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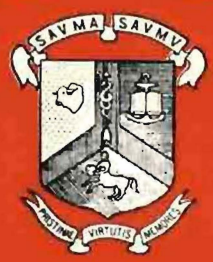

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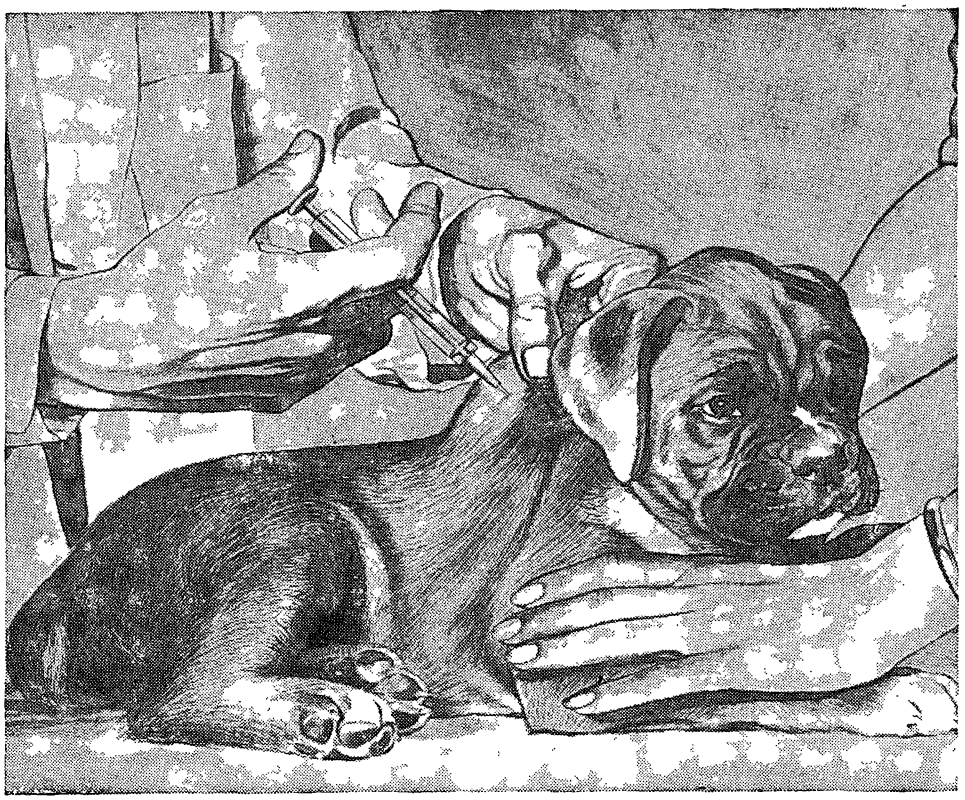

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The Editorial Committee greatfully acknowledges the contribution by Dr. J. Bosch, of Bethal Tvl. The first in the series of his contributions is published in this issue.

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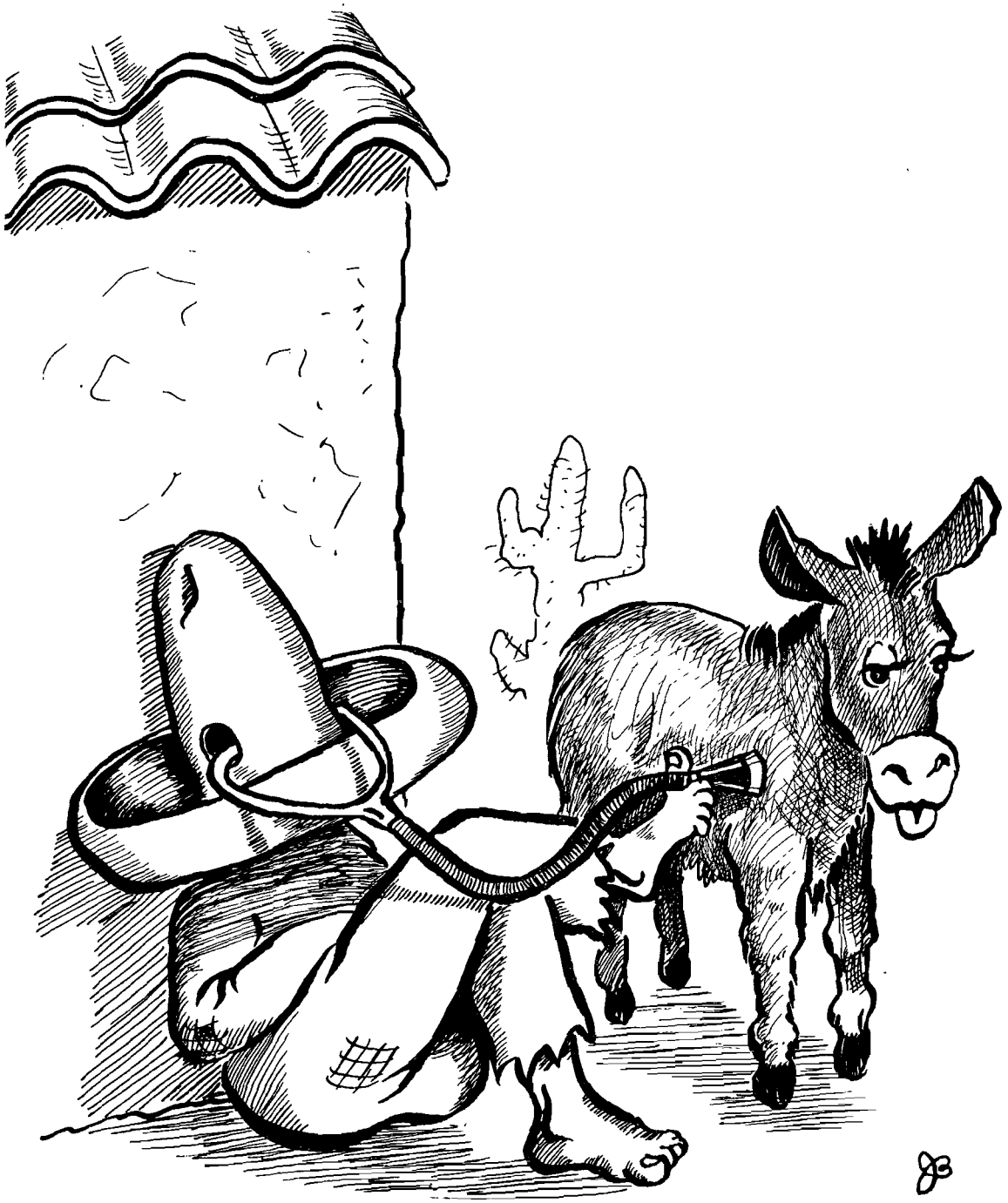

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OPENINGSREDE: WETENSKAPLIKE KONGRES EN DRIE-EN-SESTIGSTE ALGEMENE JAARVERGADERING VAN DIE SUID-AFRIKAANSE VETERINÊR-MEDIESE VERENIGING, PRETORIA, 10 SEPTEMBER 1968

SY EDELE D. C. H. UYS, MINISTER VAN LANDBOU

Dit is vir my 'n aangename taak om hierdie kongres — die 63e van die Suid-Afrikaanse Veterinêr-Mediese Vereniging — te open, en ek dank u vir u vriendelike uitnodiging. Ek waardeer dit veral daar dit my die voorreg bied om nader kontak te maak met die veeartsenykundige professie in Suid-Afrika met sy luisterryke verlede. Ons veeartse het so dikwels al in die brandpunt van 'n stryd gestaan en altyd met grootste lof en eer daarvan afgekom. As ons terugblik op die geskiedenis van veeartsenykundige dienste in Suid-Afrika sien ons 'n hele reeks van oorwinnings. Daarmee het hulle die grondslag gelê vir 'n welvarende veebedryf in Suid-Afrika. Trouens, vandag nog werk hierdie professie met ywer mee aan een van die grootste en belangrikste take wat die mensdom op die gebied van voeding het — naamlik die verskaffing van genoegsame proteïne om die snel toenemende bevolking van die wêreld te voed.

Mr. President, Ladies and Gentlemen, I am fully alive to the fact that the veterinary profession has arrived at a point where very important issues have to be decided. Some of the matters affecting these decisions are, for instance, the fact that epizootic diseases, responsible for dramatic outbreaks of mortality, have been brought under control to a large extent, and that erosive diseases have emerged as the main factor responsible for impaired production and reproduction in our livestock.

Changes have also taken place demanding increased veterinary supervision over public health aspects of milk and meat production and distribution.

Furthermore, the remedies applied in the treatment of domestic animals have become so specialised that the expertise of veterinarians is required in their production and distribution. Rapid air transport and an increased awareness of the economic significance of infectious diseases have also created an increased demand for intensified veterinary control measures over the importation and exportation of animals and their products.

The veterinarian is, moreover, assuming an increasingly important rôle in animal production especially as far as the application of preventive medicine on a herd-basis is concerned.

Due to their broad basic training in biology, veterinarians have more than proved their value in biomedical research, and many medical teams working on experimental animals incorporate veterinarians as an essential part of the team. In addition to all these spheres of activity, veterinary research cannot be neglected, but must, in fact, be expanded to provide solutions for the problems resulting from higher levels of animal production and the intensification of production systems.

All this serves to emphasise the urgent need for more veterinarians, and this applies particularly to the Republic of South Africa.

Mnr. die President, dames en here, u is almal nou al bewus van die feit dat ek onlangs 'n komitee aangestel het onder leiding van die Wetenskaplike Raadgewer van die Eerste Minister om in te gaan op alle aspekte van die opleiding van voldoende veeartse om te voorsien in al die behoeftes van ons land. Ek wil geensins in hierdie stadium die gevolgtrekkings en aanbevelings van die komitee vooruit loop nie. Ek wil volstaan met te sê dat ek die volste vertroue het dat ons tot 'n oplossing vir die nypende tekort aan veeartse in sowel blanke as nie-blanke gebiede sal geraak.

Dit staan verder soos 'n paal bo water dat die staatsdiens, vir sover dit die indiens-

neming van veeartse betref, nie sy regmatige deel kan trek nie, en nie die nodige kontinuïteit, wat absoluut essensieel is, kan handhaaf nie. Ons is almal bewus van die hoë verdien-vermoë van die veearts buite staatsverband, maar u is ook noual bewus van die feit dat 'n komitee deur Sy Edele die Minister van Beplanning aangestel is om die diensvoorwaardes en funksionering van die wetenskaplike binne die staatsdiens te ondersoek en aanbevelings te maak wat hopelik tot 'n oplossing vir die huidige onbevredigende toestand sal lei.

Dit is noodsaaklik, want die Departement kan alleen sy belangrike verpligtings op die gebied van dieregesondheid en -higiëne nakom as hy oor genoegsame veeartse beskik. Hierdie verpligtinge vereis onder meer die instandhouding van uitgebreide navorsingprogramme oor alle ekonomies belangrike fasette van veesiektes, die doeltreffende beheer van verklaarde siektes, en van in- en uitvoerbeheer oor diere en hul produkte. Ingevolge die nuwe Vleishigiënewet het vleisinspeksie ook nou die verpligting van die Departement geword.

Some members of the veterinary profession have advanced arguments in favour of divorcing veterinary training from the Department of Agricultural Technical Services. Since there exist equally forceful arguments in favour of close ties between the Faculty of Veterinary Science and the Veterinary Research Institute, I have appointed a committee to investigate this matter with due regard to the position of the Faculties of Agriculure in relation to the Department.

Vanweë die uiteenlopende aard van die toestande waaronder die beesstapel van die land versprei is en die groot getal eienaars wat almal verskillende belange en sienings het, was dit nie 'n maklike taak om oor te gaan tot die instelling van 'n amptelike skema vir die uitroei van tuberkulose en brucellose nie. Wat verder die saak bemoeilik het, was dat die voorkoms van dié siektes tot redelik onlangs toe, nie goed bekend was nie. Wat egter al vroeg bekend was, is die feit dat fenomenale somme geld hierby betrokke sou wees en dat voorsiening daarvoor gemaak sou moes word. Verder het die ernstige uitbreek van bek-en-klouseer ook 'n vertragende invloed gehad op die uitroeiing van hierdie siektes. Die Afdeling Veeartsenydiens het egter nou by die stadium gekom waar verpligte inenting teen brucellose met Stam 19-entstof in die kalfstadium toegepas word, en oorweging word ook geskenk aan stappe om tuberkulose doeltreffender te bekamp.

Intussen is die genesende werking van die nuwe middel isoniasied op tuberkulose ook op Onderstepoort vasgestel. Die gebruik daarvan behoort 'n aansienlike besparing op die uitroei van tuberkulose teweeg te bring. Dit word voorsien dat in die toepassing van hierdie uitroeiskemas die dienste van die privaat praktiserende veeartse gebruik sal word in 'n mate wat hulle vestiging op die platteland sal bevorder.

The Department of Agricultural Technical Services is making a concerted effort at providing its Veterinary Research Institute with adequate equipment and accommodation for the most sophisticated research. Within a month, a vast new building complex will become available for this purpose. This will provide room for the whole of the Section of Bacteriology and all activities associated with vaccine production and distribution. A rearrangement of the existing facilities will thus become possible, so that the remaining sections will have sufficient room for their present research activities. Plans have also been completed for the establishment of a high security laboratory complex for research on exotic viruses, including foot-and-mouth disease virus. This will enable the staff at Onderstepoort to handle virtually any conceivable problem in the virus field.

To sum up, it would be fair to state that a spirit of progress prevails in all spheres of veterinary activity in South Africa.

It is pleasing to see the comprehensive programme you have set yourselves both for the plenary sessions and sectional meetings. It is equally pleasing to see that your Congress has drawn such distinguished guests as Miss Uvarov from Britain, Dr. van den Born from the Netherlands and Dr. Gordon from Australia. I wish to extend a cordial welcome to them on behalf of South Africa.

Dit verskaf my nou besondere genoeë, mnr. die President, dames en here, om u alle sukses toe te wens op u verrigtinge hier. Daarmee het ek nou die eer om hierdie 63e kongres van die Suid-Afrikaanse Veterinêr-Mediese Vereniging ope te verklaar.

Jl S. Afr. vet. med. Ass. 39 (4): 7-8 1968

PRESIDENTIAL ADDRESS 1968

A. F. TARR

One of the difficulties facing a President on an occasion such as this, is the choice of a suitable subject. Vitally important matters concerning the profession are receiving the attention of three Commissions of Enquiry—the Marais Commission, the Mönnig Commission, and the Commission investigating the Faculties of Agriculture and Veterinary Science. These matters are thus *sub judice* and one must seek farther afield for a theme. I shall confine my remarks, therefore, to a few domestic matters concerning our association and the profession.

Few countries in the world have to contend with the variety and complexity of problems which beset this country. This is an accepted fact with which we are all familiar. These problems present a challenge and indeed an inspiration to our profession, which forms an integral part of the vast agricultural machinery entrusted with the prevention of disease, production of foodstuffs, the preservation of our soil and natural resources and the promotion and implementation of schemes to safeguard our heritage, entrench our position on the continent of Africa and to ensure that we assume our rightful place among the nations of the world.

As far as our profession is concerned, I am confident that we have the men with the ability and the necessary leadership and enthusiasm to ensure that we fulfil our allotted task in the overall scheme. One aspect, however, which does concern me, is keeping up to date with the vast outpouring of new scientific advances and development. This is not peculiar to our profession—it applies to all professions the world over. In every sphere there is a tremendous advance in new techniques, new discoveries, new drugs, etc. With the best will in the world it is impossible for most of us to cope with more than a small fraction of the available literature.

At this point one may ask: 'What is the attitude of our Association, with particular emphasis on the obligations of Council members?' Naturally, Council must fulfil to the best of its ability all those duties which are normally expected of a governing body. If, however, we are to contribute more effectively to our members, we must devote our minds and energies to matters which will result in increased efficiency: we must endeavour to promote schemes for the dissemination of information. This is a task far beyond the resources of this association at this stage, but it could initiate ideas or programmes which could enlist support and co-operation from other organisations, particularly as this is a problem which affects all scientific bodies.

Perhaps the time has arrived when serious consideration should be given to the creation or establishment of a panel of experts or consultants to investigate the implications of the constantly expanding field of veterinary activity. What is required is an adequate information service of an authoritative nature. Such a service would no doubt entail the provision of an up-to-date library, staffed with personnel experienced in the art of indexing, abstracting, etc. I accept that this is a formidable task, but I do reiterate that our profession must be a well-informed profession if it is to function efficiently.

This idea could be elaborated further, leading ultimately to the appointment of a full-time or part-time panel of specialists to give special or refresher courses in areas where facilities for such courses do not exist. Visits by leading world authorities could also be sponsored.

While on the subject of information, one is appalled at what one might term the woeful ignorance on the part of the public on matters agricultural and in particular veterinary. Agriculture needs to be presented more clearly to the public in order to dispel many of the misconceptions which exist. We need more publicity to present our image to the public.

The annual reports of most companies

consist of attractively prepared documents which present to their members information concerning their activities, progress, future developments, etc. I feel that the veterinary picture could be presented to the public along similar lines, embracing the various activities such as research, teaching, field activities, public health, commerce, private practice, vaccine production, game conservation, student affairs, personal glimpses, and other spheres of veterinary activity.

This is not a question of advertisement, nor is it necessary to do this annually. I do feel, however, that well-prepared brochures would create a favourable impression. As far as distribution is concerned, it may be possible to enlist the aid of the Department of Information, which distributes the South African Digest. These are but a few random thoughts on the subject of information. If the idea has any merit, it could be investigated and examined.

Jl S. Afr. vet. med. Ass. 39 (4): 9-15 1968

VETERINARY ACTIVITIES IN THE EUROPEAN ECONOMIC COMMUNITY

J. M. VAN DEN BORN*

Mr. President, Ladies and Glentemen,

Before starting my actual talk, I should like to say first of all that I, as a colleague from Holland, consider it a great honour and a privilege to be allowed to address you, my South African colleagues, on the occasion of the Annual Congress of your Veterinary Association. I was requested by your Executive Committee to speak in English.

In order to give you a good idea of the contribution we veterinary surgeons are making to the establishment of the EEC—or "Common Market" for short—I believe it would be a good thing if I gave you a brief sketch of the Department which I am pleased to direct.

My Department, the Veterinary Service and the Veterinary Chief Inspection of Public Health, advises the Government on all veterinary matters under its full responsibility. Advice is given after consultations with various interested groups in agriculture, trade and industry, but for the ultimate advice on policy I and my Department are fully responsible. It not only covers prevention of and combating animal diseases, but also veterinary activities for the benefit of public health, as well as veterinary research. To clarify this, I should like to mention a few specific aspects, such as the import and export of livestock and animal products, eradication programmes, vaccination programmes, meat inspection, supervision and control of the observance of veterinary legislation, preparation and elaboration of statutory measures and issue of directives.

The veterinary health care, from the public health point of view, comprises meat control and control of meat products, destruction, zoönoses, control of antibiotics, etc. and relates not only to 12,000,000 Dutch people living in a country as big as your Orange Free State, but also to people in the various countries to which we export with the veterinary guarantee that the products have been examined and found fit for human consumption and constitute no risk to the livestock population of the importing countries. Under cover of veterinary certificates, issued by my service, the annual export of these products represents a value of 400 million rand. These tasks and activities are carried out by the Central Service at The Hague, assisted by and in co-operation with 12 district field services, likewise under my direction, which have executive duties. We are strongly supported by four different national research institutes.

We have in each of the eleven provinces a health service for animals with a diagnostic laboratory and a registration of all the animals and herds in the district. The expenses of all these institutions are on the budget of the Director of Veterinary Services. These activities take place under the political responsibility of two Ministers, *viz.* the Minister of Agriculture and Fisheries as regards Veterinary Service matters and the Minister for Social Affairs and Public Health as regards the veterinary aspects of public health. It will be clear to you that there are many subjects that come under both Ministers, particularly in similar fields. The abovementioned Ministers are my two "bosses" and although differences of opinion are, of course, unavoidable because many problems are approached from different angles, I can say without hesitation that the co-operation with and between the two Ministers is excellent.

In Holland, we have a close and good co-operation between the field services of Public Health, such as medical field service, pharmaceutical field service, field service for environmental hygiene, veterinary service and so on—in total six services. We have our

* Chief Veterinary Officer of Public Health, Director of Veterinary Services, The Hague. Congress Lecture, 63rd Annual Congress, South African Veterinary Medical Association, 10th September, 1968.

central offices in the same building, have a conference once a week and form a team, of which I have the honour to be the president-elect. The salaries of the six Chief Officers of Public Health are on the same level.

At the Central Service at The Hague, I am assisted by twelve qualified veterinary surgeons, each of whom is responsible for part of the total duties of the Service.

For guidance. I will give a brief summary of these duties:

—Import and export of live animals and animal products, except meat.
—Import of meat and meat products. Domestic meat inspection. Destruction or rendering of dead animals and offal.
—Export of meat and meat products.
—Epidemiology of animal diseases.
—Epidemiology of zoönoses, such as rabies, salmonelloses and psittacosis.
—Organized control of animal diseases.
—Radioactivity and radiation protection.
—Veterinary research and international technical aid.
—Poultry diseases, poultry inspection.
—Public relations and guidance.
—Control of veterinary medicines, sera and vaccines, control of antibiotics. Residues.
—Control of the Act on the veterinary profession.

As the EEC in the past years began to develop, the resulting duties of my Department became ever more extensive and numerous. The result is that half the number of my close assistants are nowadays in Brussels attending discussions there. In addition, the Brussels discussions frequently demand the assistance of the technical specialists of the scientific institutes.

I can imagine that you, who are not directly involved in the EEC, may wonder why the Common Market, which is essentially an entirely economic institution, is making such heavy demands on the veterinary world. The answer is that the veterinary activities must cover the numbers of animals and their products within the Common Market region as shown in the subjoined table.

By instituting a common market and by gradually bringing the economic policies of the Member States closer together, the ECC's objectives in general are the promotion of:

—"a harmonious development of economic activities throughout the community"
—"a continuous and balanced expansion"
—"an increased stability"
—"an accelerated raising of the standard of living"
—"closer relations between its Member States."

The EEC tries to achieve these aims, for instance, by the elimination between Member States of customs duties and of quantitative restrictions in regard to the importation and exportation of goods, the inauguration of common agricultural and transport policies, the establishment of a common customs tariff and a common commercial policy towards third countries, and the abolition between Member States of the obstacles to the free movement of persons, services and capital. The result of this abolition of all obstacles to undisturbed economic growth will be that supply and demand of all six countries will be combined and every product will have a market of 180 million customers at this moment.

One important aspect should always be remembered. It distinguishes the EEC from all other international alliances and groups, *viz.* the willingness in principle of all the Member States to *relinquish* part of their national sovereignty and to accept instead supranational rules which are subservient to the national statutory regulations.

To clarify this, I should like to say something about the constitutional organization of the EEC, which has been laid down in what is in fact the Constitution of the EEC, *viz.* the Rome Treaty. The achievement of the tasks entrusted to the Community is ensured by:

—an Assembly,
—a Council,
—a Commission,
—a Court of Justice.

	Cattle	Pigs	Sheep	Poultry
Netherlands	+4 million	3 million	500,000	45 million
Belgium	2.7 million	2.3 million	164,000	32 million
Luxemburg	183,000	116,000	2,000	500,000
France	20 million	9.3 million	9 million	75 million
Germany	14 million	18 million	811,000	92 million
Italy	10 million	5 million	8 million	110 million
Total:	50,883,000	37,716,000	18,477,000	404,500,000

Each of these institutions acts within the limits of the powers conferred upon it by the Treaty of Rome.

The Commission is the promoting power with the EEC. The Commission recommends, proposes, advises, supervises the observance of the Rome Treaty, uses the authority conferred upon it by the Council for the implementation of the rules that have been laid down and also has power to make decisions. The Commission is composed of nine members chosen in common agreement by the Governments of the Member States for their general competence. The quality of their person guarantees their independence. In the performance of their duties they neither seek nor accept instructions from any Government or other body. Each Member State has undertaken to respect this independence and not to seek to influence the members of the Commission in any way. The members of the Commission are in the full-time service of the Community. They each have their own special field of activities which they promote, with the proviso, however, that all decisions are taken in common consultation. They hold the rank of Minister and are addressed as "Excellency." For the performance of its duties the Commission has at its disposal an official instrument divided into nine Directorates-General. The Commission may consult national experts from outside its official instrument for the benefit of its work and I assure you, they *do* consult the national expert in every instance. The office is at Brussels in Belgium.

The Council is the body of six national Ministers of the Member States. It depends on the subject on the agenda which Minister attends the Council meeting. The Council lays down the regulations prepared and elaborated by the Commission, but not until the Commission's proposals have been thoroughly studied by the various national experts and these experts have reached full agreement.

I will pass by the composition and tasks of the Assembly and the Court of Justice. This would lead me too far from my subject and be of no immediate importance regarding the veterinary aspects of the EEC. I may mention briefly that the Assembly, the European Parliament, embodies the democratic control, whilst the Court of Justice administers European jurisdiction within the Community in disputes between the Member States.

Reverting to our starting point, I shall now answer the question: 'Why are such heavy demands made on the veterinarians?'

The abolition of the customs frontiers would be a complete failure if the national veterinary measures remained unchanged. This would simply mean that instead of a customs official a veterinarian would operate the barrier. On the other hand, the animal health situation still being dissimilar in the six EEC countries, a total abolition of veterinary measures would result in spreading animal diseases and in lowering the level of animal health in the country where the combating of animal diseases is of high standard to that of the country where disease control has remained behind.

A single example will clarify this. Eleven years ago, when the EEC began its work, the Dutch cattle population was virtually free from tuberculosis and the fight against brucellosis had made good progress. In Italy, combating tuberculosis in cattle had barely started and the fight against brucellosis still had to be taken up. If the veterinary restrictions then in force had been upheld, it would have meant that, despite the abolition of the customs barrier, Italian cattle could not have passed the Dutch frontier and the free movement of goods, in fact, would have been an illusion.

Total abolition of the veterinary provisions upon the cancellation of the customs barriers would have resulted in the nullification of a large proportion of the costly eradication campaigns in the Netherlands. To achieve the objective of free movement of goods it was necessary gradually to abolish the customs barriers and to harmonise the veterinary import and export regulations.

As regards the cattle trade it meant that, for instance, the methods of combating tuberculosis and brucellosis had to be the same. And if I then tell you that when the EEC started no fewer than 12 different tuberculins were used for testing cattle within the Community and that a negative tuberculin reaction was interpreted differently in each of the countries, you can imagine what a gigantic task it was for us veterinarians to bring all those differences under a common denominator to ensure that we knew exactly what we were talking about. We have now detailed regulations concerning tuberculin and brucellosis, including how many tests and what kind of tests must be done to declare an animal and a herd free from the

diseases mentioned.

The veterinary co-ordinating provisions are laid down in directives. A directive governing the cattle and pig trade within the Community has been completed and that governing the fresh meat trade is functioning. It may be a simple matter to you to hear that the directive for the meat trade is functioning, but in actual fact it means that not only the provisions relating to imports and exports, but also the control measures had to be harmonised. The regulations governing the equipment of the slaughter-houses had to be adapted and at a later stage, when the directive came into force, the national governments had to see that the slaughter-houses duly met all requirements. Now there are a large number of recognized EEC slaughter-houses within the EEC, all meeting the same standards of hygiene, slaughtering and inspection. This inspection must be done by qualified veterinarians assisted by non-veterinarians for the work not directly connected with the control. You can imagine that both governments and municipalities had to make enormous investments before all this was realised.

A directive governing the slaughtered poultry trade and poultry inspections is ready but not yet ratified by the Council of Ministers. There are still differences of opinion of the acceptability of the so-called 'spin chiller.' Other directives in course of preparation are one governing the trade in meat products, one dealing with the use of additives to foods and one regulating the use of hormones, antibiotics, thyreostatics and similar substances. So far, the regulation of these matters had been left to the Member States themselves, but in the recent past this gave rise to so many difficulties in the trade in live cattle and meat that in fact all the Member States have pressed for regulations applicable to the entire Community. A directive to that effect is now being prepared.

Needless to say that in this co-ordination process in so many different fields of animal medicine, the veterinary policy experts urgently needed the help of veterinary specialists from the national laboratories and institutes. Therefore I proposed the setting up of the Veterinary Scientific Commission. This Commission is an advisory body on a purely scientific basis. Without taking policy aspects into account, it examines test-methods, screening programmes, etc., for serviceableness and reliability, adapts them and finally submits its advice to the working groups of the veterinary policy makers. Under the excellent chairmanship of the late Prof. Willems from Belgium, who is well-known to many of you, much good work has been done.

In the beginning of my talk I have already said that the objectives of the EEC also include the free movement of persons of all professions, veterinarians included. An important aspect for the veterinarians is the unimpeded right to practise within the EEC.

Regulations considering a number of aspects, such as co-ordination of training, specification of the terms of free practice, determining the length of preceding terms of probation before one is allowed to set up in practice, etc., have already been drafted. The results of the consultations involving almost the entire veterinary world, such as the universities and the veterinary associations, are the following:

As regards training, at least a five-year university course both theoretical and practical, must have been successfully completed and at least 4,500 hours devoted to the various subjects.

1. The theoretical and practical basic training of at least 560 hours encompasses the following subjects: physics, chemistry, zoology, botany and veterinarian mathematics applied to biological sciences.
2. The theoretical and practical veterinary training of at least 3,690 hours has been split up into twenty groups of subjects each with a fixed minimum number of hours.
3. The Member States are at liberty to determine for themselves on what subjects the remaining hours are to be spent to arrive at the stipulated minimum of 4,500 hours.

After this study has been successfully completed, the student will in principle be able to set up in practice as a veterinary surgeon anywhere within the EEC. The country of his choice, which may be a country other than that where he was trained, may impose certain conditions. The veterinarian will, for instance, have to make himself familiar with the language, way of life, sanitary and social legislation of his new country of residence, during a six months probation period. During this period

he will only be allowed to practise under the responsibility of a practising colleague, or in clinics or other veterinary services and institutions. In addition, he may be required to attend supplementary courses. After completion of the probationary period, he is handed a certificate, allowing him to practise.

A difficult point is still that free practice does not include work done in the employment of the authorities. Consequently, government posts for the time being will not be open to foreign veterinarians.

I purposedly discussed this point in somewhat greater detail, because in the near future the ever growing volume of veterinary duties, also in public health, will greatly increase the need for many more veterinarians.

As the last aspect of the duties within the framework of the EEC, I want to mention the preparation of veterinary regulations governing imports from non-EEC countries, *i.e.* from what are termed 'third countries' (inclusive of South Africa). The principle of this directive is the same as that of the directive governing the fresh meat and the cattle and pig trade within the Community. This principle is that the EEC countries shall not allow imports from third countries on conditions that are easier than those applicable among the EEC countries themselves. Since this principle leaves a very wide margin for different interpretations, the third countries directive lays down in detail the conditions under which such imports can take place

In order to prevent disputes in spite of all this, the EEC Council of Ministers of Agriculture recently sanctioned the setting up of the Permanent Veterinary Commission. This will lead to all EEC partners pursuing the same import policy with respect to third countries, and discrimination will virtually be impossible. Another advantage of this third countries directive is that, through all import regulations being the same, the trade will not be able to put the veterinary services of the various EEC countries under pressure and play them off against each other. As also the import control measures will be co-ordinated, this harmonization will foster the establishment of the common frontier of the EEC, with all the advantages attached thereto.

If I tell you now that all this work is done in separate working groups composed of experts, specialised in their particular subjects, you will realize what a heavy burden the EEC imposes upon the national veterinary services and why so many of my assistants so freqently have to be in Brussels.

Much work has already been done in Brussels but, owing to the snowball effect of the progressing developments, even much more work lies ahead in the near future. In the mean time, however, the EEC work has already produced an important positive result: it has accelerated combating of animal diseases in the Member States so that all sorts of control programmes can now be drawn up or taken in hand at a faster rate. Even so, work done in Brussels has considerable shortcomings, or perhaps I had better call them hiatuses in the organisation under which veterinary legislation in Brussels falls. Let me explain.

If statutory provisions are to have the desired effect, care must be taken that they are observed. In the case of national statutory provisions, the national authorities will exercise this control. But in the case of international statutory provisions—which is what in fact all the measures drawn up in Brussels are—it is up to the national governments to carry them into effect, but it should be the task of Brussels to see that they are carried into effect in an identical manner in all the Member States and—what is more important—that they are observed.

Unfortunately, there is no such control. Dutch quarters repeatedly press for it, but so far without success. Another hiatus, not to call it a shortcoming, of the Brussels organization, is that the Commission has so far not appointed any adequately qualified veterinary experts in executive positions. Here, too, Dutch quarters have repeatedly brought pressure to bear that this should be remedied, but time and again there are political objections. I would, however, wrong the EEC if I confined myself to the foregoing and ended up by listing these shortcomings.

I have already pointed out to you the favourable effect of the EEC measures on the combating of animal diseases and on veterinary public health, but the EEC has given full scope to other excellent veterinary activities as well.

1. In the first place, I should like to mention the combating of foot-and-mouth disease in Greece and Turkey. The objec-

tive of these campaigns was to keep out the foot-and-mouth disease types SAT and "A Near East," which are not indigenous to Europe. The EEC, together with other European countries, has placed large amounts, both in cash and material, at the disposal of the FAO for these campaigns. The EEC did not confine itself to making a single lump sum contribution, but considered every year whether such aid was still necessary and it has so far continued this aid every year.

2. The EEC has also made large sums of money and expert help available for combating African swine fever in Europe and for preventing the disease from entering this part of the world. The Office International des Epizooties in close co-operation with the national veterinary services of Spain, Portugal and Italy is responsible for the effective administration of this aid.
3. On the initiative of the EEC, extensive research is now being conducted into the entry into a country of viruses carried *in meat*. The first objective of this research was to study the possibility of encouraging the importation of meat from African countries, despite the occurrence there of rinderpest and other diseases not existing in Europe.
4. In response to my proposal, the EEC is now studying the possibility of the joint purchase of a stock of A 22 vaccine to use as a first barrier in the event of an unhoped for outbreak of this type of foot-and-mouth disease, against which the EEC cattle population is not protected by vaccination.
5. It has also been decided in principle to make funds available to fight any outbreak of epizootics within the EEC. An outbreak of exotic disease, in particular in the territory of a Member State, is no longer the object of only national care, but would affect the entire Community.
6. Already now, the national veterinary institutes are working on joint EEC projects. As examples I would mention rereach projects on African swine fever and classical swine fever. It is the intention to widen the scope of such joint research on disease problems in the EEC still further.

With the principal objective of the EEC in mind, *viz.* the completely free movement of goods, I believe I can state that all future *veterinary work will lead to the complete* co-ordination of the national veterinary legislations and veterinary policies and the joining of forces in the common fight against cattle diseases.

There is already a first beginning with a few important cattle diseases such as foot-and-mouth disease and swine fever. Attempts have been made to draw up rules allowing normal trade to continue without the risk of virus spread in order to prevent the rigorous closure of *common frontiers in* the event of an outbreak of, for instance, foot-and-mouth disease.

Unfortunately, the many subjects that still require to be co-ordinated make it impossible rapidly to launch all projects. This is a matter of even greater urgency, since the veterinary measures within the EEC are in danger of falling behind the other economic co-ordination programmes and so becoming a serious impediment to the free movement of goods. I am convinced, however, that as time goes on the veterinary harmonization will proceed at an ever increasing rate. Stimulated by the Common Market, the animal health situation within the EEC will continue to improve to the benefit of both man and animal.

After this very short summary of the EEC and the associated veterinary activities, the question remains whether there is any relation between all this and South Africa? My personal answer is, without any doubt, yes! I would like to point out why. Among several others, two aspects only need be mentioned.

1. The enormous evolution in agriculture, including animal production, in South Africa in general that I noticed and the consequences of your irrigation projects such as the Orange River scheme, will increase your production considerably. A large part of your production must be exported to foreign markets, in order to keep prices on a reasonable level so that your producers will have a living. The Common Market is such a market and a big one. It will be even bigger when other European countries join. We expect Great Britain will soon become a member. This means that you have to meet the veterinary import requirements, when your animal products and animal feedstuffs are sold in Western Europe. One of these requirements is that *quali-*

fied veterinarians have *full control* of animal production, meat production, poultry production and so on, as a basic guarantee for the certificate delivered by your official veterinary service.

No doubt that this will have an immediate influence on the veterinary profession in South Africa; only a well-organised and well-equipped veterinary service can do this job.

2. A second aspect is the internationalisation of veterinary activities. The time has gone that animal disease control is based on national efforts only. Diseases and their causes don't respect national boundaries. You know this too well!

After an experience of fifteen years in my position, I strongly believe that, especially in the veterinary activities, international co-operation is not only necessary but also that in these technical fields it is easier than in other branches of international work, because of the mutual understanding among veterinarians, without political interference.

As in Europe, also in Africa, a lot has to be done in this field to the benefit of people living on both continents. May it be so that you veterinarians of South Africa with your strong veterinary services, with your world-famous research institute in Onderstepoort, may play a leading rôle in Africa.

BOOK REVIEW

GENETICS AND ANIMAL BREEDING

I. JOHANSSON & J. RENDEL

Oliver & Boyd, 1968. Edinburgh and London. pp.489, 180 figs. Price £5.5s.

A general, but comprehensive survey of present-day knowledge of the genetics of farm animals and their improvement by breeding is given by the two authors, both being eminent in this field.

The following aspects are dealt with in 18 different chapters: The reproduction and physical basis of inheritance; Mendelian inheritance, the principles of population genetics; the inheritance of external traits and blood characteristics; the hereditary defects and disease resistance; the hereditary disposition for reduced fertility; the effects of genetics and environment on production characters in dairy and beef cattle, pigs, sheep and poultry; the estimation of breeding values, and the specific problems in breeding and selection.

The Swedish edition of the book was published in 1963, and, before being translated, was thoroughly revised and brought up to date by replacing local Swedish considerations with points of more interest to Englishspeaking readers. For the South African reader the chapter on wool production and fur quality is rather sketchy because not even the term "spinning counts" is explained properly or different types of Karakul pelts are mentioned. Angora goats or any goats for that matter are left out entirely, apparently because they are of no importance to the European reader.

These critical remarks should not obscure the fact that this book gives an excellent survey of the field which actually includes the comprehensive research work performed by both authors themselves. The senior author, Ivar Johansson, until recently Professor of Animal Breeding at the Agricultural College of Sweden and the junior author, Jan Rendel, Associate Professor at the same College, have clearly shown the significance and limitations of selective breeding and indicated the lines of future advance in this most interesting field of animal science.

Except for the chapter on "the principles of population genetics" which has to be studied thoroughly, the book is written in an easy style. The figures help to explain the different concepts, and the quality of paper and printing is excellent.

As the most complete and recent survey of the subject of animal genetics, this book will be welcomed by students of animal and veterinary science and by all concerned with livestock. In fact, this book will be prescribed as standard textbook for the teaching of Zootechnics at the Faculty of Veterinary Science at the University of Pretoria.

Dr. O.

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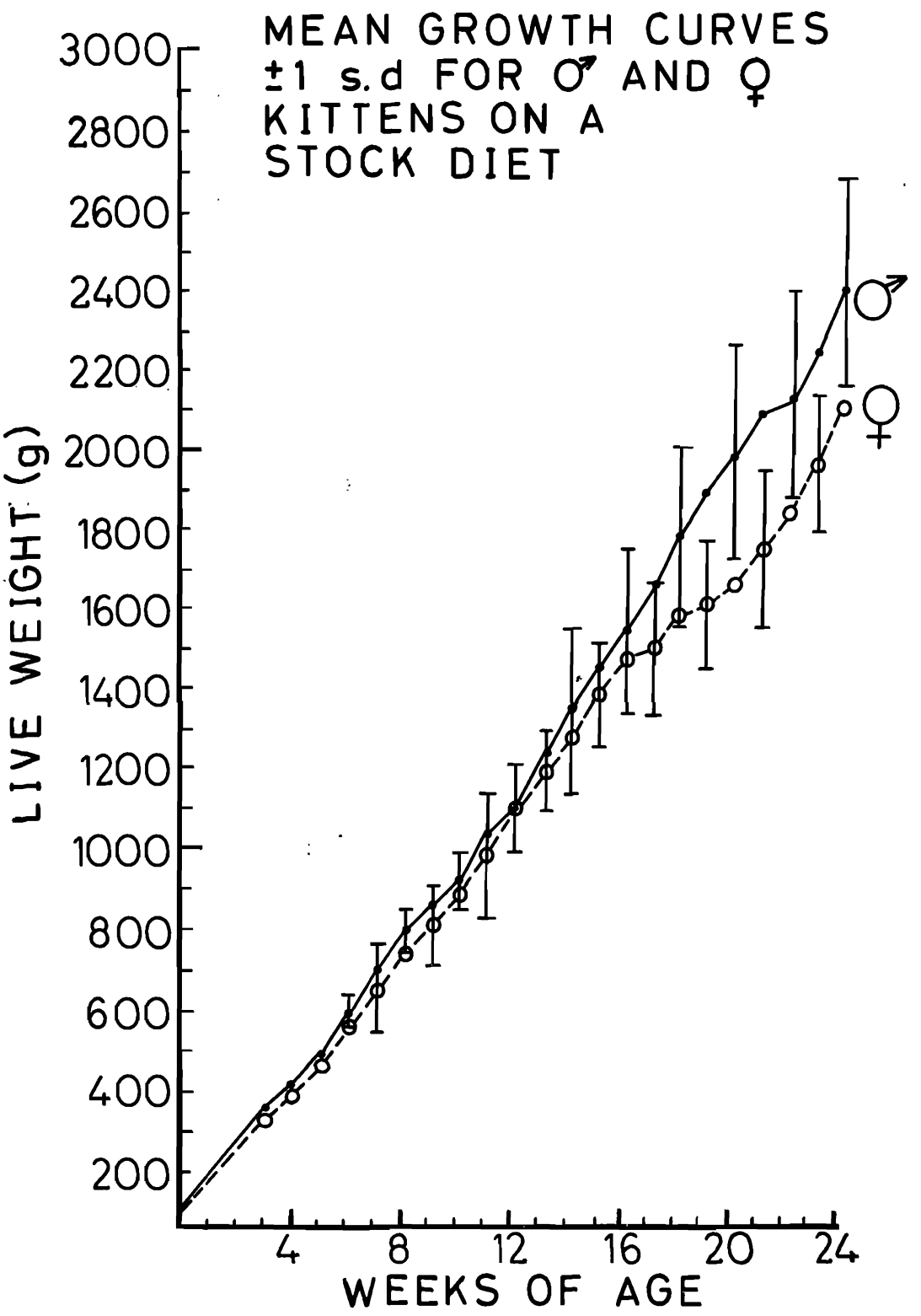

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NUTRITIONAL REQUIREMENTS OF CATS WITH SPECIAL REFERENCE TO THE SKELETON

OLIPHANT F. JACKSON*

SUMMARY

The special nutritional requirements of cats are outlined briefly with particular reference to calcium, phosphorus and iodine. Practical diets for cats are listed.

INTRODUCTION

As the result of careful embryonic, histological, physiological and nutritional studies, the peculiarities of the metabolic processes of the carnivorous cat have been shown to differ in many ways from those of the carnivorous dog and other omnivorous and herbivorous species. These specialized nutritional requirements may perhaps be related to the limited diet normally consumed as a result of its predatory habit.

These requirements are discussed briefly under the headings of protein, fat, carbohydrate, minerals for bone formation, minerals for tissue fluids, trace element and vitamin requirements. A short list of practical diets is appended.

PROTEIN

From birth to weaning, when kittens are only taking milk from their dam, they are on a higher protein intake than is provided by cow's milk.

Table 1. AVERAGE PERCENTAGE COMPOSITION BY WEIGHT OF CAT'S MILK COMPARED WITH WHOLE, PASTEURISED, COW'S MILK.

	Cat	Cow
Water	82.4	87.2
Total protein	7.0	3.2
Fat	4.8	4.0
Lactose	4.8	4.9
Ash	1.0	0.7

The protein content of cat's milk is about 50% of the dry weight [1-3]. Hand reared kittens do not thrive on cow's milk [4] but can be reared successfully on evaporated (concentrated) milk, or proprietary brands of dried milk for babies reconstituted at about double the strength recommended for human consumption [5] (and Farrow, personal communication).

Kittens weigh between 90 and 140 g at birth depending on the breed and number of kittens per litter, and they should take 5 g milk at a feed. There should be a steady body weight gain of 10 g per day or 85-95 g per week [6, 7] (see graph). At weaning the total food intake should provide about 250 kcal/kg body weight per day[8]; a considerable proportion of this must be provided as animal protein. For kittens 30-40% of the dry weight of the diet should be in the form of animal protein [9] which is equivalent to 12-18% protein in a diet containing 70% water, as in tinned food.

FAT

The cat has a remarkable capacity for digesting and utilizing triglyceride fats. Kittens grow better on a diet containing 26% fat than on one containing 5%, expressed on a dry weight basis [10]. The appetite of kittens is improved and the high calorie requirement is satisfied with a smaller volume of food on a 22% fat diet [11]. Experiments have shown that the fat content of the diet can be raised to 64% of the diet without any increase in the proportion of fat in the faeces, showing the remarkable capacity of the cat for digesting fat. Nevertheless, an excess of unsaturated fatty acids, particularly polyunsaturated fats in marine fish oils, unless 'protected' by addition of antioxidants such as vitamin E, can produce steatitis or yellow fat disease [10, 12].

CARBOHYDRATES

There is no evidence that cats require carbohydrates, but carbohydrate can be utilized quite efficiently providing it does not exceed 33% of the dry weight of food eaten. Peeled cooked potatoes, biscuit meal made from wheat, and boiled cereals are accept-

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able, especially when mixed with meat or gravy. Polysaccharides are more satisfactory than mono- or disaccharides; dextrin, for example, has been shown to be better than sucrose for promoting growth and storage of vitamin A in the liver [13, 14].

Feeding lactose to both kittens and adult cats can produce intractable diarrhoea due to the fact that, after weaning, some cats have a lactase deficiency. It is always worth while eliminating all sources of milk, even whey, when treating chronic diarrhoea in cats. Whey and by-products of milk are often added to tinned cat foods as they contain riboflavin (Vit B_2).

MINERALS

It is convenient to divide the inorganic elements into those concerned with the formation of bone, those concerned mainly with fluid balance and those trace elements concerned with metabolic conversions within the cell.

Minerals concerned with bone formation

Calcium, phosphorus and, to a much smaller extent, magnesium are the most important minerals involved in bone formation. Calcium phosphate, in the form of hydroxyapatite crystals $3Ca_3(PO_4)_2Ca(OH)_2$ is laid down extra-cellularly, in association with protein fibres to give bone its structural rigidity [15].

Much has been written about the dynamics of bone mineralization in recent years; Best & Taylor [16] give a good general discussion.

Calcium is the only mineral stored in the body in large amounts. Two percent of the body weight of a cat occurs in the skeleton [17]. Calcium is also present in small but essential quantities in plasma and extra-cellular fluids where the level is precisely adjusted by the movement of Ca^+ ions in and out of the skeletal store by the regulating actions of parathormone from the parathyroid gland [18], calcitonin from the 'C' cells of the thyroid [19] and vitamin D. This critical adjustment in the plasma is concerned with the transmission of nerve impulses at the neuromuscular junction [20] and in the blood clotting mechanism.

The plasma calcium in the animal body must be kept constant, as this is essential for life and occurs at the expense of the skeleton. Where a kitten is fed on a diet poor in calcium, there will be insufficient to fill up the mineral store; this position is aggravated by the concurrent rapid skeletal expansion. Short term deficits are made up remarkably quickly as is seen in the rapid healing of a simple greenstick fracture in an osteodystrophic kitten treated with calcium. But, in adult life, cats have sufficient calcium stored in their bones to last virtually a lifetime and, except in the lactating queen, it is almost impossible to deplete it significantly.

At birth, the calcium store of kittens amounts to about 0.75 g [21]. The amount of calcium required for good bone formation in kittens varies from 200-400 mg/day. During the lactation period the queen supplies most of this from her skeletal reserves. If her calcium intake is inadequate (as on an unsupplemented meat diet), the mineralization of the kitten's bones is much poorer at weaning than when the queen is fully supplied with dietary calcium [22]. During the latter part of pregnancy and throughout lactation a queen requires 600 mg calcium per day.

The expected values of plasma Ca for a kitten of 3-6 months, fed an adequate amount of calcium, are within the range 9.5-10.5 mg/100ml. Kittens maintained on an inadequate calcium intake, keep their plasma calcium at the lower end of this range by drawing on their bone reserves. Not until these bone reserves are greatly depleted will the plasma calcium fall to 8 mg/100 ml. Clinically it has been observed that osteodystrophic kittens have an extended blood clotting time: the change from prothrombin to thrombin is slowed down due to lack of calcium ions.

In severely affected animals, after all the reserves are exhausted, the plasma Ca will be in the order of 6 mg/100ml by which time the cat will have multiple fractures and suffer from signs of nervous disorder and muscular weakness. In collaboration with Scott (unpublished results), I have observed that experimentally induced osteodystrophic kittens show far more marked muscle fibrilation during recovery from light thiopentone sodium anaesthesia than do control animals.

Phosphorus, as phosphate, is present in all meat, liver and other animal offals, but these same foods are very low in calcium, with a Ca : P ratio of 1 : 20 or worse. There is general agreement that under certain conditions an elevated serum phosphate can result in parathyroid hyperactivity but there is no unanimity of opinion as to the

mechanism involved [16]. The best utilization of phosphorus occurs when the Ca : P ratio is 1 : 1. By supplementing a meat diet with 0.5 g calcium carbonate to every 100 g wet weight of meat, such a ratio is achieved. Dried bone meal has a Ca : P ratio of 2 : 1. Much larger amounts of bone meal must be added to achieve the optimum ratio as additional phosphorus is being added. Care must be taken not to add excessive calcium, which could result in a relative phosphorus deficiency; this may lead to the production of true rickets with osteoid seams if the vitamin D intake is low [24].

Magnesium is often involved in bone metabolism. It cannot totally displace calcium; it can only occasionally enhance the crystalline structure of hydroxy-apatite. The proportion in bone ash is $Mg_3(PO_4)_2$, 2%; $CaCO_3$, 13% and $Ca_3(PO_4)_2$, 80%.

Minerals concerned with fluid balance

Iron, copper, zinc, cobalt and manganese are all involved as trace minerals in the animal body, often combined with the organic constituents of the body to form complex enzymes and hormones. These minerals are present in very small amounts and may be toxic if present in excessive quantities in the diet.

Iron (5 mg per day) and copper (0.2 mg per day) are required by the cat for the production and maintenance of haemoglobin. Copper deficiency has been known to result in osteoporosis in dogs [25]. On the other hand there is sufficient iron and copper available to the cat on a high protein meat diet, and there is no evidence whatever that copper deficiency is responsible for feline osteodystrophy.

Minerals concerned with metabolic conversions within the cell

Iodine is incorporated into the hormones thyroxine and tri-iodothyronine by the thyroid gland. These hormones control the rate of cellular metabolism of all cells in the body, possibly by their action on the mitochondria. High protein diets in rats increase the iodine requirements of the body [26], and this may also be so in felines [23].

The daily addition of 100μg potassium iodide to the diet of an experimentally produced osteodystrophic kitten that was in negative calcium balance and was excreting calcium in its urine, restored this kitten into positive calcium balance [27]. It would therefore appear that iodine is an essential ingredient in the growing kitten's diet.

FAT SOLUBLE VITAMINS

Cats cannot synthesize vitamin A from β-carotene, the pro-vitamin present in green plants [28]. Deficiency of vitamin A in cats is probably more common than is generally realised (communicated personally by P. P. Scott and S. Y. Thompson, 1967). From experimental work in progress in this laboratory vitamin A deficiency may be of significance in dystrophies of growing bone.

Very small quantities of vitamin D are required by the cat and it is most important to see that overdosing does not occur, as this could lead to calcium reabsorption from the skeleton. Overdosing may occur when giving combined vitamin A and D supplements and by using some proprietary forms of calcium fortified with vitamin D, compounded for the treatment of rickets in other species. Since only kittens maintained in the dark develop rickets, it is probable that the cat can synthesize this vitamin and lick it from its coat.

Vitamin C must be synthesized adequately by the cat, since the scorbutic condition cannot be induced experimentally.

Vitamin K deficiency is also unknown in cats, which appear capable of obtaining their requirements from the synthesizing activity of the bacterial flora in their small intestine. The longer bleeding time that occurs after venipuncture in cats affected with osteodystrophy, is not due to lack of vitamin K.

WATER SOLUBLE VITAMINS

The vitamins of the B complex are essential for life. The deficiency signs caused by avitaminosis of the B complex will not be discussed in this paper, but it must be mentioned that the injection of multiple B complex vitamins failed to produce any response in the treatment of osteodystrophy [29, 33].

PRACTICAL DIETS FOR CATS

To assist cat owners to broaden their approach to cat feeding, foodstuffs that are acceptable to cats are listed and, where necessary, comments are made on the nutritional value or deficiency in that food.

Fresh meat, minced beef or oxheart

Many nutritionists consider that the cat must have a proportion of its diet in this form and they believe that an 'appetite factor' is involved rather than an essential nutritional requirement [30]. This diet by itself is very low in calcium and is the diet used to

produce osteodystrophy in experimental work. Kittens on this diet eat well and put on weight: the more rapidly they grow the earlier they go down with osteodystrophy. The composition of oxheart is given by Scott *et al*[29] when discussing calcium and iodine deficiency in cats.

Liver

This is often fed in sheep country and cats can become totally habituated to this one foodstuff. Sheep liver is very rich in vitamin A and an excess produces a deforming cervical spondylitis which manifests itself as varying degrees of neck stiffness, until in severe cases it is impossible to rotate the head at the atlantoaxial joint[31].

Exostoses and osteophyte formation involving other joints such as the elbow, hip and stifle are also found due to this vitamin A 'intoxication' in cats fed liver daily. Until more detailed work has been carried out it is recommended that liver is not fed to cats more than once or, at the most, twice each week.

Whole chicken including the bones

This is a diet that the veterinary profession has been taught to avoid in animal nutrition because the cat and dog are thought of as being related anatomically, economically and therefore nutritionally. This is not true, for cats are very slow fastidious eaters, often leaving the bones, licked clean, in the food dish. It is rare for a cat to swallow a bone large enough to cause an intestinal upset and bones lodged in the dental arch are not as common in the cat as in the dog.

Fish (sea or fresh water) with bones

Fish is not a cat's natural food but is accepted by most. The bones, whether large or small, are a most useful source of calcium, and, especially when cooked, are most carefully chewed up by the cat into sufficiently small lengths. Marine fish provide iodine[32]. The remnants of shell fish are also very rich in calcium and iodine and are often appreciated as a delicacy. Uncooked fish diets may result in poor uptake of thiamine due to the action of thiaminase in the fish.

Bone meal

Ground, dried bone meal, of good quality, without splinters, is acceptable when mixed with food, but green bone meal, obtained wet from the butcher, is likely to become infected very rapidly and may then cause food poisoning.

Dry processed foods

These usually contain less than 10% water and are not readily accepted by cats unless mixed with gravy or milk.

Semi-moist packs of processed foods

These, offered for sale as a frozen product, contain 30-40% water and are reasonably acceptable but require storage in a deep freeze; they must not be refrozen after thawing. They usually consist of one kind of protein, such as meat or fish, and are often poorly balanced in respect of minerals.

Tinned foods

These products, when prepared by reputable manufacturers, although they may appear to be relatively expensive, do have the advantage over meat and fish that the various deficiencies have been corrected, *i.e.* meat is deficient in vitamin A and calcium, while any naturally occurring vitamin B_1 in fish may be destroyed by thiaminase if the fish is not properly cooked. In general too, the products are balanced to ensure that the nutritional requirements of the adult animal are met, and are tested for quality, feeding value and acceptability. Heat sterilization in canning may damage the protein slightly, but this is by no means conclusively proved. The presence of mllk by-products may cause diarrhoea in those few cats with lactase deficiency in the cells of their intestinal mucosa.

The keeping qualities of tinned foods has been tested over various lengths of time. For periods up to one year, under normal storage conditions, vitamin levels are well maintained. After three years there may be loss of up to 50% of some B vitamins but vitamin A is quite stable (personal communication from A. J. Harms).

Cheese

Cheese is not a normal food component but is often well liked by cats and is very rich in calcium. Because of the strong odour it is also a useful additive—as are sardines, herrings or pilchards—when feeding to cats with catarrh of the upper respiratory tract.

Bones

When feeding wild Felidae it is well to remember that in the wild state it is frequently the young calves or yearlings that are captured, *i.e.* immature animals with softer bones. The feline dental arch has

many more cutting teeth and fewer grinding ones than that of the canine and is therefore less well equipped to eat large bones. When feeding captive Felidae, whole chicken or rabbit carcasses are readily accepted and eaten.

Seaweed

One useful additive in the treatment of osteodystrophy [33] is blended seaweed powder. An analysis is given in Table 2 showing the composition of one of the brands available. This has the advantage of supplying iodine as well as calcium.

Table 2. AN ANALYSIS OF A BLENDED SEAWEED MEAL*

Dry matter 84%		Moisture 16%	
Crude protein	6.4%	Calcium	9.5%
Oil	1.6%	Iodine	0.2%
Crude fibre	3.7%	Sodium chloride	1.4%
Carbohydrate	44.3%	Magnesium	0.9%
Ash	28.0%	Potassium	1.5%
Certain vitamins are known to be present also, namely β-carotene, thiamine, riboflavine, pyridoxine, B_{12}, pantothenic acid, niacin, folic acid, folinic acid and ascorbic acid.		Silica	0.8%
		Sulphur	0.7%
		Iron	0.7%
		Copper	0.005%

*By permission of Sea Products Research Ltd.

Table 3 gives the recommended daily vitamin requirement for the cat [29].

Table 3. DAILY VITAMIN REQUIREMENT OF CATS*

Vitamin	Daily dietary allowance	Comment
A (alcohol or ester)	1000—2000 IU (300—600 μg)	Cannot utilize carotene.
D (cholecalciferol)	50—100 IU	May synthesize and lick from coat.
Essential fatty acids	1 per cent total F.A.	Tolerates high saturated F.A. intake.
K	Negligible	? Intestinal synthesis.
E (α-tocopherol)	0.4—4.0 mg	α poly-unsaturated F.A. content.
B_1 (thiamine)	0.2—1.0 mg (or 0.1 mg/50 cal diet)	Increase in lactation or fever.
B_2 (riboflavin)	0.15—0.2 mg	Increase in lactation or fever and on high fat diet.
Niacin (nicotinic acid)	2.6—4.0 mg	Increase in lactation or fever; cannot synthesize.
B_6 (pyridoxine)	0.2—0.3 mg	Increase in lactation or fever.
Pantothenic acid	0.25—1.0 mg	
Biotin	100 mg	
Choline	100 mg	
Inositol	10 mg	Essential.
B_{12} (cobalamines)	Negligible	Intestinal synthesis (cobalt present).
Folic acid	Negligible	Intestinal synthesis.
C (ascorbic acid)	Negligible	Metabolic synthesis.

*From P. P. Scott: **Husbandry of Laboratory Animals** 1967.

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FELINE OSTEODYSTROPHY, ITS TREATMENT AND PREVENTION

OLIPHANT F. JACKSON*

SUMMARY

In small animal practice in many parts of Africa, feline skeletal abnormalities are frequently seen. A similar bone dystrophy is also seen with great regularity in wild animals reared in captivity. It can be consistently produced experimentally in any breed of cat reared on a calcium deficient diet. Rational lines of treatment for clinical cases of osteodystrophy in the growing kitten are suggested.

INTRODUCTION

(a) *In Domestic Cats.*

Feline osteodystrophy has been recognised clinically for many years and was described by Skeggs & Theobald [1], Coop [2] and by Greaves, Scott & Scott [3]. Scott, McKusick & McKusick [4] gave a list of references indicating that this disease has been reported in North America, the United Kingdom, France, Germany and Africa. In a personal communication J. A. Lawrence (1965) reported that in the mid-nineteenforties the condition was known locally in Rhodesia as Rhodesian Kitten Disease. More recently we have reported on 312 cases in the Copperbelt area of Zambia [5], indicating the particular prevalence of this disease in Central Africa and describing the characteristic signs and incidence of the condition.

(b) *Wild Felidae.*

The occurrence of the same condition in wild felines reared in captivity has been reported. Over 100 years ago Crisp [6] observed enlarged thyroids on post mortem of lion cubs born in the London Zoo. Bland Sutton [7] described skeletal changes referred to as 'rickets' in cubs and young lions. Of an eight week old cub he wrote: 'instead of playing with its companions it preferred to remain quiet...; when attempting to walk it staggered... convulsions sometimes occurred.' Marine [8] wrote: 'in zoological gardens where carnivores are held and bred in captivity and the diet is for the most part beef; goitre, rickets and osteomalacic states are quite common.' Fiennes & Graham Jones [9] recorded that eight (25%) out of a total of 32 lions exhibited at the Zoological Society of London over the preceding seven years between 1953-1960 had shown signs of this condition. Scott [10] found the weights of bones from animals reared in captivity to be much lighter than those of animals shot in the wild. Lawrence & T. Moore (personal communication, 1965 and Jackson *et al.* [5] all reported having seen the condition in several cats reared in captivity, while we have also seen cases in leopard, cheetah and mongoose when in Central and South Africa.

No report has so for been found of this condition occurring in the wild; in some instances skeletons of animals that have been shot have been examined both radiographically and analytically.

Critchley [11], A. M. Harthoorn (personal communication, 1962), Jackson [12], Lawrence, Moore and others all stress that when rearing captive young felines from weaning age they must be fed whole animal carcases such as rabbits, chickens, etc., or the unskinned limbs of small mammals such as goats. It is observed that whereas a dog can chew a large beef knuckle bone, the cat family do not appear to be capable of doing so, but they are able to make use of the bones of the smaller mammals and birds.

(c) *Experimental Production.*

Osteodystrophy can be produced experimentally by feeding kittens from weaning age on diets of either minced beef or on a purified diet deficient in calcium and was first reported by Greaves, Scott and Scott [3]. Subsequently much work has been done in the laboratory, especially on nutritional studies [13]. An outline of the nutritional requirements of cats has been given [14] with special emphasis on the requirements for skeletal growth.

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RATIONAL LINES OF THERAPY FOR CLINICAL CASES

1. The advantages of early detection are obvious. Dickinson & Scott's graph[17] showing satisfactory growth curves for male and female kittens has been reproduced in a previous article in this journal[14]. Kittens which fall below this range, at any age, should be regarded as subnormal, and should be carefully checked. Particular care should be taken to ensure that overweight kittens and pregnant and lactating queens, especially Siamese queens (see below) are in positive calcium and iodine balance.

2. The patient should be confined to a small space, say 3 ft × 2 ft × 18 inch[5]. This restriction of movement helps to prevent further skeletal damage being caused by the animal's own muscular activity.

3. Calcium, in the form of calcium carbonate, should be added to the diet at a dosage of 0·5—1.0 g (½—1 teaspoonful) to every 100 g wet weight of food, to correct the calcium : phosphorus balance and to supply sufficient mineral for rebuilding the bones to their normal density.

Kittens with osteodystrophy are presented to the veterinary surgeon most commonly when the skeletal stores are becoming depleted, but when the plasma Ca level is still within or only slightly below normal limits. At this stage calcium by mouth is usually very effective, about 80% of the calcium in the dose being absorbed in the small intestine (Scott & Humphreys, unpublished data).

4. The plasma calcium falls markedly only when skeletal stores are so low that insufficient calcium is mobilised to maintain blood levels. Clinically, these kittens are bad tempered, difficult to handle and show muscular weakness as well as some skeletal damage. These cases can be treated with advantage by parenteral administration of some soluble form of calcium salt for the first few days. By rapidly restoring the plasma calcium to normal limits, improvement in the muscular weakness and nervous disposition is attained often in a matter of hours.

5. When there is insufficient iodine in the diet, the addition of small quantities, in the region of 200—400 μg per day, aids in converting the negative calcium balance into a positive gain. This dose, or from two to four times the normal requirement[15], may be given initially but can be reduced once clinical improvement has occurred. To make up the solution take 59 mg potassium iodide in 100 ml of water; one drop represents approximately 50 μg.

6. In those cases in which there is collapse of the body of a vertebra with extradural haemorrhage, the initial prognosis must be guarded, as the haemorrhage may seep forward producing signs of ascending damage, or the blood clot may produce spinal ischaemia and the kitten become permanently paralytic.

7. Treatment of other deformities in the skeleton, in particular the pelvis, has been discussed in our earlier paper[5]; further investigations are in progress. Studies in relation to other dietary factors in the treatment of osteodystrophy are proceeding at the present of time and it is hoped to report on them in the future.

DISCUSSION AND CONCLUSION

From the regularity with which juvenile osteodystrophy can be produced experimentally in the cat, it would appear that this species has a specially high demand for certain nutrients in the period of rapid growth.

The histologically, radiologically, and biochemically proven identity of cases, whether occurring naturally in young domestic cats, or in wild felines reared in captivity, or in laboratory cats under experimental conditions, supports the hypothesis that the cause of the condition is entirely dietetic. Thus the idea that the condition is heritable, as suggested by Grant[16], by Bryson, Colley, Vercueil (in their respective personal communications, 1965 (and by Jackson *et al*[5], may be rejected, until breeding experiments under strict dietary conditions prove otherwise. The efficiency of uptake of minerals from the alimentary tract may still be shown to vary from one indiviudal to another as the result of a hereditary factor. It is certain that the most rapidly growing individuals are affected more quickly and more extensively: poor 'doers' or runts seldom show signs of juvenile osteodystrophy. The fact that Siamese cats are so highly prized by their owners leads to their own peculiar problems. Siamese queens are usually encouraged to have more litters than other cats, and are expected to raise all the members of each large litter. The pregnant and lactating queen, as well

as the actively growing kittens, are thus particularly susceptible. The logical conclusion follows that prevention of feline osteodystrophy lies in adequate attention to the nutrional requirements of the cat, as outlined previously [14].

ACKNOWLEDGEMENT

Grateful acknowledgement is made to Dr. Patricia P. Scott, Reader in Physiology at the Royal Free Hospital School of Medicine, who made much material available to the author.

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LETTER TO THE EDITOR

DOGS—AN EYE-OPENER ?

Sir,

How many days after being born should a puppy be able to open his eyes to the world for the first time? Have you ever wondered by what the duration of neo-natal ankyloblepharon is determined?

It has been stated that this period is usually from 12-15 days. In my experience most pups opened their eyes for the first time between the 8th and the 11th day. This brings us no nearer to the answer to my question.

A case has recently been observed which might give an indication. A Fox Terrier bitch gave birth to six pups. According to the owner, the pups were born 8 days prematurely. Subsequently four of them died: only one dog and one bitch survived.

Both these pups opened their eyes for the first time on the 19th day *post partum.* This seems significant. Based on these facts, I would go as far as submitting the following hypothesis:—

> 'The duration of neonatal ankyloblepharon in canine pups depends on the length of the gestation period. It is not determined by the *post-partum* period but *by the post-conception period.*'

Yours faithfully,

J. VAN STADEN.

10th October, 1968.
P.O. Box 81,
Grootfontein, S.W.A.

Jl S. Afr. vet. med. Ass. 39 (4): 31-34 1968

THE EFFECT OF PROLONGED RAIL TRANSPORT ON ADULT MERINO SHEEP

G. D. SUTTON* AND L. W. VAN DEN HEEVER**

SUMMARY

Two hundred and fifty adult Merinos of both sexes were subjected to unbroken rail transportation for periods of two to five days. Half of each group was slaughtered immediately on termination of the journey, and the other half after 24 hours of rest with feed and water available. At slaughter, urines were examined, and after 24 hours of chilling the hydrogen-ion concentration of muscle was determined. Live and dressed carcase weights were established.

The results indicate significant losses in carcase yield after transportation in excess of three days, and prove the beneficial effect of 24 hours of rest, feed and water, before slaughter, on carcase yield as well as metabolism. No depletion of muscle glycogen could be detected, even after five days of travel, although fatty changes of the liver occurred and evidence of depletion of liver glycogen was available. Rail transport for three days and longer resulted in acidosis, whereas transportation for two and more days resulted in subclinical ketosis in most sheep. There was a clear reduction in the ability of sheep to recover from this ketosis as the duration of transport increased.

It is concluded that prolongation of the maximum permissible travel time before interrupting the journey for feed and water is harmful to adult Merino sheep and presents an economic loss to the producer. Modification of present railways regulations cannot be recommended.

INTRODUCTION

Present South African Railways regulations require that where livestock is transported for longer than 48 hours, animals must be detrained every 36 hours for four hours of rest, feed and water. The possibility of amending these regulations has been suggested, mainly with the view to extending the period of travel before rest, feed and water is required. This investigation was undertaken to determine the effects of such prolongation on adult Merino sheep from the Karoo, whence the majority of sheep sent for slaughter emanate.

The work was undertaken with the assistance and co-operation of the S.A. Railways, the S.A. Agricultural Union, Messrs. Vleissentraal and the Livestock and Meat Industries Control Board.

MATERIAL AND METHODS

Two hundred and fifty adult Merino sheep of both sexes, but excluding pregnant ewes, and bearing approximately three months wool, were made available at de Aar, where 10 were slaughtered as controls. The balance were entrained in groups of 60, selected on weight and sex basis, in IZ-type trucks and railed to Onderstepoort to arrive after 2, 3, 4 and 5 days, no rest, feed and water being given *en route* (Table 1). On arrival, half of the sheep in each truck were immediately slaughtered, the balance being slaughtered after 24 hours of rest in unroofed lairage with lucerne hay and water available *ad libitum*. Sheep were weighed on the farm and soon after slaughter. Urine was collected at slaughter and examined for hydrogen-ion concentration by electrometric means, and for the presence of ketones by means of Rothera's reagent in powdered form. Muscle specimens were obtained from chilled carcases 24 hours after slaughter for electrometric determination of ultimate pH. The glycogen content of a few livers from various groups was determined at slaughter.

The investigation took place during the hot summer weather of 1968.

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RESULTS

The results are presented in the Tables 1—5.

Table 1: DETAILS OF EXPERIMENTAL PROCEDURE APPLIED TO GROUPS OF MERINO SHEEP

Group	Days Transported	Time of Slaughter
I	2	Immediate
II	2	After 24 hours
III	3	Immediate
IV	3	After 24 hours
V	4	Immediate
VI	4	After 24 hours
VII	5	Immediate
VIII	5	After 24 hours
Controls	0	On arrival at De Aar

Table 2: HYDROGEN-ION CONCENTRATION OF URINE AT SLAUGHTER AND ULTIMATE pH OF MUSCLE

Group	Urine			Muscle		
	$\bar{x}$	R	S^2	$\bar{x}$	R	S^2
Control	7.87	0.5	.029	6.2	0.5	.035
Group I	7.3	2.2	.368	6.3	0.6	.037
II	7.4	2.9	.684	6.1	0.6	.360
III	7.1	1.8	.295	6.1	0.6	.041
IV	6.1	1.6	.204	6.2	0.5	.035
V	6.6	2.2	.207	6.2	1.0	.095
VI	6.4	2.9	.583	6.1	0.5	.032
VII	6.6	1.5	.218	6.1	0.6	.045
VIII	6.2	1.9	.280	6.3	0.4	.018

$\bar{x}$ = mean; R = range; S^2 = variance

Table 3: KETONES PRESENT IN URINE AT SLAUGHTER (ROTHERA'S TEST)

Group	Number Tested*	Positive	%
Control	10	0	0
I	27	18	66.6
II	23	2	8.7
III	29	28	96.7
IV	28	8	25.0
V	26	22	84.5
VI	27	6	22.2
VII	27	24	88.8
VIII	24	10	41.4

*Randomly sampled from each group.

Table 4: GLYCOGEN CONTENT OF RANDOMLY SAMPLED LIVERS OF SHEEP AT SLAUGHTER IN GRAMS PER 100 g LIVER (g/%)

Group	Mean	Min.—Max.
Normal sheep	4.96	3.70—7.00
After 3 days travel (Group III)	3.69	3.18—4.54
After 4—5 days travel Groups V + VIII)	1.35	0.38—3.67

Table 5: MEAN FARM LIVE WEIGHTS, WARM CARCASE WEIGHTS, AND PERCENTAGE YIELD OF GROUPS OF SHEEP

Group	A Mean Farm Live Weight lb	B Mean Warm Carcase Weight lb	Carcase Yield % of A
Controls	101.8	44.1	43.3
I	101.8	43.6	42.8
II	101.8	43.5	42.7
III	101.8	41.9	41.1
IV	101.8	42.9	42.1
V	101.8	40.2	39.5
VI	101.8	41.1	40.4
VII	101.8	39.2	38.5
VIII	101.8	40.7	40.0

DISCUSSION AND CONCLUSIONS

i) *Hydrogen-ion concentration of urine:*

Statistical analysis of the results in Table 2 reveals that the difference between the mean pH values of the control sheep and group II is not significant [calculated t-value less than t(0.05)]. The differences between the controls and all the other groups, however, are highly significant [t-value more than t(5.01)]. From this it appears that when urine pH is used as index, adult Merino sheep transported for two days by rail and then rested for 24 hours with feed and water available may be considered normal, whereas all other combinations of travel and rest render the sheep physiologically abnormal.

The pH of normal ruminant urine lies between 7.5 and 8.0. Factors such as fever, ruminal stasis and alkalosis, and ketosis and acidosis result in significant changes. In ketosis there is usually an acidosis, the urine becoming markedly acid depending on the presence of aceto-acetic and β-hydroxybutyric acid.

ii) Hydrogen-ion concentration of muscle

Values above pH 6.2 are generally considered as abnormal and indicate inadequate reserves of muscle glycogen at the time of slaughter. The controls and all groups except I and VIII may thus be considered normal. Statistically the difference between the controls and groups I and VIII respectively are insignificant [t-value less than t(0.05)]. It may be concluded that even after five days of uninterrupted travel, muscle glycogen reserves were not inadequate or significantly depleted.

iii) *Ketosis:*

Table 3 indicates clearly that even after two days of unbroken travel, two thirds of adult Merino sheep developed subclinical ketosis, but that after 24 hours of rest and replenishment of food and water, almost all had recovered. As transport time was extended, the incidence of urines with ketones present increased and the degree of recovery after 24 hours of rest was reduced to the extent that after five days of unbroken travel only half the sheep recovered from subclinical ketosis after such rest. The differences between the effects of a 3- and a 4-day journey are insignificant, whereas the differences between a 2- and a 3-day journey, and between 4 and 5 days of travel respectively, are marked.

The fact that most livers of all groups had undergone varying degrees of fatty changes supports the contention that glycogen depletion took place. Table 4 indicates the degree of loss of liver glycogen in various groups, and withdrawal of glycogen from the liver is invariably accompanied by fatty infiltration. Roderich *et al.*[1] established that on a dry basis the fat content of liver rose from 28% by weight in normal sheep to over 60% in ketotic sheep.

Directors of abattoirs and livestock agents frequently encounter "domsiekte" or hypoglycaemic ketosis in sheep arriving at abattoirs[2], and at the country's largest abattoir, 3,684 of 1,254,156 sheep received for slaughter during one year were classified as casualties on arrival[3]. Partial or complete starvation resulting from withdrawal of feed, or offering feed to which sheep are unaccustomed[4], a change in ration and environment[5], etc., are all factors reported to precipitate this metabolic disease. Fat, pregnant ewes are more susceptible, but the disease is not exclusive to such animals[6]. Even comparatively short rail journeys of 24 hours have resulted in serious losses amongst heavily pregnant ewes[7]. Even in subclinical forms of ketosis, there is a marked loss of weight[6].

iv) *Loss of warm carcase weight:*

This is of considerable economic importance to the livestock owner in particular and the industry in general. It also constitutes an important index of the severity of deleterious factors in any transport and management regime.

As the mean farm live weights for each group were identical, direct comparison of mean warm carcase weights for each group was possible. Reference to Table 5 indicates a distinct downward trend in the carcase yield as travel time increased. There is also a clear increase in carcase weights in the case of sheep allowed 24 hours of rest, feed and water after arrival and before slaughter. This would indicate a degree of restoration of water balance in the tissues and possibly some tissue restoration.

Application of the Student t-test to the data revealed that, when comparing the mean carcase weight of the control sheep with that of sheep in the various groups, the difference was not significant in the case of groups I-IV significant in groups VI and VIII, and highly significant in groups V and VIII.

It is concluded that after 2 and 3 days of travel, carcase yield is not significantly lower than the yield resulting from local slaughter, but when unbroken rail transport extends beyond 3 days, the decrease in yield becomes significant and there is also evidence of excessive deleterious effect on the animal.

v) *Intestinal contents:*

The nature and consistency of the intestinal contents of various groups at slaughter may be of some significance. In sheep exposed to 5 days of unbroken travel and slaughtered on arrival, the contents of the large intestine were significantly harder and drier than in the other groups. After 24 hours of rest, feed and water, the 5-day travel group, however, were again restored to normality.

vi) *Behaviour of the sheep under experimental conditions:*

Observations revealed that adult Merino sheep seldom lie down in the truck, even on a 5-day journey. On being detrained, Merines that had travelled for 2-4 days without water and feed showed no preference for either. After a 5-day unbroken journey, however, there was a definite preference for water, feed only being taken after drinking copiously. Sheep consumed an average of ½ lb of lucerne hay per 24 hours in the rest pens, and from this one would conclude that the amount consumed during a 4-hour break in the journey would be rather low.

ACKNOWLEDGEMENTS

1. We are grateful to the following organisations and their staff for the assistance and co-operation, without which this work could not have been undertaken: The S.A. Railways, The Livestock and Meat Industries Control Board, The S.A. Agricultural Union and their affiliate, Messrs. Vleissentraal Bpk.
2. Messrs. J. J. van Staden and J. van Meyeren gave us their usual able assistance in this investigation.
3. We are also indebted to Prof. R. Clark and Drs. M. M. J. Brown and J. Procos for advice and assistance.

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BOOK REVIEW

VETERINARY CLINICAL DIAGNOSIS

W. R. KELLY

Baillière, Tindall & Cassel, London, 1967. Pp ix & 294. 232 figures. Price 63 shillings.

Here is a completely new text book from the hand of the Professor of medicine, pharmacology and food hygiene, Faculty of Veterinary Medicine, University College, Dublin, and is, therefore, an important addition to the literature in this field.

The book deals with clinical diagnosis in farm animals, the dog and cat, and its instructional value is greatly enhanced by the many excellent photographs included in the text. The author's style is lucid and easy to read, but could not the rather historic-looking figures from the Holborn catalogue be replaced with illustrations more in keeping with the times?

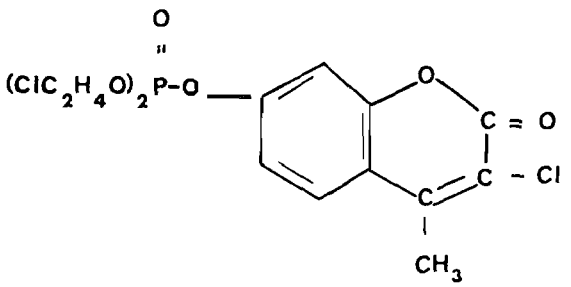
Both the topographical and systemic methods of examination have been employed, while the last chapter is devoted to diagnostic tests. It is doubtful whether a book of this nature is improved by devoting so much space to clinical haematology, blood chemistry and urinalysis, subjects usually taught as clinical pathology in most faculties today. It is felt that the space saved by the omision of much of this could be devoted more profitably to amplification of the information provided about restraint and topographical anatomy.

The section on the examination of the udder is rather disappointing, embodying some doubtful statements and incorrect techniques, while the index could be made more comprehensive.

The foregoing minor criticisms must not be allowed to detract from the excellence of Prof. Kelly's book, which provides a thorough and practical guide to student and practitioner alike in the art of clinical diagnosis, and the book is heartily recommended for this purpose. To the reviewer's mind, this must be regarded as the best text in English available today on this all-important but oft-neglected subject, and it is to be hoped that a second edition will not be long in appearing.

R. K. L.

HALOXON



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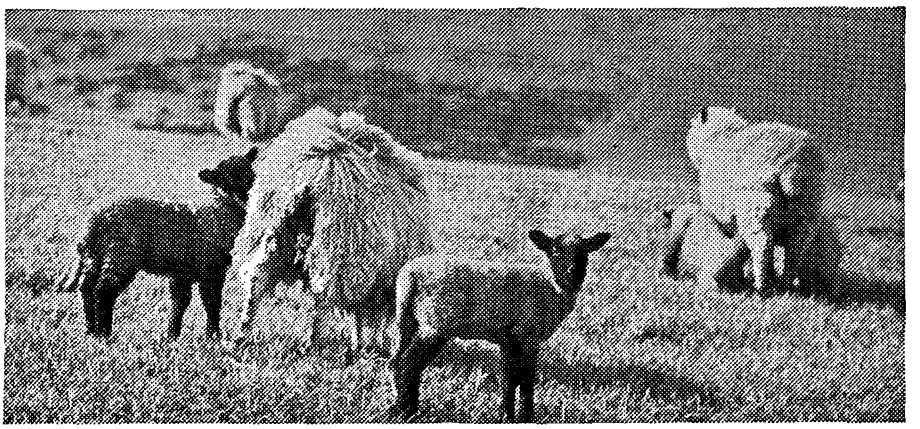

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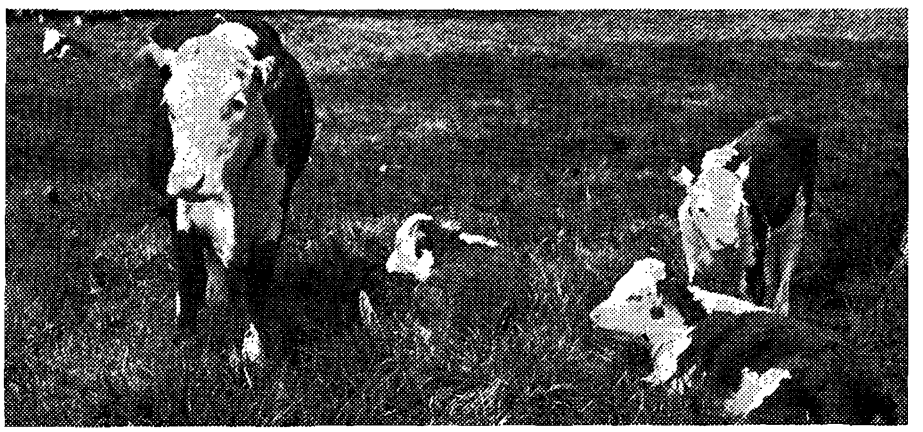

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CLOSTRIDIUM BOTULINUM TYPE D IN MUD OF LAKES OF THE ZULULAND GAME PARKS *CLOSTRIDIUM BOTULINUM*

J. H. MASON*

SUMMARY

Clostridium botulinum Type D was present in seven of 34 samples of mud taken from five lakes in the Zululand Game Parks.

INTRODUCTION

There are many references in the South African literature to the isolation or demonstration of *Clostridium botulinum* in cadaver material or in the intestinal contents of oxen, horses, rats, birds and tortoises but few dealing with its demonstration in soil. Scheuber[1] showed that *Cl. botulium* Type D toxin was present in cultures of soil taken from beneath, and one foot away from, a decomposing bovine carcase but not in samples ten or more yards away from it. A further 101 soil samples from different parts of the same farm were examined, all with negative results. Knock[2] examined 102 samples of soil from different parts of Southern Africa and isolated *Cl. botulinum* Type B from three of them; Types A, C and D were not isolated nor were their toxins shown to be present in cultures.

MATERIALS AND METHODS

Thirty four samples of mud or of muddy or sandy water were collected in 30 ml capacity screw-capped jars from the lakes, pools and water holes of four of the Game Parks of Zululand. Most were taken from the shore or close inshore but some were collected from deeper water. Different points on each lake or waterhole were sampled, two from the smallest and 13 from the largest.

In the laboratory, each sample was divided into four portions. Each portion was placed in a separate tube which was sealed and immersed in water. One was heated at 65°C for 30 minutes, another at 75°C for 15 minutes, another at 85°C for 15 minutes and the last at 80°C for 60 minutes. The heated material was transferred to tubes of meat-particle broth and incubated at 37°C for seven days. Each culture was centrifuged and the clear supernatant fluid tested for toxicity by injecting 0.25 ml of it subcutaneously into a mouse. If the mouse died, toxin-antitoxin tests were carried out, using 0.25 ml. of toxin and the antitoxin of *Cl. botulinum* Type A+B, Type C, Type D, *Cl. tetani* and a mixed gas-gangrene antioxin *(Cl. welchii* Type A, *Cl. septicum* and *Cl. oedematiens).* Each mixture, after standing for half an hour was injecting subcutaneously into a mouse which was kept under observation for seven days.

RESULTS

The toxin of *Cl. botulinum* Type D was shown by this test to be present in seven cultures made from mud from two sites on each of two lakes (Inyamati and Banzi) and from one on each of three others (Uhotwe, Tewate and Sabatana).

DISCUSSION

Type D toxin was detectable in seven of 33 cultures containing mud that had been heated at 80°C for 60 minutes but in one only of 97 cultures in which the mud had been heated at any of the other previously mentioned temperatures. But this does not mean that one hour's heating at 80°C is optimal because when this method was employed, much more mud was used than on the other occasions. In future work of this nature, it would almost certainly be advantageous to use large samples (100 g—500 g) of mud or soil collected over an area of a few square yards, so as to increase the chance of including material containing the spores of *Cl. botulinum.* The sites chosen for sampling should be those frequented by game, as

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evidenced by hoof prints and faecal droppings.

The literature attests to the difficulty and, in some cases, the impossibility of isolating *Cl. botulinum* from grossly contaminated material. Thus, it came as no surprise when attempts to isolate Type D failed, this in spite of heating cultures at different temperatures for different lengths of time, of using different media and methods of producing anaerobiosis, and of picking dozens of colonies from plates and deep agar cultures.

In spite of the high proportion of positive results, there was no evidence that botulism had occurred in game or birds.

Cl. tetani was isolated in pure culture from the mud of two lakes, Inyamati and Banzi, and the toxin of a gas-gangrene anaerobe wah demonstrated in a mud culture from a water hole in Mkuzi.

ACKNOWLEDGEMENTS

I have pleasure in thanking Mr. Mervyn Wood, Chairman, Natal Parks Board, for permission to carry out the investigation, Dr. J. D. Coles, veterinary colleague and a member of the Parks Board, for initiating, arranging and actively participating in the work, Dr. M. E. Keep, Veterinary Research Officer of the Natal Parks Board, Mr. Ian Player, Chief Conservator, Zululand Game Reserves, and many wardens and rangers for their help and courtesy and Dr. B. C. Jansen, Chief, Veterinary Research Institute, Onderstepoort for a supply of Types C and D antitoxins.

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BOOK REVIEW.

ATLAS RADIOLOGICA

KJELD WAMBERG

Medical Book Co., Copenhagen, 1966, pp. xxiii & 404. Price not stated.

At the first International Radiological Congress a veterinarian occupied the chair. After this early initiative the veterinary profession lagged behind in radiology for many years. After the end of the last war interest in veterinary radiology took a sharp upward turn so that it has become an indispensable tool in clinical diagnosis and research. Works on veterinary radiology were few and far between but have been augmented during the last few years by some good textbooks. Inevitably, however, certain gaps remained. This makes the advent of the book under review an event of great importance, as it represents, to the reviewer's knowledge, the first radiological atlas, which indicates both normality and pathology of small animals.

The text, written in English, German, French and Italian occupies very few pages, almost all of the 404 pages being taken up by radiographic reproductions, the legends of which are in Latin but which will be easily understood even by those who are not Latin scholars. The regions of the body are systematically dealt with, *e.g.* head and neck, forelimb, thorax, etc. The reproductions are of excellent quality, reflecting great credit on the radiologist and the printers.

To all veterinarians engaged in clinical work this book can be recommended as a very valuable contribution to veterinary literature in general and veterinary radiology in particular.

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Jl S. Afr. vet. med. Ass. 39 (4): 41-43 1968

A PHYSICO-CHEMICAL APPROACH TO THE SEROLOGICAL DIAGNOSIS OF CYSTICERCOSIS

N. MORRIS, EILEEN M. PROCTOR AND R. ELSDON-DEW*

SUMMARY

In the past, attempts at the serological diagnosis of cysticercosis in pigs by means of indirect haemagglutination and of gel diffusion met with varied success. The present work demonstrates, by means of immunodiffusion, immuno-electrophoresis, exclusion chromatography and by ion exchange chromatography that the antigen preparations used are extremely complex. The lack of sensitivity may well have been due to this complexity.

Components active in the induction of precipitins in natural infection have been identified, and one particular antigen found to be active in every case of porcine cysticercosis thus far studied.

Such characterised antigens should provide unambiguous diagnosis in serological tests.

INTRODUCTION

The condemnation of carcasses for cysticercosis takes place at the end of a long and expensive chain, and some means of early diagnosis is desirable.

In this laboratory, serological diagnosis has been attempted by the use of the indirect haemagglutination test and of precipitin assay based on double diffusion in gel. Though useful results were obtained by both methods, they seemed to be erratic in sensitivity. The antigen preparations used were simple extracts of cysticerci, and, as such, may well have varied from preparation to preparation. That they were complex mixtures is shown by the results presented in this paper.

MATERIALS AND METHODS

Antigens

Whole cysticerci were removed with forceps from the muscle of infected pig carcasses, and crude extract (EXT) was prepared by extraction of the freeze-dried cysts into physiological saline (0.15M NaCl; pH 7.2). After manual separation and freeze-drying, similar extracts were made of scoleces (S) and of membranes (M). Cyst fluid (CF) was centrifuged clear and used as such. Cysts were maintained *in vitro* at 37°C in tissue culture medium (TCC 199, Burroughs Wellcome). The resulting broth, which contained the metabolic products (CM) was harvested after 72 hours and centrifuged. The clear supernatant was concentrated for use as antigen.

Sera

Porcine sera were separated from blood obtained by heart puncture at slaughter. Multivalent antiserum was raised in a rabbit immunised with EXT.

Immuno-Electrophoresis

A slab of Agarose (Seravac Ltd.) gel (0.5% in barbitone buffer, pH 8.6; I=0.05) was cast on a 3″ × 1″ microscope slide. The antigen preparation, soaked into filter paper (Whatman 3 mm; 3×1 mm), was introduced into a slit at the origin, and current was applied (5 V/cm, 4 mA/cm, 30 min). At the completion of the electrophoretic separation, a trough (2×25 mm) was cut in the gel parallel to the line of migration and 5 mm from it, and antiserum introduced. Arcs of precipitate corresponding to the individual antigens in the preparation became visible after 48 hours, and were generally photographed after a further 48 hours.

Immunodiffusion

In order to detect and identify antigens, the Ouchterlony[1] principle was performed

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The Unit (Director: R. Elsdon-Dew) is sponsored by the South African Council for Scientific and Industrial Research, the Natal Provincial Administration, the University of Natal and the United States Public Health Service (Grant AI-01592). Paper presented at the 63rd Congress of the South African Veterinary Medical Association, Pretoria, September 10—13, 1968.

on a micro scale according to the method of Crowle [2]. A film of Agarose gel (1 mm thick; 0.5% in physiological saline) was poured on to a glass slide (4×4 cm), and on the surface of this was placed a perspex template 3 mm thick and having conical wells. These wells were charged with either antigen or antiserum, and diffusion proceeded for 48 hours at room temperature. At this stage the template was lifted off, and bands of precipitate could be seen in the gel. Linkage of bands arising from adjacent wells implies identity of the precipitin systems, while crossing indicates non-identity.

Indirect Haemagglutination

A modification of the test of Boyden [3] and Stavitsky [4] was used. Sheep cells, preserved in Alsever's solution, were obtained from the same source each week, and stored at 4°C. After washing, a 3% suspension of cells was tanned at 4°C for 15 minutes with a 1/120,000 dilution of tannic acid (Merck—reagent grade) in phosphate buffered saline at pH 7.2. After further washing, the tanned cells were sensitised with an equal volume of antigen dilution in phosphate buffered saline at pH 6.4 for 15 minutes at 37°C. Test sera were inactivated and absorbed with sheep cells, as was the stabilising diluent of 1% human AB serum in buffer at pH 7.2. Cells and serum dilutions were allowed to react in the waterbath at 37°C for two hours. The tubes were then shaken and placed at room temperature, the results being read the following day.

Exclusion Chromatography

A column (1×100 cm) of Sephadex G-200 (Pharmacia, Uppsala) in 0.1 M NaCl was used to separate the components of the antigenic preparations into groups according to molecular size. The column effluent was monitored by measuring the extinction at 280 nm (Uvicord Detector Unit, LKB Produkter AB).

Ion-exchange Chromatography

DEAE-cellulose in tris buffer (pH 8.2; I=0.01) was used as adsorbant. The components of each preparation were eluted with a continuous salt gradient (0⟿2 M NaCl in tris pH 8.2; I=0.01) and the effluent monitored at E_{280}.

RESULTS

Immunodiffusion and immuno-electrophoresis of EXT, CF and CM against the rabbit multivalent antiserum (Fig. 1) revealed a multitude of precipitin systems in each case. Fourteen bands could be seen with some preparations of EXT, four with CF and six with CM. The molecular sizes of the components of the preparations covered a wide range, as is shown by the chromatogram of CM on Sephadex G-200 (Fig. 2). Ion-exchange chromatography also indicated considerable heterogeneity. A chromatogram of EXT is shown as an example (Fig. 3).

The practical implication of the use of such extremely complex preparations was shown by the results with naturally infected pigs as the source of antibody.

In the haemagglutination test, whereas EXT and S contained appropriate antigens, M, CF and CM showed no activity at all!

Fractionation of EXT by exclusion chromatography showed that the antigens concerned in haemagglutination have molecular weights greater than 200,000 (macroglobulins). This fraction also contained six precipitin-inducing antigens (precipitinogens). Ion-exchange chromatography of the macroglobulin fraction of EXT produced a preparation containing a haemagglutination antigen together with three of the precipitating antigens. No further purification as yet has been attempted.

Using CM as antigen, immunodiffusion and immuno-electrophoresis against the serum of a naturally infected pig revealed three antigenic components. For convenience, these have been numbered I, II and III, in sequence from the cathode. Sera from nine infected pigs were tested in this way. The CM antigens found active are shown in the table, together with the haemagglutination titre obtained with EXT antigen.

CM PRECIPITINOGENS IN NATURAL PORCINE CYSTICERCOSIS COMPARED WITH EXT HAEMAGGLUTINATION TITRE

Pig No.	Cysts per cut	Antigens	Haemagglutination-1
1	3	I II III	1600
2	1	I	—
3	1	I	—
4	2	I II	200
5	10	I	100
6	1	I II	50
7	1	I II	50
8	10	I II III	1600
9	1	I	200
Controls	0		—

An immunodiffusion test performed with sera from six of the infected pigs is shown

in Figure 5. Linkage shows that antigen I was active in all six. In parallel tests, control sera from a large number of non-infected pigs showed no precipitin activity at all.

DISCUSSION

Physico-chemical analysis has shown that the extracts in current use as antigens for the serological diagnosis of cysticercosis are all extremely complex mixtures. It is small wonder that sensitive serological tests give erratic results, particularly when such indicator systems as complement-fixation are used. In indirect haemagglutination, where antigen is adsorbed on to the surface of red bood cells, there will be competition for the available sites by chemically similar but antigenically inactive components which constitute the major portion of the undefined mixture. Standardisation of these crude mixtures as such would be difficult, if not impossible.

As seen in the table, no correlation is apparent between parasite load, precipitin and haemagglutination titre. This is not surprising in view of the complexity of the reactants. EXT is presumably a mixture of S, M, CF and CM, but of these only S was shown to be active in haemagglutination. There is some suggestion (only two cases) of correlation between high haemagglutination titre and precipitating antigen III.

Resolution of the precipitin systems suggests that antigen I is of diagnostic value, in that it was found to react with serum from all nine infected pigs studied, irrespective of parasite load. No activity was shown by any of the non-infected pigs used as controls. The precipitins in pig sera are not easy to detect, and, though the test is technically simple, results only become available after 3 or 4 days.

In view of these findings, it is suggested that physico-chemical methods be used to purify the diagnostically important antigens for use in serological tests.

ACKNOWLEDGEMENTS

The unstinted co-operation of the Staff of the Durban Abattoir made this work possible.

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BOOK REVIEW

ATLAS OF CANINE AND FELINE DERMATOSES

ROBERT M. SCHWARTZMAN AND FRANK KRAL

Lea and Febiger, Philadelphia, 1967. Pp.

The authors are to be congratulated on producing a notable first in veterinary literature which is regarded as indispensable to any one, whether student or clinician, interested in the correct dgainosis of skin lesions in pet practice.

The book does not claim to deal with the subjects of aetiology, pathogenesis and treatment, but covers most adequately the pictorial representation of the spectrum of lesions and the histopathological features seen in particular skin disorders. The 302 excellent full-colour illustrations are beautifully presented in 22 chapters covering all the well-known and many lesser-known dermatoses so distressingly prevalent in the dog and cat in this country as well as the U.S.A. The printing and colour reproduction are of high standard and printing errors are refreshingly few. Altogether, this production is a credit to the authors' high standing as veterinary dermatologists and places the subject on a very sound diagnostic footing.

R. K. L.

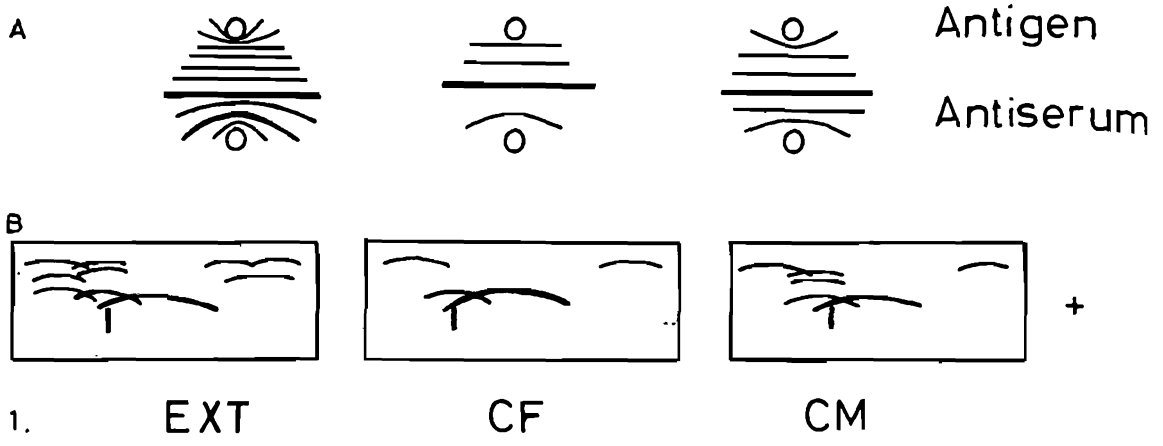
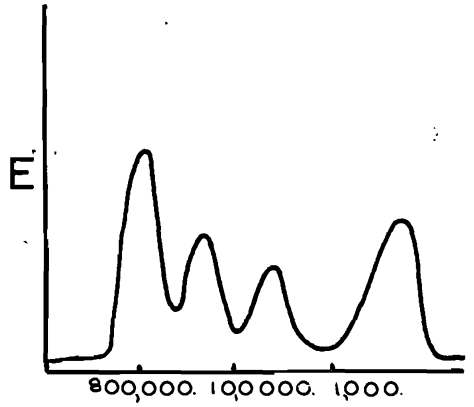
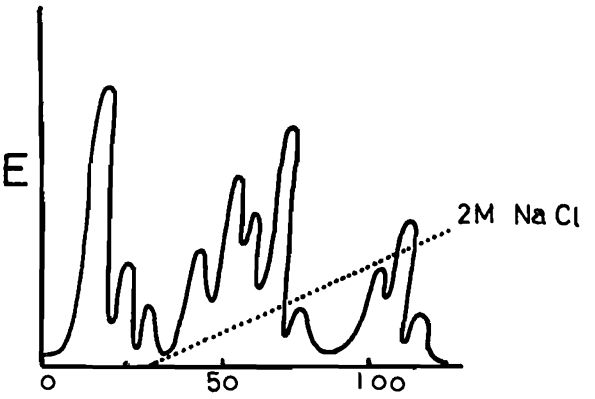


FIG. 1.



molecular weight

FIG. 2.



fraction number

FIG. 3.

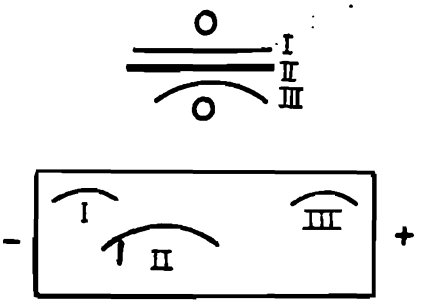


FIG. 4.

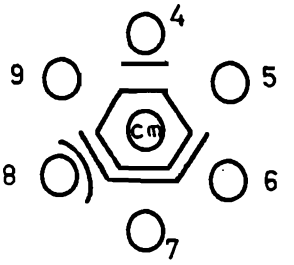
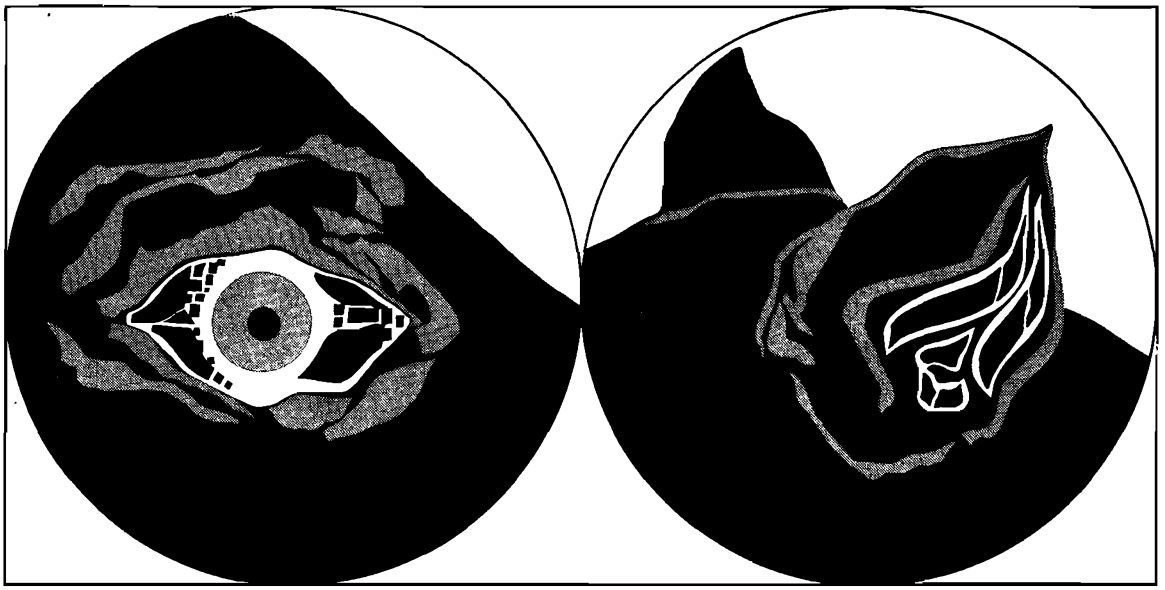


FIG. 5.

Fig. 1 Immunodiffusion (A) and immuno-electrophoresis (B) of cysticercus preparations, demonstrating the antigenic complexity against rabbit antiserum.
Fig. 2 Distribution of molecular weight in cyst metabolic products.
Fig. 3 Complexity of crude extract shown by ion exchange chromatography on DEAE cellulose.
Fig. 4 Immunodiffusion and immuno-electrophoresis of CM against infected pig serum.
Fig. 5 Immunodiffusion of CM against infected pig sera.

In superficial eye and ear conditions of domestic animals...



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TREATMENT OF *SCHISTOSOMA MATTHEEI* INFESTATION IN SHEEP

J. A. LAWRENCE*

SUMMARY

Trials with the treatment of natural *Schistosoma mattheei* infestation in sheep with stibophen, lucanthone and niridazole are described. Lucanthone at 40 mg/kg daily for three days gave a satisfactory result in four out of six treated sheep. Higher doses could be toxic. Stibophen at 10 mg/kg per day and niridazole at 35 mg/kg per day for five days were ineffective.

INTRODUCTION

Recent outbreaks of clinical and fatal schistosomiasis in sheep and cattle in Rhodesia due to *Schistosoma mattheei* have highlighted the need for a cheap, safe and effective treatment for this condition in farm animals. Very little attention has been paid to this subject in the past in Africa because, with the exception of an occasional severe outbreak, the parasite is generally considered to be relatively non-pathogenic.

Outbreaks in Rhodesia have involved sheep drinking from permanent streams, pools or reservoirs heavily infested with the intermediate snail hosts, *Physopsis* species. On some farms cattle have also shown evidence of infestation. Infested animals undergo a dramatic loss in condition and develop weakness, severe anaemia and diarrhoea. In sheep, acute bronchopneumonia due to secondary bacterial infection is often the final cause of death. Mortality among sheep is very high, in some cases resulting in the complete loss of a flock. At autopsy the principal finding are emaciation, severe anaemia, pulmonary oedema, irregularities on the surface and in the colour of the liver, and a pronounced grey pigmentation of liver and lungs. Schistosomes are numerous in the mesenteric veins, and their eggs are easily demonstrated in crush preparations of intestinal mucosa, liver and lungs.

The classical drug used in the treatment of schistosomiasis in domestic animals has been tartar emetic. It was apparently successful in the treatment of sheep in South Africa [1]. Other less toxic antimonials, which have been evolved for human therapy, have also been used. Treatment with antimonials necessitates a course of injections at intervals of one to seven days over a period of a week or more. Some of these drugs are too irritant to administer other than by intravenous injection, *e.g.*, tartar emetic, sodium antimonyl tartrate, which makes their use for mass treatment of farm livestock impracticable. Attention was turned to those capable of being administered by other routes and of these the cheapest available compound, stibophen, was selected for trial.

Lucanthone is widely used in the treatment of human schistosomiasis in Rhodesia, especially for mass treatment of *Schistosoma haematobium*. It is relatively cheap, easy to administer, non-toxic and readily available.

Niridazole is highly effective in the treatment of human bilharzia, and is easy to administer. It is, however, considerably more expensive than the other drugs chosen in this investigation. There is evidence that it is effective in the treatment of schistosomiasis in sheep [2, 3, 4].

Trichlorphon has been shown to be effective in the treatment of *Schistosoma bovis* infestation in cattle [5] but the drug is considered too toxic for sheep.

Trials were carried out to investigate the use of stibophen, lucanthone and niridazole in the treatment of natural infestations of *S. mattheei* in sheep.

MATERIALS

Animals

Sheep were purchased from flocks in

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which clinical and fatal schistosomiasis was occurring. They were Blackhead Persian, Wiltiper, Dorper, or intercrosses between these breeds and weighed from 34-66 lbs. Animals were selected that showed evidence of heavy infestation, but, in the hope that the experimental groups would survive long enough to evaluate the effect of the treatment, no animal was included that was severely affected with pneumonia or diarrhoea, or was near to death.

Drugs

Stibophen: Injection of Stibophen B.P.* was administered intramuscularly. This is a 6.4% solution containing the equivalent of 10.3 mg antimony trioxide per ml.

No dosage rate for this product is cited in the British Veterinary Codex. For cattle, Lapage[6] recommends 10 doses each of 25 ml (1.6 g) of antimosan, the potassium salt of stibophen, administered on alternate days. Such a prolonged course of treatment is very inconvenient in practice. To evaluate the possibility of a more intensive course of treatment being effective, sheep in this trial were injected intramuscularly with either 5 or 10 mg/kg/day for five days.

Lucanthone hydrochloride: Lucanthone Tablets B.P.** were administered orally. The normal human dose is a total of 60 mg/kg administered in divided doses twice a day for three days. Sheep were dosed at 20 or 40 mg/kg/day for three days.

*Niridazole****: This drug was administered orally in tablet form. The normal human dasoge rate is 25 mg/kg/day for five to seven days. In this trial sheep were dosed daily at 35 mg/kg for five days.

METHODS

A total of thirty sheep originating from three flocks was used in the principal trial. Sheep were allocated to treatment groups as follows and treatment was repeated eleven weeks later in some animals as detailed in the last column.

Stibophen	5 mg/kg/day	for 5 days	— 3;	repeated	11	weeks	later	—	3
Stibophen	10 mg/kg/day	for 5 days	— 7;	„	11	„	„	—	2
Lucanthone	20 mg/kg/day	for 3 days	— 4;	„	11	„	„	—	1
Lucanthone	40 mg/kg/day	for 3 days	— 7;	„	11	„	„	—	2
Niridazole	35 mg/kg/day	for 5 days	— 3;	„	11	„	„	—	nil
Untreated controls			— 6;						

The severity of the disease in each sheep was assessed by consideration of weight in relation to age, body condition, degree of anaemia, and leucocyte response; as far as possible the animals were distributed between the groups to ensure that each group contained a representative cross-section of the whole. A moderate *Haemonchus* infestation was detected in sheep from two flocks and these sheep were dosed with thiabendazole before the trial commenced. The animals were housed in pens, free from any sources of further infestation with schistosomes. Some animals died as a result of the disease and, where possible, these were autopsied. A number were removed from the trial and used to assess the effect of higher doses of lucanthone. The remainder were slaughtered at varying intervals from one week to four months after the completion of treatment.

The efficacy of treatment was assessed by estimating the number of schistosomes in the mesenteric veins at autopsy. The estimate was based on a count of the number of worms in the veins of that extent of mesentery that could be stretched out between two hands, at five sites selected at random from the duodenum to the ileocaecal valve. This technique is not as exact as the counting of all the parasites *in situ* or after recovery by perfusion of the veins, but the results appear to be reasonably reproducible and it does give a satisfactory indication of the severity of infestation and of the efficacy or otherwise of the treatment. The liver and the portal vein were also examined for the presence of parasites.

RESULTS

The numbers of parasites found at autopsy in those animals in which an estimate was made are presented in the table.

Experience with the animals in this trial and with cases observed in field outbreaks suggests that a level of infestation of 100 parasites or less (1_+) is of little clinical

*) "Fantorin"—Glaxo-Allenbury.
**) "Nilodin"—Burroughs Wellcome.
***) "Ambilhar"—Ciba.

PARASITES NOTED AT AUTOPSY

Group	Worms noted in individual sheep.
Controls	+ + + + ++ ++ ++ ++ ++
Stibophen	5 mg/kg/day for 5 days. Total 25 mg/kg. Two crouses of treatment. + + 10 mg/kg/day for 5 days. Total 50 mg/kg. One course of treatment. + + + + + + + + + + + + + + + Two courses of treatment. + + + +
Lucanthone	20 mg/kg/day for 3 days. Total 60 mg/kg. One course of treatment. + + + 40 mg/kg/day for 3 days. Total 120 mg/kg. One course of treatment. + + + + + + + + nil Two courses of treatment. +
Niridazole	35 mg/kg/day for 5 days. Total 175 mg/kg. One course of trentment. + + + + + + + +

KEY. + very approx. = 1 to 100 worms.
++ ,, ,, = 101 to 350 worms.
+ + + ,, ,, = 351 to 600 worms.
+ + + + ,, ,, = more than 600 worms.

significance. More than 100 worms (2_+ or more) may cause severe disease or death in some circumstances. On the basis of these observations a reduction in the number of parasites to less than 100 (0 or 1_+) may be considered as an effective treatment for practical purposes.

Lucanthone at 40 mg/kg/day for three days was therefore effective in four out of six sheep; stibophen at 10 mg/kg/day for five days in one out of six sheep and niridazole at 35 mg/kg/day for five days in none out of three sheep.

Lucanthone at Higher Dosage Rates: As lucanthone at 40 mg/kg/day for three days had not provided a complete cure it was necessary to determine whether higher dosage rates would be more effective.

Four sheep removed from the previous trial received three doses of 60 mg/kg over five days for a total dose of 180 mg/kg, the time interval being lengthened in an attempt to reduce toxicity. These sheep had all been treated previously, receiving a total dose of 60 mg/kg of lucanthone or 25 mg/kg of stibophen on two occasions, and it is thus not possible to say with certainty what parasite burden they were still carrying, but from experience in the preceding trials it was probably 2_+. One sheep died during the course of treatment. The remaining three at slaughter showed 0, 0 and 1_+ parasites present, a satisfactory but not a complete cure.

Two sheep removed from the previous trial received 80 mg/kg/day for three days. Both died, one after the first dose. The other died the day following the last dose and at autopsy had 1_+ parasite.

Three previously untreated sheep received 180 mg/kg daily for three days. One died the day following the last dose, the other two were very ill and were slaughtered one week later. None showed any parasites in the mesenteric veins, but one still had a few small live schistosomes in the veins of the liver.

Stibophen at Higher Dosage Rates: Two clinically affected sheep from another source received 15 mg/kg/day for five days. Worm counts at slaughter were 0 and 5_+. As two controls from the same flock had 1_+ and 5_+ levels of infestation, no conclusions can be drawn from these results.

Toxicity: At the dosage rates used there was no evidence of side effects or toxicity with stibophen and niridazole.

Lucanthone at a dose of 20 mg/kg/day for three days in one healthy sheep caused a loss of appetite, especially for concentrates, commencing on the day of the third dose and lasting for three days. At the rate of 40 mg/kg/day the drug also caused a moderate depression of activity and some weakness. Clinically affected sheep dosed in the trials suffered similar side effects, but at 20 or 40 mg/kg/day for three days these effects were temporary and no mortality attributable to the drug occurred.

Treatment with lucanthone at 80 mg/kg/day for three days administered to two clinically affected sheep, whose condition was gradually deteriorating, hastened their death, the one succumbing after only one dose. Three doses of 60 mg/kg over five days

administered to four infested sheep whose condition was improving caused the death of one, after only one dose. *Post-morten* examination revealed that this animal had an enlarged liver with extensive proliferation of bile ducts, probably not related to the schistosome infestation, and that haemorrhage into the abomasum and intestines, and in the epi- and endocardium had occurred. Extensive focal haemorrhages in the liver were also noted histologically.

Sheep succumbing after a full course of three doses of lucanthone at 80 or 180 mg/kg/day were very depressed before death. Faeces were very dark and loose, and the urine was orange coloured. *Post-mortem* examination revealed, in addition to lesions attributable to schistosomiasis, bright yellow staining by the drug of the mucosa of the gastro-intestinal tract and of the fat depots. There was some haemorrhage into the intestines and one sheep had subcutaneous and intramuscular haemorrhages in the thoracic region, hydrothorax and hydropericard. Histological examination of liver, kidney, heart and lung revealed no evidence of damage attributatable to the drug in these organs.

DISCUSSION

Effects of drugs.

The trials described are far from exhaustive but within their limitations some conclusions can be reached.

Niridazole dosed daily for five days at 35 mg/kg was not effective in the treatment of *S. mattheei*. This finding was in contrast to that of Gretillat[2] who, treating what was presumably *S. curassoni* infestation in sheep, found that, although this dosage rate did not achieve a parasitological cure, it did reduce the number of parasites in two sheep to a very low level and achieved what he considered to be a clinical cure. He reported that ten daily doses of 25 mg/kg were necessary to rid sheep of the parasites completely. Hurter and Potgieter[3] and Reinecke[4] working in South Africa have found that three daily doses of 100 mg/kg are very effective against *S. mattheei* in sheep but at this dosage rate the drug becomes very expensive for use on a wide scale. It appears that the susceptibility of *S. mattheei* to niridazole differs from that of *S. curassoni*.

Stibophen at 10 mg/kg daily for five days failed to give a satisfactory result. Stibophen is one of the cheaper schistosomicides, considerably cheaper than lucanthone at present retail prices on a *per capita* basis, its administration by intramuscular injection is simple, even preferable to oral dosing, and further investigations with this drug would be worthwhile. In the treatment of human schistosomiasis[7] and bovine nasal schistosomiasis[8] it is considered to be less effective than those antimonials administered intravenously, its main advantage being its low toxicity. It has, however, been found to be very effective against *S. mattheei* in cattle[9].

Lucanthone was the only drug with which it was possible to demonstrate a schistosomicidal effect. Administered at the rate of 40 mg/kg/day for three days it gave a reduction in number of parasites to what can be considered an acceptably low level in four out of six sheep treated. A complete parasitological cure was achieved in one of the six sheep. Side effects were severe but no fatalities occurred at this level. At 60 mg/kg repeated on three occasions over five days it achieved a parasitological cure in two out of three sheep surviving the course of treatment, and caused the death of one out of four sheep treated. A farmer also reported a fatality in a group of sheep treated by him at this rate. It would appear to be dangerous to exceed a daily dose of 40 mg/kg. Whether lucanthone is dangerous at higher dosage rates because of its own toxicity, or because it causes a sudden death of parasites in the blood stream, with blockage of portal veins and the liberation of foreign protein, was not established.

None of these drugs had any effect on co-existing infestations with adult paramphistomes.

Value of treatment

Strydom[10], dealing with an outbreak of schistosomiasis in sheep and cattle in Zululand, did not seriously attempt treatment, as the animals were in an advanced chronic stage of the disease and repeatedly re-infested themselves at the drinking places. Treatment is laborious and expensive and very careful thought must be given to the economic return that may be expected from it.

Experience with outbreaks in sheep has underlined this point. By the time the condition has been diagnosed, mortality is high and the majority of the flock is in a pitifully thin condition, very anaemic and with severe liver and lung damage. In this trial even complete elimination of the parasites in one sheep failed to save its life, and animals that

did recover clinically, either following treatment or spontaneously, did so slowly at great cost in supplementary feeding. Additional antibiotic treatment for secondary infections and blood transfusions might save a greater proportion of the flock but would further increase the cost.

In an established outbreak the most economical course would seem to be to sell for slaughter all store or fat stock in reasonable condition, and to reserve treatment for breeding stock and weaners in which the disease is not too far advanced. Grossly emaciated animals are unlikely to give an economic return for care and treatment and should be destroyed. As with control of *Fasciola gigantica* infestation prevention is of paramount importance. Although apparently healthy animals may harbour infestations of 600 worms or more (4_+) without obvious ill effect, animals under stress, *e.g.* weaners and pregnant or lactating ewes, may die from relatively low levels of infestation of 100 worms or more (2_+). Outbreaks of schistosomiasis in sheep that have been encountered have all occurred where sheep shared with cattle watering points heavily infested with snails. It is essential for the successful raising of sheep in Rhodesia to provide snail-free watering facilities.

One further point must be mentioned. It could be expected, and there is already limited evidence to support this contention, that sub-clinical levels of infestation in sheep might have a suppressive effect on growth. If this is proved, and if the treatment is economically feasible, there is clearly a place for more widespread treatment of farm livestock not confined to those involved in clinical outbreaks of disease.

ACKNOWLEDGEMENTS

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*Gibbons, W.J. (1951). Vet. Med., *46*:397.

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SOME CLINICAL ASPECTS OF ITCH MITE *(PSORERGATES OVIS)* INFESTATION IN MERINO SHEEP IN SOUTH AFRICA

J. A. F. BAKER*

SUMMARY

1. Observations on some clinical aspects of itch mite *(Psorergates ovis)* infestation in Merino sheep in South Africa are presented and discussed.
2. A marked correlation between the degree of scurf deposit on the skin and the degree of mite infestation present on the animal was observed. This scurf deposit is considered an effective aid to the diagnosis of itch mite infestation.
3. Some correlation between a yellowish discolouration of the fleece and itch mite infestation was noted, this being more marked under conditions of increased relative humidity.
4. Varying degrees of allergic response towards itch mite infestations were observed and indicate a complicated sensitivity syndrome by sheep in the presence of this parasite.

INTRODUCTION

Since Carter[1] first described those abnormalities of the fleece and skin associated with *Psorergates ovis* infestations of Merino sheep, the subsequent literature concerning this parasite has not to any extent dealt with the symptomatology of such infestations. This dearth of information renders it difficult for uninitiated workers to assess the degree and morbidity of mite infestations in suspect flocks, without resorting to the laborious and frequently frustrating microscopic examination of numerous individuals.

During six years of investigation into chemical control of *P. ovis* many Merino sheep suspected of harbouring these mites were examined. Sufficient numbers of moderately to heavily infested sheep for inclusion in the experimental groups was an essential but initially difficult requirement due to the author's practical inexperience. It soon became apparent that certain clinical manifestations served as excellent diagnostic aids in selecting relatively heavily infested sheep from flocks also containing animals harbouring light or obscure infestations. By comparing the score of factors affecting the clinical appearance with the number of microscopically demonstrable mites on the sheep, a significant correlation between the extent and nature of macroscopic lesions and the degree of mite infestations was revealed.

To confirm these observations, scoring procedures were maintained throughout the course of the work subsequent to the initial investigations. In addition, notes were kept of various other factors relevant to the clinical aspect of itch mite infestation in the field as and when they were encountered.

EXAMINATION PROCEDURE AND SCORING METHOD

The scoring method was based on salient features easily recognisable in the field. These were scurf deposit, wool derangement and fleece discolouration. Age levels and degree of mite infestation for each animal were included.

A. Macroscopic Lesions

Downing and Mort[2] showed the greatest density of mite population to lie along the upper third of the body. This distribution was confirmed by sample scrapings from sheep carrying various degrees of mite infestation. Their method of examining the skin from the shoulders to the rump and for nine inches down each side was thus adopted in respect of scurf deposit and fleece discolouration assessments, on the assumption

* Cooper & Nephews S.Af. (Pty.) Ltd., Box 108, East London.

that the more mites present over this area of the body the greater would be the degree of such abnormalities in these regions. The relationship between scurf deposit and mite population was based on C.S.I.R.O. (Australia)[3] reports that the mites feed on epidermal cells which supposedly die off, slough away and are trapped in the fleece together with wax exudates to form a scurf deposit.

1. *Scurf:* May be confined almost entirely to skin level or be present both on the skin and scattered fairly evenly throughout the wool for varying lengths along the fibres, and is readily observed when the staple formation is partly opened to skin level. Examination is best effected in good natural light, but not direct sunlight. For outdoor inspection on cloudless days the shadow of the worker's body is an effective means of creating ideal light conditions. It is inadvisable to flatten the surrounding area of the fleece when the staple is parted as this creates an undesirable background and the view in depth is lost. For a like reason, scurf is not as readily detected on short woolled sheep.

The scurf varies considerably in appearance. It may be granular or flaky, dry or pasty, very white or ranging from pale cream to a deep yellow orange. Depending on the degree of mite infestation, scurf may be present in large amounts on almost any of the woolled areas of the body, and on bare skin in a pasty form, or appear as sparsely deposited particulate matter on isolated areas.

The degree and nature of scurf present was assessed by opening the fleece at eight points along either side of the back line. Scoring was as follows:

(i) Deposit.

(a) Very light: Sparse, scattered particulate deposit generally not observed at each fleece opening and confined virtually to skin level.

(b) Light: Scattered particles generally observed fairly readily at each fleece opening. Confined mainly to skin level or in the staple close to skin level.

(c) Moderate: Easily discernible layer of material at skin level at all points of examination. Sometimes pasty in texture and distributed as a granular or flaky mass within the bulk of the fibres at varying distances above the skin.

(d) Heavy: Easily discernible, dense layer at skin level at all points of examination. Often pasty in texture and distributed as a heavy granular or flaky mass within the bulk of the fibres at varying distances above the skin.

(ii) Texture.

(a) Granular: Resembling maize meal in appearance. Generally dry, loose and crumbly without any marked tendency for the particles to adhere to one another. Usually white in colour.

(b) Pasty: Paste-like mass of material distributed unevenly over the skin and adhering thickly to the base and shaft of the wool fibres. At skin level it does not necessarily resemble 'scurf' in the accepted sense of the word.

(c) Flaky: Invariably recorded in conjunction with 'pasty' scurf and occurring principally as an adherent to the fibres. Its formation and appearance suggest that it is the partially dried and flaked product of pasty scurf.

(iii) Colour.

(a) White: Flat white, or slightly off white.

(b) Discoloured: Light cream or pale yellow increasing to a deep golden orange hue.

2. *External Fleece Abnormalities:* Derangement of the exterior aspect of the fleece as viewed from each side of the sheep alternately, the whole being assessed collectively. Deliberately, no attempt at a critical survey of the fleece was undertaken. Each animal was appraised in a generalised manner and only those features visible from a distance of a few feet were considered. Apart from simplifying assessment, this system, without

necessarily losing any scientific value, more closely resembles the average field inspection method practised by stockowners or field staff.

Fleece derangement either by biting and/or rubbing is the most common, resulting in rubbed or 'brushed' flanks and rumps with wispy, loose fibres present, and rat-tail or tassel-like formation of pulled wool fibres varying greatly in length and quantity, hanging from the fleece. An uneven, lumpy appearance of an otherwise seemingly undamaged area of the fleece, beneath which the fibres are generally heavily cotted, may also occur. Invariably, the shorter the fleece length the less obvious are such derangement factors.

(a) No abnormalities: No derangement of the outer surface of the fleece, in effect an animal that would pass unnoticed in the course of a normal flock inspection.
(b) Slight abnormalities: Slight suggestion of biting and/or rubbing over localised areas of the fleece.

(c) Marked abnormalities: Marked evidence of biting and/or rubbing over localised or large areas of the fleece.
3..... *Fleece discolouration:* Examination of this factor was effected concurrently with that for scurf, with which it is, when present, always associated, particularly on the backline. In marked cases, however, it may be obvious almost anywhere within the woolled areas and appears as a diffused, even staining of the fibres, deeper in colour at skin level but reducing gradually in intensity along the staple length. Colour is always within the yellow spectrum, ranging from a very pale lemon to a deep golden orange. In the presence of slight staining, observation of a partly opened fleece area to determine the degree of discolouration is often assisted by viewing the site from more than one angle. Detection of this factor is not readily accomplished under short wool conditions.

(a) No discolouration: No detectable diffused staining of a yellow shade. An off white, or pale grey shade was adjudged to be non-discoloured.

(b) Slight discolouration: Any diffused staining on the paler end of the yellow spectrum, irrespective of the actual extent of the discolouration.

(c) Marked discolouration: Any diffused staining on the darker end of the yellow spectrum, irrespective of the actual extent of the discolouration.

B. Age Determination

No reliable estimation of the ages of the sheep could be obtained, thus age based on dentition only was recorded. Lambs were classed as those animals still retaining their deciduous incisors, or in the process of shedding these incisors, that is up to the age of approximately 15 months.

C. Degree of Mite Infestation

Following selection based on one or more of the macroscopic lesions described above, a single skin scraping was made from each animal which served to establish, if mites were observed,

(i) definite diagnosis of infestation, and,

(ii) degree of mite infestation present.

For convenience, a standard scraping site four inches square, corresponding to that described by Downing and Mort[2] as the 'upper left side,' was chosen. The modified scraping technique as suggested by these workers was employed for mite removal with the exception that a blunt-edged, fairly broad bladed knife, able to transfer all the recovered oil and debris from the site to the slide in one operation, was used in place of a scalpel. Mites were recorded as either adults or immatures, all stages of nymphs and the larvae being included in this second category. In the presence of low mite populations, the slide was searched completely and an accurate count made. Where large numbers of mites were encountered, the scraped material was distributed as evenly as possible over the surface area of a vertically ruled glass slide and two or more of the sections counted. Totals were thence estimated by simple multiplication. Complete counts were taken at intervals to ensure that reasonable fiducial limits were being maintained.

The degree of infestation recorded in respect of each individual was arbitrarily based on the following total mite counts per slide:—

1—25 — Light infestation

26—99 — Moderate infestation

> 100 — Heavy infestation

Anticipating that an assessment established by the examination of a single site could be influenced by an erratic mite distribution pattern, occasional counts were made from other sites on the backline. Marked proportional similarities but on a lower numerical plane were revealed, corroborating Downing and Mort's [2] findings on the distribution density of mite populations, and suggesting that this pattern of distribution is reasonably consistent in adult sheep, regardless of the degree of infestation.

Animals revealing no mites following a single scraping were not included in the experimental groups. A number of scrapings taken over the predilection area of the backline from these animals might be made before mites could be recovered, although in many instances this did not produce a positive diagnosis irrespective of the clinical appearance of the individual.

D. General Procuderes

The search for mite infested flocks was conducted almost entirely during the late winter and spring months. This procedure was intentional, having regard to:

(i) Ecological factors favouring an increase in mite populations on the host at this period of the year as suggested by Moule [4] and Sinclair [5], and the observations of Armstrong [6] that diagnosis is difficult to confirm during January, February and March.

(ii) The main shearing season in South Africa, commencing with the advent of summer, enabled the viewing of sheep in long wool, the most favourable state in which to assess the extent and nature of the various macroscopic lesions involved.

(iii) The observation that some correlation existed between physical health and mite infestation, and the acceptance that veld grazed sheep are, during this period, generally in poorer condition than at any other time of the year due to the existing low nutritional plane.

(iv) The scope of this work being directed principally towards chemical control of mite infestations, it was desired to inspect, assess and classify into experimental groups all selected sheep at a period as close to shearing as possible, thus reducing to a minimum the time lag between inspection and post-shearing treatment.

E. Post-Shearing Examinations

Most of the sheep were shorn during October of each year. The remainder, which had undergone slightly earlier or later shearings, in September or November respectively, are, for convenience, expressed as October shorn. Post-shearing examinations were divided into three parts, 'Summer' inspections (January-February), 'Autumn' inspections (April-June), and 'Winter' inspections (July-October), this final inspection period incorporating an immediate pre-shearing examination. Visits were made every two months within these prescribed periods at which both macroscopic lesions and the presence of mites were recorded.

Skin scrapings conducted at these inspections were solely a check on the presence of mites and not a means of establishing degrees of infestation. The 'upper left side' site, on which this specific assessment was initially based, was left untouched for twelve months and only used again immediately prior to the next shearing, when a comparative mite population figure was once more determined. In the interim, two adjacent sites were examined, as were three corresponding areas on the right side, one site only being scraped at each visit.

A routine scrutiny for various other clinical factors similar to those induced by itch mite infestations was made. Where doubt existed as to the cause of the lesions, these were ignored.

F. Locality

The properties employed were all situated in the Eastern Cape Province, nineteen in the higher rainfall grassveld regions, (28-33 inches per annum) and eight in the lower rainfall Karoo and semi-Karoo areas (12-19 inches per annum). Most of the grassveld farms were below 1800 feet in altitude with those on the coastline averaging 600-800 feet. Mild winter climates with little or no frost were experienced on these coastal properties.

Under Australian conditions, emphasis has been placed on altitude range and cold winter seasons for mite development[2]. The well-established coastal infestations encountered do not indicate that this is the case in South Africa. In this regard, observations on the humidity requirements of the mites[7, 2] could seemingly be of greater importance considering the high relative humidity of the eastern Cape littoral.

RESULTS, DISCUSSION AND CONCLUSIONS

Relationship of scurf deposit to mite infestation

Figure 1 reflects the degree of scurf recorded in respect of 575 sheep with varying degrees of mite infestation on 22 different farms over a four year period. Examinations were undertaken prior to spring shearing on each occasion. Of this total, 204 sheep were lightly mite-infested, 69% of which showed light scurf deposits and 31% moderate/heavy scurf deposits. One hundred and eighty one were moderately mite-infested, 13% of which showed light scurf deposits and 87% moderate/heavy scurf deposits. One hundred and ninety sheep were heavily mite-infested, 3% of which showed light scurf deposits and 97% moderate/heavy scurf deposits.

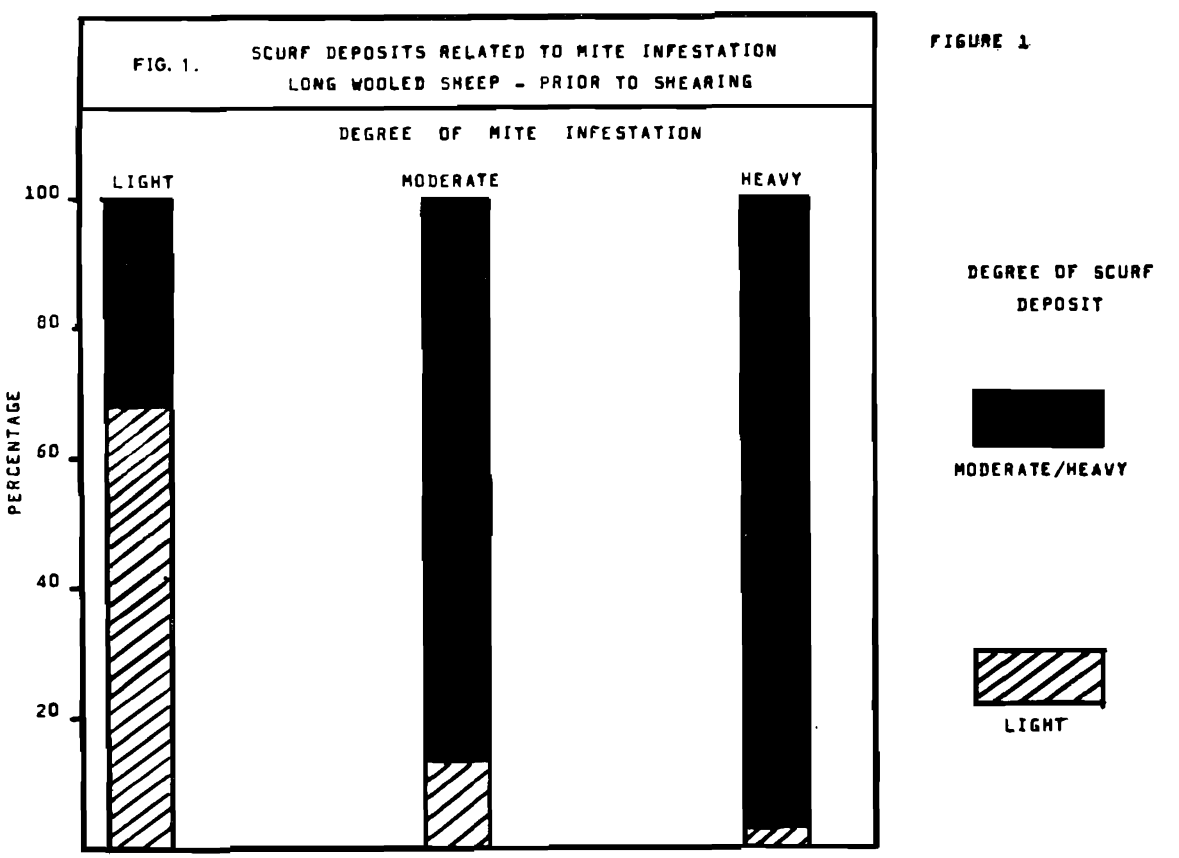
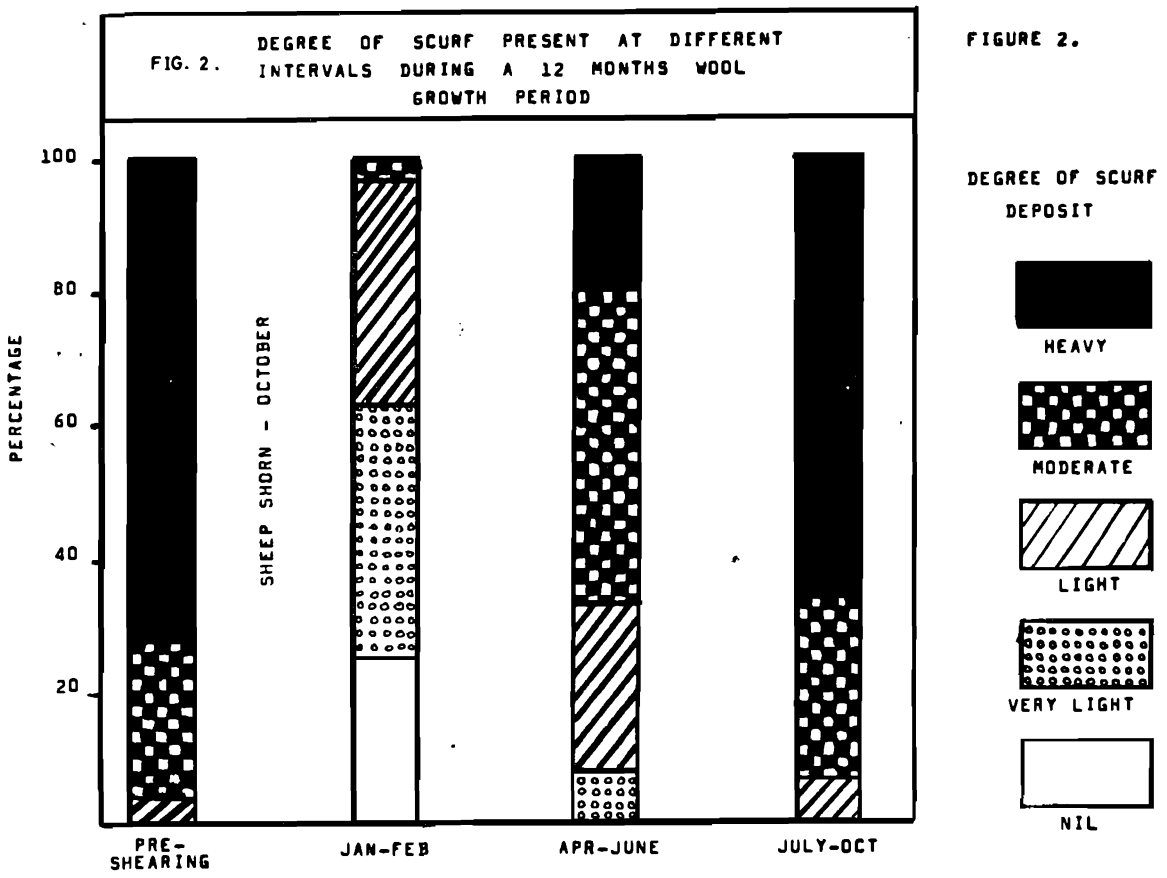


FIGURE 1

Figure 2 reflects the degree of scurf recorded in 95 sheep distributed over nine farms during the course of a twelve month cycle. All sheep were moderately to heavily mite-infested at the initial pre-shearing examination and again at the completion of infestations, such scurf deposits would probably be reduced to a hardly detectable degree during the first 6-8 months of the wool growing season.

It has been observed that, under natural grazing conditions, shearing alone can reduce



the period. Low mite activity was recorded during January-February, an increase in this activity occurring during the April-June period.

A marked reduction in the degree of scurf deposit occurred during the period of low mite activity. This increased accordingly with the development of infestations during the winter period, culminating in a scurf deposit/mite infestation relationship at the completion of the period remarkably similar to that observed at the commencement of the cycle. In the presence of lighter mite the resident mite population by as much as 80% or more [2]. The period of low mite activity experienced, leading in turn to a decreased scurf production, was therefore not unexpected. In addition, shearing has been shown to be a major factor in the mechanical removal of scurf.

A distinct correlation is shown to exist between the degree of scurf and the attendant mite population and the value of this factor as a clinical aid in the diagnosis of moderately to heavily mite-infested sheep is obvious.

The nature alone of the material recover-

ed in skin scrapings can often indicate the presence and degree of mite infestation. The smooth, pink, healthy skin of a non-infested animal yields a clear film of oil, free of foreign matter. Debris recovered from the skin of mite-infested sheep increases proportionately to that of the mite infestation present. Heavy scurf deposits result in a thick porridge-like mass requiring the addition of extra mineral oil as a diluent before microscopy can be satisfactorily accomplished.

Although scurf is commonly referred to in the literature, it is surprising that so little significance has been given to the value of this symptom in the detection of infested sheep in the field.

Relationship of Fleece derangement (sensitivity) to Mite infestation

Figure 3 reflects the degree of fleece derangement recorded in those sheep appearing in Figure 1.

Of the 204 lightly mite-infested sheep, 56% showed some fleece abnormalities. Of the 181 moderately mite-infested sheep, 34% showed some fleece abnormalities. Of the 190 heavily mite-infested sheep, 17% showed some fleece abnormalities.

These results reveal a marked lack of reaction on the part of any of these sheep to mite irritation, this influence becoming more evident with the increase in infestation.

Several workers have previously drawn attention to this factor. Graham[10], Davis[11], Downing and Mort[2] (who likened it to the sensitivity cycle in humans described by Mellanby[12] in the presence of *Sarcoptes scabiei* infestations), Sutherland[9] and Roberts *et al*[13], have all described low mite infestations accompanied by extensive signs of fleece derangement, and, *vice versa*, a normal fleece appearance in heavily infested sheep. The significance of the results prompted further studies in this respect.

A farm flock of 345 young sheep (two and four incisors) carrying seven months' wool growth was inspected individually and sorted into the categories listed in Table 1.

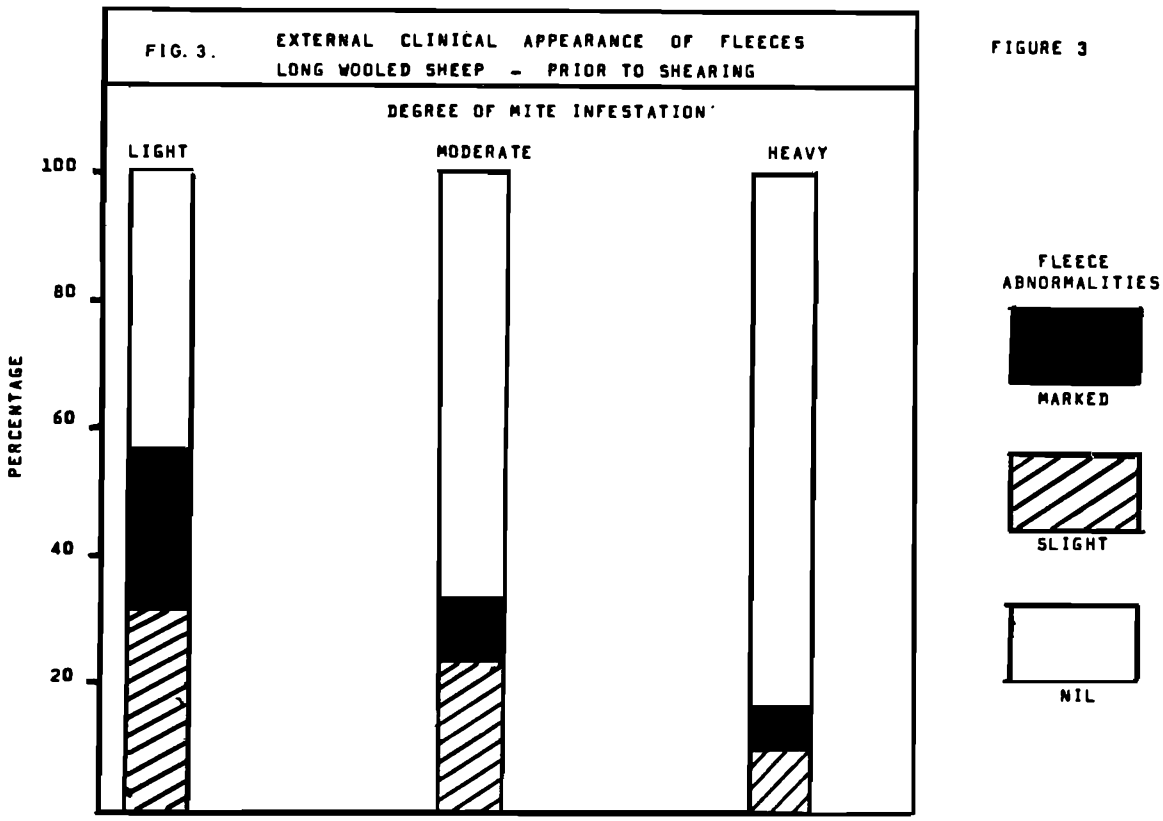


FIGURE 3

Table 1: MITE RECOVERY FROM SHEEP SUFFERING VARYING DEGREES OF CLINICAL SYMPTOMS— ONE SCRAPING SITE ONLY EMPLOYED PER SHEEP

Nature of clinical symptoms present	Total of sheep in each category	Total of sheep from which mites recovered	Degree of mite infestation		
			Light	Moderate	Heavy
Fleece derangement only	44	2	2	—	—
Fleece derangement plus very light scurf deposit	16	4	4	—	—
Fleece derangement plus light-heavy scurf deposit	14	14	8	2	4
No fleece derangement. Light-heavy scurf deposit	20	20	2	6	12

In all, 94 of the flock possessed detectable clinical manifestations of itch mite infestation. Of these, 60 sheep showed fleece derangement in the presence of light or not easily detected infestations. Only 14 of the remainder evidenced external fleece abnormalities, despite significant increases in mite populations.

Twenty five young sheep (two incisors), from a flock with a long history of mite infestation and no record of treatments, were observed for a twelve-month period. These animals were moderately to heavily infested at the initial pre-shearing period, and all possessed fleece derangement to a greater or lesser degree. (Figure 4).

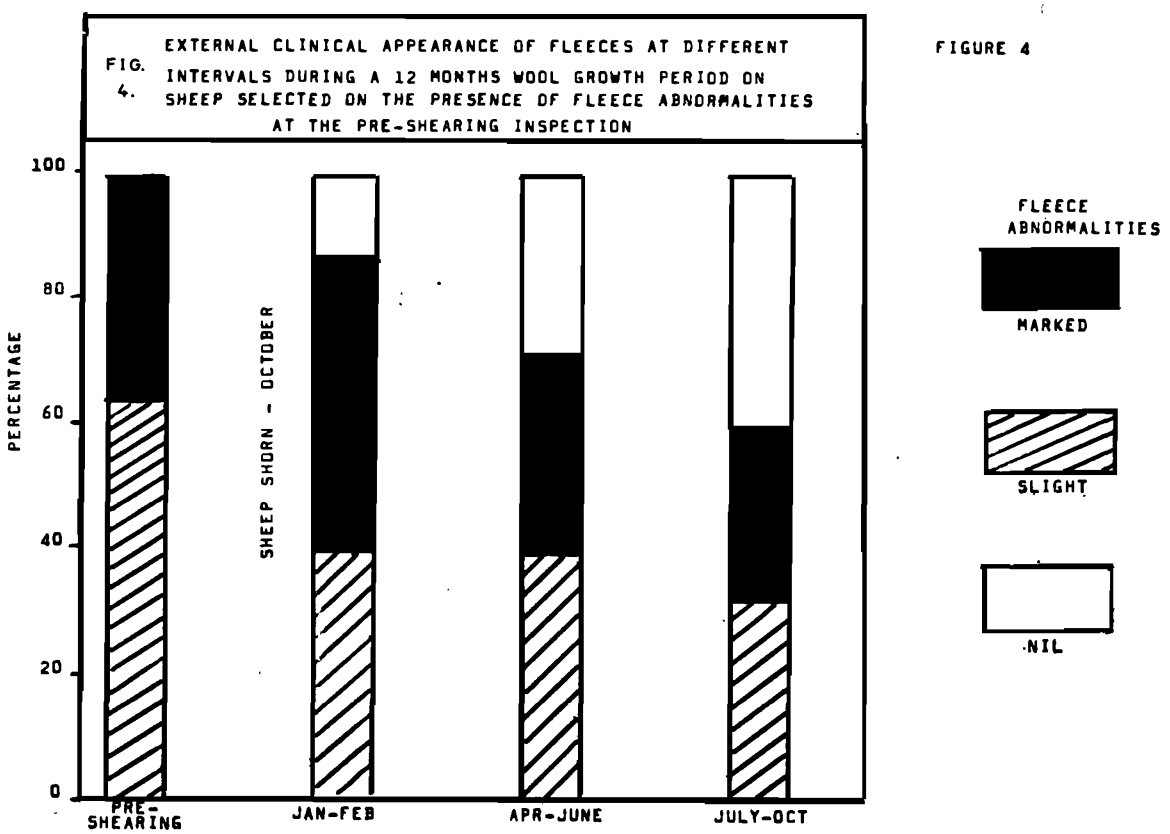


FIGURE 4

An increase in the number of animals suffering marked abnormalities four months after shearing, from 36% to 48%, was revealed. It is postulated that following a marked post-shearing drop in infestation and a subsequent seasonal decline in the surviving mite population, a transient state of increased sensitisation is exhibited by certain individuals, subsiding again as the resident mite infestation increases. The observation that a persistent mild irritation of the skin occurs during the warmer months of the year [14] could possibly be so explained. The demonstration of a state of desensitisation in a number of these lambs during the twelve-month period, confirms field observations that more young sheep in an infested flock will show fleece derangement than older animals. This is particularly true of weaned lambs in that wool growing period following their initial 'topping' and first true shearing. Severe reactions, however, similar to that noted for lambs, have been observed in 4-incisor, 6-incisor and full mouth ewes, wethers and rams, when mites have been introduced into a previously non-infested flock.

The sensitivity syndrome, if it is to occur, is therefore likely to follow a fairly set course at any stage of a sheep's life. This could be acute initially, but in most cases reducing in severity over an undetermined period until no visible clinical manifestations of irritation are apparent.

The degree of mite control practised is also likely to influence the sensitivity syndrome. Irregular treatment or only partially effective dipping materials could result in the maintenance of a higher percentage of lightly infested animals of all ages, exhibiting proportionately more fleece abnormalities, than would be present in infested flocks receiving no treatment at all. The mechanical interference caused by short interval (6-9 months) shearing procedures, especially when undertaken during the cooler months of the year, will further interfere in the normal development of mite populations.

However, some older sheep within flocks having an extensive history of mite infestation do continuously have marked fleece abnormalities. Small scale observations were instigated to observe this aspect. Four heavily mite-infested sheep suffering fleece derangement and four animals with no external abnormalities but also heavily mite-infested, were selected from a known, untreated flock. The state of dentition of all eight sheep suggested that they might just survive a proposed two year period. No previous infestation or clinical history of the selected animals was available but it was presumed that their infestations were of long standing, allowing ample time for the demonstration of a sensitivity syndrome.

Scoring for fleece derangement was altered to accommodate a more detailed analysis; "slight" and "marked" abnormalities being divided into sub-categories of "very slight" and "slight" and "moderate" and "heavy" respectively. The expression of this modified nomenclature is self-explanatory. A record of the degree of scurf deposit was also maintained. Scraping examinations were made only at the initial pre-shearing period, and at the completion of each year's wool growth, in order not to interfere with the appearance of the fleece. A heavy mite infestation was revealed at each inspection on all eight animals.

All four sheep having external fleece damage retained this feature throughout the two year period, indicating a continuing and sustained allergic response to mite infestation. No signs of fleece damage were revealed in the other four animals at the end of each annual cycle.

Evidence of very slight abnormalities shown by sheep Nos. 5 and 7 at the time of the summer, and, in the case of No. 5, also the autumn examinations, is confirmatory to the transient sensitisation factor already reflected in Figure 4. A lack of uniformity of the sensitivity cycles of sheep 1-4 is evident, indicating that the sensitivity syndrome is not entirely absent in animals exhibiting continued skin irritation. It is suggested that some sheep may never attain a desensitised state, or only after protracted exposure to mite irritation. Conversely others may not show sensitivity at any stage, or become desensitised within a short period of time after infestation.

It has been postulated that there is an itch condition of sheep not associated with external parasites or other foreign body irritation [8]. The varying degrees of sensitivity evidenced by lightly infested sheep and the difficulties experienced in demonstrating live mites on such animals, may be one explanation of this phenomenon. Attempts at mite recovery by the single-site scraping technique in newly infested flocks have yielded frustratingly low numbers of positive

Table 2: VARIATION IN CLINICAL APPEARANCE BETWEEN TWO GROUPS OF SHEEP OVER A TWO-YEAR PERIOD

Clinical Appearance	Identity	Pre-shearing 1964	First Post-shearing period 1964—65			Second Post-shearing period 1965—66		
		October	Jan.-Feb.	Apr.-June	July-Oct.	Jan.-Feb.	Apr.-June	July-Oct.
Fleece Derangement	1	+ + +	+ +	+ +	+ +	+ +	+ +	+ + +
	2	+ + +	+ + +	+ +	+ +	+ + +	+ +	+ +
	3	+ + +	+ +	+ +	+ + +	+ +	+	+ + +
	4	+ + + +	+ + +	+ + +	+ + +	+ +	+ + +	+ + + +
Scurf Deposit	1	+ + + +	+	+ +	+ + + +	−	+ +	+ + + +
	2	+ + + +	+	+ + +	+ + +	+	+	+ + + +
	3	+ + + +	−	+ +	+ + + +	−	+ +	+ + + +
	4	+ + +	−	+ +	+ + + +	+	+ +	+ + + +
Fleece Derangement	5	−	+	−	−	+	+	−
	6	−	−	−	−	−	−	−
	7	−	+	−	−	−	−	−
	8	−	−	−	−	−	−	−
Scurf Deposit	5	+ + + +	+ +	+ + +	+ + + +	+	+ +	+ + + +
	6	+ + + +	+	+ + +	+ + + +	+	+ + +	+ + + +
	7	+ + + +	−	+ +	+ + + +	+	+ +	+ + + +
	8	+ + + +	+	+ +	+ + +	−	+ +	+ + + +

− : Nil + : Very slight + + : Slight + + + : Moderate + + + + : Heavy

cases despite obvious fleece damage. A combined total of 80 lambs in four flocks aged between 8 and 15 months yielded only one moderately and twelve very lightly infested individuals.

A further form of sensitivity persisting in some sheep after the eradication of a previous mite infestation (Table 3) could be another explanation.

Of 137 sheep having fleece derangement at the pre-shearing examination prior to treatment, 14 individuals had continuing sensitivity during the subsequent twelve months. The remainder did not have any macroscopic fleece lesions at any time.

That mite eradication on these animals cannot be categorically claimed is acknowledged, but the weight of evidence strongly suggests that this was in fact achieved at the completion of the period. Scraping examinations at the prescribed intervals followed by the intensive mite search at the end of twelve months, all failed to reveal live mites. In spite of this, symptoms of irritation persisted for periods of as much as twelve months, manifesting themselves principally within the first four months after treatment.

A variation in the pattern of allergic response, such as recorded for human scabies, in which the distribution of irritation of the skin does not coincide with the actual distribution of the mites [12], has been observed in mite-infested sheep by Davis [11].

Although ineffectual treatment allowing localised mite development could have given rise to such an allergic response in these animals, the possibilities of such an occurrence remaining undetected must be precluded.

Two variations of the sensitivity syndrome of humans in the presence of scabies have been quoted. Reviewing the results recorded in Table 3, it is of interest to cite Mellanby [12] once more on this subject:

'After the patient was cured, the itching sensations by no means disappeared. Several individuals have reported that the sites of

Table 3: EXTERNAL CLINICAL APPEARANCE AT INTERVALS DURING 12 MONTHS OF WOOL GROWTH. SHEEP APPARENTLY FREE OF MITE INFESTATION AT THE COMPLETION OF THE PERIOD

Identity	Degree of Mite infestation	EXTERNAL CLINICAL APPEARANCE				SECOND PRE-SHEARING PERIOD		
		Pre-shearing October	POST-SHEARING PERIOD			Associated macroscopic lesions	Recovery of mites	Number of scraping sites per sheep
			Jan.-Feb.	Apr.-June	July-Oct.			
1	Light	+	+ +	+	−	Nil	Nil	18
2	Light	+ +	+	−	−	Nil	Nil	18
3	Light	+ +	+	−	−	Nil	Nil	8
4	Light	+	+	+	−	Nil	Nil	8
5	Light	+	+	−	−	Nil	Nil	8
6	Light	+ + + +	+ + +	+ +	+	Nil	Nil	10
7	Moderate	+ +	+	+	−	Nil	Nil	12
8	Moderate	+	+ +	+	−	Nil	Nil	8
9	Moderate	+	+ +	+	+ +	Nil	Nil	24
10	Moderate	+ + +	+ +	+	+	Nil	Nil	24
11	Heavy	+	+	−	−	Nil	Nil	8
12	Heavy	+	+	−	−	Nil	Nil	8
13	Heavy	+ +	+ +	+	−	Nil	Nil	10
14	Heavy	+ + +	+ +	+ +	+	Nil	Nil	24

− : Nil + : Very slight + + : Slight + + + : Moderate + + + + : Heavy

the old burrows itch intermittently, giving feelings very similar to those experienced when the living parasites were there. The generalised skin sensation also persisted in certain cases.'

How far the bionomics of human scabies can be related to that of itch mite infestations in sheep is most contentious, but the various analogies recorded, if not necessarily indicating relationship, do impart the idea of most marked similarities.

A third type of sensitivity syndrome existing in sheep must therefore be considered. As this may persist for a considerable period after treatment and manifest itself clinically as a fleece derangement factor, it is suggested that in some instances the condemnation of otherwise effective commercial dipping compounds by the user may actually be due to an allergic response by the individual to a past infestation rather than a true acaricidal failure.

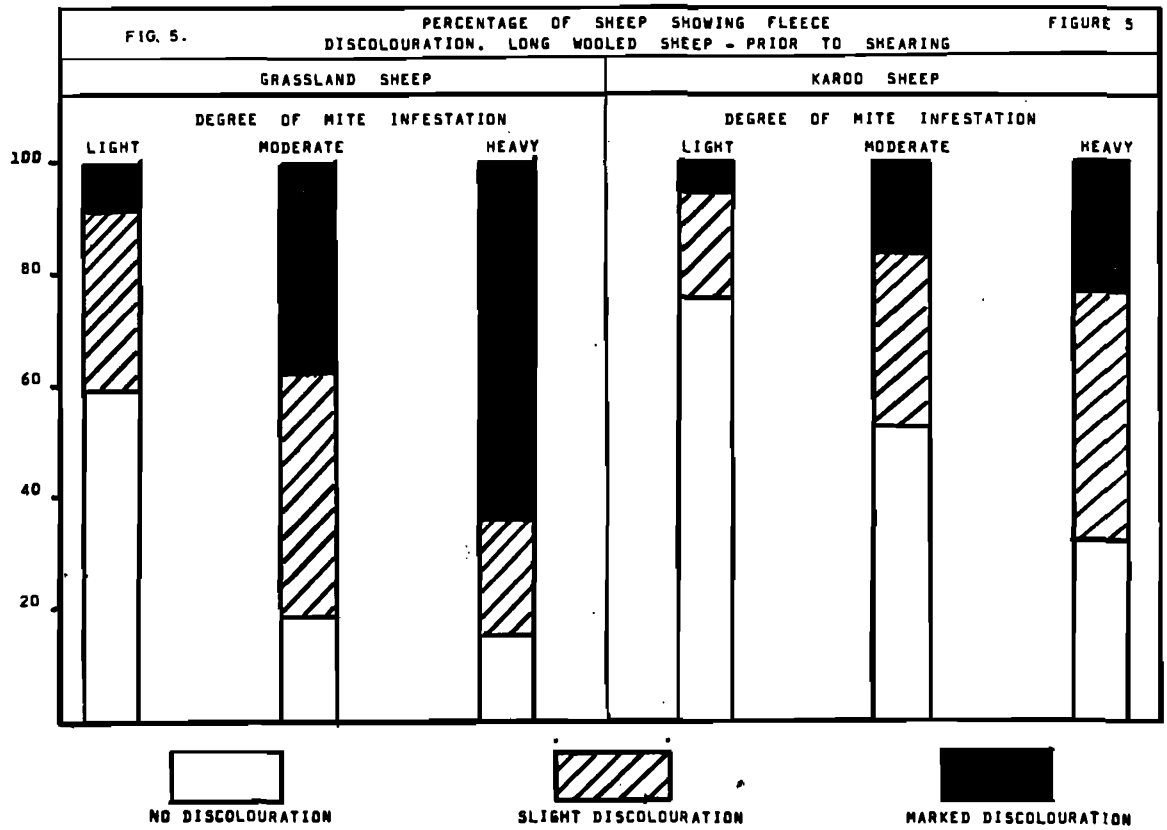
Relationship of Fleece Discolouration to Mite Infestation

Carter[1] when first recording *P. ovis* infestations, drew attention to a 'slight yellow fleece discolouration' that may be present. Apart from Downing and Mort[2], who reported wool pigmented a bright orange linked to heavy mite populations in certain instances, and Sutherland[9], who found that excessive skin scurf was often yellowish in colour, little subsequent reference has been made to this feature.

In this work observations indicated that variations in the degree of discolouration were partly depedent on mite infestation and different climatological grazing regions. Results from seven Karoo farms (lower rainfall area) and seven grassland (higher rainfall) properties are compared. (Figure 5). Groups of 50, 51 and 50 sheep each in the respective mite infestation categories are shown for the Karoo region. Totals of 101, 87 and 92 sheep comprise the respective grassland groups.

The results show a significant increase in the percentage of sheep with marked fleece discolouration occurring concomitantly with an increase in mite population, and that the fleeces of animals exposed to more humid surroundings are most likely to be stained.

Consideration can be given to the rôle of various micro-organisms, which are known to thrive under prolonged and excessive moisture conditions in the fleece, as respons-



ible agents of this discolouration. Hayman [15] has shown that fleece rot lesions on the skin, induced by excess moisture retention, provide excellent growth media for bacteria, including chromogenic organisms, which may multiply and produce fleece discolouration. Although the degree of moisture retention by skin scurf is unknown, the 'pasty' texture, so often associated with staining and a high mite count, suggests that this may well be considerable. The skin of infested sheep could thus remain damper for longer periods than that of mite-free animals, creating, in turn, favourable conditions for development of micro-organisms.

The hygroscopic nature of wool in the presence of the higher degree of atmospheric moisture experienced throughout the grassland grazing areas, would conceivably encourage the maintenance and further proliferation of various fleece bacteria. Other causes of yellow discolouration in wool not directly attributable to bacterial activity [16] could also be responsible.

Over-stimulation of the sebaceous glands by mite activity, leading to an increase in the suint output, has been suggested as a complementary factor in this staining, especially as a high suint content in the fleece is associated with 'canary yellow' discolouration.

The fact that a number of heavily mite-infested grassland sheep revealed no discolouration at all, is of interest. Mulcock [16], citing the work of Hayman [15] and Henderson [17], observes the division of sheep into two groups, those which are susceptible to bacterial discolouration of the wool and the growth of micro-organisms at the base of the fleeces generally, and those which are resistant. If of bacterial origin, this could well be an explanation.

Degree of Mite Infestation within Flocks

Forty eight lambs, 107 two-incisor, 65 four-incisor and 48 six-incisor and older animals from an untreated flock were preselected and microscopically examined (Figure 6). Only those sheep, on which scurf deposits were observed, are included (Table 4).

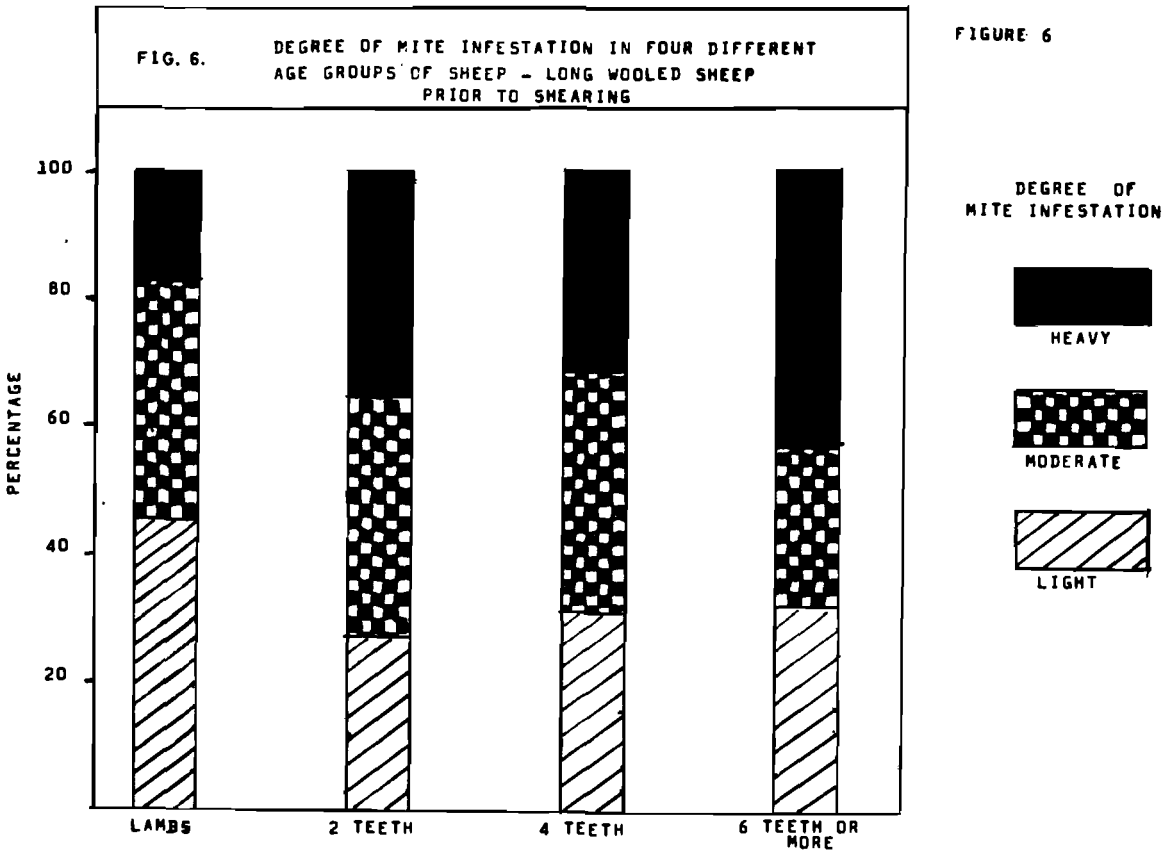


Table 4: COLLECTIVE DATA INDICATING VARYING DEGREES OF SUSCEPTIBILITY TO MITE INFESTATION BY SHEEP OTHER THAN LAMBS

Results transposed from	Total sheep	DEGREE OF MITE INFESTATION					
		Light		Moderate		Heavy	
		Total sheep	% of Total	Total sheep	% of Total	Total sheep	% of Total
Figure 1	575	204	34.8%	181	30.9%	190	32.3%
Table 1	50	16	32.0%	14	28.0%	20	40.0%
Figure 5	280	101	36.1%	87	31.1%	92	32.8%
	151	50	33.1%	51	33.8%	50	33.1%
Figure 6	220	64	29.1%	76	33.6%	78	38.3%

Comparing the results already presented with those of Figure 6, roughly one-third of all sheep examined, other than the lambs, falls into each of the three arbitrary categories of infestation with no significant variation in the distribution within these categories. As all the animals were reared on the same property and probably without exception acquired their infestations at an early age, the possibility that varying degrees of suceptibility to mite infestation exist within any group of sheep older than lambs is postulated.

The results from the same sheep were used to construct figures 1 and 5. Although these results do not yield separate information, they are, by virtue of their being differentiated geographically, of added interest in this context.

Effect of Culling.

In South Africa many stockowners cull on the basis of fleece derangement if itch mite infestation is suspected. Bell *et al.*[18] have reported similar practices in the U.S.A., whilst personal observations have confirmed this habit in local areas of Australia. Undertaken in the belief that an undesirable condition is thus being eradicated, this widespread misconception is based largely on ignorance.

Ironically, a comparison of the results of Figures 1 and 6, and Table 4, shows that culling on fleece derangement could actually increase the percentage of more heavily infested animals in a flock. On this basis, approximately 80% of the heavy infestations, 68% of the moderate infestations and 30% of the light infestations could be overlooked, that is, about 62% of all sheep harbouring the greater number of mites. The implications are obvious and could be far reaching in farm flocks where poor control methods are carried out.

Self-cure Phenomenon

Du Toit[19] reported that an apparent self-cure mechanism asserted itself when sheep were retained under artificial conditions. Neither Downing and Mort[2] nor Sutherland[9] observed this factor, although the latter author suggests this may have been due to the small number of sheep seen.

Prior to spring shearing, 43 infested adult sheep in poor physical condition were moved from one farm to another. Although 50 miles apart, both farms were within much the same climatological region. Detailed examinations 12 months later revealed that 26 of these sheep were negative for mites. The remainder showed no change in mite infestation. After a further twelve-month period, eight of the 26 non-infested sheep were again examined with the same negative result. The chief factor implicated in this probable self-cure mechanism was the dramatic change in bodily health of these sheep following vastly improved husbandry methods, the increased physical resistance thus acquired being presumably instrumental in effecting a cure.

Two infested sheep in similarly poor condition were despatched to the Veterinary Research Institute, Onderstepoort, from the same flock. After approximately nine months of artificial housing, recovery of mites from these individuals could not be effected[20].

Observations suggest that a significant correlation between animal health and mite infestation exists. Invariably, the highest percentage of mite-infested sheep have been encountered on those properties where poor stock management is practised. Many of the mite-infested sheep within a flock can be conveniently isolated by drafting sheep slowly through a gateway and cutting off the last quarter, on the assumption that most of the poorer physical specimens will be included in this batch.

A graphic comparison between the physical appearance of groups of infested and non-infested sheep from within the same flock can be obtained if such animals are viewed side by side.

Differential Diagnosis.

When inspecting sheep, the principle of accepting any clinical abnormality of the wool, externally or within the fleece, or of the skin, as a possible indication of itch mite infestation, may be considered the most practical approach. In this regard, the acquisition in the first instance of a sound mental image of the appearance of the wool and skin of a healthy non-infested animal is most desirable.

Wool break as a result of various stress factors such as febrile reaction, low nutritional plane, dipping scald, induces a loose, markedly ragged appearance of the fleece. A white, powdery deposit, with the appearance of talc having been lightly sprinkled throughout the fleece, is often present and may be confused with skin scurf.

Other ectoparasites of sheep; psoroptic,

sarcoptic, chorioptic and demodectic mites, lice, keds, blowfly larvae, harvest mites and ticks induce irritation and/or skin lesions and consequent fleece derangement, and, in addition, contaminate the fleece with faeces, moulted skins, nits, etc. Some may produce a rather loose, scurf-like deposit and a discolouration reminiscent of that associated with itch mite infestation. The intense irritation seen in scrapie could also be associated erroneously with itch mite infestation.

The puncturing of the skin by thorns or by the seeds of grasses such as 'assegaai' *(Heteropogon contortus),* or 'steekgras' *(Aristida* spp.) may cause irritation and biting at the site. The saturation of wool contaminated by leaves, soil or other foreign matter in periods of wet weather often induces fibre staining. Fleece 'combing,' especially of the flanks, of those sheep grazed in bushy areas is very suggestive of rubbing.

Mycotic dermatitis, due to the wide variation in appearance in which it can be manifested within the fleece, is probably the most confusing factor to the observer. Advanced cases are easily recognisable, but in the absence of any hardened projections at skin level, the degree of fleece discolouration and the deposit of scurf-like material on the skin or in the fleece can easily be likened to that produced by mite infestation. Microscopically, however, most of this material is shown to consist of hard, irregularly shaped granules which do not readily clear in the scraping oil as does the bulk of the true scurf deposit. Fleece discolouration, although often of a diffuse nature, is generally limited to localised areas and not evenly distributed as that resulting from mite infestations. More commonly, as in the case of fleece rot, staining arising from this cause is of a banded appearance with some lateral matting of the wool fibres along the length of the banding.

'Fleece condition' or 'yolk rise' are terms employed to describe a diffuse golden yellow discolouration in the fleece of uncertain origin, which, in some instances, is a much sought after characteristic. The bright, clean appearance of such wool is in direct contrast to the dull, lustreless discolouration shown by that staining associated with mite infestation.

Other macroscopic lesions associated with mite infestations.

Colour changes on the skin, referred to by Carter[1], who observed 'a leaden hue alternating with areas of normal skin colour,' Downing and Mort[2], who employed the term 'blue tinge,' and Sutherland[9], who refers to 'bluish grey,' were found difficult to analyse effectively and were not included on the score card. The masking effect of a layer of scurf may prohibit the easy assessment of skin colour, whilst on animals having fleece abnormalities and only very light scurf, or no scurf at all, the cause of an alteration in skin colour underneath deranged wool could be due to mechanical damage rather than acadrial action. The findings of Hayman[15], that the colour of the skin beneath wet wool was usually purple in tone in contrast to the normal pink tone seen elsewhere on the body, could also be a confusing factor in high rainfall areas.

Tiny, scattered, 'pin head' abscesses on the skin after clearance of heavy mite infestations were observed on a number of animals. Expression of the contents was not readily accomplished by gentle pressure with a blunt probe, suggesting a siting at some depth below the surface. The contents were periodically examined for the presence of mite bodies with negative results. Grass seeds or tick bites were suspected as a causal factor, but, as fellow sheep without previous histories of mite infestation were free from such lesions, it is suggested that a secondary bacterial infection was responsible.

Reduction in the tensile strength of wool fibres from sites of excessive derangement was observed; large staples could be removed with ease without damage to the skin. The removal of the entire length of the fibre suggested a marked weakening of the whole follicle structure. If 'pasty' in consistency, little of the original scurf deposit remained on the exposed site, the mass of such material adhering to the extracted staple. Skin scrapings taken on these sites resulted in relatively low mite counts, with a preponderance of immature stages, compared to those taken from contiguous, undisturbed areas. This is confirmatory in part to Murray's[7] description of the distribution of the mite stages on and within the skin. Staple length from sheep of this nature was much reduced relative to that shorn from lightly or non-infested animals in the same flock. Grossly infested sheep without external fleece abnormalities did not have these defects.

GENERAL CONCLUSION

The value of certain clinical aspects that can be related to the degree of itch mite infestation on sheep are indicated by the results. Many and complicated manifestations are apparently associated with this form of parasitism and much more exploratory work has yet to be undertaken before the full significance of such aspects can be determined.

The economic factor concerned in itch mite infestations is considered grossly underrated due largely to the customary interpretation of economic losses being based on visible fleece damage only. A more comprehensive survey of the problem will undoubtedly place this matter in its true perspective.

The education of the stockowner to *P. ovis* infestations in his flocks is desirable. Commonly encountered reluctance to discuss the subject suggests that in South Africa something of a stigma is attached to this parasite. Why this should be is difficult to understand when, at the same time, control and biology of other parasites, either external or internal, are openly and exhaustively deliberated upon. The only partly understood implications involved are probably largely contributory.

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A RECORD OF THE MITE, *SPELEOGNATHUS AUSTRALIS*, IN BOVINES IN SOUTH AFRICA

R. DU TOIT*

The presence of *Speleognathus australis* Womersley 1934 (Acarina, Ereynetidae) is recorder in the upper respiratory passages of two bovines.

INTRODUCTION

In 1934 Womersley[1] described a mite taken from moss at Glen Osmond, Adelaide, South Australia for which he created the new family Speleognathidae in the order Acarina and the new genus *Speleognathus*, describing as the type *S. australis*, which, presumably, he regarded as a free-living species.

Fain[2], in 1955, discovered a mite which differed in only minor respects from that of Womersley, inhabiting the upper respiratory passages and related sinuses of cattle at Astrida in Ruanda Urundi. Due to its locality and to certain minor differences in chaetotaxy, Fain named this mite *Speleognathus bovis*. Zumpt[3] regards *S. bovis* Fain as a synonym of *S. australis* Womersley and places it in the family Ereynetidae which Fain[4] has divided into three sub-families. The members of the Speleognathinae inhabit the respiratory system of birds and mammals, while those of the subfamily Lawrencarinae are found in the head cavities of toads, and the Ereynetinae are either free-living or parasitic in Mollusca.

OBSERVATIONS

On August 15, 1968 my attention was drawn to the presence of numerous very small mites found moving very actively on the mucous membrane covering the nasal septa and turbinate bones of two bovines which were being examined *post mortem* at Onderstepoort. On closer examination it was found that the paranasal sinuses contained large numbers of these mites which extended into the frontal sinuses as far as the bases of the horns.

Few if any pathological lesions associated with these mites appeared to be present, other than a very slight catarrh.

Specimens were collected, mounted and photographed. Figure 1 indicates the general appearance of the mite while Fig. 2 illustrates the characteristic mosaic pattern covering the coxae and legs. Fain's description details other features of these mites, notably a variety of branched hairs and ovoid, ciliated spines present on the palps, legs and body.

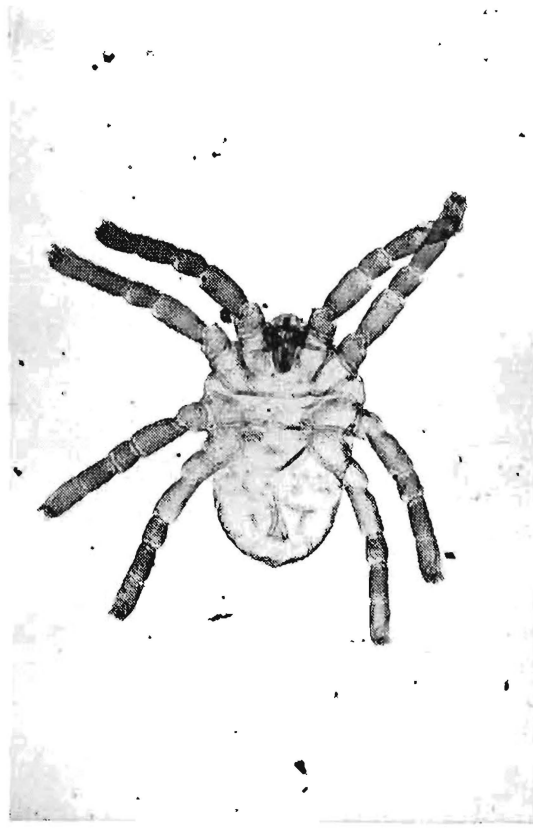

FIG. 1. *Speleognathus australis* Womersley 1934.

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That the parasites were well established in the upper respiratory passages of the bovines and appeared to be breeding, was evidenced by the fact that a number of the specimens collected contained a single large egg in which a clearly defined, six-legged larva was present.

The source of the mite infestation could not be traced. A search of the stable, in which the two cattle had been confined for several months, and of the drinking trough, revealed no evidence of the presence of any mites.

ACKNOWLEDGEMENTS

I am indebted to Mr. J. Schoeman who first noted the mites in the respiratory passages of the bovines at *post mortem* examination and to Dr. P. A. Basson who drew my attention to the occurrence and assisted in the collection of the material.

FIG. 2. *S. australis* W. Showing mosaic patterning of legs.

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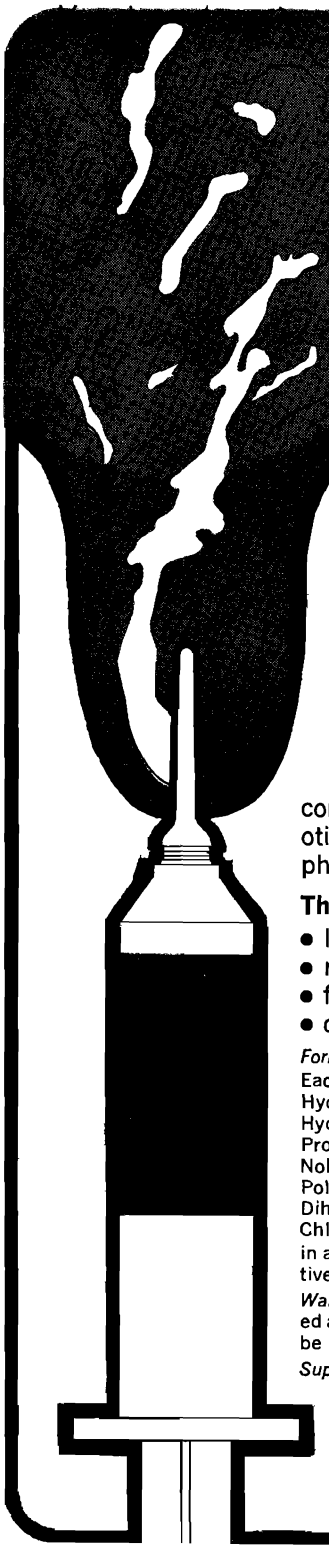

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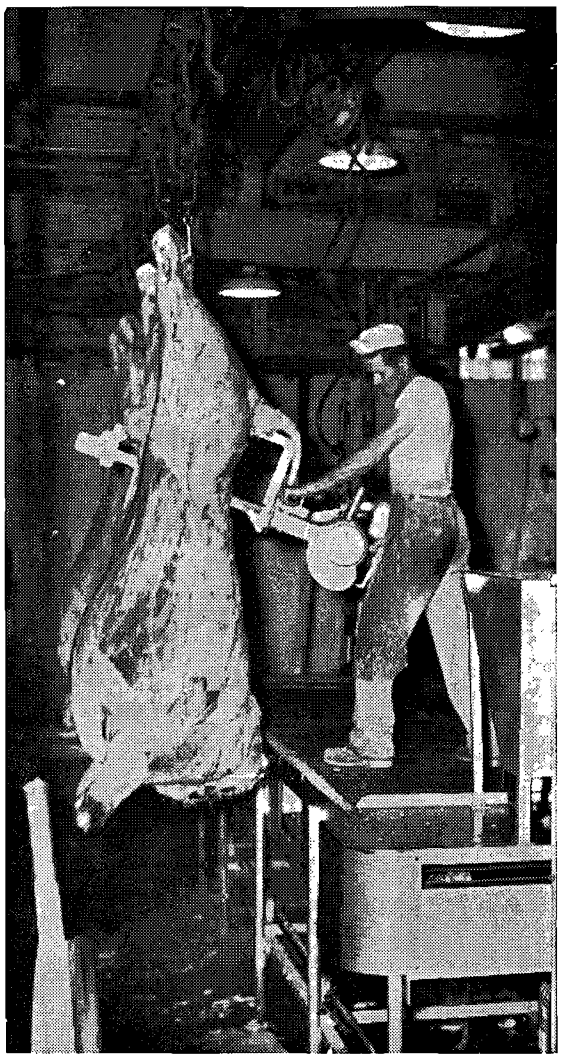

Jl S. Afr. vet. med. Ass. 39 (4): 73-74 1968

THE OCCURRENCE OF THE CAPILLATE LOUSE, *SOLENOPOTES CAPILLATUS*, IN SOUTH AFRICA

R. DU TOIT*

SUMMARY

The occurrence of the capillate louse or small European cattle louse, *Solenopotes capillatus*, Enderlein 1904 (Phthiraptera Anoplura) on cattle from widely separated areas over a period of four years indicates a probable wide distribution of this parasite in South Africa, despite the fact that its presence is recorded here for the first time.

INTRODUCTION

The small European cattle louse *Solenopotes capillatus* (Phthiraptera, Anoplura) was described by Enderlein in 1904 as a third species of blood sucking louse on cattle. The other two common cattle lice, namely *Haematopinus eurysternus*, the so-called short-nosed cattle louse, described by Nitzch in 1818 and the long-nosed cattle louse, *Linognathus vituli* described by Linnaeus in 1758, are both well known species in this country.

Solenopotes capillatus is of common occurrence in Europe and America, and has been reported from Australia, where Roberts [1], in describing the so-called tail switch louse of cattle, gives a key for the identification of Australian sucking lice. It may be assumed that it was imported with cattle from Europe or America but no record of its occurrence in South Africa has appeared till now.

The capillate louse, as it is often called, is considerably smaller than either of the other two cattle lice and is characterised by the rather prominent spiracles on the abdominal segments together with the short, rounded, anterior portion of the head, as is shown in Fig. 1. A detailed description of the species was given by Ferris [2].

The following records of its occurrence in South Africa would appear to indicate that its presence has been missed in the past and that it is probably fairly widely distributed although it is unlikely that it is of common occurrence.

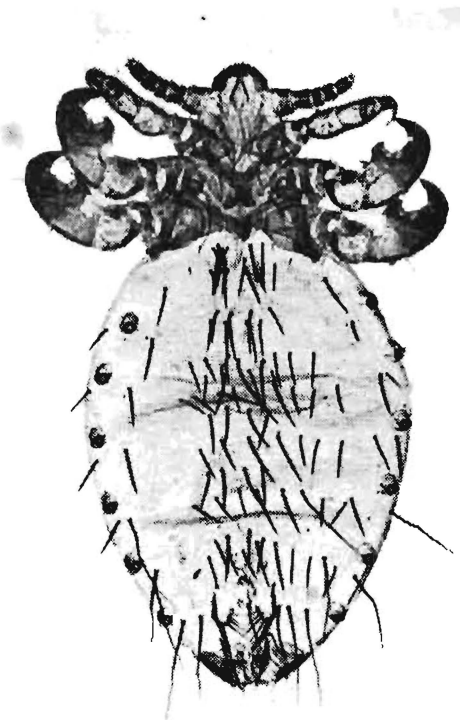

FIG. 1. *Solenopotes capillatus* ♀ *X57*

OBSERVATIONS

In January 1964, two Friesland bulls, sent to the clinic at Onderstepoort, suffered from fairly marked scurviness with some loss of hair in the region of the dewlap and lower

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neck surfaces. Numerous small blue lice were present, which proved to be *Solenopotes capillatus* End., males and females. The animals had both been purchased at the Rand Easter Show, one in 1961 and the other in 1962, and, although they had been in contact with a number of cows in the herd, a close examination of these animals failed to reveal any infestation.

A second record of the occurrence of the species was obtained late in June 1964, when it was found included in a collection of ticks from the Government farm 'Mara' in the Louis Trichardt area of the Northern Transvaal. The lice were obtained from the scapular region of a Hereford and from the head region of a Bonsmara.

These two records of the occurrence of *S. capillatus* from areas fully 250 miles apart suggested that the louse was probably fairly widely distributed. An attempt to induce farmers to submit lice specimens from different regions in the country by means of a published request in a local farming magazine was unsuccessful.

Again in 1968 a fairly heavy infestation of the capillate louse was discovered on a Friesland heifer sent to the Onderstepoort Veterinary Clinic, but the time lapse between actual collection and submission for identification prevented attempts at tracing the possible origin of the infestation. On the 22nd July, 1968, a number of lice, which had been taken from an Afrikaner bull in the Venterskroon district, proved to be *S. capillatus*.

CONCLUSION

These four records of the identification of *S. capillatus* over a period of four years from widely separated areas, prove the natural occurrence of the species in South Africa beyond doubt.

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AN IMPROVED LABORATORY METHOD OF EVALUATING INSECTICIDES FOR THE PROTECTION OF SHEEP AGAINST BLOWFLY STRIKE

R. DU TOIT*

SUMMARY

A modification of the in vitro test of du Toit and Fiedler for the evaluation of insecticides in protecting sheep against blowfly strike is described, whereby first stage larvae of the same age are used and the serum in the medium is substituted by lean beef.

INTRODUCTION

A laboratory method of determining the efficiency of insecticides was described by Fiedler and du Toit[1] and du Toit and Fiedler[2]. This has been used either as described, or somewhat modified, in many different countries with varying degrees of success.

The method entailed the dispersal of the test insecticide in serial dilution in mammalian serum which was then absorbed by suitable material such as wool or cotton wool. First stage blowfly larvae placed on the nutritional medium were observed at 24, 48 and 72 hour intervals and the mortality noted. In this way the lowest dilution of insecticide capable of killing the larvae was determined.

This test proved useful as a method of comparing the efficiency of different insecticides before resorting to the second stage of the test, *i.e.* the treatment of wool on living sheep with the insecticides to be tested and subjecting samples of the wool so treated to the test at weekly or other predetermined intervals in order to note the duration of protection afforded.

Difficulties were encountered, chief of which is the fact that serum does not provide an ideal nutritional medium for blowfly larvae. In this medium their growth is impeded or erratic, even in the absence of insecticides. Furthermore, the larvae tend to leave the nutritional medium and crawl up the sides of the glass tubes, often entering the cotton wool plugs and dying there.

The replacement of the serum with a medium more suited to the nutritional requirements of the blowfly larvae was the obvious solution.

The nutritional requirements of blowfly larvae, expressed in terms of chemically defined media, are extremely involved, as pointed out by Ginrich[3] for the larvae of the screw worm, *Cochliomyia hominivorax* (Coq.) Nevertheless, some standard, readily available material meeting these requirements is essential to make a test of this nature suitable for general use.

MATERIALS AND METHODS

Lean beef was chosen as representing a diet well suited to the requirements of the larvae used, *viz. Lucilia cuprina* Wied. The beef was pulped by means of a mincer, fitted with a very fine perforated steel plate through which the meat was forced after having been sliced by the star-shaped knife blades. A laboratory mill or grinder would have been equally suitable.

Measured quantities (by volume) of pulped beef averaging 3.5 gm in weight, (a small coffee spoon is suitable as measure), were intimately mixed with portions of 0.25 to 0.3 gm of clean wool in specimen tubes 9×3 cm.

No attempt was made to determine accurately the quantities of materials used but a series of 10 such tubes was weighed, which gave an average weight of 24.05 gm per tube.

To calculate the approximate final concentration of insecticide under test, the amount of moisture in the wool-beef mixture was determined by placing the tubes in a controlled hot oven at 60°C for 48 hours and reweighing them. The average weight was

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21.140 gm, giving a difference of 2.905 gm, which represented the amount of moisture lost. For purposes of the test, this was taken to represent 3 gm (or millilitres) of water.

To ascertain whether the blowfly larvae would grow satisfactorily and would remain visible throughout the period necessary for observations of the effect of the test insecticide upon them, 3 ml of water was added to each of a series of 10 freshly prepared samples of medium. This represented the amount of diluted insecticide to be added in the actual test. Approximately 100 blowfly eggs from a stock colony of *L. cuprina* were placed upon the surface of the medium in each tube. Eggs were used in preference to first stage larvae, as they are more easily handled and on incubation give rise to first stage larvae of equal age, which represent the most susceptible stage of immature blowflies. The tubes were incubated at 26°C and observations made at 24 and 48 hours.

Table 1: PRELIMINARY DETERMINATION OF LC_{100} OF FOUR TEST INSECTICIDES

Insecticide	Dilution %	Effect — Hours		Remarks	LC_{100} ppm
		24	48		
A	.05	−	−		
	.005	−	−		
	.0005	−	−		
(Lujet*)	.00005	+ +	+	1 larva only	0.5
	.000005	+	−		
	.0000005	+ + +	+ + +		
Control		+ + +	+ + +		
B	.05	−	−		
	.005	(+)	−		50
(RD 14639*)	.0005	+ +	+ +		
	.00005	+ + +	+ + +		
Control		+ + +	+ + +		
C	.05	−	−	ovicidal	
	.005	−	−	ovicidal	50
(Dibrom*)	.0005	+ + +	+ + +		
Control		+ + +	+ + +		
D	.05	((+))	−	slight movement in one larvae only	
	.005	−	−		
	.0005	−	−		0.5
(Bromophos*)	.00005	−	−		
	.000005	+ + +	+ +		
	.0000005	+ + +	+ +	5 larvae	
Control		+ + +	+ + +		

Explanation of symbols

− = No development
+ = 1—3 larvae but movement normal
+ + = Numbers reduced but capable of normal movement
+ + + = Normal development and number of larvae
( ) = Growth retarded, forward movement affected
(( )) = Growth retarded. Paralysed but capable of slight movement only

*5ee explanatory note to Table 2.

To determine the lowest concentration at which an insecticide would kill (LC_{100}) or adversely effect first stage larvae, serial dilutions in water were made of a number of insecticides commercially available either in wettable powder or emulsifiable concentrate form.

In the case of insecticides of unknown toxicity, arbitrary dilutions were made and tested in order to arrive at some indication of their efficiency. Such insecticides were compared with one of known potency taken as the standard, e.g. Diazinon, and tenfold dilutions above and below the expected LC_{100} made.

A quantity of 3 ml of each of the dilutions selected was added to the pulped meat-wool medium and thoroughly mixed. The mixture was tamped down by means of a flat-ended glass rod to give a flat surface.

Because the mixture already contained 3 ml moisture, the actual dilution of insecticide under test was doubled. Thus, at a dilution of 0.05%, the final dilution in the nutritional medium would be 0.025%.

The blowfly eggs, in batches of 100-150, were placed on the surface of the medium in each tube, which was plugged with cotton wool and the culture incubated at 26°C. Twenty-four hours later the tubes were examined from above by means of a stereoscopic dissecting microscope, the effect upon the larvae noted and their number, size and movements compared with those of larvae in a similar control tube without insecticide. The latter should have undergone normal, unimpeded development.

RESULTS

In all instances the larvae, upon hatching from the eggs, penetrated the medium to the level of their posterior spiracles only and thus remained visible throughout the observation period. The method appeared satisfactory for making accurate observations of the possible effect of insecticides upon the test larvae.

Table 1 represents a test conducted with three different organic phosphate insecticides and one carbamate insecticide, using tenfold dilutions.

Once an indication had been obtained as to the approximate endpoint or LC_{100} using tenfold serial dilutions, a closer evaluation was obtained by altering the dilution rate.

Evaluations were made of some insecticides and compared with Diazinon, using twofold dilutions and seven replications in each case. The results are shown in table 2.

Table 2: LC_{100} OF TEST INSECTICIDES ON BLOWFLY LARVAE AT 48 HOURS

Insecticide*			LC_{100} ppm
Diazinon	30%	E.C.	0.5 to 0.25
Bromophos	50%	E.C.	0.625
Lujet	30%	W.P.	1.0
R.D. 14639	40%	E.C.	5.0
Dibrom	38.63%	E.C.	31.25

E.C. Emulsifiable concentrate

W.P. Wettable powder

*Diazinon = 0,0-diethyl-0-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate.

Lujet = 0,0-diethyl-methylmercapto-3-methylphenyl-thiophosphate.

Bromophos = Dimethyl-dichloro-bromophenyl-thiophosphate.

R.D. 14639 = 3,5-di-tertiary butylphenyl N methyl carbomate.

Dibrom = 1,2-dibromo, 2,2-dichloroethyl, dimethyl phosphate.

CONCLUSIONS

The first stage larvae of sheep blowflies are extremely useful for the evaluation of insecticides by virtue of their sensitivity to these compounds, the ease with which they can be handled and cultivated and the fact that they represent a standard as far as age susceptibility is concerned.

By substituting lean beef for serum, a more suitable medium is provided. The reaction of the larvae to the insecticides is more clear cut and the endpoint can be determined more accurately. With serum as the nutritional medium, three readings taken at 24, 48 and 72 hours are necessary, whereas with lean beef growth of the larvae is so rapid that 48 hours suffices for the final assessment and thus the time of the test is reduced.

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THE IMPALA AS A SOURCE OF FOOD AND BY-PRODUCTS

Data on Production Potential, Parasites and Pathology of free-living Impalas of the Kruger National Park

E. YOUNG AND L. J. J. WAGENER*

SUMMARY

The following data are provided: the mean weight of dressed carcases of 577 adult animals and of a random sample of 1061 impalas; information on the percentage yield of dressed carcases, deboned meat and biltong; and the mean weight of the organs of adult animals. In addition, the incidence of some of the more significant parasitic infestations and the frequency with which carcases and organs are affected with macroscopic lesions and/or metazoan parasites are also calculated and tabulated. Twenty-seven different disease conditions and parasites of impala, some of which may be of significance in meat inspection and evaluation, are also briefly discussed. The high incidence of cysticercosis (33.9% of 1728 impalas) is significant. Two *Cysticercus* spp. have been encountered but have not yet been identified.

INTRODUCTION

The impala, *Aepyceros melampus* (Lichtenstein, 1812), a very prolific, medium-sized antelope with gregarious habits, occurs naturally mainly in tropical and subtropical thornveld savannahs. Under the protection afforded them, this species has increased to such an extent in the Kruger National Park that it was necessary to reduce their numbers in extensively overgrazed areas.

This opportunity was utilised to collect data on different aspects of the biology, production potential, parasites and diseases of impalas. Similar investigations in other parts of Africa and of the Kruger Park may yield different results. Nevertheless, these data may provide an adequately representative picture of the production capabilities and pathological conditions of impala in the Kruger National Park.

MATERIAL AND METHODS

Most of the impalas were shot at random in the southern part of the Park, usually in the head. They were then immediately bled and weighed, slaughtered and measured. The dressed carcases, head, feet, skins and internal organs as well as all the fat that could be stripped from the carcases, were weighed. The different parts were examined for the presence of parasites and macroscopic pathological lesions. For the purpose of compiling the list of diseases and parasites detailed in Table 5, reference was also made to other publications and reports.

In order to determine the net yield of meat and biltong (salted, air-dried meat) from impala, the dressed carcases of five adult males and five adult females were completely deboned. Meat and skeletons were weighed separately. Fifteen pounds of the meat was cut into thin strips for conversion to biltong by salting, and drying in a cool shady place for three weeks. The biltong was then reweighed. The mean weight of the 10 dressed carcases was 55.6 lb and represented the average adult impala. Five specimens of meat, each weighing 100 grams, were cut in to thin strips and dried at 100°C to constant weight for moisture determination.

RESULTS

All the results are summarized in Tables 1—7.

DISCUSSION

Knowledge of the mean and maximum sizes of animal carcases are of practical importance in planning transport and storage facilities. This information can be derived from Table 1 in respect of impala.

Only adult animals are hunted but usually animals of all ages and both sexes

*Veterinary Investigation Centre, P.O. Skukuza.

Table 1: MEAN AND MAXIMUM SIZES OF DRESSED HANGING CARCASES OF 48 ADULT IMPALAS OF BOTH SEXES

Measurement	Mean (Inches)	Max. (Inches)
Total length (from the hock to carpus)	52.30	58
Total dorsi-ventral depth (from tip of neck to point in line with carpus)	20.83	24
Maximum width (transverse diameter of thorax)	10.77	14

Table 2: MEAN WEIGHTS OF DRESSED IMPALA CARCASES

Type of carcasses	Mean weight (lb)	No. of animals
Adult males (two years and older)	61.22	338
Adult females (two years and older)	48.51	239
Adult animals of both sexes	55.95	577
Animals of all ages and both sexes (random sample)	49.02	1061

Table 3: THE MOISTURE CONTENT OF IMPALA MEAT AND THE YIELD (MEAN WEIGHTS) OF DRESSED CARCASES, DEBONED MEAT, SKELETON WITH ATTACHED TENDONS, AND BILTONG*

*(3 weeks after salting)

Item	Average relative percentage weight	Number of units examined
Dressed carcase	57.40% of live weight	41 adult carcases
Deboned meat	74.82% of dressed carcase	10 adult carcases
Skeleton	25.18% of dressed carcase	10 adult carcases
Biltong	29.27% of wet muscle meat	15 lb (108 pieces)
Moisture content	75.1% of wet meat specimen	5 × 100 g specimens

Table 4: MEAN WEIGHTS OF VISCERA OF 40 ADULT IMPALAS OF BOTH SEXES

	lb	oz		lb	oz
Heart	0	8.45	Head, lower legs and feet	8	6.24
Lungs (without trachea)	1	3.53	Tongue	0	2.87
Liver	1	8.12	Tail	0	1.46
Kidneys	0	4.37	Skin	4	6.40
Spleen	0	5.70	Blood	3	6.72
Tripe	6	12.00	Free fat	0	4.90

Table 5: LIST OF INFECTIOUS DISEASES AND PARASITES OF THE IMPALA WHICH MAY BE OF IMPORTANCE IN VETERINARY MEAT HYGIENE

Disease/Parasite	References	Disease/Parasite	References
Foot-and-mouth disease	1, 3	**Echinococcus sp.**	7
Lumpy skin disease	2	**Oesophagostomum columbianum**	7, 17
Papillomatosis	3	**Cooperioides hepatica**	7
Anthrax	4	**Stilesia hepatica**	7, 17
Corynebacterium spp. (Abscesses)	5	**Pneumostrongylus calcaratus**	7, 17
Staphylococcus aureus (Abscesses)	5	Pentastomiasis	7
Actinomycosis	5	**Sarcoptes sp.**	10, 14
Besnoitiosis	6	**Amblyomma hebraeum**	7, 17
Sarcosporidiosis	3	**Boophilus decoloratus**	7, 17
Hepatozoön-like infection	8	**Hyalomma sp.**	7
'Pafuri dermatitis'	7	**Rhipicephalus appendiculatus**	7, 17
Schistosomiasis	8	**Rhipicephalus evertsi**	7, 17
Cysticerosis	9, 17	**Linognathus aepyceros**	7
		Linognathus bedford	7

Table 6: INCIDENCE OF SOME OF THE MORE SIGNIFICANT PARASITIC INFESTATIONS OF THE IMPALA

Parasite	Location	Carcases examined	Incidence
Pneumostrongylus calcaratus	*Lungs*	707	94.04%
Cooperioides hepatica	Liver	707	76.80%
Stilesia hepatica	Liver	286	10.13%
Cysticercus spp.	Skeletal and cardiac musculature, rarely in liver, lungs and lymph nodes	1728	33.96%

Table 7: THE INCIDENCE OF MACROSCOPIC LESIONS AND/OR METAZOAN PARASITES IN ORGANS AND TISSUES OF THE IMPALA

Part of carcase	Carcases examined	Incidence	Parasites/Pathology
Skeletal muscles	179	34.00%	**Cysticercus**, Haemorrhages (splashing), bruising
Heart	179	2.23%	**Cysticercus**, pericarditis
Lungs	179	94.97%	**Pneumostrongylus, Cysticercus**, abscesses
Liver	179	83.24%	**Cooperioides, Stilesia, Cysticercus**, cloudy swelling, focal disseminated necrosis, biliary cirrhosis, abscesses, peritonitis
Spleen	179	0.56%	Peritonitis
Kidneys	179	0.00%	None
Serous membranes	1402	0.71%	Pericarditis, pleuritis, peritonitis
Superficial lymph nodes	137	97.81%	Lymphoid hyperplasia, abscesses

are shot when reducing the species in overstocked parks. Such random shooting retains the natural sex and age ratios. The dressed carcase weights of both adult and randomly selected animals represent relatively large numbers of impalas which lived under natural conditions and may therefore serve as an indication as to the meat production potential of this species. Reproductive and survival rates of impala may vary from year to year under natural conditions and, in my opinion, a reliable estimate of the potential meat production of free-living impalas would be very difficult to achieve.

According to Talbot [11], the mean dressed weight of African game animals is 50-63% of the live weight as compared with 44-50% in domestic stock. Our figure of 57.4% (Table 3) corresponds very well with his findings. The corresponding figure for the blue wildebeest is virtually the same, *i.e.* 57.7% [12].

The yield of deboned meat from impala carcases (74.8%—Table3) is slightly higher than the corresponding figure for Cape buffalo [13]. The yield of biltong from fresh meat of these two species is very similar. The mean amount of boneless meat obtained from five adult male and five female impalas was 41.6 pounds. About 3.4 lb of meat were necessary to produce 1 lb of dry biltong, so that an average-sized adult impala will yield about 12.2 lb of three-week-old biltong.

The above-mentioned 10 adult carcases yielded a mean of 14 lb of wet bone for possible conversion to bone meal. Weights of organs, skins, blood and free fat are also important because of their commercial value as food or material for the production of carcase-, meat-, blood- and liver-meal, as well as tallow. Heads of rams can be sold as trophies and skins can be supplied to the tanning or curio manufacturing industry.

Game tissues are frequently damaged by metazoan parasites and other pathological processes and their incidence is indicated in Table 7. This information may be of some value when the net production potential has to be calculated. It must be pointed out that affected parts are not necessarily completely unfit for further use.

Diagnoses of the infectious diseases and parasites, listed in Table 5, have all been confirmed in free-living or experimentally infected impalas in the area. More than 10 other parasitic conditions have been recognised in this species [14] but they are not at this stage known to have a significant effect on economically important parts of carcases, neither are they of much importance to public health and veterinary disease control practices.

The impala seems to be one of the species most susceptible to foot and mouth disease [11]. Only two of the seven types of foot and mouth disease, *i.e.* S.A.T. 2 and 3 have so far been diagnosed in our local impala. Affected animals may become extremely emaciated and a few are known to have aborted. Lesions have been observed on the nostrils, lips, dental pad, gums, tongue, feet, teats, ruminal pillars, abomasum and uterus. Game animals generally show very mild symptoms and lesions and it is suspected that some impalas may only develop subclinical reactions before becoming immune. The fact that foot and mouth disease may cause lesions in consumable parts of infected carcases is of less significance than its threat as a potential disease of domestic livestock. Game control and hunting activities are consequently interrupted by an outbreak of this proclaimed disease.

Experimental inoculation with the Neethling strain of the virus of lumpy skin disease resulted in necrotic foci and ulcerations in the mouth and prominent cutaneous swellings [2], but the disease has not yet been diagnosed in free-living impalas.

The incidence of cutaneous papillomatosis in impalas is quite high, up to 11% of the animals in one large herd being affected. The lesions consist of small, black, focal, disseminated wart-like projections on and above the coronary band of the hooves and have so far not been seen to involve any other parts of the skin.

Anthrax is of great significance concerning public health and veterinary disease control in that it is highly infectious and fatal for many game species, man, and his domestic animals. Outbreaks of epizootic proportions have been experienced in the Kruger National Park, but losses of impalas were relatively low when compared with other species [4].

Abscesses due to *Corynebacterium* spp. and *Staphylococcus aureus* have been recorded in impala [5]. The low incidence renders them of little practical importance except for secondary abscessations in livers with heavy infestations of the nematode, *Cooperioides hepatica*. In an examination of 179 livers, 14% of those infested with *Cooperioi-*

des also had concomintant purulent infections.

Actinomycosis or lumpy jaw has been encountered in the impala [5]. The lesions closely resemble the disease in the domestic ox and are usually confined to the mandibles. The incidence is low in the impala and the condition seems to be confined to certain parts of the Park.

In contrast to *Besnoitia besnoiti* infections in domestic cattle, besnoitiosis causes no conspicuous lesions in the skin, subcutis or musculature of the impala; instead the lesions are chiefly confined to the cardiovascular system as very small, whitish, round nodules on the endocardium and on the intima of bloodvessels [6].

Sarcosporidiosis has been diagnosed in a few impalas in which the condition assumed the same appearance as in the domestic sheep. The typical whitish, cigar-shaped Miescher's tubes were located i nthe aesophagal and skeletal musculature of the affected individuals.

Small, disseminated, necrotic foci were observed in 16.46% of 179 impala livers examined. According to Basson [8], these lesions may have been caused by schistosomiasis and by a yet unidentified *Hepatozoon*-like organism which is known to cause microgranulomata in impala livers.

Dermatitis and alopecia in individual impalas from the Pafuri area of the Kruger National Park is referred to as "Pafuri dermatitis" (Table 5). Acute skin lesions very much resemble those of sweating sickness of young domestic calves and chronic lesions result in localised or wide-spread alopecia. The cause of this condition is still unknown and although the incidence of this disease is very low, it is capable of rendering affected skins unsuitable for use as curios.

Examination of the prescapular and femoral and some of the other superficial lymph nodes revealed signs of oedema, haermorrhages and lymphoid hyperplasia in most. Similar lesions were also commonly observed in lymph nodes of buffaloes and wildebeeste but the cause has not yet been established.

Cysticercosis is the only really significant parasitic condition of the skeletal musculature of the impala, in which it commonly occurs. According to Verster [9], two *Cysticercus* spp. have so far been found in impalas of this Park but they still have to identified. *Cysticercus* cysts can be found in almost all parts of the body of the impala and are often seen in the superficial musculature underlying the skin or underneath the serous membranes of the body cavities or internal organs. In this survey, the carcases were examined without resort to any specific incisions such as employed in meat inspection of carcases of domestic stock. Some of the carcases were severely affected and had to be condemned. The significance of these particular species of *Cysticercus* as potential parasites of man and their survival capabilities in infested meat and meat-products is still largely unknown and as yet no definite recommendation as to the fate of slightly infested carcases can be made.

Only three of 600 impalas were affected with hydatidosis, according to one report [7] and our own observations. The incidence is much higher in other ungulates and one gains the impression that the impala may not serve as a suitable natural intermediate host for this parasite.

FIG. 1. Lungworms, *Pneumostrongylus calcaratus* in the bronchi of impala lung.

Much less than one per cent of 633 impalas which were examined for pentastomiasis was infested and a higher incidence occurs in some of the other herbivorous species [12, 13].

Oesophagostomum columbianum is not a typical "nodular worm" in the impala. The characteristic nodules usually associated with oesophagostomiasis in sheep have not yet been encountered in infested impalas. Oesophagostomiasis is thus of no direct importance in impala intestines.

Other parasites, however, play a more important rôle in diminishing the value of the organs of the impala. Almost all impala lungs are infested with the lungworm, *Pneumostrongylus calcaratus*. This is a very thin, thread-like, black nematode (Fig. 1) which can be found in the pale, bluish-grey, raised emphysematous lesions which most commonly affect the dorsal parts of the diaphragmatic lobes of both lungs (Fig. 2).

FIG. 2. Emphysematous bullae in impala lungs.

Cooperioides hepatica and *Stilesia hepatica* can be found alone or together in the bile ducts of impala livers. The former is the more common and is often associated with biliary cirrhosis and abscessation. The thickened bile ducts can often be seen to bulge out underneath the liver capsule. Biliary cirrhosis was also observed in heavy infestations of *Stilesia hepatica*. Both these parasites render infested livers repulsive as food.

The remaining eight parasites mentioned in Table 5 are all external metazoan parasites and, apart from their possible significance as disease transmitting agents, they may be of importance as the cause of skin lesions. *Sarcoptes* infestations are rarely encountered and are only restricted to certain areas of the Park. Affected animals can suffer severely from extensive *dermatitis crustosa* and possibly from secondary infection and intoxication. Emaciation often results [10] and it can be expected that some animals may succumb to heavy infestation. The five tick and the two louse species are not known to cause any significant damage to impala skins, although odd cutaneous abscesses may result due to tick bites and concomitant secondary bacterial infection.

Brucellosis and trichinosis are of much importance to meat hygiene and public health. Both are known to exist in the Park. Serological tests have indicated brucellosis in only one impala [15] but trichonoscopy and digestion techniques for trichinosis in impalas have yielded negative results [7, 16].

Further work is proceding to amplify and intensify knowledge concerning the diseases and parasites of impalas and other potential meat producing wild herbivorous mammals.

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THE FEEDING HABITS OF THE YELLOW MONGOOSE, *CYNICTIS PENICILLATA*, THE SURICATE, *SURICATA SURICATTA* AND THE CAPE GROUND SQUIRREL, *XERUS INAURIS*

1. Analysis of Stomach Contents

2. Observations on Free-living and Captive Animals

I. F. ZUMPT*

SUMMARY

Analyses of stomach contents and observations on free-living and captive animals showed that *Cynictis penicillata* (G. Cuvier) lives on insects, mice, lizards, birds, eggs, and meat from carcasses. In 10% of stomachs vegetable matter was recovered. It is probable that this species takes succulents to obtain moisture. *Suricata suricatta* Erxl. feeds on various insects, plants and seeds. *Xerus inauris* Zimmermann lives on vegetable matter but also on insects. There is no evidence that local extermination measures have lasting detrimental effects.

INTRODUCTION

In the control of the viverrid type of rabies which occurs in the Orange Free State, the Western Transvaal and the Northern Cape, meerkats are destroyed in an attempt to eliminate foci of rabies. As these animals are useful predators, this practice has been and is often criticised. The two species of Viverridae live in close association with *Xerus inauris* Zimmerman, so this rodent also has to be destroyed. In order to determine the importance of these species as predators, their feeding habits were studied systematically. These had been mentioned, but only casually, by several authors. *Cynictics penicillata* (G. Cuvier) is recorded as living on insects such as termites, grasshoppers, beetles, grubs, caterpillars, as well as on mice, birds, eggs, snakes, spiders, lizards, frogs, afterbirth, newborn lambs and carcasses [1-5]. *Suricata suricatta* Erxl. is known to feed on insects, soft stems of young grasses, leaves of succulents, meat, eggs and fruit [5, 6]. *Xerus inauris* subsists mainly on bulbs, corms, roots, green grass and seeds, but in captivity also takes to termites [5, 7].

1. ANALYSIS OF STOMACH CONTENTS

Method

Over a period of ten months (April 1967 to January 1968) critical ingesta analyses were carried out on animals shot, trapped or captured in the field. *Post-mortem* examination was immediately undertaken, and specimens collected. The stomachs were tied off at both ends and stored in 10% formalin. In the laboratory they were opened, washed and the contents were examined macro- and microscopically. To correlate and interpret these findings, similar studies were undertaken on animals kept in captivity but these results are not incorporated in the data presented.

Results

(a) *Cynictis penicillata* (95 stomachs)

Homogenous digested material		17
No contents		20
Remnants of:	Mice (mainly in April and September)	14
	Locusts	7
	Locusts and termites	3
	Locusts and beetles	2
	Termites	5
	Meat from undefined larger carcasses	5
	X. inauris	2
	C. penicillata	4
	Lizard	1
	Bird	1
Soil		2

*State Veterinarian, Veterinary Investigation Centre, P.O. Mafeking.

Plant material resembling dung of cattle	10
Seeds (maize, sunflower)	2

(b) *Suricata suricatta* (21 stomachs)

Homogenous digested material	3
Remnants of: Ants	4
Termites	4
Locusts	3
Scorpion	1
Frog	1
Centipede	1
Meat	1
Plants and seeds	3

(c) *Xerus inauris* (175 stomachs)

Homogenous digested material	12
Milk curdles (young specimens)	5
Remnants of: Termites	32
Beetles	8
Locusts	3
Meat	1
Spider	1
X. inauris	2
Plant material (dry)	70
Plant material (green)	9
Maize	12
Sunflower seeds	4
Ground nuts	4
Unidentified seeds	2
Stones (different sizes)	10

2. OBSERVATIONS ON FREE-LIVING AND CAPTIVE ANIMALS

Cynictis penicillata

In the field it was observed that a variety of insects, meat from fresh and old carcases, and eggs of birds were consumed. The following were hunted and probably eaten: Blacksmith Plover *(Hoplopterus armatus),* Mountain Chat *(Oenanthe montciola),* Ant-eating Chat *(Myrmecocichla formicivora)* and two snakes. It was difficult to establish to what extent these animals feed on vegetable matter except for an aloe-type plant, *Chortolirium angolense* (Bak) Berg. In captivity they eat virtually anything if sufficiently hungry, the order of preference being the following: termites, locusts, lean meat, eggs, lizards, boiled meat, beetles, mice and birds. For over eighteen months a number of *C. penicillata* were maintained on various mixtures of maize-, fish- and carcase-meal without any ill effect[8]. In two instances mothers killed and ate their two-month-old young although there was sufficient food in their cages.

Suricata suricatta

Field observations showed clearly that these animals live on insects such as termites, ants, locusts and beetles as well as young plants, seeds, and other vegetable matter. In captivity this species has been kept successfully on a mixture of mince-meat and brown bread.

Xerus inauris

In the Western Transvaal these animals occur in large numbers. They feed on various types of seeds, roots, bulbs and plant stems and cause considerable damage in maize and sunflower fields. They take only the green parts of germinating seeds and usually leave the hard remains in the ground. Stored bags of maize, groundnuts and sunflower seeds are also often attacked. In captivity they feed on termites[7], a fact confirmed by analyses of ingesta, but are readily maintained on a diet consisting of 90% maize- and 10% carcass-meal.

DISCUSSION

It has been maintained that *C. penicillata,* although a carnivorous animal, lives mainly on insects[5]. It is of interest, therefore, that remnants of mice were found in 14 out of the 95 stomachs examined. In field cages dead mice were only eaten if nothing else was available; probably this is also the case in nature. A large number of dead mice and rats were found in the field during the months of April and September when these animals were exceptionally prevalent. In two instances it was observed that *C. penicillata* kills and eats its young in captivity and stomach specimens collected from the field also contained remains of *C. penicillata.* Remnants of *X. inauris* were found on two occasions. Most probably these animals died from natural causes and were then eaten. Experience has shown that one or two *X. inauris* and a large number of *C. penicillata* kept together never attacked each other. Snyman[5] made similar observations. Meat from carcasses stained with eosin was recovered from five animals trapped in the vicinity of these carcasses. *C. penicillata* is a good hunter and it was observed that various birds, lizards and even snakes were attacked. Twelve stomachs of *C. penicillata* contained vegetable matter. Probably this is not taken deliberately but together with small insects living in cattle dung. In the field, one plant, namely *Chortolirium ango-*

lense, was eaten. As this is a succulent, it is possible it is mainly taken for its water content. In the laboratory, plant material was taken only when mixed with meat- or carcass-meal.

S. suricatta lives mainly on insects but also feeds on a large variety of plants and seeds.

X. inauris is a rodent and it is therefore interesting that over a third of the examined stomachs contained insects. Like *C. penicil lata,* this species will also devour its own young. From ten specimens, stones only were recovered. It could not be determined whether they had been taken accidentally or on purpose.

CONCLUSION

The results confirm findings already recorded[1, 3, 4, 5, 7], but the feeding habits are more complex than previously thought. It is known that the two Viverridae are important rabies carriers but are of great value to the farmer as they feed on a variety of insects and small animals. Although *X. inauris* also eats insects, the damage it causes to crops is tremendous. All three species have to be destroyed in the control of rabies. Field observations have shown that this is followed by an enormous increase in insects and small rodents. In areas where the rabies carriers were eradicated the insect population rose sharply, but so did the number of birds (especially the ground-breeders) which in turn limited the insects. As new Viverridae migrated into those regions the number of birds again decreased. The whole cycle took two to three years. It is difficult to speculate on a long term basis on the effect of destruction of these rabies carriers but there is no evidence that such measures have lasting detrimental effects on the balance of nature.

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LETTER TO THE EDITOR

AMPROLIUM* AS A COCCIDIOSTAT FOR ANGORA GOATS

Sir,

Clinical coccidiosis can be a considerable hazard in the rearing of Angora goats, particularly under intensive conditions. The use of coccidiostats is often necessary to prevent severe loss in condition and even mortality. To assess the advantages of therapy, a trial was conducted on a farm in the Cradock district during 1966.

Forty-eight six to seven month old Angora rams, which had been brought in for show preparation, developed clinical coccidiosis. The goats were then divided into three numerically equal groups for the purpose of treatment. One group received no treatment, the second group received amprolium in the drinking water daily for 31 days at an approximate daily dosage level of 33 mg/kg liveweight, the third group received amprolium in the drinking water at an approximate daily dosage level of 66 mg/kg liveweight.

A composite faecal sample was taken and an oocyst count per gramme of faeces was done at the start of the trial. Faecal oocyst counts were also done on composite faecal samples from the three groups at the end of the trial. Bodyweights were recorded at the beginning and at the end of the trial.

The dosage levels, faecal oocyst counts and average bodyweight of the three groups of goats are summarised in the following table.

FAECAL OOCYST COUNTS AND BODYWEIGHTS OF TREATED AND CONTROL GOATS

Treatment	Pre-treatment oocyst count (o.p.g)	Post-treatment oocyst count (o.p.g.)	Average initial body-weight (lb)	Average final body-weight (lb)
Control	75,000	*16,500	54	50
Amprolium at 33 mg/kg		100	58.5	68
Amprolium at 66 mg/kg		1,500	56	69

*The animals in this group were treated with amprolium during the last week of the trial to prevent mortality.

The faecal oocyst count in the control group decreased from a composite average of 75,000 o.p.g. (oocysts per gramme) to 16,500 o.p.g. during the experiment, while those of the two treated groups declined to 100 o.p.g. and 1,500 o.p.g.

The average bodyweights of the goats in the control group decreased by 4.0 lb and these goats had to be treated with amprolium a week before the termination of the trial to prevent mortalities. The group treated daily with amprolium at 33 mg/kg liveweight gained on the average 9.5 lb per animal during the trial, while the group treated daily at 66 mg/kg gained 13.0 lb.

Five rams in the control group were in a very poor condition and shed their hair, whereas at the conclusion of the trial the animals in the treated groups were all in good condition and the mohair appeared healthy with a good lustre.

Treatment with amprolium reduced faecal oocyst counts and this coccidiostatic effect was reflected in increased bodyweight and healthy fleeces when compared with untreated goats.

At present amprolium is not given in the drinking water but is administered orally as AMPROL Plus 25% Premix on four consecutive days, at an approxmiate dosage level of 50 mg of amprolium per kg liveweight.

Yours faithfully,

C. H. B. MARLOW.

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BOOK REVIEW

GUIDE TO THE DISSECTION OF THE HORSE

JAMES R. ROONEY II, WOLFGANG O. SACK & ROBERT E. HABEL

Revision of third edition of Rooney, J. A.: Guide to the Dissection of the Horse. Wolfgang O.Sack, 1967. Distributed by Edwards Brothers, Inc. Ann Arbor, Michigan. vii & 216 pages, 49 flgs. off-set litho, 9″×6″. Published price $3.00.

Veterinary anatomists, who have teethed on Bradley's three volumes, might look askance at a seemingly skimpy text of not quite 200 pages but this book is meant specifically for students who have completed a systematic dissection of preferably the dog and have about 80 laboratory hours to dissect the horse. Within this compass the guide succeeds admirably in giving the student all the essential information in a lucid, succinct and readable style. The emphasis is on clinical applications and these have been indicated briefly at all the appropriate places, sufficiently to motivate him but without trying to turn him into an amateur clinician Where necessary, the physiological or comparative morphological and developmental features come in for mention as well, thus promoting a well-balanced and uncompartmentalised outlook on the part of the student.

As clearly stated by the authors, this guide is meant to supplement and not substitute a formal and systematic text, such as Sisson & Grossman's Anatomy. In fact, it supplements this text also in the systematic field where the latter is deficient, notably in that part of the animal which is the 'business-end' to the veterinarian but often accorded rather niggardly treatment by most textbooks: the perineal region. In the guide one finds the gist of Dr. Habel's researches on this subject. In this revision, too, the inclusion of most of the fine plates from the generally unavailable 'Guide to the Dissection of the Blood Vessels and Nerves of the Horse' by G. S. Hopkins has enhanced the value of the guide to the systematist, quite apart from the student.

To the practitioner, who wishes to brush up his equine anatomy but who has neither the time nor the patience to wade through ponderous tomes, this guide will provide the required information. Obviously, the material is presented in order of dissection and may be somewhat piecemeal in parts for his purpose. In this respect the underscoring of key words in the text will aid him to find his way about quickly and that goes for the student as well. In the revised edition the original practice of presenting Ellenberger & Baum's (1943, and not 1932 as stated in Rooney's third edition) sketches of cutaneous innervation areas — but more clearly labelled — has been retained. As there are not many 1943 Ellenberger & Baum's floating around, many, besides students, will find this guide useful.

The text of the third edition has not been altered to any appreciable extent; this does not mean that the revision has been a hasty, slab-up job. Day-to-day experience in the dissecting laboratory, newer information from the literature and various suggestions accumulated over the years have all been screened with care and incorporated where necessary and here and there a deletion or change in wording effected. A useful improvement has been the marking of all instructions for palpation and study on the live animal by means of a marginal 'L'. The few remaining typing errors have apparently all been corrected. The reviewer has only been able to

spot one that has crept in subsequently, namely 'culs-de-sacs' on page 16.

The paper used in this revision is a semi-gloss of much better quality, so that the type stands out even more clearly. Not being fully glazed, the paper will probably still resist the inevitable spattering in the laboratory reasonably well. (When will we be having moisture-resistant, cleanable printing paper for laboratory manuals?) The book has now been bound properly in a rugged hard cover and the format slightly enlarged.

It is good value for money.

H. P. A. de B.

DIAGNOSTIC PROCEDURES IN VETERINARY BACTERIOLOGY AND MYCOLOGY

C. R. CARTER

Charles C. Thomas, Springfield, Illinois, U.S.A., Jan. 1967, pp. 282, Publ. price $14.00.

More and more veterinarians concerned with clinical and field work are making use of laboratory services. It was therefore timely to receive a book which is intended to facilitate the work of laboratory personnel who are engaged in diagnostic microbiology.

The author assumes that the reader has a basic knowledge of bacteriological procedures, but more stress could have been placed on the variability of biochemical and fermentation tests and the danger of using single criteria when attempting to identify organisms by means of keys. Another facet that should have been stressed, is the importance of evaluating primary cultures regarding the relative number of different colony types which are seen. This is particularly important when the aetiological significance of a specific isolate has to be evaluated.

The chapters dealing with the different groups of bacteria are concisely compiled and clearly bring out the pertinent differential characteristics. Perhaps more could have been said about the colony morphology of the Enterobacteria as seen on the various differential media. The author's experience is clearly visible from the way in which the tables are compiled. Organisms which are taxonomically unrelated but which often cause confusion in the diagnostic laboratory are grouped together to advantage. Genera such as *Kurthia*, other saprophytes and organisms of doubtful pathogenicity, *i.e.* Pasteurella-like organisms, which are frequently encountered in pathological material, are usually ignored in most texts. The inclusion of these organisms in the book will certainly prevent frustration on the part of veterinarians who wish to undertake clinical bacteriology.

The chapter on the Mycobacteria is rather incomplete and somewhat outdated and will be of little value without reference to other texts. Identification of the Mycobacteria (particularly the atypical types), however, is difficult and perhaps best left to those who are specialised in that field. To a large extent the latter also applies to the chapters on Mycoplasma and the Fungi.

The two chapters dealing with mastitis and abortion give a brief and practical approach to the bacteriological investigation of these conditions.

As stated in the preface, the author's aim was to bring together in one volume those methods that have found general application in veterinary diagnostic microbiology and in this respect the book is a success. There are, however, a number of media and tests for

which only references are given. This applies particularly to products which are commercially available. By including more of these formulae and methods in the book, a greater degree of completeness could have been obtained without sacrificing compactness.

The appendices, which contain most of the technical information, could have been arranged more carefully. Part of the difficulty results from the inconsistent use of typographical forms for headings and subheadings. There is no apparent reason why e.g. 'Moeller's Cyanide Broth' is listed under "Reagents and Tests" and not under media. Similarly, the use of EMB agar is explained under 'media' but is not mentioned in the chapter on Enterobacteria. It is also peculiar to find Lancefield's typing technique in appendix C., while serological methods for the identification of Clostridia are found in the chapter dealing with these organisms.

The inclusion of serodiagnostic tests such as the Brucella agglutination test, cervical mucus agglutination test for vibriosis and even serological tests for leptospirosis would have increased the value of the book appreciably. These tests are not beyond the scope of most diagnostic laboratories.

Despite its shortcomings, the book contains much valuable practical information and admirably fills an important gap in veterinary literature. It should find a prominent place in every veterinary laboratory where clinical and diagnostic microbiology is undertaken.

A printing error on page 225, lines 22, 23 and 24 has been corrected by a notice to that effect in the Veterinary Record, Volume 81, No. 12, p. 229. The relevant passage should read:—

> 'Those bacteria that oxidize show acid production only in the open tube while those that ferment produce acid in both tubes.'

C. C.

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SUBJECT INDEX

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AUTHOR INDEX

(Numbers in bold type indicate senior or sole author)

FEATURE PAGE

MANDIBULAR SEQUESTRUM

A cattle rancher noted that one of his heifers was not doing well and not grazing normally. The heifer made abnormal chewing movements and salivated profusely. On palpation of the buccal cavity, the piece of bone illustrated below was felt and removed without difficulty. The case was mentioned to the veterinarian, who examined the animal some time later. The ventral border of the left mandibular ramus was intact, but the molars and dorsal edge of the mandibular ramus were absent. The gums were intact but depressed, leaving a gap where the removed section of jaw had been.

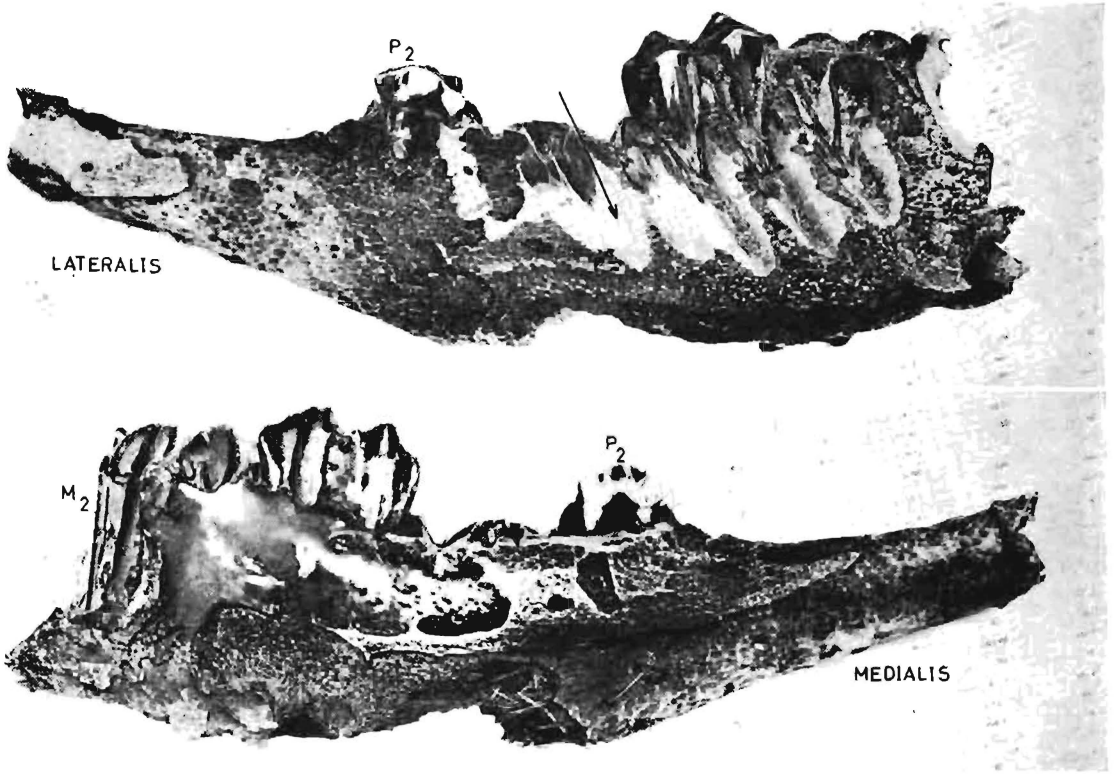
It is surmised that the heifer, about two years old according to state of eruption of the cheek teeth, had fractured the horizontal part of the left mandibular ramus, as result of a blow on the jaw, the fracture line running from between M_2 and M_3 and then forward along the mandibular alveolar canal. The fractured portion had been rotated inward along its long axis, as indicated by the deep score marks (incidated by arrow) inflicited laterally by the upper cheek teeth. Connections with the mandibular alveolar vessels apparently had been severed and a sequestrum had formed. This was eventually completely rejected, remarkably enough without infection obtaining a hold in the remaining portion of the mandible nor in the gums. The animal recovered completely.

TREFFERBLAD

ONDERKAAKSEKWESTER

'n Beesboer het opgelet dat een van sy verse nie gedy en nie normaal gewei het nie. Sy het abnormale koubewegings gemaak en baie gekwyl. By aftasting van die mondholte is 'n stuk been gevoel — hieronder afgebeeld — en sonder moeite verwyder. Die geval is aan die veearts genoem en hy het die dier op 'n latere tydstip ondersoek. Die ventrale rand van die linkeronderkaak was ongeskonde, maar die kiestande en dorsale rand van die kaak se horisontale deel was afwesig. Die tandvleis was heel, maar 'n groot gaping kon gevoel word in die plek van die verwyderde stuk onderkaak.

Dit word vermoed dat die vers, omtrent twee jaar oud volgens toestand van kiestanddeurbraak, die horisontale deel van die linkeronderkaak gebreek het as gevolg van 'n hou op die kaak. Die breuklyn het tussen M_2 en M_3 geloop, en vandaar vorentoe langs die onderkaak se tandkaskanaal. Die breukstuk het op sy lang as binnetoe gedraai, soos afgelei kon word van die diep skuurgroewe (deur pyl aangedui) deur die bokiestande lateraal daarop ingesny. Verbindings met die onderkaaktandkasvate is vermoedelik onderbreek en 'n sekwester sodoende gevorm. Dit is toe uiteindelik heeltemal verwerp en uitgewerk, verbasend genoeg sonder dat besmetting 'n houvas gekry het op die agterblywende deel van die kaak of in die tandvleis. Die dier het geheel-en-al herstel.



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