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REDAKSIONEEL

DIE VEEARTS EN DIE WETTE OP GEBRUIK VAN GEWOONTEVORMENDE MIDDELS

In die Republiek van Suid-Afrika word die gebruik van gewoontevormende middels van onweerlegbare geneeskundige waarde, of wat voordelig aangewend kan word, deur hoofsaaklik twee wette ten strengste beheer. Vanweë die moontlikheid van ernstige verslawing wat hul wangebruik inhou, is sodanige beheer ongetwyfeld noodsaaklik. Die deprimerende en demoraliserende uitwerking van verslawing aan sulke middels hoef nie in 'n professionele tydskrif beklemtoon te word nie.

Die Wet op Misbruik van Afhanklikheidsvormende Stowwe en Rehabilitasiesentrums, 1971 (Nr. 41 van 1971) klassifiseer middels in:

1) Verbode afhanklikheidsvormende middels;
2) Gevaarlike afhanklikheidsvormende middels;
3) Potensieel afhanklikheidsvormende middels.

Dit sal elke lid van die professie loon om hom op hoogte te stel met die inhoud van die drie afdelings.

Die gebruik van die middels in die eerste groep, wat amfetamien, deksamfetamien, metamfetamien, fenmetrasien en mengsels, wat sodanige stowwe bevat, insluit, is geheel-en-al verbied. Die bepalings van hierdie Wet met betrekking tot gevaarlike of potensieel gevaarlike afhanklikheidswekkende middels raak nie die bepalings van die Wet op Geneeshere, Tandartse en Aptekers 1928 (Nr. 13 van 1928), wat die gebruik van middels in hierdie twee kategorieë onder duidelike omskrewe voorwaardes toelaat, nie. Wet Nr. 41 van 1971 erken dat enige persoon, aan wie of ten behoewe van wie enige gevaarlike of potensieel gevaarlike afhanklikheidswekkende middel op geskrewe voorskrif van 'n veearts verkoop of gelewer is, sodanige middel mag besit en aan enige dier toedien waarvoor die preskripsie uitgereik is. Dis duidelik dat die wetgewers ten regte bekommer is oor die wangebruik van middels op mense en nie oor onherroeplike verslawing van bv. 'n hond of perd nie. Kan ons ons voorstel watter verantwoordelikheid dit van die veearts verg om te verseker dat die betreklik groot dosisse van 'n afhanklikheidswekkende

EDITORIAL

THE VETERINARIAN AND THE LAWS RELATING TO THE USE OF HABIT-FORMING DRUGS

In the Republic of South Africa the use of habit-forming drugs which have indisputable medicinal value or beneficial application, is extremely strictly controlled mainly by two Acts. There is no doubt that this is necessary due to the possibility of serious addiction arising from their abuse. The depressing and demoralizing effects of drug addiction do not require any emphasis in a professional journal.

The Abuse of Dependence-producing Substances and Rehabilitation Centres Act, 1971 (No. 41 of 1971) classifies drugs into:

1) Prohibited dependence-producing drugs;
2) Dangerous dependence-producing drugs;
3) Potentially dependence-producing drugs.

It would be well worth any veterinarian's trouble to acquaint himself with the contents of the three divisions.

The use of drugs listed in the first group (which includes amphetamine, dexamphetamine, metamphetamine, phenmetrazine and mixtures containing them) is entirely prohibited, but the provisions of this Act relating to dangerous or potentially dangerous dependence-producing drugs do not affect the provisions of the Medical, Dental and Pharmacy Act, 1928 (No. 13 of 1928) which allows the use of these two categories of drugs under clearly defined conditions. Act No. 41 of 1971 recognizes that any person to whom or on whose behalf any dangerous dependence-producing drug or potentially dangerous dependence-producing drug has been sold or supplied in terms of a written prescription of a veterinarian, may possess such a drug and administer it to any animal in respect of which the prescription has been issued. The legislators are clearly concerned about the misuse of drugs in humans and justifiably not about a dog or horse becoming irreversibly addicted. Can we imagine the responsibility it places on a veterinarian to assure that the relatively large doses of a dependence-producing drug prescribed for say large animals do not land in the wrong hands? A person may possess no more than the quantity of a drug prescribed by a veterinarian for use during a maximum period of 30 days.

middel vir byvoorbeeld grootdiere nie in verkeerde hande beland nie? 'n Persoon mag nie meer as die hoeveelheid van 'n middel besit wat deur 'n veearts vir gebruik vir die maksimum tydperk van 30 dae voorgeskryf is nie.

Bowendien is 'n veearts wat 'n potensieel gevaarlike of gevaarlike afhanklikheidswekkende middel inneem of aan homself toedien, skuldig in terme van Wet Nr. 41 van 1971 en kan hom by skuldigbevinding tot vyf jaar tronkstraf opgelê word.

Wet Nr. 13 van 1928 lê in besonderhede vas hoe 'n veearts, as professionele persoon, gewoontevormende middels in sy praktyk moet hanteer. Die term „gewoontevormende middels" soos gebruik in Wet Nr. 13 van 1928 in sy huidige vorm moet voorlopig vertolk word om die tweede en derde klasse onder Wet Nr. 41 van 1971 in te sluit, totdat eersgenoemde Wet na behore gewysig is. Die naam van 'n veearts word so gou moontlik na sy registrasie onder die Veeartswet deur die Veeartsraad aan die Minister van Gesondheid ter magtiging om gewoontevormende middels te gebruik voorgelê. Onderhewig aan sy diskresie reik die Minister 'n sertifikaat uit wat die veearts magtig om gifstowwe en gewoontevormende middels in te voer, koop, bekom, gebruik, voor te skryf, bestel of te lewer, uitsluitlik vir die behandeling van diere onder sy sorg en in ooreenstemming met die bepalings van Wet Nr. 13 van 1928. Dit word duidelik geïmpliseer dat middels gebruik moet word volgens algemeen aanvaarde farmakologiese beginsels. Die Minister kan te eniger tyd sodanige sertifikaat herroep as hy tevrede is dat voldoende rede daartoe bestaan; sy beslissing is finaal.

Die gewoontevormende middels word onder die Vyfde Skedule van hierdie Wet gespesifiseer en dit word gestel dat enige persoon, wat enige van hierdie middels sonder alle redelike sorg onder sy beheer aanhou of gebruik, aan 'n misdryf skuldig sal wees.

'n Gemagtigde veearts mag 'n hoeveelheid gewoontevormende middels of preparate wat dit bevat van 'n drogis of apteek aankoop op 'n geskrewe bestelling deur homself onderteken. Enige persoon mag 'n middel onder die Vyfde Skedule koop, as hy 'n voorskrif, uitgeskrewe en geteken deur 'n gemagtigde veearts, indien. 'n Bestelling of voorskrif deur 'n veearts gegee moet die hoof dra: „Slegs vir die behandeling van diere." Dit moet tewens aandui:—

a) Die naam en hoeveelheid van die middel

Furthermore, a veterinarian who takes or uses on himself any dangerous or potentially dangerous dependence-producing drug is guilty of an offence in terms of Act No. 41 of 1971 and liable on conviction to imprisonment for up to five years.

Act No. 13 of 1928 determines in detail how a veterinarian as a professional person should handle habit-forming drugs in conducting his practice. The term "habit-forming drugs" as used in Act No. 13 of 1928 in its present form should be interpreted to include the second and third classes under Act No. 41 of 1971 until the former Act is suitably amended. As soon as possible after registration under the Veterinary Act, the name of a veterinarian is submitted to the Minister of Health by the Veterinary Board to obtain authority for him to use habit-forming drugs. The Minister then issues a certificate at his discretion, authorizing the veterinarian to import, purchase, acquire, keep, use, prescribe, order or supply poisons and habit-forming drugs in the course of his practice, solely for the treatment of animals under his care and in accordance with the provisions of Act No. 13 of 1928. It is clearly implied that the drugs should be used according to generally accepted pharmacological principles. The Minister may at any time cancel such certificate if he is satisfied that sufficient reason for doing so exists; his decision in the matter is final.

Under the Fifth Schedule to this Act the habit-forming drugs are listed and it is stated that any person who keeps in his possession or under his control or uses any of these drugs without exercising all reasonable care shall be guilty of an offence.

An authorized veterinarian may purchase from a druggist or chemist a quantity of a habit-forming drug or preparation containing it by producing a written order signed by himself. Any person may buy a drug included in the Fifth Schedule on the production of a prescription written and signed by an authorized veterinarian. An order or prescription given by a veterinarian has to be headed by the words "For animal treatment only." It furthermore has to state:—

(a) the name and quantity of the drug which may be sold or supplied, and

(b) the name and address of the person for whose animal the drug is required or prescribed, or the name and address of

wat verkoop of gelewer mag word; en

b) die naam en adres van die persoon vir wie se dier die middel nodig is of voorgeskrywe word, of die naam en adres van die inrigting waarvoor dit bestel word; en

c) die naam, adres en kwalifikasie van die persoon wat die voorskrif of bestelling teken; en

d) die datum van uitreiking van die voorskrif of bestelling.

Die middel in die bestelling of voorskrif genoem mag nie meer as een enkele keer uitgereik word nie. Die persoon wat die middel verkoop of lewer moet die voorskrif of bestelling vir ten minste drie jaar behou en hy mag geen afskrif daarvan maak nie. Dit moet beskikbaar wees vir ondersoek deur enige persoon deur die Minister daartoe gemagtig, of deur enige lid van die polisiemag wat deur 'n magistraat daartoe gemagtig word, of deur die Registrateur aangestel onder Wet 13 van 1928, of enige persoon deur hom daartoe gemagtig.

Enige veearts wat in die wettige uitoefening van sy beroep gewoontevormende middels gebruik of resepteer, moet die volgende besonderhede in 'n spesiale register aanteken:

a) die hoeveelheid van die middel in sy besit of deur hom verkry;

b) die datum van verkryging;

c) die naam en adres van die persoon van wie dit verkry is;

d) die hoeveelheid verbruik, hetsy deur verkoop, reseptering of in die gewone verloop van sy praktyk. Indien deur verkoop, moet die datum daarvan en die naam en adres van die koper aangeteken word.

Die register moet op datum gehou en gebalanseer word om die hoeveelheid van elke gewoontevormende middel in voorraad op die laaste dag van Maart, Junie, September en Desember van elke jaar te toon. Die register is oop vir dieselfde inspeksie as wat vir voorskrifte geld.

'n Veearts, wat onder Wet Nr. 13 van 1928 gemagtig is om gewoontevormende middels aan te hou en te verskaf, is volgens beide privaat- en strafreg aanspreeklik vir enige daad of versuim van sy vennoot, assistent, klerk, agent of bediende ten opsigte van enige oortreding van die Wet, tensy hy bewys dat die daad of versuim nie aan enige gebrek van behoorlike bevele of toesig van sy kant toegeskryf kan word nie.

Die straf vir oortreding van Wet Nr. 13 van 1928 is swaar.

the institution for which it is ordered; and

(c) the name, address and the qualification of the person signing the prescription or order; and

(d) the date of issue of the prescription or order.

Not more than one issue of the drug mentioned in the order or prescription can be made on it. The person selling or supplying the drug is not allowed to make a copy of the prescription or order; it must be retained for at least three years. It has to be open to inspection by any person authorized thereto by the Minister, or by any member of the police force authorized thereto by a magistrate, or by the Registrar appointed under Act 13 of 1928 or any person authorized by him.

Any veterinarian who, in the lawful exercise of his profession, uses or dispenses any habit-forming drug has to enter the following details in a special register:—

(a) the quantity of any drug possessed or acquired by him;

(b) the date of acquisition;

(c) the name and address of the person from whom it was acquired;

(d) the quantity which has been disposed of and whether by sale or dispensing or in the ordinary course of practice. If it is by sale, the date of the sale and the name and address of the purchaser has to be entered.

The register has to be kept up to date and has to be balanced to show the quantity of each habit-forming drug remaining in stock on the last day of March, June, September and December of each year. The register is open to the same inspection as mentioned under prescriptions.

A veterinarian authorized under Act No. 13 of 1928 to keep and supply habit-forming drugs is liable civilly and criminally for the act or default of his partner, assistant, clerk, agent or servant in respect of any contravention of the Act unless he proves that the act or default was not due to failure on his part to instruct and supervise the other person properly.

The punishment for violation of Act No. 13 of 1928 is severe.

Sonder om verder op die besonderhede van hierdie twee Wette in te gaan, is voldoende nadruk gelê op die uiterste sorg waarmee die Owerheid probeer om die misbruik van gewoontevormende middels te verhoed. Hierdie Wette sal ongetwyfeld taksies hersien word ten einde hulle beter te koördineer en om aan behoeftes in die praktyk te voorsien, maar enige verslapping van hul strengheid is onwaarskynlik.

Die oortreding van enigeen van hierdie twee Wette deur 'n veearts is des te ernstiger in soverre die Veeartsraad kennis sal neem van enige skuldigbevinding deur die Hof. Die Raad sal met goeie rede ten strengste optree as 'n professionele persoon nie met die verantwoordelikheid van korrekte hantering van gewoontevormende middels vertrou kan word nie.

Without enlarging further on the details of these two Acts a sufficient impression has been given of the meticulous care with which the Authorities try to prevent the abuse of habit-forming drugs. These Acts no doubt will be amended periodically to bring them closer together and to comply with practical needs, but any relaxation of their strictness is unlikely.

The position of a veterinarian contravening either of these two Acts is even more serious in so far as the Veterinary Board will take cognisance of any conviction in a court of law. The Board certainly has good reason to act most strictly when a professional person cannot be entrusted with the responsibility of handling habit-forming drugs correctly.

EDITORIAL NOTE

REDAKSIONELE AANTEKENING

THE USE OF ANTIBIOTICS IN ANIMAL FEEDS

The Task Force appointed in April 1970 to undertake a comprehensive review of the use of antibiotics in animal feeds has now published its report to the United States Food and Drug Administration.

The Force included specialists on infectious diseases and animal science from the FDA, National Institutes of Health, U.S. Dept. of Agriculture, Center for Disease Control, universities and industry.

They have come to the following conclusions:

1. Most antibiotics used in animal feed are used in combination with other drugs in an attempt to increase rate of gain, feed efficiency and control diseases. Based on the data submitted to the Task Force, it appears that antibiotics used in animal feeds either alone or in combination may increase the rate of gain and/or feed efficiency. The attainment and degree of response varies with the animal's environment, its species, its age, the amount and type of antibiotic and other, as yet undefined, factors. A review of the efficacy of specific autibiotics, alone or in combination, is properly a matter for the Bureau of Veterinary Medicine to implement and administer. The Task Force understands this review has been initiated. This review should be pressed to an early conclusion. It is strongly recommended that sufficient staff be assigned to this task to allow its completion within a year.
2. Data indicate that antibiotics in feed are effective for the control of clinical illness for animal diseases when the proper antibiotic is used selectively at therapeutic levels for short periods of time. The efficacy and safety of long-term feeding of subtherapeutic levels of antibiotics for animal disease control and prophylaxis has not been demonstrated adequately.
3. Human illnesses and death have been reported due to both antibiotic-sensitive and antibiotic-resistant bacteria of animal origin. Food-producing animals constitute a major reservoir of certain bacteria (e.g. *Salmonella)* pathogenic for man. Evidence suggests that the use of certain antibiotics in food-producing animals promotes an increase in the animal reservoir of *Salmonella* through promotion of cross-colonization and infection, prolongation of the carrier state, and relapse of disease. Furthermore, the use of some antibiotics in animals produces a marked increase in the prevalence of R-factor containing bacteria which may be trans-

missible to man's enteric flora. These observations lead to the logical conclusion, though not fully documented, that such practices give rise to a human health hazard.

4. Any attempt to ascribe economic benefit to the use of antibiotics in animal feeds must of necessity be based upon estimates. Since the response to the use of antibiotics at low levels in feeds varies from species to species, from strain to strain within those species, and with environmental differences, average effects must be estimated in the absence of precise data. On the basis of data presented by the Animal Health Institute, the animal and poultry industries, universities and experimental stations as well as from the literature covering the period 1960 to 1969, this Task Force has developed estimates of improvement in rate of gain in weight, in feed efficiency, and also on the number of animals reared under these programs. (Appendix—Economic Value).
5. The continuous feeding of certain antibiotics to animals has been reported to compromise the treatment of certain animal diseases. Additional information is needed to quantitate the extent of this problem. Epidemiological and controlled challenge studies are needed to determine the relationship of the use of antibiotics in animal feed and the subsequent treatment of diseases in animals which have been fed antibiotics.
6. The categorization of antibiotics into those for human and those for animal use should be based on scientific evaluations of the efficacy of each use and the impact that the use will have on all aspects of the public health. Such categorization must not result in compromising the availability of effective antimicrobials for humans or animals. It is the consensus of the Task Force that it would be highly desirable that in the future a group of antibacterial agents be reserved exclusively for human use.
7. Limiting the types of antibiotics permitted in animal feeds is a step toward controlling the numbers of micro-organisms resistant to antibiotics. Research is needed to investigate methods for improving weight gain and feed efficiency with drug agents and animal husbandry practices which do not cause the development of organisms resistant to antimicrobials.
8. When drug withdrawal times are not adhered to, antibiotic residues may be present in meat and meat products. The Task Force has not dealt with this in depth because the FDA has indicated that this matter is currently under review within and outside of the Agency.

Their recommendations may be summarized as follows:

A. *That funds be allocated for research into:*
   - —diseases such as shipping fever, stress and hepatic abscesses;
   - —the safety of antibiotics;
   - —the transmission of bacteria from animals to animals and to man;
   - —drugs that will eliminate R-factors;
   - —the allergenic residues and breakdown products of antibiotics;
   - —the ecology of the bacterial flora of animals;
   - —the efficacy of antimicrobials for improvement of growth and production and for therapy and prophylaxis; and
   - —methods of promoting growth and the management of disease without resort to antimicrobials.

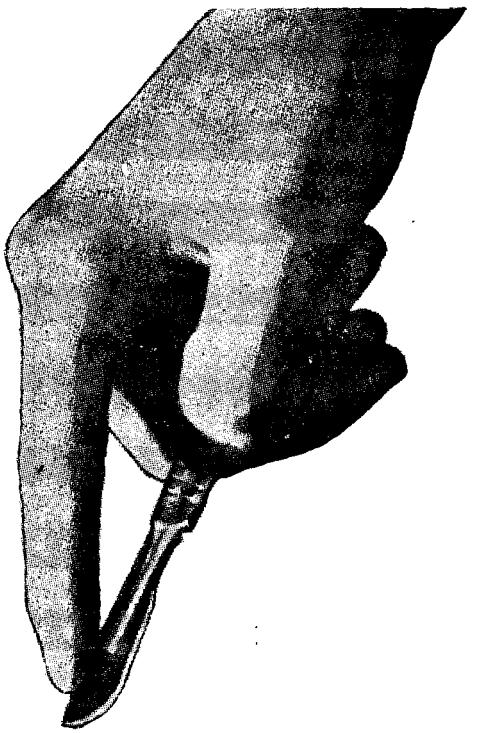
B. *That the following restrictions be placed on the use of antibacterial agents in feed:*
   - —antimicrobial agents used in human clinical medicine that fail to meet certain guidelines regarding safety and/or efficacy, be prohibited for use as growth promoters and at subtherapeutic levels by Dec. 31, 1973, and that other agents be sought and developed to increase rate of growth and feed efficiency;
   - —tetracyclines, streptomycin, DHS, neomycin, spectinomycin, penicillins and the sulfonamides be reserved for short term therapy at therapeutic levels on veterinary prescription, unless they meet safety and efficacy requirements for use as growth stimulants and at subtherapeutic levels;
   - —antibiotics such as chloramphenicol, semi-synthetic penicillins, gentamycin and kanamycin be prohibited from use in animal feeds;
   - —all medicated feeds to be labelled so as to indicate the amount of antibiotic in the final feed.

Appendix:

Antibiotics to the value of some $64m. were used in the American animal industry in 1969, and it is estimated that this brought about a return of over $400m. to the meat producer in 1970.

What's behind a precision sharp blade of persistent quality . . . . .

besides the surgeon's hand, that is?



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SPECIAL REPORT SPESIALE VERSLAG

TODAY'S MEAT HYGIENE AND INSPECTION

INTRODUCTION

From December 13 to 16, 1970, the World Association of Food Hygienists held a Round Table Conference on the above subject at Langford, Bristol, Great Britain, under joint chairmanship of Dr. E. H. Kampelmacher of the National Institute of Public Health, Utrecht and of Prof. Dr. H. Bartels of the „Institut für tierärztliche Nahrungsmittelkunde", Giessen. Twenty-eight persons from seventeen countries participated, including a representative of WHO, as well as three observers. The following summary of the main points raised in discussion and the subsequent recommendations were received for publication in the Journal of the SAVA, as part of a policy of submitting them to veterinary journals in all countries.

SUMMARY OF PROCEEDINGS

The animals on the farm

In some countries examination of animals on the farm is practised at the time they are to be sent for slaughter. This practice is of great value, since the field veterinarian is conversant with disease problems on the farm and can decide whether or not the animals will be fit for slaughter. In this case the effective identification of the animal is vital.

It was considered advisable that animals should be accompanied by a certificate indicating health status and in the case of animals sent for emergency slaughter the certificate would indicate disease status. This helps to link veterinary services on the farm with those in the abattoir and is a useful adjunct to *ante-mortem* inspection in the lairage. It cannot, however, replace the latter, especially as damage may occur or disease may develop during transport. Also it is not applicable to systems of extensive husbandry. The importance of *ante-mortem* inspection is such that it should be mandatory, although it was mentioned by several participants that this requirement would involve difficulties in some rural areas.

Arrangements to ensure that farmers receive information from the meat inspection service on the health status of their animals at the time of slaughtering have been introduced in some countries. Development of this system should be actively supported as this should encourage the passing on of information regarding the health of slaughter stock from the farm to the abattoir.

This interchange of information is the foundation upon which the protection of animals and humans from disease hazard and the protective promotion of animal health must be based.

Laboratory facilities

To obtain the fullest value from this co-operation, better laboratory facilities are needed in meat inspection and these can be used both for *ante-mortem* testing at the farm level, especially for examination of sera and faeces, and in the abattoir for microbiological and histological examination, for checking on the presence of residues and for general control of slaughterhouse hygiene. These facilities are vital as a result of the increasing use of special methods of intensive livestock production, which are producing difficulties associated with latent infections, residues of growth-promoting substances and other drugs used, and of contaminants such as pesticides which are accidentally absorbed. Moreover, meat inspection laboratories should be fully equipped to carry out surveillance programs on foods from the production up till the retail level.

It was felt that although these problems could be solved to a certain extent by the application of scientific information in improved meat inspection there would still be a great need for involvement of other authorities and in certain cases education of the public to the dangers which might result from certain eating habits.

Residues

There was considerable discussion on the growing problem of residues of antibiotics, hormones and other chemicals.

Some felt that the prohibition or control of their use in the live animal could reduce

this problem significantly. Others were of the opinion that the problem would be best attacked from the side of meat inspection. Detection of residues at levels above those permitted would result in condemnation of the carcass and thus would act as a deterrent. This would imply the application of a monitoring system of control.

Meat inspection procedures

Some of the participants stressed that meat inspection procedures were developed at the end of the last century, but the eradication of certain transmissible diseases and changes in the incidence of other diseases made a critical revaluation of traditional methods necessary in the light of present day health hazards. Whereas some emphasized the need to retain extensive methods of examination of the single animal, others suggested new methods: for example, some delegates felt that cutting of many lymph nodes was still vital, whilst others felt that there was a strong case for reduction in this practice. This was justified in particular in the case of salmonella carriers, where cutting the mesenteric lymph nodes could well lead to contamination of other parts of the carcass or other carcasses. It will be necessary to discuss this matter in future in different countries to achieve a reasonable agreement.

Whereas some delegates were of the opinion that only two decisions, fit or unfit, should be accepted, others pointed to the fact that they need to save as much meat as possible for local consumption. In these cases a third category of conditionally fit meat should be allowed, at least as long as the safety of the products was insured. In certain cases, where large scale intensive production practices were involved, a decision on unfitness might be made in the living animal.

Although the factors which have led to the adoption by some countries of different standards of inspection for meat destined for local consumption and for export are understood, the need for a single standard of fitness of meat for human consumption was generally agreed.

It is suggested that the World Health Organization should convene a meeting of experts to define minimal requirements for *ante-* and *post-mortem* inspections and the judgements to be based on them. These criteria should relate to considerations of human and animal health only.

Specific problems

A great number of specific problems were brought forward by participants, for example the very high incidence of hydatidosis in some parts of the world and the lower, but still significant, level in the more remote areas of certain highly developed countries of Europe. The continuing problem of *cysticercosis bovis* in Africa, but also the increasing incidence in Europe was mentioned. There was some epidemiological information that the latter was associated with an increasing pollution of the environment of human origin.

In the field of bacteriological diseases there were many reports of the decreasing incidence of several diseases, including tuberbulosis and brucellosis, but of an increase in the incidence of *Salmonella* infections, latent or apparent. The last indicated an increasing contamination of the environment, both by way of the contamination of feeding stuffs supplied to the animals and distribution from the farms and the abattoir in the effluent.

In one country the decontamination of sludge is achieved by heat treatment or irradiation (experimentally), so that it may be used as a fertilizer. These findings once more indicated the need for veterinarians to enter the field of environmental sanitation. Recognizing the changing pattern which was developing in connection with the abovementioned factors, it was agreed that individual *ante-* and *post-mortem* inspection must be continued.

Meat inspectors

As a result of the many new problems which were arising, it was generally agreed that much of the routine meat inspection should be carried out by meat inspection assistants, under veterinary supervision to allow the veterinarian more time to carry out, and develop, more sophisticated techniques. It should be the aim of all countries to have inspection under the control of full-time inspectors but there are at present circumstances under which this cannot be justified. When part-time inspectors are used, however, it was agreed that they should have some specialized training reinforced by refresher courses.

There was a considerable discussion on the implications of the finding of zoonoses in

the abattoir, especially with regard to the special exposure of slaughterhouse workers to these infections. The transmission of human disease from slaughterhouse workers via the meat was also discussed and the need for co-operation between medical and veterinary services was emphasized. In this respect there is much more information in two WHO reports (Third Report of the joint FAO/WHO Expert Committee on Zoonoses, Geneva, 6—12 December, 1966, *Wld. Hlth. Org. Techn. Rep. Ser.*, 1967, 378, and FAO/WHO European Symposium on the Collaboration between Veterinary and Health Services, Ghent, 15—19 March, 1966).

Education

The very variable importance attached to education of undergraduates in veterinary public health and particularly food hygiene was mentioned and stress laid on the need to increase the amount of teaching in this subject, where deficient.

There was a particular need to develop the newer scientific findings in teaching programmes. This would almost certainly assist in the motivation of students towards food hygiene.

Nevertheless, it was generally agreed that an extensive specialization was not desirable at the undergraduate level, otherwise there might be a danger that students would not realize the close relationship between various parts of veterinary science. In post-graduate education, however, there was a definite need for special training, which should form a vital part of the education of full-time food hygienists. In addition, refresher courses for both full-time and part-time workers in this field were necessary.

In addition to a knowledge of meat inspection and hygiene procedures, education should ensure that veterinarians have a wide knowledge of slaughterhouse planning and construction, the equipment of slaughterhouses, management of the slaughterhouse and control of its personnel. More specialized fields would include veterinary public health and epidemiology, environmental sanitation, food technology, microbiology, etc.

Other fields of activity

It was felt that, in addition to the control and inspection of foods of animal origin, such as rabbits, game, fish and of course poultry, the veterinarian should be involved in the supervision of the control of animal feedingstuffs.

In view of the potential public health and animal health dangers associated with poultry slaughtering and consumption, it was generally agreed that inspection procedures and hygiene control should be carried out under veterinary supervision as soon as possible, where not already put into practice.

RECOMMENDATION

1. Veterinary education in food hygiene needs to be orientated towards application of the science in the light of the requirements of existing environmental factors. Where necessary, more attention must be given to the subject in the undergraduate course, whilst avoiding any tendency to excessive specialization at this level which might tend to divide subjects into too tight compartments. This will maintain the broad background of the undergraduate veterinary course which is so vital in providing a graduate with a wide understanding of the relationship between the various stages of food production. In post-graduate education there is a need for an increase in training facilities, both in the form of courses for specialization and refresher courses for those already in this work.
2. Much more communication is needed between the farmer and field veterinarian on the one hand and the food veterinary hygienist on the other. This may be provided, for instance, by animal health certificates or other channels of information. This may apply to groups of animals, e.g. pens of pigs or batches of broilers, or, according to the circumstances of the country, it will in many instances refer to the individual, especially in the case of cattle. This may need education of the practitioner and the food hygienist in the value of this two-way exchange of information and of their responsibilities in the field of public health, including zoonoses. The transfer of information to the farmer and field veterinarian will be of value in disease control on the farm, whilst that from the farm to the abattoir will assist the food hygienist in coming to a decision and taking action. It will obviously be easier to control this situation where the field services and food hygienists are under a single administra-

tion, as has been shown in certain countries.

3. In connection with the recommendation of point 2 there is great necessity for identification of animals.

4. Meat inspection should be carried out under the responsibility of full-time veterinary inspectors. In many countries, as a result of shortage of full-time staff and for economic reasons, part-time meat inspectors are used. These should be trained in such a way that they can carry out the task efficiently. The special value of refresher courses for part-time inspectors cannot be over-emphasized.

5. Veterinarians involved in meat hygiene must be fully conversant with the whole breadth of the work in the slaughterhouse and all premises where meat is handled, but there is, in many cases, a definite need for the employment of meat inspection assistants to do routine work under the supervision of the veterinarian in order that the latter may be enabled to meet the increasing requirements of scientific applications to meat hygiene.

6. A number of meat inspection methods and procedures at present in use were developed at the end of the last century. These should be reviewed where necessary in accordance with scientific advances, and changes in the disease situation and husbandry methods in each country.

7. Problems of residues and metabolites are rapidly becoming more serious in meat hygiene and existing meat inspection services are not equipped to deal fully with many of these problems. Earnest consideration should be given to the development of methods of screening carcases, bearing in mind the need to ascertain levels of residues which are of real significance in human health. Such methods should then be introduced to the routine of the slaughterhouse, probably in the form of a monitoring system. The complete solution of these problems, however, demands a concerted application of control measures at every stage of meat production, backed by regulations produced by the responsible authority.

8. Intensive livestock raising methods are introducing many of the problems which are brought forward under items 2, 6 and 7. This justifies the implementation of these recommendations.

9. There is an urgent need for harmonization of meat inspection procedures and standardization of veterinary certificates for international trade. The requirements should not be exaggerated and only be based on scientific interpretation of human and animal health requirements.

10. Efforts should be aimed at finding safe methods of decontaminating infected carcases or parts of carcases and offal where ready access to rendering plants is not available, in order to break the cycle of infection.

11. In view of the potential public and animal health dangers associated with poultry raising and consumption, inspection procedures and hygiene control should be carried out under veterinary supervision.

12. It should be emphasized that besides knowledge of traditional tasks of meat inspection, the veterinary food hygienist should be expected to have an understanding of management, construction and design of slaughterhouses, of lay-out and utilization of equipment and of hygiene control.

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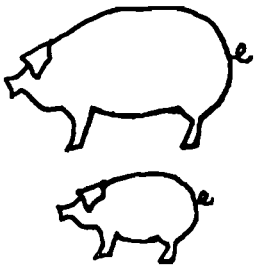

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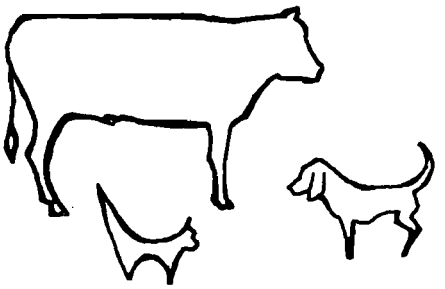

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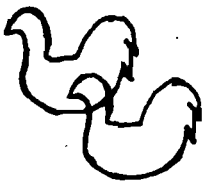

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SPECIAL REPORT SPESIALE VERSLAG

A REPRESENTATIVE SURVEY OF THE PIG INDUSTRY IN THE REPUBLIC OF SOUTH AFRICA*

S. K. Bakker and P. V. A. Davies**

SUMMARY

Various facets of pig production in South Africa were investigated by the method of surveying 40 of the larger pig farms throughout South Africa. These farms together were responsible for the production of approximately ten per cent of the total of 1¼ million pigs slaughtered in the Republic of South Africa in 1970.

The average litter size and numbers weaned per litter have been presented in tabular form. Various husbandry procedures, hygiene standards, climatic factors, housing facilities and diseases were compared in relation to pre-weaning losses.

The service procedures and sow management on the different farms were compared and litter size figures were better and the incidence of stillbirth less on those farms where the dry sows were isolated during gestation.

Attention was given to the effect of climate on reproduction. Breeding during the cooler months of the year produced more favourable results, and the necessity for the protection of breeding stock against the effects of high climatic temperatures was emphasized.

The occurrence of disease on the farms was recorded, but not the loss caused by any one disease in particular.

Reproductive disease appeared to be the main problem affecting the sow, and scouring the most important condition occurring amongst suckers, weaners and older pigs.

A large proportion of the producers complained of septic conditions in pigs of all ages, which was reflected in the slaughter condemnation figures.

ACKNOWLEDGEMENTS

The authors are grateful to the pig farmers who co-operated in the conduct of the survey; Dr. R. K. Loveday of the Veterinary Faculty, Onderstepoort, for his interest and advice; and thank the Director of the Veterinary Research Institute, Onderstepoort, for facilities provided, and the Livestock and Meat Industries Control Board for their assistance and permission to publish the report.

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**c/o The Livestock and Meat Industries Control Board, P.O. Box 1357, Pretoria.

I INTRODUCTION

This survey was conducted by the Pig Research Unit of the Meat Control Board, stationed at the Veterinary Research Institute, Onderstepoort.

The purpose of the survey was to gain information regarding existing practices and problems affecting pig farming; to familiarise the Unit with the pig industry; to indicate an average standard of production of those farms included in the survey; and, finally, to assess the identity and priority of problems for further evaluation and research.

In the pig industry today, the most important requirement is economic efficiency, which is influenced by management, housing, nutrition, genetic potential and disease. Of these the last is probably the most important and the most difficult to influence and control. There can be no sharp dividing line drawn between disease and production, and the role of the veterinarian in future must be such that by being able to appreciate economics and productivity, he will be able to recognise and remedy a disease problem within a pig herd.

All factors influencing the efficiency of production from a veterinary point of view were considered relevant to this survey. However, though nutrition is probably the most important economic factor in pig farming, and despite the role it plays in relation to disease, it was felt that this subject did not fall within the intended scope of this survey.

METHOD

The survey involved visiting 40 of the larger pig farms throughout the Republic, the provincial representation being 19 farms in Transvaal, eight in Natal, nine in Cape Province and four in the Orange Free State. This sample is proportional to the production of the provinces involved.

Each farm survey comprised interviewing and completing a questionnaire with the farmer, concerning management and production procedures with regard to housing, breeding, feeding, hygiene and disease problems; recording available production figures and slaughter records over a twelve month period; and a thorough inspection of the herd and examination of the premises. Finally each farmer was given a Husbandry Score reflecting his production procedures, and a Health Score reflecting the absence of certain abnormal or diseased conditions on his farm.

STATISTICAL ANALYSIS OF SURVEY

Number of farms visited	40
Total productive sow population	9 877
Total number of piglets weaned in 1970	136 483
Average number of piglets weaned per sow per annum	13,82
Total number of pigs marketed (May 1970 to April 1971 inclusive).....	132 688
Average number of pigs marketed per sow per annum	13,43
Approximate post weaning loss	2,80%

Table 1 is representative of 185 304 piglets born in 17 750 litters from 9 877 sows on 40 farms.

On the basis of size, the 40 farms visited can be classified as:-

Herds with more than 500 sows	4
Herds with 300 - 500 sows	8
Herds with 200 - 300 sows	8
Herds with 100 - 200 sows	15
Herds with less than 100 sows	4

(One baconer producer bought in weaners)

Of the four herds with less than 100 sows, three were pedigree herds.

ANALYSIS OF FACTORS INFLUENCING HERD PRODUCTIVITY UP TO WEANING

1. Use of farrowing crates

Out of 36 producers, 24 were using farrowing crates (66,6%). Of those using crates, 62,5% had a weaning index better than the average. Of those not using crates, only 50% had a better than average weaning index. This small, but significant difference favours the use of a farrowing crate.

2. Control of ambient temperature in the farrowing house

Out of 36 producers, 26 attempted to control the ambient temperature of the farrowing house by various insulatory means, and only one producer had a weaning loss of more than 20%. Of ten farmers who made no attempt to control the ambient temperature, seven had a weaning loss of more than 20%. These results clearly emphasize the importance of controlling the ambient temperature of the environment into which the piglet is born.

3. Piglet procedures

Of 36 producers, nine (25%) disinfected the umbilicus on the first day, with a variety of

disinfectants, such as Lugol's Iodine, tincture of iodine, acriflavine sol^{n}. 0,1 to 0,5%, ICI udderwash (hibitane), various antibiotic aerosol sprays, and gentian violet. The practice had no reflection on the weaning index.

27 producers (75%) clipped the deciduous canine teeth on day 1 to 3 after birth. The practice had no reflection on the weaning index.

5 producers (14%) docked the tail on day 1, most rather insufficiently. The practice had no reflection on the weaning index.

32 producers (89%) gave an iron injection 3 to 7 days after birth, preferring an iron dextran or iron carbohydrate preparation to a hydrogenated iron dextran preparation. Of the four farmers who did not give an iron injection, three (75%) had a weaning index more than the average.

These results emphasize the value of the injection of approximately 200 mg of iron intramuscularly to the three day old piglet, to prevent the development of piglet anaemia due to iron deficiency during the first few weeks of life.

4. Hygiene

Out of 36 producers, 24 had an above average (7+ out of maximum 10, being part of the Husbandry Score) standard of hygiene. Of these 16 (66%) had a better than average weaning index. Of 12 producers with a below average (six or less) standard of hygiene, only three (25%) had a better than average weaning index. These results emphasize the importance of disinfecting farrowing facilities between each sow, and minimizing the contact between each sow, and minimizing the contact between the newly born pig and the excreta of the sow.

5. Age at castration

This factor appeared to have no influence on the weaning index.

6. Seasonal and/or climatic variations

The monthly weaning loss as calculated for 32 farmers is presented in Figures 1 and 2.

TABLE 1

	Average	Individual high	Individual low	Comment
Average total litter size	10,44	11,95	9,02	
Average born alive per litter	9,73	11,21	8,17	
Average born dead per litter	0,71	1,40	0,09	Excluding one farmer who claimed nil.
Average weaned per litter	8,18	9,60	6,10	
% born dead	6,80	12,34	0,86	
% neonatal loss of born alive	14,23	23,04	5,67	Excluding one farmer who claimed 1,02%.
% loss to weaning of born alive	15,73*	32,28	6,53	
% loss to weaning of total born	20,95	39,08	10,38	
Number of sows per boar	16	28	9,4	Excluding pedigree breeders.
Number of sows per labour unit	21	43	11	
Number of litters per sow per annum	1,70**	2,30	1,23	
Average castration age in days	19	35	3,0	Excluding pedigree breeders.
Husbandry Score (maximum 36)	24	32	12	
Health Score (maximum 34)	22	27	17	
Average weaning age in days	40	56	35	Excluding two farmers experimenting with 21-day weaning.

* This figure is referred to later as the weaning index.

** This represents the average of the 40 farms. The direct sum of 17 750 litters from 9 877 sows gives 1,90 litters per sow per annum.

The average weaning loss for
the four coldest months (May,
June, July, August) 18,25%

For the four warmest months
(November, December,
January, February) 15,57%

For the four temperate months
(March, April, September,
October) 16,75%

The above figures emphasize again the necessity to control the ambient temperature of the farrowing house for the neonatal pig, especially during the colder winter months.

7. Seasonal variation in production

The monthly production of piglets born alive on the farms in the survey is presented in tabular and graphic form (Figures 3 and 4), both as a whole and on a regional basis (Transvaal, Orange Free State, Northern Transvaal, Natal and Western Province). This shows an overall drop in production during the autumn months of March, April and May, resulting from matings during November, December and January. The significance of this is discussed elsewhere in this article.

8. Housing

Of 39 producers, nine (23%) were wholly or partially using old buildings, and open camps with broken down fences, which by modern standards are completely unacceptable.

27 (69%) were wholly or partially using old sties, with the standard pattern of a covered sleeping area with an open dunging area offering trough space for food and water, usually in a reasonable state of repair with a satisfactory concrete floor and shelter from the elements.

26 (66%) had recently built additional new housing with the conventional design of a sleeping area under roof with an outside open dunging area, water being offered by nipple drinker or bowl, with a central feeding passage and sleeping quarters down both sides under a common roof.

14 (40%) used, partially only, new sophisticated buildings, under which is included sow stall houses of various designs and/or large fattening houses with slatted dunging passages and automatic feeding.

The average farmer builds to his own design, using cement blocks made on the farm for the walls, uninsulated concrete floors, and either corrugated iron or asbestos roofing, again uninsulated.

Only two out of nine farmers (24%) using old buildings had a weaning index of better than the average. Ten out of 14 farmers (72%) using (partially) new sophisticated buildings had a weaning index better than the average. This indicates that the standard of housing could be a limiting factor in the efficiency of pig farming.

9. Disease

The incidence of disease problems in young piglets up to weaning age was high, but it was very difficult, if not impossible, to formulate the degree of mortality caused purely by disease, as the incidence of the majority of pre-weaning diseases is greatly influenced by the standard of hygiene and husbandry. On 36 farms, the occurrence of the following conditions was recorded: -

FIGURE 1

Month	Born alive	Died	% loss
January	12 119	2 030	16, 75
February	11 292	1 916	16, 96
March	10 353	1 627	15, 71
April	10 242	1 904	18, 59
May	11 209	1 943	17, 33
June	11 036	1 850	16, 76
July	11 463	1 860	16, 22
August	13 227	2 987	22, 58
September	11 952	2 070	17, 31
October	12 092	1 894	15, 66
November	10 575	1 428	13, 50
December	11 494	1 733	15, 07

FIGURE 2

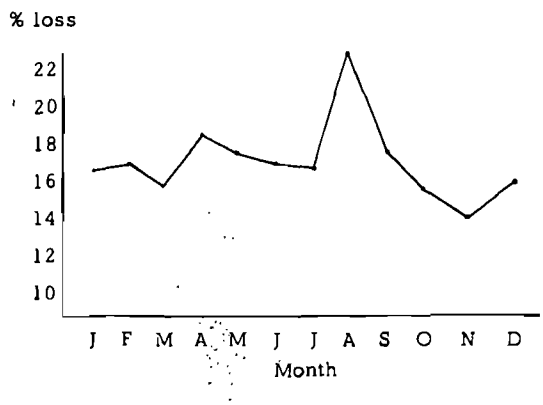


FIGURE 3

	Northern Transvaal	Transvaal	Orange Free State	Western Province	Natal	TOTAL
January	1 673	5 275	1 992	1 733	1 446	12 119
February	1 437	4 876	2 163	1 579	1 237	11 292
March	1 526	4 270	1 862	1 472	1 223	10 353
April	1 378	4 727	1 715	1 250	1 172	10 242
May	1 801	5 327	2 075	1 147	859	11 209
June	1 620	4 950	2 352	1 226	888	11 036
July	1 551	5 231	2 135	1 326	1 230	11 463
August	1 803	5 690	2 575	1 680	1 479	13 227
September	1 691	5 588	1 944	1 545	1 184	11 952
October	1 767	5 764	1 986	1 466	1 109	12 092
November	1 811	4 671	1 709	1 367	1 017	10 575
December	1 762	4 427	2 268	1 793	1 244	11 494

Scouring ..... on 32 farms (89%)

Septic conditions ..... on 21 farms (58%)

Anaemia ..... on 10 farms (28%)

Respiratory disease ..... on 8 farms (25%)

Nervous symptoms ..... on 2 farms (6%)

No reliable correlation could be drawn between standards of production and incidence of disease, as it was found that the poorer the producer, the more vague he was about specific disease problems.

10. Neonatal death

Due to the nature of the survey, figures were not always available to differentiate both a neonatal (up to three weeks of age) and weaning loss. However, of ten producers, where these figures were available, the average figures were: -

Neonatal loss - 14, 32% of born alive

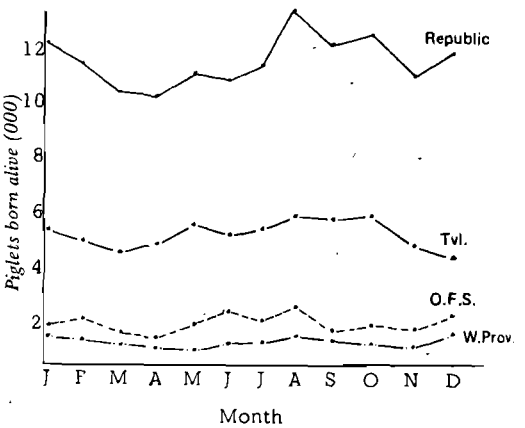
Weaning loss - 16, 65% of born alive

From this one can deduct that 86% of the loss of piglets born alive up to weaning occurs within the first three weeks of life, again emphasizing the necessity to provide farrowing facilities adequate to cater for the physiological requirements of the newborn pig.

11. Effluent disposal

Of the 40 farms visited during the survey, disposal of effluent was in most cases not a serious problem. Nearly all the farmers swept the sties once daily, manually removing the solid sweepings by wheelbarrow to compost heaps and hosing down thereafter with water daily or twice a week, this liquid effluent being run off in open channels, eventually finding its way on to a cultivated field of luceme or patch of veld by a simple flooding system. There appeared to be no influence on the weaning index by the individual farmer's efficiency of effluent disposal.

FIGURE 4



(Natal and N. Tvl. omitted for clarity)

12. Participation in the Sow recording and Health scheme

As this scheme basically records the farrowing performance of sows of pedigree herds only, participation in the scheme was discussed with the farmers in the survey. Only 14 farmers (35%) participated.

Of the 40 farms surveyed, 26 (65%) were specialised pig farmers and the production unit was run as a specific entity, and 14 (35%) were farmers with other farming interests of more importance than the pigs which still fell under their personal management.

The impression was gained that the existing Pig Health Scheme did not attract participation in by the majority of pig farmers, especially commercial producers, who considered participation to be of very little economic significance.

II SOW MANAGEMENT AND REPRODUCTION

The aspects considered here were service procedure, sow management, litter size in relation to sow management, seasonal variation in litter size and the percentage of still-born pigs.

1. Service procedure

(a) On seven out of 36 farms, where sows were left with the boar during the entire oestrus period up to one week, the average litter size was 10, 01.

(b) On six farms, where the sow was served three times during her oestrus, the average litter size was 9, 81.

(c) On a further 18 farms the sows were served twice with an average litter size of 10, 66.

The interval between services varied from 12 to 24 hours and hand service usually took place in the early morning or late afternoon, particularly during the hotter months.

It was noticed that farmers, often at the first signs of oestrus, would take the sow to be served immediately, which could be a waste of a first service, if it was in fact the very beginning of oestrus. The necessity for the correct timing of service with the time of ovulation, did not appear to be well understood by some farmers, and quite a few could not really confirm whether a particular sow had in fact been served.

2. Sow management

Sow management on 39 farms

Dry sow routine:

Sows mixed after service on ...	48, 6% of farms
Isolated in stall throughout cycle on	25, 6% of farms
Partially isolated on	20, 5% of farms
Batch-weaned, not mixed afterwards on	5, 1% of farms

Farrowing procedure:

Crates in use on	61, 4% of farms
New Z.R. or pen plus rail on	25, 6% of farms
Plain pen no rail on	12, 8% of farms

On the 19 farms where the dry sows were mixed:

Size of groups -

10 sows or less on	21, 0% of farms
14 to 20 sows on	42, 1% of farms
22 to 30 sows on	26, 3% of farms
60 to 80 sows on	10, 5% of farms

Feeding:

Closed individual feeders on	36, 8% of farms
No individual feeders on	21, 0% of farms
Open individual feeders on	15, 8% of farms
Outside individual feeders on	15, 8% of farms
Partial individual feeders on	10, 5% of farms

The tendency today is to move towards isolation of the sow during the full production cycle and the construction of simple sowstalls with minor variations seems to be the trend.

This method favours amongst others, supervision, hygiene and feeding control and appears to be the most practical way of achieving this.

3. Litter size in relation to sow management (See Table 2)

(a) Accurate figures were available for eight farms, where the mixing of dry sows in groups was common practice and these were recorded over a period of 12 months representing 3 538 litters. The average litter size was 10, 16. On these farms the average percentage stillborn piglets was 7, 3%.

(b) Similarly, figures were available for 10 farms, where the sows were isolated, either for the entire period of pregnancy or for at least the first three weeks. These farms produced a total of 4 425 litters over the same 12 months' period. The average litter size was 10, 75 and the average percentage stillborn piglets 6, 3%.

Combined these 18 farms represented roughly 5% of the recorded national production for 1970.

Isolation of the sow, particularly during the first three weeks after service favours the production of larger litters. The stress of jostling and fighting at this stage will cause losses at the early embryonic stage i.e. during embryonic implantation on the 13th day post service.

As illustrated in Table 2, the difference of 0, 59 piglet per litter represents a total loss of over 2 000 piglets on those farms where the dry sows were grouped together.

TABLE 2

	SOWS INDIVIDUAL			SOWS MIXED		
Number of litters	4 425			3 538		
	Average	Individual high	Low	Average	Individual high	Low
Total born	10, 75	11, 95	9, 98	10, 16	11, 05	9, 02
Born alive	10, 03	11, 21	9, 53	9, 47	10, 42	8, 17

Some farmers claimed an improved litter birth weight, if the sow was isolated during her last three weeks of gestation.

Also, though the figures available are too few to give a reliable reflection, the performance of those sows grouped together appeared to improve, if they were fed individually.

SEASONAL VARIATION IN LITTER SIZE AND PERCENTAGE STILLBORN

Because of the climatic conditions in South Africa, attention was given, where possible, to the seasonal effects on production and reproduction.

(a) It was observed that on 62% of the farms where reliable figures were available, slightly larger litters were born from the sows bred in the cooler months, e.g. an average litter size of 10, 54 as against 10, 40 from the sows bred during the warmer months of November to February. These figures were obtained from a total of 8 004 litters born over 12 months on 16 farms.

In addition the drop in production during autumn, which appears to be correlated to failure to conceive at first and even second oestrus during the hotter months, emphasizes the need to protect the breeding stock against the effects of high temperatures. Here it would be useful to be able to record the actual temperatures to which the animals are exposed.

Considering the fact that 46% of the producers mentioned difficulties with breeding in the summer months, it is obvious that the problem is bigger than may appear at first and, if accurate figures could be obtained to assess this effect, one could well be surprised at the size of the production loss involved.

(b) The percentage stillborn recorded over the warmer months of November to March 1970 was 7, 2% compared to 8, 0% over the colder months. These figures were obtained from 15 farms producing 66 110 piglets of which 4 681 were stillborn.

There is usually no direct supervision during parturition and the recorded figures probably include those piglets that were born alive, but died very soon after birth.

On four farms a higher stillbirth figure was recorded for the warmer months and on two of these summer temperatures can at times be extremely high.

The reasons for the higher stillbirth rates recorded in winter need closer study before any deductions can be made.

III DISEASE

Although it was one of the main objectives of this survey to get an indication of the losses suffered by the pig industry as a result of disease, it was also one of the more difficult tasks.

It was more a probe into the wider aspects of disease in general and not a disease survey as such, where specific diseases could be identified and the problem analysed.

One had to rely on the farmers' knowledge, observation, interpretation and description of diseases coupled to one's own observations on the spot.

Where disease was identified more specifically the farmer had usually obtained the information from his own private veterinarian, from a slaughter report, or from veterinary field officers.

In order to be able to discuss problems with the farmer one had, to a large extent, to rely on the presentation of a symptom complex e.g. 'scouring' regardless of actual aetiology.

The picture presented is based on a recording of disease and other problems reported on each farm and the relative frequency with which each of these appeared in the total number of herds surveyed.

These figures represent the incidence of disease, but not the loss caused by any specific disease.

A.1. Disease in sows

These figures were obtained from 35 farms representing more than 9 000 sows. (See Table).

Disease	% farmers reporting the occurrence of the disease
Agalactia - more of a serious problem	37) 77
- only odd cases	40)
Footrot - mostly associated with other septic conditions	63
Septic conditions - not associated with footrot	23
Heat stress - breeding difficulties in hot season	46
Leptospirosis - associated with abortions or based on findings at slaughter	23
Abortions - with and without association with leptospirosis	20
Skin troubles - general	17
Gastric ulcer	9
Feet problems - general	9
Hephritis	6
Haemorrhagic enteritis syndrome ('red gut')	3

From this it can be seen that the main problems affecting the sow are: -

(1) Agalactia;

(2) footrot and other septic conditions;

(3) heat stress during breeding; and

(4) abortions or reproductive disease and sepsis.

Each of these subjects would warrant closer study, because losses attributable to them can be high e.g. whole litters can be lost with lactational failure and production losses of up to 40% and more can occur with outbreaks of leptospirosis and other infectious agents causing abortion.

The footrot problem was high on the list of complaints and few farmers had an effective answer to it.

Control measures have to be evaluated, as the condition involves moisture, injury and hygiene control.

2. Reported causes of death in sows

The majority of sows appeared to have died during the dry pregnant period.

Heart failure - fighting	Nephritis
Pneumonia	Farrowing complications
Abscesses - fighting	Prolapsed uterus
Injuries by boar	Prolapsed rectum
Twisted bowel	Snakebite
Red gut	Dry sows bloating on whey

Where figures are reliable from 22 herds representing 5 170 odd sows, a total number of deaths of 222 sows was recorded for 1970, representing 4,3% sow mortality per annum.

3. Sow replacement figures

Where figures are reasonably reliable, deaths plus culling of sows averages 28,2% out of 30 herds, with an individual high of 63% and a low of 9%.

Cullings were usually based on performance, age and feet apart from disease factors already mentioned.

B. Disease in piglets from birth to weaning

These figures were obtained from 36 farms producing ± 130 000 weaners in one year: -

Disease	% farmers reporting the occurrence of the disease
Scouring of varied aetiology	89
Septic conditions - general	58
Anaemia - mostly between 3 and 5 weeks of age	28
Respiratory disease - mostly associated with other septic conditions	22
- not associated with other septic conditions	8
Nervous disease (trembling)	6

Because of lack of detailed information many other problems could not be specifically recorded.

Losses caused by scouring, even if not resulting in death, can be very high. As it is quite frequently found that infectious agents incriminated in an outbreak are of a type normally considered not so pathogenic, it is clear that closer studies of the whole scouring

TABLE 2

	SOWS INDIVIDUAL			SOWS MIXED		
Number of litters	4 425			3 538		
	Average	Individual high	Low	Average	Individual high	Low
Total born	10, 75	11, 95	9, 98	10, 16	11, 05	9, 02
Born alive	10, 03	11, 21	9, 53	9, 47	10, 42	8, 17

Some farmers claimed an improved litter birth weight, if the sow was isolated during her last three weeks of gestation.

Also, though the figures available are too few to give a reliable reflection, the performance of those sows grouped together appeared to improve, if they were fed individually.

SEASONAL VARIATION IN LITTER SIZE AND PERCENTAGE STILLBORN

Because of the climatic conditions in South Africa, attention was given, where possible, to the seasonal effects on production and reproduction.

(a) It was observed that on 62% of the farms where reliable figures were available, slightly larger litters were, born from the sows bred in the cooler months, e.g. an average litter size of 10, 54 as against 10, 40 from the sows bred during the warmer months of November to February. These figures were obtained from a total of 8 004 litters born over 12 months on 16 farms.

In addition the drop in production during autumn, which appears to be correlated to failure to conceive at first and even second oestrus during the hotter months, emphasizes the need to protect the breeding stock against the effects of high temperatures. Here it would be useful to be able to record the actual temperatures to which the animals are exposed.

Considering the fact that 46% of the producers mentioned difficulties with breeding in the summer months, it is obvious that the problem is bigger than may appeár at first and, if accurate figures could be obtained to assess this effect, one could well be surprised at the size of the production loss involved.

(b) The percentage stillborn recorded over the warmer months of November to March 1970 was 7, 2% compared to 8, 0% over the colder months. These figures were obtained from 15 farms producing 66 110 piglets of which 4 681 were stillborn.

There is usually no direct supervision during parturition and the recorded figures probably include those piglets that were born alive, but died very soon after birth.

On four farms a higher stillbirth figure was recorded for the warmer months and on two of these summer temperatures can at times be extremely high.

The reasons for the higher stillbirth rates recorded in winter need closer study before any deductions can be made.

III DISEASE

Although it was one of the main objectives of this survey to get an indication of the losses suffered by the pig industry as a result of disease, it was also one of the more difficult tasks.

It was more a probe into the wider aspects of disease in general and not a disease survey as such, where specific diseases could be identified and the problem analysed.

One had to rely on the farmers' knowledge, observation, interpretation and description of diseases coupled to one's own observations on the spot.

Where disease was identified more specifically the farmer had usually obtained the information from his own private veterinarian, from a slaughter report, or from veterinary field officers.

In order to be able to discuss problems with the farmer one had, to a large extent, to rely on the presentation of a symptom complex e.g. 'scouring' regardless of actual aetiology.

The picture presented is based on a recording of disease and other problems reported on each farm and the relative frequency with which each of these appeared in the total number of herds surveyed.

These figures represent the incidence of disease, but not the loss caused by any specific disease.

A.1. Disease in sows

These figures were obtained from 35 farms representing more than 9 000 sows. (See Table).

Disease	% farmers reporting the occurrence of the disease
Agalactia - more of a serious problem	37) 77
- only odd cases	40)
Footrot - mostly associated with other septic conditions	63
Septic conditions - not associated with footrot	23
Heat stress - breeding difficulties in hot season	46
Leptospirosis - associated with abortions or based on findings at slaughter	23
Abortions - with and without association with leptospirosis	20
Skin troubles - general	17
Gastric ulcer	9
Feet problems - general	9
Hephritis	6
Haemorrhagic enteritis syndrome ('red gut')	3

From this it can be seen that the main problems affecting the sow are: -

(1) Agalactia;

(2) footrot and other septic conditions;

(3) heat stress during breeding; and

(4) abortions or reproductive disease and sepsis.

Each of these subjects would warrant closer study, because losses attributable to them can be high e.g. whole litters can be lost with lactational failure and production losses of up to 40% and more can occur with outbreaks of leptospirosis and other infectious agents causing abortion.

The footrot problem was high on the list of complaints and few farmers had an effective answer to it.

Control measures have to be evaluated, as the condition involves moisture, injury and hygiene control.

2. Reported causes of death in sows

The majority of sows appeared to have died during the dry pregnant period.

Heart failure - fighting	Nephritis
Pneumonia	Farrowing complications
Abscesses - fighting	Prolapsed uterus
Injuries by boar	Prolapsed rectum
Twisted bowel	Snakebite
Red gut	Dry sows bloating on whey

Where figures are reliable from 22 herds representing 5 170 odd sows, a total number of deaths of 222 sows was recorded for 1970, representing 4,3% sow mortality per annum.

3. Sow replacement figures

Where figures are reasonably reliable, deaths plus culling of sows averages 28, 2% out of 30 herds, with an individual high of 63% and a low of 9%.

Cullings were usually based on performance, age and feet apart from disease factors already mentioned.

B. Disease in piglets from birth to weaning

These figures were obtained from 36 farms producing ± 130 000 weaners in one year: -

Disease	% farmers reporting the occurrence of the disease
Scouring of varied aetiology	89
Septic conditions - general	58
Anaemia - mostly between 3 and 5 weeks of age	28
Respiratory disease - mostly associated with other septic conditions	22
- not associated with other septic conditions	8
Nervous disease (trembling)	6

Because of lack of detailed information many other problems could not be specifically recorded.

Losses caused by scouring, even if not resulting in death, can be very high. As it is quite frequently found that infectious agents incriminated in an outbreak are of a type normally considered not so pathogenic, it is clear that closer studies of the whole scouring

clear that closer studies of the whole scouring complex and its relation to environmental, as well as to nutritional and other disease factors, are needed.

Hygiene at this stage is of critical importance. The anaemia was usually observed in piglets three to four weeks of age and this might have something to do with the adequate consumption of creep feed at this stage.

C. *Disease in pigs from weaning age to slaughter*

These figures were obtained from 37 farms producing over 130 000 weaners in one year: -

Disease	% farms reporting the occurrence of the disease
Scouring	54
Footrot - associated with other septic conditions	49
Septic conditions - not associated with footrot	32
Respiratory disease - associated with septic conditions	38
- not associated	3
Haemorrhagic enteritis syndrome	22
Feet troubles - general	16
Skin trouble - general	5
Anaemia	3
Nervous disease - trembling	3

Remarks made in regard to further studies apply equally here.

D. *Observations on footrot in sows and fattening pigs*

On 15 out of the 22 farms, where footrot was reported to be a problem in sows, the animals had access to soil or ground camps and were also exposed to damp conditions, such as muddy patches, insufficient drainage in places and water used for cleaning.

A tendency to develop cracked claws and secondary lesions was already noticed in selected breeding gilts of approximately six months of age and these animals could, therefore, with increase in weight develop more serious foot complaints.

In the case of fattening pigs, footrot was reported on 17 farms and on 14 of these the pigs were exposed to varying degrees of damp or wet floor conditions with uneven or damaged surfaces and/or protruding rims or barriers.

On 11 of the farms the problem was found to affect both the fattening pigs and the sows.

E. *Total condemnations of pigs slaughtered at five abattoirs in one year*

Out of 541 091 pigs slaughtered a total of 5 662 = 1,046% were totally condemned for the following conditions: -

Septic conditions	0,5%
Measles	0,42%
T.B. (generalized)	0,1%
Jaundice	0,01%
Emaciation	0,01%
Sarco cysts	0,01%

The main loss was caused by condemnations due to various forms of sepsis. The incidence of measles was highest in sausage pigs.

Few farmers actually complained about losses caused by generalized tuberculous lesions, although some producers reported a fairly high loss of heads in baconers due to such lesions.

F. *Observations on the use of antibiotics*

Of 36 producers 29 (80%) used an antibiotic in the creep. Of these 17 used a continual high therapeutic level (HTL), 8 used a continual low growth promoting level and 5 used a continual HTL sporadically. The majority of these farmers kept the piglets on creep feed up to two or three weeks postweaning.

Of seven producers not using antibiotics in the creep, three used them routinely over the weaning period (including seven days before and after).

Seven producers used antibiotics as a growth stimulant in porker and/or baconer rations and four used arsanilic acid.

Of the 36 producers one mixed an antibiotic (excluding Hygromycin B) in their boar/sow ration, but nine used Hygromycin B for worm control.

Only seven producers were found not to be using antibiotics at all for routine purposes and their average weaning loss was 15,42% with an individual high of 24,20% and low of 8,25%.

In general it can be said that a more detailed investigation of the needs of individual producers, together with sound advice, could possibly eliminate the haphazard way in which many farmers play around with various drugs, often at considerable cost to themselves.

Jl S. Afr. vet. med. Ass. 43 (2): 141—145 1972

SPECIAL REPORT SPESIALE VERSLAG

OBSERVATIONS OF VETERINARY INTEREST DURING A VISIT TO WESTERN GERMANY

S. W. J. VAN RENSBURG*

INTRODUCTION

During the first week I attended the 20th International Congress on Artificial Insemination in Animals in Wels, Austria, which was attended by 221 veterinarians and animal scientists from the different European countries and also a few from America, Japan, Africa and India. The numerous opportunities which our overseas colleagues have of meeting, exchanging views and experiences, and conducting stimulating and inspiring discussions on their work and research, very pertinently brings home to one the many disadvantages of the almost complete isolation in which our profession in Southern Africa has to labour.

THE MUNICH VETERINARY FACULTY

From October to December, 1970, I was a privileged guest at the Veterinary Faculty of the University of Munich. Since my interests are mainly centered in reproduction in animals, most of my time was spent in the Department of Gynaecology and Ambulatory Clinic, where I could observe all the activities, both day and night.

The Munich Veterinary Faculty, with approximately 100 students in a class, is the largest of its kind in Western Europe. It was interesting to observe the facilities available for practical instruction and proper tuition of such large classes.

As with ours, their course extends over five years, but all taken at the Faculty. This obviates the first year students having to study subjects that are quite irrelevant to Veterinary Science.

The academic year is divided into two semesters, i.e. winter—from 15th October to 15th February, and summer—from 15th April to 15th July. This affords students two vacation periods of two and three months respectively, but most of this so-called free time must be devoted to practical work.

The Faculty consists of 23 autonomous departments, each with its own facilities, such as administration, lecture halls, laboratories, museums, library and requirements for practical instruction. For instance, in each of those departments where microscopic examinations are essential, some 100—120 microscopes, with the necessary accessories, are available for the use of students.

Provision is made for 50 periods of instruction of one hour each per week, and lectures and demonstrations are given from 8.00 a.m. to 6.00 p.m., with no official break for teas or lunch. Teachers and students must take these breaks whenever they have a free period.

The teaching personnel comprises 73 professors and approximately 200 lecturers. Seven of the professors are formally retired but are still available to the faculty for specialized services such as the promotion of post-graduate studies. This Faculty is by no means overstaffed, considering the policy of having one teacher for every eight students during practical instruction. Virtually every department in which practical work forms an integral part of their tuition, has available the services of three or four professors and eight or more lecturers. Thus, in the Department of Genesiology, there are four professors and fifteen lecturers. In this way, adequate time is allowed for research.

The Department of Genesiology is representative of all the clinical sections. It is housed entirely in one five-storey building, with stables for cattle, horses, pigs, sheep and small animals, a large clinical hall, two ope-

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rating theatres and a very large lecture and demonstration hall with a sloping floor. The latter has seating and writing accommodation for 200 students. Besides the usual facilities, it is equipped with closed-circuit television which provides a very clear view of operations and other demonstrations which can be seen on six screens placed at suitable points in the hall. In addition, the building contains a number of laboratories, offices, a library, a few flats occupied by some of the professors, lecturers and assistants, and rooms for those on night duty. The department also has several motor vehicles for official use in the Ambulatory Clinic and on excursions, as well as two ambulances for large animals.

Munich is in the very fortunate position that there are a number of animal research institutes, breeding establishments and experimental research farms within easy reach of the Faculty, besides a very heavy concentration of privately owned large animals. Practical instruction can thus be given in six different ways:—

1. *Clinical Classes*

   In the department of Genesiology, these classes are conducted twice a week from 8.00 a.m. to 10.00 a.m. by one or more professors and the lecturers concerned. Both the fourth and fifth year students attend. Interesting cases are demonstrated and discussed. The students on the duty roster must be present to answer questions put by the other students and the teachers. For example, in one such class the following cases were presented:

   (a) A cow with dystocia. After thorough examination and discussion, a hysterotomy was performed on the spot, and every one of the 200 students could follow the operation on television.

   (b) A mare was examined for sterility, and possible causes and treatment were discussed.

   (c) A sow that had given birth to ten piglets the previous night, and of which three were deformed, was presented and the nature and possible causes of the deformities were discussed.

   (d) A bitch was presented with her six pups that had been delivered by hysterotomy.

2. *Faculty Clinics*

   Each of the clinical departments has stables and halls in its building to which large and small animals are brought for examination and treatment. There are additional facilities for accommodating and treating animals on the faculty farm, Oberwiesenfeld, 5 km from the Faculty. This farm also provides extensive facilities for teaching other subjects, e.g. animal management, nutrition, hygiene and microbiology.

   During semesters and vacations, students take turns to do duty in the various departments. The doors of the clinics are never closed and urgent cases are admitted at any time, day or night.

3. *Ambulatory Clinic*

   The animal population of Bavaria is as follows:

Cattle (of which 1 995 000 are dairy cows)	4 376 600
Horses	35 500
Pigs	3 826 000
Poultry	18 019 000

   Approximately five per cent of these animals are within a radius of 15 km of the Faculty; all veterinary services, including inseminations, are rendered to them by the Ambulatory Clinic. In addition to this, one lecturer and his students are responsible for the health of the animals in the Munich zoo—certainly one of the finest in the world—which is visited regularly three days a week.

4. *Institutes*

   Apart from farms and breeding studs, there are several large research, breeding and training institutes within a radius of 15 km of the Faculty. Veterinary services are rendered entirely by the staff and students of the Faculty; e.g.

   (a) *"Schleissheim"* — the University's agricultural experimental farm.

   (b) *"Grub"* — the main research and extension organisation of the Bavarian Department of Agriculture, handling 4 000 head of cattle, 3 000 pigs, 700 sheep and 20 000 fowls.

   (c) *"Daglfing"* — the main racecourse for trotting in Bavaria, situated only 6 km from the Faculty. All the horses are trained at this course

and an average of 1 000 horses are constantly accommodated.

(d) *Aubing Testing and Artificial Insemination Centre:* The application of AI in the Munich area started with a bull station at the Genesiology Clinic of the Faculty in 1952, but with its rapid expansion this was later moved 5 km to Aubing. In 1970, 150 000 first inseminations were done in 1 500 herds by two chief veterinarians, 57 practising veterinarians and 9 technicians. The fees for AI include free veterinary examination for pregnancy. During vacation practice with these veterinarians, students get excellent practical experience in all aspects of genesiology.

5. *Excursions*

Beyond the 15 km radius from the University, there are also a number of institutes and large stud farms that provide facilities and material for practical training of students.

Periodically, groups of a few teachers and 40 students visit three or four of these in a day. I was impressed by the very hearty and close co-operation between the owners (managers) and the teachers and students. The owners, or managers, also address the students on all aspects concerning the management of their studs.

6. *Vacation Practice*

The Faculty prescribes *i.a.* that before a student is allowed to present himself for the final examination, he must produce satisfactory evidence that he has spent at least three months as a student-learner with each of the following:

(a) the clinics of the faculty;
(b) an approved agricultural experimental farm;
(c) an approved abattoir;
(d) an approved practitioner.

ARTIFICIAL INSEMINATION AND PROGENY TESTING

In December of 1968, 1 439 487 (66,2%) of the total of 2 196 604 cows and heifers in Bavaria were registered for AI. This service is provided by 17 bull stations and the average number of cows thus served by one station is 84 676.

All the bulls used for breeding have been, or are in the process of being progeny tested. Thus, at Aubing there are 20 old proven bulls supplying most of the semen, 15 young ones still being tested and 20 kept in waiting pending the result of their test.

In Germany, as in most of the other progressive countries, the most reliable criterion for determining the breeding value of a sire is applied, namely not the performance of his ancestors, but rather the production potentiality revealed by his progeny. His breeding value is assessed on what he actually is and not on what he might be. A determining factor in the testing of young bulls is their performance in herds that are registered for milk recording. In 1969, 526 379 (26,7%) of the cows in Bavaria were registered under this scheme. Young bulls are taken in for testing at the age of 12 months and at least 300 inseminations with semen from each bull are done on such cows. To encourage farmers, a premium of R4 for the whole herd—which consists of 10 cows on an average—is paid, plus R1 for every cow inseminated with semen of a young bull in the test. It is estimated that only 25 per cent of the bulls entered pass the test despite the fact that they are carefully selected and on their breeding are considered as potentially good sires.

To maintain constant improvement of the breed and to avoid inbreeding, the surviving dams of the proven sires standing at one bull station are inseminated with semen of selected proven bulls at other stations in Bavaria.

An example of what can be achieved by the almost exclusive use of the semen of proven bulls was seen at Schleissheim, where the average milk production per cow was increased from 4 500 kg in 1962 to 6 300 kg in 1969. Here, too, the daughters of one of the proven sires yielded an average of 6 000 kg milk in their first lactation.

Milk production is by no means the only characteristic that is considered in determining the breeding value of bulls. Their potential for producing beef is regarded as being equally important.

It is quite significant that in the brochures of the bull stations the ancestors of the proven sires receive scant consideration, but the achievements of their progeny are prominently displayed. This is not confined to milk production, but includes other qualities, such as udder conformation, milkability, tempera-

ment, general conformation, food conversion ability, muscling, limbs and feet as well as good or bad hereditary characteristics.

SHEEP FARMING

Sheep farmers and experts apparently are becoming pessimistic about the future of wool, since in the research institutes on experimental and sheep farms the tendency is to devote more attention to mutton production. The many cross-breeding experiments aim at the creation of a breed with best breeding ability, rapid maturity and high quality mutton production. In one experiment at Schleissheim, the lambs are removed from the ewes twenty-four hours after birth and reared artificially. Three weeks later, the ewes are in oestrus again and are served, thus producing two groups of lambs every year. Since most of them have twins or triplets, the 120 ewes in this experiment produce about 500 lambs per year. The ram lambs are fit for slaughter at 5 months, while the ewe lambs are served for the first time at the same age.

HORSES

In keeping with the trend elsewhere, the post-war years have brought about a marked revival in the popularity of the horse. In Western Germany, this renewed enthusiasm is not confined to farmers, but is also shown by city dwellers, sportsmen and students. Within 20 km of Munich, one finds several breeders with anything from 100 to 400 brood mares each, representing some of the best blood lines in the world.

On a broad basis, one can divide Bavarian horses into four classes, namely:

1. *Heavy draught horses* which are now replacing tractors in many places.
2. *The Hafling* is a smaller but very strong compact horse with a palomino colour and probably some Arab pony blood. It rather resembles the Basuto pony but is much heavier. This hardy type is seen mostly in the mountainous regions, where it is used for draught purposes and for hauling logs out of the forests.
3. *Riding Ponies:* Horse riding is very popular with the Bavarians, and several riding schools are located either in or in the immediate neighbourhood of Munich. One of these is only 300 metres from the faculty clinic and receives veterinary services from the clinic, while the students make use of the facilities provided by the school.
4. *Race Horses:* The 1 000 horses standing at the Daglfing racecourse are a cross between the American trotter and the French thoroughbred. Bavarian racing is confined to trotting, two meetings being held at Daglfing every week.

OTHER ANIMALS

Wild Animals: The protection and conservation of wild animals now enjoys as much attention in West Germany as in South Africa, and their diseases are incorporated in the curriculum of the Faculty. Colleagues there were greatly interested in our nature conservation schemes and particularly in our latest methods of neuroleptic narcosis. Wild birds receive special attention in the poultry section.

Fishes and Bees are also included in the curriculum. The measures applied to prevent mortality in fresh water fishes are stressed very strongly. This is understandable, when one learns from Dr. Reichenbach-Klinke that approximately R2 million per year is derived from their fresh water fish, but he also estimates that about R4 million is lost annually through disease and R5 million as the result of polluted waters.

TECHNIQUES

Hysterotomy

What surprises the foreign visitor is the frequency with which caesarian section is resorted to in the treatment of dystocia in large animals. Apart from what is done on the farms, an average of five cows per week is subjected to this operation at the clinic at Munich.

There are very good reasons for the preference shown for this operation:

1. It does not involve the same risks for the dam as an embroyotomy, and her subseqent fertility is not impaired.
2. The life of the calf is saved—unless it was already dead when the operation was commenced.
3. It is not so time-consuming and tiring as an embryotomy, the whole operation as a rule being completed in less than an hour.
4. With the latest method of operating through the left flank and in the standing position, not much assistance is requred. In one case it was done by a lecturer, one student and one labourer.

Phlebotomy

A type of forceps for compressing the jugular vein when collecting blood samples from bovines is in general use there, but surprisingly this instrument seems to be quite unknown to the veterinary profession in South Africa.

Its great advantage is that it does not press on the trachea to cause the respiratory discomfort or even distress which accompanies the use of a rope, and no assistant is necessary to hold it in position.

A specimen was brought to South Africa and handed to a country practitioner for testing. He subsequently reported as follows: "The main purpose of this letter is to tell you how thrilled I am with the compression forceps. It had an exacting trial today when I bled 74 cows for C.A., and it passed the test with flying colours. I have never had such an easy and pleasant time bleeding cows, and the farmer was most impressed."

I have been unable to obtain information about availability of the instrument in this country and have suggested to the firm representing the makers that a few of these forceps be imported.

ACKNOWLEDGEMENTS

This visit was sponsored by the South African Department of Cultural Affairs and the German Academy Foreign Exchange Service (DAAD). I wish to record my sincere appreciation to them. A special word of thanks is due to Mr. Retief, our Consul-General in Munich and his personnel for their courteous and willing assistance. The invitation by the University was initiated by Professor Baier. To him and his personnel I owe a great debt of gratitude for the invitation and for the willingness with which they received me into their various spheres of activity.

BOEKRESENSIE — BOOK REVIEW

ELEMENTÊRE MEDIESE BIOFISIKA

G. G. JAROS EN B. J. MEYER

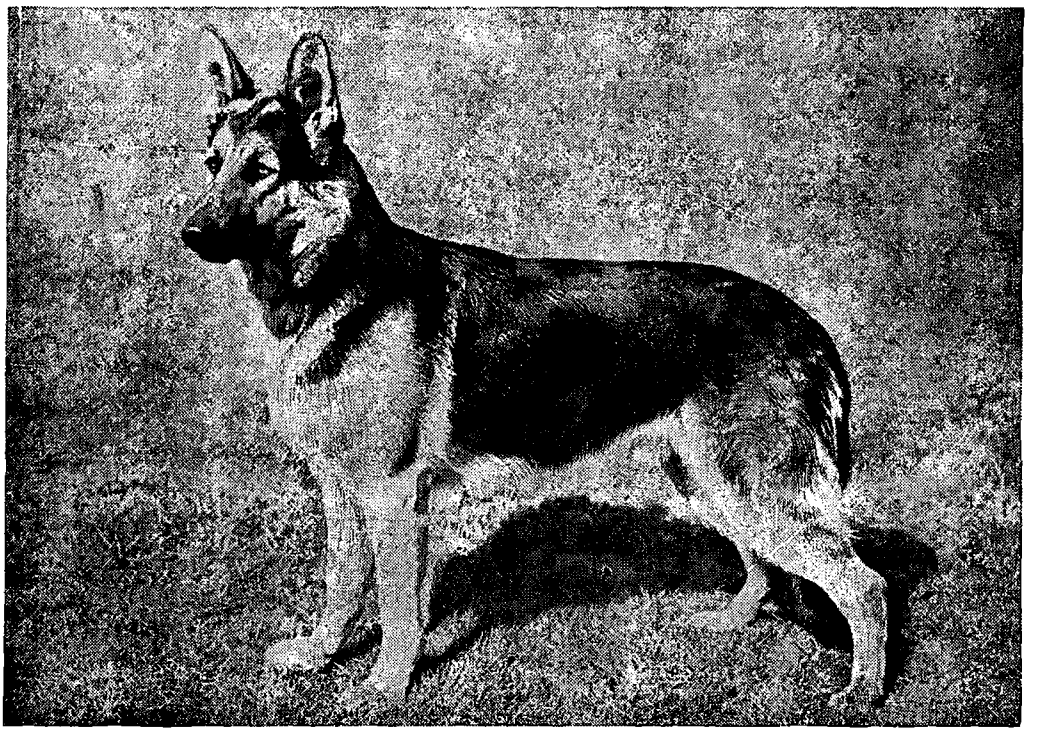
Butterworth & Kie (S.A.) (Edms.) Bpk., Durban, 1971. Pp. 119. Prys R6.90.

Hierdie boek is 'n wesenlike bydrae tot die hedendaagse nypende tekort aan wetenskaplike handboeke in Afrikaans. Die boek is spesifiek geskryf om as elementêre kursus vir studente in mediese verpleegkunde te dien. Die skrywers slaag hierin, deurdat die biofisiese begrippe so aangebied word dat studente met beperkte agtergrond die beskrywings sal kan volg. Verder is die teorie ryklik met duidelike en maklik verstaanbare lynsketse geïllustreer.

Die inhoud van die boek dek 'n breë veld en is ingedeel in vyf afdelings: (1) grondbeginsels, (2) elektrisiteit, (3) vloeistowwe, gasse en warmte, (4) strale en golwe en (5) meganika. Elke afdeling word op sy beurt in verskillende hoofstukke opgedeel. Die skrywers maak vryelik gebruik van mediese toepassings om die fisiese begrippe te ondersteun. Dié benadering is veral aantreklik aangesien studente in die mediese en paramediese rigtings aanvanklik die waarde van die suiwere wetenskappe ten opsigte van hulle gekose loopbaan moeilik begryp. In hierdie boek word die student se belangstelling behou, selfs verder geprikkel. Die handboek lê ook 'n grondslag vir 'n toekomstige, meer doelgerigte, opleiding in biofisika op hoër vlak vir onder vakrigtings.

Die handboek behoort ook byval te vind by die opleiding van veterinêre verpleegsters en biotegnici, en kan met vrug gelees word deur alle studente wat belang het by die aanwending van fisiese begrippe in die biologie.

N. C. O.



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REVIEW

OORSIG

NUTRITION AND REPRODUCTION IN SHEEP*

J. G. CLOETE**

SUMMARY

In this review of the effect of nutrition on reproduction in the sheep, it is indicated that a high plane of nutrition, but not overfeeding, favourably influences the reproductive capacity of ewes in terms of number of oestrous cycles, length of breeding season, higher ovulation rate and increased lambing percentage. Adequate protein intake is essential. Concerning the macro-minerals, phosphorus supplementation alone does not appear to have an unequivocally favourable response in sheep, except perhaps during protracted periods of food scarcity. The need for re-evaluation of this mineral's rôle is suggested. Of the trace elements, there is a copper deficiency in the south western coastal regions of South Africa, which adversely affects lambing percentage and the health of lambs with reference to the incidence of sway-back. Cobalt has an indirect effect, with reduced lambing percentage and a high rate of abortion. Manganese is essential for maintenance of ovarian activity. Vitamin A only assumes importance in preventing lamb losses after very protracted dietary deficiency of the ewe; supplementation is seldom necessary. Vitamin E does not appear to play a rôle in ruminant reproduction. In South Africa the main problem concerns deficiency of energy and protein, and of phosphorus and copper in certain areas only.

A sound sheep industry is based on a sound level of reproduction and it is unequivocally agreed that the ultimate worth of any animal lies in its ability to reproduce[1]. The major responsibility for the reproductive process lies with the ewe, because she must provide the environment for the production of viable germ cells, fertilization, development of the foetus until parturition and nurturing of the lamb until it is capable to fend for itself. Within and between these various stages in the reproduction process lie various hazards which may prevent fertilization, terminate pregnancy and lead to post-natal mortality. Of the environmental and hormonal interrelationships which are intimately associated with the very complex process of reproduction, nutrition should be regarded as one of the most prominent factors.

The incidence of droughts in South Africa, particularly in the more arid areas, necessarily links reproduction with the general concept of under-nutrition. The influence of over-nutrition will not be discussed in this review. An attempt will be made to indicate the influence of individual dietary components on the reproductive process.

It has been postulated that farm animals are the most susceptible to dietary deficiencies during the period of growth[2, 3]. It furthermore appears as if the rôle of nutrition on reproduction presents a rather complicated picture, since a dietary deficiency in farm animals frequently can not be interpreted merely as producing a single effect, but constituting part of multiple interactions.

The following dietary components are of particular importance for reproduction: (a) Level of nutrition; (b) Protein; (c) Minerals; (d) Vitamins, and (e) Sex hormones in the grazing. These will be dealt with individually.

(a) *Level of Nutrition*

Reproduction in sheep is primarily controlled by the endocrine activity of the pituitary and the gonads, although the rôle of other endocrine glands is also indirectly important[4]. Evidence of the effects of nutrition on the structure and activity of the anterior pituitary is conflicting. When the general

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effects of inanition on the pituitary are being considered, the duration of nutritional stress, whether chronic or acute, is important [5]. In young guinea pigs acute inanition has been shown to result in increases in the size and activity of pituitary basophils and a decrease in activity of acidophils, changes which in later stages are accompanied by some degeneration of the gland [6]. More recent work has suggested that a low plane of nutrition modifies the rate of release rather than the synthesis of gonadotrophins [7, 8].

It has always been recognized that underfeeding of immature animals delays sexual development by producing changes in both the structure and function of the gonads. In the mature animals reproductive function is affected [5]. Mulinos & Pomerantz [9] concluded that these effects were mediated through the pituitary which in turn impairs the function of the gonads. Partial starvation, resulting in decreases of 20 to 30 per cent in body weight, leads to a cessation of oestrous cycles in both laboratory and farm animals. First oestrus appeared later in underfed sheep [10]. The influence of the level of nutrition on the attainment of puberty of Merino ewes is presented in Table 1 [11].

Table 1: INFLUENCE OF THE LEVEL OF NUTRITION ON THE ATTAINMENT OF PUBERTY IN MERINO EWES UNTIL THE AGE OF 16 MONTHS

Level of nutrition	Early puberty (%)	Retarded puberty (%)	Body weight lb(kg)
High	83	17	106 (48,18)
Medium	81	19	86 (39,09)
Low	43	56	58 (26,36)

From Table 1 it is evident that ewes on a high plane of nutrition until an age of 16 months exhibited a higher intensity of first oestrus than those on a low plane of nutrition. The strong positive relationship between body weight and the attainment of first oestrus is very obvious from this table.

The level of nutrition also influences oestrous activity. Merino ewes on a high plane of nutrition underwent a mean number of 11,2 oestrous cycles during the breeding season which comprised 206 days, while only 7,2 cycles were observed with a breeding season extending over only 138 days in the case of ewes on a low plane of nutrition [12]. Thus the level of nutrition not only influences the number of oestrous cycles but also the length of the breeding season. Similar results were obtained by Hugo [11] who also used Merino ewes as experimental animals.

A high plane of nutrition has invariably been found to stimulate sexual activity when compared to a low plane and lead to a higher ovulation rate [13, 14], a larger number of follicles of 2 mm and over [13], larger anterior pituitary glands with an increased activity of follicle stimulating hormone and luteinizing hormone [15]; a more rapid onset of oestrus [16] and an increase in lambing percentage from 53 to 86 per cent [17]. In the latter study Bosman [17] confirmed observations [18, 19] that heavier ewes produced more lambs and higher fleece weights than lighter ewes.

The context in which the phrase "high feeding level" is used in the above-mentioned experiments should be dissociated from the term "over-feeding", since it is known that over-feeding may induce degeneration of the ovaries and a decrease in lambing percentage with age [20]. When the commonly used feeding standards are adhered to, however, the problem of over-feeding will be entirely eliminated.

(b) *Protein*

A deficiency of protein results in a retarded development of the female genital organs. Young females did not show oestrus when they were kept on a protein deficient diet for extended periods. Rectal examination of heifers indicated under-developed ovaries [21]. In considering the effects of protein deficiency on the gonads, it is important to know its severity and duration and whether the nutritional imbalance occurred before or after the attainment of puberty [5].

Protein deficiency has been shown to affect the histological appearance and endocrine activity of the pituitary, resulting in a reduced output of somatotropin in both the gland and the plasma [22] and an increase in follicle stimulating hormone [23].

When heifers were given diets low in protein from birth, puberty was delayed and occurred at a smaller body size [24], but after puberty similar diets did not adversely affect the gonads [25]. Generally an insufficient protein intake results in a reduced reproductive efficiency [26].

(c) *Macro-minerals*

There is considerable evidence which indicates that minerals, particulary phosphorus, affect reproduction. It would appear from the comprehensive reviews of Hignett[27], Moustgaard[21] and Underwood[28] that specific endocrine failure in the mature animal arising from a deficiency of an essential mineral has not been demonstrated.

Phosphorus, which is commonly deficient in South African pastures[29], plays an important rôle in the fertility of farm animals. It has been postulated that phosphorus deficient grazing reduces oestrous activity[30], restricts the attainment of puberty[31] and yields a lower calving percentage[32]. All this is in marked contrast to the response in sheep. It is indeed remarkable that notwithstanding many experiments involving grazing animals, no clear response could be obtained with phosphorus supplementation on the reproductive capacity of the ewe. Even in the case of sheep grazing in an area of severely phosphorus-deficient soils, dietary supplementation of phosphorus had no favourable effect on body growth, wool growth, growth of lambs or on the breeding performance[33]. This work strongly supported earlier findings[34] that sheep could remain apparently normal and healthy in areas where cattle would suffer from extreme phosphorus deficiency. More recently Steenkamp[35] corroborated these findings on wethers in the Karoo. On the contrary, van der Vyver & van Niekerk[36] and Cloete[37] did find a response to phosphorus supplementation on Karoo shrub veld in terms of body weight gain and mortality rate, the latter during protracted droughts. The conflicting results obtained with sheep and cattle with regards to phosphorus supplementation has been explained as possibly being due to a difference in the selective ability between these two species[38]. Sheep, with their much smaller mouths, are able to select the plant fragments with the highest digestibility and protein and phosphorus contents. In that way sheep may obtain a higher proportion of their phosphorus requirement from grazing than cattle do. It is doubtful, however, whether this fully explains the discrepancy between sheep and cattle, because during dry season grazing on grass veld even the most nutritious portions of the plant are severely deficient in phosphorus[39]. The difference in response between sheep and cattle thus largely remains obscure and is furthermore complicated by the fact that pregnancy presents a heavier burden to the ewe than to the cow. The calf is carried for 9 months and is usually a single birth whereas twin lambing is common after a gestation of 5 months.

There appears no sound basis for the view that poor reproduction in beef cattle is a common feature of aphosphorosis. It has been postulated that some of the effects of minerals operate by mechanisms involving the pituitary[40-42]. This evidence is largely circumstantial and no evidence has been documented to indicate that mineral deficiencies affect the pituitary directly[5]. Similarly, no unequivocal, direct influence of any specific mineral on the gonads has been demonstrated. It appears from the literature that no mineral can be considered in isolation, since it forms part of a complex interrelationship, involving other minerals as well as energy and protein. In our experiments on Karoo shrub veld, the positive response obtained with energy and protein supplementation during protracted droughts, as indicated by body weight change and weaning weight of lambs, outweighed the response obtained by phosphorus supplementation[37]. These experiments were conducted at both Grootfontein and Carnarvon and involved experimentation over a period of three-and-a-half years. Only during one year, when precipitation was lowest, did phosphorus supplementation yield a slight but non-significant positive response in terms of improved mating percentage[43]. The results are presented in Tables 2 and 3.

These results corroborate findings of previous workers who reported that phosphorus supplementation did not improve lambing percentage, although under the conditions of this experiment there was a slight improvement in weaning weight and weaning per-

Table 2: INFLUENCE OF VARIOUS DIETARY SUPPLEMENTS ON THE PERCENTAGE OF LAMBS BORN, LAMBS WEANED AND THE WEANING WEIGHT OF LAMBS FROM EWES GRAZING KAROO SHRUB VELD FOR A PERIOD OF 3½ YEARS

Supplement	Lambing (%)	Weaning (%)	Weaning weight at 3 months lb(kg)
Energy	90	79	38,2 (17,36)
Protein	88	76	33,2 (15,09)
Phosphorus	85	76	33,3 (15,13)
Control	89	73	31,1 (14,14)

Cf. Cloete, this Journal, Vol. 43, No. 3.

Table 3: INFLUENCE OF VARIOUS DIETARY SUPPLEMENTS ON THE PERCENTAGE OF EWES MATED AND ON THE BODY WEIGHTS OF EWES AT MATING DURING A PROTRACTED DROUGHT ON KAROO SHRUB VELD*

Supplement	Mating percentage	Body weight at mating lb(kg)
Energy	90	88,2 (40,09)
Protein	80	85,3 (38,77)
Phosphorus	83	78,3 (35,59)
Control	77	74,6 (33,91)

*Ewes were on these treatments for a period of one year before again being mated during autumn.

centage. Asdell[44] summarizes the situation with the conclusion that "when reproduction does suffer as a result of malnutrition, the animal itself nearly always shows definite signs of the disorder before the sexual functions are disturbed". No record could be traced of aphosphorosis in beef cattle influencing reproduction before other evidence of malnutrition was evident. According to Mc Clure[45] it seems more wise to consider the failure of reproduction as one aspect only of a general cellular deprivation of phosphorus. Hignett & Hignett[46] found that aphosphorosis associated with an intake of excess calcium may induce prenatal mortality.

The rôle of other macro-minerals such as sodium, potassium, magnesium and sulphur is not clear. Selenium deficiency may reduce fertility in sheep[47].

(d) *Micro-minerals*

Although these minerals are required only in traces, their physiological rôle in the animal body is of immense importance and their influence on reproduction particularly relevant to their general importance. Although not always clear, the general functions of the various trace elements are in some instances closely interrelated[48]. This makes the problem of pinpointing any particular trace element deficiency extremely difficult.

Copper: It has been soundly established that a copper deficiency supervenes in the south western coastal regions of the country[49-51]. Copper supplementation has increased lambing percentage from 48,5 to 97,8 and reduced the incidence of swayback[52] and brought about a revolution in livestock farming in these areas. It has now been well established that excess molybdenum limits the retention of copper in the body[48], an activity that is dependent on a sufficiently high intake of sulphur. The specific influence of copper on the pituitary or the gonads, however has not yet been established. The complexities associated with a deficiency of copper have been discussed by Mills[53], by Gallagher[54] and by Underwood[55].

Cobalt: The physiological function of cobalt became clear when it was discovered that the anti pernicious anaemia factor, later named vitamin B_{12}, was a cobalt-containing compound[56]. No function in animal metabolism other than as a component of vitamin B_{12} has been found for cobalt[38] and it consequently cannot be proved that ruminants require cobalt *per se*[57]. Although ruminants can synthesize vitamin B_{12} in the gut, it is likely that they have a poor capacity for absorbing it[58]. Consequently, a cobalt deficiency should be seen as an indirect deficiency. Indirectly, cobalt has an important influence on reproduction[59]. A deficiency results in a reduced lambing percentage in sheep and a high rate of abortion. As in copper deficiency, symptoms of a cobalt deficiency simulate the general picture of under-nutrition.

Other trace elements: Orent & McCollum[60] suggested that manganese did have an influence on the anterior pituitary, affecting the production or release of gonadotropins; it has also been shown to be essential for the maintenance of ovarian activity in rats[61]. From the literature it appears that the diet should contain a minimum of 20 ppm manganese for normal reproduction[62]. Although it has been postulated that fertility in ruminants may also be influenced by iron and iodine[57], their influence is not clear.

(e) *Vitamins*

The interrelationship of the vitamins, gonadal function and reproduction have been reviewed by Lutwak-Mann[63] and Mann[64]. Hart & Guilbert[65] (1928) were of the first workers to indicate that a deficiency of vitamin A caused abortion, prenatal mortality and weak calves at birth. Vitamin A deficiency has long been known to cause degenerative changes in the female reproductive tract[5] and atrophy of the foetus[66]. In the young ram signs of deficiency in the reproductive

tract were atrophy of the testis, degenerative changes in the seminiferous tubules and cessation of spermatogenesis [67]. Obvious vitamin A deficiency symptoms, however, did not reduce fertility in bulls [68]. It would appear as if vitamin A deficiency does not prevent conception [57]. Vitamin A is often supplemented when no real need for it exists. It is highly unlikely that, even after a year on a drought maintenance ration of cereals and chaffed cereal hay, lamb losses would be serious. A report by the C.S.I.R.O. [69] indicated that lambing was normal during the first year on this ration. Prolonged feeding for about two years, however, led to over 90 per cent losses in lambs. Dry sheep were not affected after two years on drought rations but lambs dropped from ewes on such rations should be drenched with vitamin A during marking to prevent losses. A secondary deficiency of vitamin A may be induced by heavy nitrate fertilizing of pastures [70].

The vitamin E content of the diet plays an important rôle in the reproduction of monogastrics but, since it is synthesized in the paunch of ruminants [57] there appears to be no proof that a deficiency interferes with reproduction in the ruminant [3, 71, 72]. There are two reasons for this. Vitamin E is seldom deficient in natural feeds and is interrelated with phosphorus. A phosphorus deficiency may consequently often be interpreted as a vitamin E deficiency [57].

(f) *Plant oestrogens*

It is a well-established fact that some legumes in temperate regions may harm the reproductive function of grazing sheep. The plant oestrogens are principally the isoflavones formononetin and genistein [73] and also includes biochanin A, diadzein, coumoestrol and miroestrol [38]. Although oestrogens have been detected in a wide variety of plants, clinical disturbances in grazing sheep have been reported from pastures chiefly containing subterranean clovers *(Trifolium subterraneum)*, red clover *(T. pratense)* or lucerne *(Medicago sativa)*. Infertility induced by plant oestrogens may be characterized by dystokia, peri-natal mortality, infertility of ewes, prolapse of the uterus, lactation in non-pregnant ewes, teat development in wethers and pathological changes in the genital tracts of both ewes and wethers [74]. Premature calvings have also been reported [75]. It appears that sheep on one farm may be severely affected whilst on an adjacent farm they are not affected, although soil types, pasture species, management systems and fertilizing treatments may be similar [76]. At lower concentrations the plant oestrogens can act as anti-oestrogens, displacing natural animal oestrogens from target organs [77].

In South Africa the major reproductive problems appear to be associated with a low plane of nutrition during times of drought. The individual dietary components associated with this low plane of nutrition appear to be deficiencies of mainly energy and protein, and of phosphorus and copper in certain areas. In the case of sheep the influence of phosphorus on reproduction is not quite clear and needs re-evaluation, particularly during protracted droughts.

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BOOK REVIEW — BOEKRESENSIE

NEONATAL ENTERIC INFECTIONS CAUSED BY *ESCHERICHIA COLI*

B. TENNANT (ED.)

Annals of the New York Academy of Sciences. Vol. 176. pp. III& 398, Figs. III, Tabs 120.

This book will be of interest mainly to the research worker—both in the veterinary and medical fields— as many of the papers presented are more of academic interest than of any immediate practical value. The papers included are not strictly limited to *E. coli* though there are many different topics of interest e.g. there are papers on the normal gradual colonization of the intestinal tract of the neonate, as well as abnormal colonization leading to diarrhoea. Other enteric bacteria are discussed, as well as the physiology and metabolism of diarrhoea in general, nutritional aspects and drug resistance of enteric bacteria. Human and veterinary aspects receive equal prominence in the papers.

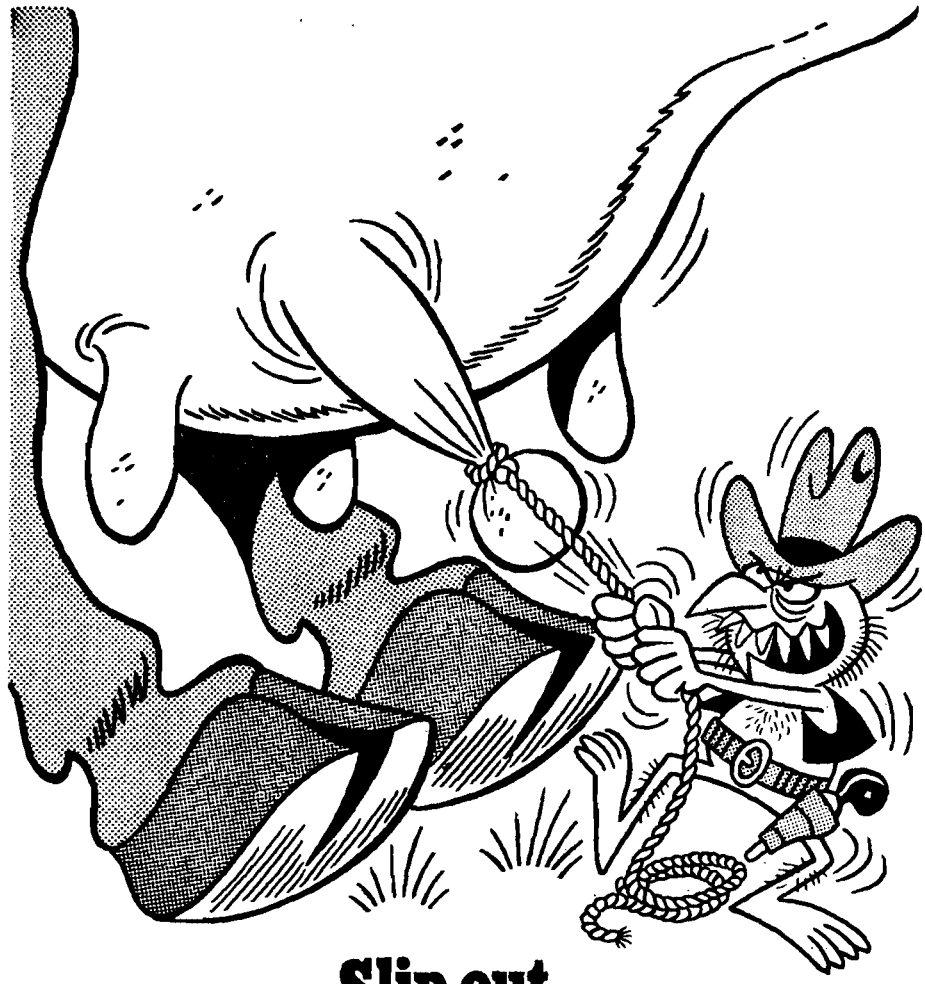
The book is the result of a conference held by the New York Academy of Sciences in May, 1970. It consists of 31 papers which have been classified under six headings:—

1. Factors determining host susceptibility and response to neonatal gastroenteritis: the international importance in children is discussed, as well as normal flora and immunity.
2. Epidemiology and microbiology: serotypes involved and species differences.
3. Experimental studies: This deals mainly with gnotobiotic animals, and a comparison of diarrhoeas of varying origin, e.g. T.G.E., *Chlamydia* and *Shigella*.
4. Metabolism and pathogenesis: Disturbances in electrolyte and water balance are discussed, as well as the effect of protein and calorie malnutrition on intestinal absorption. The importance of the gut flora to host relationship is emphasized in several papers.
5. Enterotoxins: latest developments in *E. coli* toxins as well as cholera enterotoxin.
6. Control immunization as well as antibiotic therapy are discussed, which leads to the ever-present problem of drug resistance and the part played by the normal gut flora in the transmission of resistance.

After each part, the papers are discussed by the group. These discussions are lively and interesting and provide additional information.

The papers are uniformly well written and most are well illustrated with figures and tables. Although this book deals with a rather specialized field of medicine, it should nevertheless of interest to many.

M. M. H.



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REVIEW OORSIG

MATING BEHAVIOUR OF RAMS*

P. S. PRETORIUS**

SUMMARY

The precopulatory mating behaviour patterns of the ram are characterized by nosing the perineal areas of the ewe, nudging, the Flehmen posture and mounting. Copulation is the culminant moment of sexual behaviour and consists of intromission and ejaculation. The olfactory, visual, gustatory, auditory and tactile senses play an important rôle in providing the ram with the necessary cues for identifying receptive ewes.

Although the preliminary mating behaviour patterns in the ram develop long before puberty, the complete sexual response is learned to a substantial degree during initial post-pubertal encounters between male and female. Several components of mating behaviour are measurable and comparable phenomena. Reaction time or ejaculation latency, defined as the period of time between the moment the ram finds himself within the stimulating area of the ewe and the commencement of copulation, varied from a few seconds to up to 8 minutes. Mounts per ejaculation, a parameter of mating dexterity, averaged from one to four between rams. With an excess of oestrous ewes, rams are capable of repeating copulation many times, provided that a new, not recently mated, stimulus female is introduced each time.

A dominant ram largely controls the sexual activity of subordinate rams in flock mating systems. A dominant ram which is infertile or genetically inferior can reduce the lamb crop, extend the lambing season and affect the overall merit of the progeny adversely.

INTRODUCTION

The study of mating behaviour in sheep and the possibilities which it offers in improving production efficiency, by means of improving breeding management, has received too little attention relative to its potential economic importance. Implementing knowlegde on mating behavioural patterns in breeding management, can certainly contribute much in raising low lambing percentages under flock mating conditions.

The various patterns of mating behaviour have the ultimate aim of bringing together the male and female gametes to ensure fertilization and pregnancy, and eventually the propagation of the species. In our well-organized breeding plans today, mating behaviour no longer has as principal aim propagation of the species: it has become an important economic factor. Sexual behaviour forms one of the main prerequisites for successful reproduction, perhaps more important than any other. Successful reproduction requires as minimum the coördination between male and female mating activities, terminating in copulation. This is preceded by a number of characteristic behaviour patterns, due to sexual stimulation. Nevertheless, copulation is not the full picture of sexual behaviour, it is only the best perceptible fragment. Besides copulation, there are several other phenomena of sexual behaviour, equally important in successful reproduction.

MATING BEHAVIOUR PATTERNS

If the ram is introduccd to an oestrous ewe he displays several more or less stereotyped manoeuvres, during a period of "sexual excitability". A variety of stimuli results in sexual excitability and is expressed in typical behaviour patterns preceding copulation. Sexual excitability is provoked by two factors. An endogenous one, the sexual drive or libido, and an exogenous one, which consists of sexual stimuli received by the olfactory, visual, gustatory, auditory and tactile senses. The in-

*Paper read at the Biennial National Scientific Congress of the South African Veterinary Association, East London, September 3—17, 1971.

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tensity of the sexual drive determines the duration and intensity of sexual excitability. When the libido is strong, minimal stimuli result in sexual excitability. On the contrary, when the sexual drive is weak, the external stimuli must be strong. According to Wierzbowski [1], the state of sexual excitability can be defined as the period of time when the male first noticed the female (external stimulus) and the commencement of copulation. Thus sexual excitability is a measurable and comparable phenomenon. This period is also called the reaction time, or mount or ejaculation latency [2, 3].

During the course of sexual excitability the ram displays a number of discrete courtship patterns while selecting oestrous from non-oestrous ewes. Banks [4] described the full repertoire of precopulatory fore-play in the ram. It starts with the ram nosing the perineal region of the ewe, which appears to afford olfactory and perhaps gustatory information to the ram. The subsequent manoeuvre in the courtship sequence is the nudge. The ram orients himself behind the ewe, his body pointing in the same direction as that of the ewe. One fore-leg is extended and flexed in short chopping motions. The head is lowered and tilted sideways, while low-pitched vocalisations are frequently uttered, accompanied by the rapid extension and retraction of the tongue. This pattern may be repeated several times or displayed only once, while variants of the complete action pattern occur amongst individual rams.

One of the more stereotyped acts is evoked by urination of the ewe when courtship commences or during its course. The ram may attempt to taste the urine or it may lick or nose the moistened ground. He then assumes the "Flehmen" posture [5] or lip curl, which may be held momentarily or may last for several minutes.

Further acts in the behaviour programme of the ram depend on proper feedback behaviour of the ewe. Ewes not in oestrus normally display avoidance behaviour when approached by the ram. Receptive ewes adopt a characteristic mating stance, looking back towards the ram and frequently displaying tail wagging [5, 6]. The ram responds with attempts to mount, which are accompanied by penile erection and copulation. The oestrous condition of the ewe is of major importance in determining the amount of fore-play exhibited by the ram. A ewe at the peak of oestrus may accept the ram after only an abbreviated display of courtship, whereas ewes approaching di-oestrus allow copulation only after the most strenuous efforts of the ram. Upon mounting, the ram performs a number of shallow thrusting pelvic movements, orienting the penis with respect to the vaginal opening. Successful penetration (intromission) is followed by a single deep thrust, which characterizes the intromission-ejaculation response [2, 3].

According to Wierzbowski [1], copulation is the culminant moment of sexual behaviour and the main phase of copulation consists of intromission and ejaculation. Although intromission is not always accompanied by ejaculation, it may be detected behaviourally by a single deep pelvic thrust and is always followed by dismounting. After dismounting, the ram usually urinates, an act which probably functions to cleanse the urethra [2]. Upon achieving ejaculation, the behaviour of the ram changes completely. Sexual excitability and sensitivity to stimuli disappear for some time [4]. Individual rams differ very much in post-ejaculatory reactions: it may vary from immediate resumption of courtship to total disregard of the female for some time.

Rôle of sensory teleceptors in sexual behaviour

In male animals the sense of smell has long been considered to play the most important rôle in partner-seeking activity. Experimental evidence for this assumption is by no means decisive. Much quoted evidence of smelling and licking the genital regions of the ewe may involve tactile, gustatory or visual stimulation as well. Difficulty in separating sensory cues causes confusion in determining their importance in the arousal of sexual excitability in the male. Where heterosexual contact occurs under conditions of close confinement, such as during hand-serving or semen collection with the artificial vagina, rams develop a lack of reliance on sensory capacities. Elimination of some precopulatory acts also frequently occurs [7]. The selection of oestrous ewes under more extensive conditions, such as flock mating, is a more complex process, involving a number of sensory capacities. Sexual behaviour now includes not only the acts of fore-play and copulation, but also the precopulatory discrimination and detection of receptive ewes from a distance.

Kelley [8] concluded that rams are capable of detecting oestrus by a characteristic odour in the ewe's vaginal secretions. Lindsay [9] and Fletcher & Lindsay [10] also presented evidence that olfactory cues play a significant rôle in selecting oestrous from non-oestrous females by the ram. On the other hand, Banks, Bishop & Norton [11] failed to find a significant change in the courtship behaviour of rams rendered temporarily anosmic by topical anaesthesia. The ability of the ram to detect oestrous ewes over some distance seemed to be impaired, but not the copulatory act *per se*.

The male is also stimulated by the sight of a female, a castrated male, a part of another animal's body or an inanimate object, e.g. a dummy [12]. Fletcher & Lindsay [10] reported that blind-folding reduces sexual activity in rams. Auditory stimuli appear to be of minor importance in evoking sexual excitability in sheep, either by detection of oestrous ewes or sexual activity as such [10].

Intromission and eventual ejaculation are elicited by the tactile stimuli acting on the contraceptors, distributed over the penis, especially the *glans penis* [1, 13]. Fletcher & Lindsay [10] concluded that the sexual activity of rams is affected slightly by loss of hearing, more by inability to smell and most by loss of vision, but partner-seeking is affected specifically in those rams which are unable to smell.

DEVELOPMENT OF MATING BEHAVIOUR PATTERNS

According to Banks [4], all rams have developed the preliminary motor patterns, displayed by mature males, long before they reach the age of physiological sexual maturity. Nevertheless, with their first heterosexual interaction with an oestrous ewe, relatively few rams display sexual interest and few will attempt mating [14]. If heterosexual contact with ewes is continuous, most of the young rams eventually exhibit the complete sequence of adult motor patterns and will copulate [15]. Oestrous ewes only evoke sexual arousal in these rams after the rams have had considerable experience with them. It thus seems that the array of stimuli that evokes the complete response is learned to a substantial degree during a series of initial encounters between ram and ewe [4, 14, 15]. Considerable differences in the response of rams are observed: some rams appear to be sexually inhibited and refuse mating [15]. The unisexual rearing of ram lambs, when the tendency of mounting other males develops, seems to interfere with the early development of normal heterosexual communication systems which lead to copulation [4]. Social interactions occurring early in life and assuming the form of incipient sexual behaviour, appear to be necessary prerequisites for the complete establishment of normal sexual behavioural patterns [16]. Pretorius [14] and Marincowitz, Pretorius & Herbst [17] attribute the poor sexual interest of inhibited rams to the common managerial practice of isolating rams from ewes during puberty, when homosexual tendencies are presumably formed. When sexually inhibited rams are placed in the continuous company of oestrous ewes, the majority begin to mate and the libido appears to be normal afterwards [15]. Nevertheless, a relatively large percentage of such non-interested rams displays still no heterosexual interest and refuses mating. Ahmed [18] demonstrated that sexual inhibition can be overcome partially by hormonal therapy, treatment with testosterone being more successful than PMS. Banks [4] also obtained a substantial increase in sexual behaviour in castrates by androgen replacement therapy.

EVALUATION OF BEHAVIOURAL PATTERNS

Observing the courtship patterns in the sexually experienced ram gives the impression of a smoothly coördinated sequence of actions and reactions but to analyse the mating patterns of rams experimentally, it is necessary to evaluate a variety of sexual responses quantitatively under standardized conditions. According to the previously mentioned definitions, several components of mating behaviour are measurable and comparable phenomena, e.g. characteristics such as reaction time or ejaculation latency, number of mounts per ejaculation, sexual efficiency and sexual exhaustion.

Reaction time

The period of time between the moment when the ram finds himself within the stimulating area of the female and the commencement of copulation comprises the reaction time, the period of sexual excitability or ejaculation latency [1, 2]. This period has been shown to vary with breed, degree of libido, season and also from ram to ram. The oestrous condition of the ewe is also a factor which determines mounting latency. In table 1 the

reaction time is shown to vary from a few seconds to more than 8 minutes, breed differences, if any, being obliterated by other factors.

Table 1: BREED DIFFERENCES IN EJACULATION LATENCY OF RAMS

Breed	Ejaculation latency (minutes)	Source
Merino	0,5	Wierzbowski [1]
Targhee (cross-bred)	0,44	Pepelko & Clegg [2]
Targhee (cross-bred)	1,97	Bermant et al.[3]
Merino	1,9 to 8,5	Pretorius [14]
Merino	1,13 to 6,48	Marincowitz et al.[17]
Finnish Landrace	0,3 to 4,0	Land [19]
Scottish Blackface	0,66 to 1,5	Land [19]
Unknown	0,44	Pepelko [20]

Mounts per ejaculation

The ability of the ram to serve a large number of ewes within a minimum period of time is defined as the mating dexterity of the ram [17]. The number of attempts made before gaining intromission and ejaculation serve as a parameter of mating dexterity. Pepelko & Clegg [2] reported the number of mounts per ejaculation to vary between 1,3 and 3,2 for Targhee rams. For the same breed Bermant, Clegg & Beamer [3] reported an average of 3,83 mounts per ejaculation. Corresponding values are reported in the literature for the Merino breed [6, 14, 17]. The practical importance of good mating dexterity is illustrated by the observation that the ram which requires the fewest mounts per mating, serves on average the largest number of ewes [21].

Sexual drive also influences the number of mounts per ejaculation. Rams of high libido average 3,1 mounts per ejaculation against 6,6 for rams of low libido [17]. A factor of major importance in determining the mating dexterity of a ram is body conformation. In Merino rams Pretorius [14] found a linear increase in number of mounts per ejaculation with increase of skin fold development, which produced a progressive obstacle to facile mating, with a corresponding increase in reaction time (Fig.)

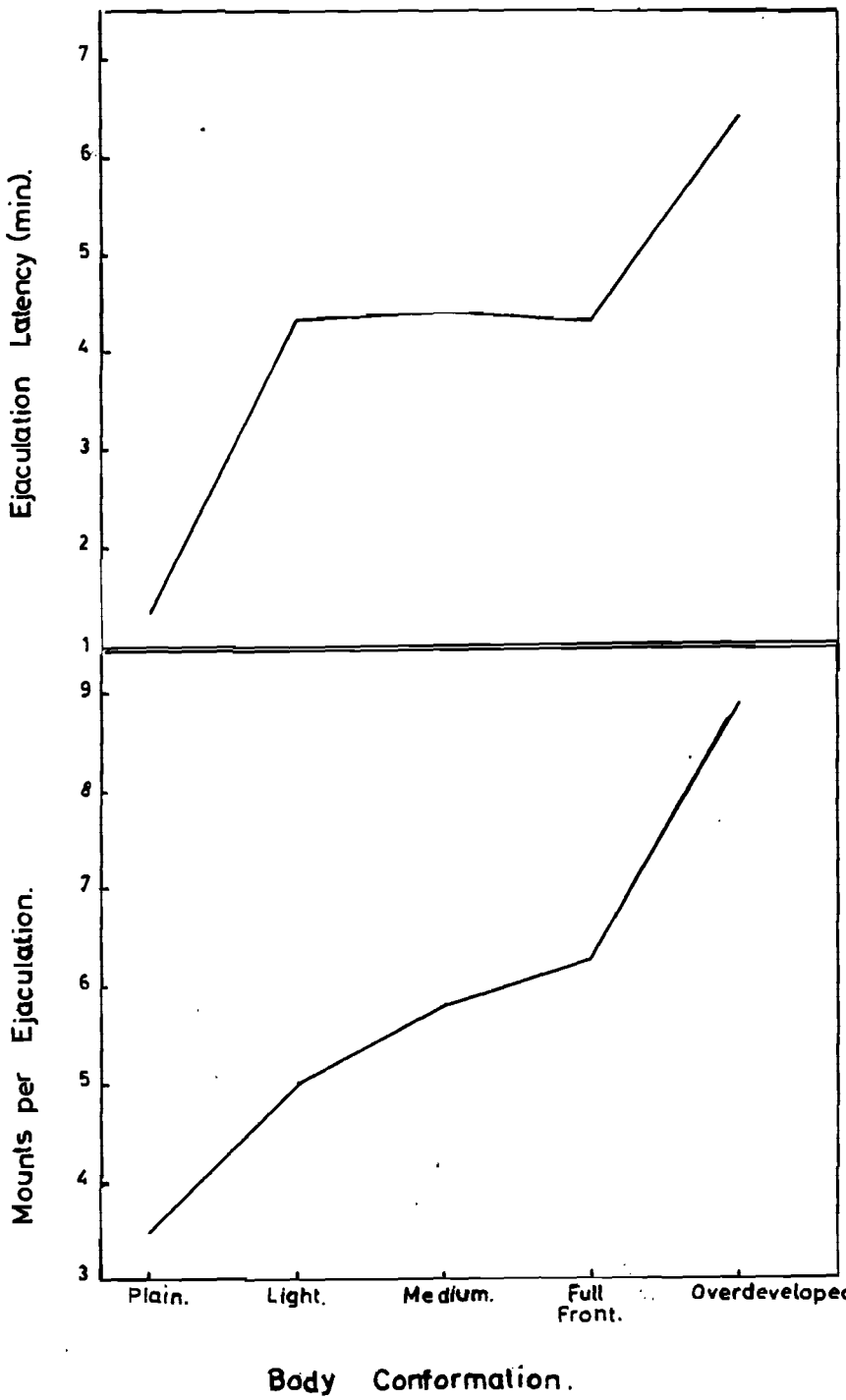
Sexual efficiency and sexual exhaustion

After copulation the male does not respond to sexual stimuli for varying periods of time. As time passes, sexual excitability increases and the male becomes ready to copulate again. Copulation repeated many times at short intervals, leads to sexual exhaustion [2]. Experimentally this phenomenon can be examined by means of registered successive copulations performed under conditions of the so-called "Exhaustion test" [1]. During the test, animals are allowed to copulate until exhaustion. The test terminates if no symptoms of sexual excitability occur within 30 minutes of the last copulation [1]. Pepelko & Clegg [2] and Bermant *et al.* [3] consider a male to be sexually exhausted if copulation is not repeated within 20 minutes. The average number of ejaculations per ram with one ewe until sexual exhaustion is reached, amounts to four or five (Table 2). Individual rams, however, exhibit large differences in the number of ejaculations performed before becoming sexually exhausted.

Table 2: NUMBER OF EJACULATIONS PER RAM BEFORE ATTAINING SEXUAL EXHAUSTION

Breed	Number of ejaculations	Source
Merino	4,0	Wierzbowski [1]
Targhee (cross-bred)	5,5	Pepelko & Clegg [2]
Targhee (cross-bred)	3,91	Bermant et al.[3]
Unknown	3,5	Pepelko [20]
Targhee	5,5	Beamer et al.[22]

Post-ejaculatory intervals, defined as the time between one ejaculation and another, increases considerably during successive matings when the stimulus female (oestrous ewe) is not changed [2]. After the introduction of a different, not recently mated female, sexual recovery is significantly quicker than that following the reintroduction of the same female or the introduction of a different, recently mated ewe [2]. Similar observations have been reported by Beamer, Bermant & Clegg [22], who also obtained a substantially faster sexual recovery when a different, recently mated female was introduced to the ram. Intromission *per se*, and not the ejaculatory reflex that normally accompanies it, seems to be the critical factor leading to the ram's waning interest in the same ewe [3]. Beamer *et al.* [22] were unable to identify the essential components of information used by the ram to



Ejaculation latency and mounts per ejaculation in Merino rams which differed in body conformation.

discriminate between the identity of the ewes. Gross alteration in the appearance of ewes is not sufficient to confuse rams about the identity of unmated and recently mated ewes.

Under range conditions, with an excess of oestrous ewes, the ram may perform up to 20 to 40 services a day [6, 23, 24]. Haughey [25] has demonstrated that many rams are capable of serving well over 100 ewes during the course of a single oestrous cycle without losing their mating potential. Lindsay & Ellsmore [26] recorded up to 10 ewes served within 24 hours, while Wiggens, Terrill & Emik [27] obtained six services of different ewes within 30 minutes. These results indicate large breed differences in the sexual potency of rams.

Copulation repeated several times during relatively short periods leads to exhaustion of the male's sexual potency and to the temporary loss of his ability to react to sexual stimuli. After exhaustion of sexual potency the male needs a recovery period: it takes some time before he reaches the same level of sexual excitability and efficiency as before. Wierzbowski [1] recorded considerable species differences in this phenomenon. During a 20 day exhaustion experiment, 50 per cent of the bulls and 30 per cent of the stallions temporarily lost their ability to mate. Rams, on the other hand, appeared to have a high sexual efficiency, as all the rams copulated during the successive 20 days.

MATING BEHAVIOUR AND REPRODUCTIVE EFFICIENCY

It is known that in flock or group mating, rams compete vigorously with one another to serve the oestrous ewes. This frequently results in delaying service; mating may even be prevented. In spite of this severe competition, one ram normally succeeds in copulation. This ability of the ram to mate successfully, even in the face of severe competition, can be attributed to some dominant characteristic. It is evident that the ram ranking highest on the scale of dominance will be the one serving the majority of ewes in the flock [17]. Conception does not necessarily follow. A dominant ram which is infertile or genetically inferior can reduce the lamb crop, extend the lambing season and adversely affect the overall merit of the progeny [17, 21]. The reduced lambing percentage will normally be ascribed to ewe infertility. Hulet *et al.* [21] and Lindsay [28] have demonstrated that the dominant ram largely controls the activity of other rams when kept within the same flock. The higher the dominance ranking of a ram, as measured by the number of teases, mounts and matings, the more the activity of subordinate rams is reduced.

The dominance of one ram over another is quickly established where rams are used under flock or group mating systems. Mature rams always dominate young rams [21]. In breeding management, the use of rams of the same size and age thus seems advisable. Considerable evidence exists that the dominant ram not only serves the majority of oestrous ewes, but that he also prevents other rams from mating while he himself is temporarily unable to serve [25, 28, 29, 30]. Further support is found in the results of Marincowitz *et al.* [17] that subordinate rams tend to serve more ewes in the absence of competition from other rams. Under range conditions, where oestrous females are normally in excess, the dominant ram cannot always effectively restrict the sexual activity of subordinate rams [23], but will remain an inhibiting factor. Contrary to the afore-mentioned, Mattner *et al.* [6] and Lindsay & Robinson [31] reported that the rate of service of subordinate rams is not markedly depressed by the presence of dominant ram(s). Paddock size and number of oestrous ewes available seems to be important in this respect, as it affects the interaction between rams. Nevertheless, it is reasonable to assume that a dominant ram of high libido and with excellent mating dexterity will serve a larger proportion of ewes in a given flock. If dominance is genetically associated with any production parameter then this phenomenon in sexual behaviour can cause unexpected genetic drift [30].

The practical importance of rams displaying superior libido and mating dexterity was illustrated by Marincowitz *et al.* [17] in the higher lambing percentages of ewes compared with those served by subordinate rams. Dominant rams largely maintain their sexual activity during the successive weeks of the breeding season and serve more ewes. Subordinate rams, on the other hand, serve less ewes and seem to lose sexual interest, resulting in a dcreasing number of ewes served in the consecutive weeks of the mating period.

The male to female ratio also influences the conception rate. A ram with a high libido

and with good semen quality is capable of a satisfactory breeding performance. This in turn affects the ram cost per lam produced[29].

From the above description of mating behaviour patterns of rams it is thus evident that delay in the commencement of breeding activity and failure of rams to breed properly most certainly contribute to the low lambing percentages and extended lambing seasons under flock mating conditions in South Africa.

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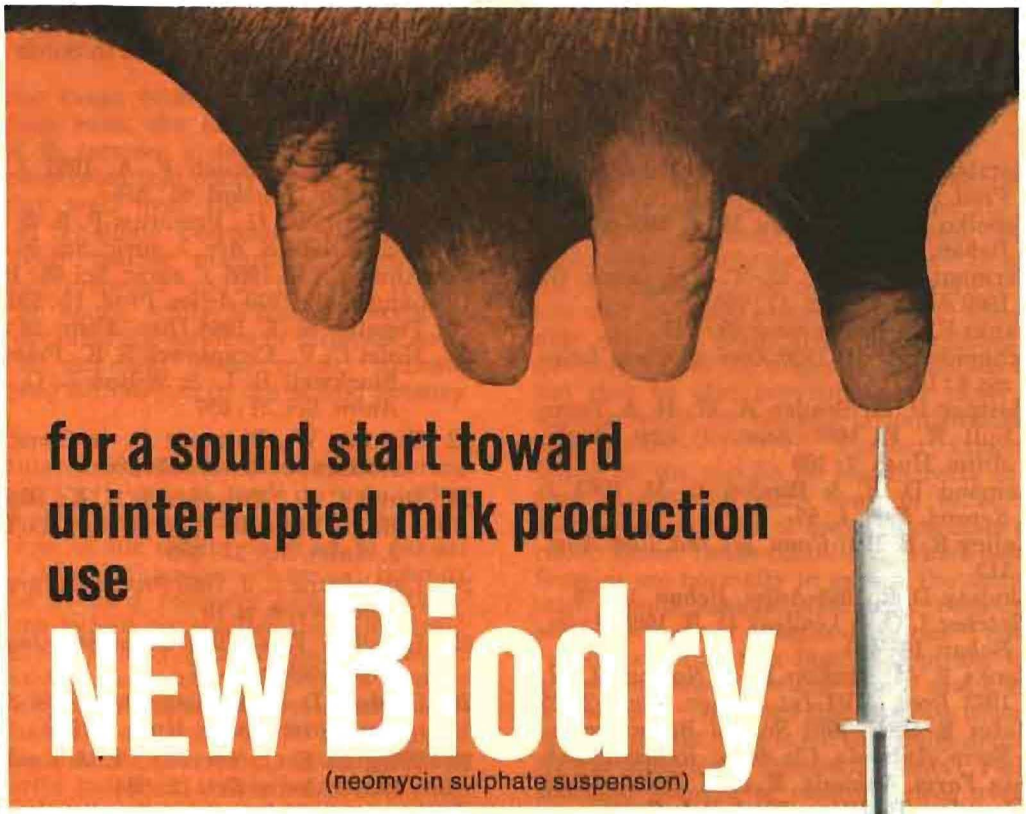

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REVIEW OORSIG

SOME ASPECTS OF THE TREATMENT OF SHOCK IN ANIMALS*

W. L. JENKINS**

SUMMARY

The pathophysiology of the three forms of shock, hypovolaemic, septic or endotoxaemic and cardiogenic, is briefly outlined, variant patterns and secondary effects are mentioned, and therapeutic measures in the light thereof are prescribed.

PATHOPHYSIOLOGY OF SHOCK

Shock may be divided into three general categories:

1. *Hypovolaemic shock* which occurs following any loss of volume from the circulation, e.g. haemorrhage, trauma, extravascular transudation, burns, severe diarrhoea or emesis.
2. *Septic or endotoxaemic shock* which may occur following septicaemia. The most common organisms involved are Gram negative, e.g. *E. coli, Klebsiella, Pseudomonas* or *Proteus,* all of which contain endotoxin. The effects of the endotoxins on the circulatory system result in "sequestration" or "pooling" of plasma. In terms of its effect upon the circulatory system, septic shock may be considered a form of hypovolaemic shock.
3. *Cardiogenic shock* which occurs in acute cardiac failure. Cardiogenic shock is not common in animals but occurs frequently in man in cases of myocardial infarction or cardiac surgery. The damage is to the heart itself but the effect on the peripheral circulation is similar in many respects to that occurring in volume loss or septic shock.

In hypovolaemic shock there is a reduction in the circulating blood volume. Whether the loss is whole blood (as in haemorrhage or traumatic shock) or plasma (as in burns, certain infectious diseases, severe diarrhoea or emesis) an inadequate volume of blood is returned to the heart. The central venous pressure will be low, provided congestive heart failure is not a complication, and the volume of blood returning to the heart, and thus the output of the heart will be low.

Similarly, in septic shock the volume of blood returning to the heart is low because of the pooling of plasma in the splanchnic vasculature, particularly in the abdominal viscera and lungs. The sequestration of plasma in these beds is due to the effect of the endotoxin in releasing catecholamines (adrenaline and noradrenaline) which cause spasm of arterioles and venules. With time and the development of acidosis, vasodilatation occurs in the arterioles but not in the venules. In this situation blood can enter the capillary beds with ease but can only leave with difficulty: the hydrostatic pressure increases and plasma leaks into the interstitial spaces. Moreover, the endotoxins damage vascular membranes directly, so that plasma leaks readily from the microcirculation. The most descriptive term for the microcirculation in this state is *stagnant anoxia.* Furthermore, the low flow rates which occur under these circumstances lead to viscosity changes and erythrocyte sludging within the capillaries. An additional complication which may arise is the activation of the clotting factors by the acidic environment; diffuse intravascular coagulation may occur. The loss of plasma volume results in a decreased venous return to the right atrium and is evident as a decreased central venous pressure. With the fall in venous return there is a fall in cardiac output. The circulatory disturbance is further compounded by the baroreceptor response to the low blood pressure, namely, vasospasm through increased sympatho-adrenal activity.

Species differences appear to exist re-

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garding the visceral organs which are most severely affected in cases of endotoxaemic shock. In the dog the major lesions occur in the gastro-intestinal tract and the liver, while in the horse the large intestine is often severely affected. In the cat, sheep and ox, the lungs appear to suffer the greatest damage during septic shock.

In cardiogenic shock there is a direct insult to the heart resulting in a reduced cardiac output. Again there is sympatho-adrenal response to the hypotension. Initially there is no change in blood volume, but because of the damaged heart, reduced cardiac output and normal blood volume, pressure soon increases on the venous side and the state of the microcirculation becomes identical to that seen in late traumatic or septic shock, i.e. that of stagnant anoxia.

From the above it is evident that in the common forms of shock the net circulatory effects are a reduction in cardiac output, tachycardia, and a decrease in arterial blood pressure. The decrease in blood pressure decreases the activity in the carotid and aortic baroreceptor systems and activates the sympathetic nervous system. In turn, the sympathetic nervous system releases increased quantities of adrenaline and noradrenaline which cause arteriolar and venular vasoconstriction in areas with alpha receptors (especially the skin and viscera). The areas with beta receptors (especially the heart and skeletal muscles) do not show this vasoconstrictive response. In the constricted vascular beds, tissue perfusion is reduced, oxygen consumption is decreased and oxygen extraction increased. The arteriovenous oxygen saturation difference is markedly increased. As oxygen consumption falls, owing to failure of delivery, cells switch from aerobic to anaerobic metabolism and there is an increased production of acid metabolites, such as lactic acid, and a decrease in pH. If this situation persists, cellular death occurs and this intensifies the acidosis.

The above represents the general scheme in the pathogenesis of shock but variations do occur. Two of these will be discussed briefly.

Variants in the Pattern of Shock

Occasionally in septic shock the cardiac output is actually elevated and the total peripheral resistance is reduced. This paradoxical finding is due to the opening of arteriovenous shunts in the lungs, abdominal viscera and skin. The effect is actually to compound the stagnant anoxia of shock by further reducing the useful flow of blood.

Another paradox which may occur is respiratory alkalosis. This is due to hyperventilation, especially where shunting takes place in the lungs. In fact, the blood pH may rise even though a metabolic acidosis is present. This effect is limited, however, and a change from an alkaline to an acid pH is often an ominous sign.

Secondary Effects of Shock

It is imperative to appreciate that, besides the primary haemodynamic failure in shock, many organs undergo secondary damage as a result of the drastic physiological alterations which occur within the body. A few of the more important considerations will be noted here:

Shock brings about a reduction of renal blood flow proportionally greater than the systemic reduction of blood pressure, a fall in glomerular filtration rate and a rapid loss of renal concentrating ability. Protracted shock may even lead to renal tubular necrosis.

Subendocardial haemorrhages and necrosis and myocardial zonal necrosis occur in haemorrhagic shock.

The reticulo-endothelial system may be adversely affected or may become exhausted in shock and the resultant increased susceptibility to infection could be fatal.

The cells of all the parenchymatous organs may undergo degeneration and major disturbances of metabolic function of cells and tissues are often observed in the terminal phase of shock.

TREATMENT OF SHOCK

Although all the factors noted above must be taken into consideration, the primary goal in the treatment of shock is the reduction of vasoconstriction and increased nutritional tissue perfusion.

1. *Volume replacement*

The essential step in shock therapy is volume replacement. This is standard therapy for hypovolaemic and traumatic shock but is not as well recognized for septic and even cardiogenic shock.

In septic shock large volumes of blood are sequestered in the microcirculation of the viscerocutaneous areas and further volume is lost through damaged vascular membranes. This fluid is lost to the effective circulating volume. Large volumes of plasma, plasma substitutes and electrolyte solutions are often

required in septic shock. Unless there is pre-existing anaemia or intravascular haemolysis, the need for red cells is not essential. In fact, the haematocrit values are often quite high, reflecting the predominant plasma loss.

Arterial pressure (P) is equal to the cardiac output (CO) times the total peripheral resistance (R), i.e. $P=CO\times R$. The goal in shock is to restore blood pressure by an increase in cardiac output rather than by an increase in vasoconstriction (resistance). Thus in hypovolaemic and septic shock, since volume return to the heart is reduced, volume replacement is the treatment of choice, since it increases cardiac output and therefore blood pressure. Volume is added to restore the blood pressure to normal limits. The central venous pressure is used as a guide if it can be monitored. Successful treatment results in an increase in central venous pressure, an increase in cardiac output and an increase in blood pressure. If the blood pressure reaches the desired level and there are clinical signs of adequate tissue perfusion (warm skin over the extremities and a measurable urine output) no further therapy is generally needed.

The choice of fluids depends on the prevailing state of shock; they include the following:

(a) *Blood.* Blood is indicated only if there has been blood loss or haemolysis. Generally speaking, if the haematocrit is below 30%, then whole blood is necessary. The dose will obviously vary depending upon the particular case but will usually be in the region of 20—40 ml/kg.

(b) *Plasma.* Plasma, lyophilized plasma, serum or albumin solutions may be used. Plasma itself is the most readily available but one should bear in mind that antiplasma antibodies may be present in the recipient. Plasma may be administered initially at a rate of 5—10 ml/min and then more slowly until a total dosage of about 20—40 ml/kg is given.

(c) *Plasma expanders.* Several types of plasma expanders are available, e.g., dextran 6% ("Dextraven"), low molecular weight dextran ("Lomodex")and gelatin polymer 3,5% ("Haemaccel"). The dosage rate of these plasma substitutes is in the region of 10—20 ml/kg.

(d) *Electrolyte solutions.* Balanced electrolyte solutions must be used. Saline or dextrose saline can result in a disturbance of electrolyte equilibrium if large volumes are given. Lactated Ringer's solution (Hartmann's solution) is a balanced electrolyte solution which will totally replace extracellular fluid. If energy is required, lactated Ringer's solution with 5% dextrose and 5% levulose is available. Plasmalyte B (Baxter) is also a satisfactory electrolyte solution for use in shock. Once again the dosage rate of these fluids may vary greatly but as a guide one may initially administer 10—30 ml/min for about 30 minutes and then decrease the rate until a total dosage of up to 40 ml/kg is given.

The above dosage rates are only *guides,* and will vary depending on the species of animal concerned and the severity of the shock. If at all possible, the central venous pressure should be monitored and the lungs auscultated during fluid therapy to avoid the danger of pulmonary oedema occurring.

2. *Direct cardiac stimulants (inotropic agents).*

In the treatment of shock additional specific drug therapy is required when volume replacement alone fails to increase the cardiac output, reduce the vasoconstriction, and to improve tissue perfusion. A direct cardiac stimulant would be a useful form of therapy but there are only a few available and these have not been successful when used alone.

(a) *Digitalis.* Digitalis increases cardiac tone and may be used in shock. In the acute case, however, it often fails. Nevertheless, it may be given early, especially if there are signs of congestive failure. Digoxin ("Lanoxin") should initially be administered i/v (0,05—0,1 mg/kg) and one to four additional doses of 0,025 mg/kg each may then be given at intervals of about one to two hours depending on the condition of the patient.

(b) *Isoprenaline.* Isoprenaline is a beta stimulating adrenergic drug which increases the rate and force of myocardial contraction. It also has the added advantage of being a peripheral vasodilator. This drug increases cardiac output and reduces vasoconstriction in beta beds, principally the voluntary muscles. The major untoward effects of isoprenaline are tachycardia, arrythmia (due to myocardial irritability) and tachyphylaxis.

The dose of isoprenaline ("Isuprel") is 0,25—0,5 μg/kg/min administered in a

5% dextrose drip. It may also be given by subcutaneous or intramuscular injection.

(c) *Heptaminol.* Heptaminol's effect on the heart is that of an indirectly acting sympathomimetic, which will thus augment the force of myocardial contraction.

The dose of heptaminol ("Cortensor") is 4—8 mg/kg given intramuscularly, intravenously, or in an intravenous drip.

3. *Vasopressors*

Previously the emphasis in treating shock was to maintain blood pressure by further increasing resistance using vasoconstricting drugs, such as adrenaline, noradrenaline ("Levophed") or metaraminol ("Aramine"), but these are alpha receptor stimulators and accentuate the viscerocutaneous stagnant anoxia. None of these agents has been shown to increase survival significantly in any form of shock and their use is **not** recommended.

4. *Vasodilators*

In shock, cardiac performance can be enhanced through reduction of peripheral resistance and stagnation, i.e. by producing vasodilation in the constricted viscerocutaneous beds.

There are three general types of drugs that induce vasodilatation. These are: (i) those that produce direct vasodilatation, (ii) those that produce vasodilatation by blocking the vasocontrictive effects of adrenaline and noradrenaline and (iii) those that produce vasodilatation by unknown means.

(a) *Isoprenaline.* Isoprenaline is the clinically available representative of the group producing direct vasodilatation. Unfortunately, the vasodilatation produced by isoprenaline is greatest in the skeletal muscle vascular beds, which are usually adequately perfused in most cases of shock, but its effect is minimal in the viscerocutaneous beds.

(b) *The alpha adrenergic blocking agents.* Three drugs produce vasodilatation by blockade of the effects of the endogenous catecholamines on alpha receptors, thereby reducing vasoconstriction produced by increased sympathetic tone. These are:
Phenoxybenzamine ("Dibenzyline") — a potent long-acting vasodilator which is not available for clinical use.
Phentolamine ("Regitine") — which has a rapid onset of action and must be given by continuous intravenous infusion.
Chlorpromazine (and its congeners) which is effective in high dosage and which may be given prophylactically to those cases with early signs of shock. The dose is 1—2 mg/kg given intramuscularly or intravenously.

(c) *Corticosteroids.* The corticosteroids, if given in large or massive doses, produce vasodilatation. These agents probably achieve this effect in two ways: they slow transmission of sympathetic nerve impulses and they preserve the integrity of the capillaries in the face of anoxia. These and other effects produce measurable decreases in the resistance of the viscerocutaneous microcirculation. The degree of vasodilatation is also dose dependent. The corticosteroid should be given as a single intravenous injection over a three to five minute period. The effects of this form of therapy include vasodilatation in two to four hours, reduction in total peripheral resistance, an increase in oxygen consumption, a reduction in lactic acid levels, an increase in urine output, and the development of well perfused warm extremities. No significant adverse effects of the administration of this single dose have been noted.

The approximate equivalent dosage rates of the available corticosteroids are as follows:

Hydrocortisone ("Ef-Cortelan", "Solu-Cortef"): 50—150 mg/kg.

Methylprednisolone ("Solu-Medrol"): 30 mg/kg.

Betamethasone ("Betsolan Soluble") and dexamethasone ("Decadron"): 6 mg/kg. If there is no response these doses may be repeated in 4 hours.

If vasodilators are administered, a radical drop in blood pressure may occur due to the increased vascular volume. The administration of fluids *must* precede and accompany vasodilator therapy.

5. *Beta adrenergic blockers.*

It has been suggested that excessive beta adrenergic stimulation with the opening of multiple arteriovenous shunts in the pulmonary and splanchnic areas is of primary importance in the pathogenesis of late shock. The beta adrenergic antagonist, propranolol

dihydrochloride ("Inderal") significantly increased the survival rates of dogs in states of haemorrhagic and endotoxin shock. The survival rates were correlated with improved haemodynamic and biochemical patterns consistent with closure of arteriovenous shunts. In these studies 5 mg propranolol was given intravenously over a 3½ hour period and then an adidtional 5 mg was administered during the next 12 hours. Intensive anti-shock therapy was given simultaneously. It would seem that in late refractory shock propranolol may be useful.

6. *Treatment of renal abnormalities accompanying shock*

Glomerular filtration rate and effective renal plasma flow are reduced in every case of shock. If the hypotensive state persists, oliguria may continue with the development of oliguric renal failure due to acute tubular necrosis. Urine flow rates must be adequately monitored during and following shock, although the disturbance in renal function is much more complex than simply a reduction in urinary output. The BUN level should also be followed carefully.

Once the animal is hydrated, the response of the kidney to mannitol (or even glucose) administered intravenously may be used as a diagnostic and therapeutic measure. A dose of 0,2 g/kg of a 10% solution over three to five minutes is used as a trial dose. A diuresis is usually observed within three hours. If urine volume does not increase during this period a second, similar dose may be given. A diuretic response indicates that oliguric renal failure has not occurred and 1 g/kg mannitol (10% solution) may be administered during the following 24 hours. The washout effect of this osmotic diuresis prevents cast deposition and increases the intraluminal pressure in the tubules.

Saluretics, e.g. furosemide ("Lasix") at a dosage rate of 1—2 mg/kg i/v. may also be used but it is essential to establish that recovery from the hypovolaemic state has been achieved prior to their administration.

7. *Antibiotics*

The control of bacterial invasion and the eradication of infection are important aspects of therapy, particularly in septic shock. Generally speaking, Gram negative organisms are involved. The early oral administration of nonabsorbable antibiotics to destroy the Gram negative bacteria in the gastro-intestinal tract has been advocated, particularly in horses. When the micro-organisms are destroyed, however, increased levels of endotoxin may be produced, hence this procedure should be carried out with caution in late endotoxaemic shock.

Antibiotics with broad spectra should be administered orally and parenterally. Examples include kanamycin, cephalothin, ampicillin, oxytetracycline and chloramphenicol.

8. *Anticoagulant and fibrinolytic therapy*

The complication of diffuse intravascular coagulation, which may occur in endotoxaemic shock, is particularly evident in the horse. The use of anticoagulants or fibrinolytic agents may play a vital rôle in the survival of an animal in certain cases. Their mechanism of action is simply based on the clearing of sludged blood clots and thrombi from damaged peripheral vessels.

Heparin may be used at a dosage rate of 1 mg/kg (100 units are about equivalent to 1 mg) in a drip over four to six hours. Fibrinolysin ("Lyovac") which contains 5 000 MSD units of fibrinolytic activity per millilitre has been employed successfully in treating endotoxaemic shock in horses but the preparation is prohibitively expensive.

9. *Oxygen*

An adequate oxygen supply is essential in the treatment of shock, especially in haemorrhagic and septic conditions.

10. *Analgesics*

In traumatic shock, pain reflexes will potentiate the severity of the condition. Pain should be alleviated by using ataractic-narcotic type preparations to minimize vasomotor reflex depression.

11. *Other procedures*

It is important to establish an open airway and to maintain adequate respiratory support in every case of shock.

The animal should be restored to normothermia as soon as possible.

The organic functions of a recovered case should be carefully monitored by urine examination, liver function tests, electrocardiogram and digestion and absorption tests, in order to establish any permanent damage which might have resulted from severe shock.

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BOOK REVIEW — BOEKRESENSIE

INFECTIOUS AND PARASITIC DISEASES OF WILD BIRDS

J. W. DAVIS, R. C. ANDERSON, L. KARSTAD AND D. O. TRAINER (EDITORS)

The Iowa State University Press, Ames, Iowa. Pp. viii 344, Figs 96, Tabs 32. Publ. price £7.50

Text-books on animal pathology devote only a limited or no space to diseases of animals not classified as domestic. There are various pertinent but obvious reasons why a separate book like this one was sorely needed by several workers in a variety of fields. The book is considered by the editors as an experimental effort in summarizing and correlating available knowledge of infectious and parasitic diseases of wild birds. The experiment was a most successful one, bearing in mind that one is dealing with a large, unexplored area of science and that knowledge in this area is expanding very rapidly. This book could be recommended at least to students, research workers in animal diseases, veterinarians, and teachers of infectious diseases in various areas of medicine. In South Africa, with its extremely rich endowment of wild life, this book receives special welcome.

There are five sections in the book:—

Viral diseases

Bacterial, Rickettsial and Mycotic diseases

Parasitic infections

Neoplastic diseases

Toxins.

These sections are dealt with in 28 chapters, arranged by diseases, and are based on the experience of the 28 contributing authors and their interpretation of the available world literature. The bibliography furnished at the end of each chapter is so designed that a reader may further his knowledge of the subject to the desired extent.

A basic knowledge of the disease in question is provided, which includes its aetiology, history, distribution, epizootiology, symptoms, pathology, immunity, diagnosis, treatment and control.

This is not only considered a very thorough work but also as an excellent link with and complement to existing standard works on poultry diseases. Even allowing for certain omissions in a work of such a comprehensive nature, one does miss chapters on mycoplasmosis, *Haemophilus* infection and mites. It should be pointed out that Newcastle disease virus is classified as a member of the paramyxo viruses, and para-influenza viruses are also members of this group (Chapter 1, page 6).

To South African workers, especially, the great value of this book lies in the fact that the majority of bird species mentioned are found in this country.

L. C.

Jl S. Afr. vet. med. Ass. 43 (2): 169—174 1972

SOME HAEMATOLOGICAL VALUES IN FIVE SPECIES OF GAME

A. C. D. Cooper*

SUMMARY

Blood from 5 animal species (90 individuals) in the north of Botswana was examined to determine various haematological parameters. The results are given in tabular form.

INTRODUCTION

During June 1970 a major game sampling exercise was undertaken in the north of Botswana to determine the foot and mouth carrier status of several species of game. Advantage of this opportunity was taken to obtain blood specimens from the animals sampled in order to determine the haemoglobin concentration, and total and differential white cell counts.

MATERIALS AND METHODS

The animals were 40 African buffaloes *(Syncerus caffer)*, 20 impalas *(Aepyceros melampus)*, 10 bushbuck *(Tragelaphus scriptus)*, 10 blue wildebeest *(Connochaetes taurinus)* and 10 tsessebes *(Damaliscus lunatus)*.

Specimens were collected during a four week period in June, which is also the winter and dry season in Botswana, in three different areas, namely the Chobe Game Reserve (20 buffaloes, 10 impalas and 10 bushbuck), the southern edge of the Moremi Game Reserve (10 impalas, 10 tsessebes and 10 wildebeest) and the Matsebe area of the Okavango swamps (20 buffaloes) (Fig. 1). All these areas have a good water supply and good grazing throughout the year.

The animals were shot and bled into a disposable plastic syringe from the jugular vein. The blood was then transferred to plastic bottles containing sequestrene. These were then stored in a mobile refrigerator until the evening, when they were processed.

Haemoglobin was estimated by the cyanmethaemoglobin method [1] using Drabkin's fluid as a diluent (Aculute, Ortho Diagnostics, Raritan, New Jersey) and Acuglobin (Ortho) haemoglobin standard.

The diluent used for the total white cell count was 1% acetic acid, and blood films were made and fixed in methanol for staining with Giemsa and examination in the main laboratory at Gaborone.

The packed cell volume was estimated by the microhaematocrit method.

RESULTS

Table 1 shows the averages and standard deviations of the results obtained, and figures 2 to 5 show the results obtained for each individual test and animal.

There were only two obviously sick animals sampled. These were a buffalo cow and her calf in Matsebe. The cow was in an emaciated condition, presumably due to an old bullet wound in the spine which had partially paralysed her. Her condition obviously affected her calf as it was also emaciated and very weak. The haemoglobin results for these two animals are represented by the two lowest figures under buffalo Matsebe in figure 2. The cow had the lower of the two results. The rest of the animals were in good condition. The distribution according to age and sex of the animals is shown in table 2.

DISCUSSION

It is interesting to note the variation in the haemoglobin concentration and P.C.V. in the two groups of buffaloes. No reason can be put forward for this, as both groups seemed to be in good condition and had similar grazing facilities.

The results for the total white cell count of the bushbuck are also of interest. With an average white cell count of 1 900/mm^3, and a range of from 900 to 3 000/mm^3, the only similar, low results that appear to have been recorded are those of Kitchen & Pritchard [2] for white-tailed deer, the range for these animals being from 1 500 to 3 000/mm^3. Only one reference to work of a similar nature could be found, that of Young [3]. Whilst a greater variety of species of animals was covered,

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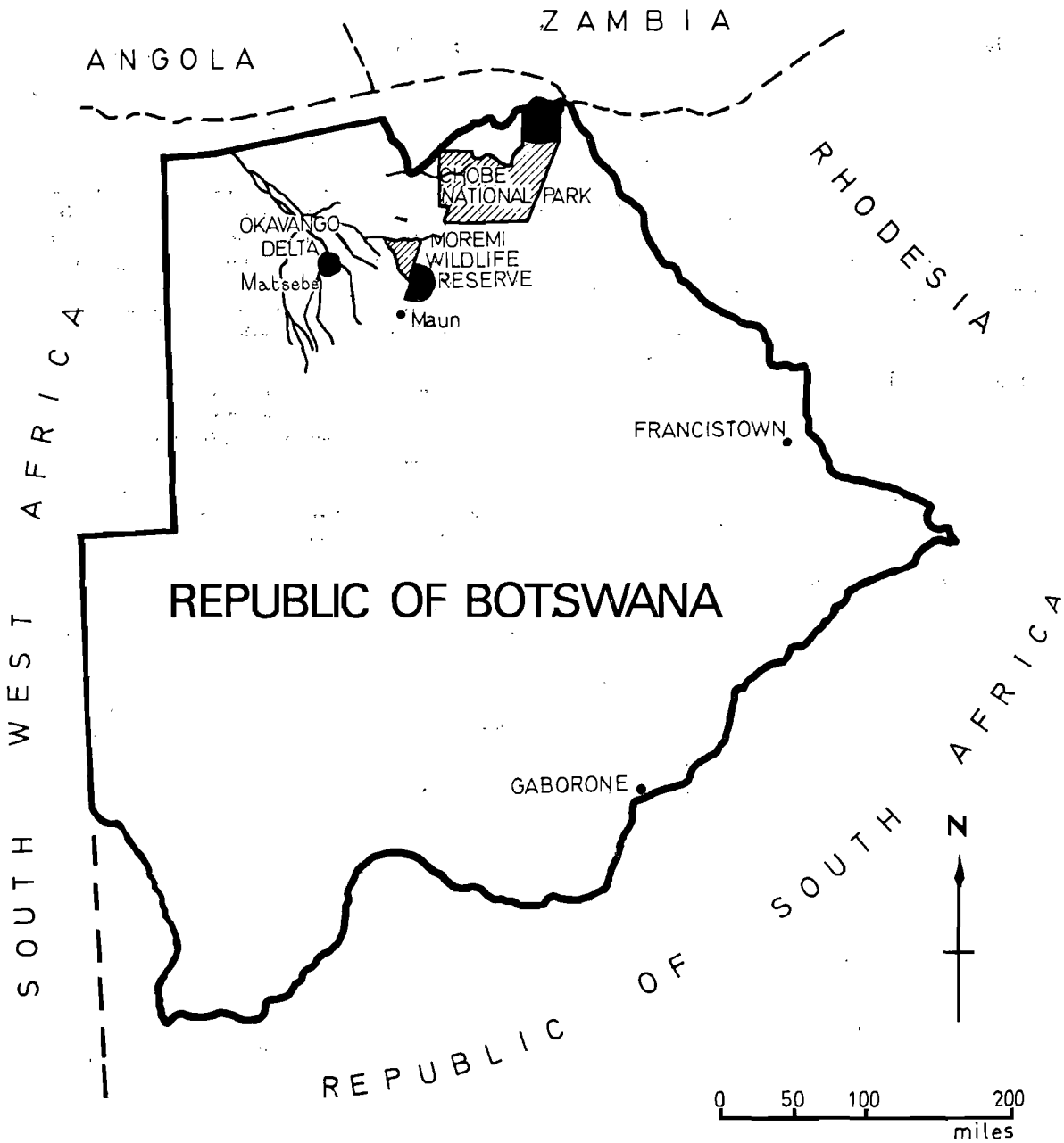

Fig. 1 Sketch Map of Botswana showing areas from which game was sampled. Areas indicated thus ●

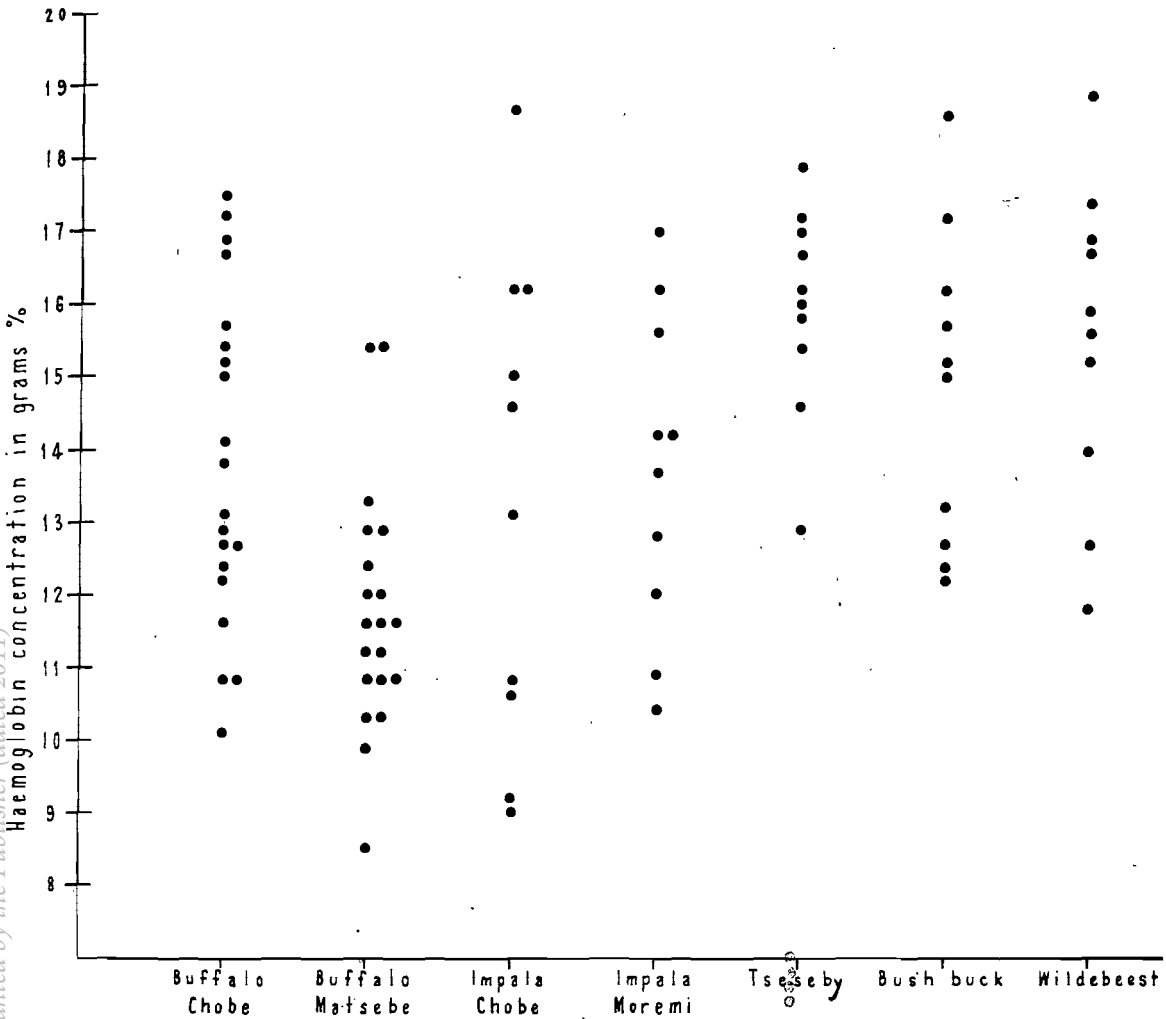

Fig 2 Values obtained for haemoglobin.
• indicates one value for one animal.

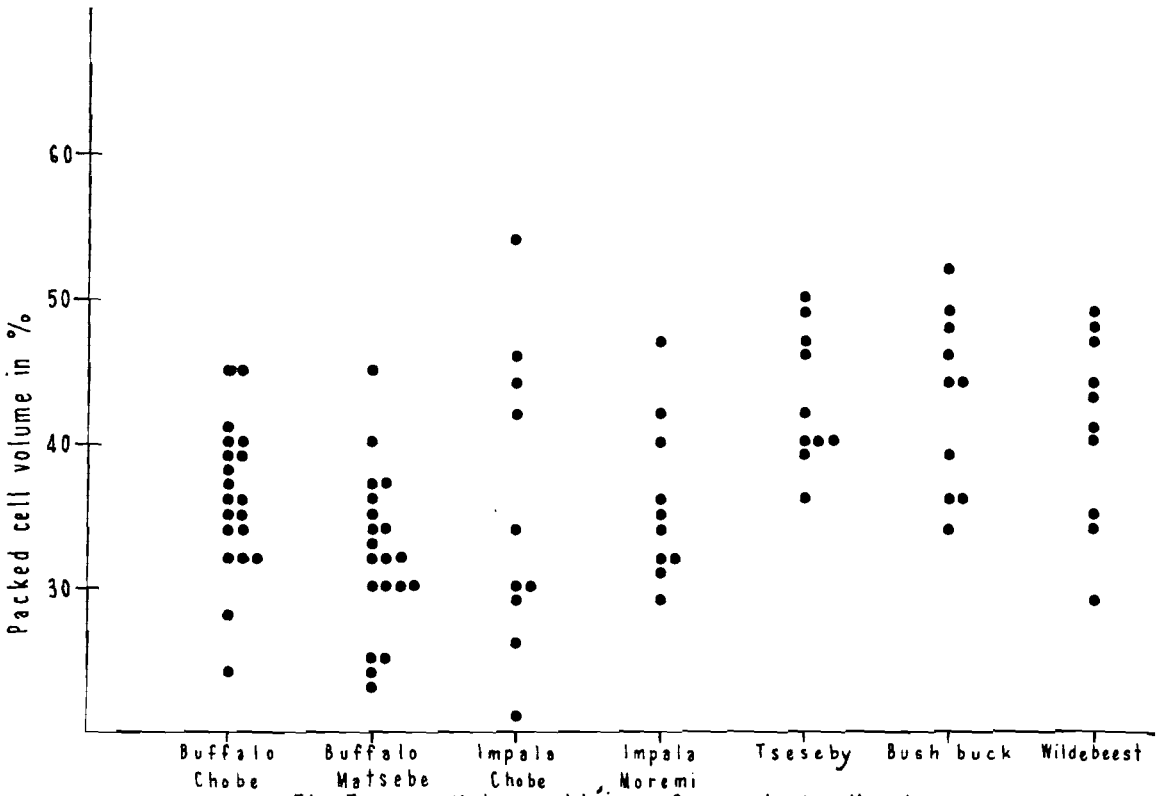

Fig.3 Values obtained for packed cell volume.
• indicates one value for one animal.

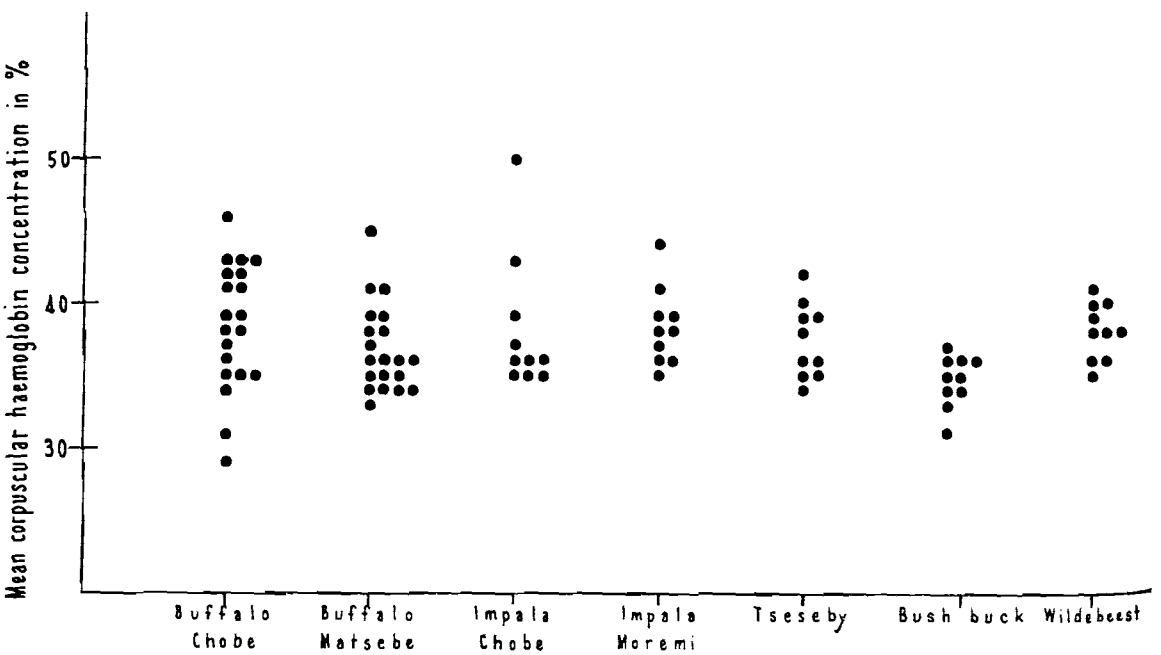

Fig.4 Values obtained for mean corpuscular haemoglobin concentration.
• indicates one value for one animal.

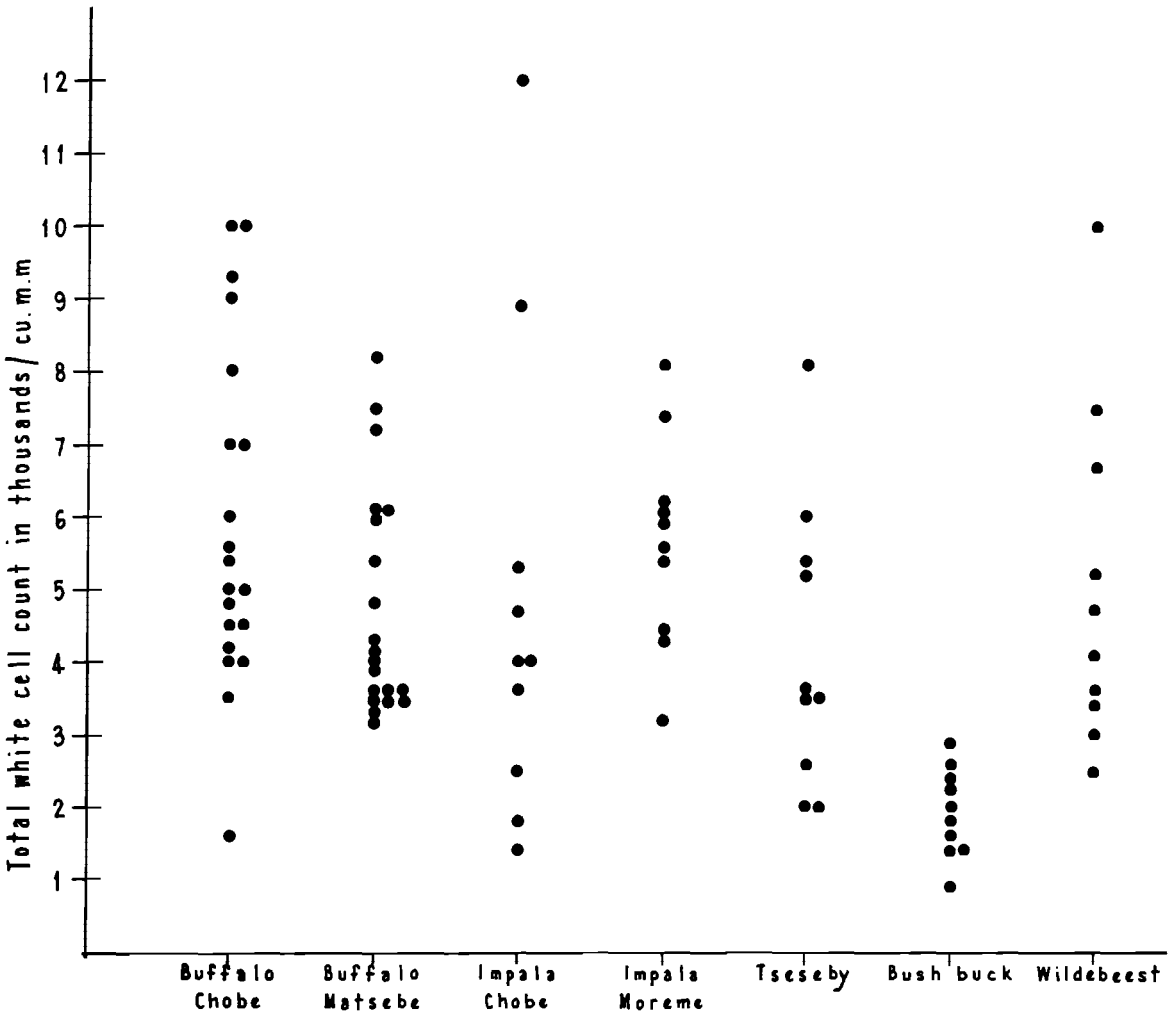

Fig.5 Values obtained for total white cell count.
• indicates one value for one animal.

Table 1: THE AVERAGES AND STANDARD DEVIATIONS OF THE RESULTS OBTAINED

	Hb		P.C.V.		M.C.H.C.		T.W.B.C.			Av. diff. W.B.C.			
	Av.	S.D.	Av.	S.D.	Av.	S.D.	Av.	S.D.	N	L	M	E	B
Buffalo Chobe	13,8	2,3	36,1	5,2	38,4	4,4	5,9	2,3	18	72	2	8	0
Buffalo Matsebe	11,8	1,7	32,2	5,5	36,8	3,0	4,8	1,6	26	61	3	10	0
Impala Chobe	13,3	3,3	35,6	10,4	38,2	4,8	4,8	3,3	32	61	3	4	0
Impala Moremi	13,7	2,2	35,8	5,6	38,2	2,7	5,7	1,5	30	60	3	7	0
Tsessebe	16,0	1,4	43,0	4,7	37,4	2,6	4,2	2,0	20	70	1	5	0
Bushbuck	14,8	2,2	42,8	6,2	34,7	1,8	1,9	0,6	38	52	8	2	0
Wildebeest	15,5	2,2	41,0	6,6	38,1	2,0	5,1	2,3	25	71	1	3	0

KEY
Av. = average
S.D. = ±standard deviation
Hb = Haemoglobin in grams %
P.C.V. = packed cell volume in %
M.C.H.C. = mean copuscular haemoglobin concentration in %
T.W.B.C. = total white cell count in thousands
diff. W.B.C. = differential white cell count in %
N = neutrophil L = lymphocyte M = monocyte E = eosinophil B = basophil

Table 2: DISTRIBUTION ACCORDING TO AGE AND SEX

	Male	Female	Calves	Young Adults	Adults	Old Adults
Buffalo Chobe	12	8	—	3	15	2
Buffalo Matsebe	9	11	2	4	11	3
Impala Chobe	6	4	—	4	6	—
Impala Moremi	6	4	—	5	5	—
Wildebeest	6	4	—	1	7	2
Bushbuck	6	4	—	1	7	2
Tsessebe	5	5	—	3	5	2

the number of animals examined per species was small, often only one animal, as in the case of the impala.

The results obtained represent the values for normal animals in good condition with two exceptions and are representative of all age groups and sexes.

ACKNOWLEDGEMENTS

The author thanks Dr. J. Falconer, the Director of Veterinary Services, Botswana, for permission to carry out the work and to publish the results; Mr. L. Tennant, Chief Game Warden; Dr. G. Child, Wildlife Ecologist and their staff in the Game Department for assistance in the field and Mr. D. Button and Mr. W. B. Craik for assistance with the tables.

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Jl S. Afr. vet. med. Ass. 43 (2): 175—179 1972

BRUCELLOSIS IN RHODESIAN WILDLIFE

J. B. CONDY AND D. B. VICKERS*

SUMMARY

A serological survey involving 28 species and a grand total of 2 320 individuals of free-living Rhodesian wild animals revealed a total of 159 cases reacting positively to serum agglutination tests, most titres varying from 20 to 80 IU/ml but an odd figure as high as 2 560 IU/ml was recorded. The highest incidence of positive cases occurred amongst zebras (24%), eland (16,9%), buffaloes (14,7%) and impalas (9,7%).

Experimental infection of 8 serologically negative individuals comprising five species, resulted in positive reactions, interpreted according to standards employed for cattle, in all of them.

INTRODUCTION

A wide range of free-living African wild animals have been reported as reacting positively to serum agglutination tests for brucellosis, and *Brucella* organisms have been isolated from free-living buffalo[1] and waterbuck[2].

A serological survey of Rhodesian wild animals for antibodies to *Brucella abortus* was undertaken to provide further substantiation. Some experimental infections of two buffaloes, impalas, kudus and one wildebeest and duiker with *B. abortus* were carried out.

MATERIALS AND METHODS

Serological survey

Sera were obtained over the last six years during anti-tsetse fly game control operations. game culling operations in National Parks and game reserves, and game cropping carried out by private game ranchers.

Sera were examined by the tube agglutination test, using an antigen prepared at this Laboratory from *Brucella abortus* strain 99, and standardized against International Standard Antiserum in accordance with FAO/WH recommendations[3]. Tests consisted, therefore, of doubling dilutions commencing at 1 : 10 and are expressed in International Units with at least 50% agglutination at the end titre (1 : 10, 1 : 20, 1 : 40=20, 40, 80 IU per ml respectively.)

Experimental infections

The following animals were caught in the wild when very young, the eldest being not more than 30 days old.

1 Duiker	*Sylvicapra grimmia*
1 Blue Wildebeest	*Connochaetes taurinus*
2 Kudus	*Tragelaphus strepsiceros*
2 Buffaloes	*Syncerus caffer*
2 Impalas	*Aepyceros melampus*

They were reared by hand, housed in quarantine pole pens, and fed lucerne hay and a commercial stock feed containing no antibiotics. At experimental infection they were all at least two years old and sexually mature. The strain of *B. abortus* used was isolated from a waterbuck, *Kobus ellipsyprimnus*, which had aborted soon after capture in the Wankie National Park[2]. It was typed by the Veterinary Research Institute, Onderstepoort, as Biotype I, identical to the common strain affecting domestic bovines.

Infection was effected via the conjunctival sac, 0,2 ml of a culture which contained 10^9 organisms per ml being instilled on to the cornea while the animal was restrained in dorsal recumbency.

The animals were bled before the experimental infection and at monthly intervals thereafter. Antibody levels were determined according to the method described above.

Biological tests

Extracts, prepared by grinding ±5 g of uterus or testes with sterile sand and saline, were made from 215 male and 170 female impalas culled in the Mana Pools National Park. Samples were pooled into lots of 10; 2 ml of each pool were inoculated into a guinea pig. Six weeks later sera from these

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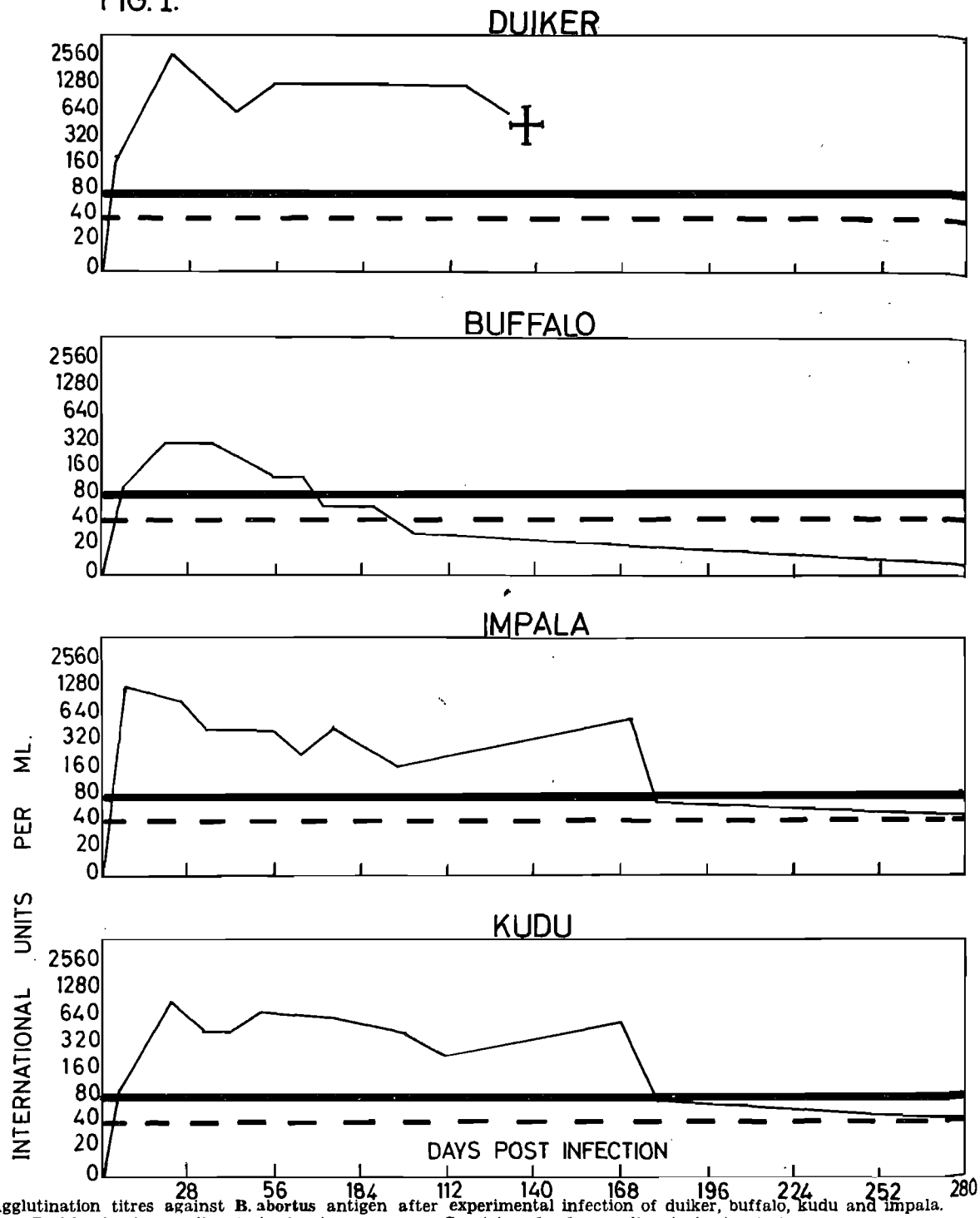
FIG. 1.



Agglutination titres against **B. abortus** antigen after experimental infection of duiker, buffalo, kudu and impala.
Positive level according to bovine test: ——— Suspicious level according to bovine test: — — — —

guinea pigs were subjected to the agglutination test and spleen cultures were made.

Fluid from hygromata from four eland and one buffalo was examined culturally and biologically.

RESULTS

Serological survey

The table shows the results of 2 320 agglutination tests in 28 species of wild animals which occur in Rhodesia.

Experimental infections

The results are recorded in figures 1 and 2. All animals showed negative reactions before being experimentally infected.

Biological tests

B. abortus Biotype I was isolated in pure culture from the fluid of a hygroma on the knee of an eland cow shot on Nuanetsi Ranch (approx. 31° 15'E, 21° 15'S) and from a four-year-old eland bull from Buffalo Range. All other tests were negative.

DISCUSSION

Van Drimmelen quoted[4] the general belief that colonization of Southern Africa introduced *Brucella* organisms into the country, but added that cattle and sheep had been found in possession of the inhabitants when early seaborne discoverers landed at the Cape and that it was possible that infection might have accompanied the herds of earlier human migrations from North African territories. He did not mention the possibility of brucellosis having been a disease of wild life before the advent of domestic livestock on the African landscape.

Subsequently published surveys which recorded agglutination reactions to *Brucella* in wild ruminants[5-7], frequently related results to infection in domestic cattle. Antibodies to *Brucella* in Rhodesian wild life have been found in wild ruminants, both in contact with, and completely isolated from, domestic livestock. It would be fruitless at this stage to speculate on how African wild life became infected with *Brucella;* the pertinent fact is that wild life in Rhodesia, isolated from cattle, are carrying the identical biotype found in cattle. This does not preclude the possibility that other biotypes may occur.

Serological survey

The interpretation of the standard agglutination test to random samples of sera from many different species of wild animals poses many problems.

As will be seen from figure 2, a low titre in a wildebeest may be equally indicative of a recent infection as is a high titre in buffalo. Because declining titres of convalescence may result in many animals being classified as negative or doubtful when, in actual fact, they may have been positive within the previous year, the standard interpretation applied to bovine tests is not used and all reactions are recorded without any attempt at interpretation.

The bovine pattern in figure 2 is composed from Stableforth[8], who comments:—

> "Titres thus vary widely at all intervals after infection: common figures are 0—160 units/ml (mode about 20) at 2 weeks, 0—1 000/ml (mode about 100) at 1 month, 40—2 500/ml (mode about 200) at 2 months, 80—10 000/ml (mode about 600) at 3 to 4 months, reaching a peak averaging about 2 000 at 5 months, but then usually tending to decrease, although the titres of some animals may still be rising, or then show a definite rise."

Apart from two porcupines and 9 spring-hares (all negative), no other rodents were examined serologically. This group of mammals commonly harbour *Brucella* spp. in America[9] but they have been neglected in African surveys.

Although Manley[10] recorded the finding of *B. suis* in a Rhodesian goat, none of 305 warthog or 28 bushpig sera produced a reaction even at 1 : 10.

Experimental infections

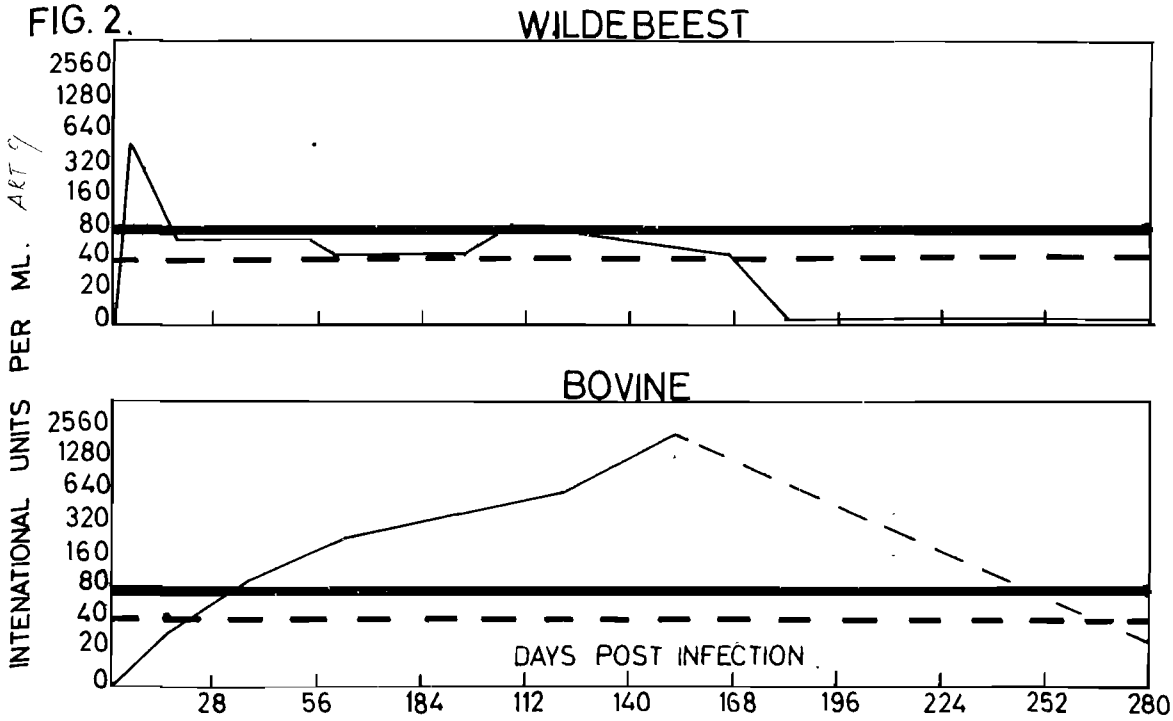
These infections were carried out with the main purpose of studying levels of agglutination titres at various times after infection. Although very few animals were used and there is probably a great deal of variation amongst individuals of the same species, the results form a useful baseline of information for further studies.

The two individual patterns, from which the means for each are plotted in figures 1 and 2, were almost identical.

Table: RESULTS OF REACTIONS TO **BRUCELLA** AGGLUTINATION TESTS IN RHODESIAN WILDLIFE

SPECIES	Number Tested	Agglutination Reaction in IU/ML							
		20	40	80	160	320	640	1280	2560
Antbear (**Orycteropus affer**)	1								
Baboon (**Papio ursinus**)	8								
Buffalo (**Syncerus caffer**)	102	9	3	1	1			1	
Bushbuck (**Tragelaphus scriptus**)	33	1							
Bushpig (**Potamachoerus porcus**)	28								
Duiker (**Sylvicapra grimmia**)	111	1	1	1					
Eland (**Taurotragus oryx**)	71	3	7	2					
Elephant (**Loxodonta africana**)	126								
Genet Cat (**Genetta genetta**)	2								
Giraffe (**Giraffa camelopardalis**)	3								
Grysbok (**Raphicerus sharpei**)	25	1							
Hippopotamus (**Hippopotamus amphibius**)	9		1						
Impala (**Aepyceros melampus**)	1 036	88	12	1					
Klipspringer (**Oreotragus oreotragus**)	2								
Kudu (**Tragelaphus strepsiceros**)	237	4	2						1
Nyala (**Tragelaphus angasi**)	2								
Porcupine (**Hystrix Africae-Australis**)	2								
Reedbuck (**Redunca arundinum**)	10								
Sable (**Hippotragus niger**)	58	2	1						
Spring hare (**Pedetes capensis**)	9								
Steenbok (**Raphicerus campestris**)	28								
Suni (**Nesotragus moschatus**)	1								
Tsessebe (**Damaliscus lunatus**)	16								
Waterbuck (**Kobus ellipsiprimnus**)	6					1			
Warthog (**Phacochoerus aethiopicus**)	305								
White Rhinoceros (**Ceratotherium simum**)	1								
Blue Wildebeest (**Connochaetes taurinus**)	38	2							
Zebra (**Equus burchelli**)	50	9	2		1				
TOTAL	2 320	120	29	5	2	1	—	1	1

TOTAL REACTIONS 159



Development of agglutinating titres against **B. abortus** antigen after experimental infection on wildebeest, and bovine control.

The pattern of reactions shown by the wildebeest (fig. 2) is very similar to that shown by serum neutralization tests following experimental infection of foot and mouth disease [11]. In both brucellosis and foot and mouth disease there is only a short, rapid rise in titres above the level recognized as positive in bovines; very soon the level drops and remains very low.

No attempts were made to recover the organism after the experimental infection.

ACKNOWLEDGEMENTS

The authors are grateful to Mr. G. Styles for his generous donation of wild animals and facilities for keeping them; to Messrs. N. Marsberg, G. Shinns, J. Joannou and Edgar Mkwakwamie for technical assistance.

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Jl S. Afr. vet. med. Ass. 43 (2): 181—187 1972

ANTHRAX IN AN AFRICAN BUFFALO *(SYNCERUS CAFFER)* IN THE KRUGER NATIONAL PARK†

E. E. McCONNELL*, R. C. TUSTIN** AND V. DE VOS***

SUMMARY

A natural case of anthrax in an African buffalo was observed clinically and at *post mortem,* during a recent outbreak in the Kruger National Park. The clinical course ultimately progressed rapidly to the fatal terminal stage; specific signs were absent until just before death. The *post-mortem* examination revealed necrotic pharyngitis, marked congestion and haemorrhage of visceral lymph nodes, especially the pharyngeal and gastric, as well as haemorrhages in most areas of the body. There was marked splenomegaly but the pulp was of a firm consistency. Very few *B. anthracis* bacilli were found in blood smears, although they were numerous in various lymph node impressions and spleen smears. The initial lesion apparently was a necrotic pharyngitis followed by generalized disease.

INTRODUCTION

Livingstone[1] was probably the first to record the occurrence of anthrax ("miltsiekte") in domestic animals in southern Africa; he also reported the disease in wild life species (mostly kudu) during his travels through Bechuanaland (Botswana) in 1850. Since then it has been observed in most species of domestic animals, various indigenous antelopes, and man. Anthrax is still potentially endemic in domestic animals in many areas of the Republic of South Africa, and constant prophylactic measures, primarily vaccination, are required to prevent outbreaks. Vaccination of free-living game animals, however, is feasible only on a limited scale. Anthrax, therefore, appears periodically in these animals, especially in the larger wild-life preserves, such as Etosha National Park, South West Africa[2], and Kruger National Park (KNP)[3]. During the latter part of 1970, an exceptionally extensive outbreak occurred in the northern part of KNP, in which over 300 cases in a variety of animal species were established. It is the purpose of this presentation to record the clinical and pathological findings in an African buffalo *(Syncerus caffer)* that died from the disease during this outbreak.

CLINICAL OBSERVATIONS

On the morning of 16 October, 1970, the helicopter patrol, used for locating carcasses, noted a lone young adult African buffalo near a dried out dam, 3,2 km northwest of Punda Milia. As it is unusual for a young buffalo to be alone and as several cases of anthrax had been found previously in this area, further investigation was undertaken. The buffalo was approached by truck and first sighted at 0900 hours. From a distance of 60 metres, no abnormal clinical features other than poor condition were observed (Fig. 1). This was not considered particularly significant, since there had been a severe drought in the area and many animals were poorly nourished. Upon closer approach, the buffalo charged suddenly but swerved at the last moment. Although it is not uncommon for a buffalo to charge at a man on foot, it is extremely rare for an unwounded one to charge at a vehicle. Further observation of the animal revealed a slightly bewildered, excitable state and a somewhat unsteady gait, characterized by a tendency towards "high-stepping" action

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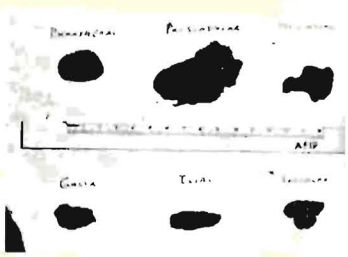


FIG. 1. Adult male African buffalo showing alert attitude, approximately 3 hours before death.
FIG. 2. Large blood clot which was expelled from the anus just after death.
FIG. 3. Various lymph nodes showing the marked difference between those draining the digestive tract (pharyngeal, mesenteric and gastric) compared to the peripheral ones (superficial cervical, iliac and subiliac).
FIG. 4. Marked splenomegaly. Note the haemorrhages on the omasum and mesenteric oedema in the background.
FIG. 5. Blood tinged hydropericardium and epicardial haemorrhages. Note the dark black appearance of the blood (lower right corner).
FIG. 6. Olive-brown necrotic pharyngitis. View from under the mandible with tongue and larynx removed.

of the front feet. The coat was staring and the eyes were slightly sunken. During the next hour, some of these signs became progressively more pronounced and the buffalo once more charged at the truck. At 1025 hours the animal lay down for the first time, in a position of sternal recumbency with the neck slightly stretched forward, but with a very alert attitude. When approached too closely on foot, the buffalo would stand and make a mock charge, but soon would resume its recumbent position. At this time mild salivation, a slight, bilateral, pink-tinged nasal discharge, and mild dyspnoea with stertorous expiration were observed.

At 1110 hours the buffalo rose with difficulty and remained standing for approximately 5 minutes, becoming more and more unsteady. It lay down in the same position as before until 1155 hours when it again rose and stood very weakly. When approached it made a feeble effort to charge but was obviously too weak to do so. The dyspnoea and expiratory sounds were more pronounced. The respiratory rate varied from 10 to 30 times per minute. There was a small amount of dark blood around the anus with a few drops on the upper aspect and brush of the tail and on the inside of the hocks.

At 1205 hours the animal started staggering around in small circles, then fell heavily on its right side in opisthotonus. Respiration was irregular and five minutes later (12[illegible] hours) it made a final effort to stand, fell back and respiration ceased. This was followed by a few spasms of the heavy leg muscles and cardiac arrest.

NECROPSY

Significant findings upon external examination of this young male buffalo, judged to be 27 months old, included a fist-sized, dark red blood clot protruding from the anus (Fig. 2) and blood oozing from several tick-bite wounds. There was a slight bilateral mucocatarrhal conjunctival exudate.

The necropsy was begun soon after death (1230 hours). A thorough examination was made according to routine procedure with all precautions to minimize the risk of exposure to all participants and of spread of infection. Fully protective clothing was worn; all speci-

Table: NUMBER OF **B. ANTHRACIS** ORGANISMS IN VARIOUS PREPARATIONS

Organ or Tissue	No. of bacilli/100 fields (oil immersion)	No. of fields with bacilli	Other observations
Spleen (I)	72	30	
Gastric L.N. (I)	TNTC>5 000	100	Very numerous
Mesenteric L.N. (I)	TNTC	100	"
Iliac L.N. (I)	52	26	
Inguinal L.N. (I)	2	2	
Right superficial cervical L.N. (I)	146	48	
Left superficial cervical L.N. (I)	2	2	
Popliteal L.N. (I)	24	20	
Blood (S) 1210 hours	1	1	
Blood (S) 1300 hours	2	2	
Bone Marrow, Rib (S)	20	8	
Bone Marrow, Mandible (S)	26	16	
Adrenal (I)	1 660	100	
Testis (I)	0	0	5 bacilli (10 min. exam.)
Muscle, Trapezius (I)	72	36	
Urine (S)	172	72	Appears to contain other bacteria and RBC's
Clot from Anus (I)	1	1	Many other bacteria present
Nasal Exudate (S)	0	0	3 bacilli (10 min. exam.)

(I) = Impression smear
(S) = Spreader slide (routine) method
TNTC = Too numerous to count

mens collected were decontaminated and rendered safe for further handling in a "disinfecting area" about 25 metres upwind from the carcass, which was eventually burned on the spot. Extensive collection of smears and impressions from a variety of organs, tissues and fluids, of specimens for histopathological and of blood from the ear vein for bacteriological examination was undertaken (see table).

The most striking macroscopic findings involved primarily the vascular and visceral lymphoreticular as well as the digestive systems. When the carcass was first opened, the blood was dark reddish-black and more viscous than normal; there was little evidence

of clotting during the entire period of the *post-mortem* examination. Widespread haemorrhages, varying from petechiae to ecchymoses, were present on most serosal surfaces and in the above-mentioned lymph nodes, meninges of both the brain and spinal cord, epicardium (Fig. 5), myocardium and endocardium and perirenal fat.

Moderate to severe enlargement, congestion, oedema and haemorrhage were observed in the lymph nodes draining the oral cavity and the gastro-intestinal and pulmonary systems. The size and appearance of the peripheral lymph nodes were within normal limits (Fig. 3). The spleen was markedly enlarged (59×17 cm), cut surfaces were blue-black and the pulp had a rather firm consistency (Fig. 4). Differentiation between red and white pulp was difficult. Towards the end of the necropsy, about 5 hours *post mortem*, the consistency of the spleen had softened considerably.

As regards the digestive tract, the mucosa and deeper layers of the pharynx, especially at the base of the tongue and in the region of the tonsils, contained multifocal ulcerated areas, which were 2 to 10 mm in diameter, yellowish-brown, and necrotic (Fig. 6). They appeared to be of at least a few days' duration. This was accompanied by moderate oedema of the subcutaneous and intermuscular septae of the ventral cervical region. Although the ruminal content was very dry, there were no lesions in the mucosa of the forestomachs, but there were marked oedema of the omentum and serosal haemorrhages (Fig. 4). The abomasum contained about one litre of red-tinged fluid and clotted blood. Its mucosa was markedly oedematous and hyperaemic with several linear ulcers 2 to 3 mm long, on the tips of the folds. The entire small intestine was hyperaemic and full of semi-clotted mucohaemorrhagic ingesta. The Peyer's patches were eroded and haemorrhagic. The caecum was dilated with black, haemorrhagic, semi-fluid debris. The remainder of the large intestine contained a small amount of black, tarry faeces and free blood. At no point throughout the intestinal tract were normal contents present.

There was moderate hepatomegaly with multifocal irregular, brown, necrotic areas, 1 to 2 cm in diameter. After formalin fixation, the liver was bright olive-green. The gall-bladder was markedly distended with thick, black, viscous bile.

The lungs were moderately oedematous and the interlobular septae were somewhat accentuated by the presence of fluid. Congestion of the kidneys was so pronounced that it obscured other possible pathological changes. The urinary bladder was filled with dark, blood-tinged urine.

The adrenal glands, which were swollen and haemorrhagic, were the only endocrine glands in which macroscopically visible lesions had occurred. The normal architecture was so distorted that it was impossible to differentiate between the cortex and the medulla.

MICROSCOPIC FINDINGS

Generally there was close correlation between the microscopic and macroscopic pathologic findings. Most tissues had undergone some pathological change, the most severe lesions occurring in the visceral lymphoid and in the vascular tissues, particularly those of the digestive tract.

The pharynx, including the base of the tongue and tonsillar regions, contained areas of epithelial necrosis and erosion with haemorrhage and leukocytic, mainly neutrophilic, infiltration. Examination of the lymphoid tissue, including tonsils and surrounding muscle and connective tissues, showed severe necrosis with haemorrhage, oedema, neutrophils and myriads of *B. anthracis* organisms. The lymphatic vessels draining this area were markedly dilated with lymph, which contained many neutrophils. The tonsils were hyperplastic with enlarged germinal centres. The adjacent salivary glands were oedematous and swollen, and many acini were dilated with mucin. The pharyngeal surface of the epiglottis contained lesions similar to those described in the remainder of the pharynx, while the respiratory surface was relatively normal.

The oesophagus and forestomachs were all within normal limits. The linear lesions noted along the folds of the abomasum consisted of deep epithelial erosions but no true ulceration. The underlying connective tissue was markedly oedematous and contained numerous anthrax organisms, although there was little leukocytic response. Large areas of the superficial epithelium of the small intestine were eroded and covered by cellular and haemorrhagic debris. Many coccidia, which resembled *Eimeria zuernii*, were found in varying stages of development in the lamina propria. Cystic dilatation of the submucosal

lymphatics had strikingly altered the normal architecture of this area. The central portions of the associated lymph follicles were uniformly necrotic, only a few reticuloendothelial cells remaining. *B. anthracis* organisms were found only in the haemorrhagic debris on the surface. The lesions observed in the large intestine were of a milder form than those in the small intestine.

The only significant lesions in the lower respiratory tract were moderate interstitial oedema, haemorrhage and emphysema of the interlobular septae and a sero-fibrinous exudate in a few of the alveoli. The bronchial exudate also contained a few alveolar macrophages and neutrophils. There was one peribronchial lymph nodule which contained a few necrobiotic cells in the centre. Anthrax organisms, though present, occurred singly and were rare. Focal areas of haemorrhage were noted in the pericardial fat, endocardium of the ventricles, and near the base of the atrioventricular valves.

The liver contained numerous large (1 to 4 cm diameter) focal areas of coagulation necrosis, which was manifested by eosinophilia of the hepatocellular cytoplasm and pyknosis, karyolysis, or absence of nuclei. This involved all areas of the hepatic lobule but was more evident in peripheral parts. The centre of each necrotic area usually contained a focus of *B. anthracis*. Early vasculitis was evident in many small branches of the portal vein; they were often plugged with anthrax organisms. Even in the more normal areas nuclear swelling and bile stasis were observed, which, no doubt, caused the green colour observed macroscopically on the fixed liver. The mucosa of the gall-bladder was oedematous, haemorrhagic and, in some areas, desquamated.

The spleen was severly congested, giving the false impression that the Malpighian corpuscles were few in number. Nevertheless, they were smaller than normal, and some of the lymphocytes were in various stages of necrosis. A few foci of anthrax bacteria were observed in germinal centres.

Nephrosis and hyaline degeneration of the cells of the convoluted tubules were the prominent lesions in the kidney. This was accompanied by granular and hyaline casts and the presence of a few erythrocytes in some of the lumens. Single bacilli were scattered through the parenchyma, although most occurred within the casts.

The adrenal glands were the only endocrine organ that exhibited histopathological lesions. Except for a thin band of the zona reticularis, the cortex of both glands had been destroyed and replaced by extravasated blood. Numerous large colonies of *B. anthracis* were scattered throughout the zona glomerulosa. The medulla was severely congested but there was no evidence of necrosis.

In the lymph nodes draining the pharynx, gastro-intestinal tract, lungs, and, to a lesser extent, the periportal lymph node, extensive lymphoid necrosis, haemorrhage and oedema were noted. Large numbers of anthrax organisms were present, centred mostly in the subcapsular lymph sinuses. The necrosis was more prominent immediately adjacent to the bacteria. The superficial cervical (prescapular), subiliac (precrural), inguinal, sciatic and iliac lymph nodes were relatively normal, with only mild oedema and reticuloendothelial hyperplasia. Only occasional bacteria were found in these lymph nodes.

Only very mild lesions were noted in the central nervous system, namely, evidence of oedema with dilatation of the peri-arterial (Virchow-Robin) space, scattered haemorrhages in the same area and in the pia-arachnoid, and leukostasis in some of the small veins.

Examination of the film spreads and impression preparations indicated the same distribution (Table) as was observed in the histological preparations, i.e. high numbers in the visceral lymph nodes, particularly those associated with the digestive system, but few in the peripheral ones. The paucity of organisms in preparations from the peripheral blood was most striking.

BACTERIOLOGICAL RESULTS

The causative organism was isolated and identified by both animal inoculation (mice and guinea pigs) and culture on nutrient agar medium. It conformed to the general requirements for identification of *B. anthracis* as laid down by Sterne [4].

DISCUSSION

The clinical signs observed in this animal did not suggest a diagnosis of anthrax until the terminal stages, when blood was noticed around the anus. If one had been unaware that the aggressive disposition and solitary behaviour of this animal was unusual for a buffalo, especially of his age, disease would

not have been suspected at all. Atypical behaviour must always be considered in detecting diseases in game animals; the disease syndrome as observed in domestic animals does not necessarily correspond to that found in wild species. Lincoln *et al.*[5], however, stated that "hyperactivity, particularly to sound or touch, is evident in most animals dying of anthrax toxins as well as the disease." The rapid terminal course is consistent with that observed in other species. In a matter of approximately four hours, this case had progressed from mild or equivocal signs of disease to death.

The lesions of the lymph nodes, gastrointestinal tract and the vascular system all support the acute nature of the systemic phase of the disease. The lesion of longest duration was the necrotic pharyngitis, which was judged to be two to three days old, based on the presence of a large number of neutrophils and the reactive hyperplasia in the associated lymphoid tissue. These, and the preponderance of organisms in these areas, indicate that the pharynx was the initial portal of entry for the organisms, followed by gastroenteric lesions and finally a generalized septicaemic state.

The spleen, while markedly enlarged, did not have the frequently described, typical "black-raspberry jam" appearance until several hours after death. The extremely soft, mushy spleens so often reported may have been due to *post-mortem* change. This possibility should be kept in mind, when one is confronted with a fresh carcass for necropsy examination.

There are conflicting reports concerning the pathology of the CNS. De Moulin[6] demonstrated widespread neuronal degeneration, while Bonventre *et al.*[7], Smith & Keppie[8], and Gleiser[9], found that neither fatal anthrax infection nor toxaemia induced significant pathological changes in the CNS. Since haemorrhage in the meninges was the only significant finding, the case under discussion would tend to support the latter observations[7-9].

The marked destruction of the adrenal cortex cannot be explained merely on the basis of severe stress, since there were numerous organisms within this area. It is more plausible to suggest a direct toxic effect, because in other areas of the body in which the organisms were noted there was necrosis of contiguous tissues. We found no explanation for the apparent predilection of the organisms for the adrenal cortex. It can be said with some certainty, however, that the severe necrosis of the cortex could have been a contributing cause of death in this animal. This lesion resembled that seen in the Waterhouse-Friederichsen syndrome, which is usually a result of an overwhelming fatal sepsis, as it was in this case. With this syndrome there is also a visceral pooling of blood. Whether the visceral congestion is a result, or cause of, or merely associated with adrenal cortical necrosis, is debatable.

The paucity of organisms in the blood smears also warrants discussion. There were so few that most probably they would have been missed in a routine blood smear examination unless the investigator was specifically looking for *B. anthracis*. It is generally accepted that rapid proliferation of *B. anthracis* occurs immediately after death of the host. As long as the host is alive, the organisms are suspended in the blood stream and microscopic examination at this stage would reveal single bacilli or very short chains. Once static conditions occur, long chains develop. In counting organisms in this case, however, long and short chains were counted as entities. Proliferation after death could not have affected the counts to any degree.

Death of this animal can be explained by the work of Lincoln *et al.*[10], which convincingly demonstrated that the host dies from toxic products of the organisms and not actually from the bacteraemia *per se*. Moreover, various animal species react differently to the effects of administration of sterile anthrax toxins; the units of toxin are directly related to the number of organisms per ml of blood in the terminal stage of the disease. Based on the above studies, the argument may be advanced that the African buffalo is very susceptible to the anthrax toxins.

Beside the difference in susceptibility to the anthrax toxin, there is also a difference in the resistance of different species of animals to infection by *B. anthracis*. This seems to be closely correlated to the pathological manifestation of the disease, as concluded by Gleiser[9], who stated: "Thus we see in the susceptible host a mild cellular and fibrinous response to the invading organism and the resulting generalized necrosis and haemorrhage, and a very intense fibrinous and cellular local response to the invading organism

in the resistant host". There thus appears to be an inverse relationship between susceptibility to infection and toxaemia, *viz.*, the more resistant the host is to initial infection, the more susceptible it is to the toxaemia and *vice versa*. In view of the severe lesions noted in the pharynx in this case and the paucity of anthrax organisms in the blood stream, we are of opinion that the African buffalo would be in the category of those resistant to initial infection but susceptible to the toxaemia.

Regarding the spread of the disease and contamination of the environment by organisms, it seems that, while still alive, this animal probably contaminated a large area via four fomites: (1) nasal exudate, (2) faeces, (3) urine, and (4) salivation, although specific smears of saliva were not examined.

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BOOK REVIEW — BOEKRESENSIE

VETERINARY CLINICAL PATHOLOGY

D. L. Doxey

Bailliere, Tindall; London, 1971. pp x+356, Figs 115. Publ. price £3.75

This soft-covered book represents a valuable new approach to the diagnosis of disease, whereby the author has correlated the use of the various disciplines, including pathology, which may be required to reach a diagnosis. Here is to be found the integration of subjects so often advocated today by veterinary educationists. And what is more, a very pleasing unity has thereby been achieved.

Part one of the book is by far the largest portion and consists of fifteen chapters dealing with the various systems, each under three main divisions, *viz.* structure and function, pathological changes (infectious diseases, parasitology, toxicology etc.) and finally *antemortem* and laboratory examinations.

A very broad field of knowledge is consequently presented by this method, including basic anatomy and physiology, infectious disease, pathology (both gross and microscopic), haematology, parasitology, and clinical chemistry. Numerous tables of normal values are included in the text, and factors influencing the interpretation of results in the various species are fully discussed. Useful cross-references abound in these chapters, each of which also concludes with a list of recent references.

Parts two and three of the book are brief but provide useful information on the collection and preservation of samples and on techniques (methods and principles) respectively. The black and white illustrations are of good quality and add to the book's usefulness. There is an adequate subject index.

While the broadness of coverage inevitably has lessened the amount of detail which could comfortably be included in a work like this, virtually all the essential basic information is available in a lucid and easily available form. For this reason it is confidently predicted that this book will prove to be an excellent "working manual" for both senior students and enquiring practitioners.

R. K. L.

EDITORIAL NOTE — REDAKSIONELE AANTEKENING

SALMONELLA IN MAN AND FARM ANIMALS IN THE U.S.A.

The following table has been compiled from data contained in a recent report from the United States Animal Health Association.

SALMONELLA SEROTYPES, IN ORDER OF FREQUENCY, ISOLATED FROM MAN AND FOOD ANIMALS, 1967-1971

Man	Chickens	Turkeys	Cattle
S. typhimurium	**S. typhimurium**	**S. heidelberg**	**S. typhimurium**
S. enteritides	**S. heidelberg**	**S. saintpaul**	**S. dublin**
S. heidelberg	**S. thompson**	**S. typhimurium**	**S. newport**
S. newport	**S. infantis**	**S. anatum**	**S. saintpaul**
S. infantis	**S. blockley**	**S. sandiego**	**S. anatum**
S. saintpaul	**S. saintpaul**	**S. senftenberg**	**S. heidelberg**
S. thompson			
S. typhi			
S. blockley			
S. javiana			

It is of interest to note that of the 9 serotypes most commonly isolated from man, 3 are commonly found in chickens, turkeys and cattle, 4 are frequently found in chickens, and one is commonly isolated from cattle. Out of a total of over 1 200 known serotypes, this appears quite significant.

BOOK REVIEW — BOEKRESENSIE

DISEASES OF DOMESTIC ANIMALS IN NEW ZEALAND

TECHNICAL COMMITTEE, N.Z. VETERINARY ASSOCIATION INC.

Editorial Services Ltd, Wellington, 1971. 3rd Ed. p. I & 439. Publ. price $9.00 N.Z.

The Technical Committee of the New Zealand Veterinary Association has taken care to cover all possible diseases of domestic animals in their country. Although the book is titled "Diseases of Domestic Animals in New Zealand", it contains information about many diseases of world-wide interest, e.g. the metabolic diseases. Its main feature is that it provides as much information in brief style about the diseases as is necessary to enable an epidemiologist or pathologist to arrive at a diagnosis when confronted with an unknown entity. Its telegraphic style makes it unsuited to a detailed study of any condition, but nobody doubts that it was never intended for this purpose. The complete index and, for every disease, a list of diseases under "Differential Diagnosis", makes it particularly useful for on-the-spot reference. In addition to the diseases of mammals, it contains a section on the diseases of poultry and various appendixes, e.g. certain acts, but these apply to New Zealand only.

This book would no doubt be of value to practising veterinarians and officers working in diagnostic laboratories.

B. C. J.

Jl S. Afr. vet. med. Ass. 43 (2): 189—191 1972

GENERAL ALGEMEEN

CONSIDERATIONS ON LARGE SCALE VACCINATION OF FREE-LIVING GAME

E. YOUNG*

SUMMARY

Every precaution should be taken to protect our wild fauna against epizootic outbreaks of diseases which threaten their existence. Special measures for prevention of disease are to be developed, tested and improved on for the effective protection of vulnerable species. This paper suggests various techniques of vaccine administration which may be considered for the large scale vaccination of free-living populations.

Some of the more important infectious diseases of domestic animals also threaten the existence of game species of this continent [1, 2].

In the Kruger National Park, for instance, anthrax killed more than a thousand wild mammals over a period of only four months during 1960 [3] and very recently also destroyed more than 10% of the entire population of the very rare roan antelope, *Hippotragus equinus* [4].

Certain game animals in the Kruger National Park were also nearly exterminated in the late nineties of the previous century by an extensive epizootic of rinderpest [5]. During 1960 large numbers of buffalo and other indigenous wild ungulates in Kenya were also destroyed by this disease [6].

The tremendous destructive potential of such highly fatal diseases calls for the development and timely employment of adequate prophylactic measures wherever wild animals are protected [7].

The increasing interest in game ranching in Southern Africa and the more intensive commercial exploitation of this valuable natural resource in future may also necessitate prophylactic vaccination of game against some of the less dramatic stock diseases to which to which they have been found to be susceptible such as, for instance, bluetongue [2], heartwater [8, 9] and lumpy skin disease [10] prior to their release on infected farms.

The concept of preventative disease control has unfortunately not yet been accepted universally by wild life managers, nor has the practical application of prophylactic control measures, such as the large scale vaccination of free-living game, so far received much attention. It is hoped that this report will stimulate research workers from various disciplines to participate in the development and improvement of vaccination techniques and other suitable methods of disease control, thereby also contributing to the survival and propagation of our fauna.

Vaccination is only one aspect of control [7]. Its use will be determined by the disease concerned, the degree of distribution of the infection, the availability of suitable vaccines and the knowledge and facilities to administer it in a reasonably short time to a sufficiently large number of animals.

Various vaccines have already been tested and used on a small scale on captured wild animals. Examples are lapinized rinderpest virus [11] and vaccines against anthrax [12, 13], haemorrhagic septicaemia [13], black-quarter [13], canine distemper [7], infectious canine hepatitis [7] and feline infectious panleucopaenia [7].

Experiments with at least one of these [12] showed that vaccines used on domestic animals need not necessarily always be safe for use on game. In this instance vaccination with anthrax vaccine resulted in propagation of the disease instead of its control. Preliminary trials should therefore be undertaken to establish the clinical effects as well the immunogenic properties of the various vaccines prior to their use on a large scale.

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The mass administration of vaccines to free-living game animals poses what might have been considered as insurmountable practical problems. Recently developed techniques of game capture have, however, also created new possibilities for large scale vaccination. A few hundred animals can now be captured within 30 minutes, when these are, for instance, driven by means of a helicopter through a funnel-shaped chute into a catchpen (Fig. 1), constructed of wooden poles,

Fig. 1: Catchpen used for the capture of blue wildebeest.

cord netting and/or broad sheets of synthetic plastic material. A variety of wild ungulates, including blue wildebeest *(Connochaetes taurinus)*, Burchell's zebra *(Equus burchelli)*, impala *(Aepyceros melampus)*, springbuck *(Antidorcas marsupialis)* and blesbok *(Damaliscus dorcas)* have already been captured successfully in this way [14-16]. Mortalities are mostly insignificant. Several hundred animals can now be vaccinated daily and marked before their release to avoid subsequent confusion between vaccinated and non-vaccinated individuals.

Fig. 2: The manual removal of blesbok from a catchpen for inoculation.

Depending on the species concerned, the captured animals in the catchpen can be caught and inoculated by men entering the holding area (Fig. 2). Alternatively, groups of animals can be driven from the catchpen through another tapering chute into a long and relatively narrow crush where they can be vaccinated. Ordinary hypodermic syringes or specially designed devices, such as the automatic, multi-dose pole syringe illustrated in Fig. 3 may be used for the administration of the vaccine.

Fig. 3: Antelopes (e.g. blue wildebeest) can be driven into a crush for vaccination purposes.

Projective syringes, fired by a variety of dart syringe propelling weapons, may also be employed directly or indirectly in the vaccination of free-living game.

Harthoorn and Lock [17] found that in one day four people could vaccinate up to 30 buffaloes, captured by means of darting equipment and immobilization drugs.

Darting equipment was also used successfully for the administration of vaccines to wild animals in captivity without prior immobilization. Palmer Cap Chur dart syringes, each with a capacity of 1 ml, fitted with short, barbless needles and filled with vaccine were used for this purpose. The application of this technique to the vaccination of free-living game against their most decimating diseases was advocated and the possibility foreseen to vaccinate even greater numbers than by Harthoorn and Lock's technique, provided that suitable, disposable dart syringes could be developed for this purpose [7].

The subsequent successful employment of helicopters for the tracing of game herds and darting of wild animals (Fig. 4) [18, 19] as well as the recent virtual perfection of vaccination darts [20] have undoubtedly contributed

very significantly to the practical application of this technique to the large scale vaccination of game animals in their natural environment. It should now be possible to vaccinate several hundred animals daily by shooting them with vaccination darts from helicopters.

Fig. 4: Helicopters may be employed in the vaccination of free-living game.

In addition to the above, other methods such as the use of vaccination bullets, or the administration of vaccines by means of drinking water [3], food or salt licks may also be considered. The latter, however, seem to be complicated by various more or less insurmountable practical limitations and future research should, for this reason, preferably be aimed at the improvement of the suggested capture-vaccination-release and dart or bullet vaccination techniques.

ACKNOWLEDGEMENTS

I express my thanks to Dr. U. de V. Pienaar, Assistant Director (Nature Conservation), Kruger National Park, for provision of facilities and for revising the manuscript, and the Directors of the Division of Veterinary Services and National Parks Board for permission to publish.

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GENERAL ALGEMEEN

WORM CONTROL UNDER FLOCK CONDITIONS IN THE GRASSVELD AREAS OF THE EASTERN CAPE AND EASTERN ORANGE FREE STATE*

G. C. DENT**

SUMMARY

The author concludes that continuous anthelmintic therapy in the form of low-level phenothiazine-, or even thiobendazole-containing licks or crumbles of the correct physical constitution is the most economical method of worm control in sheep-farming.

The first thing that strikes one when coming into contact with practical sheep farming on a large scale in the grassveld, is the amount of time and effort that is expended on attempting to keep internal parasites under control. On farms with a sheep population of 4—6 000 sheep or more, the owner/manager seems to spend most of his time during spring, summer and autumn dosing sheep. This has gone on for years without the farmer ever seeming really to get on top of his problem.

In order to study this problem it is necessary first to note the main nematodes found in the grassveld, and then to consider the various methods currently used to combat them.

The nematodes that are the main problem in these areas are: *Haemonchus contortus, Oesophagostomum columbianum, Trichostrongylus* spp. and *Ostertagia*. The rôle that these parasites have played in the past is evidenced by the names of some remedies that have been used for many years, e.g. "Wireworm Remedy" of various brands, and Onderstepoort's well-known "Nodular Worm Remedy".

Concerning methods currently used to control the parasites mentioned, we find the following being practised:

(1) Haphazard dosing with a variety of remedies, ranging from the modern broad-spectrum anthelmintics to the so-called older, cheaper remedies.

(2) Dosing at three- to six-weekly intervals with one or other of the broad-spectrum anthelmintics. Here the so-called "strategic" and "tactical" dosing programmes are sometimes followed.

(3) Daily administration of small quantities of an effective anthelmintic included in a lick, crumble, or soft block to which sheep have free access at all times.

When we come to consider these three methods of control, it will be agreed that the first is the least effective, consequently no time will be wasted in pointing out its obvious shortcomings.

The second method, dosing at regular three- to six-weekly intervals with broad-spectrum anthelmintics is good, provided that certain factors are taken into account and allowance made for them. These anthelmintics, although extremely efficient in that they look after both the larval and adult stages of the parasites, none of them has, as far as I know, any residual effect. This in effect means that if sheep are dosed with one of these preparations, the animals are "clean" within 24—36 hours in so far as parasites are concerned, but become re-infested if returned immediately to the same pastures from whence they came. In the past it has happened time and again that an owner has spent a lot of money on an expensive anthelmintic, but after dosing he returns the sheep to the same pasture. Four to six weeks later this same owner arrives at the laboratory, with sheep that are heavily worm infested, for necropsy. When he is shown that the reason for he loss of condition and eventual death is due to worm infestation, he usually has some very hard and unjustified things to say

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**State Veterinarian, P.O. Box 53, Queenstown.

about the particular anthelmintic that he used.

For this reason, if dosing is the method of control chosen by the farmer, we recommend the following:

Sheep should be kraaled for 24 hours after dosing and then put into clean camps. The reason for this is that in 24 hours the sheep will have voided a lot of egg-infested dung, and at the same time will not have had the chance to pick up more infective larvae. In this way we try to put "clean" sheep into "clean" camps, and thus stop the "snowball" of infestation building up again. By "clean" camps is meant camps that have had no sheep or cattle in them for 6—12 months, and have no water run-off from a neighbouring camp where sheep are grazing.

This works well, provided that the farmer follows a grazing system that can allow camps to be rested for 6—12 months. Unfortunately, the vast majority of farmers do not have such a system of rotational grazing, and those that do find that the odd dry spell, or splitting of sheep into groups for various other reasons, soon upsets the whole scheme.

The alternative to the above method is dosing the sheep every three to four weeks and returning them to the same camp. In this case the farmer usually finds things fairly expensive in so far as his drug and labour bills are concerned, and yet he is only managing to keep pace with his problem instead of getting on top of it.

Before describing method 3, namely of providing small quantities of an effective anthelmintic included in a lick, crumble or soft block to which sheep have free access at all times, it is important to remember that a sheep has a very soft tongue, and so will not lick anything hard as cattle do. A sheep "nibbles" with its lips rather than "licks" with its tongue. For this reason, the physical composition of any carrier used for anthelmintics, and the manner in which it is presented to the sheep, is of the utmost importance, if a daily intake by the sheep is to be ensured.

Two different drugs, namely thiabendazole and phenothiazine have been used for this purpose, and both have given good results. The work done by Snijders and co-workers [1] at Outeniqua, using a 2% thiabendazole (100 mgm thiabendazole/5 gm lick) mixture on comparatively small groups of sheep, has proved most satisfactory. On a large scale, however, at ±R20 for thiabendazole per 100 lbs of lick, calculated according to recommended amounts [1] at current prices, this would seem to be rather expensive for the farmer.

The lick used by Thomas [2] in his work on minimum phenothiazine intake, has been, with certain modifications, applied on a large scale in both the Eastern O.F.S. and Eastern Cape since 1959. Based on a daily intake of 0,5 gm phenothiazine per sheep, in a 10% phenothiazine, 60% bonemeal, 30% salt crumble, the cost of the phenothiazine per 100 lbs of crumble is ±R5, in other words a quarter of the cost of the minimum thiabendazole mixture. One has to weigh up the cost of these two licks and compare them with the results obtained, in order to determine whether the thiabendazole or the phenothiazine mixture is economically the better bet.

Costs apart, I am of the opinion that worm control by means of a medicated lick or crumble has very definite advantages over the other dorms of control I have mentioned, for the following reasons:

(1) Re-contamination of the veld is progressively reduced, and in the long run the animal is exposed to a minimum of re-infection.

(2) Because the lick is made available in all camps, the farmer can practise whatever form of veld management he pleases, without worm control complicating his planning.

(3) Labour costs, which are normally high when regular dosing is practised, are cut to a minimum.

(4) Losses due to foreign body pneumonia, or other injuries connected with dosing, are avoided.

(5) "Crutching" of sheep, owing to fouling of the wool by sudden purging, is avoided, as sheep on this lick void normal faeces in pellet form.

(6) The incidence of nodular worm infestation, and possible gut-tie resulting therefrom, is reduced to an absolute minimum.

(7) Lambs start taking the lick from an early age, and because of this, plus the fact that they are raised on veld where re-infestation is kept to a minimum, they grow out far better than do lambs on veld that is continually being re-contaminated.

(8) Handling of sheep in dusty kraals is kept to a minimum, and so the fouling of wool by dirt and dust is kept down.

(9) Costs of worm control, particularly if phenothiazine is used in the lick, are lower all round than when other forms of control are used.

For the past six to seven years this form of control has been used exclusively on a number of farms in the Queenstown area, where internal parasites had previously been responsible for very heavy losses in spite of what is regarded as "normal" dosing methods. On these farms, involving thousands of sheep, the worm position is checked regularly by means of flock dung sampling: a minimum of 10—15% of a flock is sampled, and the average epg taken as being indicative of the worm burden. Larval hatches are also done and the season of the year is taken into account, so as to allow for the seasonal variation in worm species when assessing the general worm position. Time does not allow me to go into all the extra details, but suffice to say that in spite of this last year being the wettest on record for a long time, worm control on the farms where the crumble is used, has remained excellent.

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BOOK NEWS

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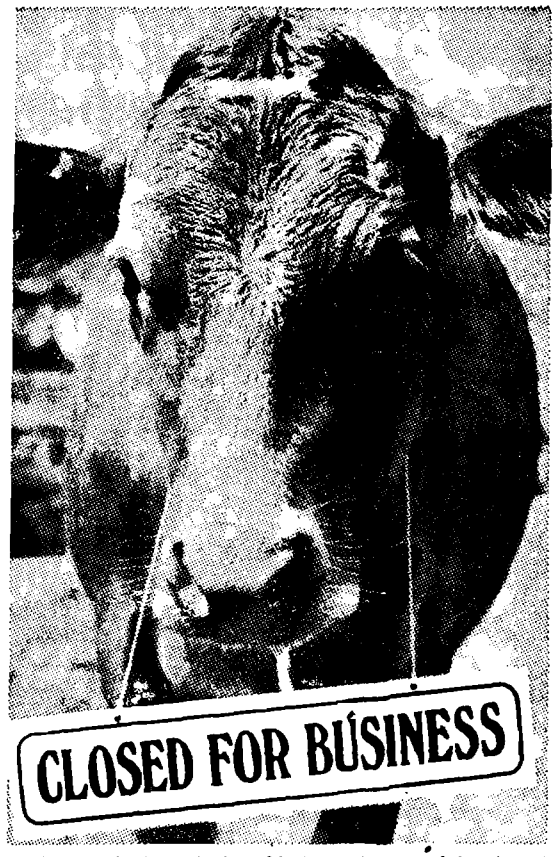

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SOME OBSERVATIONS ON *CYSTICERCUS BOVIS* AT MATSAPA ABATTOIR IN SWAZILAND

W. D. WALKER*

SUMMARY

In a survey covering a four week period at Matsapa Abattoir, details of *Cysticercus bovis* infestation are given. These cover site incidence, cyst incidence per animal, ratio of carcase to offal site incidence, and the importance of thorough examination of sites. In addition, annual perentage incidences and incidence figures covering different sources of cattle are given.

INTRODUCTION

Kaplan stated that cysticercosis is particularly troublesome in many areas of the tropics and warm weather countries and suggests that in view of the variation of predilection sites it would appear advisable to investigate the condition in countries where the disease is known to be widespread. He quotes Ginsberg as reporting a 21,7% incidence at an abattoir near Nairobi and the sites of predilection as follows: shoulder muscles, tongue, heart, masseter and adductor muscles, oesophagus and diaphragm [1]. Mitchell gives percentage figures of 28,94% for Ugandan cattle, 16,1% for Tanzanian cattle, 13,2% for low grade Kenyan cattle and 4,5% for high grade Kenyan cattle. He states that the predilection sites in order of importance are: (1) shoulder muscles, (2) heart, (3) tongue, (4) masseter muscles, (5) adductor muscles of the hind limb, (6) oesophagus [2]. Nearer Swaziland, van den Heever gives an incidence of 3,59% in an abattoir survey in the Republic of South Africa, though one abattoir recorded an incidence of 9,5% [3].

In Swaziland the recorded incidence at Matsapa Abattoir has been 9,4% in 1966, 7,8% in 1967, 7,6% in 1968, 11,3% in 1969 and 14,4% in 1970 [4]. On closer examination of the 1970 figures it is found that the mean monthly percentage varied between 10,7% in April and 20,8% in July. When the new South African inspection cuts were adopted for carcases it was found that the number of total condemnations fell from approximately 2% to 0,75% of the slaughter figures. In view of the wide variation of reports in Africa it was decided to keep more detailed records of site and number of cysts over a four week period at Matsapa abattoir.

FINDINGS AND DISCUSSION

The following results were obtained from inspection of 1 863 cattle of which 339 were infested, using the 1969 South African Standing Regulations Inspection method for carcases [5], but retaining the 1924 method for offal inspection [6]. In addition the infestation rate was compared in 3 482 cattle of known origin during the months of January and February 1971 (Table 2).

Cysts were found in order of greatest frequency at the following sites (Fig. 1):

(1) Shoulder muscles
(2) Masseter muscles
(3) Heart
(4) Tongue
(5) Lungs
(6) Diaphragm
(7) Surface of the carcase
(8) Other sites (liver, kidney, lymph node)

They have also been found in the brain but this site is not examined routinely. No cysts were detected in the oesophagus, and the adductor muscles were not examined.

The majority of animals was found to be lightly infested at routine meat inspection (Fig. 2). The percentage of infested carcases containing 1—10 cysts was 96,5%, of those containing 10—20 cysts was 2,0% and of those containing over 20 cysts was 1,5%. This corresponds generally with figures of 87,2%, 6,5% and 6,3% given by van den Heever [3], though the two sets of figures are not strictly comparable, as the 1924 Meat Inspection method [6] was used in his survey.

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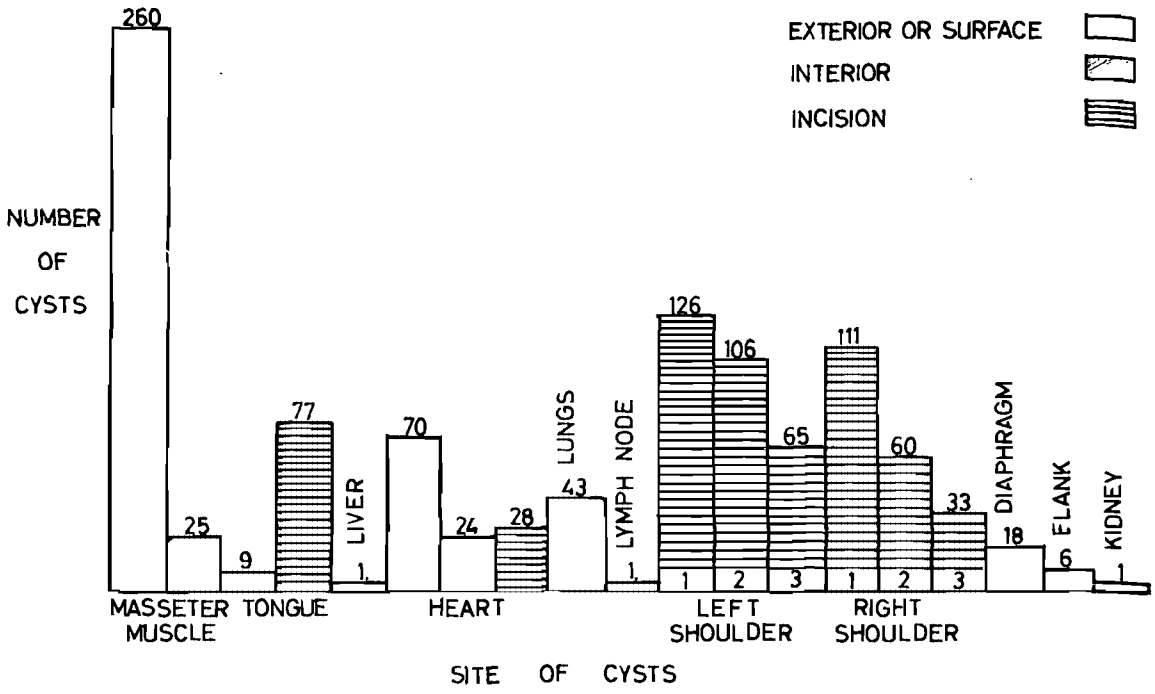

Fig. 1. Histogram: Site distribution of C. bovis in 339 infested animals.

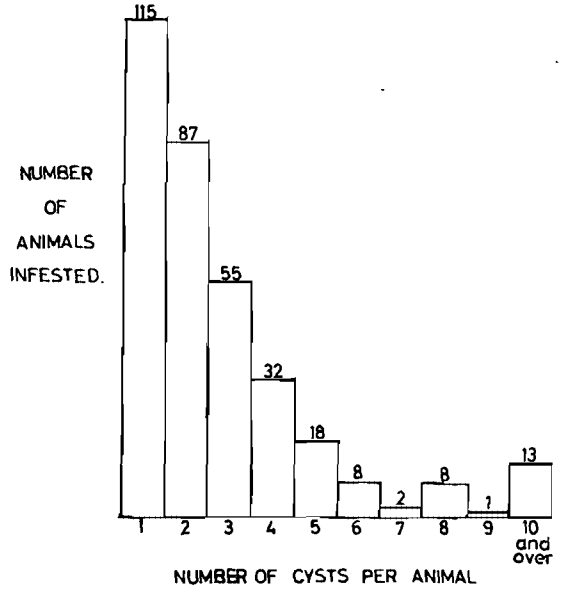

Fig. 2: Histogram: Cyst incidence of C. bovis amongst 339 infested animals.

When the frequency of detection between offal and carcases was compared, it was found that 86% of infested sites were found in the offal (Table 1).

Table 1: COMPARISON OF FREQUENCY OF DETECTION BETWEEN OFFAL AND CARCASES

Site	Number of Infestations detected	Percentage
Offal only	148	44
Offal and carcase combined	144	42
Carcase only	47	14

Thornton states that workers in South Africa showed that 47% of cattle slaughtered would have passed as measles free and in Rhodesia 58,5% would have passed if the shoulder cut was omitted[7]. In this survey, however, it was found that 157 animals (46,3%) were detected at more than one pri-

mary inspection site, though three cases condemned for excessive infestation were detected by the primary shoulder incision (i.e. cysts detected at secondary inspection sites are not included). Figure 3 shows the number of infestations that would have been missed if specific inspection sites had been omitted.

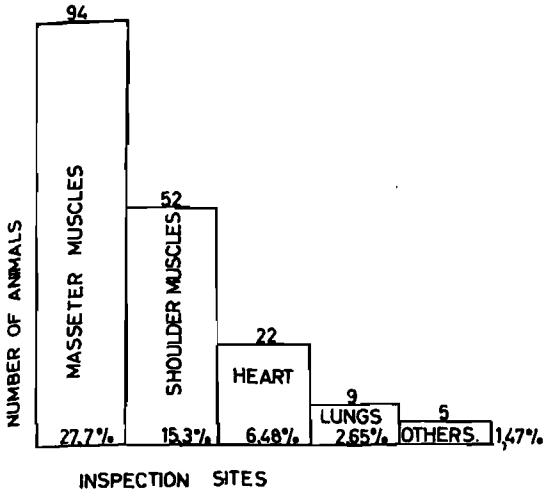

Fig. 3. Histogram: Incidence of undetected cysticercosis if routine inspection for **C. bovis** at specific sites had been omitted in 339 infested animals.

The overall incidence of *C. bovis* appears to be rising. It varies according to husbandry practice (Table 2), though there is obviously movement between groups. It is likely that cattle classified as Holding Grounds, Government Sales, Speculators and Kraaled Cattle originated from Swazi areas. It may well be that the areas of highest infestation and greatest human density are the same, but this would require further investigation.

It has been said that "All feasible inspection procedures used to date are fallible in that they may miss moderately and, more rarely, heavily infested carcases"[8]. This would appear to be true for moderately infested carcases but at Matsapa it appears to be unlikely in the latter case, as no carcase with generalized cysticercosis has been detected in the deboning department in five years.

Table 2: EFFECT OF ORIGIN ON INFESTATION

Origin of cattle	Number killed	Number infested	% infested
Ranch Cattle	908	54	5,9%
Speculators	354	50	14,2%
Government Sales	218	35	16,1%
Kraaled Cattle	712	124	17,4%
Holding Grounds	1 290	261	20,2%

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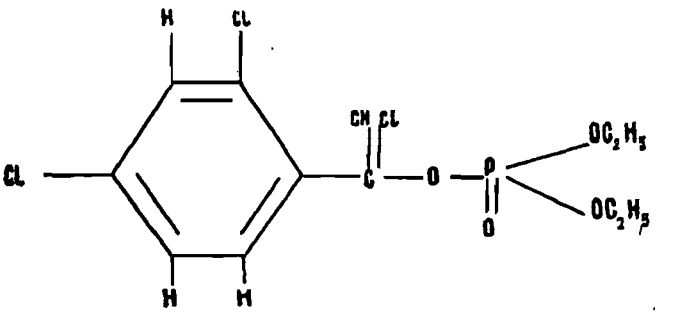

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REVIEW OORSIG

AUSTRALIAN ITCH: DIAGNOSIS, CONTROL AND ECONOMIC IMPORTANCE*

P. W. THOROLD**

SUMMARY

The history of the disease in South Africa, its symptomatology, diagnosis, treatment and economic importance are outlined. The infestation must be considered serious enough to warrant concerted efforts and proper extension work.

Australian itch was first recorded by Carter[1] in 1941 in Australia and in South Africa by Fiedler & du Toit in 1954[2], who found the condition present in several flocks in the Karoo. They assumed that at this stage the infection was fairly widespread in the wool producing areas as reports of an abnormal fleece condition, referred to as "Australian itch", had been coming in for a few years. In 1955 Fiedler & du Toit[3] carried out a survey and reported that infestation was widely distributed amongst the sheep population of South Africa. It was considered that the infection had been present in South Africa for at least 20 years and that the present upsurge of infection was due to the use of chlorinated hydrocarbon (ClHC) dips, in place of arsenic and lime-sulphur. Graham[4], in Australia, had shown that an arsenic dip gave limited control but that lime-sulphur with 1% polysulphide of sulphur would eliminate infection in one treatment. Fiedler & du Toit[3] tested a number of insecticides and in their trials were successful in curing infestations with a single dipping in 0.1% delta BHC or 0,2% malathion. They were not successful with the 1% polysulphide dip. Trials carried out in Australia[5, 6] failed to confirm the findings on delta BHC.

McHardy[7] reviewed the literature then available, reported the incidence in South Africa as far as it was known, involving eastern Cape midlands, Border, Griqualand East, eastern Orange Free State, eastern Transvaal and one district in Natal and listed the approved dips for control of the itch mite in South Africa, i.e. lime-sulphur (1% polysulphide), arsenic (0,16%), sulphur-rotenone (0,0015%), mercaptothion (0,2%) and delta BHC (0,06%).

The clinical manifestations of parasitism by the itch mite are presumably due to the habitat of the mite, all stages of the life cycle being found in and under the outer layer of the epidermis, viz. the stratum corneum. No penetration into the stratum granulosum has been observed[8-10]. The adult only is motile, so that it is this stage which is mainly responsible for transmission of infection after shearing. The upper limit of its habitat is less than 6 mm above the skin surface and the lower in the stratum lucidum of the epidermis. Murray[9] demonstrated transmission to a cloth placed next to the shorn skin, no transmission occurring after the fleece was 6 mm or longer.

The lateral spread from an infected site is extremely slow and it may take two to three years before an appreciable area of the epidermis is parasitized. In the early stages of an infestation, however, the skin irritation is more severe and certainly the response of rubbing against poles, etc. and biting and pulling at the flanks is more acute than in the later stages, when large areas of the skin are involved. This phenomenon has been noted by a number of workers and was particularly referred to by Baker[11] in his paper describing the appearance of scurf deposit

*Paper read at the Biennial National Scientific Congress of the South African Veterinary Association, East London, September 13—17, 1971.

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*Coopers Itch Mite Dip.

and yellow discoloration of the fleece following infestation, the hypersensitivity being considered an allergic manifestation. A similar acute response to infestation by *Sarcoptes scabei* has been noted in other animals and man, where the parasite also burrows into the stratum corneum, its activity presumably causing the release of histamine-like substances and the movement continually causing irritation. In skin sections, as shown by Murray[9], and Sinclair & Gibson[10], there is a thickening of the stratum corneum but no sign of any local reaction, such as leukocytic infiltration.

Some reference to mites as allergens is appropriate. Ordman[12, 13], refers to the concept of "climate asthma" (asthma covering various forms of upper and lower respiratory allergy) in South Africa and relates its higher incidence and severity to regions of higher relative humidity, particularly coastal areas, as being due to the greater number of mites *(Dermatophagoides pteronyssinus)* present in the house dust. So convincing is the evidence for the major rôle of mites in this dust form of allergy, extracts diluted to 0,0001% producing positive skin reactions, that extracts are now being used for treatment[14]. This relation of mite infestation to relative humidity was also referred to by Baker[15] when, in his dipping trials, he found a greater proportion of infested farms and infested sheep per farm in the eastern grassland and coastal areas than in the arid Karoo and inland zones.

The distribution of mites over the skin surface has been charted[10] and earlier work[6] has been confirmed, where the areas of greatest density were found on the back and upper sides from shoulder to loin, coinciding with contact points between individuals, particularly when penned after shearing.

DIAGNOSIS

The first sign of an infestation commonly occurs as a dry, stringy staple on either side, flank or thigh. If the body temperature is raised, as when sheep are driven, individuals will stop and bite at affected areas in reach, giving the fleece a pulled and ragged appearance. On opening the fleece in affected areas the wool is usually discoloured yellow, the more greasy the fleece the darker yellow to almost orange, with a deposit of fine, whitish or yellow scurf at skin level. The skin itself is thickened and typically will show ridging and a grey or blue discoloration. The wool fibres are cotted making the fleece difficult to open. Immediately after shearing, the affected areas of the skin are very obvious due to the yellow discoloration of the fleece and can be easily mapped out. In cases of longer standing where large areas of the back, sides and flank are affected, the fleece appears ragged, with pieces pulled and rat's tails hanging down due to rubbing. The wool fibres are damaged and there is a heavy deposit of scurf.

Selecting sheep from a suspect flock for examination presents no difficulty if they have 3—4 months or more wool growth. The flock can either be driven past one or one walks in amongst the flock in a kraal with a catcher and moves the sheep around, initially selecting those with rat's tails, pulled and ragged flanks and sides. The activity raises body temperatures, which stimulates mite activity, hence infested sheep will turn and bite at itchy areas. Stock initially selected are then examined for presence of scurf, yellow discoloration, ridging and discoloration of skin and finally by taking a skin scraping.

A definite diagnosis, no matter what clinical symptoms of skin or fleece derangement are present, does depend on the demonstration of the mite in a skin scraping. Three or four sites for skin scrapings are selected along both sides from shoulder to rump, on visual examination of the fleece and skin. The wool from an area at each site, about 7—8 cm^2 is clipped off as close to skin as possible, using curved scissors. A few drops of liquid paraffin or other colourless oil is then rubbed lightly into the area. The handle of a scalpel or a blunt spatula is then used to scrape the surface firmly from the sides towards the centre of the clipped area, transferring the dross and dander collected in the oil to a slide for microscopical examination. If adults are present they will immediately be noted by leg movements; larval and nymphal stages and casts have to be searched for.

DIFFERENTIAL DIAGNOSIS

The clinical picture presented can be confused with a number of other conditions: any febrile or systemic condition which may cause a break in the wool; infestations by any of the numerous ectoparasites of sheep,—the various types of mange, lice, keds, ticks, blowfly larvae, all cause severe irritation with consequent fleece derangement; lumpy wool (mycotic dermatitis) in the early stages before the exudate has gummed fibres together;

bacterial fleece rot with discoloration of the fleece, particularly over the shoulders in sheep of poor conformation. Some of these conditions of course may occur concurrently with an itch mite infestation.

CONTROL

The work done by members of the Cooper organisation for the control of itch mite has been considerable over the years and eventually crowned with success when they produced a non-arsenical dip based on fenchlorphos*, which efficiently controls the mite at one dipping. The other preparations available: lime-sulphur, arsenic, sulphur-rotenone, delta BHC and mercaptothion, all have certain limitations in their practical application or, following recent legislation, are banned. Complete and thorough immersion in the dipping fluid is essential to obtain total wetting of the entire skin surface and penetration of the stratum corneum by the insecticide.

DAMAGE TO THE FLEECE

The growth and development of the wool fibre is affected due to the position of the mite in the stratum corneum, often lying near the opening of a wool follicle, as was observed by Sinclair & Gibson [10]. The damage to the wool fibres consists of uneven thickenings and constrictions along their length, which affect their tensile strength. The combing properties of the fleece are affected by the large number of cross fibres and the cotting which occurs when the sheep rub and scratch, and the fleece becomes stained and discoloured from the excessive scurf. The value of the fleece consequently is reduced considerably.

ECONOMIC IMPORTANCE

The South African wool clip has dropped this year by some 20% and the income as given by the Department of Agriculture, Economics and Marketing in 1971 [16] has decreased by ±R40 000 000 (from R94 000 000 in 1970 to R54 000 000 this year), a loss the country can ill afford. It is, therefore, of particular importance at the present time with the drop in the price of wool due to competition with synthetic fibres and reduced production due to the drought rehabilitation programme of de-stocking, that the value of the clip is not further reduced by poor quality as a result of parasitic infestations.

Australian itch is an insidious condition and, like lumpy wool, is not really noted in a flock until a fair percentage of animals is affected, when the owner suddenly realizes the extent of the damage to his clip.

A recent survey carried out by questioning farmers, stock inspectors, extension officers and veterinarians in the major wool producing areas of the country, indicated that 97 districts in the following areas:—

Transvaal:	East and South East.
Orange Free State:	Central, East, South and South West.
Cape:	West, East and Border.
Natal:	North, East Griqualand and Underberg.

The extent to which the infestation has spread and established itself cannot be defined with accuracy. Even if one halves the positive reports received, this still leaves over 40 infested districts, spread throughout the main wool producing areas.

The problem at present is one of education and economics; the producer must know what to look for (and here he must be aided by veterinary surgeons, stock inspectors and extension officers) and be prepared to treat his flocks virtually on an annual basis, off shears or within two to three weeks after shearing.

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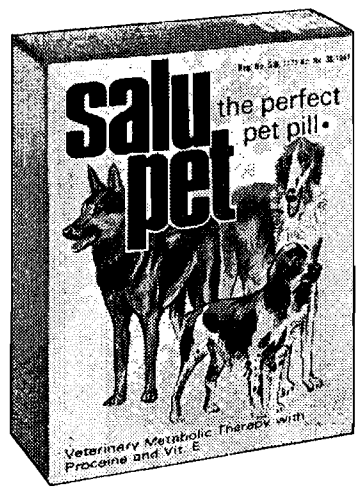

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NOTOEDRES CATI (HERING, 1838) INFESTATION OF THE CHEETAH: PRELIMINARY REPORT

E. YOUNG*, F. ZUMPT** AND I. J. WHYTE*

The cheetah, *Acinonyx jubatus* Schreber, has been found to be naturally susceptible to clinical infestation by the ear wite, *Notoedres cati* (Hering, 1838).

Lesions were oserved to develop in individuals kept in strict isolation up to six weeks and longer after being caught. This highly contagious and potentially fatal infestation of cheetahs is characterized clinically in the acute stage by severe and irritating dermatitis crustosa, particularly affecting the head, neck and ears, but also other parts of the body. Affected animals usually become extremely emaciated and dehydrated and in individuals surviving the initial stages of infestation the thickened skin becomes dry, wrinkled, hairless and pigmented. Chronically infested and lesions are especially prone to exposure, starvation and predation by other carnivores.

Malathion (S.A. Cyanamid) has so far been used successfully in the treatment of affected individuals, by bathing them in a 5% solution.

This is, to the best of our knowledge, the first report of notoedric mange in this rare species.

*Division of Veterinarw Services, Kruger National Park.
**South African Institute for Medical Research, Johannesburg.

PARASITIC DISEASES OF WILD MAMMALS

J. W. DAVIS AND R. C. ANDERSON (EDITORS)

Iowa State University Press, Ames, Iowa. Pp. 364, numerous figs. Price £10.50

This book consists of 17 chapters, written by different authors, dealing with the ecto- and endo-parasites and protozoa of wild mammals. The parasites and diseases dealt with are: Mites and pentastomes by G. K. Sweatman; Fleas and lice by E. C. Turner; Lungworms by R. C. Anderson; Trichinosis by W. J. Zimmermann; Acanthocephala by D. L. de Giusti; Bighorn sheep-lungworm-pneumonia complex by D. J. Forrester; Cyclophyllidean tapeworms of wild carnivores by P. D. Leidy & W. G. Dyer; Trematodes by J. W. Davis & K. G. Libke; *Dioctophyma renale* by A. Fyvie; Elaeophorosis by C. P. Hibler & J. L. Adcock; Myiasis by K. J. Capelle; Trypanosomiasis by E. A. Wells & W. H. R. Lumsden; Toxoplasmosis by V. L. Sanger; Toxoplasmosis in microtine rodents by W. L. Jellison; Babesiosis by D. L. Howe; Theileriosis by D. L. Howe and Besnoitiosis by W. L. Jellison.

The preface states the aim to be "The chapters, each on a specific disease or group of diseases, are based on the experiences of the contributing authors and their interpretation of the relevant world literature." Unfortunately all the authors by no means conform to this pattern and the resulting text is extremely uneven in quality. Some limit themselves to findings in North America and important references dealing with other regions are omitted. Thus the chapter on the Cyclophyllidean tapeworms of wild carnivora deals almost exclusively with work carried out in North America. Of the listed 300 to 400 references only about 5% refer to work outside this continent; important publications by Abuladze, Baer, Baer & Fain, Boev *et al.*, Bondareva and Ortlepp are overlooked.

In that the origin of statements made is not always given, it is difficult to trace erroneous ones to the relevant author, e.g. it is stated that *Fasciola hepatica* develops to maturity in about 3 months whereas this period is 7 to 8 weeks (Soulsby, 1965. *Textbook of Veterinary Clinical Parasitology.* Volume 1 Helminths, page 548). *Physopsis africana* is incorrectly listed as one of the intermediate hosts of *F. gigantica* in South Africa, whereas it has only been proved to be a vector of *Schistosoma* spp.; to date the only proven vector of *F. gigantica* in Africa is *Lymnaea natalensis* (Soulsby, 1965, p. 578). In the article on trichinosis the author unfortunately has been led astray by unreliable sources which led to the listing of *Trichinella spiralis* in the Kruger National Park in Lipotyphla (Hedgehogs and shrews), Chiroptera (Bats) and the hippopotamus.

The remaining chapters on helminths, particularly that on lungworms by Anderson, maintain a high standard both in scope and in accuracy.

Turning to the arthropod parasites, an interesting, well-documented and world-wide review is given of the mites and pentastomes. In the chapter on myiasis, however, apart from a passing reference to two of Zumpt's publications, work other than that carried out in North America is virtually ignored. The classification, distribution, transmission and development of fleas and lice is superficial. The technique recommended for the preparation of permanent whole mounts of fleas ignores the use of dehydrogenase, which is a well-known cleaning agent. In view of the general outcry against DDT and of its withdrawal from general use in most countries, it obviously cannot be recommended for control measures.

Treatment of the protozoa is also variable. In some cases, e.g. trypanosomiasis, accurate and comprehensive reviews of the subject are presented, whereas in others, e.g. theileriosis, the section on transmission bristles with mistakes, both in facts and in spelling!

In general we certainly cannot recommend this book to anyone who is not in a position to evaluate the information given, especially as so many of the contributors apparently still regard Africa as a dark and unknown continent.

A. V., J. B. W., P. H.

THE DAY OF THE ARGENTAFFINS

It is the twenty-first of July, 1982, the last day of virgin Earth, rather, the last night of virgin Earth, for this is the night of invasion by the **Argentaffins.**

Meet the Argentaffins—luminous green psychedelic creatures frightening enough to make **a bog spavin.**

Meet **Paneth,** chief of the **Islets of Langerhans,** who day and night hunts the notorious **organisms.**

Meet **A. V. Anastomosis,** the **Greek millionaire,** who pours millions into the hunt for:

Mucicarmine, the smooth Earth kid, who craves eating **zymogen,** and longs to **abduct** with:

von Ebner and **Lieberkühn,** the filthy, double-crossing German spies.

For months, Paneth chases **Abomasum** across the **Frontal Planes** trying desperately to get information about the Argentaffins. Then **Kupffer** hits the scene, a madly eccentric **trophoblast,** who believes in **bifurcation,** and nearly throttles **Purkinje** with a **sphincter.**

This is followed by a horrifying **polymorphonuclear** war, causing **oligodendroglias** to start growing all over the Earth's surface.

Back in the **Omphaloplacenta** Headquarters, **Golgi** is busy assembling the machine to end all machines... the **ginglymus.** Golgi writes Paneth a letter in **pisiform,** but Paneth decides this is a lot of **treppe** anyway, and sentences Golgi to carry the **Bundle of His** for the rest of his life.

Suddenly the Argentaffins leave the Frontal Planes and land at a **syndrome** near the **Ridge of Wolff.** In an urgent panic, Paneth draws his **sarcolemma** and **diarthroses** a few Argentaffins. Mucicarmine then falls in love with Paneth, and invites her friends **Themeda** and **Allele** over to the Omphaloplacenta Headquarters. But Paneth flees from Mucicarmine. In his rush across the hills, he slips on **arachnoid granulations,** into a great **archenteron,** and curses: **"Blastopore!"**

In the wet and murky depths of the cave, Paneth is bitten by a **bog spavin.** "O my, O my, what shall I do?" Suddenly, a fairy appears, surrounded by a group of sweet little **gamma globulins.** The fairy invites Paneth into her **Goblet cell.** As Paneth enters, he is greeted by a little **mitochondrion.**

SUDDENLY, Paneth hears the buzzing of his **antebrachial** chronometer. "I must go, I must go!" he screams, and runs out of the archenteron to the top of the nearest hill, where he gets the message loud and clear.

—— Beep, beep, beep... stop sending further **Dopa.** We have the **maximum tubular load** on at the moment, supplying all our **centrioles. Telophase** is under full control. Incidentally, if you don't get rid of that **substrate messenger, Thyroxine,** I shall kick her out myself. She may be beautiful, but she runs around raising little **B.M.R.'s** about our organisation, which could lead to the **colloidal suspension** of our key men.

Behind the scenes, secretly controlling the ambitions of all men on Earth, even the Omphaloplacenta Headquarters, is the deadly **NADP !**

The NADP is a **proprioceptive** organisation, whose chief aim is to smash the **pyridoxine ring.** The leader of the NADP is a lunatic who suffered from a severe **ultimobranchial complex,** but the actual mystic brain behind the NADP is **DOC,** a wild **Steroid** from Bohemia. NADP controls the **Chromaffin** Institute, which has under its auspices a series of **gyri**—homes for madmen, who are recruited as part of the **endoplasmic reticulum,** or secret services, of the NADP.

By this time, Paneth is on the nearest highway back to the city, where Mucicarmine is **ferritin** around for a new **Fürstenburg's rosette** in the exclusive boutique, **Meissner's Plexus** (just next to **Auerbach's).** She is attracted to a wild type of fellow, the hippy prophet **Ecchymoses.** After chatting for a while, he invites her round to see his **polymetaphosphates.** They catch a **thigmotaxis,** pass around the **Circle of Willis,** turn left at the **subanal decussation,** and continue down the **Embden-Meyerhof Pathway.**

Suddenly, the thigmotaxis crashes into a parked **infarct.** Being unable to catch another thigmotaxis, they have to walk. It is a pleasant evening, and the **nema todes** are croaking peacefully in the **Canalis Hypoglossi.** They pass the neighbouring Italian family, **Dura Mater, Pia Mater,** and **Mamma Thoracica,** who are standing outside their **villus.** Mamma Thoracica invites them in for a long cool **orangeophil.**

Unfortunately, their **corpora nigra,** by the name of **Putamen,** makes a quick break-away from the house, carrying many **nephrostomes,** including the world-renowned **Bracelet of Nageotte.** Luckily, their dog **Rhabdo** is at hand, and Dura Mater shouts **"Caecum!"** Putamen is brought down in a few short **stenoses,** and lands in a **dicrotic notch,** shouting **"Ooo... Oedema!"**

At this instant of time, a space-occupying lesion is sighted in the ionosphere—air and space traffic is grounded until a **haematome** can be launched directly at the lesion. It takes off from the **intercalated discs.** The haematome explodes and the lesion disappears in one fantastic **crepitating râle,** leaving the heavens **metachromatic** for hours.

Meanwhile, Paneth and the other agents have dropped in at the **Diverticulum of Nuck,** a cosy downtown pub, for a drink. Here they are given a fantastic cabaret show—**Cyanocobalamine '82**—the greatest band in the land:

Eustachian on his **tube;**
Taenia on the **zonula;**
Haustra on the **xiphoid;**
Al Veolus on the **bronchial tree.** ....
Head female vocalist—**Jeannie O'Glossus**
Leading male vocalist—**Basi Sphenoid**
Manager and conductor—**Amphy Arthrosis.**

They have a pleasant **infusion broth,** followed by **asparagine, Krause's end-bulbs,** and cold **jejunum,** finishing with **Wharton's jelly** and coffee.

While discussing the international crisis of NADP and the **paraganglia,** they are interrupted by **van den Bergh,** who has walked into the pub with his **azo-dyed**

safari-suit, a **long-necked bankrupt worm** trailing behind him on a **paradidymus.** "Hell, you ought to see what these things do to my sheep," he cries. That scares everyone out of the pub.

Ecchymoses and Mucicarmine then decide to go and lose themselves in the gay atmosphere of the greatest circus show on earth—the **Sertoli Sustentacular.** At the entrance a **hippocampal commissure** collects money and announces the people as they enter. Ecchymoses and Mucicarmine go and sit in a comfortable **choana** away from the crowds.

The first act in the show is a military display by the **Corpus albicans,** led by Lieutenant **Adjuvant**—all to the music of **del Rio-Hortega** and the **cerebellar peduncles.** The most spectacular act of the Corpus Albicans is a **synapse en passant.**

Next in the show is **Juxta Glomerular,** specially flown out from the Islets of Langerhans (at the request of Paneth). He does his world-famous **ipselateral** act. This was sponsored by the three Jewish medical authorities—**Billy Rubin, Hymie Globin** and **Rod Cone.**

Before the next act can get under way, a filthy tramp and local nuisance in the city, **Cassius Necrosis,** runs into the ring, spreading his foul odour throughout the circus tent. He is quickly removed by the **para oöphorons,** a paramilitary force recruited specially to remove troublesome **ropheocytes,** most of them members of **Ruffini's** body guard.

But the Argentaffins have underestimated the boys at the Omphaloplacenta. Paneth and his men have despatched **Megakaryocytes** to key positions all over Earth; they are armed with **gubernaculi-**firing **haemocytoblasts,** capable of destroying even the Argentaffnis.

The remaining Argentaffins are rounded up and placed in restriction in special camps called **Argentaffinomas.**

The crowds at the circus then hold a mass **inspissation** to celebrate the victory.

And they all live happily ever after.

N.B.—Anybody understanding the development of this story please consult an **encephalomalaciologist.**

(Brewed by Harry Biggs and Bill McGirr—B.V.Sc. III students.)

BOOK REVIEW BOEKRESENSIE

VETERINÄRMEDIZINISCHE PARASITOLOGIE

J. Boch and R. Supperer

Paul Parey, Berlin & Hamburg, 1971. Pp. 408, Figs. 106.

This text-book begins with a short introduction to parasitology, which is followed by six sections dealing with the parasites of ruminants, equines, pigs, carnivores and birds. It also includes a list of parasites of laboratory animals.

The introduction deals with the classification of parasitic protozoa, helminths and arthropods, epizootology, pathology, host-parasite relationships, control and prophylaxis. This section includes a good description of the collection and various methods of mounting parasitic arthropods as well as the diagnosis and recovery of parasitic protozoa and helminths.

The following sections contain brief descriptions of individual parasites or groups of parasites such as the lung worms of sheep and goats, while the life-cycle, pathogenesis, clinical signs and control are dealt with in greater detail. The description of each parasite or group of parasites ends with a bibliography of current literature, which includes articles published up to May 1970.

Although this book is primarily intended for veterinarians and veterinary students in Europe, workers in other regions will undoubtedly find it a useful reference for the common parasitic diseases of domestic animals. The value of this book is greatly enhanced by the superb illustrations of the helminths; unfortunately those of the arthropods are not of such a high standard. The handling of each parasite or group of parasites is concise but nevertheless comprehensive and any deficiencies in the text are amply compensated by the relevant bibliography.

A. V., T. H.

ABSTRACTS

UITTREKSELS

THE ONDERSTEPOORT JOURNAL OF VETERINARY RESEARCH

Volume 38, Numbers 3 and 4, 1971

NEITZ, W. O. & McCULLY, R. M., 1971. Clinicopathological study on experimentally produced **Trypanosoma brucei** infections in horses. Part 1. Development of clinically recognizable nervous symptoms in nagana-infected horses treated with subcurative doses of Antrypol and Berenil. P. 127.

Studies on the pathogenesis and symptomatology of the acute and chronic forms of human sleeping sickness and those appearing in equine nagana caused by **Trypanosoma brucei** Plimmer & Bradford, 1899 are given. In man the initial invasion of the blood stream and lymph nodes by either **T. rhodesiense** Stephens & Fantham, 1910 or **T. gambiense** Dutton, 1902 is invariably followed by parasites entering the cerebrospinal fluid and eventually extending to the brain and producing symptoms of meningoencephalitis. In horses the invasion of the blood stream and lymph nodes by **T. brucei** results in the development of a peracute, acute or chronic disease which nearly always terminates fatally without clinical evidence of an involvement of the central nervous system.

Consideration of the relatively short reaction periods of 2 to 3 months in **T. brucei** infections when compared with those of 9 months to several years in human trypanosomiasis, suggested that prolongation of the course of nagana in horses by subcurative treatments with Antrypol and Berenil would allow the parasite sufficient time to enter the cerebrospinal fluid and then to exert its pathogenicity on the central nervous system. It was found that such treatments resulted both in the extension of the course and in the appearance of nervous symptoms in two of the five treated horses. The involvement of the central nervous system was confirmed at necropsy by a mild hydrocephalus, oedema of the brain, thickening of the meninges and the detection of **T. brucei** in the cerebrospinal fluid.

Evidence is presented that in common with **T. rhodesiense** and **T. gambiense**, **T. brucei** under certain conditions exerts its invasive potential for the cerebrospinal fluid.

McCULLY, R. M. & NEITZ, W. O., 1971. Clinicopathological study on experimentally produced **Trypanosoma brucei** infection in horses. Part 2. Histopathological findings in the nervous system and other organs of treated and untreated horses reacting to nagana. P. 141.

A detailed description of the histopathology of the nervous system and a brief account of lesions in visceral and other organs of six horses experimentally infected with **Trypanosoma brucei** Plimmer & Bradford, 1899 are given.

Attempts to produce a chronic form of nagana in three horses by subcurative medications with Antrypol and Berenil were successful. The chronicity period was extended to 130 days in one and to approximately 9 months in the other two horses. The data on the histological findings on the three horses are listed in tabular form. The lesions in the central nervous system were characterized by a severe pleocytosis of the meninges, an extensive subpial gliosis corresponding in severity to the involvement of the overlying leptomeninges, segmental demyelination of optic tracts and some other areas of white matter as well as grey matter and extensive perivascular cuffing with lymphocytes, plasmocytes, large mononuclear and Mott cells in this order of descending frequency.

Comparison between lesions of the acute form of human sleeping sickness and those of the experimentally produced chronic form of equine nagana revealed that points of similarity are far greater than those of dissimilarity. The latter include a lymphophagocytosis in the meninges and brain of man, a higher incidence of Mott cells in the meninges of horses and the penetration of trypanosomes in the brain of man which was not seen at this site in horses.

With the exception of the pituitary of one horse, lesions of the nervous system of the remaining three horses were not striking. Histological changes in the visceral and other organs were neither pathognomonic nor of uniform occurrence.

JANSEN, B. C., 1971. The quantitative determination of the toxic factors produced by **Clostridium botulinum** types C and D. P. 177.

The Lf values of the C_1, C_2 and D factors produced by **Clostridium botulinum** types C and D were compared with the results of in vivo quantitative tests. It was found that the flocculation test is a reliable method of determining these antigens quantitatively.

ANDERSON, P. J. S. and VERSTER, ANNA, 1971. Studies on **Dictyocaulus filaria.** I. Modifications of laboratory procedures. P. 181.

Techniques used in a study of the life-cycle of **Dictyocaulus filaria** (Rudolphi, 1809) are described. First stage larvae migrate from faecal pellets placed in water. Infective larvae are cultured in clean water at room temperature and aerated overnight for 7 days. Sheep are infested per os with infective larvae. At various intervals after infestation they are killed and their organs are cut into small pieces, placed in a modified Baermann apparatus and the parasites allowed to migrate from the tissue into physiological saline at 37°C for 6 to 8 hours. Larvae are collected from lymph drained from the thoracic duct with a catheter. Some of the recovered worms are killed with an iodine solution; others intended for morphological studies are killed by heating to 60°C and preserved in a mixture containing triethanolamine.

ANDERSON, P. J. S. & VERSTER, ANNA, 1971. Studies on **Dictyocaulus filaria.** II. Migration of the developmental stages in lambs. P. 185.

Developmental stages of **Dictyocaulus filaria** (Rudolphi, 1809) were recovered from the right colic mesenteric lymph nodes of lambs 18 hours after infestation. The majority of the parasites remain in the lymph nodes until Day 6 and from Day 7 onwards migrate via the thoracic duct to the heart and pulmonary arteries. From Day 8 to Day 14 parasites occur in considerable numbers in the lung tissue. Although some worms may be present in the trachea and bronchi on Day 4, they are not present in large numbers prior to Day 10. From the 12th day the numbers in the lung tissue decrease while those free in the respiratory passages increase.

REINECKE, R. K., COLLINS, H. MARIA & ANDERSON, P. J. S. Studies on **Dictyocaulus filaria.** III. The migration of the immature stages applied to an anthelmintic test. P. 191.

The larvae of **Dictyocaulus filaria** (Rudolphi, 1809) develop to the 5th stage in the mesenteric lymph nodes within 6 to 8 days of infestation. The migration of the 5th stage to the lungs commences on the 7th or 8th day and is almost complete by the 13th day. The adult females start laying eggs in the bronchi from the 28th day.

Controlled anthelmintic tests on two groups of sheep are described. Levamisole was dosed intraruminally at 7,5 mg/kg. It was tested against the 3rd and 4th stage larvae in the lymph nodes in the 1st group and against the 5th stages in the lungs in the 2nd group of animals. In both cases data assessed by the non-parametric statistical method showed that levamisole could be classified in Class B, i.e. it was more than 60 per cent effective in more than 60 per cent of the treated flock.

VERSTER, ANNA, COLLINS, H. MARIA & ANDERSON, P. J. S. Studies on **Dictyocaulus filaria.** IV. The morphogenesis of the parasitic stages in lambs. P. 199.

In males the parasitic 3rd stage, 3rd moult, 4th stage, 4th moult and 5th stage are reached on Days 1 to 2, 3, 4, 5 to 6 and 8 respectively. The 4th stage is swollen in the anal region and accessory genitalia differentiate rapidly during the 4th moult. In females development from 4th stage larvae through the 4th moult to the early 5th stage is delayed; these stages are present from Days 4 to 6, 7 and 8 respectively. There is little differentiation in the 3rd stage. In the 4th stage the tail has become tapered and by the 4th moult the vulva lips have formed; they become patent after moulting. The genital ducts start showing evidence of patency only 7 days after the 4th moult completing this process 10 days later. The uterus contained embryonated eggs on the 28th day.

McCONNELL, E. E., BASSON, P. A. and DE VOS, V., 1971. Nasal acariasis in the chacma baboon, **Papio ursinus** Kerr, 1792. P. 207.

Mature specimens of **Rhinophaga papionis** Fain, 1955 were observed exclusively in the maxillary recesses of 29 of 31 chacma baboons (93,6%). They stimulated the formation of inflammatory polyps, which in some cases almost completely filled the recesses. The polyps were composed of a myxomatous core infiltrated with varying numbers of plasma cells and eosinophils. Hyperplastic epithelium with localized areas of stratified squamous metaplasia covered the polyps. *R. elongata* Coffee, van Aswegen, McConnell & Basson, 1971 (elongated nasal mite) was found in 3 of 44 baboons (6,8%). This remarkably long mite (5 to 6 *mm*) was located in the apex of small nodules which were randomly distributed throughout the nasal cavity. The anterior third of the mite was deeply embedded in the mucosa and in some cases even in the subjacent bone. These mites also tended to cause plugging of the mucosal glands which became markedly dilated. It is probable that both mites have a direct life cycle, with spread by way of immature forms.

NEITZ, W. O., BOUGHTON, F. & WALTERS, H. S., 1971. Laboratory investigation on the life-cycle of the Karoo paralysis tick (**Ixodes rubicundus** Neumann, 1904). P. 215.

Detailed data on the rearing of three groups of **Ixodes rubicundus** ticks at different temperature and humidity levels are presented in a series of tables and figures. The differences between the life-spans are seen to be dependent mainly upon the temperature. The average duration of 405 days at relatively high temperatures is extended to 1115 days at lower temperatures. The reason for the mortality rate of approximately 96% of the immature stages in all groups during the prefeeding, feeding and premoulting periods is obscure.

McCULLY, R. M., BASSON, P. A., PIENAAR, J. G., ERASMUS, B. J. & YOUNG, E., 1971. Herpes nodules in the lung of the African elephant [**Loxodonta africana** (Blumenbach, 1797)]. P. 225.

Lymphoid nodules associated with Cowdry Type A intranuclear inclusions in epithelial and syncytial cells were found in the lungs of 74% of 50 African elephants in the Kruger National Park. Subsequent studies proved these were caused by a herpes virus (Erasmus, McCully, Pienaar, Young, Pieterse & Els, 1971). The disease appears to be subclinical or latent. This virus, in common with other herpes viruses, might be more pathogenic in some other host. The pathogenesis of the lymphoid nodules and the various stages of their formation are given and the detailed characteristics are illustrated.

JANSEN, B. C. & KNOETZE, P. C., 1971. Tryptic activation of **Clostridium botulinum** type Cβ toxin. P. 237.

The toxicity of factor C_2 produced by **C. botulinum** type Cβ is increased by exposure to 0,1% trypsin at pH 7,5 for 30 minutes. If the tryptic action is allowed to continue at pH 7,5 at room temperature, destruction of the factor results.

BASSON, P. A., McCULLY, R. M., DE VOS, V., YOUNG, E. & KRUGER, S. P., 1971. Some parasitic and other natural diseases of the African elephant in the Kruger National Park. P. 239.

Detailed descriptions are given of the lesions encountered at autopsy on a random selection of 32 free-living African elephants [**Loxodonta africana** (Blumenbach, 1797)]. Lymphoid nodules with inclusion-bearing syncytia caused by a herpes virus were found in many lungs and similar lesions occurred in the pancreas. Suspected viral lesions somewhat resembling bovine granular vaginitis were encountered in the genitalia. **Dipetalonema gossi** Baylis, 1923, which was originally recorded from the abdominal cavity, was recovered from the portal veins of several animals. They proved to be responsible for severe intrahepatic vasculitis and eosinophilic hepatitis in 50% of the elephants. **Grammocephalus clathratus** (Baird, 1868) Railliet & Henry 1910 was constantly present in the bile ducts where fairly marked cholangitis was produced. Even mild localized pancreatitis was sometimes caused by these parasites. **Parabronema africanum** Baylis, 1921 was found in large numbers in gastric ulcers. A new mite, **Loxanoetus bassoni** Fain, 1970 was obtained from the ears. The livers of two elephants contained a few suspected schistosome ova. Sideriotic and haemangiomatoid splenic lesions occurred in several adult animals. Many of the cows had multiple periuterine papillomata. Arteriosclerosis of the aorta was occasionally encountered. Skin lesions resembling porcine lesions of zinc deficiency were observed. Mycotic lesions were seen once in the lungs and lymph nodes. The aetiology of focal disseminated cystitis in 39% of the cows was not established.

NAUDÉ, T. W. & POTGIETER, D. J. J., 1971. Studies on South African cardiac glycosides. I. Isolation of toxic principles of **Homeria glauca** (W. & E.) N.E. Br. and observations on their chemical and pharmacological properties. P. 255.

The main toxic principle (1α, 2α-epoxyscillirosidin, a new bufadienolide cardiac aglycone) was isolated by very mild isolation techniques constantly correlated with semi-quantitative toxicity determinations in guinea-pigs.

Extraction from plant material was effected at room temperature by suspending it in acetic acid solution and then extracting with chloroform. The residue was extracted with ethanolic citrate buffer and from this phase the toxic components were re-extracted with chloroform. The final separation was done by column chromatography on silica gel. The main toxic component (MTC) constituted 0,044% by mass of the dried plant material. The presence of several other related toxic components was indicated.

Certain physical and chemical characteristics of the MTC were determined.

The MTC had a subcutaneous LD_{50} of 0.194 (0,183 to 0.203) mg/kg for guinea-pigs and 3,6 (2,9 to 4,46) mg/kg for mice. The clinical signs were nervous in nature: in guinea-pigs a generalized curare-like paralysis resulted in death from respiratory failure while in mice a convulsive syndrome was encountered. The MTC had potent local anaesthetic properties.

JOURNAL NEWS — TYDSKRIFTENUUS

THE JOURNAL OF ENVIRONMENTAL QUALITY

NEW ENVIRONMENTAL JOURNAL

American Society of Agronomy, 677 S. Segoe Road, Madison, Wisconsin 53711.

Subscription price $11.00 p.a.

This is a quarterly magazine, devoted to the protection and improvement of environmental quality in natural and agricultural ecosystems. Vol. 1 No. 1 has recently been published.

THE WORLD VETERINARY ASSOCIATION

This Association now consists of 58 national Associations, each representing the veterinary profession of its respective country. The Permanent Committee of the W.V.A. met again in August 1971 during the XIXth World Veterinary Congress. The S.A.V.A. was represented by Prof. B. C. Jansen.

Prof. Dr. Jac Jansen has retired after serving the W.V.A. as Secretary-Treasurer for 18 years. Dr. M. Leuenberger, 70 route du Pont-Butin, CH 1213 Petit-Lancy, Switzerland, is the new Secretary-Treasurer. Prof. W. I. B. Beveridge was re-elected as President.

At the XIXth W.V.A. held in Mexico in 1971 90 topics were dealt with in the following 16 sections:

1. Anatomy
2. Physiology, Biochemistry, Pharmacology
3. Parasitology
4. Hygiene of Animal Products and Veterinary Public Health
5. Zootechny
6. Pathological Anatomy
7. Microbiology and Immunology
8. Experimental and Developmental Surgery
9. Clinical Studies of Dogs and Cats
10. Clinical Studies of Ruminants
11. Clinical Studies of Horses.
12. Clinical Studies of Pigs.
13. Clinical Studies of Birds
14. Clinical Studies of Other Animals
15. Veterinary State Medicine
16. Veterinary Education and Professional Interests.

A total of 4 628 persons from 64 countries participated in the congress, to which the Mexican Veterinary Medical Association acted as host.

The following resolutions were taken at the Congress.

SECTION 1 — Anatomy

a) 1. Any study concerning the effects on the embryo or foetus of experimental procedures, metabolic disturbances, teratogenic agents, radiation or abnormal nutritional status has to rely on the normal pattern of development as a basis.

2. Quantitative as well as qualitative data are still needed for a fuller understanding of prenatal development.

3. The study of development is essential to veterinary education because it provides the background for an understanding of the definitive structures of the animal body.

b) Veterinary Anatomy should be taught in both pre-clinical and clinical courses. The pre-clinical aspect corresponds to Basic Anatomy, and should be a required course for all students. The clinical aspect comprises Applied Anatomy, and the course should be adapted to the student's specific professional needs.

SECTION 3 — Parasitology (including Helminthology, Protozoology and Entomology)

1. Cysticercoses-Taeniases are serious obstacles to the full development of the vitally important meat industries in developing countries and

2. Are parasitic diseases of major medical, veterinary medical and public health importance in that they are Zoonotic diseases resulting in ill health and death in humans and

3. The marked increase in the cysticercoses in developed countries, due to mass movement of people by tourism, immigration and migration of labour forces are endangering the already established valuable meat industries of these countries and

4. Existing research supported by F.A.O., W.H.O., O.A.U. and other organizations and institutions indicates the possibility of solving these problems.

Therefore, this Congress, recognizing the pressing urgency of this problem which affects both human and animal welfare, urges intensification of collaborative efforts by all concerned in dealing with this serious and growing global medical and veterinary medical problem.

The Congress urges financial and technical support from the United Nations Agencies such as W.H.O., F.A.O. and U.N.D.P., the World Bank, Government Agencies and non-Government foundations as a direct investment leading to the eradication of these parasitic entities.

SECTION 4 — Hygiene of Animal Products and Veterinary Public Health

a) A recommendation has been made by Section IV, Topic 3, that inspection of fish products at fishing ports should be made by veterinarians in countries that are Members of the World Veterinary Association, where no such inspection exists already.

b) The Public Health Section (4), by unanimous acclamation, resolved that a World Veterinary Epidemiology Society be affiliated with the World Veterinary Association and that the World Veterinary Association add epidemiology to the specialities that are affiliated with the World Veterinary Association.

c) In view of the ever increasing development of the international meat trade, the participants in the XIXth World Vererinary Congress in Mexico consider it appropriate that there be a standardization of the hygienic standards of meat handling in the different countries and that in those countries where an official meat inspection does not yet exist, such an inspection be introduced. The following stipulations should be laid down in the rules for hygienic handling which we propose:

1. All animals, the meat of which is destined for human consumption, should be subject to an inspection by a veterinarian, or at least under his supervision.
2. The inspection of the animals on foot and of slaughtered animals should be carried out according to recognized scientific methods.
3. Slaughterhouse animals should be inspected in a sanitary way, beginning at their place of origin. When they are slaughtered, the results of the sanitary inspection should be available and these animals should be controlled by marking them.
4. Diseased or suspected animals should be housed at special places or at least at places strictly separated from healthy animals which are being processed.
5. The official inspection should be extended to the detection of harmful residues. To this end intensive use should be made of laboratory research which will also be helpful to describe usefully latent infections.
6. The hygienic standards should not only refer to slaughterhouse animals and their carcases but also to the forms of processing, conservation and transport of meat.

SECTION 7 — Microbiology and Immunology

Having recognized the importance and success of non-agglutinogenic vaccines in the control of brucellosis, it was recommended that intensive research should be continued to try to develop more rapidly the use of such vaccines in the field.

SECTION 14 — Clinical Studies of Other Animals

The preservation of all forms of animal life by the prevention or treatment of diseases has always been the concern of the veterinary profession.

There is presently evident a far greater danger that many forms of land, air and marine life may become extinct by man's exploitation of natural habitats, over-harvesting, or through pollution of food, water and air.

Be it resolved therefore by the World Veterinary Congress that it use all the means at its disposal to support measures at local, national and international levels that will ensure preservation of existing wildlife.

Note: The above resolution received unanimous approval from Section XIV of the XIXth World Veterinary Congress but due to organizational problems did not reach the Resolutions Committee in time for presentation at the General Assembly at the Closing Session on August 21, 1971.

SECTION 16 — Veterinary Education and Professional Interests

a) While there is a great need for new veterinary schools in many parts of the world, we would wish to draw the attention of governments who are proposing to open such schools, to the problems arising from the capital costs for buildings, laboratories and clinical facilities necessary to ensure adequate instruction. The most important need is, however, adequately trained veterinary staff.

b) The Section recommends that in all countries further training courses should be provided for veterinarians who are responsible for clinical work.

The XXth World Veterinary Congress is to be held in Thessaloniki, Greece, in 1975.

Note the new address of the Secretariat of the World Veterinary Association: Dr. M. Leuenberger, Secretary-Treasurer, W.V.A., 70, route du Pont-Butin — CH 1213 Petit-Lancy, Switzerland.

New account for payment of annual fees: Association Fund, W.V.A., Banque Populaire Suisse, Geneva, Switzerland.

BOOK ANNOUNCEMENT

BOEKAANKONDIGING

ARNOLD THEILER
HIS LIFE AND TIMES

GERTRUD THEILER

Publication of the University of Pretoria, New Series No. 61—1971

Distributors: Van Schaik's Book Store, 268 Church Street, P.O. Box 724, Pretoria

Pp. 42. Afrikaans Summary. Price R1,25

The inability to appreciate that today's actuality is to-morrow's history, a general lack of historical awareness, may be said to be a national short-coming amongst South Africans. The importance of recording men and events before time dims acuity of perception is too often ousted by the demands of the present.

It is, therefore, at last gratifying to experience repayment of a debt of honour to the memory of one of South Africa's outstanding adopted sons, albeit in very modest form, by the publication of this booklet, written by Theiler's eldest daughter. Documented with meticulous care, Theiler's life is shown against the background of his time. Despite its brevity, this work does gather all the important occurrences in strictly factual perspective. Colleagues and past students have been allowed to reminisce, for the rest philosophizing and speculations have been kept in rigorous check: only the occasional vignette lights up the personal side of Arnold Theiler's character, but does so vividly. Lady Theiler's rôle, although not stressed particularly, is well brought out.

As a contribution to the record of the dawn of science on this continent, this work is invaluable and a worthy fore-runner of the anticipated and more extensive biography (by another author), at the moment still in the early planning stage.

WORLD ANIMAL REVIEW

FAO, via delle Terme di Caracalla, 00100 Rome, Italy.

Annual subscription US $3.00 or £1,20. Single Issue US $1.00 or £0,40

The FAO is publishing a new quarterly periodical, WORLD ANIMAL REVIEW, which reviews and reports on the various aspects of animal production, animal health and animal products (meat, milk and milk products, eggs, wool, etc.) with special reference to developments in these spheres in the developing countries. It is believed, therefore, that the publication of such a review journal will serve a very real purpose in disseminating useful and usable information to those concerned with the live-stock industry in developing countries.

World Animal Review is written primarily for a technical audience, but also for the live-stock policy maker and the decision taker in the developing countries and for the university teacher, research worker, and international expert. The articles will be illustrated and will normally be about 2 500 words in length. In addition there will be a few pages of news, notes, book notices, etc. Three separate editions are available—in English, French and Spanish.

The first issue, No. 1, has appeared this year and a copy is available at the SAVA office for perusal. Its list of contents is as follows:—

A message from the Director-General.

F A O's activities in livestock development: J. A. Jasiorowski.

Epizootiology of foot-and-mouth disease in developing countries: J. B. Brooksby.

The production and use of rinderpest cell culture vaccine in developing countries: W. Plowright.

Disease-free zones and beef export: R. B. Griffiths.

An aid to cattle identification: D. M. Redfern.

Fattening beef cattle on molasses in the tropics: T. R. Preston.

Dairy training for rural women: A. W. Marsden.

Livestock cooperatives in the Syrian Arab Republic: Mohammed Mo'tassem.

A cheesemaking demonstration in Masailand: A. W. Marsden.

News and notes.

International meetings, seminars, courses.

New books.

Future issues will contain articles on:—

F A O's programme for stimulating pig production in developing countries.

Sheep production potential in the Near East region.

Newcastle disease—a world poultry problem.

Poultry techniques for a developing area.

Increasing milk yield and calf performance by combined milking and suckling.

The Kenya feedlot project.

Payment for quality in beef.

Pig production in Asia, in Africa, and in Latin America.

Alpaca production in the High Andes.

Dairy equipment for developing countries.

Ice cream: demand and manufacture.

Contagious bovine pleuropneumonia.

Single cell proteins as animal feed.

Protected proteins in animal nutrition.

Any request for World Animal Review or any other F A O Publications, as listed in this Journal (No. 3) may be directed to: The Chief, Distribution and Sales Section, F A O, via delle Terme di Caracalla, 00100 Rome, Italy, or to the South African agents, van Schaik's Book Store, Church Street, P.O. Box 724, Pretoria.

THIRD INTERNATIONAL CONGRESS OF PARASITOLOGY

MÜNCHEN 1974

On the occasion of the Second International Congress of Parasitology in Washington, D.C., in 1970 the World Federation of Parasitologists entrusted the organization of the Third International Congress of Parasitology (Third ICOPA) to Deutsche Gesellschaft für Parasitologie (DGP).

We would like to inform you that the Third ICOPA will be held from August 25th to August 31st, 1974, in München, Kongress-Zentrum, Messegelände.

Anyone interested in receiving further information, please contact the Secretary-General, Deutsche Gesellschaft für Parasitologie, Prof. Dr. G. Lämmler, Institute for Parasitology of the University, R. Buchheim-Str. 4, D 6300 Giessen, Federal Republic of Germany.

THE WORLD ASSOCIATION OF VETERINARY FOOD HYGIENISTS

The Association is arranging its 6th Symposium to take place in Denmark from 21 to 25 August, 1973. The theme of the symposium will be *"Current problems in food-borne disease: Relation to international trade and traffic"*. Details are available from Dr. L. W. van den Heever, Faculty of Veterinary Science, University of Pretoria, P.O. Onderstepoort.

Copies of the Proceedings of the 5th Symposium held in Opatija, Yugoslavia, in 1969, are available (R15.00) from the Secretary, W.A.V.F.H., Postbus 1, Bilthoven, Nederland.

REPORT OF THE COMMITTEE ON PHYSIOLOGICAL EFFECTS OF ENVIRONMENTAL FACTORS ON ANIMALS

National Academy of Sciences Printing and Publishing Office,
2101 Constitution Avenue, Washington, D.C. 20418. 374 pp. paper. $10.50

A valuable source of information for investigators, engineers and administrators and others concerned with evaluating the effects of various environmental conditions on physiologic responses of animals. It is also a useful guide for those responsible for the design and operation of environmental testing facilities.

ANAPLASMOSIS *(ANAPLASMA CENTRALE)* VACCINE

Following well-substantiated complaints about the relative inefficacy of Onderstepoort anaplasmosis vaccine, attempts were made to improve its immunogenicity. This has been achieved but has resulted in a concomitant increase in virulence of the vaccine, which is, however, still appreciably less virulent than virulent *A. marginale* infection.

The more virulent *A. centrale* vaccine will be issued henceforth by Onderstepoort and Allerton instead of the old vaccine.

Reaction: The reaction, which may vary in severity from inapparent to very pronounced, usually starts from 4 to 6 weeks after vaccination and lasts about 14—21 days.

Maximum parasitaemia usually occurs 6 to 8 weeks after vaccination and is often associated with a mild febrile response lasting several days to a week. Morning temperatures may reach 103 to 105°F. Listlessness, inappetence, decreased lactation, constipation, anaemia and icterus may develop shortly thereafter. Death may follow in a low percentage of untreated animals.

Treatment: To control severe vaccine reactions specific therapy with tetracyclines is necessary. Best results are obtained by treatment at or close to peak parasitaemia before severe anaemia and icterus have had a chance to develop.

Although maximum parasitaemia is usually associated with the febrile reaction the latter may be either absent or very difficult to detect. Vaccinated animals must therefore be kept under close observation for the abovementioned symptoms and treated at the first indication.

A single treatment with tetracyclines at 10 mg per kg is usually sufficient to control the reaction but a second injection will not interfere with the subsequent development of immunity. Excessive tetracycline therapy should, however, be avoided since the infection may be sterilized. Additional symptomatic treatment will be necessary in severe cases.

Very valuable animals may be given a "blocking dose" of tetracyclines 5 to 6 weeks after vaccination but should be kept under close observation for further therapy if necessary.

Other recommendations: It is not advisable to vaccinate more animals than can conveniently be handled when the reactions occur.

Calves are more resistant to anaplasmosis and this is therefore the best age at which to vaccinate.

Pregnant animals should not be vaccinated because abortions may occur.

Since it takes at least 2 months for the immunity to develop the best time of the year to vaccinate is in winter when the incidence is low. A life-long immunity results from a single injection.

The vaccine should be administered as soon as posible on receipt. If not used immediately it should be unpacked and stored at ±4—8°C in a refrigerator in the interim. Do not use after the expiry date!

Director: Veterinary Research Institute,
Onderstepoort.

BOOK REVIEW BOEKRESENSIE

DIE ANAPLASMOSE — ÄTIOLOGIE, EPIDEMIOLOGIE, BEHANDLUNG UND VERHÜTUNG — UNTERSUCHUNGEN UND ERFAHRUNGEN IN DEN HOCHTÄLERN DER ANDEN UND KÜSTENEBENE PERUS

HORST S. H. SEIFERT

Verlag M. & H. Schaper, Hannover, 1971. 243 pp., 33 illustrations, 7 graphs, 16 tables, 429 references. Price: DM 45.

The author, who was actively engaged over a period of 14 years with investigations on and control of malignant bovine anaplasmosis (*Anaplasma marginale* infection) in the coastal region (Casa Grande and Trujillo area) and the highland (Sierra) of Peru, gives an excellent account of his observations and achievements.

In the foreword special mention is made that in enzootic regions of tropical and subtropical countries anaplasmosis is an important hazard in the production of beef and milk required for supplementing the protein deficient human diet, which consists mainly of cereals.

The subject matter is divided into 15 sections which includes the (1) geography, climate and vegetation, (2) cattle breeds, (3) economic importance of the disease, (4) epidemiology, (5) incidence, (6) pathogenicity, (7) transmission by ticks and insects, (8) aetiology with special reference to the morphology, physical and chemical properties of the parasite, (9) pathology, pathogenesis, symptomatology and diagnostic methods, (10) immunology, (11) prophylaxis, (12) chemotherapy, (13) state veterinary control measures, (14) summary and (15) literature references. Where necessary, each section is preceded by a review of the international literature of which approximately 80% appeared in journals published in North, Central and South America. This is followed by a description of well-planned experiments and a discussion of the results.

Studies on the pathogenicity show that all cattle breeds, the progeny of *Bos taurus* and *Bos indicus*, are equally susceptible to anaplasmosis. Although it is known that American deer are susceptible, there is no evidence that wild animals serve as reservoirs of *A. marginale*.

Observations show that *Boophilus annulatus* is not the only vector but that mechanical transmission by blood-sucking insects plays a far greater rôle in disseminating anaplasmosis. The breeding habits and habitats of several insect vectors occurring in Peru are described. The horn fly (*Syphona irritans*) is widely distributed and serves as the main vector at altitudes of up to 2 500 m, while *Tabanus* spp. are equally important as transmitters at altitudes between 2 500 and 4 000 m above sea level. Several effective methods for the control of these insects are described. Of these, the auto-application of the insecticide "Coumaphos" in dust-bags suspended at a convenient height in the entrance and exit leading towards water and mineral lick troughs in paddocks is very satisfactory.

Studies on the symptomatology, pathology and pathogenesis have revealed that "high mountain disease" or "brisket disease" (Spanish—"Mal de altura") is a chronic form of anaplasmosis. It occurs at altitudes varying from 2 500 to 5 000 m above sea level. As many as 2% of cattle may be affected. A progressive anaemia accompanied by an oedema extending from the brisket to the jowl and ventral abdomen, ascites, anorexia, dyspnoea, and diarrhoea are characteristic features.

Critical chemotherapeutic tests show that two successive administrations of tetracycline at an interval of 1 to 2 weeks and at the rate of 10 mg/kg bodyweight sterilize *A. marginale* carriers. Mention is made of the sterilization of 18 000 head of anaplasmosis premune cattle. The author claims that in Peru systematic vector control and chemotherapeutically induced sterilization are a more economical prophylactic measure than that which would be obtained by immunizing cattle with live anaplasmosis vaccines.

It is unfortunate that the author did not consult a tick taxonomist on the identity and distribution of the tick vectors. Several of the listed tick species have a wider distribution than that given in the table: *Ixodes ricinus* does not occur in the United States of America; *Rhipicephalus evertsi* is not a proven vector even though it is recorded as such in an American publication; it has not established itself in Madagascar; *Hyalomma aegyptium* is a tortoise tick and does not serve as a vector.

This publication is a most valuable contribution to our present knowledge of malignant bovine anaplasmosis. It will be of great value to veterinarians, zoologists and chemists engaged in research and in the control of this disease in tropical and subtropical countries.

W. O. N.

THE PHYSIOLOGY OF LACTATION

A. T. COWIE AND J. S. TINDALL

Edward Arnold Ltd., London, 1971. Pp. 392; Figures 57; Tables 2. Price £6.50

In six chapters this monograph of the Physiological Society deals with: 1. Physiology of the mammary gland (pp. 1—52); 2. Prolactin and the related mammotrophic hormones (pp. 53—83); 3. Mammary growth (pp. 84—135); 4. Milk secretion (pp. 136—184); 5. Milk removal (pp. 185—222); 6. The neuroendocrine regulation of mammary gland function (pp. 223—282). Literature published immediately prior to completion of the monograph is dealt with in various addenda (pp. 353—371). An extensive bibliography occupies 75 pages (pp. 283—352 and 372—378). The quality of paper, printing and illustration is of a very high standard.

True to the authors' preface, the book represents a review of data for the advanced student of certain aspects of udder physiology. It is not a complete, up-to-date review of all recently published work on the physiology of lactation under the subject headings as claimed by the publishers. Thus, amongst other notable omissions, the radiographic studies of the suckling behaviour of calves (Happel, F. 1963, *Tierärztliche Umschau* 18: 493, 597) is not mentioned in the chapter on "Milk Removal".

The publication is nevertheless considered to be an excellent and very comprehensive effort, which cannot be recommended too strongly to the student working in this field. This applies particularly to the chapters and the numerous figures dealing with the ultrastructure of the mammary gland, the neuroendocrinological regulation of mammary function and the wide range of mammalian species which are included.

The publication serves indirectly to emphasize the extensive research into lactation in small laboratory animals in contrast to the dearth of similar research in the large domesticated species. The lactation of equines apparently has not featured in recent literature. As far as cows and goats are concerned, it appears that studies on the physiology of milk ejection have been confined to animals milked by hand or by machine, systems which cannot be regarded as normal. Accordingly there appears to be inadequate justification for comparison with normal suckling by babies. The publication also serves to emphasize subjects somehow grossly neglected by researchers e.g. in depth studies of the anatomy, histology and physiology of the bovine teat. The advanced research documented in this book also indicates the dire need for an up-dating of information readily available to the young students of human and veterinary medicine.

A point of major criticism is that the authors make no attempt to correlate the data presented. A wealth of information is offered but from the overall physiological point of view the publication lacks functional cohesion and interpretation. Thus, whilst dismissing the existence of segmental reflexes, there is no reference to the possibility of axon reflexes as suggested by the "tap reflex" detailed in another chapter. Acetylcholine is shown to elicit contractions of myoepithelial cells. Since the mammary gland does not appear to have parasympathetic innervation, however, the authors suggest that the physiological significance of the effects of cholinergic drugs on myoepithelial cells remains to be determined; they make no reference to the possibility that apparently there are postganglionic sympathetic fibres with acetylcholine as neurohumeral transmitter. (Goodman, L. S. & Gilman, A. 1968. 3rd ed. *The Pharmacological Basis of Therapeutics*, Macmillan).

The authors point out further that the sympathetic system tends to discharge *en masse* rather than discretely; in view of the above reference this would appear to be rather the exception than the rule, as the sympathetic system discharges *en masse* as an alarm-reaction but usually achieves fine co-ordination of organs to a constantly chang-

ing environment by discrete and continuously varying adjustments.

It may be concluded finally that the publication under discussion represents a valuable and extensive review of a considerable amount of recent literature; as such it is highly recommended. Nevertheless, to those advanced students who are not so much interested in obtaining a break-down of research results for the sake of research but who are more interested in obtaining concepts facilitating a better overall understanding of the physiology of lactation, the publication may prove disappointing.

W. H. G.

BOEKRESENSIE — BOOK REVIEW

LA PESTE AVIAIRE ET LA PESTE DU CANARD

J. JANSEN

L'Expansion Scientifique Française, Parys 1971. pp VIII & 172, Figs. 31 (2 kleur), Tab. 6. Geen prys aangegee nie

Hierdie is 'n bydrae deur die bekende Prof. J. Jansen van die Universiteit van Utrecht, Nederland. Dit maak deel uit van 'n monograaf-versameling saamgestel deur P. Lépine en P. Goret, wat handel oor virussiektes van diere, waarvan reeds agt verskyn het, wat oor 'n verskeidenheid siektes handel, bv. Afrikaanse varkpes, aansteeklike anemie van perde, Aujeszky se siekte, hondsdolheid, bees-rinotrageïtis, ens. Dit is jammer dat die Franse taal deur so min veeartse in Suid-Afrika goed verstaan word, want hierdie werk is 'n uitstekende manier om nuwe kennis saam te vat, met goeie literatuurverwysings, en geskryf deur kenners van elke siekte.

Hierdie twee virussiektes van pluimvee kom nie in Suid-Afrika voor nie, en speel selfs in ander lande 'n klein rol. Dit is egter vir studente, veral nagraads, die soort publikasie om te raadpleeg, want 'n baie volledige beskrywing word gegee van bykans alle aspekte van die siektes en hulle oorsake. Die onderwerpe word onder duidelike opskrifte behandel. Die werk gee besonder goeie inligting oor enige iets van die geskiedenis, etiologie, patologie, epidemiologie, tot beheermaatreëls, waaronder die immuniteit wat verkry word met verskillende soorte entstowwe ook verskyn. Die foto's is goed, en hierdie werk kan as een van goeie gehalte beskou word.

L. C.

BOOK NEWS — BOEKENUUS

PRINCIPLES OF ANIMAL PHYSIOLOGY

JAMES A. WILSON

The Macmillan Co. Dept. C., Riverside, New Jersey, 08075, 1972. ±816 pp. $14.95

This book deals in continuing themes of regulation and comparative physiology with both invertebrate and vertebrate physiology, in order of increasing organizational complexity. Physical and chemical ideas are treated unusually completely. The bibliography is extensive.

VETERINARY CLINICAL PARASITOLOGY

MARGARET W. SLOSS

4th Edition. Iowa State University Press, Ames, Iowa. 1970. pp. viii+250, Figs. 290.

As noted in the preface, the emphasis in this manual is on the parasites of domesticated mammals and poultry of North America. This limits the value of some sections to veterinary parasitologists in Africa, e.g. in the relatively short account of blood parasites there are no illustrations of any *Theileria* spp. and only one of a trypanosome, *Trypanosoma equiperdum*.

In general the text is brief. It includes information on the methods of preparing specimens for examination and lists of references for further study but usually very little about the classification of the different organisms. Most space is devoted to illustrations of the parasites as seen under the microscope.

The detailed description of the examination of faeces for nematodes, cestodes and trematodes should be useful, also that of blood smears for microfilaria, etc. The photomicrographs of helminth eggs are very clear.

The section on mites includes illustrations of most of those likely to be encountered by the veterinarian in South Africa, except *Psorergates ovis*, the itch mite of sheep. The majority of lice occurring on domestic animals here is also shown.

J. B. W., A. V.

THE VETERINARY ANNUAL

C. S. G. GRUNSELL (ED.)

John Wright & Sons Ltd., Bristol. Twelfth issue, 1971. 305 pp. UK price £3.25

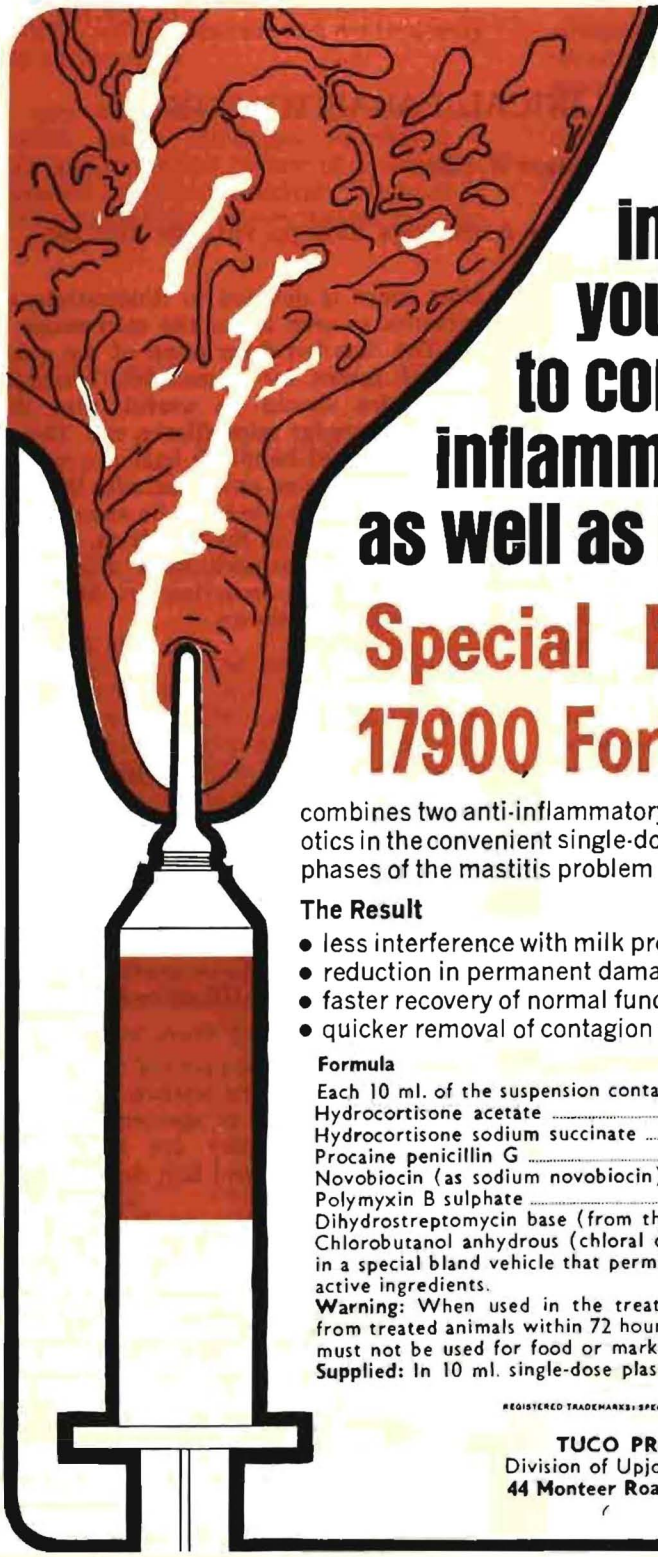
With the publication of the twelfth issue of The Veterinary Annual the editor has again provided the veterinary profession with an up-to-date review of the latest developments in a wide spectrum of topical subjects. The information is systematically arranged and is read with ease. Of particular interest is an account of the implications for the United Kingdom of the recent veterinary developments in the European Economic Community.

A detailed discussion of the diseases of the ear, nose and throat of the horse, a review of the physiological considerations regulating piglet survival and a profound study of the reasons for abdominal surgery in cattle are valuable to clinicians, but also convince the reader that veterinary science is rapidly moving in the direction of species specialization. In the same category are the interesting articles on poultry and fish diseases.

The twelfth issue, similarly to the previous editions, contains a review of the current literature on infectious diseases, parasitology, reproduction and reproductive disorders, pharmacology and therapeutics, toxicology and animal husbandry. Lists of new publications and new drugs and appliances are included.

There is, obviously, no need to stress the usefulness of this concise publication to the busy members of our profession.

B. C. J.



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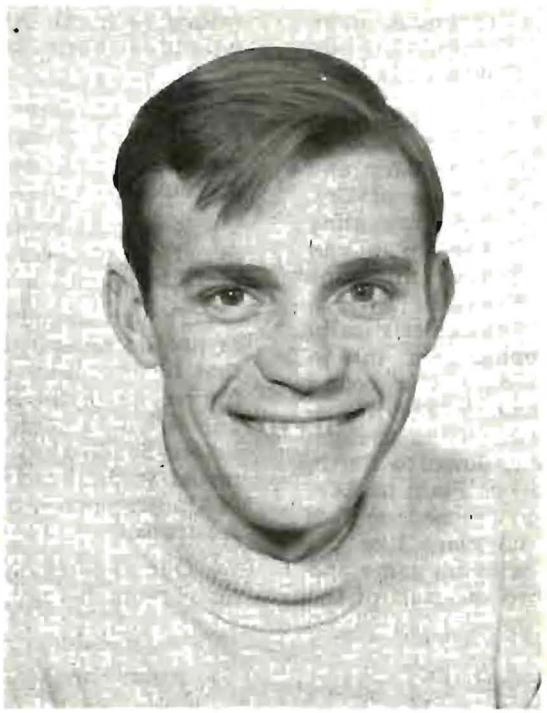

LEWIS DOUGLAS JOHNSTONE MACAULAY
1944—1972

Lewis, elder of two sons to Scottish parents, was born on 31st May, 1944, in Nakuru, Kenya, where his father was a veterinarian in the then British Colonial Service.

His education began in 1949 at Codrington School, Mazabuka, Northern Rhodesia, now Zambia, where the family had moved, and continued at primary level in Parklands School, Nairobi, when they returned to Kenya in 1952. On moving to higher education at Prince of Wales School in 1956, also in Nairobi, Lewis decided to live in as a boarder. His health had been below normal since the age of six months, and active participation in games was not feasible for him; nevertheless his dogged attendance at all important matches, practical work in compiling records and in scoring and time-keeping, so impressed the sympathetic masters and prefects of the school, that he was awarded honorary sports colours in his final year.

His scholastic results sufficed to gain matriculation exemption and entry to Grahamstown in February 1962, where he took the science subjects required for acceptance in the Faculty of Veterinary Science at Onderstepoort, as he had decided to attempt to follow the veterinary career of his father and of his maternal grandfather, the latter having been a practitioner in Dumfriesshire, Scotland.

Class-mates recall how, at first, Lewis Macaulay attended lectures armed with an Afrikaans dictionary. Afrikaans was a foreign language to him but he flatly refused to have the lectures translated for him. Four years later, when he left, Lewis was not only fluent

in Afrikaans, but had won the Theiler Medal. Though plagued by ill-health, he found time and energy to serve on the House Committee. His resolute manner and stubborn refusal to be intimidated by personal problems, more than even his academic brilliance, won him the lasting admiration of all who knew him.

After graduation he worked for a short time in the practice of Dr. Boswell, based at Halfway House between Johannesburg and Pretoria, then went to the practice of Drs. Gouws & Cook of Johannesburg. Struggling against ill-health, he had to give up in mid 1968. He rejoined his parents, at this time living in Adelaide, South Australia. After a short convalescence, he characteristically packed all necessary camping gear into a V/W "Beetle" and set off on a tour round Australia, visiting Melbourne, Sydney, Brisbane, Alice Springs, Darwin, across the top of the Continent to Broome, down to Perth, then back across the Nullarbor Plain to Adelaide. One clear conclusion reached on this trip was that there was no place like the Republic of South Africa, with its game and wide open spaces. He joined the staff of the Institute of Medical and Veterinary Science, Adelaide, as a histopathologist, and was later appointed as honorary veterinary surgeon to the Adelaide Zoo; but still hoped one day to return to South Africa, if possible in some wild life service.

In December, 1971, he became engaged to a Miss Margaret Dwyer, a physiotherapist, daughter of a doctor who had been police pathologist and was one of the stoutest supporters of the Flying Doctor Service.

Recurrent bouts of pneumonia and abdominal complications rendered him more and more frail until a final bout in March, 1972.

Though he seldom complained of his lot in life, he several times mentioned his regret that he had been unable to present himself for receipt of the Sir Arnold Theiler Award, and it was a great joy to him, only a week before he died on March 25, to receive this medal at the hand of Mrs. H. P. A. de Boom of Onderstepoort, during a visit she made to Australia.

Our sincerest sympathies are extended to his parents, his brother and his fiancée.

JOURNAL NEWS — TYDSKRIFTENUUS

A 'NEW' SOUTH AFRICAN SCIENTIFIC JOURNAL OF INTEREST TO VETERINARIANS

THE SOUTH AFRICAN JOURNAL OF ANIMAL SCIENCE
DIE SUID-AFRIKAANSE TYDSKRIF VIR VEEKUNDE

South African Society for Animal Production, P.O. Box 10084, Sunnyside, Pretoria.

Subscription price R5 p.a.

In October, 1971, the "Proceedings of the South African Society for Animal Production," published as journal since 1968, appeared as the *South African Journal of Animal Science*, Vol. 1, No. 1. Two numbers per annum are planned for 1972.

Like this Journal, the *S.A. Journal of Animal Science* is an independent publication, the official organ of its Association, and likewise will continue in augmentative co-existence with its Departmental counterpart, in this case *Agro-animalia*.

Also like this Journal, its aims are to serve the whole of Southern Africa and its sphere will not be restricted to the Republic only. Contributions are approximately 85 per cent in English and 15 per cent in Afrikaans.

In welcoming the *S.A. Journal of Animal Science*, we wish it a long and fruitful existence in the interests of the South African livestock industry.

LETTER TO THE EDITOR — AAN DIE REDAKSIE

Sir,

SOME MEAT INSPECTION FINDINGS AT MATSAPA ABATTOIR IN SWAZILAND

Armillifer armillatus was recorded in July 1967 at Matsapa Abattoir in Swaziland[1] and although this has not been recognized between May 1969 and June 1971, it is felt that the following table of bovine meat inspection findings may be of interest.

SITE	PARASITE	INCIDENCE
Tongue	*Cysticercus bovis*	3,5%
Skeletal Muscle	*C. bovis*	16,4%
	Onchocerca gibsoni	Present but incidence not recorded
	Sarcocysts (Eosinophilic myositis)	Occasional
Heart	*C. bovis*	4,3%
	Cordophilus sagittus	0,416%[2]
	O. gibsoni	Rare
Lungs	*C. bovis*	2,0%
	Dictyocaulus viviparous	Rare
	Hydatid cysts	10%
	Aberrant flukes	Occasional
Liver	*C. bovi*	
	Fasciola gigantica	7%
	Hydatid cysts	0,6%
	Schistosoma sp.	Occasional
	Stilesia hepatica	0,7%
Tripe	*Paramphistomum* sp.	Present but incidence not recorded
Intestines	*Oesophagostomum* sp.	34,7%
Intestinal Veins	*Schistosoma* sp.	Present but incidence not recorded
Kidney	*C. bovis*	Rare
Peritoneal Cavity	*Artionema labiato-papillosa*	Occasional
Lymph node	*C. bovis*	Rare

The incidence percentages are based on the meat inspection returns for 1970, apart from the *C. bovis* infestations, which concern 339 infected animals out of 1 863 slaughtered during a four week period in February-March 1971.

My thanks are due to Dr. Anna Verster of the Veterinary Research Institute, Onderstepoort for identification of the nematode species.

Yours faithfully,
W. D. WALKER.

References:
1. du Toit R. & Sutherland R. J. 1968 *Jl S. Afr. vet. med. Ass.* 39 : 77
2. Walker W. D. 1971 *Vet. Rec.* 88 : 342

Present Address:
Ministry of Agriculture Fisheries and Food.
Old Government House,
Dee Hills Park,
Chester,
U.K.

SARKOPTIESE BRANDSIEKTE IN WILDE LEEUS

Dit is onlangs vasgestel dat leeus, **Panthera leo,** onder sekere natuurlike toestande klinies waarneembaar besmet kan raak met **Sarcoptes scabiei** en dat swaar besmettings in sekere gevalle mag bydra tot vrektes, veral onder jong leeus.

In die Krugerwildtuin is 33 leeus onlangs gevang en met 'n groot mate van sukses met BHC en/of malathion-bevattende preparate behandel.

'n Jong leeu met kroniese letsels van veral die agterkwarte en stert kan in een van die bostaande foto's gesien word terwyl die ander foto die behandelingsproses illustreer.

Ingestuur deur: E. Young, Veeartsenykundige Ondersoeksentrum, Skukuza; F. Zumpt, S.A.I.M.N., Johannesburg en I. J. Whyte, Veeartsenykundige Ondersoeksentrum, Skukuza.
Fotografie: E. Young.

SARCOPTIC MANGE IN FREE-LIVING LIONS

It has recently been established that free-living lions, **Panthera** leo, may under certain conditions develop characteristic mange lesions due to infestation by **Sarcoptes scabiei** and that in some cases severe infestations may contribute to mortalities especially in young cubs.

In the Kruger National Park 33 lions have recently been captured and treated with a great deal of success with BHC and/or malathion-containing preparations.

A young lion with chronic skin lesions especially of the hindquarters and tail can be seen in one of the above photographs, while the other photograph illustrates one of the lions being treated.

Submitted by: E. Young, Veterinary Investigation Centre, Skukuza; F. Zumpt, S.A.I.M.R., Johannesburg and I. J. Whyte, Veterinary Investigation Centre, Skukuza.
Photography: E. Young.