lacking since the last world war. In the areas where a meat marketing scheme was in force in terms of the Marketing Act, the abattoir had become an integral part of the marketing system and local authorities were obliged to provide services and facilities at the lowest possible cost. In 1967 an Abattoir Commission was appointed in terms of Act 86 of 1967 to effect co-ordination and rationalization of the abattoir industry. In 1970 a change in meat marketing policy provided for the erection of private abattoirs in the Witwatersrand controlled area, and at the same time there was an increased interest in the meat and export trade generally. All this brought about great activity, and considerable developments in the abattoir industry in the next five years are confidently expected.

At the same time it became clear to many of the larger local authorities that the original concept of a municipal abattoir was no longer valid, and Germiston, Benoni, Springs, Pietermaritzburg, Durban, Johannesburg and Pretoria have relinquished their priorities to operate abattoirs in their areas of jurisdiction. In terms of ministerial policy the Abattoir Commission has assumed responsibility for the erection and management of abattoirs in these urban areas. Accordingly, the State must augment the organization of the C.M.H.O. to provide continuous meat hygiene services on a much larger scale than originally anticipated, if it is to serve the increasing number of large private and Commission abattoirs. This means the end, in these areas, of the era of the veterinary director of abattoirs who is appointed to direct the operation and to provide a meat hygiene service in the abattoir. This will be felt with justifiable regret. In its place we have a system where the State will appoint one or more veterinarians to implement Act 87 of 1967, while the Commission and the private owner will appoint its own manager or superintendent.

This development constitutes a new challenge to the profession. A much larger perset van meer as 51 BE per week hanteer het. In totaal was daar 334 abattoirs in die besit van plaaslike besture; die 18 groot abattoirs het ongeveer 65% van die land se slagvee gehanteer. Aanvanlik is aanvaar dat hierdie situasie onveranderd sou bly. Die Wet het voorsiening gemaak vir plaaslike besture om die Regulasies in hulle abattoirs te implementeer, terwyl die Staat inspeksiedienste in private abattoirs sou lewer. 'n Relatief klein sentrale beheereenheid en die Staatsveeartse en hulppersoneel in hulle wyke, sou die saak kon hanteer.

Abattoirontwikkeling in die Republiek was, met enkele uitsonderings, sedert die laaste wêreldoorlog feitlik afwesig. In die beheerde bemarkingsgebiede het munisipale abattoirs deel geword van die vleisbemarkingstelsel ingestel onder die Bemarkingswet, en plaaslike besture moes dienste en fasiliteite teen die laagste moontlike koste lewer. 'n Abattoirkommissie is kragtens Wet 86 van 1967 ingestel om koördinering en rasionalisering van abattoiraangeleenthede te bewerkstellig. Die verandering in bemarkingsbeleid in 1970 om die oprigting van private abattoirs in die beheerde gebiede van die Witwatersrand te bewerkstellig en die opbloei van die uitvoerhandel in vleis het 'n geweldige oplewing in die abattoirwese laat plaasvind; groot ontwikkelings staan in die eerskomende vyf jaar voor die deur.

Vir baie van die groter plaaslike besture het dit gaandeweg duidelik geword dat die oorspronklike konsep van 'n munisipale abattoir nie langer geldig is nie en het Germiston, Benoni, Springs, Pietermaritzburg, Durban, Johannesburg en Pretoria hulle eerste reg tot eienaarskap van abattoirs opgesê. Ooreenkomstig Ministeriële beleid het die Abattoirkommissie self verantwoordelikheid vir die bestuur en oprigting van abattoirs vir hierdie stedelike gebiede geneem. Dienooreenkomstig moet die Staat die organisasie van die HVHB aanpas om op 'n veel groter as die beoogde skaal voltydse deurlopende vleishigiënedienste en inspeksie by die toenemende getal private en Kommissie-abattoirs te lewer. Dit beteken die einde, in daardie stede, van die era van die veearts wat as direkteur van die abattoir aangestel is, die bestuur daarvan waarneem en ook vleishigiënedienste daarin beheer. Daaroor kan ons met regverdigheid jammer wees. In die plek daarvan kom 'n stesel waar die Staat een of meer veeartse sal aanstel om Wet 87 van 1967 toe te pas, ter-

centage of its members will now be involved in full or part-time meat hygiene duties than before. Those in full-time service will hopefully take the opportunity to specialize academically and in practice, so as to support the important meat industry. For the practitioner in the part-time service of State or local authority there is the opportunity to use his training and knowledge of meat hygiene and at the same time to stabilize his practice by rendering a daily service at the abattoir according to a specified contract. It is to be hoped that the Abattoir Commission and private owners of abattoirs will also make full use of the proved and acknowledged ability of veterinarians in the field of abattoir management, more particularly in view of the numerous obligations placed upon abattoir superintendents by the Act.

For the profession and the country in general there is also the advantage of being able to extend veterinary activities to rural areas and to serve more remote sectors of the livestock industry by virtue of the allocation of meat hygiene duties to the rural practitioner.

It is, however, of the utmost importance that every member of the profession should fully realize his responsibilities and always act accordingly. Service must remain the prime consideration, and conscientious attention to the maintenance of only the highest of standards is essential in order to justify the recognition now accorded the veterinarian in the field of meat hygiene. Finally, every veterinarian engaged in meat hygiene work must ensure that his competence in this field is up to date.

wyl die Kommissie en private eienaars hulle eie bestuurders of superintendente sal aanstel.

Dié ontwikkeling stel 'n nuwe uitdaging aan die professie. 'n Veel groter persentasie van sy lede as vroeër sal nou op voltydse of deeltydse basis amptelik by vleishigiënedienste betrek word. Vir dié in voltydse diens is daar geleentheid om akademies en prakties te spesialiseer en daardeur die belangrike vleisbedryf te bedien. Vir die praktisyn in deeltydse diens van die Staat of Plaaslike Bestuur is daar die geleentheid om sy opleiding in, en kennis van, vleishigiëne te gebruik om stabiliteit aan sy praktyk te gee deur volgens kontrak gespesifiseerde dienste by die abattoir daagliks te lewer. Hopelik sal die Abattoirkommissie en die private eienaars van abattoirs ook ten volle gebruik maak van die bewese en erkende kennis en bekwaamheid van veeartse in suiwer abattoirbestuur, veral inagnemende die veelvoudige en spesifieke pligte wat die Wet aan so 'n abattoirsuperintendent opdra.

Vir die professie en die land as geheel is daar ook voordeel. Die toesegging van deeltydse werk t.o.v. vleishigiëne aan plattelandse praktisyns sal veel bydra tot die vestiging van veeartse op meer afgeleë dele van die platteland waar hulle diens aan die veebedryf so broodnodig is.

Daarby is dit egter van die allergrootste belang dat elke betrokke lid van die professie sy verantwoordelikhede terdeë besef en nakom. Diens moet die eerste motief wees, en noulettende aandag aan die handhawing van slegs die hoogste standaarde is nodig om die erkenning op die gebied van die vleishigiëne, wat nou aan die veearts gegee word, te regverdig. Dit is dan ook die plig van elkeen wat vleishigiënewerk onderneem om te sorg dat hy ten volle in die vakgebied bedrewe is.

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EDITORIAL NOTE

REDAKSIONELE AANTEKENING

OPENING OF NEW HEAD OFFICE BUILDING BOTANICAL RESEARCH INSTITUTE

The size and impressiveness of a building bear no relation to the measure of activity going on inside it. Nevertheless, the opening of the new head office building of the Botanical Research Institute is a good indication of the expansion of activities of that Institute and of the progress that has been made. To any one in any way interested in the scientific, cultural and economic welfare of South Africa, such a sign on the part of our fellow-scientists, the botanists, is to be welcomed most warmly.

The need for close collaboration between the veterinary scientist and the botanist is probably nowhere as great as in South Africa. This was realized by no one less than Arnold Theiler, who already in the second decade of this century had Mr A.O.D. Mogg seconded from the Botany Division to the Division of Veterinary Services, and who had Dr Marguerite Henrici come from Switzerland as plant physiologist to assist in local veterinary problems. The close co-operation and collaboration between the two divisions have been a natural and accepted *modus operandi*, so that officers in the Division of Botany have become looked upon rather as friends, even by those at Onderstepoort not even remotely concerned with botany.

The official opening of the new building on July 2, 1973, by the Minister of Agriculture, the Hon. Hendrik Schoeman, was a memorable event, distinguished by excellent organization; the conveyance of congratulations by leading botanists and heads of botanical organizations from all over the world, many of them being present in person; by a superbly produced slide series, with commentary, on the historical development of the Division and its activities; and by Minister Schoeman's spirited address, in the course of the latter two of which the following issues and facts were pointed out.

Knowledge of vegetation is indispensable to man because without plants we could not continue to exist. In a country like South Africa with its limited area of arable soil the indigenous vegetation is of special value and importance.

Over 75 per cent of the country's total surface is covered by natural indigenous pastures. We are dependent for our existence on this natural plant cover, not only because of its productive value for our livestock, but also because it protects our soil against erosion and loss of fertility. The more intimate our knowledge of this vegetation, the better we will be able to ensure a prosperous future for ourselves.

One of the most important functions of the Institute is to study the South African vegetation and its ecology, in order to appreciate our environment scientifically and to utilize plant growth and ecological systems to best advantage.

Veld studies undertaken by research workers of the Institute have already brought to light knowledge which has directly affected the welfare and development of the Republic. For instance, it has been ascertained that a disquietening deterioration is taking place in the veld cover of extensive parts of the country, more especially in the transition regions between the grassveld and the Karoo bush vegetation.

The knowledge thus collected serves as a basis for the reclamation work being undertaken by researchers and extension officers of this Department and will ultimately prove to be of great economic importance to the country.

The Institute's achievements in connec-

tion with vegetation surveys are apparent from the fact that the Republic is at present one of the few countries in the world which has a national, comparatively detailed vegetation map on which veld types are shown in areas demarcated more or less according to the same agricultural potential.

Another sphere of special importance in which the Institute is active is economic botany. A thorough knowledge of our vast variety of plants is necessary to establish which varieties have an economic value and can be used. Thus, for instance, basic information has been obtained concerning the improvement of beautiful flower varieties which are now of great economic value. Today many of them are much sought after to beautify our gardens and homes and are enjoying a growing overseas market.

Further examples are plants containing food and water — the latter of vital importance in desert and semi-desert areas, plants of medicinal value, plants capable of binding sand, plants containing fibre, or oils, or resins, or other properties which could be exploited. Attention is being given to plants containing possible anti-carcinogens.

Studies regarding the possible economic value of our indigenous plants are, however, only in the initial stage and much work remains to be done in this connection. But poisonous plants and weed varieties also have an economic significance, even if this is only a negative aspect, and knowledge concerning them is of particular interest to our livestock industry. In the same category, but more of public health concern, are the plants containing habit-forming constituents.

Authorities believe that there are over 1 000 poisonous plants among some 20 000 plant species occurring in the Republic and that about 100 of them cause stock poisoning fairly regularly. Unfortunately not all of them are well known and it is the task of the Institute to gather and disseminate more information about this undesirable group.

Mr Schoeman drew attention to the excellent services rendered by the Botanical Research Institute, such as those provided by the herbaria, its achievements in the sphere of flora research, and its publications, such as the Flora of Southern Africa, Bothalia, Flowering Plants of Africa, Botanical Survey Memoirs and many others which are enjoying world esteem.

The occupation of the new building now makes it possible for all the activities of the Botanical Research Institute to be carried out under one roof. The building was erected at a cost of approximately R750 000 in the National Botanical Garden in Pretoria. This garden, which was started some 26 years ago and covers 77 ha, houses about 5 000 plant species and represents a number of indigenous ecological systems. It is regarded as one of the most important scientific collections in the country. The Garden also serves as a centre of dissemination of indigenous plants and information concerning them to horticulture and other divisions of agriculture.

The Institute houses the National Herbarium containing some 60 000 dried plant specimens; a further 30 000 are kept in the various Regional Herbaria.

The Institute's function to collect and collate information and to make it available will be enhanced in the near future by linking up with the new computer of the Department of Agricultural Technical Services. Data from the Herbarium, the Garden, field surveys and concerning plants of economic value will then be available immediately.

In conclusion the Minister said that experts on the subject of botany from here and overseas, as well as agricultural scientists and experts on other subjects, were aware of the quality of the research done by the Institute and the services it rendered.

The South African Veterinary Association has much pleasure in tending its heartiest congratulations to the members of the Botanical Research Institute and to the triumviriate that has carried it to its present zenith: the Director, Dr L.E.W. Codd; his immediate predecessor, Dr R.A. Dyer; and his immediate successor, Dr Bernard de Winter.

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REVIEW OORSIG

SALMONELLOSIS IN SLAUGHTER ANIMALS AS A SOURCE OF HUMAN FOOD POISONING

P. J. MEARA*

SUMMARY

Salmonellosis in the different species of slaughterstock is reviewed. Circumstances which build up infection in animals before slaughter are considered. Improved abattoir practice is required to eliminate contamination of meat. Clean premises and equipment, a high standard of personal hygiene and good slaughtering techniques are essential. Adequate veterinary and health inspection staff are essential for effective meat inspection and meat hygiene. Veterinary bacteriological control of feed supplements of animal origin is desirable in the Republic. Scientific investigation into the incidence of salmonellosis in farm animals in South Africa is needed.

INTRODUCTION

The outdated slaughter facilities in the Republic have been a long-standing matter of concern, culminating in the appointment during March, 1961, of the Government Commission of Enquiry into Abattoir and Allied Facilities which reported its recommendations in May 1964.

During the parliamentary session in May, 1965, the Government announced acceptance of certain of the Commission's recommendations, but the eventual national pattern of new abattoir development only became evident after the Minister of Agriculture's statement in the House of Assembly on April 24th, 1972 [129].

The projected new abattoirs will be required to ensure a safe and suitable meat supply for local inhabitants, as well as to comply with overseas hygienic requirements for meat exports.

Many reviews in recent years have dealt with the food poisoning problems presented by salmonellas [28, 32, 49, 50, 67, 70, 125, 148, 149, 155, 157]. This paper, regarding the abattoir implications of salmonellas, may prove helpful to the many individuals and organizations concerned with these problems in developing and operating the projected new abattoirs.

SALMONELLOSIS IN SLAUGHTERSTOCK

Suspected food poisoning is notifiable in England and Wales. Of the 4 256 reported incidents of food poisoning in England and Wales in 1967, 3 259 were due to salmonella organisms. Salmonellas accounted for 97 per cent of all incidents of which the cause was ascertained, and for 23 of the 27 deaths from food poisoning. The commonest source of the infection in man was meat and meat products [68, 126].

Food animals are the main source of salmonella food poisoning in Britain, where the most frequent causal serotypes are common in these animals and their products [18, 51, 147]. Contrary to earlier ideas, livestock (including poultry) are now believed to be the main source of human salmonellosis infections in Britain [35, 148]. The blame for food poisoning in man falls less and less [3, 4] on the human excreter. Human to human spread is relatively unimportant in maintaining salmonellosis in man. The human carriers are regarded as victims of the infected environment arising from the food animals [176]. Human infections are expected to dwindle if salmonellosis in animals can be reduced substantially [3].

Salmonella contamination may be spread from emergency-slaughtered and also from apparently healthy animals [50]. Efficient meat inspection services should prevent the flesh and organs of an ill animal being distributed for food. In the abattoir, possible salmonella contamination of meat and meat products by the intestinal contents of the apparently healthy food animal itself, or by another such animal, or by man, must also be prevented by improved abattoir practice [43].

Beef, veal, pork and poultry are responsible for sporadic cases and outbreaks of human disease [68, 124]. Sheep are usually not considered a source of human salmonella infection from meat.

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Cattle

Twenty-one per cent of abattoir drain swabs were positive, and salmonellas were found more frequently where a high proportion of cattle was slaughtered [124]. Forty-one per cent of positive drain swabs were obtained in Glamorgan abattoirs over three years [60]. The serotypes isolated from sewer swabs in an abattoir may be different from those infecting the local population [77].

Clinical disease is more common in calves, but cattle of all ages may become infected with salmonellas [50]. The clinical course is usually short, so that actively infected cattle are rarely sent to an abattoir [37, 38]. In any event, appropriate *ante-mortem* and *post-mortem* meat inspection procedures at the abattoir should obviate the possibility of infected meat being distributed from cattle suffering from generalized systemic salmonella infection.

The animals which recover from clinical disease, or those with subclinical infections, may remain healthy carriers, excreting salmonellas in their faeces for many years [37, 94, 136]. Conditions of stress or inter-current disease may also lead to salmonellas being excreted [50, 125]. A survey in New Zealand showed that 13 per cent of calves and 15 per cent of dairy cattle were symptomless excreters of salmonellas [106]. Apparently healthy active carriers and latent carriers therefore present an insidious hazard, necessitating satisfactory slaughterhouse hygiene if contamination of their carcases or others is to be avoided [2, 38, 147, 148]. A clinically normal cow, constantly excreting *S. parathyphoid B* and unlikely to be detected as an active carrier, is an extremely dangerous animal, likely to yield a grossly contaminated carcase [162].

Faecal samples are more reliable for isolating salmonella than rectal swabs [10]. A carrier rate of 10 per cent of healthy Irish cattle was revealed by faeces testing [136]. The carrier state may persist for at least two years [37]. The customary methods of meat inspection cannot detect symptomless excreters and this presents a grave problem to the veterinary meat inspector [73, 109]. The factors which transform the symptomless carrier into a bacteraemic animal of greater disease potential need to be studied [111, 124].

Australian workers found salmonellas in 45 per cent of ruminal fluid specimens from apparently healthy slaughtered cattle after the viscera had been passed for consumption [54]. Salmonellas were isolated from 18 per cent of bovine rumen samples as compared with 10 per cent of faecal samples [23]. A greater incidence of salmonellas was found in the rumen of cattle held for a longer period between farm and slaughter [55]. In Holland, 1,6 per cent of rumen samples yielded salmonellas, compared with 0,5 per cent of faeces samples [33]. Salmonella positive rectal swabs were collected from 10,1 per cent of live cattle and 5,2 per cent of goats in an abattoir at Colombo [103]. In Botswana, a salmonella carrier rate of 7 per cent was found by testing faeces samples from apparently normal cattle. [100].

The development of intensive cattle rearing has introduced a further food poisoning risk [146, 147, 148]. Associated with the changing of husbandry practice to intensive rearing of calves for producing baby beef, a striking increase of salmonella infection occurred in cattle in Britain during the ten-year period 1958 to 1967 [2, 149, 157]. Important causal factors were the dealing in and handling of calves from a variety of breeders or markets, together with the various associated conditions of holding and cross-infection, and possible overcrowding and unsuitable transport during distribution.

Transport conditions of animals, their penning at the abattoir and the period of holding many promote cross-infection with salmonellas. Measures will have to be taken to reduce salmonellosis in food animals and possible transfer of infection to man [125]. The isolation rate of salmonellas 12—18 hours after cattle arrived was not significantly different from that found soon after arrival [93], yet the longer animals are exposed to cross-infection from latent carriers or diseased animals within the lairage the greater must be the risk from contamination and infection.

Calves

An outbreak of human infection owing to *S. typhimurium* and involving 90 people was caused by the introduction of contaminated calves' heads to butcheries [1, 5, 43]. In Sweden, in 1953, *S. typhimurium* in veal was responsible for approximately 8 000 notified cases, with 90 deaths [28, 88]. Evidence is also accumulating of *S. typhimurium* infection of persons working in intensive calf units [50, 126, 148].

Between 1958 and 1960, an increased incidence of salmonella infection in calves was observed in Britain and a closer relationship was found between outbreaks of salmonella infection in calves and man than previously recorded [49]. A build-up of infection within a calf rearing unit may follow the admission of infected animals [177]. The carrier rate may reach 50 per cent in small groups of calves in certain areas [66]. During an outbreak of *S. typhimurium* most of the calves excreting salmonellas were symptomless and could have contaminated an abattoir severely if sent for slaughter [124, 177]. Salmonellas were isolated from the mesenteric and portal lymph nodes, gall-bladder and faeces of 12 per cent of normal slaughter calves, and the incidence of *S. typhimurium* was 55 per cent [80]. One to seven per cent of calves coming to two slaughterhouses from different regions in the Netherlands were positive for salmonellas [32]. In another investigation, 23 per cent of abattoir calves yielded salmonellas of 16 serotypes with *S. typhimurium* the commonest in approximately half the cases [29].

Calves lack resistance to transport stress On the farm they may suffer sporadically from mild or subclinical disease, but exposure to secondary aetiological factors, such as travel weariness, chilling, dietary abuse and intercurrent infections, may provoke an outbreak of severe disease [153]. Bringing calves together in early life from different farms and markets for transport over long distances under conditions of unfavourable environmental temperature, hunger, and fatigue, all serve as important stress factors [43, 148]. Ideal conditions for the spread of salmonellas are provided by the opportunities for cross-infection during the congregation and transporting of calves, as well as the terminal holding period in a lairage at the abattoir. During a sudden brief outbreak of *S. typhimurium* infection in a group of 60 calves, half were excreting salmonellas in their faeces with little evidence of clinical disease [177].

An increased rate of salmonella infection between farm and abattoir has been reported. Compared with only 0,6 per cent positive samples from calves shortly before entry to the abattoir, 36 per cent positive faeces samples were obtained in calves held and fed together for two to five days [5, 49, 148]. In New Zealand, 6,6 per cent of calves slaughtered at meat works yielded salmonellas; *S. typhimurium* was the most common serotype [108]. Transit and holding times totalling less than 12 hours yielded 10 per cent of samples positive for salmonellas, compared with 40 per cent for longer times after leaving the farm [109].

At least 18 per cent of calves condemned for enteritis at Johannesburg abattoir during 1949/50 were infected with salmonella [117].

The calf management problems during 1961 at Johannesburg abattoir culminated in statutory prohibition of admission into the abattoir from Friday midday until 7 a.m. Monday each week-end, and during public holiday periods [121].

Difficulties in feeding calves in abattoir lairages make it desirable that calves be penned in small groups and slaughtered as soon as possible after arrival [153]. Amongst many important features aggravating calf infections are:—

(i) Transportation from farm to abattoir, predisposing calves to digestive upset.

(ii) Unavoidable change of diet from farm to abattoir.

(iii) Wrong quantity of feed. Small amounts of properly mixed milk substitute at body temperature are desirable.

(iv) Irregular feeding. Calves should be fed at least twice per day.

(v) Mass feeding. Individual feeding is desirable, by bottle or by bucket. At the abattoir this is not possible owing to the practical difficulties of feeding large numbers.

Careful attention to the above factors, as well as discriminating exposure in sales yards, improved hygiene and animal management, and vaccination may reduce the incidence of infection [18, 50, 86, 87, 125, 153].

Pigs

An outbreak of food poisoning affecting 472 persons was associated with the occurrence of *S. typhimurium* in pigs [101].

S. cholerae-suis, which is almost host-specific for the pig, is usually responsible for incidents of acute or chronic disease. The incidence of salmonellas in the mesenteric lymph nodes of healthy domestic animals was investigated [148]: the isolation rate was higher than for faeces and *S. typhimurium* was the type most commonly found. Salmonellas were

found more frequently in pigs than in the other species. The examination of occasional faecal samples, or of one or several lymph nodes, is misleading as they indicate only a fraction of the real salmonella infections [79, 80, 82]. The many salmonellas causing subclinical infections in apparently healthy pigs throughout the world can usually be isolated from the mesenteric lymph nodes. Although *S. typhimurium* is more commonly found than *S. cholerae-suis* in these carriers, the surveys may have underestimated the incidence of *S. cholerae-suis* because of suppression by the generally used culture media [51].

An outbreak of disease in a piggery of 200 pigs with morbidity up to 75 per cent and resulting in 15 per cent mortality, was due to *S. cholerae-suis* [110].

Healthy pig excreters were common in Britain [94]. Infection was persistently spread to farms from breeding establishments supplying healthy, excreting pigs [48]. Sixty specimens were positive from 500 healthy pigs at an abattoir in Essex [144]. Salmonellas were isolated from the tissues and livers of 15 out of 18 clinically normal pigs excreting salmonellas in their faeces [115]. Nevertheless, a recent appeal by a survey team asks for information concerning actively infected pig herds, because the investigation of nearly 12 000 pigs has revealed only 1,47 per cent of symptomless excreters [63].

In the Netherlands, 25 per cent of normal slaughterhouse pigs harboured salmonellas in the mesenteric and portal lymph nodes and faeces, as well as an internal infection of the meat (0,5—1,5%), and of the organs (diaphragm 5,5% spleen 3,3%; liver 3,7%) [80]. Normal slaughterhouse pigs suffering infection of the meat and/or organs constitute a serious problem of meat inspection [79]. Salmonellas were isolated from 36 per cent of faeces samples from pigs and from 30 per cent of mesenteric lymph nodes in carcases passed for human consumption [167]. The salmonella infection rate in the portal and mesenteric lymph nodes and faeces of normal pigs slaughtered in 7 abattoirs in the Netherlands increased from 25,3 per cent in 1960 to 30,1 per cent in 1969 [31]. Salmonellas were found in 12 per cent of mesenteric lymph nodes of pigs slaughtered in Athens [113].

In an Australian abattoir 27 per cent positive results were obtained from the intestine and mesenteric lymph nodes of slaughter pigs (ileum 18%; colon 17%; lymph nodes 15%) [134]. Salmonellas were isolated from 8,7 per cent of carcases examined at slaughter [21]. Canadian workers detected salmonellas in the mesenteric lymph nodes of 20 per cent of pigs investigated, which procedure they believe to be the most effective means of isolating salmonella from pigs [57]. In Dakar, 28 serotypes of salmonellas were isolated from the mesenteric lymph nodes of 137 healthy, slaughtered pigs [20].

After accidental *S. typhimurium* infection of pathogen-free pigs, this organism was excreted sporadically in the faeces for 6 months and *S. typhimurium* was present in the tissues in various sites up to 6 months after clinical recovery (e.g. tonsils: 10 out of 12 cases) [52].

The frequency of infection in apparently normal pigs means that abattoir personnel must constantly be alert to the public health hazards which may originate in the abattoir and can be conveyed by pork products. In 1946 a large outbreak of meat-borne salmonellosis, affecting approximately 4 000 persons and resulting in 3 deaths, came from infected pigs in Essex [19]. At the Colindale Central Laboratory, *S. cholerae-suis* was isolated from approximately 10 humans per year between 1950 and 1966 [110].

The incidence of infection in pigs before they leave the farm is less than after they have been held at the abattoir before slaughter. Seven per cent of pigs at the farm were positive, compared with 25 per cent in the abattoir holding pens and 50 per cent on the killing floor [46]. Another survey established that only 2,9 per cent of pigs examined immediately after arrival at the abattoir were excreting salmonellas in their faeces but that holding pigs for one to seven days increased the incidence to 13,5 per cent [94]. Positive caecal swabs were derived from 9,1 per cent of pigs held 1—7 days at the abattoir as compared with only 3,2 per cent for pigs held less than one day [17]. The mesenteric imph nodes from 5 to 11 per cent of short-stay pigs were positive for *S. brandenburg* compared with 32 to 91 per cent of long-stay pigs kept two days to one month or longer before slaughter [78]. Limiting the duration of the stay in the lairage and preventing overcrowding, substantially reduce the proportion of animals found to be infected at slaughter. Salmonella-excreting pigs which had consumed infected

feed ingredients on the farm were responsible for the build-up of salmonella infection in contact pigs in the contaminated abattoir environment[174]. After four hours transport, 21 per cent of previously negative pigs were giving positive rectal swabs. After 12 to 19 hours in the holding pens, this was reduced to 2,5 per cent, but 23 per cent of ceacal swabs were positive after slaughter[173]. Twenty-eight per cent of the faecal samples from pigs slaughtered on arrival at the abattoir were infected as compared with 44 per cent after pigs had been held in lairage for 1 to 2 days[167]. Of ceacal swabs, 3,2 per cent positive ones were obtained from pigs retained less than 24 hours, compared with 9,1 per cent from pigs retained for one to seven days[42]. Despite a low rate of salmonella infection at farms, the isolation of salmonella from mesenteric lymph nodes increased from 5 to 11 per cent after one day at the slaughterhouse, and to 32 to 96 per cent in pigs held for longer periods[10, 148].

After marketing, mixing and holding, pigs have an increased infection when examined at slaughterhouses. The risk of infection of healthy animals in contact with diseased animals or latent carriers is increased, as well as the risk of contamination of meat from animals of the group.

An alternative point of view is presented by other investigations, which show that the differences in the rate of recovering salmonellas at the farm and slaughterhouses are the result of physiological change rather than active infection, i.e. the pigs react to the stresses by an evacuation of the caecum with rapid passage of faeces, thus preventing control of the numbers of salmonellas by the host's defence mechanism[173]. After 20 rectally swabbed salmonella-negative farm pigs had been transported in a specially cleaned motor lorry for approximately 3 hours, further rectal swabs showed that 6 pigs (30%) were excreting salmonellas[175]. Rectal swab measurement of the undisturbed pig cannot be taken to indicate salmonella infection in a meaningful way, so that the extent of pig infection on the farm does not appear to be measurable. It is believed that the changed bowel action owing to stress results in detectable excretion of the infectious agents previously unascertainable by the usual methods. Temperature extremes of hot or cold weather may also act as a contributory stress factor, leading to increased prevalence of salmonellas[58, 173].

Against the general idea that prevalence of salmonellas in market swine is attributable to contaminated abattoir holding pens, a build-up of infection may represent an exacerbation of existing infection[173]. Investigations concerning the presence or absence of salmonella serotypes before and after marketing have in fact suggested that the high prevalence of salmonella-infected animals at slaughter may be independent of the abattoir lairage contamination factor[58, 84].

Sheep

In Britain, salmonella infection is infrequent in sheep, which are not an important source of infection for man[51, 124]. During 1966 a severe outbreak of *S. typhimurium* in ewes and lambs caused the deaths of 108 animals in a flock of 800 sheep; the report is believed to be the first published account of the enteric form of the infection in Britain[140]. Another outbreak, characterized by abortion, caused 5 per cent mortality amongst ewes and 7 per cent amongst lambs[7]. From 1958 to 1967, *S. abortus-ovis* was involved in 481 of 768 episodes of salmonella infection in sheep (62,8%), followed by *S. dublin* (26,4%) and by *S. typhimurium* (7,4%) and others. No cases of human food poisoning were reported as being due to *S. abortus-ovis*, which is host specific for sheep[149]. In Australia and New Zealand, sheep salmonellosis outbreaks are common[26, 138, 140]. Intensified husbandry and housing of sheep in future years are likely to aggravate salmonella infections[51, 62].

Horses

Greater salmonella contamination of horsemeat was found amongst horses slaughtered on the first three days of the week, compared with horses slaughtered on Thursdays and Fridays on arrival at the plant. This was attributed to infection in the holding pens amongst the horses held in the abattoir lairages over the week-end[142].

Contamination of imported horsemeat has frequently been reported[45, 67, 168].

IMPORTED MEAT

Of samples of frozen meat imported into the United Kingdom between 1959 and 1961, 2,9 per cent were infected with salmonellas[67, 68]. During the years 1961—63 salmonellas were frequently isolated from frozen, packed, boneless meat imported into Britain

for human consumption (veal 18,5%; beef 15,2%; mutton 9,8%). Salmonellas were isolated from 4,3 per cent of samples of carcase meat and from 10,3 per cent of samples of boneless meat [70]. As cutting-up, deboning, the increased handling, and the greater meat surfaces exposed favour increased bacterial contamination, boneless meats have twice the contamination rate of carcase meat. Approximately 42 per cent of samples of horsemeat and 50 per cent of samples of horse offal were contaminated with salmonellas [67]. In 1965 the positive results obtained for meat imported from Holland were: carcase meat 6,2%; boneless meat 7,4%; offal 8,6% [27]. Horsemeat from South America was found to be contaminated with salmonellas to the following extent: carcase meat 15%; boneless meat 57% [168]. Sixty-one per cent of samples of imported boneless horsemeat were contaminated with salmonellas [53].

Beef imported into the United Kingdom from Botswana in 1960—61 was found to be salmonella-infected [67]. Continued contamination of beef exported from South West Africa into Britain during 1971/72 was traced to Ovambo operators carrying the same serotype of Salmonella detected at Southampton [169].

PETS' MEAT

A chain of salmonella infection has been demonstrated from the farm via knackers-yard, pets' meat shop and kitchen to human being [9, 43, 45, 68]. Pets' food is an important source of human salmonellosis. Twenty-seven per cent of samples of horsemeat, sixteen per cent of other raw meat and twelve per cent of prepared meat were contaminated by salmonella [45]. Salmonellas were isolated from 94 of 375 samples of raw meat on sale [44]. Over a three year period salmonellas were isolated repeatedly from pets' meat [9].

ANIMAL FEEDSTUFFS

Animals eating contaminated feedstuffs suffer a latent infection and excrete organisms [148]. Feeding slaughterstock with salmonella-contaminated foods is likely to establish a large reservoir of infection, which may pass through animals to human food and constitute a great hazard to the population [10, 101].

The infection of animals by contaminated food with resultant contamination of carcases and meat products has been considered by many workers [24, 44, 50, 56, 104, 105, 119, 120, 125, 145, 148, 159, 170].

Many different salmonellas occur in feedstuffs of both animal and plant origin [155]. Feedstuffs of animal origin, such as meat meal, carcase meal and bone meal, are frequently contaminated with salmonellas [119]. Fifty-six out of fifty-seven samples of crushed bone yielded salmonellas [61]. A wide-spread outbreak of bovine salmonellosis resulted from the feeding of cow meal containing contaminated bone meal [56]. Twenty-six per cent of samples of fish meal were positive for salmonellas with ten per cent contamination due to *S. typhimurium* [75]. Foods of vegetable origin may also be contaminated [50].

The degree of contamination of the animal protein derivative incorporated into animal feedstuff did not improve over a nine year period [24]. Meat meal, carcase meal and bone meal are often heavily contaminated owing to faulty processing, or to post-processing contamination from personnel, equipment, rodents, dust and dirty sacks. During the later stages of processing abattoir by-products, the salmonella-free, post-melting and expelled rendered material may become contaminated from the environment [89]. For instance, salmonellas are isolated most frequently from the percolator area in the heat rendering plant. Contamination from this environment is an important source of salmonella organisms in meat and bone meals [164].

Two-thirds of samples from the animal protein meal deliveries to a feed mill were positive for one or more serotypes (meat meal 86%; feather meal 57%; fish meal 18%) [176]. Salmonellas were isolated from 9,0 per cent of raw ingredients and 2,8 per cent of finished meals from a large manufacturer, and from 13,1 per cent of raw ingredients and 9,0 per cent of finished meals from twelve other factories [120]. Twenty-four per cent of samples of pig meal from farms contained salmonellas [105]. Salmonellas could be isolated from the mesenteric lymph nodes of pigs without clinical symptoms fourteen days after the feeding of salmonella-contaminated feeding meals to healthy pigs [145]. Salmonella species isolated from the mesenteric lymph nodes of 20 per cent of swine examined in abattoirs were traced to salmonella-contaminated feed supplies [57]. Animal excretion of the same serotypes introduced with fish meal feeds was reported [84]. The primary source of infection for baconer-pigs in a factory was traced to salmonella-contaminated feedstuffs [165]. Salmonella-contaminated feed ingredients create a

risk of infecting pigs [104].

Because insufficient organisms may be ingested for clinical infection, salmonella-contaminated protein feed supplements generally give rise to a latent infection, with the attendant slaughtering hazard that the same or another carcase may then be contaminated by alimentary contents and give rise to food poisoning in man [148]. A long period of symptomless excretion of salmonella serotypes was described following accidental infection of a hysterectomy-derived pig breeding establishment [48]. Two epidemiological investigations have pointed to animal feedstuffs as the origin of widespread human salmonellosis [10, 101]. Protein feed concentrates should be salmonella-free [104]. Feeding pigs on pellets prevented infection [30, 34, 48, 66].

It is desirable to free animal feedstuffs from salmonellas by heat sterilization of the feed ingredients of animal origin [43, 104, 125]. The use of gamma radiation has been advocated [10, 67, 68, 78, 85]. Adequately heating animal feedstuffs would have a pronounced effect on the incidence of salmonellas in animals. With compulsory heat treatment of animal feeds in Denmark only 0,3 per cent of Danish meat and bone meal samples contained salmonellas compared with 23 per cent of United Kingdom samples. In the latter country this was associated with a rising incidence of salmonella infections in pigs by salmonellas other than *S. typhimurium*, while the incidence in Denmark fell [130, 143].

FERTILIZERS

Organic fertilizers may be a source of unexplained salmonella outbreaks in man and animals. Forty per cent of samples of organic fertilizers and seventy per cent of bone meal specimens were positive for salmonellas [170]. Up to 94 per cent of samples of bone meal fertilizer were contaminated with salmonellas, and the potential danger of bone meal fertilizer as a source of salmonellosis is emphasized [163].

MANURE, SEWAGE, EFFLUENT AND ABATTOIR WASTE

S. typhimurium survived not less than 280 days in soil exposed to ordinary weather conditions [90], and *S. paratyphi B* not less than 213—259 days in soil from cow pastures [161]. In order to reduce the spread of salmonellas among sheep congregated in earthen yards, the salmonella-containing sheep debris were sprayed monthly with a 5 per cent aqueous solution of formalin. Salmonella organisms were eliminated after two sprayings [139].

With the change from dairy cowsheds to loose housing, cow faeces are washed down with water to form slurry instead of being mixed with bedding to form dung. *S. typhimurium* and *S. dublin* survived for 12 weeks in cattle slurry [118]. *S. dublin* survived 13 to 24 weeks on pasture spread with slurry [41]. An outbreak of *S. typhimurium* caused the death of 9 cattle in a herd of 77 animals which grazed pasture irrigated three weeks previously with slurry, and the overflowing slurry also introduced *S. typhimurium* into a stream [74]. Calves grazing pasture polluted the previous day with 10^6 *S. dublin* per ml of slurry became infected [158]. Long persistence of salmonellas in slurry spread on to pastoral land constitutes a risk to grazing animals [40]. Slurry should be applied to arable land rather than to pasture. Not more than 15,000 gallons of slurry should be applied per acre per year, and before grazing is permitted, 6 months should elapse after the organic irrigation [74].

A stream contaminated by human effluent is believed to have caused a serious outbreak of *S. paratyphoid B* infection in a dairy herd [59*]. Human sewage effluent on grazing land caused *S. aberdeen* infection of a herd of dairy cows [11]. A time interval of two to three weeks between discharging settled sewage effluent on to irrigated pasture land and introducing cattle to the pasture obviates significant danger of animal infection [12].

Salmonella can be identified frequently in abattoir effluents [77]. Adequate treatment of abattoir effluent is important because of its high organic content, helminthic eggs, pathogenic bacteria and infectious viruses. Seventy per cent of waste water samples from Duisberg abattoir contained salmonella organisms [154]. Fifty-three per cent of sewage effluent samples contained salmonellas [12]. Investigations at the Johannesburg abattoir showed that viral zoonoses are unimportant, provided that the sewage effluent is greatly diluted and that grazing of irrigated pastures is not permitted for three weeks [91]. The water usage at Johannesburg abattoir is only approximately 300 gallons per cattle unit, as compared

*See also George et al (1972), Brit. med. J., 3: 208—211, whose report appeared while in press.

with the usage of 500 to 1 000 gallons of water in overseas abattoirs [99]. Increasing dilution of abattoir effluent could be expected to diminish salmonella infectivity commensurately.

CONTAMINATED MEAT AND OFFAL IN SOUTH AFRICA

Salmonellosis in South Africa constitutes a serious public health problem as well as being a frequently occurring zoonosis.

In 1959, 4,3 per cent of prospective or employed food handlers were found to be infected with salmonella or shigella organisms, despite the acknowledged limited value of examining single faecal specimens [14].

Of rural Bantu school children, examined regularly during twelve months, 44 per cent had at least one salmonella infection. Seventy-two per cent of rural Bantu school children in the Rustenburg area were infected with salmonella [15] and 29,3 per cent in the peri-urban area of Witkoppen outside Johannesburg [131]. In the Eastern Transvaal lowveld 8 of 99 Bantu school children investigated in winter and summer had either salmonellas or shigellas on both occasions, indicating a carrier state [133].

Notwithstanding negative bile and caecal test results for approximately 50 000 sheep and 8 000 cattle slaughterings, a variety of salmonella serotypes were found in different sites at the new Port Elizabeth abattoir [172]. Thirty-four serotypes were isolated from 458 samples of ruminant meat and viscera investigated during a survey of the municipal abattoir and retail butcher shops in Pretoria, i.e. 7,4% positive samples [135].

The public health problem of human salmonellosis attributable to offal foodstuffs was investigated in Soweto township [132]. It was concluded that the paunches and intestines are not adequately treated after leaving the Johannesburg abattoir to render them free from faecal contamination, giving rise to risk of infection, particularly of salmonellas. *S. typhimurium* (23%) and *S. london* (18%) were the types most frequently isolated. *S. dublin* was isolated on only one occasion.

The distribution of salmonella-contaminated meat because of the need for cheap protein foods has been deplored [160]. A special orientation of environmental hygiene and general sanitation has been recommended towards improved processing and distribution of offal [152]. A Departmental Committee of Inquiry into the cleaning and handling of abattoir offal for human consumption recommended that specific investigation be undertaken into economically feasible ways of rendering gastro-intestinal offal hygienically acceptable for use as food [127]*.

PREVENTION AND CONTROL OF SALMONELLOSIS

Despite the isolation by the late Professor Henning of approximately 600 strains of salmonellas from calves [64], relatively little is known about salmonella infection of slaughter stock in South Africa. Detailed monitoring of the incidence of salmonellas in South African abattoirs has not been carried out. Considerable research is needed to investigate the reservoirs in the domestic and other animals, as well as the prevalance of salmonellas in our slaughterhouses. As with any salmonella infection, there is a public health hazard with salmonella abortion in cattle which has a world-wide distribution, including South Africa [13] and Rhodesia [141], and which has similar epidemiology to salmonella enteritis [65].

The purpose of this paper is not to cover all the projected control measures already reviewed in many excellent publications [87, 104, 111, 128, 153, 160]. Matters directly and indirectly associated with the chain of transmission of infected meat via abattoir to man are mentioned, and attention is drawn to various local circumstances.

1. *Farm*

The prevention of salmonellosis in meat has to start on the farm [81].

(i) Producers will need to apply the appropriate animal husbandry measures to prevent salmonellosis in their slaughter stock [62, 81, 104]. Hygiene and cleanliness are vitally important because of the trends towards intensified animal production for veal, pork and beef [86, 147, 148]. Good animal housing can aid considerably in controlling salmonellosis [36]. Improved animal husbandry and optimal hygiene offer the best hope for controlling animal infection [2]. Accumulation of dung and mud on hide, skin, fleece and feet during finishing of fatstock should be prevent-

*See also Horton B. G. W. & Van den Heever L. W. This Jl, 43 : 251 (Ed.)

ed. Dung and mud should be removed before consignment to the abattoir. A build-up of skin contamination with salmonellas occurs when animals are placed in improperly cleaned vehicles or pens [137].

(ii) Bacteriological control of the manufacture of animal feeding stuffs and the institution of efficient feed sterilization methods are necessary to prevent the introduction of salmonellas to farms through contaminated animal feeds [48, 125]. Gamma radiation as an alternative process for heat treatment also merits consideration [10, 67, 85].

(iii) Active adult salmonella carriers should be identified and removed [49, 50, 153].

(iv) It has been suggested that clinical salmonellosis of adult animals should be declared a notifiable disease [2, 39, 102, 153]. The British Veterinary Association, however, considered that compulsory notification would contribute less to control of the disease than the adoption of a suggested code of practice [22].

(v) The Swann Report recommends creating a Veterinary Officer of Health, the equivalent of the Medical Officer of Health, to be responsible in each area at least for all infectious diseases of animals which may threaten public health, with the right of entering, investigating and using adequate powers to curb the spread of disease [126].

(vi) Warning has been given that antibiotic treatment of sick animals is ineffective and results in acquisition of transferable drug resistance and human infection with drug-resistant *S. typhimurium* of almost entirely bovine origin [2].

(viii) Food hygienists point to the factors at the farm which break the epidemiological cycle (sufficient colostrum, regular feeding, isolation of purchases, early treatment of disease, superior housing, effective cleaning and disinfection); and to the slaughterhouse need for comfortable transit, humane *ante-mortem* penning and handling, best standards of slaughter and bacteriological aids to diagnosis [87, 111, 166].

2. *Transit*

Improved treatment of food animals being transported to the abattoir by rail and by road is desirable, e.g. direct marketing, comfortable accommodation, cleanliness and reasonable duration [71, 122]. Seepage on to and contamination of the bottom sheep on a double decker vehicle is undesirable. Careful handling of slaughter stock is necessary to eliminate animal injury, discomfort and stress [86, 153].

3. *Abattoir*

There is no practical means of detecting slaughter animals with a subclinical infection. Each infected animal is a potential source for the spread of salmonellas in the abattoir [46]. An infected cow without clinical sign of disease excreted *S. paratyphi B* for five months and was likely to escape detection as an active carrier during life and as a grossly contaminated carcase after death [162]. During an outbreak of *S. typhimurium* infection most of the calves excreting salmonellas were symptomless so would have spread infection at a slaughterhouse [124]. In order to minimize cross-contamination of slaughter animals, and of their carcases and offal, the over-all abattoir environment needs to be improved, from off-loading the animal to the final dispatch of meat and offal from the abattoir [47, 95, 104, 114, 125].

(i) *Lairage:* Important considerations are:
(a) suitable design of lairages, feed and water troughs and hayracks;
(b) regular cleaning of lairages to reduce build-up of bacteria and contamination of the animal exterior;
(c) adequate pre-slaughter rest;
(d) optimal animal management;
(e) minimal feeding to prevent pre-slaughter loading of the alimentary tract;
(f) shortest possible time of holding stock before slaughter;
(g) veterinary *ante-mortem* inspection;
(h) separation of stock suspected of disease for slaughtering separately from healthy animals.

(ii) *Slaughterfloor:* It is essential to prevent faecal contamination of carcase and offal by employing good techniques of slaughtering, dressing, meat inspection and handling carcases. The practical requirements are stated in many excellent publications [25, 47, 97, 107, 122].

(a) *Premises and fittings:* Effective clean-up procedure of premises and plant is necessary, and the state of cleanliness must be ensured by bacteriological surveillance [25].

(b) *Personnel and equipment:* Essential features are:—

(i) the cleanliness of the equipment (clothing, hands, knives and scabards);

(ii) the immediate washing of hands and equipment whenever they become contaminated;
(iii) adequate and convenient hand-washing *water spray* facilities;
(iv) effective sterilization of knives, steels and scabbards;
(v) regular cleaning of mechanical flayers, saws, leg- and brisket-cutters, containers and hide-pullers [122].

The shortcomings of the current methods of cleaning hands and knives do not prevent indirect contamination of meat. Knives, for example, must be immersed for 2 minutes at 82°C (180°F) to reduce the count of contaminating organisms to 10^2 per square centimetre [47].

Persons who work as abattoir operators are insensitive to cleanliness and resist change. Coercion is necessary to ensure that regular washing of hands after toilet use becomes habitual. A hand-washing water spray is preferred to a basin, with warm water at a controlled temperature issuing from a single point. Even if a hand basin is not fitted with a plug, the outlet will be plugged and the hands rinsed in filthy water. Supervision is necessary to ensure effective hand washing. Strategic placing of basins in view of everybody and also where observation can easily be maintained, such as outside a toilet door, may prove helpful. Washing the hands with soap and warm *running water* for 15 seconds is needed to remove an inoculum of 100 or less salmonellas per finger-tip, while larger inocula leave viable salmonellas on the hands even after such washing [116].

Education and practical demonstration are needed to motivate abattoir operators to work hygienically, and to have increased pride in their work, knowing that they are doing all they can to prevent contamination of food.

(c) *Slaughtering, dressing and handling carcases:* The transverse cutting of the throat generally performed in South African abattoirs for bleeding cattle spreads salmonellas and other contamination. It is time that the throat cut was prohibited in favour of sticking, except for ritual slaughterings. The tongue and cheek meat commonly contaminated by ruminal contents should be washed thoroughly with hot water to remove infection [54].

Salmonella contamination of meat is essentially gastrointestinal pollution. Therefore, ligature of the oesophagus before severance, and tying of the rectum, are important. It is also important to prevent the hide or fleece from contaminating the surface of the carcase, and to avoid puncture or rupture of the alimentary tract, or the opening of the viscera, on the slaughterfloor. Transfer of contamination by splashing on to the carcase, and from personnel and equipment, should be avoided.

(d) *Meat inspection:* The purpose of meat inspection is to prevent food poisoning in man. Only sound healthy meat free from contamination must leave the slaughterfloor for human consumption. Deficient personnel means a reduced standard of meat inspection and increased risk to the consumer. **Clearly then, provision to attract adequate numbers of competent veterinarians and meat inspectors must be accorded priority.** Successful slaughterfloor supervision rests upon these individuals to break the chain of transmission from infected food to man at the level of the abattoir.

Owing to the poor image of the veterinarian in abattoir work, meat inspection does not attract veterinary students and graduates in New Zealand [96]. A chronic reluctance on the part of veterinarians to take up abattoir appointment also prevails in Johannesburg. The unattractive slaughterhouse environment cannot compare with the more pleasant working conditions in State research and field work and in university teaching, and abattoir remuneration lags behind the steadily improving potential of veterinary private practice and commercial and university employment.

A serious shortage of meat inspectors over the past 20 years in the Witwatersrand and Pretoria and elsewhere has not yet been relieved, and deserves urgent attention.

The population needs an adequate supply of food. The meat industry is vital in the local and national economy (the Johannesburg meat output alone is worth approximately R60—70 million per annum at the primary cycle of distribution) and abattoir staffing deficiencies affect producers, traders, consumers and many others. Adequate veterinary and technical supervisory abattoir personnel is essential to ensure that the meat is sound and healthy. The vital public health problem of possible faecal pollution of meat supplies will persist until the chronic deficiencies of abattoir veterinarians and meat inspectors are suitably corrected.

(e) *Bacteriological meat inspection:* Bacteriological examination of meat is an important aid to acceptance or rejection of carcases conditionally passed at visual inspection [69, 111, 122, 128, 160]. Laboratory methods are also indispensable in ensuring a high standard of abattoir hygiene. Already unseen dirt and contamination receive considerable attention in overseas countries. Laboratory procedures, therefore, must become a regular feature of meat inspection [128]. This will require proper laboratory facilities under the control of veterinarians trained in abattoir laboratory procedures [72].

(f) *Contamination of meat:*

(i) *Cleaning:* Requirements for improving the sanitary dressing of carcases of sheep and lambs have been adopted by the New Zealand meat industry [97]. Soiling is best washed off the surface by water spray before drying occurs [114].

(ii) *Papering:* Contamination of lamb and mutton carcase may be diminished by protecting the surface of the freshly exposed crutch and brisket by applying water-proof paper [114].

(iii) *New techniques for dressing sheep:* Improved techniques may be applied for removing the carcase from the skin in order that the carcase will not be contaminated by loose flaps of skin [47].

(iv) *Washing:* The unopened, flayed carcase is best washed immediately the hide or fleece is dropped. When dressing has been completed, there should be a final washing of the upper and lower carcase by *suitable high pressure water sprays* [8, 83, 98].

A fan jet at a dynamic line pressure of 21 429,6 Pa (100 p.s.i.), with a surface water temperature of 60°C (140°F), surface impact of 32,14 Pa (0,15 p.s.i.) and flow rate of 8,5 l/min (1,9 gallons per minute) yields clean lamb carcases with good bloom and relatively low numbers of residual bacteria. Spraying the carcase for 1 minute, as compared with ½ minute, reduces the residual carcase bacteria [6].

(v) *Cleaning aids:* Warm washing water at 43°C is advantageous. Residual free chlorine up to 20 ppm in the wash water is an additional precaution to offset unavoidable bacterial contamination [8, 83, 98, 114]. The use of chlorinated washing water was beneficial at all concentrations from 15 to 350 ppm [6].

(vi) *Bacteriological check:* Bacteriological monitoring of the surface cleanliness of the freshly dressed and chilled carcases is necessary to correct defective slaughter floor practice [25, 69].

(vii) *Refrigeration:* Some microbial contamination will occur even with the best slaughterhouse hygiene; refrigeration is essential to check proliferation of food poisoning and spoilage organisms. As salmonellas can multiply at temperatures below 10°C (50°F), a chilling temperature below 4°C (40°F) is recommended to restrain the growth of the accidental bacterial contaminants and to reduce the food poisoning hazards [150, 151, 171].

(viii) *Meat transportation:* The preceding precautions are worthless unless carcases are properly loaded and transported in mechanically refrigerated, enclosed vehicles.

(ix) *Animal by-products:* Statutory control of the abattoir production of by-products must be vested in veterinary authorities [72, 128]. Contamination of the animal by-products at the abattoir must be avoided by rigid isolation of the raw materials area, together with its associated personnel, change-room, eating and toilet facilities, from the processing side of the by-products plant; and by proper plant clean-up [48, 67, 164].

Code of Abattoir Practice

The drawing up of a code of abattoir practice recommended in 1964 by the Commission of Enquiry into Abattoir and Allied Facilities has not yet proceeded [123].

A code of practice providing guidance by laying down minimum standards concerning all aspects of hygiene is called for, in order that the various individuals and interests who handle slaughter stock and carcases will appreciate and apply the procedures necessary for good meat hygiene, e.g.—

(i) factory practice relating to the abattoir;
(ii) the *ante-mortem* treatment of the slaughter animals;
(iii) the slaughtering, dressing and inspection of animals;
(iv) the treatment of carcases and condemned material, and the removal of carcases, offal, hides and skins and other products;
(v) the transport of carcases and edible offal in distribution from abattoir to wholesaler and to retailer;
(vi) general practices regarding meat hygiene.

Abattoir Personnel: Health Examination

The U.K. regulations require that persons suffering from salmonellosis be excluded from employment in abattoirs and processing plants exporting meat to Britain. The European Economic Community demands that for intra-community trade in fresh meat the operators in an abattoir must be free of active or carrier states of infectious enteritis (salmonellosis, including typhoid fever and paratyphoid A and B). Other carrier states must also be excluded, such as dysentery, infectious hepatitis and scarlet fever, and contagious tuberculosis. In South Africa the Standing Regulations under the Animal Slaughter Act require that no person who is suffering from a communicable disease or is a carrier of any infectious disease shall handle meat in an abattoir.

During 1971 and 1972 the abattoir operators at Johannesburg were examined medically with the co-operation and assistance of the Medical Officer of Health and the South African Institute for Medical Research according to the following schedule:

(i) Thoracic X-ray examination.
(ii) Laboratory blood tests.
  (a) Widal agglutination tests (lowest serum dilution 1/50)—
    S typhi O
    S typhi H
    S paratyphi AH
    S paratyphi BH
    S paratyphi CH.
  (b) Vi agglutination test (lowest serum dilution 1/10)—
    S typhi "Vi"
  (c) Kolmer test.

The 1971 results were as follows:—

Miniature chest X-ray examination:

X-ray—Totals, all races		707
—Recalled for full-size X-rays	5	

These were not open, infectious cases of pulmonary tuberculosis; they returned to duty.

Blood tests:

(i) Kolmer—Total, all races		824
Negative	806	
Positive	15	
Insufficient (repeat)	3	

The Kolmer results at titres greater than 10 units were referred for treatment and follow-up.

(ii) *Widal/Vi*—Total, all races		824
Negative	744	
Titres insignificant	35	
Positive titres	4	
Insufficient blood	1	

Further blood tests or stool and urine samples for *S. typhi* culture were done on persons showing significant Widal/Vi titres, finally giving 15 positive results out of 824 (2%).

There is doubt concerning the efficacy of this type of health examination [76]. The rectal swab culture method cannot be relied upon to detect carriers unless several swabs are taken, the number depending upon the duration of the carrier state and the number of organisms excreted [92]. Regular examination of staff excreta is unlikely to be a profitable means of discovering carriers, nor of preventing contamination of food products [60, 112]. Anderson has warned against over-playing the human element in the epidemiology of salmonellosis, perhaps resulting in wasted effort examining food handlers for infection, while the salmonellas continue to enter food establishments in meat and poultry [4].

Exporting abattoirs will perforce have to comply with the health requirements demanded by importing countries. The majority of slaughterhouses in the Republic, however, serves the local population, and these slaughterhouses require a clear directive from the health authorities prescribing the specific medical tests for personnel, the frequency of testing and other technical details. Until the Government authorities define the national policy, uniform procedures for testing the health of slaughtermen and handlers of meat are unlikely to evolve.

6. *Shop, Home and Kitchen*

The possibility of manually transferring salmonellas from infected raw meat was demonstrated by the isolation of enteric organisms from the fingers of 13 of 110 butchers, as compared with negative findings from 100 people not handling meat [116]. Unless shop hygiene is good, widespread contamination of surfaces and equipment may promote outbreaks of food poisoning [16]. Defective shop hygiene can spread a source of infection widely [19, 150]. Rigid separation of cooked meat from raw meat during processing, slicing, packing, storing, transporting and display is necessary as is also the avoidance of cross-contamination by personnel (separate individuals, hand-washing, clean protective clothing) [151].

Uncertainty that salmonella contamination can be excluded absolutely from raw meat means that final precautions will always be needed in the kitchen to avoid the possible hazards of contaminating food from infected raw meat via hands, surfaces, cloths and utensils; or of inadequate time and temperature of cooking; or of lengthy ambient temperature storage of joints and meat dishes after cooking.

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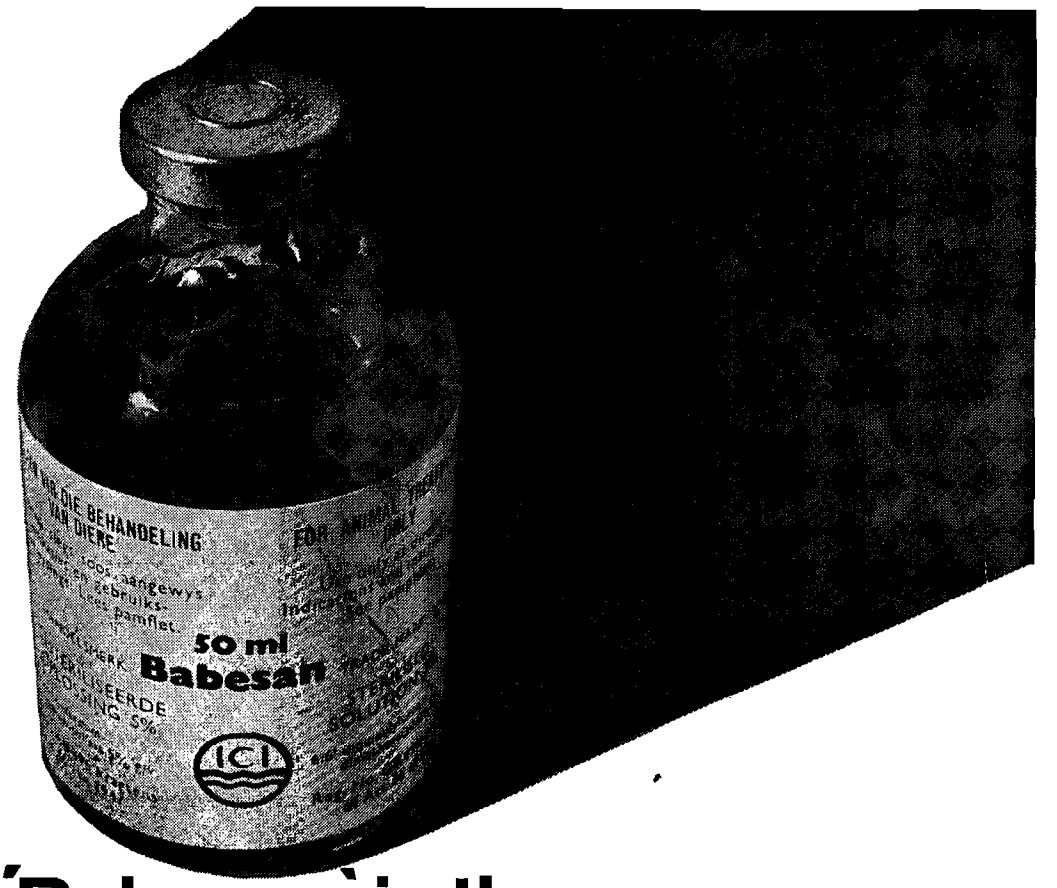

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Jl S. Afr. vet. Ass. 44 (3): 235—240 1973

INFECTION OF RAMS WITH *ACTINOBACILLUS SEMINIS*

E. M. VAN TONDER*

SUMMARY

Infection of rams with *Actinobacillus seminis,* as well as the symptoms and diagnosis, is discussed. Evidence of the existence of antigenically different strains of *A. seminis* is presented.

The complement-fixation test is as reliable as, if not more reliable than, clinical, semen smear and bacteriological examinations. Titres of 1 : 10 are regarded as suspicious of infection with *A. seminis;* in subclinical cases, serological tests should be repeated after a few weeks.

An extensive clinical and serological survey, as well as routine examinations, revealed a high incidence and wide distribution of this infection in the Republic of South Africa.

INTRODUCTION

A. seminis was first described as a cause of epididymitis in rams by Baynes & Simmons [1] in Australia. In a subsequent survey in the same country, a high incidence of this infection was found in only one flock of Border Leicester sheep [7]. The same microbe was isolated in the United States of America by Livingston & Hardy [6] from the semen of a Rambouillet ram suffering from epididymitis.

Epididymitis in rams due to *A. seminis* was first reported in South Africa in 1968 [8, 11] where the isolation of a similar micro-organism from semen in bulls suffering from acute epididymo-orchitis was also recorded.

There is evidence of a genital infection of rams caused by *A. seminis*-like organisms, which also differ from the unclassified gram-negative pleomorphic microbe described by Dodd & Hartley [3] in 1955. Ekdahl, Money & Martin [4] in New Zealand and Watt [10] in Western Australia isolated strains from epididymal lesions in rams; these closely resembled, but were not identical to, *A. seminis.* Laws & Elder [5] reported the isolation of *A. lignieresi* from a ram suffering from acute epididymo-orchitis.

SYMPTOMATOLOGY AND TRANSMISSION

Infection with *A. seminis* is clinically manifested as an acute or chronic orchitis, epididymo-orchitis, or epididymitis [1, 2, 6, 11]. The first two are usually acute and are characterized by intense swelling, pain and heat of the scrotal contents, accompanied by a severe systemic reaction. These symptoms are usually followed by loss of condition and fleece, and often also rupture of the scrotum on the affected side, with discharge of a slimy pus, greyish white to yellow in colour. Death has been known to result from the acute infection, especially in young rams.

The more chronic and insidious epididymitis usually following *Brucella ovis* infection also frequently results from infection with *A. seminis.*

After the acute stage of epididymo-orchitis, the affected side usually remains enlarged and hardened. The affected testicle usually atrophies following primary damage to the testicular tissues as result of acute orchitis without subsequent epididymitis, or as result of secondary damage owing to occlusion of the epididymal duct as occurs in chronic epididymitis. Subclinical infections are also encountered, apparently representing an earlier stage of the clinical disease, or a persisting primary infection of the accessory glands causing no palpable lesions. Subclinical cases persist for periods up to four years, when the testes usually become small, soft and flabby. Clinically affected rams are easily detected while subclinical cases can be identified only by semen examination.

The effect on fertility may extend to complete sterility and is dependent upon the severity of infection, contamination by inflammatory and bacterial products, testicular involvement and semen production, patency of the genital ducts, and whether one or both sides are affected.

It is generally assumed that, as in the case of *Br. ovis,* transmission of *A. seminis* is venereal. General observations, however, indicate that transmission occurs either via the mucous membranes of all the natural orifices of rams during direct contact and crowding, especially in the pre-mating period when homosexual behaviour is rife, or through the ewe as intermediate carrier. The possibility of ewe to lamb transmission cannot be excluded.

SEROLOGICAL STUDIES

In all their investigations the authors used the complement-fixation (CF) test described by Worthington & Mulders [12], using heat-extracted soluble antigens prepared by a slightly modified technique.

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Use of an antigen prepared from the Australian strain* or from a closely related local isolate, for examining sera in an extensive survey (Table 4) and routine material obtained in this laboratory, yielded results which were confusing, as only a small percentage of clinical cases reacted positively to the CF test.

Since efforts to improve the efficacy of the soluble antigen failed to yield more positive serological results, the occurrence of antigenically variant strains was suspected. This suspicion was enhanced when isolates from clinically positive and serologically negative rams proved to have cultural and biochemical properties similar to those of strain 70.64, designated the 'original' strain on which much of the earlier work was based. Positive serological reactions resulted when autogenous antigens were used for testing rams, thus confirming the existence of more than one antigenic type. Subsequent investigations have revealed the existence of four antigenically related and one non-related strain. These findings will be reported fully elsewhere.

The results of the CF test using antigens of the 'original' as well as the other four strains (U207, 6201, T981V and V350) on a number of clinically positive rams are given in table 1.

The discrepancy between the number of sera tested and the total number of positive reactions to the various antigens is due to some sera reacting to more than one antigen. Despite the limited number of clinically infected rams tested against antigens of various strains, the differences in antigenic type are clear. The serological pattern of distribution might differ, were a larger and more representative number of clinically affected rams tested.

Table 1: DISTRIBUTION OF POSITIVE CF TESTS* USING VARIOUS ANTIGENS. SERA FROM CLINICALLY AFFECTED RAMS

Sera	POSITIVE TO ANTIGENS:						Negative to all
	70.64**	U207	6201	T981V	V350	Br. ovis	
44	25	18	7	6	15	0	2

*Titres of 1 : 20 and higher regarded as positive.
**Original strain.

Two rams were classified as negative; one reacted only to strain 70.64 at a titre of 1 : 10 and the other was completely negative.

Although the original strain (70.64) and strain U207 appeared to be closely related according to these tests, some differences were encountered. In order to illustrate differences as well as cross-reactions, the 42 positive sera (Table 1) were tested against the five antigens listed in table 2.

Table 2: DETAILS OF POSITIVE SERA FROM TABLE 1 REACTING POSITIVELY TO ONE OR MORE ANTIGENS*

POSITIVE SERA		POSITIVE TO ANTIGENS:				
Code	No. tested	70.64**	U207	6201	T981V	V350
70.64	25	25	16	5	1	0
U207	18	14	18	5	0	2
6201	7	5	5	7	1	2
T981V	6	1	0	1	6	3
V350	15	0	2	2	3	15

*Titres of 1 : 20 and higher considered positive.
**Original strain.

*Kindly supplied by Mr. G. C. Simmons, Animal Research Institute, Yeerongpilly, Queensland, Australia.

Sera that reacted with a specific antigen were assigned the code number of that antigen. They were then tested against the other antigens for cross-reactions. It can be seen from table 2 that of the 25 sera positive to antigen 70.64, 16 reacted with U207, five with 6201 and one with T981V, etc.

The above figures confirm the presence of antigenic differences between the various strains. Although the possibility of concurrent infection with more than one strain cannot be excluded, a close relationship seems to exist between strains 70.64 and U207. Despite the fact that only seven of the 44 sera reacted positively with antigen 6201 (Table 1), this isolate also seems to be closely related to the afore-mentioned strains, while the other two antigens clearly show independent reactions (Table 2). For the sake of brevity the actual titres which illustrate the relationship between the antigens more clearly are not compared in this paper.

COMPARISON OF SEROLOGICAL AND OTHER TESTS

In table 3 the results of CF tests on 119 rams are compared with those of clinical examination, microscopy of semen smears for neutrophils and bacteriological culture of semen.

These figures indicate a close correlation between the three tests in clinically affected rams. Whereas 33 of the 37 rams with clinical lesions were positive to both semen smear and culture examinations, 35 reacted with one or more antigens at serum dilutions of 1 : 20 and higher and 36 at titres of 1 : 10 and higher. Since no semen could be obtained from one ram with bilateral testicular involvement, and no evidence of infection could be detected in the semen of three others with unilateral chronic lesions, the epididymal ducts of the affected organs may not have been patent. Three of these rams were positive to the CF test, while the other one had a positive titre of 1 : 10 to strain 70.64. As the other two tests are dependent upon the availability of semen, the CF test seems to be more reliable in clinically affected rams.

In the subclinical cases combined semen smear and culture examinations appear to be more reliable than CF tests, since of the 44

Table 3: COMPARATIVE RESULTS OF CLINICAL, SEMEN SMEAR (NEUTROPHILS), BACTERIOLOGICAL AND SEROLOGICAL EXAMINATIONS OF 119 RAMS

Clinical status	Positive semen smears	Positive cultures	SEROLOGY							
			Titre	70.64	U207	6201	T981V	V350	Total Positive	Total Negative
Clinically positive 37*	33	33	>20 >10	20 23	16 17	7 7	6 6	13 14	35 36	2 1
Clinically negative, sub-clinically positive** 44	36	31	>20 >10	10 25	2 2	5 5	1 9	6 14	17 36	27 8
Clinically and sub-clinically negative 38	0	0	>20 >10	— 2	— 1	— 1	— 1	— —	0 3	38 35

*From one ram no semen could be obtained.

**Positive on semen smear and/or culture examination with no clinical signs of infection.

subclinically infected rams (positive to one or both of these examinations) 36 and 31 were positive to the semen smear and culture examinations respectively, while only 17 reacted to one or more of antigens in the CF test at a titre of 1 : 20 and higher. If titres of 1 : 10 are regarded as positive, however, the serological test gives comparable results.

With regard to the clinically and subclinically negative rams, the serological test confirmed the absence of infection at a dilution of 1 : 20. The sera of three rams were positive at a dilution of 1 : 10; this may have been due to experimental error or to a rising antibody response.

DISTRIBUTION AND INCIDENCE

Bacteriological and serological specimens received at this Centre from various districts indicate that *A. seminis* infection is present throughout the Cape Province and Orange Free State. Results obtained in an extensive clinical and serological survey in the Cape and Southern Free State and, to a limited extent, serological results from the other two provinces, indicate the infection to be widespread. The Australian antigen was used in these tests.

Bacteriological and/or serological investigations have confirmed the existence of infection in all popular breeds of sheep and, in a few instances, in ennobled Boer goats, Angora goats, two Afrikaner bulls and one Friesland bull.

During mild outbreaks of abortion in two flocks of Dorper ewes and one severe outbreak in Boer goats, pure cultures of *A. seminis* were obtained from specimens from the foetus, foetal membranes and uterus. Sera from these ewes had titres of 1 : 80 (the highest dilution tested) against strain V350, but were all negative for *Br. ovis* and *Br. abortus*.

The incidence of *A. seminis* and *Br. ovis* infection, as revealed by the above survey, is given in Table 4.

Although the percentage of clinically affected rams appears very low (2,3%), the survey was limited to stud farms where rams are usually examined more frequently and eliminated as soon as testicular abnormalities are detected. The high incidence of subclinical cases, therefore, reflects the true position much more accurately. According to the serological test, *Br. ovis* was responsible for 14,6% of clinically affected rams, while *A. seminis* (strain 70.64) accounted for 21,6%. The serological test, therefore, failed to detect 63,8% of clinical cases. Were a titre of 1 :10 regarded as indicative of infection, *A. seminis* (strain 70.64) would be considered responsible in 48,7% of cases and *Br. ovis* in 19,4%, whereas 32,1% of clinically affected rams would have been serologically negative. The presence of a proportion of rams with testicular lesions which could not be accounted for serologically, provides supporting evidence for the occurrence of antigenically different strains.

Table 4: RESULTS OF A CLINICAL AND SEROLOGICAL SURVEY FOR **A. SEMINIS** AND **BR. OVIS**

No. of rams examined	Testicular lesions	SEROLOGY				
		Sera tested	A. seminis		Br. ovis	
			Positive*	%	Positive*	%
32 410	Present 731 (2,3%)	629	136	21,6	92	14,6
	Absent 31 679	7 609	1 066	14,0	500	6,6

*Titres of 1 : 20 and higher considered positive.

Table 5: INCIDENCE OF **A. SEMINIS** AND **BR. OVIS** ON BACTERIOLOGICAL AND/OR SEROLOGICAL TESTS IN RAMS EXAMINED AT REGIONAL VETERINARY INVESTIGATION CENTRE, MIDDELBURG, OVER A PERIOD OF TWO YEARS

No. tested	CLINICALLY POSITIVE				SUBCLINICALLY POSITIVE				Completely Negative
	No.	Pos. A. seminis	Pos. Br. ovis	Neg.	No.	Pos. A. seminis	Pos. Br. ovis	Neg.	
704	151	111	8	32	138	118	3	17	415

Table 6: RESULTS OF EXAMINATIONS OF SALE RAMS FROM A SINGLE STUD

No. of rams	Clinically affected	Neutrophils in semen smears	A. seminis isolated	Serologically positive		Completely negative
				Titre >1 : 10	Titre >1 : 20	
31	3	17	22	21	9	6

Further evidence on the incidence of *A. seminis* and *Br. ovis* infection obtained from bacteriological and/or serological tests on semen of rams examined at this Centre over a period of two years, is recorded in table 5. Although some of these rams were offered as suspicious cases of *A. seminis* infection, the majority represents animals presented for routine examination for fertility prior to sale or export. These figures clearly emphasize the high incidence of *A. seminis* infection in the ram population. The results of the examination of 12-months-old sale rams from one stud provide ample evidence of the importance of this particular infection (Table 6).

CONCLUSIONS

The above findings show that a definite diagnosis can best be made by a comprehensive examination comprising clinical, semen smear, bacteriological culture and serological examinations. In order that the CF test be a reliable guide, various antigenic strains should be included in the test.

The results given in this paper indicate a close relationship between semen smear, bacteriological and serological examinations. Serological titres (CF) of 1 : 20 and higher are to be regarded as positive, while titres of 1 : 10 should be taken as suspicious, especially in subclinical infections.

In the absence of *Br. ovis* infection in clinically and subclinically affected rams whose semen contains non-acid-fast bacilli closely associated with neutrophils and epithelial cells, infection with *A. seminis* can be diagnosed with reasonable accuracy.

Cultures should be made whenever possible, especially in subclinical cases; this is imperative when organisms cannot be demonstrated clearly.

Where only a serological test is carried out, it is recommended that animals showing titres of 1 :10 be re-tested after a few weeks.

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BOOK REVIEW

BOEKRESENSIE

CANINE HEARTWORM DISEASE

THE CURRENT KNOWLEDGE

R. E. BRADLEY AND G. PACHECO (EDS)

University of Florida, Gainesville, 1972. Pp. 148; Figs 56;Tabs 35. Price $12.00

This work entails the proceedings of the Second University of Florida Symposium on Canine Heartworm Disease held at Jacksonville, Florida on October 25, 1971, in conjunction with the 54th Annual Meeting of the Southern Veterinary Medical Association. There are 19 articles written by 33 authors, with considerable emphasis on chemotherapy but also include immunity, pathology, epizootiology, *in vivo* arteriography, evaluation of diagnostic tests and scanning electron microscopy of adult male *Dirofilaria immitis*.

Certain structures of taxonomic significance are well demonstrated in the micrographs taken with the scanning electron microscope and illustrated in the figures. A detailed study of carbohydrate metabolism is well documented and the authors suggest that a knowledge of these metabolic pathways may indicate where chemotherapy would be effective.

Other interesting and unusual reports in this symposium are those concerning the lesions caused by *Dirofilaria immitis* in man, in whom the granulomas in the lung closely resemble the pulmonary gummata found in tertiary syphilis. Immunopathological studies show high concentrations of gamma-globulin in the lesions of the intima of pulmonary bloodvessels, probably constituting immunological reactions, while eosinophil infiltration in phlebitic sites in the hepatic veins may be an allergic reaction.

Obviously this book will be of great value to veterinarians along the Atlantic and Gulf Coasts, particularly in Florida, Louisiana and Georgia. It will also be of considerable value in any parasitological laboratory where modern diagnostic techniques are practised.

R.K.R.

Jl S. Afr. vet. Ass. 44 (3): 241—245 1973

EHRLICHIA CANIS INFECTION

(TROPICAL CANINE PANCYTOPAENIA OR CANINE RICKETTSIOSIS)

A. IMMELMAN* AND C. BUTTON*

SUMMARY

The epizootiology, transmission, incubation period, parasitic morphology, clinical course, symptomatology, laboratory findings, diagnosis and treatment of *E. canis* infection are described. The principal clinical features of the disease are a continuous or intermittent fever with weight loss, anaemia and leucopaenia, with or without epistaxis.

INTRODUCTION

Ehrlichia canis infection was first diagnosed in Algeria in 1935 [4]. It was described by Neitz and Thomas in 1938 [14] when domestic dogs were dying and wild dogs *(Lycaon pictus)* appeared to be dying in the Kruger National Park. They reproduced cases by subinoculation of blood from an infected dog, and stated that the disease had a 100 per cent mortality [7, 14]. Lawrence described *E. canis* infection in Rhodesia in 1938 [11]. Malherbe [12] described clinical cases in the Pretoria District in 1947, reporting a low mortality rate.

E. canis infection was manifested as a new syndrome in South Africa in 1971 with the outbreak of a 'persistent biliary fever' amongst Police and Army dogs in the Pretoria area. On closer investigation, the symptoms were found to be due to *E. canis* infection, or a combination of *E. canis* and *Babesia canis* infections. Since then, the authors have diagnosed several apparently isolated cases of tropical canine pancytopaenia (TCP) in a variety of breeds at the Outpatient's Section of the Faculty of Veterinary Science.

Positive blood smears have been received from Durban and the Witwatersrand.

EPIZOOTIOLOGY

This disease is most serious where:

a) large numbers of dogs are kept in kennels in close contact with one another. In South Africa outbreaks have occurred amongst Police and Army dog kennels, a canine security unit and a commercial kennel.

b) tick control is poor. The red kennel tick *Rhipicephalus sanguineus* breeds easily in cracks in kennel walls and floors.

TRANSMISSION

(a) *Natural.* The red kennel tick, *R. sanguineus,* which is found throughout South Africa, has been proved to transmit the disease in all stages of its life cycle, and to transmit the parasite from an adult female to her larvae, i.e. transovarially.

(b) *Experimental.* The authors have transmitted the disease using 10 ml of heparinized blood taken from an infected animal and injected intravenously into susceptible animals. The simultaneous transmission of *B. canis* was prevented by the injection of 4 A 65† subcutaneously into recipient dogs at the same time as the blood.

Other authors have had no difficulty in transmitting the disease using infected blood injected intravenously [1, 6, 14] intravenously intraperitoneally and subcutaneously [14] into susceptible dogs.

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INCUBATION

The experimental incubation period was found by Neitz and Thomas to be 8 to 16 days [14] and by Walker *et al* to be 5 to 15 days with a mean of 11 days [17]. The authors' cases fell within the above limits; parasitaemia could detected within 24 hours of the rise in temperature.

PARASITIC MORPHOLOGY

The parasite occurs in the cytoplasm of monocytes. Lymphocytic [3, 6, 16] and neutrotrophilic [6] forms have also been described. The authors recognize the three forms described by Carter, Seamer & Snape [3], viz. :

(a) *The Morula.* The morula is the most characteristic form; it consists of a round body made up of tightly packed granules or elementary bodies staining a dark blue with Giemsa stain.

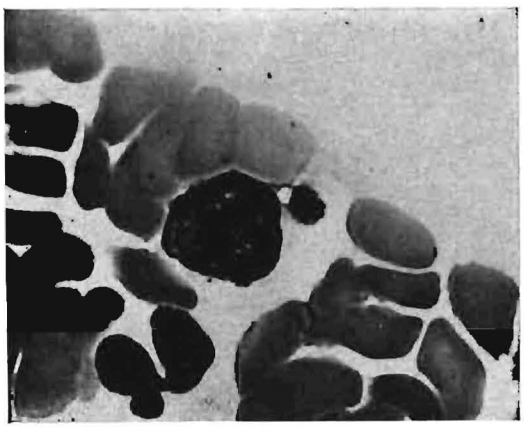

FIG. 1

b) *The Amorphous Form.* The amorphous form is a round, structureless body which varies greatly in size. It may occur in a vacuole in the monocyte cytoplasm.

(c) *The Granular Form.* Multiple granules occur in the monocyte cytoplasm, alone or in association with either of the above two forms. Parasitic granules can be confused with azurophilic granules which occur in the cytoplasm of normal canine monocytes and lymphocytes. The authors consider the presence of large numbers of granules in the cytoplasm of monocytes sufficient for a positive diagnosis of TCP.

†Burroughs Wellcome.

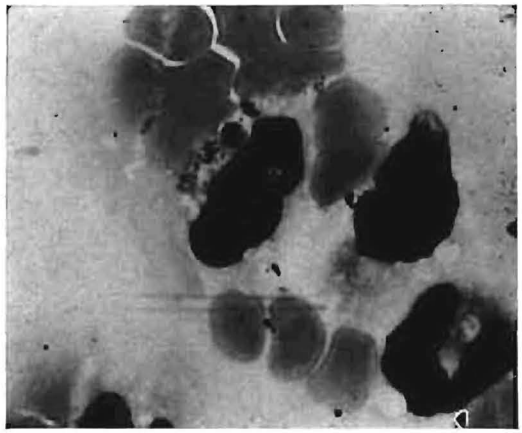

FIG. 2

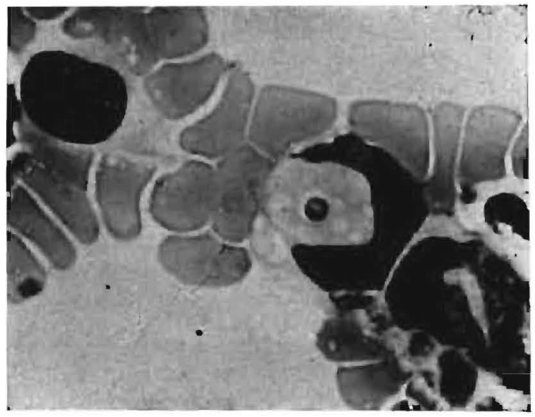

FIG. 3

COURSE AND SYMPTOMATOLOGY

The current syndrome appears to be more pathogenic than that described by Malherbe [12] but not as pathogenic as that described by Neitz and Thomas [14], whose cases all died. The present form of the disease closely parallels that seen amongst British dogs in Singapore [18], American war dogs in Vietnam [17], military dogs in Israel [10] and cases in Oklahoma, U.S.A [5].

Fig. 1: A morula form of **E. canis** in monocyte cytoplasm.
Fig. 2: An amorphous form of **E. canis** with multiple granules in monocyte cytoplasm.
Fig. 3: An amorphous form of **E. canis** within a vacuole in monocyte cytoplasm.

After the incubation period there is what the authors term the primary acute phase. Natural cases are not often seen during this stage, which lasts from two to ten days (mean five days) [17]. There is fever (39,6 to 41°C), depression, and variable loss in appetite and weight. Most cases suffer from tumor splenis and peripheral lymphadenopathy. Anaemia develops but is usually less severe than in later stages. Vomition, bloody diarrhoea, keratitis, conjunctivitis and subcutaneous oedema of the hind legs and scrotum have been described [17], but the authors have not seen such symptoms. Dogs may die in this stage. One of the authors' experimental cases died two weeks after the initial rise in temperature.

Most dogs survive the primary acute phase and are said to be in the subclinical phase [17] when they appear normal on a clinical examination. Dogs may take a few days to several months to become clinically normal. A few remain permanently thin. The subclinical phase lasts an average of 11 weeks (4 to 34) [17].

Most dogs suffer from periodic relapses or secondary acute phases. These are severe and are characterized by fever, loss of appetite and weight, and serous, mucoid or mucopurulent conjunctivitis and/or rhinitis. If epistaxis is present, it may take the form of a serohaemorrhagic nasal drip, dried dark blood crusts at the nasal openings or a frank uni- or bilateral haemorrhage. This may be accompanied by petechiae or ecchymoses of the buccal, conjunctival and preputial mucous membranes and of the skin of the abdomen [17]. The authors have seen one case, a German Shepherd dog, with haemorrhage into the anterior chamber of the eye (hyphaemia). Anaemia becomes severe and animals may develop posterior ataxia owing to extreme weakness. Dogs may survive the secondary acute phase and improve clinically, only to go down with another acute phase after some weeks. This pattern may continue for several months.

Death may occur during the secondary or subsequent acute phase and is due to anaemia, uraemia, secondary bacterial infection or a combination of these, e.g. Case C (see table).

PATHOGENESIS

Bone marrow depression may be involved. Bone marrow hypoplasia has been found at necropsy [8]. It has been proposed that the later stage of TCP, characterized by anaemia and leucopaenia, may be due to an auto-immune reaction with erythrophagocytosis in the spleen and lymph nodes [2]. Leucopaenia predisposes dogs to secondary infection.

LABORATORY FINDINGS

(a) *Anaemia and Leucopaenia.* Anaemia and leucopaenia are characteristic of the subacute disease. During the secondary and subsequent acute phases anaemia and leucopaenia become more severe (Compare Cases B1 and B2, see table). American workers in Vietnam [17] considered that dogs with a white cell count of less than 7 500 per cu mm and a haematocrit of less than 37 per cent were pancytopaenic and therefore probably infected with *E. canis*. They used these two parameters as a means of screening large numbers of dogs for TCP.

Most of the authors' cases had a slight macrocytic anaemia with a mean cellular volume of more than 80 μm^3 (see table). Schalm [15] quotes normal values of 60 to 77 μm^3 with a mean of 70 μm^3.

The leucopaenia is balanced [17]. The authors have not seen the monocytosis described by Malherbe [13].

(b) *Thrombocytopaenia.* Seamer and Snape [16] found thrombocytopaenia and morphological aberrations of the thrombocytes in dogs infected with *E. canis*. Examination of smears made by the authors showed thrombocytopaenia. This was particularly severe in cases suffering from epistaxis (Cases B2 and C, see table).

(c) *Elevated Erythrocyte Sedimentation Rate.* The ESR tends to rise during primary and subsequent acute phases (Cases B2 and C, see table).

(d) *Elevation of Blood Urea Nitrogen.* A rise in BUN is seen only in more advanced cases. American authors [17] state that a BUN of over 60 mg 100 ml in association with TCP indicates imminent death (Cases B2 and C, see table).

(e) *Hypergammaglobulinaemia and Hypoalbuminaemia.* Hypergammaglobulinaemia and hypoalbuminaemia were recorded in more advanced cases (Cases B2 and C, see table). Similar findings have been recorded by other authors [2,17].

DIAGNOSIS

Blood smears were prepared by the method described by Malherbe [13] and stained with Giemsa to show the parasites. Low parasitaemia and extreme leucopaenia may necessitate a prolonged search for parasitized cells and examination of more than one smear

is often necessary to make a diagnosis. Buffy coat smears and, at necropsy, organ impression smears (lung, liver, kidney and spleen [3, 10, 14]) have been used to demonstrate the organism.

Direct immunofluorescence has been used to diagnose TCP [3]. This method is rapid, since smears can be examined under low power and larger fields can be scanned in shorter periods.

Clinicians should be alerted by a history of a chronic disease with continuous or intermittent fever, weight loss, anaemia, leucopaenia and epistaxis.

Subinoculation of blood from suspected cases to susceptible dogs is a reliable but expensive and time-consuming method of confirming a diagnosis.

DIFFERENTIAL DIAGNOSES

(a) Canine haemorrhagic diseases, most especially canine auto-immune haemolytic anaemia and Warfarin poisoning.
(b) Canine distemper.
(c) Canine babesiosis. Many cases of TCP have had *B. canis* infection as a complicating factor.
d) Trypanosomiasis.

TREATMENT

The authors administered oxytetracycline parenterally at 10 mg/kg for 10 days. In their experience this therapy usually led to a prompt drop in temperature, followed by a gradual improvement in habitus, gain in body weight, elevation of red and white cell counts and an increase in haemoglobin values and packed cell volume. Some dogs appear to recover fully. More remain 'poor doers'. Dogs may relapse in spite of treatment. Advanced cases may die despite all therapy.

The authors have used parenteral chloramphenicol at 10 mg/kg with no success

Corticosteroid therapy has been reported to help control the epistaxis of TCP [17]. This may be due to suppression of the auto-immune response postulated by Burghen *et al* [2].

CONTROL

Strict control of ticks on both the dogs and premises resulted in virtual elimination of new cases at the Police and Army kennels. There is evidence that dogs surviving the disease remain permanent carriers [9]. It is advisable to separate all sick and apparently recovered dogs from normal dogs.

Table: CLINICAL DATA ON THREE CASES OF TCP

	CASE A	CASE B1	CASE B2	CASE C
Breed	Doberman Pinscher	German Shepherd		German Shepherd
Age (years)	4	2½	2½	3
Sex	Male	Male	Male	Male
Mass (kg)	32,5	28,0	22,3	30,0
RCC	6,15	5,04	2,23	1,22
Hb	15,2	14,1	5,3	3,6
PCV	41	42	18	14
ESR	3	0	64	42
WCC	5763	5800	1540	703
MCV	66,6	83,3	80,7	114,8
BUN	18,4	12,9	33,1	86,4
TSP	6,2	—	6,1	6,1
Gamma Glob.	—	—	1,45	1,28
Albumin	—	—	1,77	1,89
A : G Ratio	—	—	0,41	0,45
Epistaxis	Absent	Absent	+	+
Thrombocytes	—	—	Few seen	None seen

— = not investigated

CASE A: An experimental case 7 days after the first rise in temperature.

CASE B1: A natural case in the subclinical phase.

CASE B2: The same dog at the febrile peak of relapse.

CASE C: A natural case in extremis following seven months of untreated intermittent epistaxis.

RCC = Red cell count in millions per mm^3.

Hb = Haemoglobin in g/100 ml of blood.

PCV = Packed cell volume of haematocrit.

ESR = Erythrocyte sedimentation rate mm/hour (Wintrobe).

WCC = White cell count in thousands per mm^3.

MCV = Mean cellular volume in μm^3.

BUN = Blood urea nitrogen in mg/100 ml blood.

TSP = Total serum proteins in g/100 ml serum.

Gamma Glob. = Gamma globulins in g/100 ml serum.

Albumin = Albumin in g/100 ml serum.

ACKNOWLEDGEMENTS

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CONGRESS NEWS — KONGRESNUUS

XITH INTERNATIONAL EMBRYOLOGICAL CONFERENCE

The Eleventh International Embryological Conference, which is sponsored by the Editorial Board of the Journal of Embryology and Experimental Morphology, will be held in Sorrento, Italy, from April 1 to April 6, 1974 on the occasion of the 15th meeting of the Editorial Board.

G. Augusti-Tocco, G. Chieffi, F. Ghiara, G. Marin, S. Metafora, A. Monroy, E. Scarano and M. Siniscalco will be hosts at the meeting.

Full programmes together with registration forms will be sent out in the autumn of 1973 to all those scientists who names appear in the address lists of the General Embryological Information Service.

The meeting is open to all scientists interested in Developmental Biology and anyone whose name does not appear in the above list, who is interested in attending the meeting, should write to: Dr. C. F. Graham, Zoology Department, South Parks Road, Oxford, OX1 3PS, U.K., requesting the full programme and registration form, which will be sent in the autumn.

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Jl S. Afr. vet. Ass. 44 (3): 247—250 1973

INCIDENCE AND DISTRIBUTION OF NEUTRALIZING ANTIBODIES TO PORCINE ENTEROVIRUSES IN SOUTHERN AFRICA

A. PINI AND GERTRUIDA SMIT*

SUMMARY

High levels of neutralizing antibodies to Smedi A, B and C as well as T80 virus were demonstrated in sera from sows, both in South Africa and Rhodesia. The sera originated from herds where the Smedi syndrome had recently occurred. The Smedi viruses may have played a rôle in causing reproductive failure in such herds.

INTRODUCTION

Porcine enteroviruses have a world-wide distribution and can cause reproductive disorders and diseases of the nervous and respiratory systems. The pathogenicity of antigenically related strains may vary within wide limits.

The viruses primarily responsible for reproductive failures, characterized by stillbirth, mummification, embryonal death and infertility, have been designated Smedi viruses [3]. At present five groups have been identified: Smedi A and D, which are antigenically related, and B, C and E [2]. The C group has been found to be antigenically related to the viruses of Teschen-Talfan disease which now often occurs as an inapparent infection [1]. Dunne [4] compared 72 strains of porcine enteroviruses obtained from North America, England and Japan and provisionally subdivided them into eight antigenic groups. According to his classification Smedi A and D belong to group 8, Smedi B to group 3, Smedi C to group 1 and Smedi E to group 6.

In South Africa two strains of Smedi B virus were isolated recently from foetal tissues originating from two pig herds in which cases of foetal mummification, abortion and stillbirth had occurred [5]. In addition, a strain of T80 virus was obtained from the intestinal contents of a pig sent to the abattoir (A. Pini, 1972, unpublished observation). This virus is also widely distributed and, although its effects are not well understood, it appears to be responsible for pathology of the nervous system [7]. It belongs to Group 2 in Dunne's classification.

This paper records the incidence and distribution of antibodies to Smedi A, B, C and T80 viruses in Southern Africa.

MATERIAL AND METHODS

Virus

Lyophilized cloned cultures of the following viruses were obtained from the Central Veterinary Laboratory, Weybridge, England: Smedi C (Dunne's Group 1) [4], T80 (Group 2), Smedi B (Group 3) and Smedi A (Group 8).

On arrival virus stocks were prepared in primary foetal pig kidney tissue culture cells. When the cytopathic effects were generalized, the virus was harvested and centrifuged to remove cells debris, and the supernate stored at −20°C in aliquots of 0,5 ml in sealed ampoules as first passage suspensions of virus. The identity of the stocks was checked by the serum-virus neutralization test using specific reference sera obtained from the Central Veterinary Laboratory, Weybridge, and sera produced at Onderstepoort in SPF piglets.

Tissue Culture

Primary or secondary foetal pig kidney tissue culture cells were prepared by standard techniques. Eagle's minimum essential medium with 10% (v/v) bovine serum was used for the production of cell monolayers. In the maintenance medium the concentration of serum was decreased to 2%.

Production of SPF Piglets

Ten piglets were obtained from a sow on the 110th day of gestation by caesarian section under sterile conditions. The newborn animals were reared in individual cages in an isolation unit with forced filtered air ventilation. No mortality or untoward symptoms were observed during the period of observation.

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Preparation of Reference Hyperimmune Sera

Second passage virus suspensions were prepared for the inoculation of the SPF piglets. After collection of samples for virus titration, the suspensions were pre-warmed at 37°C and inactivated during continuous agitation by the addition of betapropiolactone (BDH Chemicals Ltd., Poole, England), to a final concentration of 1 : 2 000. Complete loss of infectivity of the four viral suspensions was confirmed by two consecutive passages in pig kidney tissue culture cells. In each case, no cytopathic effects were observed over a period of 7 days.

At 3 weeks of age the SPF piglets were divided into five pairs. On two occasions at an interval of one week, four pairs were each inoculated with one of the virus suspensions containing not less than $5 \times 10^{7,0}$ inactivated tissue culture infective doses ($TCID_{50}$). The animals of the fifth pair served as the source of negative control serum. Three weeks after the second inoculation of virus, all the animals were exsanguinated, the serum separated and stored at −20°C.

The neutralizing antibody titres of the specific antisera were Smedi A 1 : 80, Smedi B 1 : 320, Smedi C 1 : 1280 and T80 1 : 320.

Serum-virus Neutralization Test

In all instances serum dilutions were tested against approximately 100 $TCID_{50}$ of each virus. The virus concentrations in different tests varied between the limits of 30 and 300 $TCID_{50}$. Field sera for screening purposes were diluted 1 : 15, 1 : 45 and 1 : 135. The virus-serum mixtures were kept for 2h at room temperature and then each mixture was inoculated into a group of two tubes containing monolayers of pig kidney tissue culture cells. After adsorption at 37°C for one hour the maintenance medium was added. Controls were prepared according to standard procedures. Final readings for the inhibition of cytopathic effects were carried out on the 6th day post infection. Serum titres were calculated by the method of Reed & Muench [6] and are expressed as the reciprocal of the serum dilution protecting 50% of the cultures from the effect of the virus. For the field sera, titres between 25 and 45 were considered of doubtful significance, whereas titres equal to or higher than 75 were considered positive. The latter titre was chosen in order to enhance the specificity of the test (S. F. Cartwright, 1972, personal communication).

RESULTS

The origin of the 220 sera tested are given in table 1. They were obtained from sows belonging to herds in which the Smedi syndrome had occurred recently.

Table 1: ORIGIN OF THE SERA TESTED

	No. of herds	No. of sera
Transvaal	18	92
Orange Free State	3	18
Natal	2	16
Cape	3	29
	26	155
Rhodesia	14	65

The number and percentage of herds with significant serum titres (⩾75) are given in table 2. In South Africa the percentage varied between 23% for the Smedi B virus and 65% for the T80 virus. In Rhodesia similar values were obtained. The incidence per herd of positive sera to any of the four viruses varied between 12 and 100%; in 6 herds no significant antibody levels were found.

Table 2: HERDS WITH POSITIVE ANTIBODY TITRES (⩾75)

	South Africa		Rhodesia	
	No.	(%)	No.	(%)
Smedi A	14	(54)	9	(65)
B	6	(23)	5	(36)
C	15	(58)	4	(28)
T80	17	(65)	7	(50)

Table 4: INCIDENCE OF POSITIVE SERA (⩾75) IN THE FOUR PROVINCES OF SOUTH AFRICA

	ANTIBODIES TO			No. of sera tested
	Smedi A	Smedi B	Smedi C	T80
Transvaal	13 (14,1)*	15 (16,6)	30 (32,6)	35 (38)	92
Orange Free State	7 (38,9)	4 (22,2)	0 (0)	13 (72,3)	18
Natal	2 (12,5)	5 (31,3)	5 (31,3)	10 (62,5)	16
Cape	6 (20,7)	0 (0)	7 (24,2)	3 (10,7)	29

*( ) percentage

The distribution of the sera from South Africa according to their antibody titres to the four enteroviruses is given in table 3. Sera reacting positively with the Smedi B virus were found to have the lowest incidence; those reacting with the T80 virus had the highest.

Table 3: DISTRIBUTION OF SERA FROM SOUTH AFRICA ACCORDING TO THEIR ANTIBODY TITRES

Virus	SERUM TITRES 0—15 No. (%)	30—45 No. (%)	⩾75 No. (%)	Total No.
Smedi A	94 (60,6)	33 (21,3)	28 (18,1)	155
B	97 (62,6)	34 (21,9)	24 (15,5)	155
C	71 (45,8)	42 (27,1)	42 (27,1)	155
T80	63 (40,7)	31 (20,0)	61 (39,3)	155

From the data given in table 4 it appears that antibodies to the enteroviruses tested are widespread in South Africa.

The distribution of the sera from Rhodesia according to their titres is given in table 5. The incidence of sera positive to Smedi B virus is the lowest and compares with that observed in South Africa.

Table 5: DISTRIBUTION OF SERA FROM RHODESIA ACCORDING TO THEIR ANTIBODY TITRES

Virus	SERUM TITRES 0—15 No. (%)	30—45 No. (%)	⩾75 No. (%)	Total No.
Smedi A	20 (30,8)	23 (35,4)	22 (33,8)	65
B	42 (64,7)	14 (21,5)	9 (13,8)	65
C	37 (56,9)	17 (26,2)	11 (16,9)	65
T80	23 (35,4)	24 (36,9)	18 (17,7)	65

In a few instances the endpoint of sera with a titre higher than 75 has been calculated and values up to 1215 were found.

From these results it can be seen that some of the sera tested had positive titres to more than one virus: 23% of the sera had positive antibody levels to two viruses and 5% to three viruses. When serum titrations were carried out to calculate the endpoints, it was found that the difference in titre of the same serum against different viruses did not exceed one threefold dilution.

CONCLUSIONS

No information was available until recently[5] regarding the presence in Southern Africa of those porcine enteroviruses that have been associated with the Smedi syndrome in other countries. Their role in causing abortion, stillbirth, mummification and embryonic death is difficult to assess. Their pathogenicity varies widely and their pathological effect on the sow and her progeny is not specific. The rate of virus isolation is low and is not always of diagnostic significance, because virus can be isolated from normal as well as from affected animals in the same herd at the same time. The significance of the serological results is difficult to assess. The examination of paired serum samples for the detection of a rise in antibody titre cannot always be applied, because of the interval which may occur between infection and clinical evidence. Porcine enteroviruses are widespread and their inter-group serological relationships are not fully understood. Within the eight groups defined by Dunne[4] reciprocal cross-reactions do not always occur, while, on the other hand, inter-group antigenic relationships have been demonstrated.

Inter-group reactions are more frequent with the strains of faecal origin, whereas the phenomenon is rare in strains obtained from tissues[4].

With the present survey high levels of antobodies to Smedi A, B and C, as well as to T80 virus, have been demonstrated in sera from sows in both South Africa and Rhodesia.

Fifty-nine per cent of the herds that were tested had antibody to Smedi A, 29% to Smedi B, 43% to Smedi C and 57% to T80 virus. In South Africa, 18% of the sera were positive to Smedi A, 15% to Smedi B, 27% to Smedi C and 39% to T80 viruses. In Rhodesia the percentages were 33, 13, 16 and 27 respectively. The rate of infection in each herd varied between 12 and 100% of the sera tested. The absence of sera positive to Smedi C virus in the Orange Free State and to Smedi B virus in the Cape Province can be explained by the low number of sera tested.

The diagnostic significance of our serological results cannot be assessed fully at present, though it appears that the Smedi viruses may have played some rôle in causing reproductive failure in those herds in which a high incidence of positive sera were found. An accurate interpretation can only be made after systematic testing, carried out whenever new animals are introduced, and at regular intervals during the breeding season.

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PUBLICATIONS PUBLIKASIES

ELEMENTARY MEDICAL BIOPHYSICS

G. G. JAROS AND B. J. MEYER

Butterworth & Co. (S.A.) (Pty.) Ltd., Durban, 1972. Pp. 210. Price R6.90

This useful book which appeared originally in Afrikaans and was reviewed in the *Jl S. Afr. Vet. Ass.* 43 (2) : 145 (1972) is now available in English.

THE LARVAL ANTHELMINTIC TESTS IN RUMINANTS

R. K. REINECKE

Published by the Department of Agricultural Technical Services, Private Bag X144, Pretoria, as Technical Series No. 106, 1973.

CONTROL OF INSECT PESTS IN STORED PRODUCTS IN SOUTH AFRICA

J. H. VILJOEN

Published by the Department of Agricultural Technical Services, Private Bag X144, Pretoria, as Technical Series No. 105, 1973.

Jl S. Afr. vet. Ass. 44 (3): 251—263 1973

TRIALS WITH RAFOXANIDE*

6. THE EFFECT OF REPEATED AND SINGLE TREATMENTS WITH RAFOXANIDE AGAINST *HAEMONCHUS CONTORTUS* AND *OESTRUS OVIS* IN SHEEP

A. J. SNIJDERS, I. G. HORAK AND J. P. LOUW†

SUMMARY

Rafoxanide administered to sheep at 7,5 mg/kg live mass at intervals of either 3, 4 or 5 weeks for a period of five months virtually eliminated faecal worm egg counts owing to *Haemonchus contortus* and apparently prevented re-infestation with the larval instars of *Oestrus ovis* during the trial period.

The compound was ineffective against hypobiotic fourth stage larvae of *H. contortus*, but was highly effective against adult worms within 48 hours of treatment. It had no ovacidal effect on the eggs of *H. contortus*.

Rafoxanide was highly effective against overwintering first instar larvae and against second and third larval instars of *O. ovis* within 96 hours of treatment.

INTRODUCTION

The efficacy of rafoxanide against infestations of *Haemonchus contortus* [2, 4, 6] and *Oestrus ovis* [5, 11] in sheep is well documented. In addition, it has been noted that the regular administration of rafoxanide to sheep naturally infested with *H. contortus* results in a suppression of faecal egg output for periods in excess of three weeks after treatment when compared with those in sheep treated with other anthelmintics [7, 10]. The probability of a residual effect against the re-establishment of *O. ovis* infestation in recently treated sheep has also been reported [5, 7].

These observations seemed worthy of further investigation; at the same time it was decided to determine the efficacy of rafoxanide against hypobiotic fourth stage larvae of *H. contortus* and overwintering first instar larvae of *O. ovis* and the rapidity of action against these species.

EXPERIMENT 1

MATERIAL AND METHODS

On 21 January 1971, 15 Dormer (Dorset Horn × German Merino) and 25 Merino lambs raised and weaned under worm-free conditions, were divided into five numerically equal and comparable groups based on breed, sex and mass. They were treated with thiabendazole§ at approximately 55 mg/kg live mass and put into a movable camp on an irrigated grass-clover pasture with five untreated Merino wethers that had been running on the pasture for two years.

Three of these groups of lambs were treated with rafoxanide at 7,5 mg/kg live mass at intervals of either 3, 4 or 5 weeks. The fourth group of lambs was treated with thiabendazole at 44 mg/kg live mass at intervals of 4 weeks and the fifth group was maintained as an untreated control.

Weekly worm egg counts were done on the faeces of all sheep from 10 February onwards and the faeces from the sheep in each group were combined in a group faecal culture.

On 14 April one sheep from each group was removed from the pasture, starved for 48 hours and slaughtered. On 8 June dogs savaged a number of the sheep and one of these sheep from each group was removed from the pasture on 10 June, housed under worm-free conditions and starved for 48 hours prior to slaughter on 18 June.

All the experimental sheep were removed from the pastures on 7 July and one from each group was slaughtered. The others were stabled under worm-free conditions and starved for 48 hours prior to slaughter on 20 and 21 July.

At slaughter, *O. ovis*, *H. contortus* and *Moniezia* spp. were recovered according to procedures previously outlined [5, 6]. During the

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

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course of the experiment a number of sheep died. Parasites were recovered from the two sheep that died in the control group. The single sheep that died in the group treated with rafoxanide at five weekly intervals and the two that died in the group treated with thiabendazole were not examined for infestation.

At 28-day intervals from 19 March onwards, separate groups each consisting of three worm- and *O. ovis*-free lambs were put out as tracers on the pasture with the experimental sheep. These lambs were removed from the pasture after 33 days, starved for two days, slaughtered and examined for helminth and *O. ovis* infestation.

RESULTS

Faecal Worm Egg Counts

The mean faecal worm egg counts owing to *H. contortus* infestation in each group of sheep are summarized in table 1.

The mean egg count in the control group rose rapidly and reached a peak of 27 261 eggs per gram (epg) of faeces on 5 May, 1971, thereafter it declined erratically to 1 718 epg on 7 July when the sheep were removed from the pasture.

In the group treated with rafoxanide at intervals of 3 weeks the faecal worm egg count never exceeded 35 epg and was negative on 11 occasions after the commencement of treatment.

Mean egg counts in the sheep treated with rafoxanide at intervals of 4 weeks had reached 854 epg at the time of the first treatment, thereafter they never exceeded 33 epg and were negative on 14 occasions.

In the group of sheep treated at intervals of 5 weeks the mean egg count was 4 646 epg at the time of the first treatment with rafoxanide; it decreased dramatically thereafter but had risen again to 950 epg by the next treatment, thereafter it never exceeded 22 epg and was negative on 10 occasions.

Thiabendazole at intervals of 4 weeks resulted in a marked decrease in mean egg counts in the two weeks following treatment, but these had risen again to fairly substantial levels by the time of the next treatment, particularly during April and May.

Worm Recoveries Post-Mortem from Treated and Control Sheep.

The degree of infestation with *H. contortus*, *Moniezia* spp. and *O. ovis* of the sheep in each group is summarized in table 2.

In the control group of sheep the proportion of adult *H. contortus* to fourth stage larvae decreased as the trial progressed from late summer to winter. With one exception a fair number of adult worms was always present. The mean fourth stage and adult burdens for the sheep slaughtered in this group were 9 138 and 1 139 worms respectively and five of these sheep each harboured more than 10 000 fourth stage larvae of *H. contortus*.

All the sheep were infested with *Moniezia* spp. and, but for the sheep slaughtered in in April, all were infested with *O. ovis*.

Adult *H. contortus* was present in only two of the eight sheep treated with rafoxanide at intervals of three weeks and then only in minute numbers. The mean fourth stage burden was 7 624 worms; three sheep harboured more than 10 000 fourth stage larvae. Three of the sheep were infested with *Moniezia* spp.; *O. ovis* was absent.

The sheep, slaughtered during April in the group treated with rafoxanide at intervals of four weeks, harboured 326 adult *H. contortus;* in the sheep slaughtered subsequently adult worms never exceeded 15. One sheep harboured more than 10 000 fourth stage larvae and the mean infestation in this group was 4 977 larvae. Two sheep were infested with *Moniezia* spp. and none was infested with *O. ovis*.

In the group of sheep treated with rafoxanide at intervals of 5 weeks adult *H. contortus* burdens were low, but exceeded 100 worms in two of the sheep slaughtered on 20 or 21 July. Two sheep had fourth stage burdens exceeding 10 000 worms and the mean burden was 6 033 larvae. Three sheep were infested with *Moniezia spp.;* no *O. ovis* larvae were present.

Treatment with thiabendazole at intervals of four weeks resulted in reduction of fourth stage larvae and adult *H. contortus*. The latter were present in sheep slaughtered throughout the experimental period. None of the sheep was infested with *Moniezia* spp. and all but one were infested with *O. ovis*.

Worm Recoveries from Tracer Lambs

The parasite burdens of the tracer lambs exposed for 33 days on the pasture are summarized in table 3.

The lambs exposed in March and April acquired considerable burdens of *H. contortus*, while those exposed in May and June acquired progressively fewer parasites of this species. The proportion of adult worms to total infestation decreased from approximate-

Table 1 : Experiment 1. Mean Faecal Worm Egg Counts due to H.contortus Infestation

Date	Mean faecal worm egg counts (e.p.g.)								
	Controls		RFX 3 weekly		RFX 4 weekly		RFX 5 weekly		TBZ 4 weekly
10 February	38	→	0		71		79		71
17 February	2 395		7	→	854		1 164	→	1 338
24 February	5 833		3		0	→	4 646		0
3 March	11 400	→	6		0		1		29
10 March	13 071		0		33		(-)		19
17 March	18 600		(-)	→	10		28	→	1 367
24 March	18 308	→	10		1		97		7
31 March	18 600		0		3	→	950		0
7 April	16 866		0		0		22		1 079
14 April	17 844	→	4	→	0		0	→	4 901
21 April	19 358		(-)		(-)		(-)		6
28 April	15 861		0		0		3		(-)
5 May	27 261	→	(-)		0	→	0		700
12 May	20 116		0	→	0		0	→	3 259
19 May	21 791		35		4		10		7
26 May	15 680	→	0		0		0		70
2 June	8 814		13		0		0		286
9 June	10 580		0	→	0	→	0	→	217
16 June	7 700	→	0		0		0		0
23 June	5 276		0		0		0		0
30 June	6 857		0		0		0		0
7 July	1 718	→	0	→	0		0	→	39

Note: All sheep were treated with thiabendazole on 21 January.

→ = Treatment
RFX = Rafoxanide
TBZ = Thiabendazole
(-) = No larval differentiation

Table 2 : Experiment 1. Parasite Recoveries post mortem in Control and Treated Sheep

Sheep No.	Date of last treatment	Date off pasture	Date slaughtered	Parasites recovered								
				H.contortus			Moniezia spp.		Larval instars of O.ovis			
				4th Stage	Adult	Total	Non-gravid	Gravid	1st	2nd	3rd	Total
Untreated Controls												
M183*	-	2 April	2 April	654	2241	2895	2	19	0	2	16	18
M188	-	14 April	16 April	4719	4350	9069	4	4	0	0	0	0
M186	-	10 June	18 June	13650	241	13891	0	12	42	13	2	57
M187*	-	2 July	2 July	11976	3817	15793	0	7	-	-	-	-
D181	-	7 July	7 July	12060	792	12852	1	0	8	9	1	18
D182	-	7 July	20 July	13855	840	14695	1	4	6	0	3	9
D184	-	7 July	20 July	329	1	330	2	0	0	3	2	5
D185	-	7 July	21 July	10215	611	10826	0	7	0	1	0	1
Mean**				9138	1139	10277	1	5	10	4	1	15
Rafoxanide 3 weekly												
M31	24 March	14 April	16 April	2939	0	2939	1	0	0	0	0	0
D29	26 May	10 June	18 June	11170	0	11170	0	0	0	0	0	0
M35	16 June	7 July	7 July	6686	2	6688	2	5	0	0	0	0
D30	7 July	7 July	20 July	13027	5	13032	0	0	0	0	0	0
D32	7 July	7 July	20 July	192	0	192	0	1	0	0	0	0
M33	7 July	7 July	21 July	9620	0	9620	0	0	0	0	0	0
M38	7 July	7 July	21 July	6220	0	6220	0	0	0	0	0	0
M40	7 July	7 July	21 July	11135	0	11135	0	0	0	0	0	0
Mean				7624	1	7625	< 1	< 1	0	0	0	0

Rafoxanide 4 weekly												
M7	17 March	14 April	16 April	3512	326	3838	9	1	0	0	0	0
M8	9 June	10 June	18 June	12127	0	12127	0	0	0	0	0	0
D1	9 June	7 July	7 July	8595	0	8595	0	5	0	0	0	0
D2	7 July	7 July	20 July	238	1	239	0	0	0	0	0	0
M3	7 July	7 July	20 July	3249	15	3264	0	0	0	0	0	0
D4	7 July	7 July	21 July	3972	0	3972	0	0	0	0	0	0
M5	7 July	7 July	21 July	8064	14	8078	0	0	0	0	0	0
M6	7 July	7 July	21 July	57	2	59	0	0	0	0	0	0
Mean				4977	45	5022	1	< 1	0	0	0	0
Rafoxanide 5 weekly												
M105	31 March	14 April	16 April	2912	0	2912	1	27	0	0	0	0
D102	9 June	10 June	18 June	3052	0	3052	0	0	0	0	0	0
M106	9 June	7 July	7 July	10312	4	10316	0	1	0	0	0	0
D101	9 June	7 July	20 July	2778	0	2778	0	0	0	0	0	0
M103	9 June	7 July	20 July	7495	120	7615	0	2	0	0	0	0
M107	9 June	7 July	21 July	10660	155	10815	0	0	0	0	0	0
M108	9 June	7 July	21 July	5025	30	5055	0	0	0	0	0	0
Mean				6033	44	6077	< 1	4	0	0	0	0
Thiabendazole 4 weekly												
M303	17 March	14 April	16 April	1091	682	1773	0	0	0	0	0	0
D301	9 June	10 June	18 June	454	11	465	0	0	2	1	2	5
M308	9 June	7 July	7 July	50	24	74	0	0	0	1	4	5
D302	7 July	7 July	20 July	8	2	10	0	0	4	3	0	7
M306	7 July	7 July	20 July	57	143	200	0	0	3	3	5	11
M307	7 July	7 July	21 July	493	330	823	0	0	4	4	5	13
Mean				359	199	558	0	0	2	2	3	7

* = Died
** = Excluding dead sheep
M = Merino
D = Dormer

ly 22% in April to approximately 7% in July.

With the exception of the lambs exposed in June, which acquired no cestodes, two of each group of three lambs exposed prior to this became infested with *Moniezia* spp.

The lambs exposed in March harboured no *O. ovis* at slaughter, but one of every three lambs exposed thereafter acquired infestation.

DISCUSSION

When rafoxanide was administered at intervals of three or four weeks, faecal worm egg counts owing to *H. contortus* were drastically reduced after the first treatment and remained negative or very low while treatment was continued. With a dosage interval increased to five weeks, faecal worm egg counts rose to a fairly substantial level 5 weeks after the first treatment but thereafter remained negative or very low.

This prolonged repression of egg production could be the result of one or more of a number of factors. Firstly, treatment with rafoxanide could have prevented re-infestation taking place. This, however, is unlikely as the sheep slaughtered in April had considerably less *H. contortus* than those slaughtered later in the trial, thus indicating continuous infestation.

Secondly, rafoxanide could have retarded the development of fourth stage larvae through to adulthood. This is a likely supposition, as the adult worm burdens of all sheep slaughtered less than four weeks after treatment were negative or very low while those of most sheep slaughtered four weeks or more after treatment exceeded 30 worms.

Thirdly, rafoxanide could have interfered with the egg production of adult female *H. contortus*. This is another likely supposition, which, unfortunately, cannot be substantiated fully by the trial results, as only one sheep (No M7) had a substantial number of adult worms at the time of slaughter. Nevertheless, the faecal worm egg count in this sheep was negative two days prior to slaughter.

Fourthly, rafoxanide could have had a more lethal effect on the female *H. contortus* than on the male worms. Although no sex differentiation was made on the worms recovered in this experiment, other experiments in sheep and cattle have confirmed the above statement [2, 8]. Thus, although adult worms may be present after treatment, the majority of these are males and consequently incapable of egg production.

It is probable therefore, that the repression of egg output of *H. contortus* during the period of treatment was caused by a combination of three factors last mentioned, viz. retarded development, interference with egg production and a more lethal effect on female worms.

The importance of this repression in faecal egg ouput is two-fold. In the first place, when conventional anthelmintics are used to maintain negative egg counts, treatment in the case of *H. contortus* infestation has to be repeated at intervals of less than three weeks to prevent pasture contamination. When rafoxanide is used, however, a considerable saving in labour is possible, as treatment intervals can be extended to five weeks in order to achieve the same type of result. Secondly, provided all the sheep in the flock are treated at regular intervals with rafoxanide during the summer, it may be possible to reduce pasture contamination owing to *H. contortus* to insignificant levels. This, followed by a single treatment with a broad spectrum anthelmintic during the winter to remove overwintering hypobiotic larvae, may well be all that is required in the Highveld summer rainfall areas, where *H. contortus* is the most important nematode parasite.

The slaughter results showed that all treatment regimens had some effect on *Moniezia* spp. infestation and that the sheep treated with thiabendazole at intervals of 4 weeks were entirely free from this cestode.

Rafoxanide apparently prevented re-infestation with *O. ovis* occuring in the periods between treatment. Although the level of infestation was low during the period of the trial, as only one of every three tracer lambs exposed from April onwards became infested with the larvae of this fly, none of the treated sheep harboured any larvae irrespective of the time between the last treatment and slaughter. This result was not unexpected, as the probability of a residual effect against *O. ovis* has been suggested previously [5, 7].

EXPERIMENT 2

MATERIAL AND METHODS

Thirty-one Merino wethers, approximately eight months old, were purchased on the Transvaal Highveld and transported to Hennops River on 24 and 28 April, 1971. Seventeen of these sheep were treated with thiabendazole at 88 mg/kg live mass and put out to pasture with the sheep in Experiment

Table 3 : Experiment 1. Parasite Burdens of Tracer Lambs

Lamb Number	Date Exposed	Date slaughtered	Parasites recovered								
			H.contortus			Moniezia spp.		Larval instars of O.ovis			
			4th Stage	Adult	Total	Non-gravid	Gravid	1st	2nd	3rd	Total
1	19 March	23 April	3495	947	4442	3	2	0	0	0	0
2	19 March	23 April	3980	908	4888	13	14	0	0	0	0
3	19 March	23 April	1215	590	1805	0	0	0	0	0	0
4	16 April	21 May	5670	1086	6756	147	53	0	0	0	0
5	16 April	21 May	3750	483	4233	0	0	4	1	4	9
6	16 April	21 May	2304	353	2657	1	0	0	0	0	0
7	14 May	18 June	959	93	1052	0	0	6	3	0	9
8	14 May	18 June	1580	74	1654	1	0	0	0	0	0
9	14 May	18 June	850	35	885	0	2	0	0	0	0
10	11 June	16 July	429	29	458	0	0	0	0	0	0
11	11 June	16 July	658	52	710	0	0	2	0	0	2
12	11 June	16 July	350	33	383	0	0	0	0	0	0

Table 4 : Experiment 2. Parasite Recoveries from Control and Treated Sheep

Sheep No.	Parasite recoveries						
	H.contortus		M.expansa		Larval instars of O.ovis		
	4th Stage	Adult	Non-gravid	Gravid	1st	2nd	3rd
Indicator Controls							
90	1894	680	1	1	33	12	2
99	1000	316	6	0	37	3	1
100	1871	314	2	1	46	4	0
Mean	1588	437	3	< 1	35	6	1
Controls							
84	1499	841	7	16	25	8	8
85	2731	428	7	36	50	8	7
92	922	107	1	5	50	8	1
Mean	1717	459	5	19	42	8	5
Treated with rafoxanide							
91	960	3	36	29	0	0	0
94	921	2	1	0	0	0	0
95	1606	17	0	1	0	0	0
97	2414	15	3	0	1	0	0
Mean	1475	9	10	8	< 1	0	0
Treated with Cambendazole							
86	0	0	0	0	29	5	7
87	9	1	0	0	62	10	5
93	14	1	0	0	11	5	3
96	3	0	0	0	14	1	0
Mean	7	0,5	0	0	29	5	4
Treated with thiabendazole							
88	26	25	1	1	32	7	3
89	26	7	4	10	49	16	2
98	693	87	7	0	48	18	10
Mean	248	40	4	4	43	14	5

Table 5 : Experiment 3. Faecal Worm Egg Counts and Cultures

Sheep No.	Faecal worm egg count on											
	3 June	7 June	8 June	9 June	10 June	11 June	12 June	13 June	14 June	15 June	16 June	17 June
Untreated Controls												
75	10833	26433	NS	40633	47833	44300	44300	40066	39666	57433	45600	46800
77	9633	15800	31066	25600	13800	25450	22433	24500	26800	28800	24366	26433
83	9000	19000	-	-	-	-	-	-	-	-	-	-
Culture				Hc 100L	Hc 100L	Hc 100L	Neg*	Hc 32L*	Hc 100L	Hc 100L	Hc99L Oc IL	Hc 100L
Treated with rafoxanide												
70	21450	43033	29033	2033	433	0	0	-	-	-	-	-
71	15833	35800	32000	3600	400	0	0	0	-	-	-	-
72	9600	21866	15700	200	0	0	0	0	0	0	0	-
73	24600	38033	55000	466	266	200	266	433	600	333	400	466
74	10200	40800	14033	133	0	0	0	0	0	0	-	-
76	4366	10666	3000	250	0	0	0	0	0	0	0	0
78	11250	28800	39466	200	0	-	-	-	-	-	-	-
79	6000	19600	9850	400	-	-	-	-	-	-	-	-
80	10600	25033	8033	600	0	0	0	0	0	-	-	-
81	4266	25600	17666	-	-	-	-	-	-	-	-	-
82	10800	34633	15000	233	0	-	-	-	-	-	-	-
Culture			Hc 200L	Hc 200L	Hc 10L Oc 3L	Hc 16L Tric 2L	Hc 3L*	Hc 6L* Tric IL Oc 4L	Hc IL Tric 2L Oc 4L	Hc IL Tric 2L Oc 5L	Hc 65L Tric IL Oc 34L	Neg

Hc = H.contortus
Oc = O.columbianum
Tric = Trichostrongylus spp.

* = Faeces stored at 4° C
L = Larvae
NS = No sample

Table 6 : Experiment 3. Parasite Recoveries from Control and Treated Sheep

Sheep No.	Days between treatment and slaughter	Parasites recovered						
		H.contortus			Larval instars of O.ovis			
		4th Stage	Adult	Total	1st	2nd	3rd	Total
Indicator Control								
83	0	39	2585	2624	13	4	5	22
Untreated Controls								
75	10	6	3586	3592	24	4	5	33
77	10	0	1964	1964	46	3	3	52
Treated with Rafoxanide								
81	1	26	913	939	31	3	5	39
79	2	14	2	16	0	1	6	7
82	3	25	10	35	5	0	3	8
78	4	3	24	27	0	0	0	0
70	5	3	0	3	0	0	0	0
71	6	11	7	18	0	0	0	0
80	7	41	8	49	0	0	0	0
74	8	0	3	3	0	0	0	0
72	9	0	1	1	0	0	0	0
73	10	5	124	129	0	0	2	2
76	10	2	8	10	0	0	0	0

1 on 30 April. The other 14 were used in Experiment 3.

After 33 days on the pasture they were removed, randomly allocated to five groups and housed under conditions that precluded the further acquisition of helminth and probably *O. ovis* infestation. Two days later, three of the sheep were slaughtered as indicator controls, four were treated with rafoxanide at 7,5 mg/kg live mass, four with cambendazole* at 20 mg/kg live mass, three with thiabendazole at 44 mg/kg live mass and three were kept as untreated controls. Ten days after treatment all the sheep were slaughtered and subjected to standard procedures for the recovery of *H. contortus*, *Moniezia* spp. and *O. ovis*.

RESULTS

The parasite burdens of the control and treated sheep are summarized in table 4.

The mean numbers of fourth stage larvae and adult H. *contortus* recovered from the indicator controls and the controls were remarkably similar. All the sheep in these two groups were infested with *Monieza* spp. and *O. ovis*.

Treatment with rafoxanide was highly effective against adult *H. contortus* and *O. ovis*. It was ineffective against hypobiotic fourth stage larvae and *Moniezia spp.*

Cambendazole was highly effective against fourth stage and adult *H. contortus* and non-gravid and gravid *Moniezia* spp.; it was ineffective against *O. ovis*.

Thiabendazole was effective against both developmental stages of *H. contortus;* it was ineffective against *Moniezia* spp. and *O. ovis*.

DISCUSSION

The lambs were put out to pasture with the specific intention that they should acquire infestations of hypobiotic fourth stage larvae of *H. contortus*. This they did, as can be seen when comparing the fourth stage burdens of the indicator controls and controls slaughtered 10 days later (Table 2). As *H. contortus* larvae require seven to nine days to develop from the early fourth stage to the fifth stage [12], few fourth stage larvae should have been left in the control sheep, but their burdens equalled those of the indicator controls slaughtered 10 days earlier.

Rafoxanide was highly effective against adult *H. contortus* but had no effect on the hypobiotic fourth stage larvae. This result is in sharp contrast to the excellent efficacy obtained even at 5 mg/kg live mass against induced infestations of fourth stage larvae [6] and possibly can be ascribed to the fact that these hypobiotic larvae are not avid blood suckers and consequently do not ingest sufficient anthelmintic, which is bound to the plasma proteins [9], to cause death.

EXPERIMENT 3

MATERIALS AND METHODS

The 14 Merino wethers that were not used in Experiment 2 were treated with thiabendazole at 88 mg/kg, followed a few days later by cambendazole at 20 mg/kg live mass. They were then housed under conditions which precluded accidental helminth and, probably, *O. ovis* infestation.

On 6 May 1971 cultures were made from the faeces of the group of untreated lambs on the pasture in Experiment 1. Larvae were harvested from these cultures on 12 May, counted and administered to the sheep in the present experiment, so that each wether received 3 700 larvae of *H. contortus*. Twenty-two days later, faecal worm egg counts were done on all the sheep and four days later 11 sheep were treated orally with rafoxanide at 7,5 mg/kg live mass. At the same time faecal worm egg counts were done on all the sheep and one untreated sheep was slaughtered as an indicator control. Faecal worm egg counts were done daily for the following nine days on all the remaining sheep, and one treated sheep was slaughtered. On the tenth day the two remaining treated sheep and the two untreated sheep were slaughtered after faeces had been collected for egg counts. All the sheep were examined for *H. contortus* and *O. ovis* infestation.

RESULTS

The faecal worm egg counts of the control and treated sheep are summarized in table 5.

The faecal worm egg counts of all the sheep had exceeded 4 000 epg 22 days after infestation and had increased to more than 10 000 epg at the time of treatment four days later. In the treated group, with the exception of two sheep, egg counts had decreased on the day following treatment and, with the exception of one sheep, were negative on the fourth day following treatment. In this sheep

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the egg count which remained positive until slaughter, was partially due to an infestation with *Trichostrongylus* spp. and *Oesophagostomum columbianum*. Treatment had no apparent effect on the viability of worm eggs, as living larvae were harvested from faecal cultures made after treatment.

The faecal worm egg counts of the controls remained at a high level throughout the trial.

The burdens of *H. contortus* and *O. ovis* of the control and treated sheep are summarized in table 6.

The indicator control and the control sheep harboured predominantly adult *H. contortus*, while first larval instars comprised the greater portion of the *O. ovis* infestations.

The *H. contortus* infestation was drastically reduced within one day of treatment and still further reduced thereafter. Except in the case of one sheep, *O. ovis* had disappeared by the fourth day after treatment. This particular sheep also harboured more adult *H. contortus* than the other treated sheep and these worms were partially responsible for the persistent faecal worm egg counts in this sheep.

DISCUSSION

Two observations are of particular interest in this experiment. Firstly, the larvae of *H. contortus* used were cultured from faeces collected from the control lambs in Experiment 1. Had these larvae developed on pasture, they would probably have given rise to hypobiotic fourth stage larvae in sheep grazing the pasture (Experiment 1 and 2). In the laboratory, however, the larvae had given rise to adult worms 22 days after infestation and few, if any, fourth stage larvae were recovered from the untreated control sheep. Rafoxanide was highly effective against these adult worms within 48 hours of treatment but had no ovacidal effect. Similar observations have been made by Blitz & Gibbs [1], who speculated that the subsequent arrested development of larvae acquired on the pastures during autumn was triggered by autumnal environmental conditions acting on the infective larvae.

Secondly, the first instar larvae of *O. ovis* present in the sheep were probably a hypobiotic or overwintering infestation. These sheep had been kept in the laboratory stables since 24 or 28 April, where the chances of infestation were minimal, and yet at slaughter 40 to 54 days later the controls harboured 13, 24 and 46 first instar larvae, a delay in development ascribed by Cobbett & Mitchell [3] to overwintering. The first instar larvae in the sheep in Experiment 2 were probably also overwintering and were already present when the sheep arrived at Hennops River. Rafoxanide was highly effective against these and the other larval instars present.

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Jl S. Afr. vet. Ass. 44 (3): 265—269 1973

PARASITOLOGICAL STUDIES ON IMPALA: PRELIMINARY REPORT

IRMGARD G. HEINICHEN*

SUMMARY

The deleterious effects of confining wild animals to a restricted area are exemplified by the history of the bontebok, *Damaliscus dorcas dorcas* in which worm infestation played an important rôle. This justified a preliminary parasitological study on an impala game ranch in Zululand. Infestations by *Paramphistomum* sp., *Stilesia hepatica*, *Pneumostrongylus calcaratus*, *Haemonchus bedfordi*, *Ostertagia* sp., *Trichostrongylus axei*, *T. colubriformis*, *Cooperioides hamiltoni*, *Gaigeria pachyscelis* and *Trichuris globulosa* were found.

Lymnaea columella and a few *Gulella* shells were found in regular attempts to collect snails at waterholes on the ranch. They were not parasitized by intermediate stages of helminths. A promising start was made with the culture of larval stages from nematode eggs. The relevant literature is reviewed.

INTRODUCTION

When wild animals are confined to a restricted area, such as a reserve or a ranch, they are exposed to stress factors which do not occur under natural conditions. These factors may act separately or as synergists to endanger their survival in a given locality. The effect of such stress factors on an antelope in a limited area was clearly illustrated in the case of the bontebok, *Damaliscus dorcas dorcas* (Pallas, 1766).

At the beginning of the last century the bontebok was already threatened with extinction and it owes its survival to protection by the farmers in its natural area. In 1931, when only 17 bontebok remained, the National Bontebok Park in the Bredasdorp District was established, where they increased to such an extent that in 1949 the Parks Board could supply small herds to various farmers [26]. In 1957, however, 64 animals died. Investigations showed that 15 had succumbed to swayback caused by a copper and cobalt deficiency, and the other 49 to verminosis [29]. Ortlepp [19] recorded conical flukes, three intestinal nematodes and two lungworms from these animals, but it was mainly the two lungworms, *Pneumostrongylus cornigerus* Ortlepp, 1962 and *Protostrongylus capensis* Ortlepp, 1962, which had been responsible for the deaths. Both these helminths belong to genera which pass through an intermediate host before they are infestive to antelope. The particular intermediate hosts of these two lungworms are unknown, but as a related lungworm of sheep, *Protostrongylus rufescens* (Leuckart, 1865), utilize snails in this capacity [5, 8], it is probable that those of the bontebok also pass through snails. At certain times of the year, three-quarters of the Park was covered with water [28], thus creating favourable conditions for the propagation of both the parasites and their intermediate hosts.

In 1960 the Park was moved to a more favourable locality in the Swellendam District. The 62 surviving antelopes adapted to the new environment and had increased to 149 within five years. Recently, however, another factor, viz. inter-specific transmission of helminths, has again endangered the bontebok. In 1960 and later, springbuck, *Antidorcas marsupialis* (Zimmerman, 1780) were also introduced into the Park [4]. These animals were infested with a lungworm, *Dictyocaulus magna* [13]. The type host of this helminth is the blesbuck, *Damaliscus dorcas phillipsi* Harper, 1939, which is subspecifically related to the bontebok. It is therefore not surprising that bontebok have become infected with this lungworm and that some of them have died [32].

Although the parasite fauna of many antelopes, particularly the impala, *Aepyceros melampus* (Lichtenstein, 1812), are well known, little or nothing is known of the worm burdens which occur naturally, or of the life-history of these parasites. The impala is the most numerous of South African antelopes in Game Reserves, Parks and on ranches and it is therefore essential that more detailed information be obtained in different localities.

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Table: PARASITES RECOVERED FROM IMPALA, **AEPYCEROS MELAMPUS** (LICHTENSTEIN, 1812) IN AFRICA

Parasite species	Kenya	Malawi	South Africa	Swaziland	Tanzania	Zambia
Calicophoron calicophorum (Fischoeder, 1901)			+			
Cotylophoron fuelleborni Näsmark, 1937		+				
Schistosoma mattheei Veglia & Le Roux, 1929			+			
Schistosoma sp.						+
Avitellina centripunctata (Rivolta, 1874)	locality not given					
Cysticercus impalae Martinaglia & Brandt, 1947				+		
Cysticercus tenuicollis Rudolphi, 1810	+					
Cysticercus sp.	+		+			+
Moniezia benedeni (Moniez, 1879)					+	
Moniezia expansa (Rudolphi, 1810)			+			
Stilesia hepatica Wolffhügel, 1903	+					
Thysaniezia giardi (Moniez, 1879)	locality not given					
Bigalkenema sabie (Mönnig, 1932)			+			
Cooperia fuelleborni Hung, 1926			+			
Cooperia hungi Mönnig, 1931			+			
Cooperioides hamiltoni (Mönnig, 1932)	+		+			
Cooperioides hepaticae Ortlepp, 1938			+			
Gaigeria pachyscelis Railliet & Henry, 1910			+			
Haemonchus bedfordi Le Roux, 1929			+			
Haemonchus contortus (Rudolphi, 1803)	+		+			
Haemonchus krugeri Ortlepp, 1964			+			
Impalaia nudicollis Mönnig, 1931			+			
Impalaia tuberculata Mönnig, 1923						
Muellerius capillaris (Müller, 1889)	+					
Oesophagostomum columbianum Curtice, 1890	+		+			
Onchocerca sp.	locality not given					
Ostertagia sp.			+			
Pneumostrongylus calcaratus Mönning, 1932			+			
Setaria scalprum (Linstow, 1908)						+
Setaria yorkei Thwaite, 1927						+
Strongyloides papillosus (Wedl, 1956)	+					
Trichostrongylus colubriformis (Giles, 1892)	+		+			
Trichostrongylus thomasi Mönnig, 1932			+			
Trichuris globulosa (Linstow, 1901)			+			

LITERATURE REVIEW

Round [26] lists 4 trematode, 8 cestode and 22 nematode species in the impala in Africa.

Mönnig [14] described *Trichostrongylus thomasi, Cooperioides hamiltoni* and *Pneumostrongylus calcaratus,* while Ortlepp described *Cooperioides hepaticae* in 1938 [18] and *Haemonchus krugeri* in 1964 [20]. These five helminths are the only species which appear to be specific to the impala. Lynda Gibbons [6] described *Kobusinema banagiense* as a new species of trichostrongylid in a number of African game animals, including the impala.

The life-cycles and morphogenesis of the majority of these nematodes are unknown. The development of the following species, which also occur in sheep, has been studied by various authors: *Gaigeria pachyscelis* by Ortlepp [17], *Haemonchus contortus* by Veglia [30], *Muellerius capillaris* by Rose [23, 24], Morgan [15], and Gerichter [5], *Oesophagostomum columbianum* by Basir [2] and Veglia [29] and *Trichostrongylus colubriformis* by Mönnig [11]. The effect of environment on stages of various ruminant nematodes has been studied by Levine [10] and Kates [9], but similar information on the ecological requirements of the helminths of impala is still lacking.

The life-cycle of *Pneumostrongylus calcaratus* is unknown, but Anderson [1] found that terrestrial slugs and snails transmit *Pneumostrongylus tenuis* Dougherty, 1945, a lungworm of ruminants in North America. It was also possible to infest *Lymnaea* spp. experimentally with this parasite.

There is little information on the transmission of helminths from antelopes to domestic livestock and *vice versa.* Mönnig [12, 13, 14] successfully transferred *Haemonchus bedfordi, Cooperia fuelleborni, Cooperia hungi* and *Impalaia nudicollis* from impalas to sheep. It is difficult, therefore, to evaluate the importance of domestic livestock as a source of infestation of antelope.

Extensive investigations have been carried out on the worms and worm burdens of sheep in different regions, viz. Western Province [16], Eastern Province [25], Karoo [33, 34] and the Highveld [27]. Similar studies on cattle are those of Reinecke [21] in the Northern Cape and Hobbs [7] in Natal.

The work done on domestic stock has made it possible to control the parasites more effectively. It is probable that the need for similar treatment of antelope on ranches will arise in the near future.

MATERIAL AND METHODS

The present studies are being undertaken on the Nyala Game Ranch of Mr Scott-Barnes, situated 20 kilometres northwest of Empangeni, between 28°39 and 28°41 S, and 31°42 and 31°43 E. It is approximately 444,13 ha in extent with a rainfall of 754,4 mm per annum. It was changed from a cattle farm into a game ranch during 1964.

In this investigation two impalas are examined each month for a period of two years. Once the animal has been shot, body mass and measurements for age estimations are recorded, and the lungs, liver, heart and alimentary canal are removed and placed into a plastic bag for transportation to the laboratory.

The liver, lungs, heart, rumen, reticulum and mesenteric blood vessels are examined macroscopically for parasites. The abomasum and intestine are cut from the mesentery and divided into four parts: the abomasum, the proximal small intestine (10 m), the distal small intestine, and the caecum and colon.

To recover all the worms from the intestine, all of the contents are put into a modified Baermann apparatus, and placed into Shone's waterbath [22] Nylon grid-gauze (500 μm aperture) is supported in a wire basket, suspended in a stainless steel tray, 2—3 cm above the bottom of the tray. The tray contains 0,09% saline solution. The ingesta are placed on the sieve and incubated at 40°C in a waterbath for one hour. The gauze is then taken out of the wire basket and the residue washed off into a bucket. The filtrate is placed into a separate bucket. The worms are killed by placing the buckets in boiling water and stirring until a temperature of 60°C is reached. Formalin is added and the suspension is washed into an Endecott sieve with 400 mesh per 250 mm (39 μm aperture). The ingesta and worms remaining on the sieve are transferred to a glass jar, in which the material is preserved with an equal quantity of 10% formalin.

The larger worms which remain in the residue are recovered and counted macroscopically, but the filtrate, which contains smaller worms, is examined microscopically. When there are more than 1 000 worms in any one part of the intestine, three aliquots of 1/10 each are removed and the helminths counted. The method of Clark, Tucker and Turton [3] was found more useful when estimating the worm burdens in heavy infestations. When possible, 120 helminths are removed

identification.
from each part of the intestine for subsequent

RESULTS

From March to June 1972 one animal was examined each month. In August and September two animals were examined per month. In October the shooting season closed and owing to unforeseen difficulties no further material could be collected.

(i) *Helminths recovered:*

In the rumen and reticulum a conical fluke, *Paramphistomum* sp. was found in five out of eight animals. The total number of *Paramphistomum* recovered varied from 2 to 441; the heaviest infestations were encountered in August and September.

In three of the eight animals, *Stilesia hepatica* was recovered in the bile ducts of the liver.

Six of the eight animals examined were infested with *Pneumostrongylus calcaratus:* these infestations were classified as medium (30 to 50 lesions) to heavy (more than 50 lesions). The last examined were pregnant ewes which were not infested with this lungworm.

The following nematodes have been recovered from the intestinal tract: *Haemonchus bedfordi, Ostertagia* sp., *Trichostrongylus axei, Trichostrongylus colubriformis, Cooperioides hamiltoni, Gaigeria pachyscelis* and *Trichuris globulosa.*

No parasites were found in the hearts, mesenteries or abdomens examined.

(ii) *Life-cycle studies:*

From July snails were collected regularly at waterholes on the ranch. To date, however, only *Lymnaea columella* and a few *Gulella* shells were found. On dissection no larval nematodes were found in these snails.

Cultures of some nematode eggs were made to investigate the different larval stages. Satisfactory results were obtained shortly before this preliminary trial was terminated.

CONCLUSION

The preliminary results justify extension of this study to include a quantitative and qualitative survey of internal parasites of the impala, a study of their life-cycles, which would entail examination of terrestrial snails and slugs for infective larvae, and correlation of the findings with metereological data. Attempts would have to be made to transmit the nematodes to sheep.

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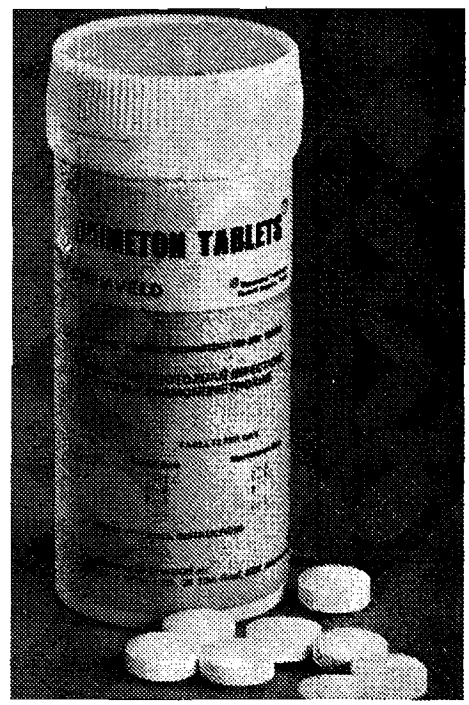

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CAUSES OF VARIATION OF COPPER, IRON, MANGANESE, ZINC AND MAGNESIUM LEVELS IN BOVINE LIVERS*

1. DETERMINATION OF TRACE ELEMENTS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY

P. F. THERON**, R. RIMMER**, H. A. NICHOLLS* AND W. J. EHRET***

SUMMARY

Sample preparation, matrix interferences, flame stoichiometry and storage of solubilized samples are factors which can affect the accuracy and precision of trace metal analysis in bovine livers by atomic absorption spectrophotometry. A wet ashing sample preparation method was shown to give equivalent or higher values than a dry ashing method for all metals investigated except manganese. The average recovery of added metals to wet ashed samples was quantitative, but a large scatter of individual results around the mean was observed. This was thought to be due either to incomplete suppression of interferences by the releasing agent or poor flame stoichiometry, since a single elemental analysis, replicated ten times, showed good precision. After storing wet ashed samples in plastic containers for one week, significant increases in the iron, magnesium and manganese concentrations were found, indicating possible dissolution of these metals from the container.

INTRODUCTION

Certain elements in animals diets are regarded as essential to stimulate health, growth and reproduction. Deficiency states have been correlated with subnormal levels of the element in the blood or organs of the deficient animal. The liver has been analysed more often than any other internal organ, mainly since variations in dietary uptake are more readily reflected in the liver which is the main storage organ for some of the elements [24].

Many analytical techniques are currently in use for the detection and estimation of trace elements in solutions, solids and gases. Atomic absorption spectrophotometry is one such instrumental technique which, since its introduction by Walsh [23], has proved to be a relatively inexpensive and rapid method for the estimation of metal concentrations. Although this technique has often been described as element specific and interference free, a literature survey indicated that it needs careful optimization before reliable and reproducible results can be obtained. The effects of sample preparation, matrix interference and flame stoichiometry on the precision and accuracy of the method are factors to be considered.

This study was therefore directed towards enumerating some of these influences and establishing a reliable routine method suitable for handling large numbers of liver samples on a routine basis.

SAMPLE PREPARATION

Organic matter in biological samples can be destroyed by either dry or wet ashing. In both instances the residues are dissolved in mineral acids which, after dilution, can be aspirated directly into the flame. A flameless technique has also been described for the estimation of trace metal concentrations in freeze-dried livers [10]. In this method the solid sample is placed in a heated graphite crucible which serves to vaporize and atomize the metals which are carried by an inert gas into the optical system.

Samples are dry ashed for 12 hours [5] or overnight [22] while Knauer [8] found that oven-dried shrimps could be ashed in as little as four hours. A weakness of this method is the danger of elemental loss due to volatilization and retention of the elements by the crucible. Knauer [8] investigated the influence of various temperatures on the recovery of magnesium, manganese, iron, copper and zinc in marine

*Based upon a dissertation submitted by W. J. Ehret to the University of Pretoria in partial fulfilment of the requirements for the degree M.Med.Vet. (Zootech.). Promotor: Dr P. A. Boyazoglu.

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shrimps. A temperature range between 560° and 620°C was found suitable for all five elements.

The metals are extracted with various concentration of hydrochloric acid [1,5,12,22] or in aqua regia [3,14]. Knauer [8] used 1+1 dilutions of nitric acid, hydrochloric acid and aqua regia to extract metals from ashed samples and found no significant difference between the three extractants.

Wet ashing or wet oxidation of organic material is achieved by the action of oxidising mineral acids which include mixtures of nitric, perchloric and sulphuric acids [6,17], nitric and perchloric acid [7], and nitric and sulphuric acid [3]. The use of strong acids implies the availability of efficient fume extraction systems and the careful handling of strong acids. By virtue of its strong oxidising properties, perchloric acid is an obvious choice but this acid must always be diluted with other mineral acids to avoid explosions. A mixture containing sulphuric, nitric and perchloric acid appears to be less likely to cause explosive reactions than perchloric/nitric acid mixtures, although the presence of sulphuric acid in the final solution may cause some loss of sensitivity in the atomic spectrophotometric determination of metals [1].

Kahnke [7], using a wet ashing method, recovered ± 96% of added zinc, copper, manganese and iron in formalinized human tissue but reported a total loss for added magnesium.

Wet ashing has the advantage that the destruction of organic material and the liquefaction of the metals take place simultaneously.

By contrast, dry ashing is rather laborious, entailing a two-step procedure. Yet it is relatively simple and requires less attention than wet ashing.

Since long ashing times are indicated, the dry ashing method is unsuitable for the handling of large numbers of samples, unless sufficient muffle furnace space is available, which is not always the case in most laboratories.

Both sample preparation methods were investigated in this study, in addition studies on recovery of magnesium added to samples analysed by wet ashing were undertaken.

INTERFERENCES

The determination of metals by atomic absorption spectrophotometry has often been described as interference free. Despite this fact, certain effects are observed which must be accounted for when accurate results are required. Some of these factors have been described [15,18] and are generally of three types, namely, ionization effects, chemical interference and molecular absorption or scatter. The most troublesome type is chemical interference which results from the loss of those atoms bound in molecular combinations in the flame [22] and usually occurs when the flame is not sufficiently hot to dissociate the molecule, or because the dissociated atom is immediately oxidised to a compound that will not dissociate further. Ionization and chemical interferences quite often are controlled by the addition of a large excess of so-called 'releasing agents'.

Copper determinations in the air-acetylene flame are apparently free from interferences except those which result from large amounts of solids in solution [22]. Sodium chloride, in excess, will enhance copper concentration [19] while Sattur [16] found copper to be relatively free from interferences over the range 0,001% to 80% copper in a non-ferrous matrix.

Both sodium chloride and phosphate in excess will reduce iron absorption but can be eliminated by the addition of 10 ml of a 5% solution of lanthanum chloride to 100 ml of analyte solution [19]. Curtis [4] showed that sulphate, phosphate, sodium and potassium produced a depression of the absorbance reading for iron, while the ammonium ion enhanced the reading. These interferences were eliminated by the use of a fuel-lean flame. Ottaway *et al* [11] investigated interferences produced by a large range of anions and cations on the determination of iron and found that a fuel-lean flame gave maximum sensitivity for its determination. Under these conditions chromium (III)†, manganese (II)†, zinc, magnesium and aluminium did not interfere in concentrations as high as 5 000 mg/*l*. Hydrochloric, nitric, sulphuric, perchloric and phosphoric acid caused little interference in concentrations up to 5 per cent. Cobalt, nickel and copper, on the other hand, interfered significantly owing to signal depression which reached a maximum at a concentration of about 100 mg/*l* for all three metals. Releasing agents such as calcium, strontium, barium and 8-hydroxyquinoline eliminated most of these effects, provided sufficiently large excesses were used. Sattur [16] found that phosphorus, alu-

†Denotes valency.

minium, nickel and tin interfered in the determination of iron in copper-base alloys. These interferences were controlled by the addition of lanthanum or strontium. The transition metals, silicate, sulphate, the ammonium ion and citric acid interfere in the determination of iron but can be suppressed by using a fuel-lean flame and by the addition of 25 ml of a 5% lanthanum chloride solution to 75 ml of the analyte solution [9]. Sulphate, boron, fluoride and phosphate interfere in the determination of iron [20]. Sulphate interference can be controlled by the addition of 1 ml of a 5% solution of barium chloride per 100 ml analyte solution, while the addition of 10 ml of a 5% solution of lanthanum oxide to the solution will control boron, fluoride and phosphate interferences.

In a reducing air-acetylene flame, the absorbance for manganese is reduced by phosphate, perchlorate, iron, nickel and cobalt. In an oxidising flame these interferences are minimized (Varian Techtron Manual). The interferences by boron, fluoride and phosphate in the determination of manganese can be suppressed by lanthanum [20].

The determination of zinc is generally free from interferences [16, 22].

Magnesium is almost free from chemical interferences except for a small protein interference which can be controlled by the addition of releasing agents [22, 25]. Ramirez-Moñoz [18] found no chemical interferences for magnesium determinations when using a fuel-lean air-acetylene flame but strontium was nevertheless added to mask any residual interference. Aluminium interference in magnesium analysis was noted by Sattur [16] but was controlled by the addition of lanthanum. Schmidt-Dujmovic [21] used 0,5% lanthanum oxide to suppress interferences in magnesium determinations.

It appears therefore, that chemical interferences can be controlled by the addition of a releasing agent and the use of an oxidising air-acetylene flame. Lanthanum is the most commonly-used releasing agent in concentrations ranging from 0,5% to 1,25%. For the present study a 1% lanthanum chloride concentration was selected.

EXPERIMENTAL

Instrument

A Varian Techtron AA4 equipped with a laminar flow burner and operating on an air-acetylene mixture was used. A Servogor flat-bed recorder was coupled to the instrument to record permanent traces of readings. The instrument was operated according to the manufacturer's instructions. Lamp currents and slit-widths were substantially the same as recommended. Flame stoichiometry was optimized for each of the five elements by the two calibration standards technique as described in the manufacturer's manual. The established flow-rates were noted and used throughout the investigation.

Digestion Mixture

A mixture of analytical grade sulphuric, perchloric and nitric acid was prepared in the volumetric ratio of 1 : 7 : 40. Six ml of this mixture was used for the wet ashing of samples. This mixture was substantially the same as that used by Boyazoglu & Barrett [2]. Each new batch of acid mixture was analysed for the presence of any of the five metals and the sample concentrations accordingly corrected.

Lanthanum Chloride Solution

A 6% (m/v) solution of lanthanum chloride in distilled water was prepared.

Sample Mass

The samples received at the laboratory consisted of a piece of liver of about 20 g contained in a glass bottle and covered with a 10% aqueous formalin solution. The liver was cut in half in the bottle and one half removed and placed on a coarse filter paper to absorb excess moisture. A piece of about 1 g was cut from the centre of this piece and the mass determined by difference in order to minimize any errors inherent in the qualitative transport of the sample to the ashing receptacle.

Wet Ashing Procedure

The sample of known mass was placed in a micro-digestion tube and 6 ml digestion mixture added. Heating was controlled to avoid excessive frothing and heating was continued until the solution was colourless and white fumes were emitted. The solution was cooled, 5 ml of lanthanum chloride solution added and the mixture diluted to 30 ml with distilled water.

Dry Ashing Procedure

The sample was placed in a 50 ml fused silica dish and put in a cold muffle furnace. The temperature of the furnace was raised to 600°C and maintained for a period of eight

hours. The dish was cooled and the ash extracted with 3,5 ml of aqua regia, 5 ml of lanthanum chloride solution added and the mixture diluted to 30 ml with distilled water.

Calibration standards

All standards contained 1% (m/v) lanthanum chloride in addition to 0,5% (v/v) sulphuric acid when wet ashed samples were analysed. Standards for dry ashed samples contained 12% (v/v) aqua regia in addition to 1% lanthanum chloride. The range of standard solutions used appears in table 1.

RESULTS

Recovery of Added Magnesium — Wet Ashing Method

In order to minimize the effects of the possible uneven distribution of trace metals in the liver, recovery studies for added magnesium were carried out on a homogenized sample. Known concentrations of the metal were added to aliquots of known mass of the prepared sample and the ashing and dilution carried out as previously described. The results are summarized in table 2.

An average recovery of 98% was achieved for added magnesium over the range 25 to 100 μg per gram of sample using the proposed wet ashing method. The findings of Kahnke [7], therefore, were not substantiated and in terms of his other findings it was concluded that the recovery of all given metals would be quantitative when using the wet ashing method.

Comparison of Wet and Dry Ashing Methods

Thirty separate homogenized livers were solubilized by both wet and dry ashing methods and the metal concentrations determined. The statistical significance of the difference between two sets of results was determined by employing the Student 't' table at a 95% confidence limit. For this limit and the number of samples, the two methods were deemed not significantly different if $t < 2$. The results of this experiment appear in table 3 and from these the following could be demonstrated:

1. The wet ashing method gave significantly higher values for magnesium and zinc.
2. Manganese concentrations were significantly higher using the dry ashing method.
3. No significant difference was found between the two methods for copper and iron concentrations.

Matrix and Flame Stoichiometry Effects

Ten different liver samples were solubilized by wet ashing. After the addition of lanthanum chloride solution, the acid extracts were diluted to 20 ml. The diluted samples were halved and known quantities of copper, iron, magnesium, manganese and zinc added to one half before diluting it to 15 ml. The other half was diluted to 15 ml and used for the determination of the actual metal concentrations of the liver.

The results, which appear in table 4, indicate good recoveries for all the metals except for magnesium, for which they were considerably less than those obtained in table 2. As indicated by the percentage standard deviation, on the other hand, the precision with which magnesium was determined, was considerably superior to that of the other metals. Copper and zinc yielded particularly poor recovery rates, the individual results deviating from the mean by almost 9% and 10% respectively. This wide scatter of results can only be due to either the incomplete suppression of interferences by the releasing agent or poor flame stoichiometry, since the next investigation showed the excellent precision with which an elemental determination can be carried out in a uniform sample matrix and with a flame adjusted for a fixed metal concentration.

Replicate Analysis of One Liver

The previous results indicated poor precision for most of the metals determined; in order to eliminate instrumental instability as a possible cause of low precision, ten replicate determinations for each metal were carried out on the same wet ashed liver sample. The results in table 5 indicate excellent precision for all the metals except manganese, the concentration of which, in this particular sample, approached the minimum detectable level. Abnormal scale expansion had to be used, resulting in increased instrument drift and subsequent poor precision. Poor precision can be eliminated by analysing for concentrations sufficiently far removed from the minimum detectable limits to avoid unnecessary scale expansion, provided that the sample matrix remains reasonably constant and that the fuel-support ratio be altered for any change in analyte concentration.

Effect of Storage on Metal Concentration of Ashed Samples

The remainder of the sample, used in the previous study, was placed in a plastic container, stoppered and stored for one week and the replicate analysis repeated. The two

Table 1: RANGE OF CALIBRATION STANDARDS

Metal	Concentration μg/ml			
Copper	0,2	0,5	1,0	2,0
Iron	1,0	3,0	6,0	10,0
Magnesium	1,0	3,0	6,0	10,0
Manganese	0,1	0,3	0,6	1,0
Zinc	0,6	1,0	2,0	3,0

Table 2: RECOVERY OF ADDED MAGNESIUM: WET ASHING METHOD

Concentration* in liver, μg/g	μg added	μg found	μg recovered	% recovered
104	25	129	25	100
104	50	152	48	96
104	75	177	73	97
104	100	204	204	100

*Average of triplicate analysis

Table 3: COMPARISON OF WET AND DRY ASHING METHODS

Element	Copper		Iron		Magnesium		Manganese		Zinc	
Method	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Average Concentration μg/g	5,57	5,34	142	149	207	176	3,5	4,1	55,9	53,5
Standard deviation	0,16	0,16	11,79	28,76	10,35	11,62	0,20	0,87	2,18	3,58
Statistical Difference: 't'	0,39		0,31		10,73		3,64		3,08	

Table 4: RECOVERY OF ADDED METALS TO WET ASHED SAMPLES

Element	Copper	Iron	Magnesium	Manganese	Zinc
μg added	7,5	45,0	93,0	4,5	15,0
μg recovered (average)	7,2	45,0	87,0	4,5	15,3
Percentage standard deviation	8,3	6,7	3,8	6,7	9,8

Table 5: REPLICATE ANALYSIS OF ONE LIVER SAMPLE AND THE EFFECT OF STORAGE ON METAL CONCENTRATIONS

Element	Copper		Iron		Magnesium		Manganese		Zinc	
Storage time, weeks	0	1	0	1	0	1	0	1	0	1
Average concentration μg/ml	0,695	0,698	2,3	2,4	3,4	3,5	0,3	0,4	0,63	0,62
Percentage standard deviation	2,0	1,9	2,2	1,4	0,6	0,7	22	16	2,8	3,3
Statistical difference: 't'	0,47		4,94		9,41		3,26		1,11	

sets of results were stastically analysed, using the Student 't' table at a 95% confidence limit; the difference between the two sets of results was regarded as insignificant for $t < 2{,}1$.

From table 5 it is evident that the concentrations of iron, magnesium and manganese were significantly increased on storage for one week in a plastic container. Most likely this is due to dissolution of these metals from the container.

CONCLUSIONS

1. Magnesium can be recovered quantitatively using the described wet ashing method.
2. Wet ashing of samples yielded significantly higher values for magnesium and zinc than the dry ashing method, while the reverse was found for manganese. Copper and iron concentrations were unaffected by the method of liquefaction.
3. Although recovery of metals added to wet ashed samples was good, the precision with which these metals was recovered from a large number of different liver samples was poor, magnesium being the exception. This is thought to be due to either insufficent suppression of chemical interferences by the releasing agent, or to poor flame stoichiometry. The latter is particularly difficult to optimize when varying concentrations of metals are analysed routinely.
4. A single metal determination can be carried out with a high degree of precision provided abnormal scale expansion is avoided; owing to the influences described above such a result may not necessarily be accurate.
5. Metal concentrations of solubilized liver samples stored for prolonged periods in plastic containers can be seriously affected by dissolution of metals from the container.

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SYMPOSIA ORGANIZED BY THE ITALIAN SOCIETY FOR ZOOTECHNOLOGICAL PROGRESS*

The closing session of the VIIIth International Symposium on Zootechnology took place on the 17th April 1973. It was organized by the Italian Society for the Improvement of Zootechnology in collaboration with the National Academy of Agriculture. Its title was: 'Intensification of Animal Husbandry and Problems in Animal Reproduction.' Sen. Dr Giovanni Spagnolli, who is the Honorary President of the Society, presided over the session; many scientists and government officials, both Italian and foreign, as well as consular representatives, were present. Conclusions and recommendations, presented by Prof. R. Ferrando of the Ecole Nationale Vétérinare of Alfort (France), were approved. The President of the Society, Prof. T. Bonadonna, Professor at the University of Milan, stated that 31 countries had participated in the Symposuim at which 95 papers had been presented, all of great scientific and technical interest. He also announced the title of the IXth International Symposium on Zootechnology, which will be held in Milan from 15 to 17 April 1974, namely 'Conventional and unconventional proteins in animal feeding and utilisation of animal products for human nutrition.'

The Society has awarded particular recognition (medals and diplomas) to three technicians in the field of artificial insemination in Austria, Denmark, Canada, Finland, France, Germany and Hungary, the first of its kind in the world.

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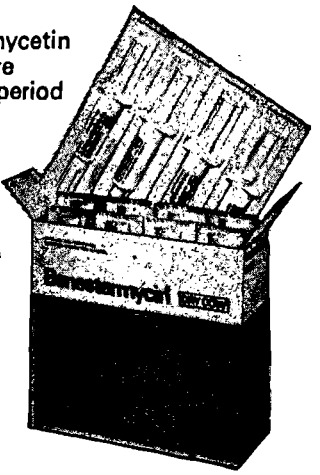

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FLUCTUATIONS IN PITUITARY FSH AND LH IN THE NORMALLY CYCLING ANGORA GOAT

P. S. PRETORIUS*

SUMMARY

Pituitary FSH and LH activity increased continuously during the luteal period (Day 1 to Day 18) in the cycling female goat. FSH levels attained a maximum value during early oestrus (Day 0), while LH activity had already reached its highest level at pro-oestrus (Day -1). Following these high pre-ovulatory levels, a sharp drop in both FSH and LH in the pituitary occurred towards late oestrus (Day 1). During the period of di-oestrus, gonadotrophin levels equalled those recorded during the mid- and late luteal periods in the cycling female. Gonadotrophin hormone activity is discussed in relation to ovarian follicular activity in the doe.

INTRODUCTION

Studies by Van Heerden [21] and Van Rensburg [23] revealed an apparent weakness in the endocrine mechanisms of the Angora goat which culminated in various aberrations from the normal reproductive pattern. Apart from the abnormal periodicity and duration of oestrus, embryonic resorption and foetal abortion were the more serious reproductive problems encountered in this species. These dysfunctions seemed to have a hormonal basis which could be traced back to the pituitary gland. Nevertheless, the pituitary-endocrine relationships in this breed of goat have been subjected to speculation only. Generalizations on the chronological and cyclical production and release of pituitary gonadotrophins and their effect on the target organs cannot be extrapolated to apply to the reproductive disorders experienced in the Angora goat with any certainty. Species differences do occur and the normal pattern of a particular species must be investigated before the deviation therefrom in individuals of lowered reproductive efficiency can be evaluated and understood.

As no comparable data are available on the pituitary gonadotrophin levels in the Angora goat with normal reproductive function, and owing to the special fertility problems experienced in this goat breed, an investigation on the pituitary gonadotrophic hormone activity during different reproductive phases in the normal animal was undertaken. The object of this paper is to report on the pituitary FSH and LH activity in the cycling animal.

PROCEDURE

Animals and Reproductive Stages

Angora goats displaying normal periodicity of oestrus [13] were slaughtered, six each at the following reproductive stages: pro-oestrus (Day -1); early oestrus (Day 0; 4 h following onset of behavioural oestrus); late oestrus (Day 1: 36 h following onset of oestrus); early luteal stage (Day 6); mid-luteal (Day 12); late luteal stage (Day 18); and early, mid- and late di-oestrus, the date of slaughter being determined by the onset, exact mid-period and end of the previous di-oestrus period. Only five animals were slaughtered during the early and middle di-oestrus stages.

Oestrus was detected with the aid of vasectomized teaser Angora rams. The does were slaughtered at the local abattoir, situated some 320 km away from the feeding pens. Care was taken not to subject the animals to any conditions of stress prior to slaughter.

Collection of Pituitary Glands

Pituitary glands were removed intact from the cranial cavity within 10 minutes of death and deep-frozen. Following thawing and cleaning, the posterior part was removed. The anterior pituitary was subsequently weighed and preserved in cold acetone according to the method described by Melampy, Henricks, Anderson, Chen & Schultz [6]. The acetone-dried anterior pituitary glands were ground to a fine powder and stored in a desiccator at approximately 4°C. Before bio-assay, the pituitary powder was homogenized in cold 0,9 per cent saline and diluted to the desired concentration. Pituitaries of animals in the same reproductive stage were pooled in order to provide sufficient material for repeated bio-assay.

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BIO-ASSAY

(i) *Follicle Stimulating Hormone (FSH)*

Pituitary FSH activity was determined by the HCG-augmentation assay of Steelman & Pohley[20]. Intact immature female Sprague-Dawley rats, 21 to 22 days of age, received pituitary homogenate subcutaneously, twice daily, over a period of three days. A total dose of 16 mg pituitary material in 3 ml 0,9 per cent saline (6×0,5 ml) was administered to each rat. The augmentation dose was 25 IU HCG (Lutormone, Burroughs Wellcome & Co.) per rat, which was added *in vitro*. Control rats received HCG alone. Five rats were employed in each group. At necropsy on the fourth day, 72 h after the first injection, the extirpated ovaries were cleaned and weighed. FSH activity was expressed as the percentage increase in ovarian mass over that of the HCG control animals.

(ii) *Luteinizing Hormone (LH)*

LH activity was determined by the ovarian ascorbic acid depletion method of Parlow[9, 10]. Some minor modifications in the standard pre-treatment procedure for the rats were adopted. Younger rats were used at the start of the assay, and two PMS injections, instead of one, were given during the pre-treatment of the rats.

Intact, immature female Sprague-Dawley rats, 23 to 24 days of age, each received subcutaneous injections of 30 IU pregnant mare serum (PMS) (Burroughs Wellcome & Co). A second PMS injection (30 IU) was administered 48 h later. Sixty-five hours after the last PMS injection, 25 IU HCG (Lutormone, Burroughs Wellcome & Co.) were administered to each rat. The rats were used for assay eight full days following HCG administration. At the time of assay the rats were lightly anaesthetized and the test solutions (pituitary homogenate) injected intraperitoneally[8] in a single 0,5 ml dose. Pituitary material was administered at a dose of 0,8 mg per rat.

The rats were killed three hours after the intraperitoneal injection and both ovaries were removed, cleaned and weighed. Ovaries weighing less than 70 mg each were discarded. Both ovaries were homogenized in a mortar and pestle in 10 ml ice cold 2,5 per cent freshly prepared metaphosphoric acid and filtered. Ascorbic acid concentration was determined in the clear metaphosphoric acid filtrates by the method of Mindlin & Butler[7]. Pituitary LH activity was expressed as per cent ovarian ascorbic acid depletion over that of control animals.

Statistical Analysis

Standard statistical procedures[19] were employed in analysing the experimental results. In dose-response assays, lambda values were calculated according to the method of Bliss[1] and compared with the values of Loraine[4] for acceptability.

RESULTS

Follicle Stimulating Hormone

According to the figure, a considerable and statistically significant ($P < 0,05$) increase in pituitary FSH content occurred from pro-oestrus (Day -1) to early oestrus (Day 0). Maximum FSH activity was recorded 4 h following the onset of oestrus (Day 0). From the pre- to the immediately post-ovulatory stage of the cycle (Day 0 to Day 1), which constituted a period of only some 32 h, a large and highly significant ($P < 0,01$) drop in FSH activity of the anterior pituitary occurred. A low, minimum level for the oestrous cycle was recorded at the late oestrous stage (Day 1). Following this post-ovulatory level, a small but non-significant increase in FSH activity was recorded during the first six days of the luteal period (Day 1 to Day 6). From Day 6 to Day 8 of the cycle, FSH activity increased more rapidly to attain a highly significant ($P < 0,01$) higher value at Day 18 than on Day 1. This rise in pituitary FSH activity continued through pro-oestrus of the next cycle (Day -1) until early oestrus (Day 0).

Relatively low values for pituitary FSH activity were observed in females slaughtered during the period of di-oestrus (Fig.). From early to mid-di-oestrus a decline in FSH activity was recorded, to be followed by a slight increase towards the end of di-oestrus. The mean value for FSH activity of di-oestrus was considerably lower ($P < 0,01$) than the mean value recorded for the oestrous cycle. The levels of pituitary FSH activity during di-oestrus resembled those of the second half of the luteal period, but were considerably lower than the levels recorded around the occurrence of oestrus (Fig.).

Luteinizing Hormone Activity

Following maximum activity during pro-oestrus (Day -1), a sharp drop ($P < 0,01$) in pituitary LH level was recorded (Fig.). This decrease continued through early oestrus (Day 0) to attain a minimum level for the cycle during late oestrus (Day 1). Following this low level during the immediately post-ovulatory stage of the cycle, a continuous and

highly significant increase ($P < 0,01$) in LH activity was recorded during the whole luteal period (Day 1 to Day 18). This increase was more rapid during the first (Day 1 to Day 6) and last third (Day 12 to Day 18) of the luteal period than during the middle period (Day 6 to Day 12). From the late luteal phase of the cycle (Day 18) until pro-oestrus of the subsequent cycle (Day -1), a further increase in pituitary LH activity was evident to attain a maximum level for the cycle (Fig).

The figure also indicates that pituitary LH activity was maintained at a nearly constant level during the period of di-oestrus. Although small differences in value were found between the levels at various phases of di-oestrus, a slight tendency to increase on the part of LH activity was noticed as di-oestrus advanced. Pituitary LH levels during di-oestrus were comparable to those of cycling females during the mid-luteal phase (Day 12).

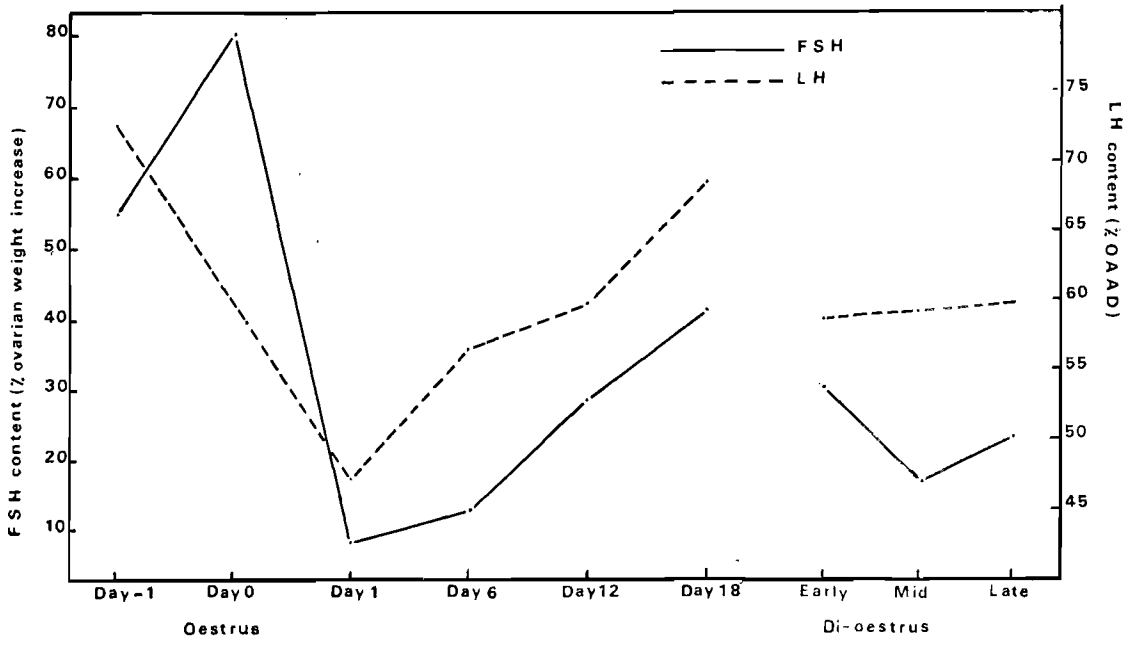
DISCUSSION

The rapid decrease in both FSH and LH activity of the anterior pituitary some time immediately prior to the onset and end of behavioural oestrus seemed to indicate that FSH as well as LH played an active part in the induction of oestrus and ovulation in the cycling Angora goat. These rapid changes in gonadotrophin levels presumably indicated a massive release of both these hormones from the pituitary during a period of only a few hours. It did not, however, exclude the possibility that these sudden changes in pituitary gonadotrophin activity might be superimposed on a background of a steady release of one or of both these hormones during the cycle, as a continuous increase in both FSH and LH activity was recorded during the inter-oestrus period of the cycle.

The cyclic changes in the ovarian follicular system of the Angora goat reported earlier on by Pretorius[12] fit in well with the presently recorded changes in pituitary gonadotrophin activity. The increase in pituitary gonadotrophin activity during the luteal period was accompanied by considerable ovarian follicular growth, which reached a maximum towards pro-oestrus, to be followed by ovulation. These observations in the Angora goat concur with the fairly well established cyclic variation in pituitary gonadotrophin content in other species of domestic animal. Some differences in the time sequence of release, however, do seem to occur[2, 11, 15, 16, 18].

The release of FSH and LH from the pituitary did not seem to be synchronous in the Angora goat. A decline in LH was evident some time before that recorded for FSH. A de-

Fig. Pituitary gonadotrophic hormone activity in the normally cycling Angora goat.



crease in LH activity was already noticed at pro-oestrus, whilst an increase in FSH activity still occurred at that stage. A dramatic release of FSH did not seem to occur until commencement of oestrus. Differences in the times at which pituitary gonadotrophins are released were also reported in sheep by Robertson & Hutchinson [16] and by Robertson & Rakha [17]. In these studies, FSH was released a few hours before LH. The difference in results of the present study and the accepted time sequence in release of FSH and LH in other animal species could be explained on the basis that some of our experimental goats might have experienced a relatively short period of pro-oestrus and that they were very close to, or actually in oestrus, when killed. According to Marincowitz [5], pro-oestrus lasts for an average period of 1,6 h in the Angora goat, but may vary from 0 to 8 hours. If this were the case, it might be inferred that the release of both FSH and LH occurred approximately simultaneously. Nevertheless, the possibility that an early release of LH from the pituitary might be a normal feature in the Angora goat cannot be excluded and could possibly be related to the phenomenon of cystic ovarian follicles in the doe reported by van Rensburg [22] and by Pretorius & van der Westhuizen [14]. Luteinization seemed to have commenced before ovulation occurred.

Pituitary gonadotrophin levels in the anoestrous goat equalled those recorded during the second half of the luteal period in the cycling female. Ovarian follicular activity, however, was considerably less during di-oestrus than during the late luteal stages of the oestrous cycle [12]. Nevertheless, large individual follicles were present in the ovaries of di-oestrous females. It appears that only enough gonadotrophin is released by the pituitary to maintain the size of the larger follicles, while the smaller ones undergo atresia. These observations are in agreement with those of Robertson & Hutchinson [16] in sheep. On the other hand, Warwick [24] and Lamond, Radford & Wallace [3] did not observe differences in pituitary gonadotrophin content between the breeding and non-breeding season in sheep. Kammlade *et al* [2] reported even higher pituitary gonadotrophin values in sheep during di-oestrus period compared to the breeding season.

It thus appears that the synergistic action of both FSH and LH from the pituitary is responsible for the cyclic ovarian changes in the Angora doe and ultimately leads to oestrus and ovulation.

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GAME CASE REPORTS WILDGEVALVERSLAE

MYCOBACTERIOSIS IN A BLACK RHINOCEROS (*DICEROS BICORNIS* LINNAEUS 1758)

M. E. KEEP* AND P. A. BASSON**

HISTORY

In early 1967 an old black rhinoceros female in Hluhluwe Game Reserve developed a very large swelling over the caudal part of the left mandibular ramus, which, from a distance, was tentatively diagnosed as a salivary cyst. The swelling subsequently reduced in size until only a small fibrous enlargement could be detected upon close examination. At no time did the condition appear to inconvenience or affect the animal.

During 1968 she was seen to be lame on the left hind leg and she had septic wounds in the groin and perineal region. She was immobilized, the leg was examined and the wounds were treated, and she was released into the veld. The wound healed and the lameness improved, till she walked soundly but limped when running. During this period she had several oestrous cycles; it was noticed that when a bull attempted to mount her prior to mating, her hind legs collapsed under her.

In January 1970, her calf, which still accompanied her, was darted from a moving Land Rover. When the cow was chased, her hind legs collapsed, and she was unable to rise again immediately. Some hours later it was observed that she had risen and had walked away.

MACROSCOPIC EXAMINATION

The cow died on 19th October 1970, and a *post-mortem* examination was commenced two hours after death. Her condition had been noticeably deteriorating for some months prior to death, by which time she was very thin indeed. She had not calved since 1966. Old healed fibrous scars were evident in the groin and perineum. The lips of her vulva were deformed by the contracting cicatrization of old wounds caused by the horns of other rhinos. There was a heavy tick infestation surrounding the mammary glands, and in both axillae. There was generalized, severe subcutaneous oedema and all mucous membranes were anaemic. Blood and spleen smears were examined for protozoa, but none was detected. A large abscess was found in the pelvic cavity and all the lymph nodes draining the area were enlarged. There was, in addition, generalized oedema of the lymph nodes throughout the body. No abnormality was observed when the spinal cord in the lumbosacral region was exposed. The pericardium was thickened and a large amount of pericardial fluid was present. The heart appeared normal. Circumscribed areas of the stomach wall were thinner than normal; it appeared that the serosa and part of the muscular coat had become ulcerated. Apart from the oedematous mesenteric lymph nodes, the whole mesentery was oedematous and therefore greatly thickened. The liver was congested, and had extensive areas of fibrosis at its periphery. The reproductive system was inactive, the ovaries being small and fibrotic and the uterus atrophic. There were multiple abscesses throughout the lungs, varying in diameter from a few millimetres to five centimetres. When opened, some were filled with liquid pus, while others had become organized and calcified. Chronic pleural adhesions were present.

In addition to a normal heavy infestation of nematodes, cestodes and dipterous larvae in the alimentary canal, unidentified nematodes were isolated from the bronchioles.

HISTOPATHOLOGICAL EXAMINATION

Focal disseminated areas of chronic granulomatous reactions were found in the lungs, regional lymph nodes and pleura. They contained multinucleated giant cells and areas of calcification. The Ziehl-Nielsen stain revealed the presence of small numbers of an acid-fast *Mycobacterium* sp. Mucocatarrhal bronchiolitis was also present.

DISCUSSION

Only one free-ranging animal has recently been found to have died naturally from mycobacteriosis. This was an Impala from the Kruger National Park.

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**Division of Veterinary Services, P.O. Grootfontein, South West Africa.

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MYCOTIC INFECTION IN BLUE WILDEBEEST (*CONNOCHAETES TAURINUS* BURCHELL 1823)

M. E. Keep* and P. A. Basson**

HISTORY

During August 1970 large numbers of blue wildebeest calves in the Mkuzi Game Reserve, Northern Zululand, were seen to have skin lesions which appeared to be ringworm. The calves, then about 9 months old, were the only age group affected. They were in poor condition owing to the inferior nutritional state of the grazing at that period. During the following summer rainy season, when the condition of the calves had improved, no visible lesions were apparent.

In late June and early July of 1971, numbers of surplus wildebeest of all ages were captured alive in Mkuzi Game Reserve and retained in pens to await transfer to game ranches. Some of the calves in this group were in poor condition and also had irregular and circular bare areas of the skin on the face, body and legs (Fig.).

One female calf was destroyed and portions of the skin lesions were preserved in 10% buffered formalin. Fresh scrapings from lesions were carefully examined under the microscope for the presence of mange mites without success. Fresh samples of hair and detritus from the skin surface were forwarded to the Veterinary Research Institute at Onderstepoort for examination.

RESULTS

Macroscopical Examination

Lesions on the legs and body were roughly circular and varied in diameter from 2 cm to 7 cm. They were hairless and covered with a thin layer of keratinized, dead epithelial cells. Where this layer had been rubbed off, an underlying hyperaemic surface was present. The lesion was only slightly raised above the normal skin surface. The head lesions, which were frequently more obvious from a distance than the ones on the body and leg, were irregular in outline, often following the facial skin folds.

Histopathological Examination

Mild acanthosis and hyperkeratosis accompanied by loss of hair, localized areas of congestion and very mild perivasculitis in the *stratum papillare* were noticed. Both within and around the hair shafts numerous circular fungal spores were found.

Biological Examination

Both *Microsporon* and *Trichophyton* sp. were isolated and identified.

DISCUSSION

Ringworm is common in small species of wild mammals, but is infrequently encountered in the larger species.

The source of infection in this case is not known, but this population of wildebeest had been able to mix with domestic cattle living on the areas surrounding the game reserve; the latter were frequently affected by *Trichophyton* sp.

The fact that lesions had appeared during successive winters suggests that the infection may be present in the wildebeest all the time, but only shows itself during times of stress, when the grazing, and thus the physical condition of the animals, is at its poorest.

BESNOITIOSIS IN A WARTHOG (*PHACOCHOERUS AETHIOPICUS* CUVIER 1822)

M. E. KEEP* AND P. A. BASSON**

HISTORY

On 17th July, 1970, a male warthog, about twenty months of age, was shot during routine culling operations in Hluhluwe Game Reserve, Zululand. A detailed *post-mortem* examination was carried out soon after death. No abnormal macroscopical pathology was detected, except cysts resembling *Sarcosporidia* in the voluntary muscles. Tissue samples were taken from organs, thoroughly washed, and placed in 10% buffered formalin.

HISTOPATHOLOGICAL EXAMINATION

One mature *Besnoitia* cyst was found in each of the following localities: a small localized area of pneumonitis in the lung, within the interstitium of the testes, in the epididymis, and in one lymph node. No host response was present in the latter three localities, except reticulo-endothelial hyperplasia in the lymph node.

DISCUSSION

As far as the authors can ascertain, this is the first recorded case of besnoitiosis in a warthog. In the Hluhluwe Game Reserve *Besnoitia* cysts can be found commonly on the lining of the cardiovascular system of the blue wildebeest *Connochaetes taurinus* (Burchell, 1823). McCully *et al* described observations on *Besnoitia* cysts in the cardiovascular system of some wild animal species, including the blue wildebeest, impala *Aepyceros melampus* (Lichtenstein, 1812) and the kudu *Tragelaphus strepsiceros* (Pallas, 1766) in the Kruger National Park. Many impala have been examined macroscopically in Zululand for *Besnoitia* cysts, but nothing has been found. Similarly, since the cysts were detected histologically in the warthog, a further twenty members of this species have been examined visually for the presence of the disease, with negative results.

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A TESTICULAR TERATOMA IN A NYALA (*TRAGELAPHUS ANGASI* GRAY, 1848)

M. E. KEEP* AND P. A. BASSON**

HISTORY

An apparently healthy, immature, male nyala of about six months of age was shot during routine game control in the Ndumu Game Reserve in northern Tongaland. Upon examination it was found to have an enormously enlarged scrotum. The animal was otherwise in excellent physical condition (Fig.).

RESULTS

Macroscopical Examination

The entire scrotum which contained one normal and one abnormal testicle measured 19 x 9 x 9 cm, in comparison with the normal scrotum of an nyala of this age which measures about 5 x 4 x 3 cm. It was markedly pendulous with very little suggestion of a constriction or neck. The skin of the scrotum was grossly thickened and the surface epithelium dry and flaking over extensive areas. Dark brown, irregular pigmented patches occurred on the surface.

The affected testicle, which measured 15,5 x 7,0 x 7,5 cm, was hard and lobulated, filling almost the entire scrotum. The tunica vaginalis was not identifiable and the diseased testicle was closely adherent to the fascia and skin of the scrotum. The testicular artery and vein were greatly enlarged Testicular tissue and epididymis could not be differentiated. In longitudinal section the organ appeared to consist of loosely connected, multiple tumours.

The other testicle, including the epididymis, measured 3,5 x 1,5 x 2,0 cm, and was normal in all respects.

Microscopical Examination

A testicular teratoma containing various tissue elements such as ganglion cells, glial cells, epidermis with areas of hyperkeratosis, cartilage, various types of glandular tissue, and suspected ependyma, was diagnosed.

DISCUSSION

In domestic species testicular teratomata are frequently found, especially in young horses, but in free-ranging wild-life they are rarely if ever encountered. The young nyala was in excellent physical condition in spite of the relatively large size of the tumour.

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CASE REPORT GEVALVERSLAG

AN UNUSUAL CASE OF ASCITES IN A PUPPY

C. BUTTON* AND R. C. BARTSCH**

SUMMARY

Ascites in puppies is usually due to hypoproteinaemia of verminous or nutritional origin. The case reported here had an uncommon aetiology, viz., rupture of cysts on malfunctional polycystic kidneys and filling of the peritoneal cavity with partially processed urine.

HISTORY

A 5-months-old Cocker Spaniel bitch had been vaccinated against distemper, hepatitis and leptospirosis, but not dewormed. She had suffered from constipation and haematuria 18 days prior to admission and was presented, with marked ascites, to a practitioner two days before being referred to the Department of Medicine. For one week prior to admission the bitch had had partial anorexia (she would eat meat only), polydypsia and polyuria. She had urinated freely. There was intermittent 'vomition' of a frothy fluid, and the faeces were soft and yellowish.

EXAMINATION

Clinical

Temperature, pulse and respiration were normal. The bitch was alert, but there was a slight posterior ataxia. Visible mucosae were markedly congested, and there was a moderate tonsillitis. The abdomen was markedly distended and tense, and pain was evidenced upon palpation over the kidney areas. Abdominal ballotment suggested the presence of fluid.

Laboratory

i. *URINE ANALYSIS:* S.G. 1,009; pH 6, 0: No casts were seen upon examination of a urinary sediment, and no glucose, bilirubin, protein or ketones were present.

ii. *ASCITIC FLUID:* A sample of slightly cloudy fluid smelling of urine was drawn by sterile paracentesis. The S.G. was 1,001; pH 6,5; glucose 0,25%; protein 30 mg/100 ml, and urea nitrogen content 160 mg/ 100ml.

iii. *HAEMATOLOGY:* Red cell count: 3,28 million/mm^3; packed cel lvolume: 29%; haemoglobin: 10,8 g/100ml; erythrocyte sedimentation rate: 63 mm in 60 min; white cell count: 11 200/mm^3.

iv. Total plasma proteins were 8,2 g/100 ml.

v. Blood urea nitrogen was 112,5 g/100 ml.

DIAGNOSIS

On the basis of the following findings:

1. marked ascites with the ascitic fluid smelling of urine and having a high level of urea nitrogen;
2. a history of polydypsia and polyuria, and low urinary S.G.;
3. generalized congestion of visible mucosae despite moderate anaemia;
4. elevated BUN;
5. pain on palpation over the kidney area;

a provisional diagnosis was made of uraemia with ascites as a result of rupture of cysts on the surface of malfunctional. polycystic kidneys.

The provisional diagnosis was confirmed upon exploratory laparotomy. Both kidneys were hard and had 'knobby' surfaces caused by multiple cysts projecting above the surface. Owing to the hopeless prognosis, the bitch was euthanized with intravenous pentobarbital while under surgical anaesthesia, and was presented for necropsy at once.

NECROPSY

The cadaver was pale. The kidneys were moderately shrunken with pale, whitish cortices approximately 1 cm thick and containing multiple fluid-filled cysts 1—30 mm in diameter. The capsules were much thickened (about 1 mm) and firmly adherent to the cortices. Microscopically, there was a diffuse fibrosis of the cortices and a reduction in the amount of cortex. There was necrosis and calcification of nephrons with many dilated and cystic tubules surrounded by connective tissue.

The bladder wall was oedematous, and there were petechiae on the inner surface.

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Microscopically, there was an infiltration of polymorphonuclear cells into the submucosa.

The brain was normal macroscopically, but microscopically there was a severe meningoencephalitis characterized by perivascular lymphocytic and plasma cell cuffing, and a few scattered foci of gliosis and neuronophagia. Granules seen in the cytoplasm of a few lymphocytes were thought to resemble *Erhlichia canis* parasites in morphology. The significance of these neuropathological findings is not apparent.

There was moderate dystrophic calcification and necrosis of the interstitium and gastric glands of the stomach.

Calcification and necrosis in the bronchiolar mucosa and peri-bronchiolar tissues of the lungs were present.

In short, the necropsy showed uraemia with polycystic kidneys, anaemia, mild cystitis and a meningoencephalitis of undetermined origin. The ascitic fluid had been drawn off during surgery.

PUBLICATIONS — PUBLIKASIES

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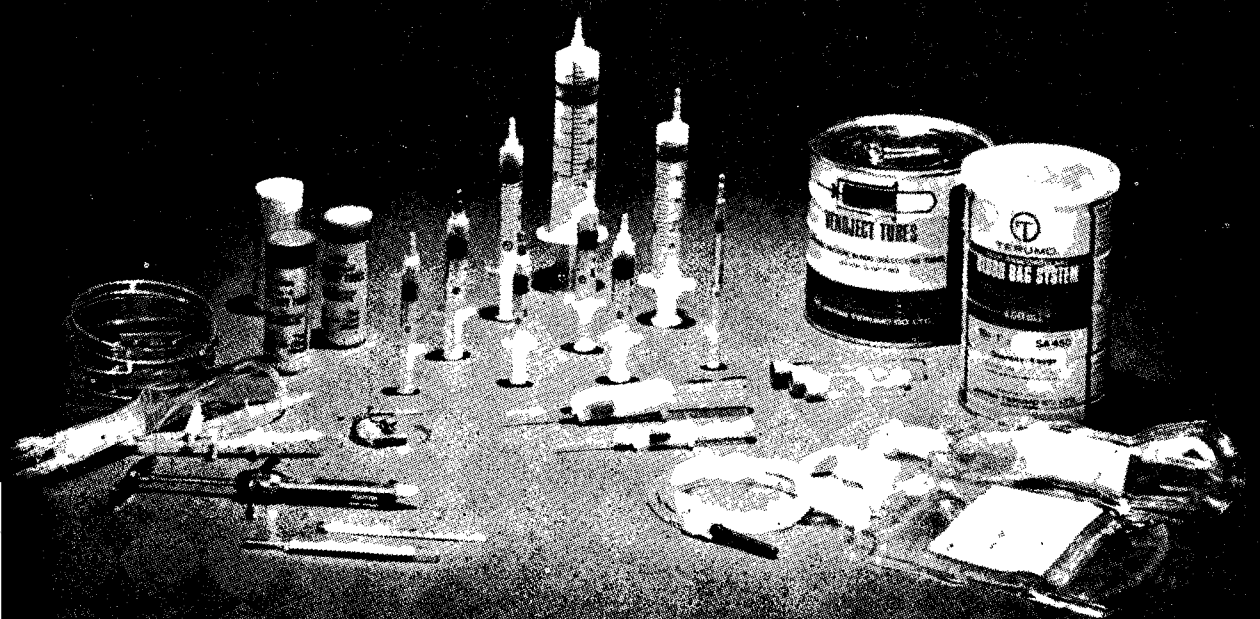

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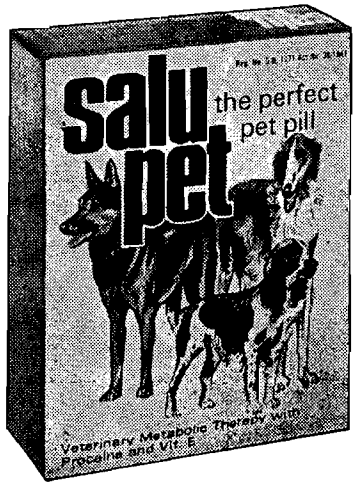

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SURGICAL NOTE CHIRURGIESE AANTEKENING

SURGICAL CORRECTION OF RUPTURE OF THE CRANIAL CRUCIATE LIGAMENT IN THE DOG

G. E. FROST*

SUMMARY

A method is described for surgical correction of a ruptured cranial cruciate ligament in the dog, incorporating principles of two separate procedures regularly employed individually in the surgical treatment of this condition.

INTRODUCTION

Rupture of the cranial cruciate ligament in the dog is a common, well documented clinical entity which inevitably leads to degenerative joint disease and osteoarthritis of the affected joint if left untreated.

This paper covers four cases of rupture of the cranial cruciate ligament operated upon, employing a method which is a combination of two previously described techniques:—

(a) Securing the tendon of the m. extensor digitorum longus in a bony trough in the tibial crest as described by Hohn & Miller [2]. This establishes a new ligament-like structure which serves to stabilize the stifle joint by preventing medial rotation and anterior drawer movement.

(b) Translocation of the distal insertion of the semimembranosus muscle cranially on to the tibia and advancing and attaching the caudal belly of the the sartorius muscle to the patellar ligament and to the lower border of its cranial belly as described by Hohn [1]. This lends further stability to the joint.

SURGICAL TECHNIQUE

After induction and maintenance of anaesthesia with Fluothane (I.C.I.) the dog is secured in lateral recumbency with the affected leg uppermost and suitably draped to facilitate manipulation during surgery.

A cranio-lateral, para-patellar incision is made from a point just proximal to the suprapatellar pouch to approximately 3 cm distal to the tibial tuberosity. The skin and subcutaneous tissues are retracted to expose the lateral patellar retinaculum. The crural fascia is incised along the tibial crest and tuberosity and laterally along the margin of the tibial plateau, to expose the m. tibialis cranialis, which is elevated subperiosteally from the sulcus muscularis of the tibia and the lateral edge of the tibial crest.

The m. tibialis cranialis is retracted to expose the tendon of the m. extensor digitorum longus as it crosses the tibial plateau. This tendon becomes muscular as it passes deep to the m. tibialis cranialis. The tendon is freed to its origin on the lateral condyle of the femur.

The patellar ligament is dissected from the lateral third of the tibial tuberosity and crest and a trough is cut into the tuberosity and crest with an osteotome or bone saw. The tendon of the long digital extensor is then lifted into the trough, making sure that it is seated deeply. The tendon is secured in place by drilling two holes through the tibial crest with Kirschner wire. Steel wire is passed through each hole and back under the patellar ligament. By the tightening of these sutures the trough is collapsed and so grips the tendon tightly.

In this position the tendon closely parallels the original position of the cranial cruciate ligament. It now restricts cranial drawer motion and rotation of the stifle joint.

The cranio-medial aspect of the joint can be stabilized even further by the following procedure:—

The patient is repositioned to allow surgery to the medial aspect of the joint. By medial retraction the original incision easily allows the exposure of the medial retinaculum and the distal attachments of the cranial and caudal bellies of the sartorius muscle.

The proximal three quarters of the insertion of the caudal sartorius muscle is cut and the muscle retracted, exposing the caudal tendinous insertion of the semimembranosus muscle on the medial condyle of the tibia

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under the medial collateral ligament of the stifle. The tendon is cut at its attachment and is reattached more cranially to the tibial end of the medial collateral ligament with No. 0 chromic catgut. Contraction of this muscle will now help to prevent anterior drawer motion, especially when the joint is extended in weight bearing.

With the joint in moderate extension the caudal sartorius component is also moved cranially and sutured to the patellar ligament and to the cranial belly of the sartorius muscle with No. 0 catgut. This will lend further stability to the joint. The subcutis and skin are closed in the usual fashion.

The animal is hospitalized for one week and thereafter restricted to light exercise only for a further two weeks.

RESULTS AND CONCLUSIONS

By using the above technique maximum stabilization of the joint is achieved. As both the technique of translocation of the long digital extensor and caudal capsulorrhaphy give good long term results it is felt that the combined operation has merit.

The four cases reported on responded well to the surgical treatment described. Immediately post-operatively, cranial drawer motion can still be elicited in the joint, but as the relocated tendon becomes shortened and stabilized in the bone trough and the muscles rehabilitate, the joint itself stabilizes. After six weeks, three of the animals were clinically normal. The fourth, a ten year old obese Retriever bitch, still favoured the sound leg slightly, but this animal had sustained the ruptured ligament six months previously and arthritic changes were present in the joint at the time of surgery. The owner nevertheless reported that the animal was once again running around and playing, something she had not done since the original injury.

One advantage of caudal capsulorrhaphy which warrants mention is that the medial aspect of the joint can be inspected more clearly for rupture of the medial meniscus. Medial meniscectomy is essential if the meniscus is torn, as cartilage injuries of this type cause painful synovitis and eventually lead to arthritic changes. Nevertheless, rupture of the cranial cruciate ligament is most commonly due to degeneration of the ligament, and when rupture occurs as a result of mild stresses on the ligament, the animal is immediately inclined to favour the affected leg, so that the meniscus is not invariably traumatized extensively. Roush, Hohn & DeAngelis[3], in evaluating translocation of the long digital extensor in 100 joints treated in 92 dogs, found meniscal damage in 11 joints only. If rupture is due to severe traumatic forces, such as motor accidents, it is more likely that the caudal horn of the medial meniscus, being attached caudally to the tibia and caudal aspect of the joint capsule, will become trapped and lacerated between femur and tibia as the tibia is moved forward forcibly.

ACKNOWLEDGEMENT

The assistance received from Professor C.F.B. Hofmeyr is gratefully acknowledged.

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3. ROUSH JAMES C. II, HOHN R. B. & DE-ANGELIS M. 1970 Evaluation of transplantation of the long digital extensor tendon for correction of anterior cruciate ligament rupture in dogs. *J. Am. vet. med. Ass.* 156 : 309

THE VETERINARY ANNUAL 1972

C. S. G. GRUNSELL AND F. W. J. HILL (EDS)

John Wright, Bristol. 1972. Thirteenth Year. Pp XVI+377; Figs 74. S.A. Price R11.00

After having reviewed The Veterinary Annual for so many succesive years, I am convinced that this edition is again successful in providing for the needs and demands of the busy general practitioner who is unable to cope with the large volume of current literature. A particularly wide coverage is provided of the latest developments in the various fields of practice—more subjects are covered in a shorter form than before. The material is subdivided on a species basis and liberally illustrated. A separate section deals with clinical diagnostic techniques and laboratory medicine. The book contains more than thirty articles on small animal medicine and surgery while the reviews in the field of Animal Husbandry, Parasitology and Reproductive Diseases concern mainly farm animals. To those veterinarians engaged in game conservation the comprehensive article on 'The Use of Drugs for Immobilization, Capture, and Translocation of Non-domestic Animals' will be of particular interest.

B. C. J.

DIAGNOSTIC PROCEDURES IN VETERINARY MICROBIOLOGY

G. R. CARTER

Charles C. Thomas, Springfield, Illinois. 2nd Edition, March 1973. Pp. VIII+ 362; Figs. 68 (2 colour); Tabs 55. Publ. Price approx. R16,95

When this book was first published in 1967, it appeared under the title *Diagnostic Procedures in Veterinary Bacteriology and Mycology* in a hard cover format. It fulfilled a real need in that it brought together in one tome almost all the microbiological techniques used in veterinary diagnostic laboratories. The particular usefulness of this manual lay in its emphasis on simplicity and practicality in all the procedures discussed. The second edition has retained this clarity of presentation, although it has been extensively revised and rearranged. It now appears in a ring-backed laboratory manual format.

A particularly gratifying revision is that of classification and nomenclature, which now follows that of the 7th Edition of *Bergey's Manual* with a few modifications in line with newer knowledge. The use of outdated nomenclature was an irritating feature of the previous edition.

The selection and submission of clinical specimens have been given more prominence than in the original volume, and are discussed in greater detail. Of particular note is a useful table summarizing the routine culture procedures used for different specimens. A list of pathogens and potential pathogens associated with the various organs of each domestic animal is another very useful innovation.

There are considerably more photographs than in the first edition, including two colour plates. Chapter 27, *Mycology: Introduction*, chapter 33, *Bovine Mastitis* and chapter 34, *Antimicrobial agents & susceptibility tests* have been rewritten by H.A. McAllister; and chapter 23, *Spirochaetes*, by T.R. Cole.

The extremely useful section on *Bacteriology for the Practising Veterinarian*, a feature of the first edition, has been retained and supplemented with a table listing simple procedures which aid in the diagnosis of various bacterial and fungal diseases.

In all, this book is essential in any veterinary diagnostic laboratory where microbiology is investigated and is highly recommended as a manual or textbook for veterinary technicians. It should also be of interest to practitioners who might wish to undertake a limited number of microbiological diagnostic procedures.

C. M. E. McC.

Trivetrin*

An advance on the antibiotics

"Trivetrin" is indicated in a wide range of infections caused by both Gram-negative and Gram-positive bacteria. It is particularly valuable for the treatment of infections of the respiratory, urogenital and alimentary tracts.

Respiratory tract
Bronchitis, empyema, lung abscess, lobar and broncho-pneumonia, tonsillitis, pharyngitis.

Urogenital tract
Metritis, pyelitis, urethritis, cystitis, pyelonephritis.

Alimentary tract
Gastritis, enteritis, haemorrhagic gastro-enteritis, peritonitis.

General infections
Septicaemias, especially those due to "problem" organisms resistant to other antibacterial agents. Also wound infections.

Spectrum of activity

Organism	Relative in vitro sensitivity to Trivetrin
Escherichia coli Clostridia spp. Shigella spp. Salmonella spp. Proteus mirabilis Bacillus anthracis Pasteurella spp. Haemophilus influenzae Vibrio spp. Streptococcus zooepidemicus	Very Sensitive
Streptococci viridans Brucella spp. Enterococci Staphylococcus aureus Klebsiella spp. Proteus spp Actinomyces Corynebacterium spp. Bordetella spp. Neisseria spp.	Sensitive
Pseudomonas aeruginosa* Mycobacterium tuberculosis Leptospira spp. Erysipelothrix rhusiopathiae	Resistant

Jl S. Afr. vet. Ass. 44 (3): 299—300 1973

TECHNICAL NOTE TEGNIESE AANTEKENING

A JUGULAR VEIN COMPRESSOR FOR USE IN BOVINE PRACTICE

R. EVERY*

SUMMARY

A new instrument for compression of the jugular veins of cattle is described. The manner in which it is applied is discussed, and the advantages which its use presents over other existing methods are noted.

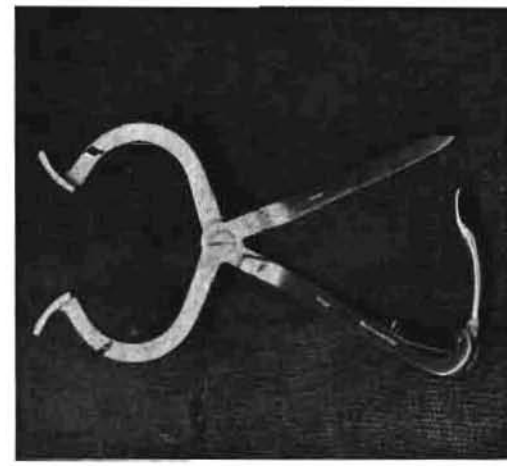
INTRODUCTION

Jugular venipuncture in the bovine species presents its own peculiar problems. These become only too apparent when one's assistants are unskilled and when one is dealing with an animal with a well developed neck and thick skin. The jugular veins of cattle are usually distended by applying pressure over the jugular furrow with the thumb, hand or fist, or by partially occluding the veins by pulling taut some type of noose applied around the animal's neck. Both of these methods involve the use of an assistant in the relatively simple task of distending the vein required, when he could be employed more profitably in restraining the animal.

The jugular compressor** described in this note has been in use at the München Veterinary School (West Germany) for some time and the author has been using it in his practice for the last two years. It can be applied to animals of all ages, but has proved most successful in the case of calves and cows. It is not always possible to use it on bulls with very thick necks. Nevertheless, it has proved of such value that it is considered an indispensable part of a veterinarian's equipment.

DESCRIPTION

The jugular compressor is shown in the accompanying photograph. Basically, it has the form of a pair of tongs, the long handles of which are fitted with a ratchet and spring, permitting one to lock it when the correct degree of compression of the veins is produced. The jaws of the device terminate in two flat, serrated plates. These fit snugly into the jugular grooves on either side of the neck, the serrations serving to prevent the instrument from slipping out of place. The particular instrument used by the author is ruggedly constructed of stainless steel and has proved easy to maintain in first class condition.



APPLICATION

The instrument is applied over the trachea as shown in the second photograph. The best point of application was found to be in the region of the upper third or half of the neck. As shown in the photograph, this provides the operator with an area of well-distended vein which is more than adequate for venipuncture. The instrument is applied with the curvature of the handles directed backwards and the necessary degree of tension is attained by gently closing the handles over the spring rachet. In most animals, light pressure only is sufficent to distend the vein adequately.

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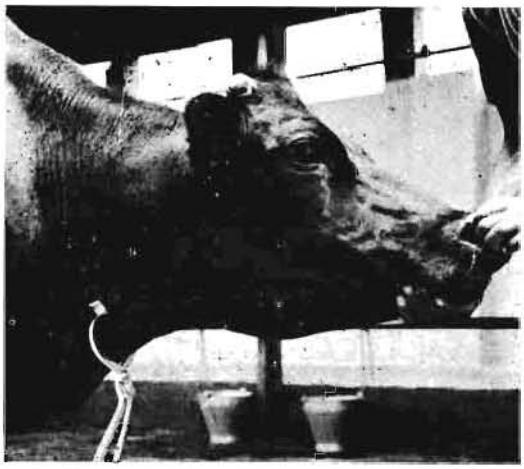
**H. Hauptner, Solingen.



ADVANTAGES

As shown in the second photograph, the assistant is free to devote his entire attention to restraining the animal. The operator is likewise free to devote his attention to the job in hand. Since the jaws of the device fit loosely over the trachea of the animal, it is completely free from any distressing feelings of suffocation such as are produced by a tight noose. It is consequently more amenable to handling. Since the jaws of the instrument are locked in place by the ratchet, the desired degree of tension is maintained throughout the operation and the vein remains distended after any movements that the animal may make with its head or neck. The instrument does not usually slip, but remains firmly lodged at the point of application in the jugular groove, despite the usual head and neck movements of the animal in this type of work. In the case of animals with well-developed necks and in which the jugular furrow is not well defined, it sometimes slips, but usually remains in position on re-application. As mentioned earlier, it is sometimes impossible to apply the device to bulls with very thick necks. The necessity of having continually to adjust a distending device such as a rope noose, is entirely eliminated by this instrument.

The greater freedom of operation in performing venipuncture and the increased tranquillity of the animal during this work are the most outstanding advantages which the use of this instrument has to offer. It proves its value in no uncertain manner when one has to bleed a large number of animals for brucellosis tests, for instance. The author has no hesitation in commending this device to his colleagues.

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VAN RENSBURG S. W. J. 1972 Observations of veterinary interest during a visit to Western Germany. *Jl S. Afr. vet. Ass.* 43 : 141

SERIAL PUBLICATIONS — PUBLIKASIEREEKSE

BERLINER UND MÜNCHENER TIERÄRZTLICHE WOCHENSCHRIFT

This well-known periodical, one of the fore-most veterinary journals in Germany, now in its 86th year of publication, appears bi-monthly, and contains original papers in German, with English summary, numerous abstracts classified according to subject matter, book reviews, reports of meetings, reports on occurrence of infectious diseases in Western Germany, information briefs and news from the veterinary faculties of Western German universities. Foreign subscription DM 28 plus postage. **Editor:** Prof. dr. J. Boch, 8 München 40, Leopoldstr. 5. **Publishers:** Paul Parey, 1 Berlin 61 (West), Lindenstr. 44—47.

Jl S. Afr. vet. Ass. (3): 301—313 1973

INFORMATION INLIGTING

EXCERPTS FROM
LANDBOUNUUS / AGRICULTURAL NEWS

OFFICIAL NEWSLETTERS OF THE DEPARTMENTS OF AGRICULTURAL TECHNICAL SERVICES AND AGRICULTURAL ECONOMICS AND MARKETING

Published by: Dept. Agricultural Technical Services, Pretoria

PASTURE SYSTEM PROVIDES PROTEIN FOR DAIRY COWS

Results of a study by the Ohio Agricultural Research and Development Center, Wooster, proved that top grazing can be used successfully to supply total protein needs of high producing dairy cows during summer months.

Alfalfa overseeded with ladino clover has proved to be the most productive in a short-term paddock system. Using a combination of rotation and strip-grazing, cows were allowed to graze the 0,6 ha plot for 3 to 4 days, or until the forage was 20 to 25 cm high. Approximately 23 days were allowed for regrowth before the cows were again turned into graze.

Since bloat is common among cows on legume pastures, poloxalene (a bloat-preventing surfactant) was added to the concentrate ration at the rate of 10 to 20 g per head per day. Bloat was not a problem and cows grazing the paddocks produced comparably to control cows fed entirely in the barn. All cows received 40 per cent of their total dry matter from in-stall feeding of corn silage and grain.

Highest milk yield achieved for an individual cow on the pasture trials was 44,5 kg per day.

Slightly more than 726 kg of protein, valued at an estimated $175, were consumed from each acre grazed. This is probably the most economical system for harvesting this amount of protein from forages.

(1972 No. 46 p. 8)

GOUSIEKTEBOSSIE KAN MOONTLIK MET SKAPE BEHEER WORD

Waarnemings op die proefplaas Zwartrand in Wes-Transvaal toon dat as die gousiektebossie kort bewei word, hergroei baie stadig plaasvind. Skape neig om die plant baie straf te wei en dit kan 'n hulpmiddel wees in die uitroeiing daarvan.

Proewe het getoon dat vergiftiging plaasvind wanneer skape die veld na willekeur bewei, maar nie wanneer gesonde veldbestuur toegepas word nie. Wanneer min skape op 'n groot oppervlakte wei, kan die diere wat die gousiektebossie verkies in 'n betreklike kort tyd genoeg daarvan vreet om vergiftiging op te doen. Dit is egter nie moontlik as beweiding beheer word nie.

Gedurende die plant se vroeë groeistadium (November tot Desember) word dit net by geleentheid deur beeste gevreet en meestal wanneer dit verstrengel is met smaaklike grasse. In die herfs wanneer die gras minder smaaklik word, word die gousiektebossie doelbewus deur die diere gevreet.

Oordeelkundige beweiding gedurende die lente kan derhalwe die volume van die gifplant tot so 'n mate verminder dat minder vergiftiging in die herfs plaasvind.

Daar is verder bevind dat onkruidmiddels wat fenac as aktiewe bestanddeel bevat, die plant doeltreffend beheer en sommige boere het reeds begin om swaar besmette veld met onkruidmiddels te bespuit. Volgens dié boere oorskry die koste nie twee rand per hektaar nie.

(1972 Nr. 46 p. 7)

VACCINE PRODUCTION AT ONDERSTEPOORT

The Veterinary Research Institute at Onderstepoort has issued more than 128 million doses of vaccine during the past year. This is about 14 per cent more than in the previous year. Two new vaccines were produced — one against rabies in cats and the other for infectious bronchitis in poultry.

Altogether 32 different vaccines are now being prepared at Onderstepoort. The increase in the number of doses is attributed to

outbreaks of Newcastle disease, chicken pox, quarter-evil and lung sickness.

The demand for vaccine against rabies in dogs has more than doubled. The demand for brucellosis vaccine has also increased and is regarded as proof of the progress that is being made in the scheme to stamp out this disease. (1972 No. 47 p. 4)

VERLOOP VAN VLEISVERBRUIK

Volgens die Afdeling Landboubemarkingsnavorsing se jongste Kortbegrip van Landboustatistiek het die totale verbruik van bees- en kalfsvleis in die Republiek in 1971/72 na skatting 565 700 t beloop, vergeleke met 560 900 t in 1970/71 en 532 800 t in 1969/70.

Die per kapita-verbruik van bees- en kalfsvleis het egter betreklik konstant gebly gedurende die afgelope drie jaar. In 1971/72 het dit na raming op 25,2 kg te staan gekom, vergeleke met 25,7 kg in 1970/71 en 25,2 kg in 1969/70.

Tien jaar gelede (1961/62) was die totale verbruik 491 200 t en die per kapita-verbruik 29,6 kg.

In 1971/72 is daar in totaal na skatting 200 300 t skaap- en bokvleis in die Republiek verbruik, teenoor 219 900 t in 1970/71 en 210 600 t in 1969/70.

Die per kapita-verbruik het onderskeidelik 8,9 kg, 10,1 kg en 10,0 kg beloop.

In 1961/62 het die totale verbruik en die per kapita-verbruik op onderskeidelik 152 200 t en 9,2 kg te staan gekom.

Na skatting is daar 78 800 t varkvleis in 1971/72 verbruik, vergeleke met 79 800 t in 1970/71 en 77 400 t in 1969/70.

Die per kapita-verbruik was onderskeidelik 3,5 kg, 3,7 kg en 3,7 kg.

In 1961/62 was die totale verbruik en die per kapita-verbruik onderskeidelik 52 400 t en 3,2 kg.
(1973 Nr. 2 p. 4)

NUWE BRONNE VAN PROTEÏENVOEDING WORD ONDERSOEK

Die Navorsingsinstituut vir Vee- en Suiwelkunde stel tans ondersoek in na die verbetering van bestaande proteïenbronne en die daarstelling van nuwe bronne vir dierevoeding. Die ondersoek word as uiters belangrik beskou in die lig van die wêreldwye verandering wat in verband met vismeelvoorrade ingetree het.

In die verlede kon die Republiek nog altyd sterk steun op vismeel wat die proteïenverskaffing in dierevoeding betref. Oor die afgelope twee jaar was daar egter aanduid-

ings dat die toestand kan verander totdat die vismeelposisie verlede jaar wêreldwyd verswak het. Dit het veevoervervaardigers onverwags oorval. Die internasionale vraag na vismeel het verlede jaar opgeskiet en die prys na R300 per ton gestyg nadat die vangste in Peru in duie gestort het. In die Republiek is die binnelandse pryse aan die einde van verlede jaar tot R150 per ton verhoog.

Weens die bevolkingsaanwas neem die vraag na vis wêreldwyd toe en dit word oorweeg om ru-vismeel te verwerk vir regstreekse gebruik deur die mens in plaas daarvan dat dit eers deur die dier gestuur hoef te word.

Naas vismeel as 'n bron van proteïen word daar tans in dierevoeding gebruik gemaak van veral grondbone-, sonneblom-, katoensaad- en mieliekiemoliekoek en op 'n klein skaal ook van karkas- en bloedmeel. Die produksie van die bestaande oliekoeke het egter nie die afgelope paar jaar na wense gestyg nie en veevoervervaardigers het derhalwe na nuwe proteïenryke voedselsoorte begin soek.

In 'n poging om nuwe bronne van proteïen te vind is veral in Engeland en Frankryk reeds aansienlike vordering gemaak met die vervaardiging van gisprodukte uit die afval van olieraffinaderye. Volgens berekening bestaan daar genoeg potensiële olie om 20 miljoen ton proteïen per jaar te maak. Prosesse word ook ontwikkel om proteïen te vervaardig van metaan wat voorkom in natuurlike gasse.

Petroleumgis is al volledig getoets in voermengsels van pluimvee en varke. Die toetse op nie-herkouers was so geslaagd dat petroleumgis al gebruik word om vismeel in sodanige veevoere te vervang. Probleme word nog met produksie en prys ondervind, maar dit sal hopelik te bowe gekom word.

In Durban word al jare 'n gisproduk van suikerriet-afval gemaak wat al op klein skaal in sowel dierlike as menslike voeding gebruik word, maar die prys is nog steeds te hoog om met bestaande proteïenprodukte te wedywer.

Prosesse en toerusting word ook ondersoek om hoender- en ander mis ekonomies te droog vir gebruik in veevoermengsels.

Wat plantaardige proteïenprodukte betref skyn die sojaboon die beste moontlikhede in te hou om vismeel in veevoere te vervang. Sojameel, hoofsaaklik ontvet, word vandag op groot skaal in dierevoedsel in die V.S.A. en ook in Europa gebruik. In die V.S.A. word oor die 60 persent van die proteïensupplemente in veevoere deur soja verskaf.

In dierevoeding word daar ook nou aandag gegee aan die gebruik van soja in die volvet-vorm. Duur en omslagtige olieverwydering word sodoende uitgeskakel en die olie word behou as 'n gekonsentreerde energiebron. Soja kan egter nie rou aan diere gevoer word nie omdat dit sekere antigroeifaktore bevat. Dié faktore word deur hitte vernietig en daar bestaan reeds sekere grootskaalse toerusting vir die doel, maar die aanwending daarvan is nog duur. Gevolglik word aandag aan die ontwikkeling van goedkoper toerusting geskenk.

'n Aansienlike hoeveelheid werk is reeds oorsee gedoen om die waarde van verwerkte volvet-soja vir verskillende diersoorte te bepaal. Op grond van bevindings skyn dit of soja ook tot groot voordeel in veevoere in die Republiek aangewend kan word.

Die moontlike styging in die verbruik van sojabone kan van groot betekenis vir sojaboonprodusente in die Republiek wees. Op die oomblik is die sojaboonvoorrade gering en pryse het reeds skerp gestyg. Na verwagting sal die vraag na sojabone vanjaar reeds 'n miljoen sak van 50 kg beloop.
(1973 Nr. 4 p. 2)

TOETSVERSLAE OOR MELKMASJIENE BESKIKBAAR

Die Departement van Landbou-tegniese Dienste se toetsverslae oor melkmasjiene, ruimskoots geillustreer met foto's en tekeninge, verskyn in die Januarie-uitgawe van Boerdery in Suid-Afrika. Die vyf fabrikate van melkmasjiene waaroor die Afdeling Landbou-ingenieurswese verslag doen is Alfa-Laval, Bou-Matic, Fullwood, Milkrite en Surg-Melotte.

In 'n artikel wat saam met die toetsverslae gaan en gegrond is op beamptes se bevindings tydens die toetse en hulle besoeke aan melkmasjiengebruikers word nie alleen die vinger gelê op die lokvalle en leemtes wat so maklik by melkmasjienstelsels kan ontstaan nie, maar praktiese oplossing en nuttige wenke word in duidelike taal aangegee. Aandag word ook aan die verskillende stelsels gegee met 'n benaderde koste-aanduiding van elke stelsel.

In die loop van die veldopname in samewerking met 72 boere het dit ook aan die lig gekom dat die organisering van die arbeidsproses nog groot ruimte vir verbetering laat. Daar is boere teëgekom wat soveel as 25 koeie per man-uur melk terwyl ander boere, met dieselfde stelsel, selfs minder as 10 koeie

per man-uur melk. Indien in aanmerking geneem word dat die koste van meganiese melking uit arbeidsbesparings gedelg moet word, hou hierdie bevinding ernstige bedreigings in vir die betrokke ondernemings.

Tydens die laboratoriumtoetse het elke melkmasjien vir 'n aaneenlopende periode van 4 400 werkure geloop. Dit verteenwoordig sowat 3 jaar se werk vir nagenoeg 4 uur per dag. Gedurende die toetsperiode is belangrike waarnemings gemaak soos bv. olieverbruik van die vakuumpompe, konstantheid van pulsasie, doeltreffende werking van die uitskeier en menige belangrike onderhoudsdienste wat elke onderdeel vereis.

Hierdie onderhoudsdienste word breedvoerig in elke verslag aangegee. 'n Belangrike onderdeel soos die pulsator het bv. in die toetsperiode die speenhulse elkeen nagenoeg 13 miljoen keer laat saamtrek en die melkpomp het ruim 'n ½ miljoen keer aan- en afgeskakel.

Die deelnemende firmas het die toetsbevindings met die nodige erns bejeën en deur hul welwillende samewerking is reeds van die leemtes wat aan die lig gekom het, reggestel. Sodoende is die gehalte van die masjiene reeds noemenswaardig verhoog.

Herdrukke van die toetsverslae kan gratis by streek- of voorligtingskantore of van die Direkteur, Afdeling Landbou-ingenieurswese, Privaatsak X515, Silverton, verkry word.
(1973 Nr. 4 p. 5)

ABATTOIRS EXPENSIVE UNDERTAKINGS

The Abbattoir Commission says in its report for the year ended 30 June 1972 that it had, since its establishment on 1 November 1967 until 30 June 1971, given approval to 24 local authorities for the erection of new abattoirs in uncontrolled areas.

At the end of the year under review, two of these abattoirs were completed and in use while some of the abattoirs were in the process of being planned or erected.

Because of rising costs and the required better facilities to meet standards of hygiene now prescribed, abattoirs have become expensive undertakings. Some of the local authorities, when the estimated costs of the undertakings became known, became hesitant to proceed with the projects because, according to their views, the financial risk is too great to invest large sums of money without the assurance that the abattoirs will always be utilized economically.

During the year under review, approval was given to a further 13 local authorities and 13 private bodies to erect new abattoirs, mainly to replace existing obsolete slaughter facilities

One application for the erection of a public abattoir and 5 applications from private bodies were refused by the Commission. Three of the private bodies lodged objections against the decisions of the Commission of which two were upheld by the Minister. In the other case the Minister confirmed the Commission's decision.

Fifteen applications by local authorities for the erection of public abattoirs and 24 applications by private bodies were received during the year. Of these, 5 public and 9 private abattoirs were approved during the year while the remaining applications were still under consideration at the end of the year under review.
(1973 No. 5 p. 7)

JONGSTE RAMING VAN VEEGETALLE

Die Afdeling Landboubemarkingsnavorsing se jongste raming van veegetalle in Blankegebiede in die Republiek is soos volg:

1000

	Kaapprovinsie	O.V.S.	Natal	Transvaal	Totaal
Beeste:					
Nov. 1972	2 075	1 751	1 378	3 107	8 311
Aug. 1972	2 010	1 699	1 305	3 028	8 042
Skape:					
Nov. 1972	17 469	8 030	1 464	3 480	30 443
Aug. 1972	17 249	7 914	1 481	3 493	30 137
Bokke:,					
Nov. 1972	2 005	82	148	323	2 558
Aug. 1972	1 891	81	139	313	2 424
Varke:					
Nov. 1972	286	160	150	411	1 007
Aug. 1972	285	155	144	387	971

(1973 Nr. 6 p. 1)

GOUSIEKTE KAN MET VELDBESTUUR BEHEER WORD

Navorsing wat deur die Departement van Landbou-tegniese Dienste gedoen is, het getoon dat vergiftiging deur die gousiektebossie feitlik voorkom kan word deur die toepassing van goeie veldbeheerstelsels.

Na aanleiding van veevrektes in die omgewing van Derby en Koster in Wes-Transaal het 'n opname in die streek getoon dat vrektes as gevolg van gousiektevergiftiging minimaal is op plase met meer as drie kampe per kudde. Die grootste uitbreke van gousiekte het onlangs op plase voorgekom waar daar weens beweerde waterskaarste nie behoorlike veldbeheer toegepas kon word nie.

Daar is ook vasgestel dat die gousiektebossie feitlik permanent uitgeroei kan word met onkruiddoders wat Fenac bevat. Goeie resultate is behaal met besonder lae konsentrasie van die spuitstof. 'n Kwaai styging in die prys van die spuitstof en die feit dat voorrade skaars is, bemoeilik egter nou die chemiese beheer van die gousiektebossie.

Boere wie se veld erg besmet is en wat van die spuitstof in die hande kan kry, word aangeraai om gedurende Februarie en Maart te spuit. Die uitwerking van die onkruiddoder is baie beter as die plante blaarryk is, want dan is die opname van die gifstof doeltreffender. Dit sal dus nie baat om plante te bespuit wat reeds grotendeels afgevreet is nie.

Dit is ook van belang dat die regte konsentrasie van die spuitstof aangewend word. As die konsentrasie te hoog is, brand dit die blare en die spuitstof kan nie behoorlik opgeneem word nie. Is die konsentrasie te laag kan die spuitstof nie die wortels dood nie.

Onkruiddoders is duur en heelwat daarvan is normaalweg nodig om onkruide te bestry. Dit is dus gewoonlik 'n duur proses om gifplante met die middels uit te roei. Gelukkig is die gousiektebossie geneig om kol-kol te groei en min spuitstof per hektaar is dus nodig as bespuiting korrek uitgevoer word.
(1973 Nr. 6 p. 4)

WERK AAN SLAGPLASE VORDER GOED

Die Voorsitter van die Abattoirkommissie, Mnr. M. J. Jamneck, sê goeie vordering word gemaak met die verbetering en uitbreiding van slaggeriewe in beheerde gebiede. Uitbreidings en verbeterings aan bestaande abattoirs behoort in die meeste gevalle vanjaar voltooi te wees.

Die verbeteringsprogram aan die Oos-Rand geskied teen 'n koste van R700 000 per abattoir. Na verwagting sal die werk aan die Germistonse slagplaas teen Maart vanjaar voltooi wees; die aan die slagplaas op Springs binne 15 maande en die van Benoni in die loop van 1973.

Die verbeteringsprogram aan die Durbanse abattoir wat teen 'n koste van R700 000 aangepak is, sal na verwagting in Julie vanjaar afgehandel word. Ondertussen nader die beplanning van die nuwe Johannesburgse abattoir voltooiing.

Die Pretoriase Munisipaltieit sal nagenoeg R800 000 bestee aan die uitbreiding en verbetering van die slagplaas wat teen Julie vanjaar die verhoogde deurset behoort te kan hanteer.

Die Munisipaliteit van Krugersdorp het die beplanningsfase van sy nuwe slagplaas afgehandel en bouwerk sal na verwagting vanjaar begin.

Wat die oprigting van slagplase deur privaat-instansies in die Pretoria/Johannesburg-omgewing betref sê mnr. Jamneck dat die bou van twee slagplase waarskynlik binnekort sal begin. Wanneer al die privaatabattoirs eers opgerig is, sal dit in 'n kwart van die geraamde behoeftes aan beeste wat teen 1981 in die gebied ondervind sal word kan voorsien.
(1973 Nr. 6 p. 7)

MILK CAPACITY OF COW IMPORTANT DURING LACTATION

For every kilogram increase in body mass a calf requires 8 kilograms of milk.

A study on Bonsmaras has shown that the cow yields 5,75 kg of milk per day on average. The lactation graph of the Bonsmaras showed an average of 8 kg of milk for the first 60 days and thereafter a gradual decline to 3 kg per day after 210 days.

The growth of the calf followed a similar graph. Noticeable differences in milk production between cows were reflected in the mass of the calf. This can be shown by performance testing.
(1973 No. 8 p. 8)

VERBOD OP PLAAGMIDDELS TREE VANJAAR IN WERKING

Die Departement van Landbou-tegniese Dienste vestig die aandag daarop dat die verbod of beperkings wat op die gebruik van sekere plaagmiddels geplaas is vanaf 1 Oktober vanjaar in werking tree.

Vervaardigers en verspreiders van landboumiddels is reeds sowat twee jaar gelede ingelig oor die inkorting van en beperkings op die gebruik van bepaalde plaagdoders in die landbou, huistuine en vir binnenshuise gebruik.

Die middels wat deur die maatreëls geraak word, is die volgende:

1. DDT: Die gebruik daarvan in die huis, in die huistuin, op groente en die meeste ander eetbare gewasse is ingetrek.
2. TDE (Rhothane): Alle gebruike van dié middel is ingetrek.
3. BHC: Alle gebruike van dié middel is ingetrek, behalwe in 'n spesiale berokingsformulasie.

4. CIC (Toxaphene): Alle gebruike van dié middel is ingetrek.
5. Dieldrin en HHDN (Aldrin): Die gebruik van dié middels word beperk tot die bestryding van enkele grondinsekte en vir beskerming teen motte in die nywerheid.
6. Nendrin (Endrin): Alle gebruike van dié middel is ingetrek, behalwe ten opsigte van die bestryding van plae in bosplantasies.
7. Chlordaan: Alle gebruike van dié middel buiten vir die bestryding van miere in die landbou, in die huis en huistuin.
8. Arseen: Alle gebruike van dié middel is ingetrek.
9. Fosfor: Alle gebruike van dié middel is ingetrek
10. Endosulfan (Thiodan): Alle gebruike van Endosulfan is ingetrek op gewasse wat hoofsaaklik as veevoer gebruik word.
11. Gamma-BHC (Lindaan): Die gebruik van dié middel is ingetrek in 'n huis waar dit toegedien word as 'n ruimtespuitmiddel.
12. Mengsels van DDT en ander insektemiddels: Alle gebruike van dié middels is ingetrek, buiten op gewasse soos katoen, sorghum en aartappels.

(1973 Nr. 10 p. 2)

DIFFERENT METHODS TO REAR CALVES

There are different methods of rearing calves for meat production. Bearing in mind the high ruling prices of milk it is recommended that calves should be given milk up to 5 weeks and to wean them when they are eating about 750 g of starter meal per day.

If one wishes to save even more milk, milk substitutes can be used. It is important however, that during the first few days the calves should get colostrum.

Research has shown that it is uneconomic to feed calves from birth till when they are slaughtered at the age of one year. It is preferable to use natural pasturage during summer and cheap roughage for wintering.

When the animals are about 18 months they can be finished intensively for the market.

Good results can also be obtained if the calves are fed on maize silage. With good quality silage it takes about 200 days to get the weaned calves ready for the market. The calves should take in as much of the silage as they can. They should also get a daily protein supplement such as 100 g of a 40 per cent protein concentrate.

(1973 No. 15 p. 8)

VEEARTSENYLABORATORIUMS LEWER BELANGRIKE DIENS

Die Minister van Landbou, mnr. Hendrik Schoeman het begin Mei die nuwe veterinêre streeklaboratorium van die Afdeling Veeartsenydiens op Stellenbosch geopen en gesê dat weens die goeie vordering wat gemaak is met die bekamping van veesiektes die klem al meer kan verskuif na die bevordering van dieregesondheid. As deel van hierdie bevorderingsveldtog is veeartsenykundige laboratoriums op strategiese plekke in die Republiek en Suidwes- Afrika opgerig.

Aanvanklik is 25 laboratoriums in die vooruitsig gestel, maar as gevolg van verskillende oorwegings is onlangs besluit om behalwe die sentrum op Onderstepoort, in hierdie stadium net die streeklaboratoriums op Stellenbosch, Allerton in Natal, Middelburg in die Kaapprovinsie en dié in Windhoek toe te rus. Die laboratoriums sal in noue samewerking met die sentrale laboratorium op Onderstepoort 'n ineengeskakelde diens aan die veebedryf verseker.

Die omvang van die dienste wat deur die laboratoriums verskaf word, neem steeds toe. Die getal ondersoeke en toetse gedoen van monsters by streeklaboratoriums en staatsveeartskantore het byvoorbeeld in die afgelope vyf jaar met meer as 100 000 gestyg. Verlede jaar is altesaam 255 000 ondersoeke gedoen. Dit is met die oog op die steeds stygende behoeftes dat geriewe soos hierdie geskep word.

Onderstepoort het in die afgelope jaar die besonder groot getal van meer as 128 miljoen dosisse entsof teen 32 verskillende dieresiektes uitgereik en daar word nog steeds nuwe entstowwe berei, soos die nuwe teen ensoötiese aborsie wat pas vrygestel is. Die nodige navorsing in verband met dié siekte is binne 'n kort tydjie afgehandel en die entstof beskikbaar gestel.

(1973 Nr. 17 p. 1)

REDE VIR DALING IN SKAAPGETALLE

Van Augustus 1969 tot 1972 het wolskaapgetalle in Blankegebiede met nagenoeg 20 persent gedaal. Dié verskynsel word aan verskeie faktore toegeskryf. Die Afdeling Landboubemarkingsnavorsing som dit soos volg op:

'n Dalende tendens in wolpryse is oor die afgelope dekade ondervind, met 'n daling in die netto inkome van wolboere. Skaapgetalle is gevolglik verhoog, wat gelei het tot oorbeweiding. Langdurige droogtetoestande het in die jare sestig geheers en dit het geforseerde

bemarking van skape genoodsaak wat 'n nadelige uitwerking gehad het op die reproduktiwiteit van kuddes.

Noodmaatreëls vir die beskerming en herstel van die natuurlike weiveld het noodsaaklik geword en om dié rede is die Veeverminderingskema in 1969 ingestel. Die daling in wolpryse en gunstiger vleispryse het in skaapweistreke gelei tot die oorskakeling na vleisskape. Die verhoudelik lae peil waarop wol- en skaapvleispryse beweeg het, het in die dele waar oorskakeling na ander bedryfstakke moontlik was, meegebring dat skaapgetalle drasties verminder is.

Die peil waarop wol- en vleispryse tans beweeg, sal ongetwyfeld belangstelling in die bedryf stimuleer en aanduidings bestaan dat die daling in skaapgetalle in die meeste streke reeds gestuit is. Die opbou van kuddes in streke wat hul daartoe leen, kan egter nie oornag geskied nie en die heersende droogte sal dit ook vertraag.

Dit volg logies dat die daling in wolskaapgetalle hoofsaaklik verantwoordelik was vir die daling in wolproduksie. Daarnaas het daar, as gevolg van die toepassing van die Veeverminderingskema en stygende vleispryse, 'n verandering in die kuddesamestelling ten opsigte van die ooi/hamelverhouding ingetree. Dit is waarskynlik verantwoordelik vir die verhoudelik groter daling in wolproduksie, vergeleke met die daling in skaapgetalle.

(1973 Nr. 17 p. 6)

COMMISSION TO ENQUIRE INTO POULTRY IMPORTS

The State President has appointed a commission to enquire into the import of poultry breeding material into the Republic. Mr. G.J.V. Jordaan, Senior Magistrate of Pretoria, has been appointed chairman. The other members are Mr W.C.J. Viljoen, Assistant Director of the Animal and Dairy Science Research Institute, Dr L. Coetzee, of the Veterinary Science Research Institute, and Mr P.A.M. Gouws, secretary of the South African Poultry Association.

The terms of reference of the commission are to enquire into, to report upon and to submit recommendations on the following aspects regarding the import of poultry breeding material:

- The extent to which illegal importation, if any, of poultry breeding material is taking place.
- The effectiveness of existing legislation for the control of illegal importation of poultry breeding material and the necessity, or otherwise, of any adjustment in this respect.
- Methods that can be employed by the Department of Agricultral Technical Services, the South African Police, the Department of Customs and Excise and other organizations to control the importation of poultry breeding material and to prevent the illegal entry of such material into the country.
- The existing quarantine facilities for imported poultry breeding material. The effectiveness and/or adequacy of such facilities must also be investigated.

Those interested were to requested to submit memoranda on the matters to be inquired before 9 June, 1973, to the secretary of the commission, Mr A.C. van Niekerk, Private Bag X116, Pretoria.

After consideration of the written representations, those interested were afforded an opportunity, if so desired, of making personal and more detailed representations to the commission.

(1973 No. 19 p. 1)

GOEIE VORDERING MET BESTRYDING VAN TUBERKULOSE BY VEE

Goeie vordering word gemaak met die bestryding van tuberkulose onder kuddes in die Republiek deur middel van die uitroeiingskema wat in 1969 deur die Departement van Landbouetegniese Dienste van stapel gestuur is.

In die jongste verslagjaar is meer as 1 600 sertifikate ingevolge die skema uitgereik aan kuddes wat vry is van tuberkulose. Daar is nou reeds sowat 3 000 kuddes wat aan die skema deelneem.

Gedurende die verslagjaar moes die Staat byna R½ miljoen uitbetaal ten opsigte van vee wat positief op die tuberkulosetoetse gereageer het en geslag moes word. 'n Groot persentasie van hierdie karkasse is nie by die slagpale afgekeur nie en meer as die helfte van die koste van uitbetalings is verhaal.

Die omgewings wat die swaartse besmet was met tuberkulose, te oordeel aan die getal positiewe reageerders by die verskillende slagpale, was in volgorde: Johannesburg, Kaapstad, Port Elizabeth, Pretoria, Oos-Londen, Pietermaritzburg, Kimberley en Durban.

(1973 Nr. 19 p. 2)

BLAASBRANDMIELIES VEILIG AS VOER

'n Waarnemingsproef wat in Maart vanjaar by die Landbounavorsingsinstituut van die Hoëveldstreek op Potchefstroom gedoen is, toon dat mielies wat met blaasbrand besmet is blykbaar nie vir herkouers giftig is nie.

In die proef is strafbesmette mielieplante elke oggend vars gekap en gemaal en aan drie jong osse gevoer. Daar is gepoog om die maksimum toksisiteit te verkry deur slegs plante wat besmet was te gebruik. Die voerperiode het oor 14 dae gestrek en die mis van die diere is ontleed om die aktiwiteit van die spore vas te stel nadat dit deur die spysverteringskanaal van die diere beweeg het.

Gedurende die proeftydperk het die drie osse onderskeidelik 294, 289 en 257 kilogram voer gevreet en 21, 18 en 14 kilogram in massa toegeneem. Die diere het in geen stadium enige tekens van siekte getoon nie.

Die misuitskeiding van die diere was buitengewoon donker en dit het geblyk dat die spore lewendig en sonder verlies van besmettingsvermoë deur die spysverteringskanaal beweeg het. Blaasbrand kan dus versprei word deur diere wat besmette plante gevreet het.

Geen kliniese effek kon vasgestel word ten opsigte van veranderings in die wit- of rooibloedseltellings van die diere se bloed nie. Die liggaamstemperatuur was ook normaal.

Hoewel die voerperiode betreklik kort was en vergiftiging moontlik wel oor die langtermyn kan plaasvind, is die navorsers redelik seker dat blaasbrand nie gevaarlik vir herkouers is nie. Hulle beklemtoon dit egter dat die afleiding net vir blaasbrand geld en nie vir Fusarium- en Diplodiabesmetting nie. Boere word aangeraai om eers die swam te laat identifiseer voordat die besmette plante aan herkouers gevoer word.

(1973 Nr. 20 p.5)

BLOUBUFFELSGRAS KAN WEIDING BESTENDIG

Mnr. Johan du Toit van die Landboukollege Glen sê bloubuffelsgras kan 'n belangrike rol vervul in diê dele waar bosindringing soos dié van swarthaak probleme skep. Deur die vee of 'n gedeelte daarvan ná reëns van die natuurlike veld te onttrek en op aangeplante blouffelsgras te laat loop, kan die algemene toestand van die veld aansienlik verbeter word.

Die aanplant van blouffelsgras kan verder die produksiepotensiaal van die boerderyeenheid verhoog. Dit kan dien as kontantgewas in dié gebiede waar wisselvallige klimaatstoestande die sukses van graanverbouing in die weegskaal plaas.

Die aanplant van die gras kan ook 'n deurslaggewende bydrae lewer tot die vestiging van veeboerdery en die uitbreiding daarvan.

Daar bestaan 'n groot verskeidenheid bloubuffelsgrastipes of seleksies wat baie van mekaar verskil ten opsigte van eienskappe, produksiepotensiaal, droogtebestandheid en aanpasbaarheid. Maar in Suid-Afrika is nog net saad van cultivar Molopo in die handel beskikbaar.

By die vestiging van die gras is dit belangrik dat gesertifiseerde saad gebruik word. Die saad moet in die droë bogrond geplant en met die trekker se wiele vasgetrap word.

Die gras moet in die eerste seisoen nadat dit gevestig is nie bewei word nie sodat die plante goeie wortelstelsels kan ontwikkel. Om die gras doeltreffend te kan benut, moet dit in klein kampies verdeel word waar 'n ooprotasieweidingstelsel gevolg word.

Die diere moet in die kampies gejaag word wanneer die gras begin saadskiet en onttrek word as die gras sowat 20 cm hoog is. Stikstof- en fosfaatbemesting is noodsaaklik vir die instandhouding van die weiding. Die grond moet ook gereeld tussen die grasrye losgemaak word.

(1973 Nr. 20 p. 6)

ERTSFOTO'S VAN GROOT PRAKTIESE BETEKENIS VIR DIE LANDBOU

Wetenskaplikes in Pretoria wat die eerste reeks foto's bestudeer het wat deur die Amerikaanse Aardhulpbronsatelliet (ERTS) geneem is, is dit eens dat dié foto's vir die hele land van groot waarde sal wees. Vir die landbou in die besonder hou die foto's groot praktiese nut in.

So byvoorbeeld het die foto's die indringing van die Karoo in die hart van Suid-Afrika op dramatiese wyse aan die lig gebring. Uit die foto's blyk dat die grens van die Karoo gedurende die afgelope 20 jaar byna 70 km ver gebiede binnegedring het wat voorheen grasveld was.

Sowat 26 persent van die oppervlakte van Suid-Afrika bestaan uit grasveld, terwyl savannes en die halfwoestyn-Karoo met sy dwergstruike 31 tot 35 persent van die oppervlakte beslaan. Volgens die wetenskaplikes wat die foto's bestudeer het, het die ergste en omvangrykste agteruitgang van die plantegroei in die Karoo self, in die savannes en die aangrensende grasveld voorgekom waar groot

dele deur swakker plantegroei ingeneem is.

Die ERTS-foto's het bewys dat die grens van die Val-Bo-Karoo nie meer is waar dit tydens die 1953-opname was nie. In 'n gebied rofweg tussen Aliwal-Noord en Wepener het die grens 70 km weswaarts verskuif in 'n streek wat voorheen grasveld was.

Nog iets wat die foto's duidelik en akkuraat aandui, is die dele waar veldbrande voorgekom het. Dit maak dit vir wetenskaplikes moontlik om die voorkoms en omvang van veldbrande regdeur die land vas te stel, iets wat volgens die gewone metodes geheel en al op nasionale skaal onuitvoerbaar was.

Ondersoeke van ERTS-foto's het so onder meer aan die lig gebring dat 121 000 ha, 36 persent, van die Hoëveldse suurveld in die Tugela-opvanggebied in die vroeë lente afgebrand is, die tyd wat deur weidingkundiges aanbeveel word as die beste — as daar gebrand móét word. Dit het egter ook duidelik uit die foto's geblyk dat die noordelike dele van dié gebied afgebrand is lank voor die aanbevole tyd.

Die span wetenskaplikes wat die ERTS-foto's bestudeer het, is gekoördineer deur die hoof-ondersoekbeampte van die ERTS-program in die Republiek, dr. O.G. Malan van die W.N.N.R. se Nasionale Fisiese Navorsingslaboratorium. Wetenskaplikes van die Navorsinginstituut vir Grond en Besproeiing, die Navorsinginstituut vir Plantkunde, Geologiese Opname en die Departement van Beplanning was lede van die span.

(1973 Nr. 20 p. 8)

AFRIKANERBEES SAL IN AFSIENBARE TOEKOMS NOG GROOT ROL SPEEL IN VLEISPRODUKSIE

In die Republiek, Suidwes-Afrika en Rhodesië word dit voorsien dat die Afrikanerbees vir die afsienbare toekoms nog 'n groot rol in die veebedryf behoort te speel, het dr. J.H. Hofmeyr, Direkteur van die Navorsingsinstituut vir Vee-en Suiwelkunde, onlangs op 'n saamtrek van die Afrikanerbeestelergenootskap op Potchefstroom gesê.

Dr. Hofmeyr, wat oor die onderwerp Afrikanerbees — Quo vadis? gepraat het, het gesê dat die ras vir kommersiële doeleindes, voorlopig, altans, twee duidelike gebruike sal hê.

In die eerste plek sal die Afrikaner in die ekstensiewe en marginale streke waar 'n kombinasie van omgewingstoetstande sodanig is dat ander beesrasse biologies en ekonomies minder suksesvol daar ingeskakel kan word, waarskynlik vir 'n onbepaalde tyd sy dominante rol kan speel. In hierdie gebiede is die moontlikhede om getalle uit te brei beperk en word daar 'n min of meer statiese posisie voorsien.

In die tweede plek sal die Afrikaner vanweë sy getalsterkte en gevolglik sy beskikbaarheid, 'n voor-die-hand-liggende keuse bly as basiese moederlyn in plaaslike kruisteelt-programme, ook vanweë sy verdienste vir dié doel.

"Daar is dus 'n rol vir die Afrikanerbees," sê dr. Hofmeyr, "maar dit is wenslik om dié stelling nie ongekwalifiseerd te laat nie. Die rede is omdat daar dramatiese ontwikkelings in die vleisbeesbedryf onderweg is en nuwe produksiepatrone is besig om ook plaaslik te ontplooi."

Die vleisbeesbedryf, sê hy, is vinniger besig om te intensiveer as wat telers skynbaar besef. Intensiewe produksie- en groot voereenhede is besig om die swaartepunt van die bedryf weg te verskuif van die bekende produksiegebiede en tradisionele produksiestelsels.

Daar word verwag, aldus dr. Hofmeyr, dat sowat 50 persent van die slagvee teen 1980 minstens gedeeltelik in voerkrale afgerond sal word vóór bemarking. En hierdie fabrieksgeoriënteerde produksiestelsels stel hoë eise aan diere waarin die klem val op groeisnelheid of massa-vir-ouderdom, asook doeltreffendheid van voeromsetting.

Ander rasse en tipes en veral kruisteeltstelsels word hierby betrek en dit kan wees dat dié neiging sal toeneem, aldus dr. Hofmeyr.

Om te verseker dat die Afrikaner sy rol volwaardig in hierdie ontwikkelings speel en om aan die vereistes te voldoen wat in die toekoms beslis van al groter belang gaan word, wag daar 'n besonder groot taak op die stoetteler as hy die mededingingsposisie van sy ras wil verstewig en 'n verskaffer van teelmateriaal wil bly.

Buite die grense van die Republiek, meen hy, kan die Afrikanerbees moontlik ook nog 'n baie groot rol in vleisproduksie speel. In Afrika is daar in bepaalde gebiede 'n geweldige potensiaal vir vleisproduksie waar die ras besonder goed sou kon inskakel. 'n Groot persentasie van Afrika se beesbevolking van sowat 158 miljoen bestaan uit onverbeterde, laagproduserende inheemse tipes en rasse. Met 'n tydsame evolusionêre ontwikkeling vanaf primitiewe veeboerderystelsels, sê dr. Hofmeyr, kan 'n oorgangsfase voorsien word waarin 'n bees soos die Afrikaner, minstens

teoreties beskou, 'n ideale tussenganger en verbeteraar kan wees.

Meer spesifiek in Angola met sy geweldige potensiaal vir vleisproduksie kan die Afrikaner die grondslag van 'n groot bedryf vorm. Angola (wat groter as die Republiek is) het 'n potensiaal van meer as 30 miljoen beeste, maar die land dra tans net 2,7 miljoen.

Kenners meen ook dat die Afrikaner in lande soos Australië en Brasilië in ekstensiewe beesboerderytoestande daar 'n groot rol kan speel.

(1973 Nr. 21 p. 3)

WILD LAAT VELD AGTERUITGAAN

Omdat boere gewoonlik nie wild in aanmerking neem wanneer hulle die drakrag van hul veld bereken nie, is daar gebiede soos die Noord-Transvaalse Bosveld waar die veld geweldig oorlaai is. 'n Stelselmatige uitdunprogram om wildgetalle te verminder tot 'n realistiese syfer is noodsaaklik in hierdie dele.

Dr D.M. Joubert, Direkteur van die Paneel Vakkundige Hulpdienste, en mnr. J. G. Low, ook van die Paneel, het die mening verlede week in Pretoria uitgespreek op die simposium oor wildboerdery en -benutting. Hulle het 'n referaat gelewer oor wildproduksie en -bemarking in S.A., gesien uit die oogpunt van die landbou.

Gegewens oor die omvang van wildboerdery in die Republiek in die geheel is nog nie beskikbaar nie ('n opname word tans deur die Departement van Landbou-tegniese Dienste gedoen), maar heelwat besonderhede daaroor in die Transvaalstreek is beskikbaar, aldus die referente.

Daaruit blyk dat daar in dié streek 213 plase is met 'n totale oppervlakte van meer as 351 000 ha wat uitsluitend vir wildbeskerming en -bewaring gebruik word. Verder is daar ook 567 plase in die Transvaalstreek met 'n totale oppervlakte van byna 1 miljoen morg wat in die eerste plek vir veeproduksie gebruik word, maar waarop wild in beduidende getalle aangehou word.

In Noord-Transvaal, sê dr. Joubert en mnr. Low, is daar meer as 12 000 ha natuurlike weiding wat met wildwerende heining afgekamp is met die uitsluitende doel om dit vir wildboerdery te benut. En op hierdie weidings is daar duidelike tekens van veldagteruitgang as gevolg van die onuitvoerbaarheid van weidingsbestuur.

Daar word voorts bereken dat wildgetalle op sowat 10 persent van die plase in Noord-Transvaal wat nie wildheinings het nie so hoog is dat hulle 'n betekenisvolle invloed uitoefen op die natuurlike voedingsbronne.

In die Noordwestelike Transvaal waar wild grootliks beperk is tot die soetveldgebiede, dus die distrikte van Thabazimbi en Ellisras, is byna 100 000 ha met wildheinings afgekamp, terwyl daar verder sowat 570 000 ha in dié twee distrikte is waarop baie wild aangehou word — in die geval van impalas tot 200 en 250 per 1 000 ha.

Dr. Joubert en mnr. Low sê daar is bevind dat die inkamping van wild gewoonlik lei tot 'n snelle opbou van wildgetalle, met 'n toenemende druk op die soeter dele van die veld. En dikwels degenereer die botaniese samestelling van sulke dele tot die pionierspesies wat baie vatbaar is vir droogtes.

Groot getalle wild word ook in Oos-Transvaal, veral die distrik Nelspruit, en in Noord-Natal op plase en private wildreservate aangehou.

Die referente sê ten besluite dat wildboerdery vandag as 'n integrale deel van die boerdery in baie dele van die Republiek beskou moet word, ten spyte van baie probleme verbonde daaraan.

Deskundiges stem in die algemeen saam dat wildproduksie nooit kan meeding met 'n goedbestuurde veeboerdery nie, maar dat dit beslis 'n bate is wat 'n baie goeie bykomende verdienste aan die boer kan besorg.

(1973 Nr. 22 p. 4)

TEKORT AAN BEESVLEIS SAL STYG TENSY PRODUKSIEVERLIESE BEPERK WORD

Die aanduidings is daar dat die Republiek teen 1980 met 'n bevolking van ongeveer 28 miljoen en met die huidige per kapita verbruik van 25,2 kg beesvleis 706 miljoen kg beesvleis jaarliks sal benodig. As die beesvleisbedryf nie biologies doeltreffender funksioneer nie, sal daar minstens nog 2,1 miljoen beeste nodig wees om dié hoeveelheid vleis teen die huidige omset-tempo te lewer.

Dié stelling is onlangs deur dr. J.H. Hofmeyr, Direkteur van die Navorsingsinstituut vir Vee- en Suiwelkunde, op Potchefstroom gemaak tydens 'n saamtrek van Afrikanerbeestelers.

Hy sê daar is tans 'n wêreldwye tekort aan proteïene van diere-oorsprong en in die ontwikkelde lande van die noordelike halfrond is daar tans 'n geweldige vraag na beesvleis. Die E.E.G.-lande alleen sou elke kilogram kon absorbeer wat die Republiek kan produseer — en dit teen 'n baie goeie prys ook.

Maar ongelukkig produseer Suid-Afrika nie genoeg beesvleis vir eie gebruik nie en

voer tans sowat 20,4 persent van sy behoeftes in van aangrensende gebiede. Die posisie word verder gekompliseer deur die feit dat die Republiek een van die hoogste bevolkingsgroeitempos ter wêreld het, naamlik 3,5 persent per jaar.

Dr. Hofmeyr sê dit is onwaarskynlik dat die verhoogde produksie van 'n noemenswaardige groter getal beeste sal kom. Alternatiewe metodes sal dus gevolg moet word, soos verhoogde omset of verhoogde produksie per dier of per eenheid grondoppervlakte.

Om hierdie verhoogde produksie per dier te verkry, is daar voor-die-hand-liggende, bekende en beproefde metodes wat aan die meeste veeboere bekend is. Die meeste hiervan het regstreeks met bestuurspraktyke te doen. Veeverliese weens vrektes as gevolg van siektes, droogtes en klimaatsfaktore bedra jaarliks 5 tot 11 persent, aldus dr. Hofmeyr.

Onregstreekse verliese as gevolg van siektes, interne parasiete en ondervoeding met gevolglike swak groei bedra na raming waarskynlik 20 tot 35 persent van die huidige produksie. Hierdie verliese word in die praktyk weerspieël in lae speen- en karkasmassas.

As drastiese stappe gedoen sou word om verliese van hierdie aard in te perk, kan die vereiste 24 persent verhoogde produksie wat benodig word vir 1980 waarskynlik hierdeur verhaal word.

Sulke pogings sê dr. Hofmeyr, sal nie net onmiddellike effek hê nie, maar ook bydra om die belangrikste biologiese rede vir die skynbare onvermoë van die vleisbedryf om sy getalsterkte te vergroot, naamlik lae reproduksie of lae kalfpersentasies, grootliks uit die weg ruim.

Na raming is die kalfpersentasie vir die nasionale vleisbeeskudde in die Republiek nie hoër as 50 tot 55 persent nie. As die hoë kalfvrektesyfer ook in berekening gebring word, is dit duidelik dat die speenpersentasie minder as 45 persent is, aldus dr. Hofmeyr.
(1973 Nr. 22 p.7)

NUWE PROEFPLAAS VIR ANGORAS

'n Angorabokproefplaas sal eersdaags in die Angoraproduksiegebied opgerig word, het mnr. J.J. Malan, Adjunk-minister van Landbou, in Port Elizabeth gesê waar hy die jaarkongres van die S.A. Sybokhaarkwekersvereniging geopen het.

Die Departement van Landbou-tegniese Dienste, sê hy, het nog altyd baie gedoen om die Angorabokboere by te staan in hul pogings om kwalitiet te handhaaf. Hierdie werk sal in die toekoms verskerp word deur die navorsingswerk wat op die proefplaas gedoen sal word.

Die werk op die proefplaas sal in die eerste plek toegespits wees op die beheer en benutting van die natuurlike weiding. Verskillende praktiese metodes van veldbenutting, wisselweidingstelsels en spesiale veldbehandelings vir die verskillende veldsoorte sal getoets word. Saam met die veldnavorsing sal ook baie aandag aan voedingsaspekte gegee word.

Daarbenewens sal die navorsers die voordeligste bestuurspraktyke in verband met Angorabokboerdery uitwerk en demonstreer.

Die Adjunk-minister het ook na spesifieke probleme verwys wat opgelos moet word soos absorsies by Angoras, iets wat boere al jare lank hoofbrekens besorg. Die Departement sal hom dit ten doel stel om 'n absorsievrye Angorakudde deur teling en seleksie op die proefplaas te ontwikkel.

Voorts sal aandag ook gegee word aan die ontleding van die ekonomie van Angorabokboerdery deur noukeurige rekordhouding. Op dié manier sal gepoog word om onbetalende praktyke sover as wat dit moontlik is uit te skakel en om die mees ekonomiese bestuurspraktyke te vind.

Die Adjunk-minister sê hy hoop Angorabokboere sal die proefplaas en sy personeel ten volle benut en dat dit vir hulle 'n hulpmiddel sal wees om die gehalte van hul produk te verbeter. Die ondervinding het geleer dat die grooste stimulant en dryfveer tot sukses vir 'n navorsingsinrigting die daadwerklike belangstelling is van die boere wat dit moet bedien.
(1973 Nr. 23 p. 5)

ANTHRAX WELL UNDER CONTROL IN THE REPUBLIC

It appears from the latest annual report of the Department of Agricultural Technical Services that anthrax is one of the numerous livestock diseases which at present is well controlled in the Republic. Only ten outbreaks occurred during the past year and only 10 cattle and 1 sheep died from the disease.

The exceptionally high number of over 6 million cattle, 176 000 small stock and almost 9 000 horses were vaccinated against the disease by or under supervision of officers of the Division of Veterinary Services. As far as precautionary immunization is concerned this is a very satisfactory figure.

Since the 1970 outbreak of anthrax in the

northern parts of the Kruger National Park, all anthrax carcases found have been incinerated in an attempt to minimize the sources of infection. It would appear that this has led to an improvement in combating the disease as only 2 roan antelope, 3 kudu, 1 buffalo, 2 steenbuck, 1 nyala and 1 impala died from anthrax.

The roan antelope is especially susceptible to the disease and an experiment has been launched to immunize this species against anthrax. A helicopter was used among other things in the process of immunizing and marking these antelopes. Almost 100 roan antelope have already been vaccinated against this disease.
(1973 No. 24 p. 4)

HANDLEIDING VIR VELDGEBRUIK BESKIKBAAR

Die Transvaalstreek het pas 'n baie praktiese en maklik bruikbare handleiding gepubliseer deur middel waarvan die landboupotensiaal van die Noordwes-Transvaalse Soetbosveld bepaal kan word. Die handleiding is saamgestel deur dr. J.J. Coetzee en mnr. G.J. Mentz van die Transvaalstreek.

Dr. F.R. Tomlinson, Direkteur van die Streek, spreek in sy voorwoord tot die handleiding die hoop uit dat dit baie daartoe sal bydra om boerdery in die soetbosveld tot groter fisiese stabiliteit en ekonomiese voorspoed te voer.

Die doel met die handleiding is om die boer of landboukundige te help om die langtermynse produksievermoë van 'n plaas, kamp of land te bepaal sodat 'n aangepaste boerderystelsel daarop gevolg kan word. So 'n stelsel moet oor die langtermyn volgehou word en maksimum produksie en wins vir die boer voortbring sonder dat natuurlike hulpbronne soos veld, grond en water agteruitgaan.

Die gebruik van die handleiding berus op die vermoë van die gebruiker daarvan om òf tussen plantegroeisoorte op sy plaas te kan onderskei, òf om grondsoorte volgens kleur en tekstuur te kan uitken.

Die handleiding bestaan uit vyf afdelings, naamlik Algemeen, Grond, Weistreek, Bome en Grasse. Belangrike en besonder bruikbare inligting oor die Noordwes-Transvaalse Soetbosveld word onder elkeen van dié afdelings aangegee.

Die handleiding kan verkry word van die Direkteur, Transvaalstreek, Privaatsak X180, Pretoria.
(1973 Nr. 24 p. 6)

CALVING PERCENTAGE ALARMING

Mr W.S. Grobbelaar, Deputy Director: Research, Free State Region, told a farmers' day meeting at Allemanskraal recently that the latest census figures indicated that the calving percentage of all cows of calving age and heifers older than two years was 35 per cent. This included cattle in Bantu areas.

Mr Grobbelaar said the calving percentage of cows belonging to White farmers could hardly be more than 50 per cent in these circumstances.

It was alarming that 50 per cent of the cows in the country should have to be fed from the limited feed supplies without producing offspring.

According to Mr Grobbelaar the most important managerial practice in animal production, whether for red meat, milk or wool, is the storing of adequate fodder supplies for times of shortage.
(1973 Nr. 26 p. 5)

STUDY OF GRAZING HABITS OF ANIMALS

The Karoo Region of the Department of Agricultural Technical Services has begun a research programme to study the grazing habits of animals and the effect of grazing on the veld.

Different types of livestock have different grazing habits and preference for natural vegetation. Some are better adapted to arid bushveld and others to grassveld.

The Director of the Karoo Region says knowledge of grazing habits and preferences is essential to enable farmers to protect the veld and get the best use out of it. The types of livestock included in the programme are Merinos, Dorpers, goats and cattle.
(1973 Nr. 27 p. 7)

BLADSKRIF OOR KUDDESAMESTELLING

Die skaarste aan skaapvleis in die Republiek het onder meer daartoe gelei dat boere meer teelooie wil aanhou en 'n groter omset wil bereik. Om dié rede word in 'n toenemende mate oorgeslaan na intensiewer produksie.

Veekundiges van die Vrystaatstreek sê intensiewer produksie moet gepaard gaan met beplanning van die kuddesamestellings. Dit beteken die toepassing van produksiestelsels wat in ooreenstemming is met die weidingpotensiaal en voerproduksiemoontlikhede van

die boerdery-eenheid. Die verhoging van kleinveeproduksie op dié wyse behels onder meer dat regte verhouding tussen veesoorte beplan word en dat veld- en bestuurspraktyke só verbeter dat dit doeltreffendheid in die hand werk.

Volledige besonderhede oor dié en ander aangeleenthede verskyn in 'n bladskrif oor kuddesamestellings vir wol-, vleis- en pelsrasse wat onlangs deur die Department Landbou-tegniese Dienste uitgegee is. Dit is opgestel deur mnre. H Botha en O. Steyn van die Landboukollege Glen en kan kosteloos verkry word van Die Direkteur, Afdeling Landbouinligting, Privaatsak X144, Pretoria. Die bladskrifnommer is 112.

(1973 Nr. 27 p. 5)

INFORMATION — INLIGTING

THE BRITISH MILK MARKETING BOARD'S CELL COUNT SCHEME FOR CONTROL OF SUBCLINICAL MASTITIS

This scheme has been instituted to make dairy farmers aware of the incidence of subclinical mastitis in their herds and as an aid to the assessment of the progress made in the control of this scourge by the application of a herd mastitis control programme.

The scheme is based on the monthly somatic cell count performed by an electronic counter on representative herd samples submitted in preservative to the M.M.B's laboratories. To eliminate the effect of factors other than mastitis which may elevate the cell count (e.g. prolonged lactation) it is emphasized that producers should never take too much notice of a single month's count. Average counts over 12 months are considered preferable. The service costs the farmer £6-00 per year (±R12,00) and the results are confidentially available only to the farmer and his veterinarian.

The M.M.B bases its service on 250 000 cells/ml being an indication of a low degree of infection in a herd. A survey of 150 000 herds during 1971/72 showed that less than 10% of herds had such low cell counts.

Decreases in counts are found to be correlated with increase in milk production and a corresponding elevation of economy. Decreases in counts are effected by attention to efficiency of milking machines, teatdipping, dry cow therapy, veterinary consultation and culling of incurable cows. The percentage of 'heavily infected' herds diminished from 17—9,7% after 1 year and dropped to 6,6% in the second year of the scheme.

Adapted from **London Press Service**; Quote 2801/3; Lawrie Tester, 1973.

SAFE USE OF PESTICIDES: TWENTIETH REPORT OF THE WHO EXPERT COMMITTEE ON INSECTICIDES

World Health Organisation Technical Report Series, 1973 No. 513.

Pp 54. Price $1.00

Available: Van Schaik's Bookstore (Pty) Ltd. Box 724, Pretoria.

This is another of the now well-known series of technical reports by expert committees on a variety of important subjects affecting health. The text is divided into five parts: Part I deals with *Insecticides in Public Health*, Part II with *Molluscicides in Public Health*, Part III with *Rodenticides in Public Health*, Part IV with *Health Aspects of Pesticides not directly associated with Vector Control*, and Part V with *Progress in Diagnosis and Treatment*.

The text covers a field in which the veterinarian is inevitably concerned, such as results of recent studies and observations on exposure of animals and man to DDT and dichlorvos, with dosage-response relationships and dosage-storage curves. Progress in the WHO programme for the evaluation of new insecticides is recorded and eleven new insecticides are reviewed. The growing evidence that ultra-low volume applications of insecticides will play an important role in the control of vector-borne diseases, is discussed. Other methods of control of insects such as chemosterilants, juvenile hormone and biological control are also considered.

An annexure provides a most useful summary of the latest developments in the diagnosis and treatment of insecticide poisoning, and this will also find veterinary application.

The Report is authoritative and highly recommended.

L.W.v.d.H.

THE STOMOXYINE BITING FLIES OF THE WORLD

F. Zumpt

Gustav Fischer Verlag, Stuttgart 1973. Pp VIII+175, Figs. 97

This book is the first comprehensive publication on the Stomoxyinae as a well-defined monophyletic group, in which these biting flies (stable flies, horn flies and buffalo flies) are classified into 10 genera. Earlier authors vary widely in their opinions on the classification of the Stomoxyinae, recognizing from 1 to 12 genera, and this treatise has brought order into the previously confused picture.

There are eight chapters in the book, as follows:

General morphology and anatomy
Classification of Stomoxyine genera
Key to the genera of Stomoxyinae
Systematic—synonymic catalogue of Stomoxyinae
Taxonomy and biology of species
Economic importance
Control measures
Technique (collection, preservation, cultivation)

The 49 known species are well described and their distribution recorded. The key to the genera is of great value to the veterinary or medical entomologist burdened with the task of identifying the biting flies and much useful information is contained in the section dealing with the techniques for collecting, preserving and cultivating them.

Discussion of the economic importance of the haematophagous flies and control measures employed against them adequately covers our present knowledge on the subject; it also reveals the many problems that remain to be investigated.

The author is a world authority on arthropod parasites and the book is highly recommended to workers specializing in this field.

C.J.H.

VIRUSES OF VERTEBRATES

ANDREWES AND PEREIRA

Baillière Tindall, London, 1972. 3rd Edition p.451 UK price: £6.00

Since its first publication in 1964, this book came to be regarded as the standard work of reference on the properties and characteristics of viruses affecting man, domestic animals, birds and other vertebrates. The third edition is in every sense a worthy successor to the previous editions.

The text is divided into three parts. Part I covers the classified and unclassified RNA viruses in eleven chapters. The DNA viruses are dealt with in Part II, which comprises six chapters. The few uncharacterized viruses are discussed in a single chapter in Part III of the book. For each virus or group of viruses the essential information is presented under the following headings: morphology and development, chemical composition, physico-chemical characters, antigenic properties, cultivation, distribution, host range, pathogenicity, ecology and control.

In order to keep the extent of the new edition within reasonable bounds the authors had to condense the mass of available information considerably and had to be very selective in the matter of references. Their critical ability and characteristically readable style, however, fully compensate for the condensation and ensures easy reading.

This book is absolutely indispensable for virologists and post-graduate students in virology; it should also serve as an invaluable reference work for undergraduate students in medicine, veterinary science and microbiology.

B.J.E.

ONCOGENESIS AND HERPESVIRUSES

IARC SCIENTIFIC PUBLICATION No. 2

P. M. BIGGS, G. DE-THÉ AND L. N. PAYNE

World Health Organization, Geneva, 1972. pp. XIV+515; Figs 273; Tabs 109. Price

The International Agency for Research on Cancer (IARC) was established in 1965 as an independently financed organization within the framework of the World Health Organization.

The Agency conducts a programme of research concentrating particularly on the epidemiology of cancer and the study of potential carcinogens in the human environment. The publications of the Agency are intended to contribute to the dissemination of authoritative information on different aspects of cancer research.

This second IARC scientific publication entails the proceedings of a symposium held at Christ's College, Cambridge in June 1971 and organized jointly by the IARC and the Houghton Poultry Research Station, England. The aim of the Symposium was to bring together those engaged in the study of oncogenic herpesviruses and their associated diseases for the presentation of the current state of knowledge and for discussion of recent work.

The introductory lecture, given by Dr. B. Roizman, is a review of the facts concerning the biochemical features of herpesvirus-infected cells, particularly as related to their potential oncogenicity.

The pathology, virology and epidemiology of Marek's disease is covered very thoroughly by eighteen outstanding papers and three

discussion summaries.

Five papers are devoted to the discussion of the salient features of Lucké frog renal carcinoma.

The pathology, virology and epidemiology of Burkitt's lymphoma, nasopharyngeal carcinoma and infectious mononucleosis are dealt with in thirty excellent contributions.

The other herpesviruses which can be associated with neoplasms and the relationships amongst oncogenic and other herpesviruses are discussed in seventeen papers.

The concluding lecture, a very skilful summing up and critical appraisal of the whole Symposium, was delivered by Professor George Klein.

The Symposium splendidly succeeded in its aim of bringing together the foremost research workers in the field of viral oncology; the scientific contributions presented were of the highest standard and contained the very latest authoritative information. The book is printed on high quality paper and is amply illustrated by no less than 273 excellent figures.

This book is, therefore, absolutely indispensable for those working in the field of viral oncology as well as for those interested in the wider concepts of carcinogenesis. Poultry pathologists, post-graduate students in virology and pathology as well as workers in related disciplines may benefit by the invaluable information contained in this book.

B.J.E.

LA MALADIE NODULAIRE CUTANÉE DES BOVIDÉS

P. BOURDIN

L'Expansion Scientifique Française, Parys, 1970. Pp VIII+100; Figs 15; Tab.1.

Geen prys aangegee nie.

Hierdie werk deur Dr. P. Bourdin, hoof van die Nasionale Laboratorium van Veeteelt en Veeartsenykundige Navorsing te Dakar (Senegal), is nog 'n bydrae in die reeks monograwe oor virussiektes van diere onder direksie van P. Lepine en P. Goret.

'n Volledige uiteensetting van knopvelsiekte onder die hoofde virologie, kliniese en patologiese studies, diagnose en prognose, episoötiologie, patogenese, behandeling en profilakse word gegee. Die werk word beskou as 'n volledige oorsig van wat van die siekte bekend is en van wat daaroor gepubliseer is. Die lys van verwysings getuig van die wye veld wat gedek is. Deurgaans word in die werk 'n onderskeid gemaak tussen die Neethling- en Allerton-virusse en skaappokkies. Die fotos is van goeie gehalte. 'n Paar verdere illustrasies, veral van die makro- en mikroskopiese patologie, sou nuttig gewees het. Enkele spelfoute is waargeneem maar nie hinderlik gevind nie. Beskrywings is oor die algemeen besonder helder en duidelik, en kan waarskynlik aan die goeie oordeel van die samesteller toegeskryf word, maar toon ook terselfdertyd tot watter plastisiteit en presiesheid van beskrywing die Franse taal hom leen.

Dit is jammer dat so min veeartse en veeartsenykundige studente Frans magtig is, want hierdie werk kan 'n waardevolle toevoeging wees tot die studie-materiaal, nie alleen van voor- en nagraadse studente nie, maar selfs ook tot dié van die navorser en die leermeester.

J.L. du P.

THE VISCERA OF THE DOMESTIC MAMMALS

R. NICKEL, A. SCHUMMER AND E. SEIFERLE

Translation and revision by W. O. SACK

Paul Parey, Berlin 1973. 1st English Edition. Pp. XIV+401. Figs: 559 Plates 13, Tables 10. Price R38

In many countries, including South Africa, veterinary anatomy departments are regarded as stepchildren by people who can at best claim to retain some obfuscating concepts on the subject of anatomy. If those people would care to take this book in hand, they will be surprised to learn that there are exceptions to the rule; that in some countries the synthesis of research and teaching in anatomy is still a cherished tradition; that anatomy as a basic discipline is of fundamental importance in veterinary education and research, and that only in such circumstances the field is likely to attract men of the stature of the authors of this book.

The veterinary, indeed the biological, world has become accustomed to receiving anatomical texts from German and Swiss anatomists, and it is pleasant to express the opinion at the outset that we have here a major contribution to the literature on the subject. In its form and character it maintains the best traditions of German anatomy texts and is entitled to a place alongside the best of those emanating from the Ellenberger-Baum, Zietzschmann-Ackerknecht-Grau and Martin-Schauder Schools. The book under review is the second volume of a series of five. The first volume deals with the locomotor system, the fifth volume (in print) comprises avian anatomy, and the third and fourth volumes (in preparation) treat of the vascular and nervous systems. When completed, this textbook is bound to become a standard work on the comparative anatomy of the domestic mammals and monument to the industry and erudition of its authors.

In 400 pages and 559 illustrations the anatomy of the viscera is revealed with precision and in a wealth of detail. The subject matter is presented on didactically sound principles, namely: abolishing any particular species as a type animal and discussion of each organ system or subdivision in a general comparative description followed by necessary additional details of each species, with reasonable equal coverage. In this regard mention should be made of the sketches of the intestinal tract (plates II and III) illustrating the modifications of the ascending colon, the ontogenetic development of the embryonic gut illustrating its rotation around the cranial mesenteric artery, and the development of the omenta which are essential to understand and interpret the relations in the adult. Not only is the macromorphology described, but also the microscopic and functional anatomy of the parts are stressed and reference is made to applied aspects. The whole text gives a complete over-all picture, without omitting important details. Experts and students alike will be able to find references to their problems without difficulty.

Anatomy is a visual subject. Viewing the object as a preparation and as illustration is equal in rank to its portrayal in word and technical language. The illustrations are superb. Their quality and originality match those of the text. An exceptionally good choice of illustrations of topographical anatomy provides everything necessary in this field. The placing of illustrations of the same region of different species in a single plate enables one to make comparisons very easily. Well-produced and instructive coloured plates, in the Schmaltz tradition, increase the value of the book. Among these the beautiful illustrations depicting the paranasal sinuses — the first of their kind to appear in any textbook — and the ovary of the cow deserve special mention. It is rather a pity that the legends for adjacent drawings do not all carry the identical numbers. A study of the drawings demands much patience since the abundant labelling with numerals and letters must be looked up in the legend — a laborious task. References to figures and parts labelled in the figures are given in the text,

and after struggling through 8 to 10 such references in one sentence one has learned a lot, but the task is not made easy.

Prof. W.O. Sack of the Cornell University has taken it upon him to translate this work — a monumental task. He deserves the gratitude, praise, and encouragement of all those interested in veterinary anatomy for bringing this book within the reach of the English-speaking world. He has succeeded admirably in producing a free translation which offers pleasant effortless reading in clear and simple language. The nomenclature conforms to the most recent official edition of Nomina Anatomica Veterinaria, and will be welcomed by both teacher and student with a sigh of relief. A bibliography provided at the end of each chapter is a valuable improvement on the German edition.

The reviewer will consider a few general features which, in his opinion, detract from the excellence of the work. On p. 3 the serous membranes are said to release small amounts of *exudate* and on p. 4 the reader is led to believe that the endothoracic fascia is a sheet of pure elastic tissue. The serous cavities are completely filled by the organs with only capillary spaces between the organs and between the latter and the body wall. This concept is not translated on page 4. The hypochondriac region does not lie over the costal cartilages but is covered by the cartilages of the asternal ribs (p. 9). The veral part of the omentum in the dog arises medial to the left kidney, not the right kidney (p. 127). On page 139 the caudal flexure of the descending duodenum of the pig is not described as lying ventral to the right kidney. On p. 236 the glottis is said to enclose the narrowest part of the pharyngeal cavity. Indiscriminate use of the terms *excretory, secretory, lymphoid,* and *lymphatic* is disturbing. Reference is made to the excretory duct system of the pancreas on p. 121 but in fig. 168 on page 122 a secretory duct is labelled. The lingual tonsil of the horse contains *lymphoid tissue* (fig. 67) but corresponding tonsil in the pig (fig. 68) contains *lymphatic tissue*. Similarly, measurements for various structures, e.g. the foliate and buccal papillae, are given in cm and mm. The palatine muscles of all species and the glossal and laryngeal muscles of the dog need revision in the light of published literature. No mention is made of the development of penile spines in the cat and the hormonal correlation. The topograhy of the prostate in the ageing dog is disregarded as well as the time of ossification of the os penis in this animal. The apical ligament of the bovine penis is mentioned but not described; in the cat it is not mentioned. The reviewer fails to appreciate the value of footnotes explaining the etymology of a few selected terms. It is a laudable idea, provided all terms are covered, in which case a glossary could have been appended. It is also strange why terms like trocar and rumenotomy should be explained in a work of this nature. Amongst some 55 typographical errors noticed, figs. 326 —329 are not labelled.

The question at issue is whether this volume should have been improved in this edition. The translator claims to have revised the book. The main defect is the most casual fashion in which the perineum is treated and illustrated — a topic most likely to concern the clinician. Some of the omissions are indeed startling from any viewpoint. A couple of references to relevant papers are no substitute in a work of this stature and price, which, whether it makes the explicit claim or not, is clearly to be regarded as a work of reference. And it is even more startling when one bears in mind that some of the most stimulating literature on this topic originated in the translator's department! Had it not been for the few references added by him, this up-to-date textbook would have been outdated exactly twenty years. To name but one or two structures, the relations of the external anal sphincter and the retractor penis in the dog are described (translated) wrongly (p. 133). It is in any case impossible to visualize the rectal part of this muscle in the dog from the description. It is most distressing to search for a description of the mare's retractor clitoridis and to find it ultimately fully described in the chapter on the digestive system. There are vague statements to the effect that a retractor clitoridis is apparently present in the cat but not in the bitch and that the ischiourethral muscle of the dog is thought to influence the blood flow in the dorsal vein of the penis. The relevant literature gives decisive answers on these matters, unless Giessen doesn't care about the happenings in Berlin and Cornell doesn't know what's cookin' in Davis. It is to be hoped that a separate chapter will be devoted to the perineum with a second revision. Radiological anatomy is totally disregarded and should also be included in future editions.

The typographical presentation and the excellent quality of the paper are prominent features of the book. Veterinary literature is enriched by this volume and attains the high-

est scientific standards. The high cost may not play a rôle in a country where students contribute practically nothing to their university education, but in South Africa it may deter students. Nevertheless, it will be a very poor department of veterinary anatomy, human anatomy, or zoology that does not have this book available, and it should decorate the bookshelf of every practising veterinarian.

J.M.W. le R.

BLOOD COAGULATION AND ITS DISORDERS IN THE DOG

D. E. HALL

Baillière Tindall, London 1972. Pp XII+188; Figs 5; Tabs 22. Publ. Price £4.00

This monograph provides a valuable review for the non-specialist of the progress made in the field of blood coagulation and its disorders. Its usefulness is further enhanced by an extensive bibliography of 504 references, many of which refer to other species including man. There is also a useful index.

An extensive discussion of the haemostatic mechanism in its contemporary complexity precedes a fascinating chapter on all aspects of true haemophilia, including genetics, identification of carriers and treatment. The disease is defined as "a sex-linked recessive condition in which an isolated lack of factor VIII (antihaemophilic globulin) occurs". Regrettably, one of the earliest reports of this condition (in a golden cocker spaniel) by Purchase and Grieg in 1960 *J1 S.Afr. vet. med. Ass.* 31: 289) is not cited and the cocker or any other type of spaniel does not appear among the breeds of dog in which haemophilia has been reported (Table 2).

For the clinician the book's greatest value lies possibly in Chapter 4 on acquired bleeding disorders. Here may be found a 'check list' of most possible differential diagnoses in the dog. The subjects discussed include leukaemia, aplastic diseases, vitamin deficiency, autoimmune syndromes, renal and liver disease, infectious disease, warfarin and other chemical agents causing bleeding. Among the latter, oestrogens, aflatoxin and phenylbutazone receive attention. Discussing *Ehrlichia canis* infection '. . the evidence suggests a true thrombocytopaenia as a sequel to marrow aplasia with a typical bleeding syndrome.'

An informative chapter on intravascular coagulation contains much of value to physiologist and clinician. Particularly interesting are the sections on haemorrhagic shock and haemolysis. The final chapter discusses the principles of investigation, the evaluation of the laboratory results obtained and the methodology involved. The book is highly recommended reading for the continuing education of clinicians and educators alike.

R.K.L.

MADOQUA

Series I, No. 5 and No. 6 have appeared, as well as Series II No. 2, and are available at R4,65, R2,27 and R2,00 respectively.

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Contents:

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MADOQUA SERIES II No. 2

Contents:

Jl S. Afr. vet. Ass. 44 (3): 321—330 1973

SPESIALE VERSLAG

SPECIAL REPORT

UITTREKSELS UIT VORDERINGSVERSLAE VAN NAVORSERS OP ONDERSTEPOORT — 1972/73*

EXCERPTS FROM PROGRESS REPORTS OF RESEARCH WORKERS AT ONDERSTEPOORT — 1972/73

SUMMARY

The following aspects are covered:

1. The decrease of Cu, Mn, and Zn content of livers of ewes and lambs receiving S supplement in the form of Na_2SO_4 in licks, and the increase of Co content.
2. Immunization of chicks against Newcastle disease, the Komarov and Lasota vaccine strains being compared.
3. Development of a vaccine against infectious bronchitis, using the H 120 strain.
4. Study of the incidence of *H. gallinarum* in South Africa and development of an experimental vaccine.
5. Comparative toxic effects of Dieldrin and Photodieldrin on sheep of different breeds and sex, and on blesbuck and springbuck.
6. The synergism between diamidines and organic phosphates relative to anticholinesterase activity.
7. The chronic neurotoxic effect of the combined use of Haloxon and carbon bisulphide on horses.
8. Toxicity of *Fusarium moniliforme* in horses.
9. Development of methods for determination of cardiac glucosides in blood, urine and tissues of poisoned animals and the effects of *Homeria glauca* poisoning on the heart.
10. Study on the aetiology of geeldikkop, facial eczema and other photosensitization syndromes, with special reference to the rôle of mycotoxins.
11. Efforts to enhance the effectiveness of *Vibrio fetus* vaccine.
12. Production of teaser bulls by resection of the retractor penis muscle.
13. The preparation of a chemically almost pure *Clostridium welchii* epsilon toxoid and the relative absorption rates thereof by various tissues.
14. Comparative studies on Brucella strains for vaccine production, indicating the superiority of strain 19.
15. *Clostridium oedematiens* and *Cl. septicum* as cause of death in sheep and cattle and development of a combined clostridial vaccine.
16. Improvement of the botulinus vaccine as result of identification of the toxic factors produced by types C and D and the quantitation thereof, as well as by the use of an oil adjuvant.
17. Improvement of tetanus vaccine.
18. Control of ticks by dipping in view of development of tick resistance.
19. Indications of suitable substitutes for DDT and BHC.
20. Effect of dipping on maintenance of immunity against redwater in cattle.
21. Culture and attenuation of horsesickness virus types in cell culture systems.
22. Improvement of Rift Valley fever vaccine.
23. Incidence of swine fever virus in *Ornithodorus moubata* collected from warthog lairs, and of Smedi viruses in pigs in South Africa.
24. Development of a practical method for diagnosing three-days-stiff-sickness, study of the morphology of the virus and of its attenuation in an effort to develop a vaccine.
25. Viability and immunogenicity of Anaplasma vaccine.
26. Preparation of a vaccine against besnoitiosis on an experimental basis.
26. Pathology of *Strongyloides papillosus* infestation in goats.
27. Study of the development of biuretolytic activity of rumen flora.
28. Comparison of sheep and goat as host of *T. ovis*.
29. Effects of re-infestation of cattle with *Schistosoma mattheei*.
30. Study of chlamydiosis and development of a vaccine.

*Die goedgunstiglike beskikbaarstelling van hierdie verslag deur die Direkteur van die Navorsingsinstituut vir Veeartsenykunde te Onderstepoort word met dank erken.—Red.

31. Attempts at adapting *Cowdria ruminantium* to mice; improvement of the keeping qualities of hearwater-infected blood used for immunizing.

(Further details may be had on request from the Director, Veterinary Research Institute, Onderstepoort.).

1. MINERALE BALANSE IN DIERE

Werk gedoen i.v.m. lekke aan skape het getoon dat die byvoeging van swawel in die vorm van natrium sulfaat (6%) in 'n lek gelei het tot betekenisvolle verlaging van die koperinhoud van die lewers van beide die ooie en lammers wat oor 'n lang tyd daarvan gekry het. In die ooie het mangaan, magnesium en sink ook verminder, terwyl kobalt vermeerder het. Hierdie proewe het bewys dat langdurige, aanhoudende gebruik van swawellekke ernstige mineraal-wanbalanse kan veroorsaak, met veral 'n neiging tot 'n kopertekort en dat die gebruik van sulke lekke ingekort behoort te word, of dat koper, mangaan, magnesium en sink terselfdertyd bygevoeg moet word om die meedingende effek teen te werk.

2. PLUIMVEESIEKTES

i) *Newcastlesiekte*

(a) Entstof is berei met die Lasota-entstofstam uit Engeland verkry. Met verskillende toetse is vasgestel dat die Lasota-entstof, na die Komarov-stam, die beste resultate gee. Verder is bevind dat individuele toediening beter as massatoediening is en dat die drinkwater-metode baie onbevredigend is. Aerosol-toediening gee goeie resultate as dit reg toegepas word, maar met primêre toediening is entstofreaksies kwaai.

Die bevinding is ook dat kuikens progressief beter immuniseer namate hulle ouer word. Met inenting van dagoud kuikens wys sleg 50% na drie weke enige immuniteit, terwyl 5 dae oud kuikens 67% en 10 dae oud kiukens 95% immuun is na drie weke. Hoe langer die eerste inenting uitgestel kan word (tot 6 weke ouderdom) hoe beter is die beskerming.

Passiewe immuniteit by kuikens het slegs vir ongeveer een week 'n beskermende waarde. Daarna belemmer dit die ontwikkeling van aktiewe immuniteit na inenting, tot 'n ouderdom van 4 weke.

(b) Ten einde biologiese kontroletoetse op Newcastlesiekte-entstof te vereenvoudig, is pogings aangewend om die Komarov-stam in ander gasheerstelsels as bebroeide eiers te kweek. Daar is in geslaag om dié entstofstam in 'n gevestigde sellyn van aapnier-weefselkultuur aan te pas en te kweek; vergelykende immuniteitsproewe het getoon dat die entstof wat in weefselkultuur berei word net so immunogeen is as die eier-entstof. Newcastlesiekte-entstof (Komarov-stam) word dus nou met groot sukses in weefselkultuur berei.

ii) *Aansteeklike Brongitis*

Na uitgebreide proewe met geïnaktiveerde en lewende, verswakte lokale stamme van aansteeklike brongitis-virus as entstof vir pluimvee in Suid-Afrika, is besluit om 'n lewende entstof wat berei is van die H 120 stam (Hoekstra, Nederland) vry te stel vir gebruik, omdat hierdie stam 'n beter immuniteit, gebaseer op serum-teëliggame, verwek het. In die uittoets van die entstof is 1,5 miljoen dosisse eksperimenteel in lêhenne en roosterkuikens in Natal, Transvaal en Wes-Kaap gebruik. Die resultate het getoon dat die entstof veilig en doeltreffend is. Die aansteeklike brongitis-entstof (stam H120) is geruime tyd reeds beskikbaar.

ii) *Aansteeklike Verkoue*

Ondersoek is uitgevoer na die voorkoms van *Haemophilus gallinarum* in Suid-Afrika. Hierdie werk het daartoe gelei dat die organismes nou doeltreffend van verdagte gevalle van verkoue afgesonder kan word en 'n eksperimentele entstof teen die siekte berei en uitgetoets kon word. Tot dusver is 11 000 hoenders geënt met 'n eksperimentele bakterien wat aluminium hidroksied as hulpmiddel bevat het. Na 5 maande was die hoenders nog steeds teen uitdaging met die homoloë stam van *H. gallinarum* bestand.

3. TOKSIKOLOGIESE PROBLEME

i) *Akute en Subakute Toksisiteit van Dieldrin en Fotodieldrin vir Vee en Wild*

Daar is bevind dat blesbokke en springbokke meer vatbaar is vir dieldrin as ander diere. In beide spesies was ramme meer vatbaar vir fotodieldrin as ooie. Fotodieldrin was hoofsaaklik verantwoordlik vir mortaliteit in wildsbokke na bespuiting van die weiveld teen termiete.

Die simptome in wildsbokke het behalwe die gewone senuweesimptome, dikwels 'n domvorm met blindheid ingesluit. Die letsels het o.a. 'n opvallende degenerasie van gestreepte- en hartspier ingesluit, wat baie gelyk het soos vlekspiersiekte.

In vergelykende proewe tussen Merino- en Dorperskape is gevind dat Dorpers sewe keer meer weerstand teen dieldrin het. Die aansienlike vetreserwes by die Dorper is moontlik die verklaring. Die min vet in wilds-

bokke maak hulle waarskynlik meer vatbaar.

ii) *Wisselwerking tussen Organiese Fosfate en Diamidiene*

Die resultate van proewe in beeste kan as volg opgesom word:—

1. Trichlorofon („Dylox") as wurmmiddel *per os* teen die terapeutiese dosis van 50 mg/kg toegedien, veroorsaak 'n daling in heelbloed asetielcholienesterase (ChE) -vlak van ongeveer 50% en dit neem ongeveer 6 weke vir dié ensiem om na die normale peil terug te keer.
2. Phenamidine (onderhuids) teen terapeutiese dosis veroorsaak geen opsigtelike val in ChE nie en indien die dier 14 dae later trichlorofon doseer word, is daar nie 'n groter daling in ChE as wat trichlorofon alleen veroorsaak nie.
3. Indien trichlorofon en Phenamidine egter geltyktydig in terapeutiese dosisse toegedien word val die ChE na feitlik nul en toon die diere tekens van organiese fosfaatvergiftiging (een uit ses diere is inderdaad dood). Verder neem dit ongeveer 2 maande vir die ChE om na normaal terug te keer.

Loodseksperimente is ook uitgevoer met 'n ander organofosfaat-bosluisspuitstof, dicrotofos („Ektafos") en Phenamidine. Hier moes vier keer die aanbevole konsentrasie van dicrotofos gebruik word om 'n ChE daling van ongeveer 50% te verwek. Indien Phenamidine egter tegelyk toegedien is het dié waarde, net soos tevore, na feitlik nul gedaal.

Soortgelyk is die diamiden „Berenil" in kombinasie met trichlorofon getoets. Die kombinasie het 'n groter daling in ChE veroorsaak as wat trichlorofon alleen veroorsaak het, maar dit was nie so dramaties as met die fenamidien-trichlorofon-kombinasie nie.

iii) *Toksisiteit van Gekombineerde Gebruik van Haloxon en Koolstofbisulfied in Perde*

Haloxon is 'n organiese fosfaat met 'n lae toksisiteit in soogdiere. Omtrent 20 keer die normale dosis veroorsaak egter 'n kroniese senuweesindroom.

Koolstofbisulfied word algemeen gebruik vir papies in perde. Gedurende die laaste jare het dit gewone praktyk geword om hierdie twee middels gelyktydig in perde te gebruik.

Na groot vrektes in perde in 1971, is uiteindelik eksperimenteel bewys dat wanneer 'n normale dosis CS_2 gekombineer word met 'n dosis van Haloxon wat net bo die normale is, dit 'n dramatiese verhoging van die kroniese neurotoksiese effek tot gevolg het. Letsels het veral in die *medulla oblongata* voorgekom asook in die rugmurg. Dit was dus die verklaring vir die mortaliteit in perde na die gekombineerde dosering.

iv) *Fusarium moniliforme*

In eksperimente met perde is bewys dat hierdie swam, wat dikwels op mielies voorkom, vergiftiging mag veroorsaak, veral in ouer perde.

Lewerbeskadiging was die vernaamste letsel en geelsug en subkutane edeem die vernaamste simptome. Senuweeletsels wat deur ander werkers in Egipte beskryf is, kon sover nie hier verwek word nie.*

v) *Studie van Suid-Afrikaanse Hartglikosiede*

(a) *Bepaling van hartglikosiede in bloed, urien en weefsel van vergiftigde diere:* Geen diagnostiese toets bestaan om die teenwoordigheid van hartglikosiede (HG) in diere te bepaal nie. 'n Bestaande metode vir die bepaling van HG in menslike wefsel is aangepas vir diereweefsel (bloed, urien en orgaanweefsel). Die waardes van urien en plasma van 10 normale skape is bepaal.

Eksperimente met tulp, *Homeria glauca,* om akute vergiftiging in 3 skape te verwek is uitgevoer en uurlikse bepalings van HG-konsentrasies in bloed- en urienmonsters is volgens dié indirekte metode gedoen. Gelyktydig is eletrokardiografiese en fonokardiografiese opnames asook bloed-suur/basis-bepalings gedoen. Nadoodse orgaanmonsters is vir die teenwoordigheid van HG getoets.

Belowende resultate is verkry: twee uur na dosering kon die teenwoordigheid van HG in die bloed en urien aangetoon word. Die skape is gemiddeld na 5½ uur dood. Die teenwoordigheid van HG is in die organe aangetoon, selfs in monsters wat 48 uur na dood geneem is.

Die teenwoordigheid van HG is ook in verskeie dieremonsters van verdagte veldgevalle van tulpvergiftiging aangetoon.

(b) *Die effek van* Homeria glauca *vergiftiging op die hart:* In die mens word tipiese EKG-veranderings met hartglikosiede selfs in terapeutiese dosisse aangetref en proewe is in skape uitgevoer om vas te stel of soortgelyke veranderings wat van diagnostiese waarde kan wees in diere plaasvind. Vir vergelykende doeleindes is gedroogde *Homeria glauca per os* toegedien, teenoor die aktiewe gifstof, naamlik epoksi-skillirosidien, intraveneus, en die hartglikosied digoksien, intraveneus. 'n Nuwe metode van elektrokardiografie, wat vir herkouers ontwikkel is, is in hierdie proewe gebruik.

*By die ter perse gaan is berig dat tipiese senuweeletsels wel verwek is. —Red.

Die volgende EKG-veranderings is gevind:

Die veranderings wat met tulp en sy aktiewe bestanddeel gevind is, was vergelykbaar en het bestaan uit aanvanklike bradikardie gevolg deur 'n erge sinus tachikardie, wat later opgevolg is deur atrio-ventrikulêre dissosiasie en wederkerende ventrikulêre tachikardie. Uiteindelik is die ritme totaal versteur en het die dood ingetree. In die terminale stadia was dispnee uitgesproke en het 'n parese, wat oorgegaan het tot 'n paralise, ook voorgekom.

Met lae dosisse van die hartglikosiede is dissosiasie feitlik onmiddellik ingetree en het die EKG-veranderings verder verskil deurdat die verlenging van die P-R-tussenpose, wat wel na verwagting met digoksien voorgekom het, nie by tulp of sy aktiewe gifstof ingetree het nie.

Met lae dosisse van die hartglikosiede is geen EKG-veranderings waargeneem nie, maar slegs 'n verbygaande rumen-stase, ataksie en swaar abdominale asemhaling.

vi) *Geeldikkop en ander Fotosensitisasie-sindrome*

Hoewel die ooreenkoms tussen aangesigekseem (facial eczema) en geeldikkop 'n geruime tyd gelede reeds opgemerk is, het die eerste bevestigde uitbreek van aangesigekseem in Suid-Afrika, onder skape in die Oos-Kaap, en die vasstelling van die veroorsakende swam, *Pithomyces chartarum,* op weidingsgewasse, nuwe stukrag gegee aan die navorsing op geeldikkop en verwante fotosensitisasie-sindrome. In samewerking met die Afdeling Plantbeskerming, die Afdeling Veeartsenydiens en ander instansies is 'n aktiewe navorsingsprogram van stapel gestuur om vas te stel of geeldikkop deur mikotoksiene veroorsaak word en om die verskillende fotosensitisasie-sindrome in Suid-Afrika te karakteriseer.

Met die ondersoek na die voorkoms van swamme op weidingsgewasse ten tye van uitbreke van fotosensitisasie in 20 verskillende areas is 'n hele reeks swamme versamel, geïdentifiseer en in skape vir toksisiteit uitgetoets. Verskeie spesies van vier groepe swamme, nl. *Alternaria, Cladosporium, Fusarium* en *Phoma* is in al die areas gevind. *Pithomyces chartarum,* die oorsaak van aangesigekseem, is net op aangeplante weidings in die Humansdorp- en Underberg-distrikte gevind, maar laasgenoemde stam was nie toksies vir skape nie. 'n Nuwe, verwante swam, *Pithomyces karoo,* is in die Karoo en die Vrystaat gevind, maar van altesaam 12 swamspesies wat vir toksisiteit getoets is, was dit slegs *Pithomyces chartarum* van Humansdorp wat fotosensitisasie in skape veroorsaak het, ten spyte daarvan dat moontlike faktore wat die toksisiteit van die swamme gedurende kunsmatige groei in die laboratorium mag beïnvloed, ondersoek is.

In die poging om hepatogene fotosensitisasie-sindrome in Suid-Afrika te karakteriseer, is verskeie uitbreke van fotosensitisasie ondersoek. Uitbreke van klassieke geeldikkop is net op natuurlike weidings gevind en is terloops weer eksperimenteel verwek op Middelburg, Kaap, met *Tribulus terrestris.*

Al die ander sindrome, waaronder dikoor of *Panicum*-fotosensitisasie, waarvan uitbreke in die Vrystaat ondersoek is, het op aangeplante gewasse voorgekom.

Hepatogene fotosensitisasie, wat klinies nie van geeldikkop onderskei kan word nie, is ook eksperimenteel in skape verwek met die plante *Asaemia axillaris* en *Lasiospermum bipinnatum,* maar die lewerpatologie van dié vergiftigings verskil radikaal van dié van geeldikkop en van aangesigekseem en word gekenmerk deur 'n sonale degenerasie en nekrose van die lewerselle. Die patologie van geeldikkop is intensief bestudeer en vergelyk met dié van aangesigekseem en ander fotosensitisasie-sindrome.

Hoewel die werklike oorsaak van geeldikkop nog nie bepaal is nie, is goeie vordering gemaak en is dit baie duidelik dat 'n mikotoksien die mees waarskynlike oorsaak is.

Navorsing op die oorsaak van ensoötiese geelsug het aan die lig gebring dat kroniese kopervergiftiging moontlik tog 'n rol kan speel. Kroniese kopervergiftiging is onlangs vir die eerste keer eksperimenteel in 'n skaap veroorsaak deur klein hoeveelhede kopersulfaat oor 'n tydperk van 9 maande te voer. Hierdie resultaat was uiters bemoedigend, aangesien die geval van kroniese kopervergiftiging nie van klassieke ensoötiese geelsug onderskei kon word nie.

4. VOORTPLANTING

i) Vibrio fetus- *entstof*

Heelwat werk is gedoen om 'n doeltreffende entstof te ontwikkel.

Verskillende stamme is geïsoleer en gevestig.

Twee tipes entstof is ontwikkel met verskillende emulsiferende stowwe.

'n Goeie immuniteit kan in verse bewerkstellig word.

Die terapeutiese waarde van hierdie entstowwe vir die behandling van vibriobesmette verse en bulle is ook ondersoek.

Beide besmette verse en bulle was negatief na 3 en 8 weke onderskeidelik, nadat hulle met tipe-I-entstof geënt was.

Met tipe-II-entstof was die resultate nie so gunstig in bulle nie; verse moet nog getoets word. Geen nadelige gevolge op spermatogenese of saadkwaliteit van bulle wat met tipe-II geënt was, kon aangetoon word nie.

Tipe-I-entstof, wat deurgaans 'n baie goeie beskerming teen vibriose verwek het en ook 'n besondere terapeutiese waarde vir besmette gevalle inhou, kan ongelukkig nie ekonomies vervaardig word nie. Ander metodes sal gevind moet word om antigeen in groot hoeveelhede te produseer.

In die huidige vorm word probleme ondervind met die toediening. Daar sal gepoog moet word om die konsistens sonder verlies van doeltreffendheid te verander, sodat dit prakties toegedien kan word.

In teenstelling behoort tipe-II-entstof wel ekonomies vervaardig te kan word. Die massaproduksie van antigeen behoort baie min probleme op te lewer. Hierdie emulsie is baie stabiel en die produk is prakties hanteerbaar. Ongelukkig is die terapeutiese waarde nie vergelykbaar met tipe-I-entstof nie. Daar moet ook nog meer data ingewin word oor die immuniteit wat hierdie entstof verwek voordat finale gevolgtrekkings gemaak kan word.

ii) *Bereiding van Koggelbulle*

'n Nuwe praktiese metode is ontwikkel om koggelbulle te produseer; reseksie van die *retractor penis*-spier is gebruik. Dit is 'n eenvoudige operasie, doen min afbreuk aan die libido van die bul en verhoed dekking.

5. BAKTERIOLOGIE

i) *Clostridium welchii*-epsilon-toksien is in feitlik chemies suiwer en elektroforeties homoloë vorm geïsoleer. Dit is bewys dat muisbrein groot hoeveelhede van die toksien kan absorbeer en dat nierweefsel dit tot 'n mindere mate doen, terwyl ander weefsel feitlik niks absorbeer nie. Dit bied 'n baie interessante verklaring vir die predileksie van letsels in die nier en brein van skape met bloednier.

ii) *Vergelykende Studie met Brucella-entstowwe*

Proewe is uitgevoer om 'n vergelyking te tref tussen die beskermende waarde teen aborsie tussen stam-19-entstof, PB (Franse entstof) en 'n geïnaktiveerde stam-45/20-entstof.

Hierdie proef het duidelik bewys dat stam 19 verreweg die mees doeltreffende entstof is en uitstekende beskerming teen aborsie gebied het. PB entstof het feitlik geen beskerming gebied en die geïnaktiveerde entstof kon ook nie daarin slaag om 'n doeltreffende immuniteit teweeg te bring nie.

iii) Clostridium oedematiens *en* Clostridium septicum as *Oorsaak van Dood in Skape en Beeste*

Deur middel van spesifieke fluoresserende teëliggaamtegnieke is bewys dat *Clostridia*-infeksies neig om meer in die lente na die eerste reëns, asook in die vroeë herfs, voor te kom. Enkele gevalle van *Cl. oedematiens* is gediagnoseer en *Cl. septicum* is gevind in heelwat gevalle van verdagte kwaadaardige edeem.*Cl. septicum* is ook in suiwer kultuur geïsoleer van kliniese gevalle van sponssiekte te Mara-Navorsingstasie, in diere wat gevrek het ten spyte van gereelde inenting teen sponssiekte. In ses uitbreke van gangreneuse metritis in skape en bokke wat gevolg het op partus of aborsies, is *Cl. septicum* as oorsaak gediagnoseer.

Proewe met 'n gekombineerde *Cl. oedamatiens*-, *Cl. septicum*- en *Cl. chauvoei*-entstof het reeds vér gevorder en die uitreiking van so 'n entstof sal in die nabye toekoms oorweeg word.

iv) *Lamsiekte-entstof*

Intensiewe navorsing het daartoe gelei dat die toksiese faktore wat deur *Clostridium botulinum* tipes C en D geproduseer word nou geïdentifiseer en vir die eerste keer kwantitatief bepaal kan word. Hierdie werk was 'n noodsaaklike voorvereiste vir die verbetering van die entstof. In voortsetting hiervan is die optimale toestande van kweking en toksienproduksie van *Cl. botulinum* tipes C en D uitgewerk, asook die beste metode van ontgifting van toksien en die bewaring van die toksoïed. Verder is bepaal wat die minimum hoeveelheid toksoïed en konsentrasie van teëliggame is, wat nodig is om beeste te beskerm teen inname van die toksien. In die geval von *Cl. botulinum* tipe D is gevind dat 0,0002 ml toksienbevattende kultuurfiltraat per kilogram liggaamsgewig voldoende is om 'n bees binne 7 dae dood te maak en dat beeste met 'n teëliggaam-konsentrasie van selfs 0,04 eenhede per ml serum nie met 10 dodelike dosisse gedood kan word nie. Beeste met 'n waarde van 1,0 eenheid per ml serum het 1000 dodelike dosisse toksien weerstaan en hierdie serumwaardes kon maklik met lamsiekte-enstof verkry word.

Die finale stap in die verbetering van die entstof was proewe om die konvensionele aluminiumfosfaat-entstof met 'n olie-hulpmiddel-entstof te vergelyk. Daar is gevind dat laasgenoemde entstof 'n baie beter immuniteit

verwek, wat terloops ook baie langer hou.

So 'n olie-hulpmiddel-entstof teen lamsiekte sal eersdaags vir gebruik vrygestel word.

v) *Tetanus-entstof*

Navorsing, soortgelyk aan die op lamsiekte-entstof, is op tetanusentstof uitgevoer ten einde die doeltreffendheid van die entstof te verhoog.

Daar is eerstens bepaal wat die laagste konsentrasie van teëliggaampies is wat nodig is om skape teen tetanus te beskerm. Die bevinding was dat 'n skaap met 0,1 IE antitoksien per ml serum 'n uitdaagdosis van 10 dodelike dosisse kan weerstaan.

Met hierdie gegewens tot beskikking is groepe dragtige ooie eskperimenteel met verskillende sterktes tetanus toksoied in 'n olie-hulpmiddel geïmmuniseer. Die serum-teëliggamme van die ooie voor partus en van die lammers na suiping van biesmelk en tot op die ouderdom van 5 weke, is bepaal. Sodoende kon 'n geskikte dosis tetanus-toksoied gekies word om as entstof te dien, ten einde lammers lank genoeg te beskerm, totdat alle moontlike operasies op hulle uitgevoer is.

'n Verbeterde olie-hulpmiddel-entstof teen tetanus sal moontlik eersdaags beskikbaar wees.

vi) Corynebakterium pseudotuberculosis-*entstof*

Uitgebreide proewe in muise en skape is uitgevoer in 'n poging om die immunogeniteit van *C. pseudotuberculosis*-entstof te verhoog.

Die immuniteit kon nie verbeter word deur gelyktydige toediening van heteroloë lewende entstowwe nie; ook nie deur intraveneuse toediening van entstowwe nie, óf deur die inspuiting van eksotoksien of bakterieë wat op spesiale groeibodems gekweek is nie. Die toediening van 'n tienvoudig gekonsentreerde entstof het egter 'n effense verhoogde teëliggaam-konsentrasie en 'n aansienlike verbeterde immuniteit teweeg gebring.

Hoewel die entstof teen *C. pseudotuberculosis* nie altyd 'n absolute immuniteit verwek nie, het dit tog besliste waarde as dit strategies en met die nodige diskresie gebruik word.

6. ROOIWATER- EN BOSLUISBEHEER MET DIPPING

i) In die Port Shepstone- en Ixopo-distrikte van Suid-Natal, het mortaliteit onder beeste as gevolg van babesiose oor die afgelope dekade onrusbarend toegeneem. Op versoek van die Afdeling Veeartsenydiens is 'n gesamentlike projek onderneem om ondersoek na hierdie verskynsel in te stel.

Dipmonsters versamel en getoets het aangetoon dat slegs 18% van die gemonsterde dipbakke op voldoende konsentrasie gebruik word.

Proewe uitgevoer by 'n reeks dipbakke met die bestaande dipstowwe teen die korrekte dipstofkonsentrasie het aangedui dat bestandheid van die teenwoordige bosluisspesies geen groot probleem is nie.

Laboratorium-toetsing van *Boophilus microplus* (Natal) teenoor bestande *B. decoloratus* (Oos-Kaap) in 'n reeks dipstowwe het aangedui dat *B. microplus* slegs 'n laegraadse bestandheid teen arseen ontwikkel het.

Dit is gevind dat die Asiatiese bloubosluis, *B. microplus,* wydverspreid in die intensief-gemonsterde gebied van Suid-Natal voorkom en dat dit *B. decoloratus* oorheers in 'n verhouding van 85% teenoor 15% by monsterpunte waar albei spesies saam voorgekom het.

Proewe op 'n plaas in die Ixopo-distrik, oor 'n periode van twee jaar uitgevoer, het bewys dat:

(a) Immuniteit teen rooiwater by beeste nie verenigbaar is met kort-tussenpose-dipfrekwensies nie, as gevolg van onderdrukking van die vektor spesies tot 'n vlak waar instandhouding van die babesia parasiete wisselvallig word.

(b) Die ongedipte kontrole-diere gedurende die hele twee jaar nooit rooiwater ontwikkel het nie, waarskynlik omdat bosluislading op die diere gedurig voldoende was om immuniteit te verstewig.

ii) *Plaasvervangende Dipstowwe vir die Beheer van* B. decoloratus *en* B. microplus

Weens die onttrekking van BHC en DDT vir dipdoeleindes, moes aanbevelings gemaak word oor plaasvervangende dipstowwe, na aanleiding van laboratoriumtoetse oor die vatbaarheid van bloubosluise van verskillende gebiede vir dié dipstowwe. Vir die doel van die toetse is bloubosluise uit die Port Shepstone-gebied, waar *Boophilus microplus* oorheersend is en nog deur arseen, BHC en DDT beheer kon word, vergelyk met bloubosluise uit Oos-Londen-gebied, waar *B. decoloratus* nie meer deur arseen, BHC, DDT en sekere van die organiese fosfate beheer kon word nie.

Die resultate van onderdompelingsproewe met volgesuigde wyfies in 'n meetkundige reeks van 6 tot 8 sterktes van verskeie dipstowwe het getoon dat *B. decoloratus* van die Oos-Kaap bestand is teen sekere organiese fosfate. Die bestandheid is egter beperk tot die besondere streek en beide *B. decoloratus*

en *B. microplus* in die res van die land is vatbaar vir alle organiese fosfate.

Volgens die resultate kan slegs enkele dipstowwe suksesvol in die bestande Oos-Kaapstreek in die dipbakke gebruik word, naamlik fenchlorovinfos of fenchlorovinfos plus dioksation of fenchlorovinfos plus kamfechloor.

In alle ander streke kan die organiese fosfate soos dioksation, batestan, fenchlorovinfos of fenchlorovinfos plus dioksation en kwintiofos in dipbakke gebruik word.

7. VIRUSSIEKTES

i) *Die Kweking en Attenuering van Perdesiekte-virus-tipes in Selkultuur-sisteme*

As gevolg van probleme, soos byvoorbeeld oormatige neurotropisme en swak immunogeniteit wat ondervind is met die huidige muisbrein-aangepaste perdesiektevirus-entstofstamme, is besluit om attenuering van die virus in selkulture uit te voer.

'n Sekere lyn van baba-hamster-nierselle het geblyk die beste te wees wat betref kweking van perdesiekte-virus. Hoë viruskonsentrasies is binne 'n redelike kort tydperk van 2—4 dae verkry en het gepaard gegaan met die ontwikkeling van duidelik waarneembare selveranderings. Verteenwoordigende stamme van al nege serotipes is derhalwe verswak deur seriepassering in bogenoemde selle. Die stamme is op verskillende passaat peile vir veiligheid en immunogeniteit in perde uitgetoets. Heelwat probleme is egter ondervind. Sommige virusstamme het hul immunogeniteit voor hul patogeniteit verloor en in ander gevalle het virusstamme volkome veilig na uittoets op beperkte skaal voorgekom, terwyl ernstige reaksies ondervind is wanneer grootskaalse proewe gedoen is.

Daarna is besluit om attenuering te verkry deur intraserebrale passering in babamuise. Al nege serotipes is vir 60 generasies in baba-muise oorgeplant en daarna in perde uitgetoets. Weer eens was die resultate teleurstellend. Oor die algemeen was die immunogeniteit van hierdie stamme baie swak en teëliggaamvorming was meestal afhanklik van 'n waarneembare kliniese reaksie.

Daar is terselfdertyd ook voortgegaan met enkele van die selkultuur-aangepaste stamme. Kloonseleksie is gedoen op Vero-selle ten einde 'n homoloë virusbevolking te verkry. Daar is egter gevind dat plaak-grootte baie varieer; gevolglik is kloonseleksie van groot sowel as klein plake gedoen. Hierdie merkers het met verdere passering redelik konstant gebly en proewe in perde het aangedui dat die klein plaak deur hoogs virulente perdesiekte-virus-partikels gevorm word, terwyl die groot plaak deur avirulente partikels ontstaan. Perde wat met eersgenoemde materiaal ingespuit is, het derhalwe perakuut gevrek, terwyl perde wat met laasgenoemde gespuit was, geen kliniese reaksie ondergaan het nie, maar nogtans 'n baie soliede immuniteit ontwikkel het.

Tydens werk op die patogenese van perdesiekte, is ook sekere „lyne" d.m.v. selektiewe passering van bv. longmaterial, miltmateriaal en supra-orbitale vet ontwikkel. Plaak-toetse op hierdie materiaal het die indruk van 'n korrelasie tussen plaak-grootte en patogeniteit bevestig.

Hierdie bevindings het dus 'n belowende alternatiewe metode daargestel vir die seleksie van avirulente virus-partikels vir gebruik as entstowwe. Omdat seleksie op 'n lae passaat peil gedoen kon word, word vermoed dat min probleme met immunogeniteit ondervind sal word. 'n Aanvang is reeds gemaak met die seleksie van geskikte klone van al die bekende sero-tipes. Sommige hiervan is gereed om in perde uitgetoets te word.

ii) *Slenkdalkoors-entstof*

Veldverslae het aangedui dat die standaard-entstof nie voldoende beskerming in beeste gebied het nie. In eksperimente hier uitgevoer is bevestig dat dit wel die geval was en die entstof nie doeltreffend in beeste is nie.

'n Stam van die virus, gepasseer in lam nierselle vir 60 passate, het 'n goeie immuniteit verwek, maar na 95 passate het dit geen immunogeniteit getoon nie. Dit blyk dus dat 'n goeie entstof vir beeste verkry sal kan word deur die 60ste passaat van die virus as saad-materiaal te gebruik.

iii) *Die Voorkoms van Varkpesvirus in Suid-Afrika*

'n Opname om die voorkoms van varkpesvirus in Suid-Afrika te bepaal, is in samewerking met Afdeling Veeartsenydiens onderneem. Vir die doeleindes van die opname is sagte bosluise *(Onithodorus moubata)* in vlakvarkgate gekollekteer en na Onderstepoort gestuur vir vasstelling van varkpesvirus in die bosluise. Tot op datum is ongeveer 10 000 bosluise van 149 vlakvarkgate op 73 plase in die Rustenburg-Thabazimbi-Waterberg- en Potgietersrust-distrikte versamel en getoets. Versameling van bosluise was grotendeels beperk tot die noord-westelike grense van die distrikte al langs die Limpoporivier.

Baie interessante en belangrike resultate is tot dusver verkry. Virus is afgesonder van bosluise verkry uit 27% van die vlakvarkgate

en 37% van die plase in die vier distrikte het besmette bosluise opgelewer.

iv) *Die Voorkoms van Smedi-virusse in Varke in Suid-Afrika*

'n Groot reeks enterovirusse van varke is in alle dele van die wêreld afgesonder, waaronder vier serotipes van die sogenaamde Smedi-virusse, nl. A, B, C en T80, wat afgesonder is van gevalle van aborsie, reproduksiesteurnisse en onvrugbaarheid onder varke.

'n Serologiese opname is in Suid-Afrika gedoen om vas te stel of dié virusse ook hier voorkom. Vir dié doel is 200 serummonsters van varke afkomstig van 39 plase getoets vir teëliggame teen Smedi-virusse A, B, C en T80: meeste van die serummonsters was afkomstig van plase met reproduksieprobleme onder varke. Van die monsters was 18% positief vir Smedi-A-virus, 16% vir B, 27% vir C- en 39% vir T80-virus.

v) *Drie-dae-stywesiekte van Beeste*

Enkele jare gelede is die virus van drie-dae-stywesiekte vir die eerste keer deur navorsers op Onderstepoort geïsoleer, deur dag-oud muise intraserebraal met besmette bloed of leukosiete in te spuit. Daarna is daar ook in geslaag om die virus in weefselkwekings van hamster-nierselle af te sonder. Deur die toepassing van die fluoresserende teëliggaamtegniek op die besmette weefselkweking en op besmette leukosiete in bloedsmere, is 'n praktiese diagnostiese tegniek ontwikkel.

Verdere navorsing het getoon dat die virus van drie-dae-stywesiekte 'n interessante en eienaardige morfologie het en saam met die virusse van hondsdolheid en vesikulêre stomatitis as 'n Rhabdovirus geklassifiseer kan word. Laasgenoemde virusse het 'n koeëlvormige struktuur, maar die virus van drie-dae-stywesiekte is bepaald pleomorf en kan as beide koeëlvormige en kegelvormige partikels voorkom. Hierdie waarnemings is ook met Australiese en Japanese isolate van die virus bevestig.

Die virus van drie-dae-stywesiekte verloor sy patogeniteit baie gou deur seriepassering in muise en weefsel-kultuur. 'n Geattenueerde stam van die virus is dus beskikbaar vir die bereiding van 'n entstof, maar aangesien 'n olie-hulpmiddel gebruik moet word om 'n doeltreffende immuniteit in beeste te bewerkstellig, sal heelwat tegniese probleme eers opgelos moet word voordat 'n entstof vir gebruik vrygestel kan word.

8. PROTOSOÖLOGIE

i *Die Lewensduur en Immunogeniteit van Anaplasma-entstof*

Deur alleen ontmilte diere vir entstofproduksie te gebruik is die entstof teen anaplasmose grootliks verbeter.

Eksperimente het egter bewys dat die *A. centrale* entstof 'n meer drastiese reaksie in volledig vatbare diere verwek as wat tot nou toe aangeneem is. Verder is gevind dat die entstof na 7 dae nog goed bruikbaar is. Die houvermoë is dus beslis langer as die voorgeskrewe 5 dae. Hoe langer die entstof na 5 dae gehou word, hoe langer word die inkubasieperiode. Op grond van hierdie eksperimente is die dosis van die bloed verminder na 2,0 ml.

Diere wat drie maande na inenting met *A. marginale* uitgedaag is het 'n goeie immuniteit getoon.

ii) *Besnoitia-entstof*

Die blouwildebees-stam van *B. besnoiti* is as 'n lewende entstof teen olifantsvelsiekte ontwikkel. Die parasiete is aanvanklik op kulture van nierselle van lammers en daarna op Veroselle gekweek. 'n Milde plaaslike reaksie met regionale limfknoopvergroting het na inenting voorgekom. Geen kliniese olifantvelsimptome het ontwikkel nie. 'n Ligte koorsreaksie en 'n tydelike steurnis van spermatogenese in bulle het soms opgetree.

'n Groot aantal beeste is reeds eksperimenteel onder veldtoestande geënt en 'n langdurige immuniteit is verkry. Die entstof het 'n 100% beskerming verleen teen die kliniese vorm van die siekte en 97,9% teen die subkliniese vorm.

Dit wil tans voorkom of 'n doeltreffende entstof wel ontwikkel is. Sodra probleme, wat ondervind word om voldoende hoeveelhede van die entstof te vervaardig, oorbrug is, sal oorgegaan word tot die kommersiële uitreiking van die entstof.

9. DIE PATOLOGIE VAN STRONGYLOIDES PAPILLOSUS BY BOKKE

Hierdie ondersoek het getoon dat *S. papillosus* beslis patogeen is vir bokke en onder veldomstandighede skyn dit 'n probleem te wees in jong diere, veral in S.W.A., maar ook in die Republiek.

Afgesien van 'n opsigtelike enteritis in die dermkanaal, kom letsels veral in die lewer, sentrale senustelsel en skeletspiere in beide natuurlike en eksperimentele gevalle voor. Die lewer toon hepatomegalie en soms ruptuur met hemoperitoneum, terwyl die skeletspiere Zenkerse hialien-degenerasie wys en die brein 'n uitgesproke *status spongiosum*. In kroniese gevalle, wat gepaard gaan met 'n kopertekort, word uitermatige vermaering aangetref en ook terminale senusimptome.

10. BIURET IN DIE VOEDING VAN HERKOUERS

Dit is welbekend dat biuret as bron van nie-eiwit-stikstof in die voeding van herkouers gebruik kan word, aanvullend tot swak hooi. Verdere navorsing is uitgevoer om die biuretolitiese aktiwiteit en aanpasbaarheid van die rumenflora te bevestig met verteenwoordigende monsters van rumeninhoud.

Dit is gevind dat die rumeninhoud van skape, wat nooit voorheen biuret gevoer is nie, geen biuretolitiese aktiwiteit besit nie en dat dit etlike dae neem vir die rumenflora om aan te pas. Nadat 'n dier voorheen biuret gevoer is, vind heraanpassing binne 24 uur plaas en is die rumenflora weer ten volle in staat om biuret in die voer te benut. Hierdie heraanpassingsvermoë van die rumenflora duur vir ten minste 8 maande.

11. HELMINTOLOGIE

i) *Die Vergelyking van Skape en Bokke as Tussengasheer van* Taenia ovis

In proewe om die normale tussengasheer van *Taenia ovis* te bepaal, is 'n aantal skape en boerbokke elk met 8000 *T. ovis* eiers besmet en 96 dae later ondersoek. Die bevindings het getoon dat, hoewel al die skape swaar besmet was, meeste van die siste (92,8%) gekalsifiseer was. Net 'n paar bokke het ligte besmetting getoon, maar slegs enkele (12,2%) van die siste was gekalsifiseer.

Dit wil dus voorkom asof die bok, en nie die skaap nie, die normale tussengasheer van *T. ovis* is.

ii) *Die Herbesmetting van Beeste met* Schistosoma mattheei

In 'n proef om die effek van herbesmetting van beeste met *S. mattheei* te bepaal is drie groepe vatbare beeste gebruik. Die eerste groep is eenkeer besmet met 'n hoë dosis serkarië, 'n tweede groep is lig besmet en het toe 18 maande later weer 'n ooreenstemmende hoë dosis serkarië ontvang, terwyl die derde groep eers relatief swaar besmet is en toe 12 maande later die hoë dosis serkarië gekry het.

Al die diere in die eerste groep het tussen 56 en 59 dae na besmetting gevrek. In groep twee het 2 uit 6 beeste na 118 en 174 dae onderskeidelik gevrek; hul simptome was heeltemal verskillend van dié diere wat 'n enkel hoë dosis serkarië ontvang het. Die oorblywende diere was 180 dae na herbesmetting nog klinies normaal. Nie een van die diere in groep drie het gevrek nie en almal was 6 maande na herbesmetting klinies normaal.

Hierdie resultate dui onteenseglik daarop dat beeste 'n mate van weerstand teen herbesmetting met *S. mattheei* opbou en dit word verder ondersteun deur die feit dat die persentasie ontwikkeling van wurms heelwat laer in herbesmetting teenoor enkelbesmette diere is.

12. CHLAMYDIOSE

Die onverwagte en onverklaarbare uitbreek van ensoötiese aborsie onder skape verlede jaar het 'n groot hoeveelheid bykomstige werk meegebring. Behalwe die toename in diagnostiese werk met die ondersoek van duisende monsters, is heelwat tyd ook aan navorsing en die voorbereiding van 'n entstof bestee.

Uit die serologiese werk, isolasie van die organismes en ondersoek van smere, was dit duidelik dat die siekte landswyd met 'n baie hoë voorkomssyfer opgetree het. Die rede vir die skielike opvlamming van die siekte is nie bekend nie, maar was beslis nie te wyte aan die gebruik van Onderstepoort-bloutongentstof soos sommige mense beweer het nie. Behalwe dat die roetine biologiese kontrole van entstowwe dié moontlikheid reeds uitgesluit het, is spesiale ondersoek ingestel om te bewys dat bloutong- en ander entstowwe vry is van *Chlamydia*.

Met die isolasie van die organismes in bebroeide eiers en ondersoek van smere is interessante gegewens verkry. Die organismes is geïsoleer van patologiese toestande in beeste, skape, bokke en perde en toevallig ook van 'n springbok, blesbok en kameelperd wat gevrek het. Dit blyk dus dat die organismes 'n wye gasheerreeks het.

In beeste is die organismes in geaborteerde fetusse, in swakgebore kalwers, in gevalle van kalwers met longontsteking, gewrigsontsteking, oogontsteking en fokale limfositêre nefritis, en in die geslagsorgane van bulle gevind.

In skape is *Chlamydia* in geaborteerde fetusse en in gevalle van swak, pasgebore lammers en lammers met longontsteking en gewrigsontsteking gevind. Die organismes is ook uit die geslagskanaal van ramme geïsoleer.

In bokke is *Chlamydia* in geaborteerde fetusse en in gevalle van longontsteking gevind, terwyl 'n *Chlamydia* wat in sekere opsigte verskil van die wat in herkouers gevind is, uit geaborteerde perdefetusse en gevalle van oogontsteking in perde geïsoleer is.

Navorsing het getoon dat daar nie 'n opvallende verskil is tussen die organismes wat van beeste, skape of bokke afkomstig is nie. Met *Chlamydia* wat uit skape geïsoleer is, is aborsies in koeie, swak kalwers en gevalle van

longontsteking, senu-aandoening, gewrigsontsteking, enteritis en limfositêre nefritis in kalwers gereproduseer. Met 'n bees-isolaat van die organisme is al die bekende sindrome van chlamydiose in skape verwek, behalwe gewrigsontsteking.

'n Lokale skaapstam van *Chlamydia* is aan bebroeide eiers aangepas en is toe gebruik vir die voorbereiding van 'n geïnaktiveerde olie-hulpmiddel-entstof teen chlamydiose in skape. Proewe met die entstof in skape en bokke, gebaseer op serologiese reaksies, het bevredigende resultate gegee. Die entstof is in 'n rekord tyd voorberei en vir gebruik beskikbaar gestel, maar die aanvraag vir entstof was en bly steeds teleurstellend. Hoewel dit nog nie onteenseglik bewys is dat die skaap- en bokstamme van die organisme identies is nie, word aanbeveel dat bokke met die skaapentstof gespuit word. Navorsing oor die gebruik van die skaapentstof in beeste het ook al belowende resultate gelewer, maar verdere werk word nog gedoen, veral die onderlinge vergelyking van die stamme van organismes afkomstig uit die verskillende spesies. 'n Ander faset wat ook ondersoek word is die kweking van *Chlamydia* in weefselkultuur; baie belowende resultate is ook hiermee verkry deur gebruik te maak van 'n endoteelsel-kweking wat op Onderstepoort ontwikkel is.

13. HARTWATER

Hoewel heelwat navorsingstyd bestee is aan pogings om die hartwaterorganisme in die laboratorium te kweek en 'n entstof voor te berei, was die resultate uiters teleurstellend en is nog geen vordering gemaak nie. Daar is wel in geslaag om die organisme in serie in muise oor te spuit, maar die muisaangepaste stam van die organisme het nie voldoende beskerming verleen teen 'n veldstam van hartwater nie.

Sukses is egter behaal in navorsing om die houbaarheid van bloed wat vir entstofdoeleindes uitgereik word te verbeter. Deur die byvoeging van 5% dimetielsulfoksied word die besmetlikheid van bloed met bevriesing en na ontdooiing op 'n hoë vlak gehou.

SERIAL PUBLICATIONS — PUBLIKASIEREEKSE

WORLD ANIMAL REVIEW

New Quartely aiming to promote development of livestock industry in under-developed countries; excellent illustrations and primarily written for a technical audience. UNIPUB Incorporated, Box 433, New York, N.Y. 10016. $3.00 per annum.

SCIENTIFIC PROGRESS / WETENSKAPLIKE VORDERING

This fully bi-lingual (English/Afrikaans) review of important scientific developments in South Africa, and of which Volume 6 No. 3 appeared on July 3, 1973, is issued by the Scientific Advisory Council of the Prime Minister, on behalf of which it is compiled and published by the Publishing Division of the Council for Scientific and Industrial Research (CSIR). Enquiries and contributions should be addressed to: The Editor, Scientific Progress, P.O. Box 395, Pretoria. Copyright free.

E. COLI VACCINE FOR PIGS

The *E. coli* vaccine for pigs is now being issued by the Veterinary Research Institute, Onderstepoort. It is an alum precipitated bacterin of six strains of *E. coli* isolated from outbreaks of colibacillosis in pig herds in South Africa. The strains selected are known to be involved in a large percentage of outbreaks both here and overseas.

The vaccine is intended for use in pigs of any age, depending on the occurrence of colibacillosis and oedema disease in a particular pig herd. If the disease is confined to suckling piglets, the sows are immunized by a single 5 ml subcutaneous injection 2—3 weeks *prepartum*. Sows must be revaccinated before each partus. If the disease occurs mainly after weaning, the young piglets should be vaccinated with a 2 ml subcutaneous dose 2—3 weeks before weaning (if they are weaned at 5 weeks, they must not be immunized until they are 3 weeks old, as they do not exhibit a satisfactory immune response). The vaccination may be repeated at weaning if the problem is severe.

If colibacillosis occurs in young piglets of all ages, the sows as well as the piglets may be vaccinated, and if it occurs at any other stage of growth, which is rare, the pigs may be vaccinated 2—3 weeks before the disease is likely to occur.

The vaccine will not prevent diarrhoea and death if the infection rate on the farm is very high owing to poor hygiene, poor husbandry, or if the pigs are subjected to severe stress.

Although there is a certain degree of cross-immunity between strains, the vaccine will not protect against all strains of *E. coli* pathogenic for pigs. If the vaccine appears to be ineffective, a thorough bacteriological investigation should be undertaken.

E. COLI ENTSTOF VIR VARKE

Die *E. coli* entstof vir varke is nou deur die Veeartsenykundige Navorsingsinstituut beskikbaar gestel. Dit is 'n aluingepresipiteerde bakterien van ses stamme van *E. coli* wat van verskeie uitbreke van kolibasillose in varke in Suid-Afrika geïsoleer is. Die stamme is geselekteer omdat hulle in 'n groot persentasie uitbreke beide hier en oorsee betrokke is.

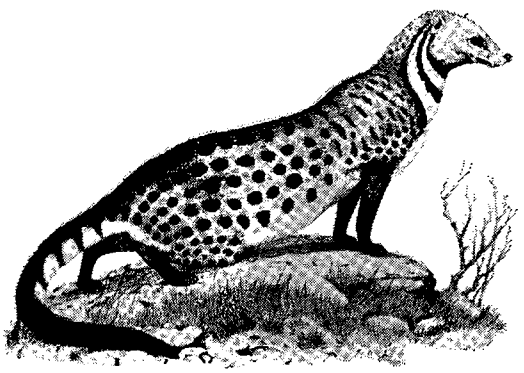
Die entstof is bedoel vir gebruik in varke van alle ouderdomme, afhangende van die voorkoms van kolibasillose en edeemsiekte in 'n bepaalde varktrop. As die siekte net in suip-varkies voorkom, moet die sôe met 'n enkele 5 ml onderhuidse dosis geënt word, 2—3 weke voor partus. Sôe moet elke keer voor partus geënt word.

Vir kolibasillose in gespeende varkies moet die varkies geënt word met 'n 2 ml onderhuidse inspuiting 2—3 weke voor speen (as hulle op 5 weke gespeen word, moet hulle nie voor die ouderdom van 3 weke geënt word nie, aangesien hulle nie bevredigend op die entstof reageer nie en nie genoeg immuniteit ontwikkel nie). Die enting kan op speenouderdom herhaal word as die voorkoms hoog is.

As kolibasillose in varkies van alle ouderdomme voorkom, kan die sôe sowel as die varkies geënt word, en as dit op enige ander groeistadium voorkom, kan die varke geënt word 2—3 weke voordat die siektetekens verwag word.

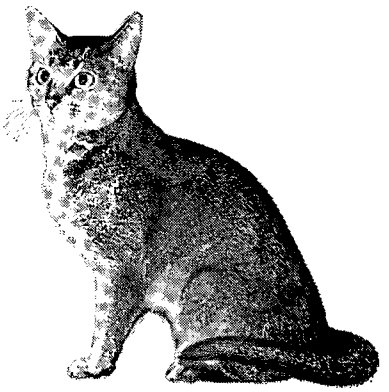
Die entstof sal nie diaree en vrektes verhoed indien die besmetting op die plaas weens swak higiëne baie hoog is, of as die varke onder swaar stress-faktore ly, of as die bestuur swak is nie. Alhoewel daar 'n sekere mate van kruis-immuniteit tussen stamme bestaan, sal die entstof nie teen alle stamme van *E.coli* wat patogeen vir varke kan wees, beskerm nie. Indien die entstof skynbaar ondoeltreffend is, moet 'n deeglike bakteriologiese ondersoek dus onderneem word.

Animals at Risk



Viverra megaspila civettina,
Large-spotted civet

The Travancore race of large-spotted civet was once very common in the plains and hills of coastal Malabar and Travancore, but is now rare and may even have become extinct.



Felis felis,
The cat

The domestic cat is numerous, but because of this, often suffers from unintentional neglect and in this modern world is at risk from infection.

BOVINE PARAFILARIASIS

Bovine parafilariasis was first recorded as occurring in Southern Africa in 1964 (Pienaar & van den Heever: **JI S. Afr. vet. med. Ass.** 35 : 181). At that time, the condition was considered rather a curiosity, with nothing known about its incidence, distribution and significance. The fact that the parasite is only found in about 25% of the carcase lesions, and that the characteristic manifestations of parafilariasis are readily and usually attributed to more common and better known causes, has undoubtedly hampered the recognition and diagnosis of the condition. In the live animal (Fg. 1) the focal cutaneous haemorrhages resemble injury by thorns, wire, biting flies or ticks. The subcutaneous lesions on the carcases of affected cattle look remarkably like those caused by contusion during handling and transport at some time before slaughter. The distribution of lesions on affected animals is indicated in the table.

Table: FREQUENCY AND DISTRIBUTION OF 129 PARAFILARIAL LESIONS ON BEEF CARCASES

SITE	Frequency (%)
I CRANIO-CAUDAL	
Neck	32,8
Withers	17,05
Thorax	24,03
Loins	17,08
Hindquarters	9,04
	100,00
II DORSO-VENTRAL	
Topline (10 cm either side of midline)	35,7
Lateral aspect of carcase	45,7
Ventral third of carcase	18,6
	100,00

It is now known that **Parafilaria bovicola** occurs in cattle in South West Africa, Botswana and most parts of the Transvaal. In cattle emanating from an experimental farm in the Northern Transvaal some 68% were found to be infested at slaughter. Discussion with livestock owners has disclosed that bleeding animals are frequently seen, particularly when gathered in kraals and feedlots. At abattoirs the incidence varies according to the source of the livestock: of 100 random carcases examined on each of three successive days at the Pretoria Abattoir, 60%, 32% and 58% (50% of the total of 300) were affected. The lesions almost always need to be trimmed away, resulting in decrease of total marketable carcase mass and leaving a blemished carcase which in some cases is awarded a lower grade. Data submitted by a livestock marketing agent, Mr Bossenger, indicate that in 10 severe cases the resulting losses averaged R7,77 per carcase, a total mass loss equal to 185 kg.

Investigations are currently under way to determine the life cycle, transmission, responsible insect vectors and their distribution, and possible means of control. Awareness, and the eventual diagnosis of

BEES-PARAFILARIASE

Beesparafilariase is eers in 1964 in Suidelike Afrika vasgestel (Pienaar & van den Heever: **Tydskr. S. Afr. vet.-med. Ver.** 35 : 181). Destyds was dit eerder as 'n seldsaamheid beskou: voorkoms, verspreiding en betekenis was onbekend. Die feit dat die parasiet slegs in 25% van karkasletsels vasgestel kan word en dat die kenmerkende tekens geredelik en gewoonlik aan beter bekende en meer algemene oorsake toegeskrywe kon word, het ongetwyfeld 'n demper geplaas op die herkenning en diagnose van die toestand. In die lewende dier (Fig. 1) lyk die omskrewe huidbloedings op beserings deur dorings, draad, bytende vlieë of bosluise. Die onderhuidse letsels in die karkasse van aangetaste diere lyk baie soos dié wat deur kneusing gedurende hanteer en vervoer op een of ander tyd voor slagting veroorsaak word. Die verspreiding van letsels oor aangetaste karkasse word in die tabel aangedui.

Tabel: VEELVULDIGHEID EN VERSPREIDING VAN 129 PARAFILARIA-LETSELS OP BEESKARKASSE

LIGGING	Veelvuldigheid (%)
I KRANIO-KOUDAAL	
Nek	32,8
Skof	17,05
Borskas	24,03
Lende	17,08
Agterkwart	9,04
	100,00
II DORSO-VENTRAAL	
Toplyn (10 cm weerskante van middellyn)	35,7
Sy van karkas	45,7
Ventrale derde van karkas	18,6
	100,00

Dis nou bekend dat **Parafilaria bovicola** in beeste in Suidwes-Afrika, Botswana en meeste dele van Transvaal voorkom. Van beeste van 'n proefplaas in Noord-Transvaal is ongeveer 68% by slagting besmet gevind. Uit besprekings met vee-eienaars het geblyk dat beeste met bloeiplekke dikwels gesien word, veral in krale en op voerterreine. By slagplase wissel die voorkoms volgens herkoms van die vee: van 100 karkasse lukraak op drie agtereenvolgende dae by die Pretoriase slagplaas ondersoek, was 60%, 32% en 58% onderskiedelik besmet, gemiddeld 50% vir die totaal van 300. Die letsels moet feitlik altyd weggesny word, met gevolglike verlies aan totale bemarkbare karkasmassa, en 'n gehawende karkas wat in sommige gevalle 'n laer graad behaal. Volgens gegewens van 'n vee-bemarkingsagent, mnr. Bossenger, het die gemiddelde verlies in 10 gevalle van swaar besmetting R7,77 per karkas beloop, 'n totale massaverlies van 185 kg.

Huidige navorsing word toegespits op lewensloop en oordraging van die parasiet, en moontlike beheermaatreëls. Bewustheid en uiteindelike diagnose van

parafilariasis must precede introduction of control, whereas differentiation between parafilariasis and bruising is of importance in relation to transport and pre-slaughter handling of cattle. The two pages of colour plates have been kindly sponsored by the Livestock and Meat Industries Control Board, Pretoria and will undoubtedly assist in making more widely known the appearance of parafilariasis in live cattle and beef carcases.

Submitted by: L. W. van den Heever, Faculty of Veterinary Science, University of Pretoria, P.O. Box 12580, Onderstepoort.

E. Nevill and B. G. W. Horton, Veterinary Research Institute, Onderstepoort.

Photography: A. M. du Bruyn and assistants, Veterinary Research Institute, Onderstepoort.

parafilariase moet instelling van beheer voorafgaan; onderskeiding tussen die siekte en gewone kneusing is weer van belang wat vervoer en hantering van vee voor slagting betref.

Die twee bladsye kleurafdrukke, goedgunstiglik deur die Raad van Beheer oor die Vee- en Vleisnywerheid geborg, sal ongetwyfeld daartoe bydra om die voorkoms van parafilariase in lewende beeste en op beeskarkasse wyer bekend te stel.

Ingedien deur: L. W. van den Heever, Fakulteit Veeartsenykunde, Universiteit van Pretoria, Posbus 12580, Onderstepoort.

E. Nevill en B. G. W. Horton, Navorsingsinstituut vir Veeartsenykunde, Onderstepoort.

Fotografie: A. M. du Bruyn en assistente, Navorsingsinstituut vir Veeartsenykunde.

LEGENDS

Fig. 1: Focal and prolonged haemorrhage from the skin leads to a characteristic streak of blood. Bleeding may take place from more than one point, particularly in old bulls.

Fig. 2: Microscopic examination of free-flowing blood from bleeding point on skin reveals fully embryonated ova.

Fig. 3: Appearance of bleeding point on skin when haemorrhage eventually ceases and blood dries.

Fig. 4: Removal of hair reveals slightly thickened and reddish skin around central puncture wound made by female worm prior to initiating haemorrhage.

Fig. 5: Exposure of subcutaneous aspect of bleeding point during or shortly after haemorrhage reveals presence of female worm in blood-stained area.

Fig. 6: The usual appearance of older lesion on carcase. Dirty reddish-brown areas, particularly along dorsal aspect of neck, shoulder, thorax and loins. Lesions remain slimy even after rest of surface has dried off owing to chilling of carcase. Presence of worm variable.

Fig. 7: Lesions may consist of area stained bright to dark red, with or without areas of necrosis. Worm may or may not be present.

Fig. 8: Parasites, usually females, may be found away from lesions in apparently unaffected subcutaneous connective tissue.

Fig. 9: Dead, partially encapsulated worms may be found particularly in carcases of aged individuals. Surrounding tissue may be 'normal'.

Fig. 10: In other instances the tissue reaction to the disintegrating worm is obvious.

Fig. 11: Extensive subcutaneous lesion of typical greenish yellow, dirty, slimy appearance; corresponding discolouration of underside of hide. (The 18-inch ruler indicates size of lesion).

Fig. 12: Regardless of age, extent or type of lesion, microscopic examination of Giemsa-stained lesion smears reveals very numerous eosinophilic leukocytes and granules liberated from such cells.

BYSKRIFTE

Fig. 1: Langdurige puntbloeding van die vel lei tot 'n kenmerkende bloedstreep. Bloeding kan van meer as een punt plaasvind, veral in ou bulle.

Fig. 2: Mikroskopiese ondersoek van vry-vloeiende bloed van die bloeipunt toon eiers met volledig ontwikkelde embrio's.

Fig. 3: Voorkoms van bloeipunt op die vel wanneer bloeding uiteindelik opbou en bloed droog word.

Fig. 4: Verwydering van hare toon 'n effens verdikte en rooierige vel om 'n sentrale steekwond, wat deur die wyfie-wurm gemaak word voordat bloeding aan die gang gesit word.

Fig. 5: Blootlegging van die onderhuidse aansig van 'n bloeipunt gedurende of kort na bloeding toon die teenwoordigheid van die wyfie-wurm in 'n bloedbevlekte kol.

Fig. 6: Die gewone voorkoms van ouer letsels op die karkas: vuil rooibruin kolle, veral langs die bo-dele van nek, skouer, borskas en lende. Letsels bly slymerig, selfs nadat die orige karkasoppervlakte uitgedroog het as gevolg van verkilling. Aanwesigheid van wurm wisselvallig.

Fig. 7: Letsels kan uit helder- tot donkerrooigekleurde kolle met of sonder weefselafsterwing bestaan. Wurm kan aan- of afwesig wees.

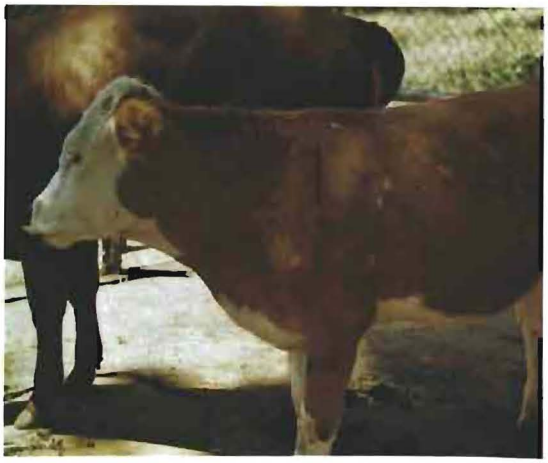
Fig. 8: Parasiete, gewoonlik wyfies, kan weg van die letsel in skynbaar onbeskadigde onderhuidse bindweefsel gevind word.

Fig. 9: Dooie, deels omkapselde wurms kan veral in karkasse van ou diere gevind word. Omliggende weefsel kan „normaal" lyk.

Fig. 10: In ander gevalle is die weefselreaksie teen die disintegrerende wurm in-die-oog-lopend.

Fig. 11: Uitgebreide onderhuidse letsel met tipiese groeneriggeel, vuil, slymerige voorkoms; ooreenstemmende verkleuring aan die binnekant van die vel. (Die 18-dm liniaal dui die grootte van die letsel aan).

Fig. 12: Afgesien van letsel se ouderdom, uitbreiding of tipe, toon mikroskopiese ondersoek van Giemsa-gekleurde smere tallose eosinofiele leukosiete en korrels deur sodanige selle vrygestel.



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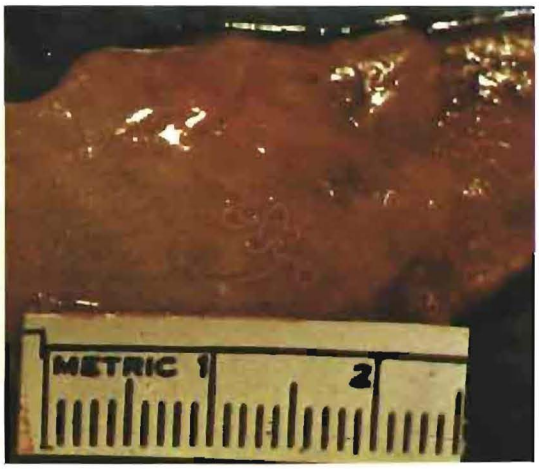

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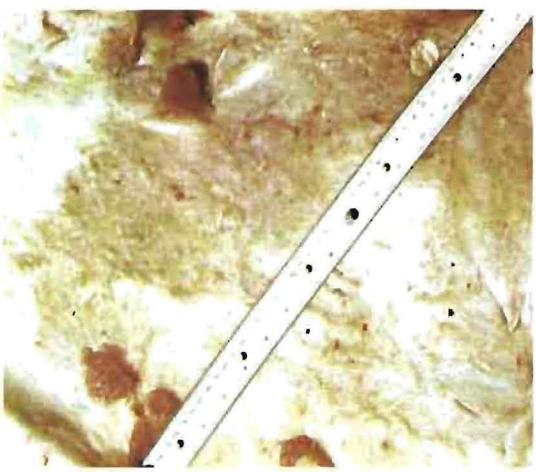

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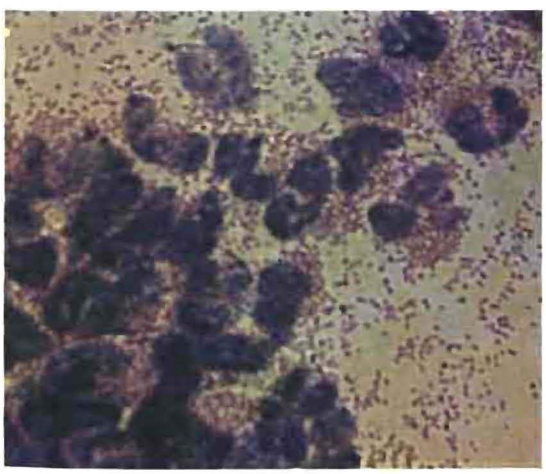

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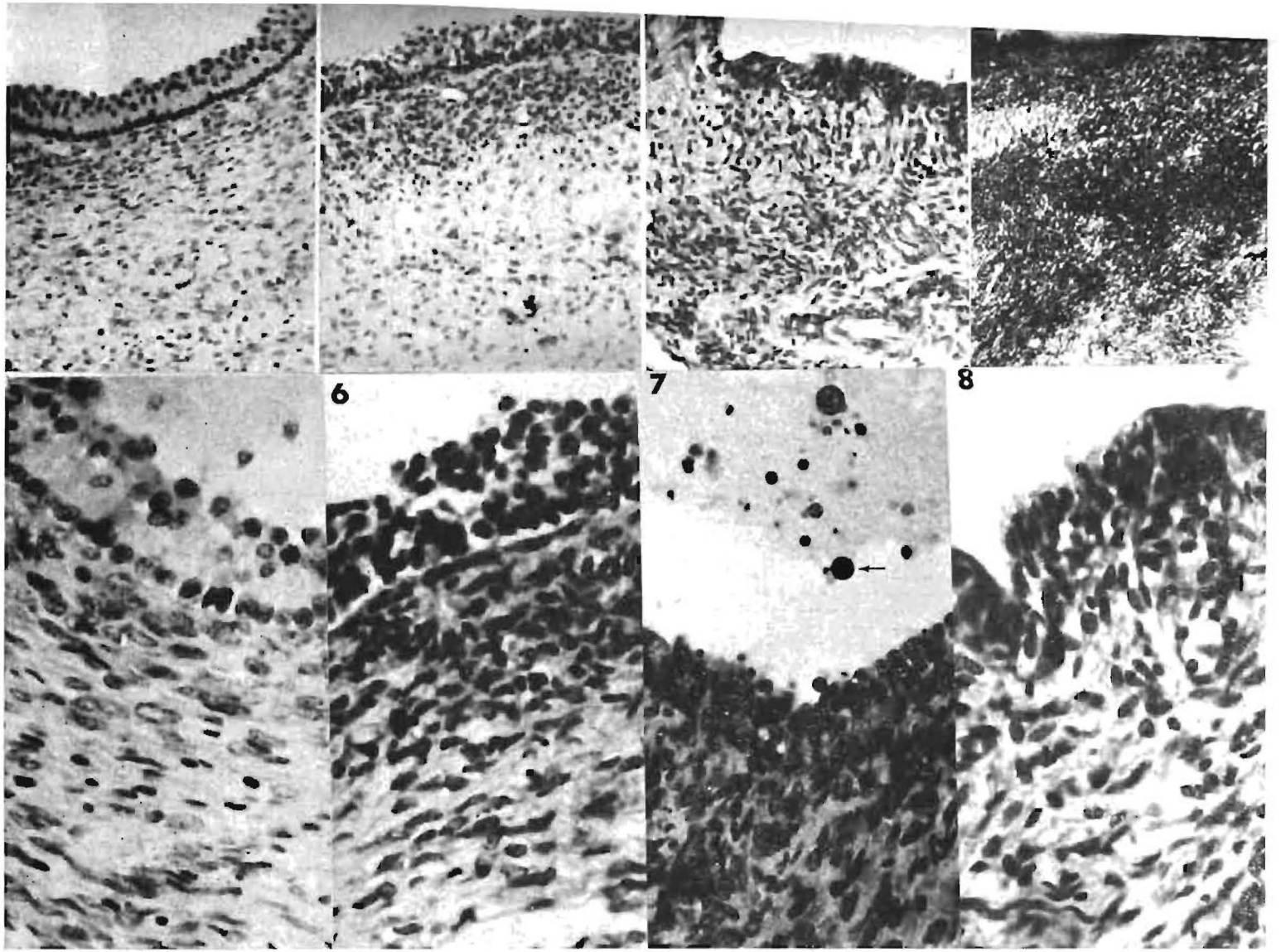
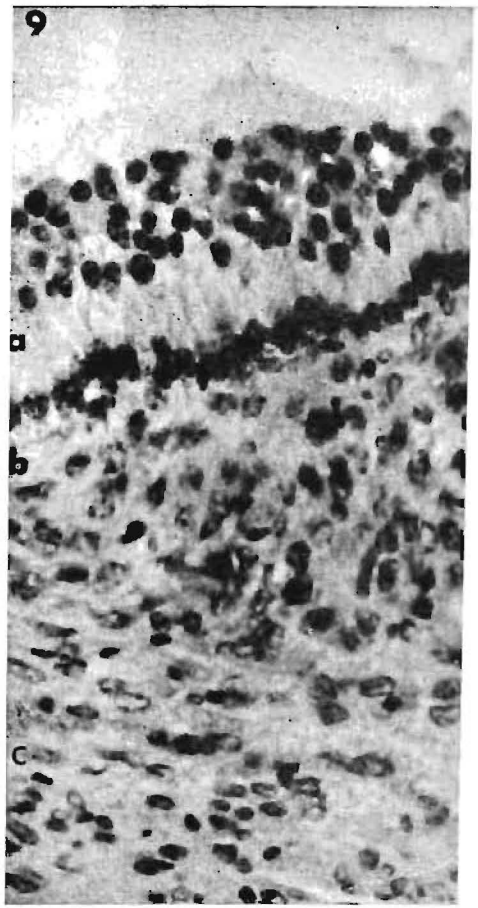
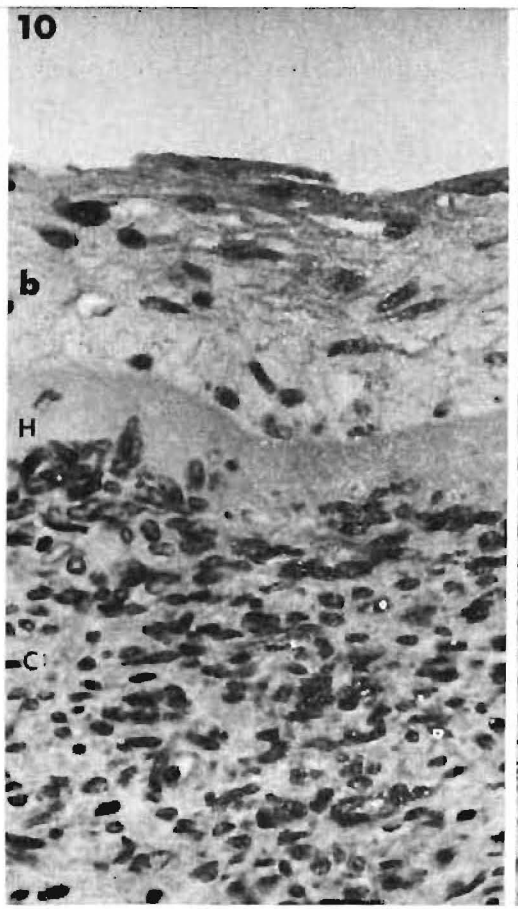


Fig. 1: (×80) Section of the wall of a small normal growing follicle. Note the well-organized stratum granulosum with its basal layer of tall cuboidal cells with proximally arranged nuclei. Differentiation between the theca interna and theca externa has not yet commenced.
Fig. 2: (×80) Section of the wall of a small follicle in the first stages of atresia. Note the disorganization of the stratum granulosum and desquamation of its distal cells. The basal layer of cells are no longer cuboidal, the nuclei are no longer arranged in a row.
Fig. 3: (×80) Section of the wall of a small follicle in a more advanced stage of atresia. Most of the granulosa cells have sloughed off into the antrum. The fibroblasts of the undiffentiated theca layers are actively proliferating and invading the remaining stratum granulosum.





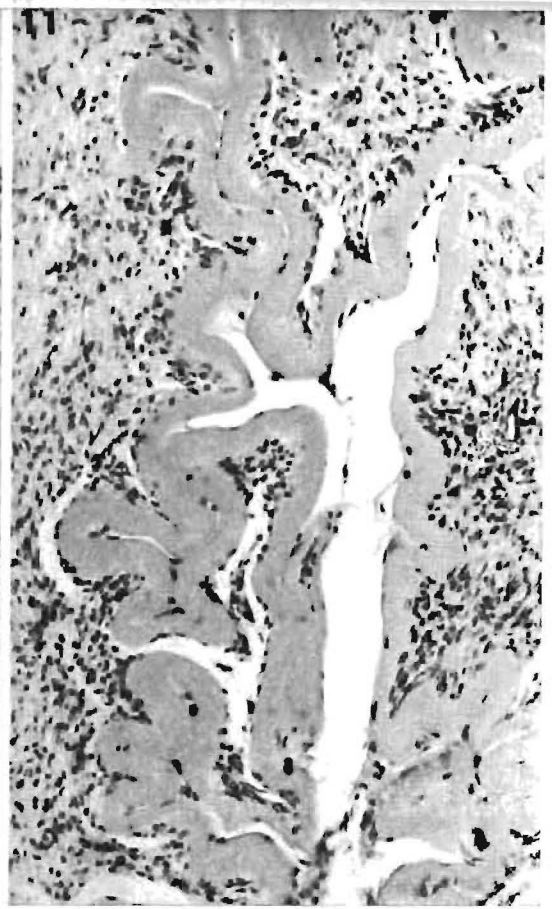


Fig. 4: (×80) Section of the wall of a small follicle at an even further stage of atresia. The fibroblastic invasion of the follicular wall is more advanced and ultimately will obliterate the antrum.
Fig. 5: (×512) A section of the wall of a normal small follicle. The stratum granulosum consists of a few layers of polyhedral cells with actively dividing, round, vesicular nuclei surrounded by a fair amount of cytoplasm. The basal layer consists of tall cuboidal cells with their nuclei arranged in a row close to the basement membrane. Note that just under these cells a few stromal thecal cells have begun differentiating into theca interna cells with large vesicular nuclei.
Fig. 6: (×512) A higher magnification of Fig 2 to show in the stratum granulosum the disorganized situation of the cells, the pyknotic nuclei, and the basal layer of cells separating from the basement membrane.
Fig. 7: (×512) Sloughing of the granulosa cells to form the pyknotic atretic bodies (arrow) floating in the follicular fluid.
Fig. 8: (×512) A higher magnification of Fig. 3 to show the active proliferation of the thecal stromal fibroblasts and invasion of the remaining stratum granulosum.
Fig. 9: (×512) A section of the wall of a medium-sized, normally growing follicle. Note the well-differentiated stratum granulosum (a), theca interna (b), and theca externa (c).
Fig. 10: (×512) A section of the wall of a medium-sized follicle undergoing atresia. Note that the stratum granulosum cells have sloughed off completely and have been replaced by a layer of phagocytic cells which have penetrated through from the theca interna. A hyaline band (H) with theca interna cells in various degrees of penetration has formed on the distal aspect of the theca interna (below H), i.e. between it and the desquamated stratum granulosum.
Fig. 11: (×512) A section of the wall of a medium-sized follicle in the late stage of atresia. The phagocytic layer distal to the hyaline band has regressed while the hyaline band itself has contracted causing collapse of the follicle and partial obliteration of its antrum.

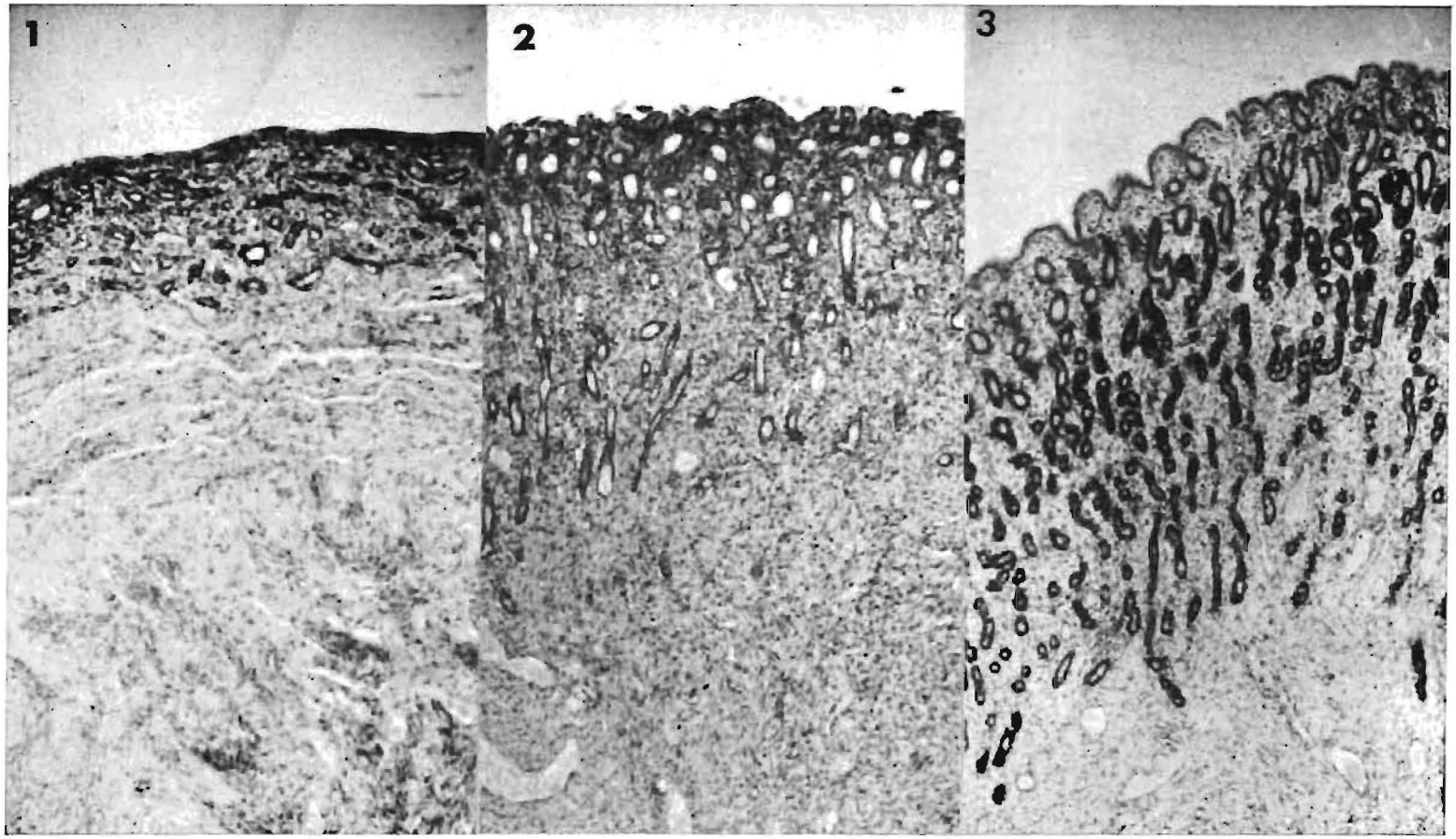


Fig. 1: (×80) A section through the wall of the uterus of a mare in deep anoestrum. Note the smooth endometrial surface and the narrow zone of glandular tissue.
Fig. 2: (×80) A section through the wall of the uterus of a mare in shallow anoestrum. Note that the surface of the endometrium is thrown into small secondary folds. Compared with Fig. 1, the glandular zone is about twice as wide, there are more glands present and the diameter of the glands is greater.
Fig. 3: (×80) A section through the wall of the uterus of a mare during an abnormally long oestrous period. Compared with Fig. 2, the secondary folds on the endometrial surface are larger, the glandular zone is about twice as wide, there are more glands per unit area and they are more coiled.
Fig. 4: (×512) A higher magnification of Fig. 1. The epithelial cells are cuboidal with a small amount of cytoplasm and small nuclei. The epithelial cells of the glands are small, condensed and stain darkly.
Fig. 5: (×512) A higher magnification of Fig. 2. Compared with Fig. 4, the surface epithelial cells are much higher, being low columnar. The nuclei are large, oval and lie vertically to the basement membrane. The diameter of the glands is greater and the epithelial cells are about as large as the surface epithelial cells although their nuclei are smaller.
Fig. 6: (×512) A higher magnification of Fig. 3. Compared with Fig. 5, the surface epithelial cells layer is higher, now being tall columnar with a large amount of cytopalsm. The large oval vesicular nuclei are more densely packed and lie vertically to the basement membrane. The glandular epithelial cells are smaller than the surface cells, but somewhat larger than the glandular cells of Fig. 5.